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Original Scientific Article

Original scientific articles should provide new, reliable information that is relevant to the science and practice of cardiac and general thoracic surgery. The reviewer should assess the articles' interest to readers; strengths and weaknesses; originality; clarity of text, tables, illustrations and figure legends; presentation; analysis of results; credibility of results; importance of the findings; depth of scholarship; relationship of the results to the existing literature; and presence of marginally relevant or unnecessary archival material. Ethical issues, such as prior publication of all or part of the data; plagiarism; transgression of human or animal rights; or dishonesty should be noted, if detected.

Original scientific articles are usually one of three types: prospective, retrospective, or observational studies. For prospective studies the protocol of the study is planned before data are collected. The most common form is the 'Prospective, randomized controlled trial', which is well suited for many experimental animal studies and some human trials. Retrospective studies use data recorded before the study protocol was designed.. Most original scientific articles in clinical disciplines, particularly surgery, are retrospective, but modern statistical models are now available to analyze objectively retrospective data using a variety of statistical methods. Observational studies record observations of one or more groups of patients. These studies may record changes in various laboratory or biochemical tests in response to procedures or other therapy or determine the indications, efficacy and safety of a new procedure or laboratory or diagnostic test.

The following topics are offered to help guide the reviewer's assessment of an original scientific article. Not all topics are relevant to every article.

- 'Title' should reflect the content of the article and be concise and clear 'Abstract' should indicate the purpose of the study, subjects and methods used, most important results and the main conclusions supported by results.
- 'Introduction' should indicate the rationale and focus of the study and state the purpose or hypothesis.
- 'Methods' should present the design of the study, fully describe the number and subjects and exclusion and inclusion criteria; whether subjects were enrolled consecutively; methods used to gather data, including follow-up data; methods by which control and experimental groups were assembled; the primary outcome variable; secondary outcome variables; how outcome measurements were made and validated; the statistical design of the study; and the statistical methods used to analyze the study.
- 'Results' should concisely present the most important findings in text and relegate to tables data of lesser importance. Data should be reported as means or medians with appropriate indicators of variance and exact p values in tables and text. Figures should be well selected to highlight important findings and should not be used to present data of lesser significance. Survival and event curves should indicate specified confidence limits or subjects at risk. Regression diagrams should include the regression equations, regression coefficient and exact p value in the figure legend. Figure legends should adequately and clearly describe the important information illustrated.
- 'Comment' should not repeat results, but should point out the significance and conclusions of the new data, integrate the authors' new data with that in the prior literature, draw inferences and conclusions regarding the question or purpose addressed by the study and point out the limitations of the study. The 'Comment' section should not be a review of the literature.
- References should be properly cited, reasonably current, accurate, in proper format and selected. Important omissions should be noted.

New Technology

Articles describing new technology are necessarily descriptive and do not pose or test a hypothesis. These articles evaluate new devices, systems, machines, equipment, instruments, monitors, implantable material and similar technology designed for improving patient care and outcomes. The reviewer is asked to evaluate the efficacy, safety and indications of the new technology and the rigor, completeness and objectivity of the evaluation study.

Topics which the reviewer should consider include:

- Probable importance or usefulness of the technology.
- Problem or task that the technology addresses.
- Newness and innovation of the technology.
- How well the technology is described and illustrated.
- Protocol used for evaluation.
- Methods used to test the technology; and the results obtained.
- Reasons for selecting the methods of testing and evaluation.
- All studies used in the evaluation.
- Ease and difficulties in application including successes and failures.
- Advantages, complications and late adverse events of the new technology.
- Whether are included or should be included in the evaluation.

The conclusion section should summarize the indications, deficiencies and drawbacks. The article should have an objective, dispassionate tone and avoid the enthusiasm of an advertisement or endorsement.

The reviewer needs to inspect the 'Disclosure statement' after the text, before References. This statement should disclose the source of funds used for the evaluation study and whether or not the product was purchased, borrowed or donated by the manufacturer or inventor. Conflicts of interest statements for authors are managed by the editorial staff.

Case Reports, How to Do It, Images

Case reports describe interesting presentations of disease and innovative management of the patient's or patients' problem. ***How to Do It*** articles emphasize innovations in the operative management of technical challenges and new ways of doing things. ***Images***, which must fit on one printed page, are graphics of interesting presentations of disease within the chest.

Reviewers should evaluate the clarity and completeness of the case or procedure descriptions and the selection and quality of the illustrative material. Reviewers should also note whether or not the paper adheres to the format restrictions enumerated in "Information for Authors". The reference list should be selective rather than inclusive.

Review Article

Reviewers should assess the importance of the subject matter, need for the review and probable interest to readers. Reviews of very rare and unusual diseases are discouraged; subject matter should be sufficiently broad to have instructional and practical value for readers. Reviewers should note if authors have respected the format and restrictions of this category as stated in "Information for Authors".

The 'Introduction' should provide the rationale for reviewing the subject matter and provide the outlines of what is included and not included in the review. In the 'Methods' section reviewers should assess the methods used to search for articles, including search words and databases probed. The body of the review should be well organized with well chosen topical headings arranged in logical order. Within each topical heading the material should be presented in an integrated, comprehensive, objective manner. Statements should be referenced accurately. Reviewers should look for a "summing up" of the topical content before the author proceeds to the next topic. Reviewers should reject topical presentations consisting of "one sentence précis of referenced articles" arranged serially.

The review should provide a general overview of the subject matter assessing progress, pointing out deficiencies in present management and indicating opportunities and directions of future work. The reviewer should also assess the selection of references and note important absences or trivial inclusions.

Footnote.

This editor carefully reads all reviews and respects the time and effort that each reviewer has expended on behalf of the author and all readers. The reviewer remains anonymous; there is no reward beyond listing on the annual thank you list. The reviewer should direct his or her critique to the authors in the style and format that suits them best. The recommendation to the editor is made separately with or without additional comments.

Perpendicular Distal Anastomosis of Coronary Vein Graft, Early Experience and Outcome

Cardiovascular

Mahmoud Khairy El-Haish

Objective: **The purpose of this study is to evaluate the safety and early outcome of a 90° end-to-side distal coronary vien graft anastomosis in comparison to conventional beveled anastomosis. It could be facilitate suturing and orientation of coronary vein graft; that allow a simple and rapid procedure of coronary artery bypass grafting (CABG).**

Methods: **To evaluate the short term outcome of perpendicular distal coronary anastomosis (end to side) technique, we compared the results in 40 patients submitted to CABG with predominantly perpendicular distal coronary vien graft anastomosis (group A) with the results of another 40 patients had conventional beveled anastomosis (group B). All patients proved to have multivessel coronary artery disease with no difference between patients in preoperative clinical variables. They submitted to CABG by the same surgeon (the auther) between March 2009 and November 2011.**

Results: **Perpendicular group (A) had significant shorter operative time than conventional group (B); it was 224.2 ± 44.1 min in group (A) versus 250.4±33.7 in group (B). Also it had significant shorter aortic clamping time and cardiopulmonary bypass (CPB) time.**

Low number of patients in perpendicular group (A) required inotropic support with high dose (adrenaline >0.15 ug/kg /min) during periperative period.The study showed two cases of mortality in both groups.

At 6 months follow-up, No clinical difference between both groups, but late post-operative ejection fraction (E.F) in group (A) was better compared to group (B).

Conclusions: **Initial results indicate that perpendicular distal coronary vien graft anastomosis appears to be safe and effective and significantly reduce time of anastomosis, specialy in lateral and inferior location. It met current incidence of postoperative complications, mortality and Intensive care unite stay.**

During more than 3 decades, coronary artery bypass graft**ing** (CABG) has been performed through full sternotomy, with extracorporeal circulation and cardioplegic arrest as the treatment of choice for patients with multivessel **coronary** artery disease. Many patients who undergo this procedure today are older and sicker than in the past. For this reason, major efforts have focused on the development of innovative strategies to minimize general trauma due to the operation and to accelerate the patient's recovery (1).

We describe our initial clinical experience with perpendicular distal coronary vien graft anastomosis during CABG surgery and assess its efficacy and safety.

Despite developments in coronary surgery have been driven by the introduction of new technologies, suturing techniques using running polypropylene material remain the gold standard; however, sometimes these techniques limit the surgeon's ability to perform complete revascularization with high-quality anastomoses in a less invasive way.

The success of CABG is determined by the long-term patency of the coronary graft. This depends mainly on the quality of distal anastomoses, the best modality for determining the morphology of the anastomosis has not been investigated.

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Codex : o3/01/1207

This article presents clinical and echographic results (through 6 months) of 40 patients who received a perpendicular distal coronary anastomosis between a saphenous vein graft and a native coronary artery.

The aim of this work is assessment of perpendicular distal coronary vien graft anastomosis; on the operative, immediate postoperative period and the short term follow up after 6 months; in comparison with conventional beveled distal coronary vien graft anastomosis in multivessel coronary artery disease.

The choice of grafting technique is important to the success of coronary surgery; by preventing kinking of the graft and taking short anastomotic time.

Sutured coronary anastomoses still represent the standard of surgical treatment; handsewn anastomoses may have a high variability between surgeons and procedures. Factors such as skill of the surgeon, coronary anatomy, progression of disease, procedural access and exposability, and instrumentation may basically contribute to the level of quality of an anastomosis (2).

Several mechanical connectors have been developed, to facilitate, standardize, and accelerate distal coronary anastomosis construction,but it has revealed difficulties in achieving equivalence to the conventionally sutured standard. Also, detailed data on tissue response and hemodynamic performance need further study (3).

Perpendicular distal coronary vien graft anastomosis was investigated in our clinical trial

Methods

In a prospective, randomised study, the safety and efficacy of the end-to-side 90° vein graft to coronary artery anastomosis was investigated.

From March 2009 and November 2011, a total of 80 patients (63 male and 17 female) with a mean age of *56.7 ± 10.2* years enrolled in this study. Fourty patients from them submitted to CABG with perpendicular distal coronary anastomosis technique for their coronary vien grafts (group A) and the other 40 patients submitted to CABG with conventional beveled distal coronary anastomosis technique (group B). We compared the two groups as regard the pre, operative and postoperative data to determine feasibility and effectiveness of perpendicular distal coronary vien graft anastomosis during CABG surgery.

The patients were operated in Egypt by the same surgeon (the auther), after taking informed consent and approval of our Ethical Committee.

They were candidates for first-time isolated CABG via a median sternotomy and scheduled for at least one non-LAD saphenous vein bypass graft with a target coronary artery stenosis ≥50% via angiography and ≥2mm inner diameter verified intraoperatively by probing the coronary artery. The patients' cardiovascular medical history is summarized in [Table 1]. All patients were operated on using standard cardiopulmonary bypass techniques and cardiac arrest with moderate hypothermia (32°C-34°C). In general, left internal thoracic artery was anastomosed individually to a left anterior descending artery by conventional beveled technique in all patients and saphenous vein was used to bypass the remaining coronary arteries. No sequential graft was used, all grafts were handsewn.

The demographic, clinical, and preoperative characteristics of the study cohort are shown in [Table 1].

		Perpendicular anastomosis ***Group A*** ***(N = 40)***	**Conventional anastomosis** ***Group B*** ***(N = 40)***	***P***
Age (years)	*(mean ± SD)*	*54.6 ± 10.1*	*58.4 ± 10.4*	*>0.05*
	Range	*35 – 75*	*38 – 80*	
Sex:	*Male n (%)*	29(72)	33(82)	*>0.05*
	Female n (%)	11(28)	7(18)	*>0.05*
Anginal Functional Class n (%)				
	I or II	6(15)	5(12)	>0.05
	III or IV	34(85)	35(88)	>0.05
EUROSCORE *(Mean±SD)*		2.2±1.98	2.52±1.69	*>0.05*
Preoperative Ejection fraction				
	(Mean±SD)	54.21± 10.47	53.81± 10.29	*>0.05*
	Double vesseles	10	12	*>0.05*
	Triple vesseles	30	28	*>0.05*

- SD = Standard deviation, LAD = Left anterior descending, CX = circumflex artery, PDA=Posterior descending artery, P >0.05= insignificant, P < 0.05= significant, P < 0.01 = highly significant.

Table 1. Preoperative variables among patients in perpendicular and conventional Groups

Meanwhile, the comparison of preoperative characteristics of the 2 groups of the study shows that they are compatible.

Euroscore was used to evaluate the risk factors (4), with no difference between the groups in preoperative clinical variables.

They were selected according to the following criteria: Multivessel coronary artery disease, and no sex limitation.

Exclusion criteria were associated valve lesions, ventricular aneurysm or previous CABG.

Hand-Sutured nastomotic Procedure

Routine surgical techniques were used, but including cutting the end of the vein graft at a 90° angle, making 4-5-mm-long arteriotomy in target coronary artery and using a 7/0 polypropylene monofilament running suture technique. All suture anastomoses were constructed by the same experienced cardiothoracic surgeon.

Postoperative assessment

Early postoperative data analyzed included peri-operative mortality, inotropic support, use of intra-aortic ballon and the incidence of new ischemia, myocardial infarction, coronary re-intervention, and fatal arrhythmia, re-exploration for bleeding, stroke, mediastinitis, and renal failure. Operative mortality was defined as death within 30 days of surgery or in-hospital death.

All patients received postoperative antiplatelet treatment with salicylic acid (150 mg daily)and clopidogrel (75 mg daily for 28 days), starting on the morning of the day after surgery.

At discharge; all patients were followed up by rest ECG and Echo-cardiography, to evaluate global left ventricular function.

After 3- 6 months all patients were evaluated by clinical examination, 12 lead rest ECG, and Echo-cardiography.

Statistical Analysis

Data are presented as mean±SD. Statistical comparison between groups was performed through paired *t* -test. *P*<0.05 was considered to indicate a significant difference, and highly significant at *P* <0.01.

RESULTS

The Perioperative and Postoperative variables of the study cohort are shown in table [2] .

High significant difference between perpendicular group (A) and conventional group (B) concerning operative time/min was observed where it was 224.2 ± 44.1 in (group A) versus 250.4 ± 33.7 in (group B).

There was significant difference concerning aortic clamping time where it was less in group (A) 48.9 ± 16.2 versus 57.8 ± 18.4 minutes in group (B). Cardiopulmonary bypass (CPB) time was significantly shorter in perpendicular group than in conventional group 95.4 ± 29.1 vs 107.1 ± 37.2 (P <0.05).

There was no significant difference concerning the total days of stay in ICU where it was 2.71±1.91 in group (A) versus 2.91±1.39 days in group (B). The ventilation time was *5.81±3.3* hours in *perpendicular* group and *6.51±2.62* hours in *conventional* group (*P* >0.05). The postoperative hospital stay in *perpendicular* group was 8.80±3.92 vs 9.15±4.13 days in *conventional* group (*P* >0.05) [Table 2].

	Perpendicular anastomosis ***Group A*** ***(N = 40)*** *Mean±SD*	**Conventional anastomosis** ***Group B*** ***(N = 40)*** *Mean±SD*	***P***
Operative time(min)	*224.2± 44.1*	*250.4± 33.7*	*<0.01*
Aortic clamp time(min)	*48.9 ± 16.2*	*57.8 ± 18.4*	< 0.05
CPB time(min)	*95.4 ± 29.1*	*107.1 ± 37.2*	< 0.05
Distal anastom. (n)	*3.24± 0.36*	*3.17± 0.45*	*>0.05*
Proximal anastom. (n)	*1.70± 0.86*	*1.86± 0.35*	*>0.05*
No. of grafts	*2.8± 0.05*	*2.65± 0.07*	*>0.05*
Duration of ventilation in hours	*5.81± 3.3*	*6.51± 2.62*	*>0.05*
Total days in ICU	*2.71± 1.91*	*2.91± 1.39*	*>0.05*
Total postoperative days	*8.80± 3.92*	*9.15± 4.13*	*>0.05*
Postoperative ejection fraction	*54.35±9.9*	*52.61±10.1*	*>0.05*

-SD = Standard deviation, CPB= Cardiopulmonary bypass, ICU= intensive care unit, P>0.05= insignificant, P < 0.05= significant, P < 0.01 = highly significant.

Table (2). Perioperative and postoperative variables among patients in perpendicular and conventional Groups

As regard postoperative events (Table 3), there were 4/40 cases of perpendicular group (A) required inotropic support in high dose (adrenaline >0.15 ug/kg /min) during the operation or at early postoperative period while 8/40 cases of group (B) required that.

On the other hand, 6/40 cases in group (A) and 5/40 cases in group (B) showed arrhythmias which are mostly AF (atrial fibrillation) with insignificant difference.

As regard mortality, group (A) showed two cases of mortality, one intraoperative and one postoperative as result of heart failure. Group B showed two cases of mortality, one patient died early postoperative as result of low cardiac output and the 2nd died after 2 weeks because of renal failure.

After 3-6 months follow-up, No deaths occurred. No patients had recurrent angina or myocardial infarction, and no additional revascularization procedure.

An electrocardiogram did not show any signs of new myocardial ischemia.

Postoperative ejection fraction (E.F) 54.71±11.01 in group (A) was higher compared to values of group (B) 52.25±9.98; While there was no significant difference between both groups.

Postoperative complications:	**Perpendicular** *Group A (N = 40) N (%)*	**Conventional** *Group B (N = 40) N (%)*	*P*
-ECG new ischemia	*3(8)*	*2(5)*	*>0.05*
- Arrhythmia	*6(15)*	*5(13)*	*>0.05*
- Conduction defect	*1(3)*	*2(5)*	*>0.05*
-Intra-aortic balloon	*3(8)*	*2(5)*	*>0.05*
*-Inotrop*ic support (adrenaline) >0.15 ug/kg /min	*4(10)*	*8(20)*	*<0.05*
- Mediastinitis	*1(3)*	*2(5)*	*>0.05*
-Resternotomy for bleeding	*1(3)*	*2(5)*	*>0.05*
- Pericardial effusion	*4(10)*	*2(5)*	*>0.05*
-Neurological complications	*1(3)*	*2(5)*	*>0.05*
- Renal impairment	*2(5)*	*1(3)*	*>0.05*
- Mortality	*2(5)*	*2(5)*	*>0.05*

-P>0.05= insignificant, P < 0.05= significant, P < 0.01 = highly significant

Table (3). Postoperative complications among patients in perpendicular and conventional Groups

Discussion

The aim of cardiovascular surgical operations is to improve cardiac functions, while creating minimal damage to other systems. Many innovative techniques have been designed to reduce perioperative; postoperative complications and hospital stay (5).

Current efforts to develop less invasive CABG have done, to facilitate connections between bypass grafts, the aorta and the coronary vessels. Any alternative anastomotic technique to perform vascular connection needs to meet the same safety and long-term reliability as those obtained with the standard hand-sewn technique.

In this study, the safety and efficacy of a novel 90° end-to-side distal coronary anastomosis could be proven. All standard targets for coronary revascularisation were reached with this anastomosis. Its application was fast and easy.

Perpendicular distal coronary anastomosis technique is a competitive method compared to conventional beveled anastomosis. In the overall comparison, perpendicular anastomosis technique significantly reduced the operative time that may result in faster recovery, shorter ICU and hospital stay, lower morbidity and reduction of costs.

Myocardial damage is known to occur after long periods of aortic cross-clamping accompanied by cardioplegia during CPB.

In our study there was no difference in the average number of total grafts between the groups which allows better matching and comparison of the two patient groups, and reduces the possible bias that could be involved in the selection of the surgical procedure.

Already, distal perpendicular vascular anastomosis have been used in distal mechanical coronary connectors, sequentional coronary grafting…extra.

Also, it must be used obligatory when there is target intramycardial coronary artery.

Anatomically, distal perpendicular vascular connection present in our body like perforator arteries of chest wall, vascular archs of hand and foot, collateral septal branches to stenotic LAD of ischemic heart…extra.

In addition, it is important during off-pump coronary surgical procedures by reduction of myocardial ischemia during rapid creation of distal anastomosis and by shortening time for heart positioning.

Perpendicular distal coronary vien graft anastomosis, provide numerous advantages over conventional beveled anastomosis technique in facilitating the procedure, easy orientation of the viev graft ,and has shorter operating and ischemic times, This technique have been advocated with increasing frequency for multi-vessel coronary artery disease. However, small graft diameter and size mismatch (graft diameter smaller than coronary artery diameter) make this technique troublesome.

Previous experemental study suggestd that the perpendicular anastomotic angle not protect from intemal hyperplasia and thrombosis, in comparison with acute angled distal gaft anastomosis (6).

Our results do not show superior graft patency rates with the new perpendicular distal coronary anastomosis technique compared with conventional beveled anastomosis.

A randomized and prospective trial would be needed to compare graft patency rates with and without perpendicular distal coronary anastomosis technique. Evaluation over a longer period of time is essential; other multicenter trials evaluating this graft's patency rates at > 6 months are needed.

Reported vein graft patency rates vary between 85.2% (7), 91% (8) and 95% (9) at 3 months, 81% (10) and 88.3% at 1 year

(11), and 95% at 5 years (12) for sutured beveled vein grafts with the use of aortic clamping and cardioplegia.

There are flow advantages of a 30° end-to-side anastomotic coupler compared to anastomoses with an increased angle (13); Increasing the angle of a end-to-side anastomosis leads to increased shear stress on the vascular bed across from the toe and to increased flow separation near the toe (14).

We have no practical knowledge about use of the perpendicular anastomosis in off-pump surgery, we would like to point out that an optimal visualisation of the coronary vessel and an optimal stabilisation of the heart is essential also for this kind of anastomosis.

In the absence of objective methods of determining the indication, the judgment and experience of the operating surgeon currently govern the application of perpendicular anastomosis.

However, one should remember that although graft patency depends on multiple factors, the quality of the distal anastomosis is one of the most important. The success of the handsewn technique is highly related to surgical experience and skill.

Limitation of our study was its small number of patients, short-term results. Another study with more patients and examination of later results may prove the possible superiority of our method in comparison to the conventional one.

We believe that future intraoperative evaluation of coronary grafts and anastomoses will consist of the combined approach of flowmetry and epicardial ultrasound that not available in our center nowadays.

CONCLUSIONS

In our experience, perpendicular end-to-side distal coronary vien graft anastomosis is applicable for revascularization of lateral and inferior coronary vessels. It facilitates suturing and orientation of coronary vein graft that allow a simple and rapid procedure; also it has acceptable mid-term results when compared with traditional coronary graft anastomosis; But it must study the long term outcome especially the patency of the grafts.

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Diagnostic Value of Cardiac Troponin I for Development of Atrial Fibrillation in Patients Underwent CBAG

Ibrahim Kasb MD

***Objectives*: This prospective study aimed to evaluate the predictability of elevated postoperative (PO) cardiac troponin I (cTnI) blood levels for the development of atrial fibrillation (AF) in patients underwent coronary artery bypass grafting (CABG) surgery and to suppose the most probable cutoff point for such predictability.**

***Patients & Methods*: The study included 115 CABG patients; 30 patients developed PO AF (AF group), while 85 patients passed smooth PO course (No AF group). Data collection included age, gender, co-associated morbidities and echocardiogram; operative data including CPB time, aortic cross clamping time and number of grafts. The primary end-point was occurrence of AF episode requiring any type of medical treatment and/or lasting for more than 30 minutes.**

***Results*: There was non-significant difference between both groups as regards age, gender, frequency of associated morbidities, preoperative cTnI levels, aortic clamping time and number of used grafts, but cardio-pulmonary bypass (CPB) time was significantly longer in AF group. All AF patients recovered to normal sinus rhythm on an attempt of management protocol and, but 7 patients (23.3%) developed a new episode of AF and received additional acute amiodarone therapy and two of them were maintained on warfarin. Mean PO levels of cTnI were significantly higher in AF group compared to their preoperative levels and to No AF group. ROC curve analysis defined elevated PO cTnI blood levels, prolonged CPB time, male gender and old age as significant predictors for AF development in decreasing order of probability, but Regression analysis defined PO blood cTnI level as the persistently significant predictor. PO cTnI level at 0.914 ng/ml was the most appropriate cutoff point for prediction of PO AF with good sensitivity and specificity, while cutoff point of 1.105 ng/ml was a sure diagnostic value with highest specificity.**

***Conclusion:* Post-CABG AF is a common complication with a frequency of 26.1% and estimation of PO cTnI could accurately discriminate those liable for such complication with sensitivity rate of 83.3% for values ≥0.914 ng/ml and specificity rate of 95.7% for values ≥1.105 ng/ml.**

***Keywords:* Coronary arteries bypass grafting surgery, postoperative atrial fibrillation, cardiac troponin I**

Troponin I (cTnI) is a specific marker of myocardial damage, that has proved to be more sensitive and specific compared to some biochemical enzymes that were used before, such as creatine kinase, MB isoenzyme and myoglobin. Post cardiac surgery elevated cardiac troponins have been described, although in this setting troponin release may also be the result of myocardial cell injury due to different causes. Several studies suggest, however, that an increased postoperative troponin release after cardiac surgery is associated with mortality and an adverse outcome [1, 2, 3].

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Atrial Fibrillation (AF) remains the most common arrhythmia after cardiac surgery. Its incidence depends on patient's preoperative profile and the type of operation performed. AF occurs in approximately 28-33% of the patients undergoing coronary artery bypass grafting (CABG) and in 30-63% of those operated for coexisting ischemic

heart and valve disease. The majority of AF arrhythmias appear within the first 4-5 postoperative days and the peak frequency is in the second or third postoperative day. It has been reported that patients with postoperative AF have longer Intensive Care Unit (ICU) stay, longer hospitalization, and higher incidence of re-admissions increasing the cost of hospitalization by 30%[4,5,6].

Koletsis et al. [7] tried to define pre- and peri-operative factors that may affect the occurrence of AF and found preoperative factors presenting significant correlation with the incidence of post-operative AF included: age older than 65 years, previous history of AF, associated chronic obstructive pulmonary disease, left ventricular dysfunction with ejection fraction <40% and proximal lesion of the right coronary. The intraoperative factors that appeared to have significant correlation with the occurrence of postoperative AF were: CPB-time longer than 120 minutes, myocardial ischemia index less than 0.27 ml/m^2/Kg/min, total positive fluid-balance during ICU-stay, FiO2/PO2 >0.4 after extubation and during the ICU-stay, inotropic support with doses 15-30 μg/Kg/min, long ICU-stay recovery for any reason and perioperative myocardial infarction

However, exclusion of these factors if possible could not predict assuredly that AF will not occur; this raises the value of the predictability of certain biomarkers for the predictability of the possibility of development of AF. Thus, the current study was designed to evaluate the relationship between elevated postoperative cTnI blood levels in patients did not develop postoperative ischemic insults for the occurrence of post-CABG AF and as a trial to suppose the most probable cutoff point for such predictability.

Patients and Methods

The current prospective comparative study was conducted at Cardiosurgery Departments at Benha University Hospital and Nasser Institute, Cairo. The study aimed to collected data of patients underwent elective, isolated first time CABG operation with ejection fraction (EF) ≥50% using cardiopulmonary bypass (CPB). Patients with EF<50%, a concomitant valve surgery, urgent CABG, concomitant surgery for post-myocardial infarction complications, reoperation for myocardial revascularization and prior history of atrial fibrillation were not included in the study. For equalization of the results, all patients followed the same protocol of anesthesia and surgical procedure. Anesthetic protocol included midazolam pre-medication, induction of anesthesia using fentanyl and atracurium and maintenance of anesthesia using sevoflurane. The CPB circuit constituted a non-heparin coated membrane oxygenator and circuit. All patients received antegrade, intermittent, cold blood cardioplegia enriched with potassium and adrenaline and/or dopamine were used as inotropic when necessary and nitrate as vasodilator. All patients had monitored continuously for rhythm during their ICU stay and once daily after ICU discharge. Preoperative bet-blockers were continued postoperatively. All patients developed AF were managed similarly according to a standard protocol using 5-7 mg/kg amiodarone within 30-60 minutes as a loading dose during the attack and as a continuous infusion up to 1.2 g of amiodarone within the first 24 hours after the loading dose and maintenance therapy of amiodarone 200 mg tab once daily with a day off/ week for 3 months. Blood samples were obtained at night of admission (Pre value) and at ICU admission postoperatively (PO value) for estimation of blood levels of cardiac troponin I (cTnI) measured.

Data collection

Clinical data including age, gender, co-associated morbidities and echocardiogram were reported. Operative data including CPB time, aortic cross clamping time and number of grafts used were obtained.

Study end-points

The primary end-point was occurrence of AF episode requiring any type of medical treatment and/or lasting for more than 30 minutes. The secondary end-point was the verification of multiple cutoff points for blood cTnI levels so as to determine the point with highest accurate predictability for development of post-CABG AF.

Statistical analysis

Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon (Z test) and Chi-square test. Sensitivity & specificity of evaluated parameters as predictors for development of post-CABG AF were evaluated using the receiver operating characteristic (ROC) curve analysis judged by the area under the curve (AUC) and its significant was compared versus the null hypothesis that AUC=0.5. Regression analysis was used for verification of these parameters to define the persistently significant predictor. ROC curve analysis was used to define co-ordinate cutoff points and test validity characters were calculated for each cutoff point to define the most appropriate one. Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

Results

The study included 115 CABG patients; 30 patients developed postoperative AF (AF group), while the other 85 patients passed smooth PO course without developing AF (No AF group). There was non-significant (p>0.05) difference between both groups as regards age, gender distribution and frequency of associated morbidities, (Table 1). All patients developed AF received the assigned management protocol and recovered to normal sinus rhythm. Unfortunately, 7 patients (23.3%) developed a new episode of AF during their hospital

			AF group	No AF group	Statistical difference
Number			30 (26.1%)	85 (73.9%)	
Age (years)			63.5±8.2 (52-76)	59.4±9 (48-78)	Z=1.230, p=0.219
Gender	Males		19 (63.3%)	62 (72.9%)	X^2=0.521, p=0.121
	Females		11 (36.7%)	23 (27.1%)	
Associated co-morbidities	Diabetes mellitus	Yes	12 (40%)	39 (45.9%)	X^2=2.938, p=0.081
		No	18 (60%)	46 (54.1%)	
	Dyslipidemia	Yes	13 (43.3%)	33 (38.8%)	X^2=0.496, p=0.117
		No	17 (56.7%)	52 (61.2%)	
	Hypertension	Yes	14 (46.7%)	35 (41.2%)	X^2=0.441, p=0.107
		No	16 (53.3%)	50 (58.8%)	
Left atrium size (mm)			40.15±3.07 (36-43)	38.3±1.68 (36-41)	Z=1.770, p=0.077

Data are presented as mean±SD & number; range & percentage are parenthesis *p<0.05: significant difference*

Table 1. Patients' characteristics and clinical data

stay and received additional course of acute amiodarone therapy and two of them were maintained on warfarin as anticoagulant for their persistent AF.

Mean CPB time was significantly (Z=3.529, p=0.007) longer in patients developed AF compared to those had sinus rhythm. However, mean aortic cross clamp time was non-significantly (Z=1.902, p=0.057) longer in AF group compared to sinus rhythm group. Moreover, number used grafts was non-significantly (X^2=0.523, p=0.127) higher in patients developed AF compared to those had sinus rhythm, (Table 2)

Preoperative cTnI levels showed non-significant difference between patients developed post-CABG AF compared to those had sinus rhythm, while postoperative levels were significantly higher in those developed AF compared to those had smooth PO course despite the significantly higher levels in both groups compared to their preoperative levels, (Table 3, Fig. 1).

Evaluation of the diagnostic validity of estimation of cTnI blood levels both preoperative and postoperative versus age, male gender, presence and multiplicity of co-morbidities, CPB and aortic clamping time as predictors for probability of development of post-CABG AF, using ROC curve analysis,

		AF group	No AF group	Statistical difference
CPB time (min)		85.3±19.2 (65-130)	65.2±14.5 (45-90)	Z=3.529, p=0.007
Aortic cross clamp time (min)		56.7±16.6 (35-80)	51±19.6 (25-80)	Z=1.902, p=0.057
Number of grafts	One	3 (10%)	12 (14.1%)	X^2=0.523, p=0.127
	Two	12 (40%)	32 (37.7%)	
	Three	11 (36.7%)	28 (32.9%)	
	Four	4 (13.3%)	13 (15.3%)	

Data are presented as mean±SD & number; range & percentage are parenthesis *p<0.05: significant difference*

Table 2. Patients' operative data

revealed that elevated PO cTnI blood levels (AUC=0.916, p<0.001), prolonged CPB time (AUC=0.767, p<0.001), male gender (AUC=0.652, p=0.016) and old age (AUC=0.638, p=0.031) could predict the development of AF with that order of decreasing probability, (Table 4, Fig. 2).

Regression analysis (Stepwise Method) was used to verify these parameters and defined postoperative blood cTnI level as a significant predictor in three models, long CPB time in two models and old age in one model, (Table 5).

Evaluation of various values of blood cTnI level as cutoff points for prediction of post-CABG AF using ROC analysis defined five probable cutoff values with either high sensitivity or specificity. Calculation of test validity characters for these cutoff values defined PO blood cTnI level at 0.914 ng/ml as the most appropriate with good sensitivity and specificity and defined PO blood cTnI level at 0.3083 ng/ml as a screening test with highest sensitivity, while the cutoff point of 1.105ng/ml as a sure diagnostic value with highest specificity, (Table 6, Fig. 3, 4).

	AF group	No AF group	Statistical difference
Preoperative	0.054±0.03 (0.007-0.097)	0.059±0.036 (0.006-0.15)	Z=0.082, p_1=0.934
Postoperative	1.592±0.349 (0.089-1.56)	0.602±0.564 (0.21-2.56)	Z=4.679, p_1=0.000 Z=7.271, p_2=0.000 Z=4.782, p_3=0.000

Data are presented as mean±SD; ranges are in parenthesis
p<0.05: significant difference
p_1: significance versus AF group
p_2: significance versus preoperative level in AF group
p_3: significance versus preoperative level in No AF group

Table (3): Blood levels of cTnI estimated in studied patients pre- and post-CABG

Parameter		AUC	Std Error	Significance	Asymptotic 95% Confidence Interval	
					Lower bound	Higher bound
Age		0.638	0.058	=0.031	0.523	0.748
Male gender		0.652	0.056	=0.016	0.543	0.761
Co-morbidities		0.475	0.064	>0.05	0.350	0.601
CPB-time		0.767	0.050	<0.001	0.670	0.865
Aortic clamping time		0.602	0.057	0.107	0.490	0.714
High serum cTnI	Pre	0.450	0.067	0.432	0.320	0.581
	PO	0.916	0.037	<0.001	0.844	0.988

AUC: area under curve *Std Error: Standard error* *p<0.05: significant difference*

Table 4. ROC curve analysis for the predictability of the studied parameters for the probability of development of post-CABG AF

		β	t	Significance
Model 1	PO cTnI level	0.636	10.180	0.000
	CPB time	0.310	4.960	0.000
	Old age	0.176	2.954	0.004
Model 2	PO cTnI level	0.642	9.896	0.000
	CPB time	0.312	4.813	0.000
Model 3	PO cTnI level	0.734	10.710	0.000

β: Standardized coefficient *p<0.05: significant difference*

Table 5. Regression analysis for evaluated parameters as predictors for post-CABG AF

Outcome	cTnI (ng/ml)	0.3083	0.5405	0.7850	0.914	1.105
	True positive	29	28	27	25	24
	True negative	12	36	51	55	67
	False positive	1	2	3	5	6
	False negative	58	34	19	15	3
Test validity characters	Sensitivity	96.7%	93.3%	90%	83.3%	80%
	Specificity	17.1%	51.4%	72.9%	78.6%	95.7%
	Accuracy	41%	64%	78%	80%	91%

Table 6. Test validity characters of varied values of cTnI blood levels as predictors for probability of developing post-CABG AF

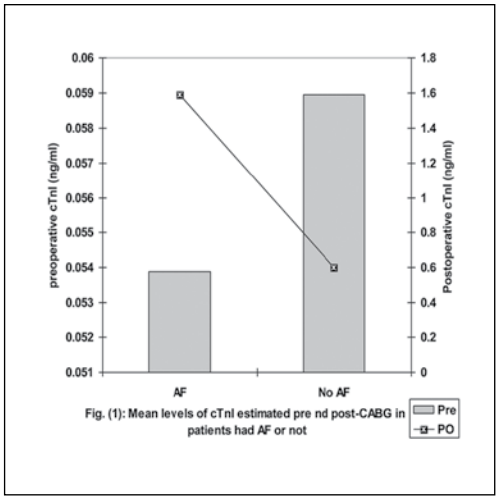

Fig. (1): Mean levels of cTnI estimated pre nd post-CABG in patients had AF or not

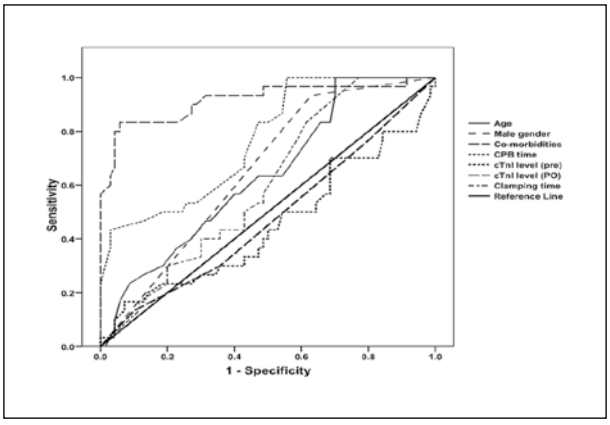

Fig. 2. ROC curve showing the predictability of studied parameters for probability of development of post-CABG

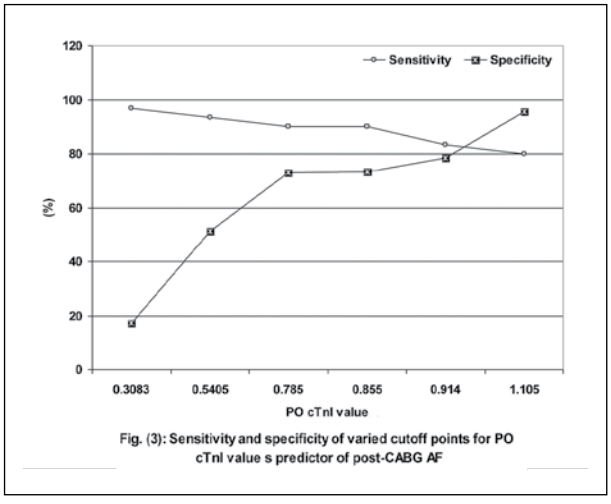

Fig. (3): Sensitivity and specificity of varied cutoff points for PO cTnI value s predictor of post-CABG AF

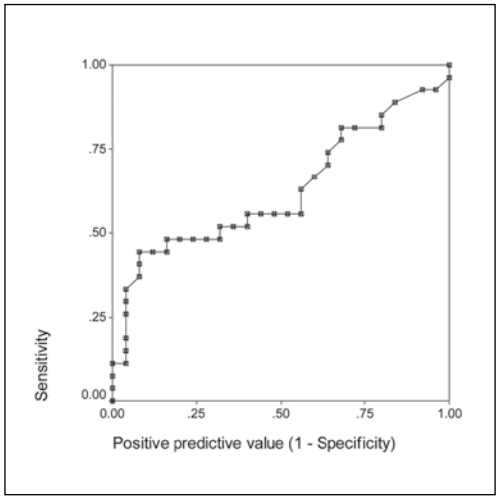

Fig. 4. ROC curve showing the predictability of cTnI level at cutoff point of 0.914 ng/ml for the probability of development of post-CABG

Discussion

The current multi-center study tried to cautiously choose patients free of most of predisposing factors for development of post-CABG AF as identified by **Koletsis et al.** [7]. However, post-CABG AF was recorded for a frequency of 26.1%. Such figure coincided with that previously defined in literature; **Tamura et al.** [8] reported a frequency of post-CABG neo AF in 34.2% of studied patients. **Gibson et al.** [9] found AF to occur at a frequency of 39% among their series of CABG patients. **Koletsis et al.** [7] documented that AF occurs in 28-33% of the patients undergoing coronary artery revascularization. **Iskesen et al.** [10] reported that AF occurred during the hospitalization period in 28.2% of patients had CABG.

Postoperative blood cTnI were found to significantly higher, irrespective of development of AF, compared to preoperative blood level. However, patients developed AF showed significantly higher PO blood cTnI levels compared to those passed smooth postoperative course without development of AF. These data indicated the deleterious effect of surgery on myocardial cells and indicated the effect of surgery induced ischemia on its vitality. In line with this observation, patients developed AF had significantly longer CPB time, but non-significantly longer aortic clamping time compared to those did not develop AF; a finding indicating a relation between the development of post-CABG AF and surgical manipulations.

Using ROC curve analysis for the predictability of various constitutional, clinical and operative and blood levels of cTnI estimated prior to and after surgery, defined high PO blood cTnI levels, long CPB time and old age as the significant predictors for development of post-CABG AF. These predictors assured the risk factors and predisposing factors previously documented by **Choi et al.** [11] who found that Univariate analysis demonstrated old age, pre-existing chronic renal failure, low left ventricle ejection fraction (LVEF <30%), highest CRP before the onset of AF, vasopressor and inotropic therapy, packed red blood cells transfusion and amount of chest tube drainage as predictors of postoperative AF and go in hand with **Koletsis et al.** [7] who defined prolonged CBP time for >120 min and aorta clamping time as predisposing factors for development of AF.

However, regression analysis defined the high predictability of high PO cTnI for probability of development of AF in three models; i.e. persistently significant predictor. This finding assures the role of PO estimation of cTnI as a predictor for post CABG AF and goes in hand with multiple studies related elevated blood levels of cTnI to various post-CABG complications; **Paparella et al.** [12] reported that preoperative cTnI values were significantly associated with a higher incidence of major postoperative complications including low cardiac output syndrome, intra-aortic balloon pump necessity, mechanical ventilation >72 hours, acute renal failure, in-hospital mortality. **van Geene et al.** [13] found that postoperative cTnI level, measured within the first hour after cardiac surgery, can identify a subgroup of patients with increased risk for hospital mortality. **Fellahi et al.** [14] documented that the combination of EuroSCORE and postoperative cTnI provides the best discriminative power and performance in predicting adverse outcome after cardiac surgery and is suggested as being an effective model that improves early identification of high-risk patients

As regards the specificity of high cTnI blood level estimation for prediction of post-CABG AF, multiple studies defined the relationship between elevated blood cTnI levels and development of AF in various situations; **van den Bos et al.** [15] reported that minor elevations in troponin I on hospital admission are associated with mortality and cardiac events in patients with atrial fibrillation and might be useful for risk stratification. **Providência et al.** [16] found a direct relation between rising concentrations of cTnI and a higher prevalence of transesophageal echocardiogram changes found in AF patients and concluded that cTnI seems to be associated to thromboembolic risk in patients with AF. **Beaulieu-Boire et al.** [17] also found cTnI elevation predicts new-onset AF on 24-hour Holter measurement in patients with acute ischemic stroke or transient ischemic attack and may indicate a poorer prognosis and a higher risk of stroke, myocardial infarction, and death at 3 months.

In trial to define a discriminative cutoff value for prediction of post-CABG AF, ROC curve analysis and calculation of test validity characters identified blood cTnI level at 0.914 ng/ml could identify patients liable to develop post-CABG AF with sensitivity rate of 83.3%, specificity rate of 78.6% and accuracy rate of 80%, and the cutoff point of 1.105 ng/ml as a sure diagnostic value with highest specificity 95.7% and accuracy 91%. Such figures coincided with **Amin et al.** [18] documented that prognostically, the most informative cut off value for cTnI was 5.6 ng/ml, above this value; CABG patients progressed 2.58 times faster to adverse outcomes. **van Geene et al.** [13] reported that ROC analysis indicates a cTnI level of 4.25 microg/l is an optimal cut-off point for predicting hospital mortality, with a sensitivity of 70% and a specificity of 89% after coronary artery surgery. **Leal et al.** [19] reported that cTnI levels at the postoperative period after CABG were higher in patients who subsequently developed AF and the cut-off value of 0.901 ng/ml is useful for prediction and preventive therapeutic action with sensitivity of 60% and a specificity of 87%.

It could be concluded that post-CABG AF is a common complication with a frequency of 26.1% and estimation of postoperative cTnI could accurately discriminate those liable for such complication with sensitivity rate of 83.3% for values ≥0.914 ng/ml and specificity rate of 95.7% for values ≥1.105 ng/ml.

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Aortic Valve Repair Initiation and Short Term Results

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Hala M. M. El-Farghaly,

BACKGROUND: **Experience with aortic valve repair is still less extensive than that of mitral valve, and long-term follow up of valve repair in this subset of patients is limited. We undertook this study to look at our short term results as an early experience with aortic valve repair in ten patients of two different pathologic categories; AI associated with VSD and rheumatic AI.**

METHODS: **From August 2010 through February 2012, eight patients underwent aortic valve repair; 4 patients with sub aortic VSD and aortic incompetence due to prolapse of right coronary cusp into the VSD and six patients with rheumatic aortic valve incompetence four of them were combined with mitral valve disease. The mean age of patients with VSD was 9.7 years three of them were in NYHA class III and one in class II, 1 male and 3 female. Closure of VSD was done through RA using Dacron patch in 3 patients and trans aortic with direct closure in 1 patient. Reparative procedures of aortic valve included triangular resection in 3 patients and central leaflet plication in 1 patient, and sub commissural annuloplasty for the 4 patients. The mean age of ptients with rheumatic pathology was 18.8 years , 4 in NYHA class III and 2 in class II, four were females and two males. Reparative procedures included cuspal thinning (n = 3), commissurotomy (n = 1), subcommissural annuloplasty (n = 4), leaflet extension using pericardium (n = 5) and combinations of procedures (n=6). Associated procedures included mitral valve repair (n =4).**

RESULTS: **Early mortality was 0%. follow-up period is still short; six months .The ten patients on pre discharge echocardiography had trivial or mild aortic regurgitation except one patient with rheumatic AI had grade II. Six patients showed no progression of the grade of AI over the short follow up period , one patient of each group have a progression from grade I to grade II AI and two patients are still not reaching the six months. There was no significant pressure gradient across LVOT (mean gradient more than 20 mmhg considered to be significant) in either the in hospital or the follow up echocardiography.**

CONCLUSIONS: **Aortic valve repair in patients with aortic incompetence associated with VSD and in rheumatic aortic valve pathology is feasible and yields encouraging short-term results.**

Key Words: ***Aorta, valve repair, short term***

Aortic valve replacement (AVR) has been the preferred surgical therapy for patients requiring surgery for significant aortic valve disease[1]. However, there are many problems when making the decision to replace the valve especially in children and young adults. Mechanical valves require anticoagulation, and patients have an ongoing, constant risk of thromboembolic and bleeding complications[2-4]. Noncompliance with activity restrictions and medical regimens, combined with the high-risk behavior that characterizes adolescence, makes the use of mechanical valves less attractive[5].

Although aortic homografts result in excellent early hemodynamics, durability is limited in the pediatric population[6,7]. Neither mechanical valves nor homografts allow for growth, and if valves are not initially oversized in small children, patient-prosthetic mismatch will result. The pulmonary autograft, frequently chosen for infants

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and small children, does allow for growth; however, late dilatation of the neoaortic root with aortic insufficiency (AI) has been identified in a subgroup of patients[8,9]. Beside the above mentioned disadvantages ; the option of homografts and Ross procedures are not available in Egypt. And even in adulds anticoagulation related complications of mechanical prosthesis and patient prosthesis mismatch are a real risk.

Aortic valve repair techniques have evolved slowly and have not yet gained wide acceptance. Nevertheless, repair techniques that result in satisfactory hemodynamics and acceptable late outcome may provide a reasonable alternative for selected patients. Aortic valve repair in patients with aortic root pathology and normal aortic valve leaflets as in cases of aortic dissection, or annuloaortic ectasia is a well known procedure (aortic valve sparing operations). It has generally been preferred for patients with aortic incompetence (AI) associated with ventricular septal defect,[10-13]. Experience with aortic valve repair in patients with rheumatic heart disease is limited, and long-term follow up of valve repair in this subset of patients is limited but some reports showed encouraging results[14-20]. We undertook this study to look at our short term results as an early experience with aortic valve repair in ten patients four of them with AI associated with VSD and six with rheumatic AI .

Patients and methods

The choice of patients scheduled in our study initiated when the decision to replace the valve was critical; mainly to avoid anticoagulation either in children with VSD and young adults with rheumatic pathology. So, we included these two categories. First, children with grade III or IV AI associated with VSD. Second, young adult with rheumatic AI. We excluded patients with grade I or II AI, patients with concomitant mitral valve replacement and patients with ejection fraction less than 40%.

From August 2010 through February 2012, ten patients underwent aortic valve repair; four patients with sub aortic VSD and aortic incompetence (two with grade IV and tow with grade III AI) due to prolapse of right coronary cusp into the VSD and six patients with rheumatic aortic valve disease four of them were combined with mitral valve disease scheduled four mitral valve repair (four with grade IV, two with grade III AI).

Preoperative assessment:

All components of the aortic root were assessed by transthoracic echocardiography. Aortic cusps were examined for number, thickness, appearance of their free margins, the excursion of each cusp during the cardiac cycle. And the lines of coaptation of the aortic cusps were determined. The direction and size of the regurgitant jets were recorded. Aortic annulus was examined for dilatation, calcification and relation of its diameter to that of the sinotubular junction, aortic sinuses for symmetric or assymmetric enlargement, sinotubular junction and ascending aorta were also examined to identify the pathology and anatomy of the aorta and whole aortic root. But obviously, the aortic cusps are the most important determinant of aortic valve repair. If the cusps were thin, mobile, and have smooth free margins, the feasibility of aortic valve repair was very high. Calcified or scarred and fibrotic aortic cusps precluded aortic valve repair. Transoesophageal ecchocardiograpy (TEE) was performed on the operating table befor CPB for mor clarification of anatomy and guidance of repair and after CPB for assessment of the repair. No more than grade I was accepted as a residual AI. (Figure 1).

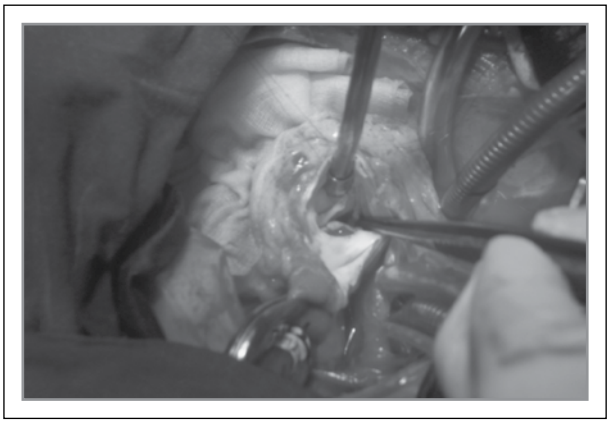

Fig 1. (Intraoperative assessment).

Patients characterestics:

The range age of age in patients with VSD was 5-11 years with mean age was 9.7 years and three were in NYHA class III and one in class II, 1 male and 3 female. Preoperative transthoracic echocardiography was performed in all patients. Aortic valve function was defined as normal when there was no AI or valve prolapse. Aortic valve prolapse was mild if there was buckling of the aortic cusp with minimal herniation during systole, moderate if there was obvious herniation into the VSD, and severe if the sinus herniated into the right ventricular outflow tract during systole and diastole[21]. Aortic incompetence was graded by Doppler echocardiography according to previously published criteria[22,23] on a qualitative scale of +1 to +4, AI with grade +1 was considered of mild severity, grade +2 as moderate, grade +3 as moderate to severe , grade +4 as severe. (Table 1).

The range of age in patients with rheumatic pathology was 10-28 years with mean age was 18.8 years , four in NYHA class III and two in class II, also four were females and two were males. These patients had evidence of rheumatic heart disease. Preoperative transthoracic echocardiography was performed in all patients and AI was graded as IV (n = 4) and III (n = 2). Pure AI was present in 5 patients and one case was mixed with moderate AS with mean gradient 35 mmhg. The mitral and tricuspid valves were also assessed in a similar fashion. Specified criteria of possible aortic valve repair in rheumatic

pathology included minimal or no calcification of aortic valve leaflets, some degree of mobility of cusps, and at least 2 to 3 mm of central leaflet coaptation[24]. (Table 1).

	G.A RH. AI	G.B AI +VSD
Mean Age (year)	18.8	9.7
Female/male	4/2	3/1
NYHA	4 : III 2 : II	3 : III 1 : II
Grade AI	4 : IV 2 : III	2 : IV 2 : III

Table 1. (Patients characterestics)

Operative procedure

Surgery was performed through median sternotomy, under cardiopulmonary bypass with standard aortic-bicaval cannulation and moderate hypothermia (28c). Cold blood antegrade ostial cardioplegia was used. After aortic crossclamping, nearly circular aortotomy was made, and the aortic valve was furtherly examined and data obtained by echocardiography were confirmed.

For cases with VSD; the VSD was inspected firstly trans aortic. The VSD was approached through the right atrium and tricuspid valve and closed using dacron patch and continuous polypropylen suture in three cases and transaortic by direct suture in one patient because it was small considering the idea that direct closure helping the septum to support the aortic root.

A variety of reparative procedures were performed. These have been described by others [25-27]. triangular resection (3 patints) in the center of the reduntant cusp with reapproximation. The apex of the triangle is ended midway to the annulus where the valve cusp tissue remains thickened . Central leaflet plication (1 patient), Performed with a 5-0 or 6-0 Prolene suture and extended perpendicularly from the free margin, about 4 to 5 mm through the belly of the leaflet to decrease cusp belly distension and respect its natural nest shape. Sub commissural annuloplasty for the tow commissure beneath the right coronary cusp (4 pateints); Subcommissural triangles are closed by horizontal mattress sutures (U shaped) (4-5 0 polypropylene) reinforced with teflon pledgets. Coaptation height increases more, the lower the sutures are placed. (Figure 2)

Surgical approach, CPB and cardioplegia for cases with rheumatic AI was the same as menthioned above. Mitral valve repair was performed first. Aortic valve repair was attempted only if the mitral valve repair appealing satisfactory and the patient had moderate or severe aortic valve disease. The aortic valve was inspected and operative findings included commissural fusion (n = 1), cusp thickening (n = 3), minimal calcification at the base of the cusps (n = 2), retraction of the cusps (n = 5).

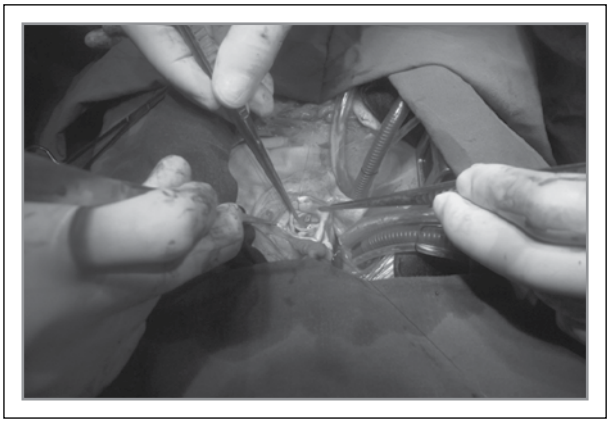

Fig 2. (subcomissural annuloplasty)

A variety of reparative procedures were performed. These have been described by others[28,29]. Commissurotomy was performed when commissural fusion was present (1 patient). A No. 11 blade was used to open the commissure up to the aortic wall. Cuspal thinning (3 patients) was performed by peeling off the thickened endocardium using a vascular forceps. The peeling off was started from the left ventricular outflow tract, and this fibrous peel was removed in a upward direction toward the free edge of the aortic valve cusps to remove all the excessive tissue and to make the valve leaflets thin and pliable.

Cusp retraction was repaired with glutaraldehyde-treated autologous pericardium. The retracted cusp or cusps were augmented at the free edge[30](5 patients) by trimming The autologous pericardium into a rectangular strip, The length of pericardial strip was adjusted according to the length of the free edge of the retracted cusp, The height of pericardial strip was adjusted to be 2 mm higher than its commissure, usually about 5 to 6 mm in height. Then, the pericardial strip was sutured to the free edge of the prolapsed cusp using a 6-0 polypropylene suture.(Figure 3). Basal augmentation was not done but is possible [31] where the retracted cusps are incised on the base of the Valsalva sinus 1 mm away from the annulus between the commissures, a semicircular pericardial patch are sutured from the annulus to the mobilized leaflet edge with a 5-0 polypropylene continuous suture, the base of the semicircular patch is sutured to the annular edge of the incision. The dimension of the semicircular patch dependes on the size of the native leaflet. The radius of the patch is 2 mm smaller than the annular radius of the treated cusp. The enlargement procedure of the cusp provided optimal depth of the Valsalva sinus for coaptation. Subcommissural annuloplasty was done as described.

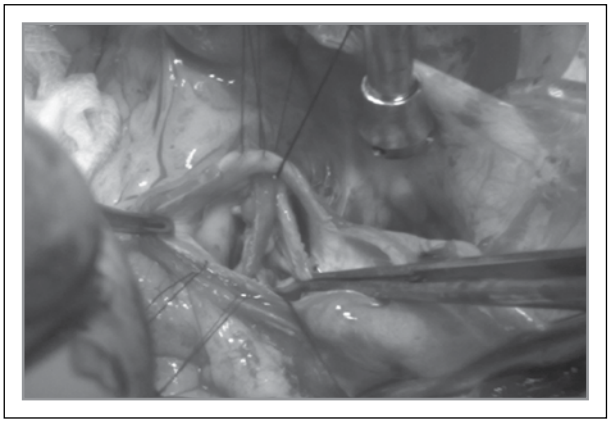

Fig 3. (pericardial free edge augmentation)

Assessment of Repair

Aortic valve repair was assessed as follows: (1) the cusps were visually inspected, gentle traction was applied on the commissures, the center of the cusps was pressed, and leaflets were aligned with each other to observe for redundant tissue (2) Saline can be injected into the aortic root after closure of aortotomy and noticing the filling af aortic root. (3) Heart is deaired , cross clamp is removed and LV is noticed. (4) TEE is the most important tool for assessment of repair after weaning from cardiopulmonary bypass. No more than mild AR was accepted with normal hemodynamics.(Figure 4).

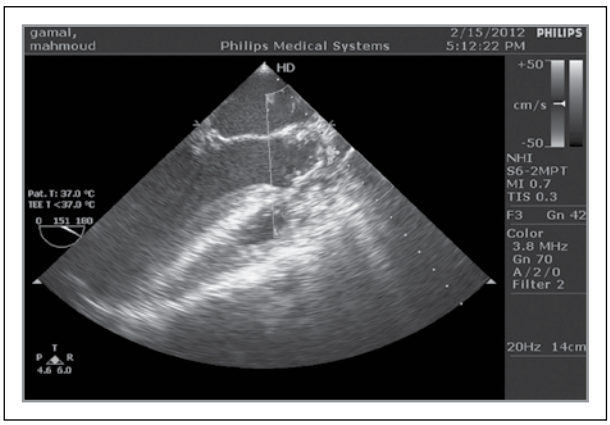

Fig 4. (TEE color Doppler assessment post repair)

RESULTS

The mean aortic cross-clamp time and cardiopulmonary bypass time for aortic valve repair with VSD closure were (72.5 minutes and 89.75 minutes) respectively and the mean duration of mechanical ventilation was 11.75 hours and of hospital stay was 10.75 days. The mean aortic cross-clamp time and cardiopulmonary bypass time for aortic valve repair with concomitant mitral valve repair were (90.2 minutes and 112.7 minutes) respectively and for single aortic valve repair were (52.4 minutes and 66 minutes) respectively . The mean duration of mechanical ventilation for aortic valve repair with concomitant mitral valve repair was 14.8 hours and of hospital stay was 12.7 days and for single aortic valve repair were 12.4 hours and 12 days. All patients required inotropic support. There were no in hospital mortality or valve-related complications. Before discharge from the hospital, transthoracic echocardiography was carried out; the ten patients had trivial or mild aortic incompetence except one patient with rheumatic AI had grade II AI. Follow up echocardiography was done after 6 months for eight patients only who passed this period; six patients showed no progression of the grade of AI over the short follow up period but one patint of each group have a progresion from grade I to grade II AI. There were no significant pressure gradient across LVOT in either the in hospital or the follow up echocardiography.(Table 2,3,4).

	Mean x clamp (minutes)	Mean CPB (minutes)	Mean mech. Ventilation (hours)
G.A. 1; RH AI+MVR	90.2	112.7	14.8
G.A. 2; RH.AI	52.4	66	12.4
G.B; AI+VSD	72.5	89.7	11.7

Table 2. (Operative data)

	Grade of AI	Mean Grade of AI	Max. PG (mmhg)
G.A; RH.AI	4 Cases : I 1Case : II 1 Case: 0	1	13
G.B; AI+VSD	4 Cases: I	1	8

Table.3 (Immediate post operative results)

	Progression of Grade of AI	Mean Grade of AI	Max. PG (mmhg)
G.A; RH.AI	3 Cases : no 1 Case : I II	1.33	15
G.B; AI+VSD	3 Cases: no 1 Case: I II	1.25	6

Table.4 (follow up results)

Follow-Up

No anticoagulants or antiplatelet drugs were prescribed for patients undergoing isolated aortic valve repair. For patients undergoing mitral valve repair using an annuloplasty ring in addition,warfarin was prescribed for 3 months, Long-acting benzathine penicillin was prescribed every 3 weeks to all patients younger than 40 years of age. Patients were followed for 6 months and are scheduled for longer periods of follow up.

Limitations

Our study is considered as a pilot study with the following limitations:

1) The number of patients is still small.

2) The follow up period is still short.

So, it is planned to expand the study to larger numberof patients and to extend the follow up period.

Discussion

The well known advantages of valve repair compared with replacement include and The encouraging results of valvuloplasty in the atrioventricular valves have influenced a resurgence of AV reconstruction[32]. However, aortic valve repair is technically more demanding than mitral valve repair and still carries a high failure rate because of the complexity of the valve pathologic disease, which includes deformed cusps, combined stenosis and regurgitation, and restricted mobility of cusps. Assessment of the reparability and postrepair assessment of aortic valve function are also difficult[14,15,32].

Aortic valve repair is nearly exclusively limited to patients with aortic regurgitation (AR). In order to perform this operation, the cusps must be thin and flexible without or with mild calcifications. The decision to repair an aortic valve is made by weighing the risk of repair failure versus its benefits[24]. Proper patient selection on the basis of the pathology of the valve and the routine use of TEE are essential to avoid an immediate unsuccessful repair and only trivial or mild AR is considered acceptable. However, there is a definite risk of reoperation related to progressive damage to the valve leaflets, annular dilatation, and recurrent attacks of rheumatic activity. A combination of factors may be responsible for these in any given patient [33].

However, considering the advantages of valve repair versus replacement and the safety of reoperations in present surgical practice, this encouraging us to initiate the experience of aortic valve repair. We started with cases in which the benefit of aortic valve repair is high enough to accept the risk; children with VSD and moderate or severe AI due to cusp prolapse and young adults with moderate or severe rheumatic AI in whom apparently successful mitral valve repaire has been done.

Cusp prolapse is generally caused by a distension of the free margin and it occurs Approximately in 5% of patients with VSD which is a well known association causing AI [34]. valve repair produced the best results before 7 years of age. After this age, valve pliability decreases, severity of prolapse and regurgitation increases, and with advancing age, valve repair is more vulnerable to failure. A subarterial VSD requires prompt repair even if the Qp/Qs is less than 2 [21]. The mean age in this set of patients in our study was 9.7 years due to late referral and the immediate and short term results as regarding the degree of AI and clinical status are accepted except one case with progression from grade I to grade II AI.

We prefferd to deal with the prolapsed cusp with the technique of triangular resection in three of the four cases because it is more valuable when large area of the cusp was redundant and it removes the most affected central area with fibrosis and calcification[25]. Central leaflet plication was done for one patient with less extensive cusp prolapse. It is recommended now that the best place for the plication suture is not near the commissure where the free margin is very thin but next to the node of arantius where the margin holds a suture better[25,26]. Sub commissural annuloplasty was also preferred because it is easy to do, adjustable and not impairing the haemodynamics of the aortic root[24].

Experience with aortic valve repair in patients with rheumatic heart disease is limited, and long-term follow up of valve repair in this subset of patients is limited[14-20]. But with the passage of time,there are some reports about growing experience and increased the follow up periods[33. Four of our patients were females and had combined aortic and mitral valve repair, This has been particularly important in young patients and in women of child-bearing age in whom anticoagulation is best avoided. Although our patients were with good left ventricular function, Poor left ventricular function is not a contraindication for repair [30]. The mean age in this set of patients in our study was 18.8 years and the immediate and short term results as regarding the degree of AI and clinical status are accepted except one case showed residual grade II AI and one case showed progression of the degree of AI from grade I in predischarge to grade II in 6 month echocardiography.

Surgical techniques in cases with rheumtic pathology depend mainly on type of lesion or lesions and the decision was made only after precise intraoperative examination; Specfically the thickness and hight of the cusps , and the degree of commissural fusion. Thinning to thickened less mobile cusps or augmentation of retracted cusps and sub commissural annuloplasty as a supporting procedures were the most commonly used techniques.

Conclusions

Aortic valve repair in patients with aortic incompetence associated with VSD and in rheumatic aortic valve pathology is feasible and yields encouraging short-term results.

Acknowledgment

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Initiation of Modified Ultrafiltration In Pediatric Cardiac Surgery Department, NHI

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Background: The use of cardiopulmonary bypass (CPB) is associated with many deleterious effects especially in pediatric patients. There is an increase in total body water and inflamatory response decreasing Pulmonary compliance and myocardial, modified ultra filtration (MUF) is one of the best efforts to reduce these detrimental effects.

Patients and methods: Through the year 2011 till April 2012 tow hundred pediatric cardiac patients underwent open cardiac procedures using CPB, modified ultrafiltration was done using a simple circuit.

Results: The use of MUF increses hematocrit value, increases blood pressure with accepted ventilation time and ICU stay.there were no serious complications or mortality related to the MUF technique.

Conclusion: MUF is safe and effective in improving outcome in pediatric cardiac surgical patients.

KEY WORDS: Modified ultrafiltration, Pediatric, Cardiac

A number of adverse effects are associated with the use of cardiopulmonary bypass (CPB) in children [1, 2]. There is an increase in total body water and edema formation due to increase in capillary permeability that leads to decreased Pulmonary compliance, gas transfer and myocardial dysfunction [3]. Water retention is especially important in neonates and infants. The ratio of prime volume to patient blood volume is greater in smaller patients [4] and whole body inflammatory response" is especially large in children [5].

Conventional efforts to reduce the detrimental effects of capillary leak syndrome after CPB include reducing circuit volumes, optimizing bypass techniques, various anti-inflammatory therapies, postoperative diuresis, and peritoneal dialysis [6]. Conventional ultrafiltration during CPB to reduce excess water is limited by the need to maintain a minimum level in the venous CPB reservoir. This is especially true in pediatric CPB because lower prime volumes are used, Also has limited role in reducing inflammatory mediators [7].

In 1991, Naik and Elliot developed the technique of modified ultrafiltration (MUF) as an alternative method to reduce the adverse effects of CPB in pediatric patients [8]. MUF reverses haemodilution, reduces total body water, improves hemodynamics, decreases the need for blood transfusions, minimizes myocardial edema, improves cerebral metabolic recovery after circulatory arrest and improves respiratory mechanics in patients who have undergone CPB[6-8].

In an effort to improve results in our department (Department Of Pediatric Cardiac Surgery, National Heart Institute ,Cairo, Egypt) we tried to get the benefits of this technique, wehave been using a MUF circuit witha simplified design especially in low body weight babies and high risk surgical procedures.

Patients and methods

Through the year 2011 till April 2012 tow hundred pediatric cardiac patients underwent MUF at the end of CPB. The diagnosis of these patients varied between

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VSD, CAVSD, TOF, TAPVC, ASO, senning operation and cavopulmonary anastomosis with intracardiac procedures. Most of these patients are low body wight or suffered congestive heart failure.

Inclusion criteria

The criteria used to determine if MUF would be used or not are variable. At first we tried to use MUF for every open-heart pediatric case as many centers in Europe and north America do [9] but due to economic issues a weight-based inclusion criterion was mainly used and we continue to use MUF for body weight below 10 kg as a routine but other situations like prolonged bypass, low HCT or increased body water at the end of CPB may indicate the use of MUF in otherwise larger babies more than 10 kg.

Exclusoin criteria

We excluded patients more than 10 Kg who underwent short uncomplicated procedures.

Technique

Circuit desighn

Cardiopulmonary bypass is performed with a standard roller pump and membrane oxygenator. The extracorporeal circuit is primed with Ringer's lactate solution and sodium bicarbonate for a total prime volume of 1,200 mL/m2. Fresh frozen plasma and packed red blood cells are added as needed to reach a final hematocrit of 30%. Heparin is added to the priming solution.

Mode and connections: Thearteriovenous MUF is the mode that we are using. And because we have no separate blood cardioplegia system with a separate heater cooler we accessing the CPB circuit utilizing a dedicated port added to the circuit specifically for MUF on the arterial line distal to the oxygenator Controlled by a stopcock. The inflow line for the choosenHaemoconcentrators used for MUF (either neonatal or pediatric ; according to age and body weight) is then passed through the small pump desighned for cardioplegia to actively infuse through the ultrafilter when needed. MUF infusion line. After passing through the haemoconcentrator, concentrated blood must be returned to the patient. A dedicated MUF infusion line was used by adding a venous extension line only at the time of MUF mounted by a14 gauge peripheral canula.(Fig. 1)

Conduct of MUF

Determination of MUF pump flowrate could be categorized into four groups. fixed flow rates (independent of patient size), indexed MUF pump flow rates to the patient's weight, MUF flow rates based upon an individual patient's haemodynamic stability and MUF flow upon a calculation of 10% of the patient's normal cardiac output (9). We use the indexed MUF pump flow rates to the patient's weight on 10-15ml/kg/min.

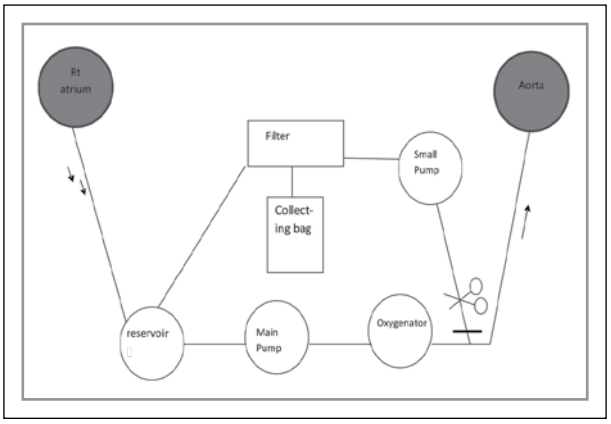

Fig 1. MUF circuit during bypass (not working).

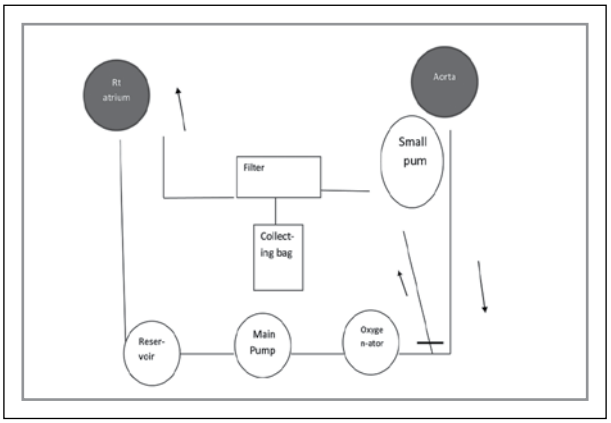

Fig 2. MUF circuit post bypass (working).

Pump strategies: All the AV MUF centres utilized a similar pump control strategy (9). After coming off bypass the MUF pump flow is established retrogradly withdrawing blood from the patient through the arterial line, this pump is usually maintained at a constant flow rate. The arterial pump flow is varied to maintain an optimal filling pressure for the patient; When patient filling pressures are low, the arterial pump flow may be started slowly, resulting in less volume removed from the patient and greater titration from the CPB circuit into the MUF circuit. If filling pressures become excessive, the arterial pump flow may be stoped, thus removing more volume from the patient for ultrafiltration. Heightened communication between anaesthesiologist, perfusionist and surgeon concerning optimal filling pressures during MUF is essential during this period.

MUF end point: Reported parameters for the termination of MUF were variable between ;complete salvage of circuit contents,a time-based end point of 10–20-min duration,

surgeon's preference, haematocrit based end point and a combination of the above parameters (9). We use the time based end point as we continue MUF initially for 10 minutes but another 1 to 5 minutes may be added according to the situation.

Results

We have performed this technique in 200 pediatric patients with mean body weight 6.8 +/- 0.6 kg . A mean volume of 584 +/- 72 mL were obtained during MUF, in 35 patiets conventional ultrafiltration was added witht added mean ultrafiltrate volume of 290 +/- 44 ml. All patients showed hemodynamic improvement at the end of MUF; rising of the haematocrit value at the end of MUF than after coming off CPB, there was a trend of decreasing central venous pressures while systemic blood pressure rose, there was rapid improvement in oxygen saturation (mostly reading 100% in cases with no RT to LT shunt) even befor the end of MUF, improvement in medical bleeding and lesser oozing from the surgical field also noticed and 35 patients recovered from transient heart block due to tissue edema during and shortly after MUF. (Table 1).

Table 1. Mean value of haematocrit (HCT) and systolic blood pressure (SBP) pre and post MUF.

	Post CPB, pre MUF	Post MUF
HCT	26.5 +/- 3.7%	43.2 +/- 4.9%
SBP	74+/- 6 mmhg	92 +/- 8 mmhg

Regarding the ICU course; all patients showed full CNS recovery within 4 hours in the ICU except patients planned to be sedated for longer time according to the hemodynamic situation (46 patients) and acceptable ABGs and 116 patients (58%) extubatetbefor 12 hours. The mean post operative drain loss was 12 +/- 1.8 ml/kg and the mean ICU stay 2,8 +/- 0.7 dayes.

Many technical complications directly related to the MUF technique were reported especially with early experience with MUF including air cavitating out of solution in the arterial line, Patient cooling during MUF especially in centres not using a blood ardioplegia system and a clotted MUF circuit [9]. but most common complication facing us is patient cooling but mostly to a tolerable degree.

Comment

Considering the deleterious effects of increased body water and systemic inflammatory response related to CPB espescially in high risk neonates and small infants most of them suffering pulmonary hypertention and/or heart failure; the mechanisms and effects of MUF remains optimal for improving outcome in this set of patients. By removing excess water and inflammatory mediators MUF improves myocardial and respiratory functions decreasing the need for prolonged ventillatorysupport, reverses hemodilution and dilutionof plasma proteins and coagulation factors reducing the postoperative chest drain loss and blood transfusion requirements[7-8].

We did not measure total body water content, but others have reported significant decreases in total body water using MUF [10]. In most patients, systolic and mean blood pressures increased during MUF. This has also been observed by others [7-8-10]. The rise in blood viscosity due to water loss may be responsible for this blood pressure increase. Another explanation may be found in the removal of vasoreactive substances by MUF . Inflammatory mediators such as interleukins, tumor necrosis factor, and activated complement components many of them having cardiodepressive characteristics are reported to be removed by ultrafiltration [11-12]. Similar mechanisms improve cerebral metabolic recovery after circulatory arrest and improves respiratory mechanics [13-14].

Of course, the use of MUF does not reduce the need for further efforts to limit the CPB prime volume to diminish water overload while at the same time trying to restrict the use of blood and blood products as much as possible.

Conclusion

MUF for pediatric cardiac patients undergoing corrective or palliative procedure using CPBis safe and effective and encourages us to continue using the MUF technique. Our circuit offers the following advantages: (1) It is a simple design (1) It allows CUF. (3) No extra tubing is added to the CPB circuit except a venous extention line. (4) There is no need to change tubing in the pump roller head.

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After STICH trial. Is surgery of ventricular restoration still needed in modern cardiac surgery?

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Background: **Myocardial infarction (MI) causes the affected area to be no longer functioning where the non-infarcted myocardium becomes spherical in shape with its global systolic function worsens. It has been postulated that surgical ventricular reconstruction for these patients results in better clinical outcome than conservative medical treatment, but The STICH trial may potentially alter treatment of congestive heart failure (CHF) after ischemic cardiomyopathy (ICM) following MI.**

The aim of our study was to evaluate the early outcome of surgical ventricular restoration, in aspects of survival and functional status.

All patients underwent CABG concomitantly with SVR. The hospital mortality rate was 4%. Early postoperative complications were in average rate. NYHA functional class improved from 3±0.6 preoperatively to 1.42±0.5 at 6 months follow-up. Echocardiographically, EF% increased from 31.2±4.4 to 40.5±5.7% and left ventricular EDVI & ESVI were reduced from 110.04±7.26 ml/m2 and 75.6±6.99 ml/m2 to 51.75±2.42 ml/m2 and 30.79±2.87 ml/m2 respectively. Conclusion; SVR may be added to CABG in ischaemic cardiomyopathy with reasonable operative risk. Although the STICH trial suggests a cautionary approach to SVR, further evidence is needed to property identify which patients will benefit from this procedure.

Keywords: ***STICH trial- Ventricular Restorative Surgery- Cardiomyopathy.***

In recent years there has been an increased incidence of heart failure. It is estimated that in the United States 500 thousand new cases of heart failure are diagnosed annually, and about 2/3 of them have ischemic cardiomyopathy , which is usually the result of massive myocardial infarction (MI). Left ventricular dilatation develops in approximately 20% of patients after myocardial infarction [1]. It is believed that the area of akinesia / dyskinesia by alters the wall stress in the myocardium during systole, and this stimulates the remodeling of the remote "healthy" segments of the myocardium. Along with the increase of the left ventricle size it loses the normal ellipsoidal shape, which further lowers the systolic and diastolic function. The more it is increased the more the LV assumes a spherical shape, which - according to law of Laplace – creates larger stress on the wall, leading to ischemia and subsequent remodeling of all segments of the LV. The prognosis of ischemic cardiomyopathy is poor, with a three-year mortality rate of 25-30%.Characteristically; mortality correlates b with the reduction of LV ejection fraction [2].

It was recently reported that coronary artery bypass surgery alone in patients with ischemic heart disease and grossly increased left ventricular volumes relieved anginal symptoms, but the long term prognosis was dismal with 76% of patients died within 10 years, most of them due to heart failure[3] .

At the end of the last century, several research groups have proposed some surgical techniques to treat ischemic cardiomyopathy with large areas of akinesia/ dyskinesia. These treatments called (Surgical Ventricular Restoration, SVR) by eliminating the areas of akinesia / dyskinesia and reducing the volume to improve LV systolic function. This is achieved by using either a modified linear streak resection [4], or by using endoventricular Dacron patch plasty (Dor procedure). [5]

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Dor sought to remove and/or exclude fixed, non-contractile scars to minimize dyskinetic regions of myocardium. The defect was then covered with a patch, and the myocardium was closed over the patch. Dor was also the first to emphasize complete revascularization and repair or replacement of the MV in these cases **[6].**

The STICH trial compared medical therapy alone with medical therapy plus CABG in patients with coronary artery disease and left ventricular dysfunction. The rates of death from cardiovascular causes and of death from any cause due to hospitalization for cardiac causes were lower among patients assigned to CABG than among those assigned to medical therapy **[7].**

PATIENTS AND METHODS

Twenty-five patients, with previous anterior myocardial infarction and secondary LV dilatation, underwent surgical SVR using endoventricular patch plasty technique, done in Cairo University Hospitals and Emory University Hospital at Atlanta, USA from October 2008 to May 2011, represented the population of this study.

All patients had simultaneous coronary artery bypass grafting(CABG) done as well.

Patients are considered suitable for surgical ventricular reconstruction if they demonstrated an enlarged either dyskinetic or akinetic left ventricle accompanied by left ventricular dysfunction

All patients underwent operation through a standard median sternotomy incision, on cardiopulmonary bypass, Myocardial protection was achieved by intermittent warm antegrade blood cardioplegia.

All distal anastomoses were constructed first except LIMA to LAD. The LV is opened through the apical scar. At the border of the endocardial scar and normal myocardium, an endoventricular purse string suture is placed (Fontan stitch) using a 2-0 polypropylene suture on 40mm half circle taper cut needle. A homemade rubber sizing balloon, which is passed through the purse string and inflated to the theoretical normal end diastolic volume of the patient's left ventricle according to the body surface area. We used Menicanti's sizing guidelines .The stitch is then tied, restoring the normal ventricular size.

Based on the remaining orifice, an endoventricular patch (Dacron) is fashioned and secured over the orifice with a running 2-0 polypropylene suture. Before completion of closure of the orifice, the balloon is deflated and removed.

Linear closure of the excluded scared part of LV is done over the Dacron patch with enforcement by 2 strips of the treated pericardial patch, which was fixed in gluteraldehide 6% for 10 min.The procedure then continued with anastomosing the LIMA to the LAD, followed by placement of the proximal anastomoses.

Pre, post operative and six months later transthoracic echocardiogram was done to assess ejection fraction, the end-systolic volume, the end diastolic volume as well as to detect worsening or development of new mitral regurgitation.

• *Six months assessment* according to NYHA criteria was included in this study.

Statistical Analysis

Results are expressed as mean ± standard deviation (SD). Comparison between the mean values of different variables pre-, immediate post treatment and 6 month follow up was performed using paired student *t* test. SPSS computer program (version 12 windows) was used for data analysis.

Correlation between parameters was performed using Pearson correlation test. *p*-value less than or equal to 0.05 was considered significant and less than 0.01 was considered highly significant.

RESULTS

The study consisted of 22 males (88%) and 3 females (12%).The average age of patients was 54.5 years (range 32 to 66 years). Concerning risk factors, hypertension was present in 8 cases (32%), Diabetes mellitus in 13 patients (52%), hyperlipidemia in 16 patients (64%), 6 patients (24%) were diagnosed with chronic obstructive pulmonary disease (COPD) and 9 patients (36%) were obese. All patients had positive history of previous myocardial infarction, presenting with heart failure symptoms of NYHA functional class II, III and IV (20%, 56% and 24%, respectively). Overall preoperative NYHA functional class of the study group was 3.00 ± 0.66.

Distal coronary anastomoses were constructed in the study patients with a mean of 3 (range: 1 to 5) anastomoses per patient. Mean total operative time was 329.8 ± 98.1 min, while the mean duration of aortic clamping time and cardiopulmonary bypass were 115.1 ± 59.9 min and 183.2 ± 39 min, respectively.

The overall hospital mortality was one patient, constituting a 4% mortality rate. This was a 59-year-old male patient who was markedly obese, diabetic, hypertensive with previous anterior myocardial infarction, preoperative NYHA functional class IV. Preoperative echocardiography showed that Ejection Fraction of 30%, left ventricular EDVI and ESVI were 191 ml/m^2 and 92ml/m^2, respectively, as well as akinetic anterior wall and hypokinetic inferior wall and grade II mitral regurgitation. He received LIMA-LAD, SVG-OM1 and SVG-PDA grafting, as well as SVR.

Following weaning from CPB, patient needed high inotropic support, a long with an intra-aortic balloon pump support to maintain the hemodynamics. Postoperative inferior myocardial infarction evolved. Patient could not be weaned from inotropic, intra-aortic balloon support or mechanical ventilation.

Bed side transthoracic echo showed deterioration of EF to 25% as well as akinetic inferior wall. Patient started to develop low cardiac output manifestations .He died on the 8th postoperative day because of refractory heart failure.

The mean period of ICU stay was 4 ± 1.7 days; while the mean hospital stay time was 11 ± 2.4 days. 6 patients required prolonged ICU stay > 5 days, due to either high inotropic support or due to the occurrence of arrhythmias .We placed IABP in 4 patients preoperatively on elective basis, 2 of them had tight left main disease and the other two had left ventricular EF of 26% associated with grade II MR. Intraoperative need for IABP support occurred in 1 patient (4%). Four patients (16%) required prolonged ventilatory support (longer than 48 hours). Arrhythmias occurred in 6 patients, in the form of, one patient developed ventricular tachycardia. Two patients developed frequent ventricular extrasystoles. And lastly 3 patients developed atrial fibrillation.

In - hospital mortality	1 (4%)
ICU stay (days)	4 ± 1.7
Hospital stay (days)	11 ± 2.4
Mechanical ventilation (hours)	14.5 ± 3.2
Inotropic support needed >48 hrs	7 (28%)
IABP support	5 (20%)
Postoperative MI	1 (4%)
Re-exploration for bleeding	1 (4%)
Sternal wound infection	0
Acute renal failure	2 (8%)
Cerebrovascular accident	1(4%)
Arrhythmias	6 (24%)

Table 1. Postoperative morbidity and mortality

Assessment of postoperative NYHA functional status before discharge from the hospital and six months after surgical procedure, revealed a significant improvement from class 3.00 ± 0.66 preoperatively, to 2.13 ± 0.45 before discharge and that continued to improve to 1.42 ± 0.50 after six months.

On comparing preoperative NYHA functional class with that after six months, we found that 11 patients (45.8%) improved by one functional class, 12 patients (50%) improved by more than one functional class and one patient didn't show an improvement in his NYHA functional class. During the follow up period one patient required rehospitalization for recurrent heart failure symptoms, for whom antifailure medications were readjusted and he improved.

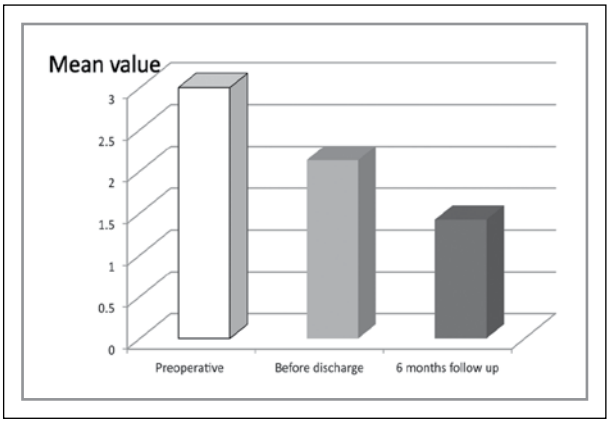

Fig 1. Mean NYHA functional class preoperatively, before discharge and after 6 month postoperatively.

Echocardiographic Results

Table 2: Echocardiographic findings in the studied patients

	Preoperative (n= 25)	Immediate postoperative (n= 24)	6 month follow up (n= 24)
EDD (cm)	7.05 ± 0.27	6.68 ± 0.29	6.43 ± 0.39
EDV (ml)	216.00 ± 20.26	102.20 ± 8.18	101.88 ± 8.05
EDVI (ml/m²)	110.04 ± 7.26	52.04 ± 2.61	51.75 ± 2.42
ESV (ml)	148.56 ± 16.37	66.76 ± 7.84	60.58 ± 7.21
ESVI (ml/m²)	75.60 ± 6.99	34.04 ± 3.60	30.79 ± 2.87
EF (%)	31.24 ± 4.41	34.76 ± 5.61	40.50 ± 5.76
PAP (mmHg)	33.60 ± 4.68	31.72 ± 4.26	28.42 ± 4.63
MR	0.88 ± 0.83	0.44 ± 0.51	0.33 ± 0.48

A highly significant reduction was noticed in left ventricular EDVI from 110.04 ± 7.26 ml/m² preoperatively to 52.04 ± 2.61 ml/m² in immediate postoperative study. As well as a highly significant reduction in left ventricular ESVI occurred from 75.60 ± 6.99 ml/m² preoperatively to 34.04 ± 3.60 ml/m² in immediate postoperative study. The reduction in the left ventricular EDVI and the left ventricular ESVI continued decreasing through the 6 months follow up period. There was also a highly significant increase in the left ventricular ejection fraction that was demonstrated at immediate postoperative study (34.76 ± 5.61%) and 6 month later. MR degree decreased to 0.44 ± 0.51 in immediate postoperative study and that improvement was maintained in the six month follow up.

Another finding in our study was that a highly significant correlation between the improvement in the left ventricular

ESVI and the improvement in the NYHA functional class, as well as the improvement in the left ventricular ejection fraction.

	ESVI	
	Pearson Correlation	*Sig. (2-tailed)*
NYHA	0.562	0.004**
EF	-0.854	0.001**
PAP	0.322	0.117 NS
MR	0.264	0.202 NS

***p 0.01 < = highly significant*

Table 3 . ***Correlation between ESVI and different variables measured before discharge in patients group***

DISCUSSION

Major findings of our study are as follows:

- Results of the in hospital mortality showed that the SVR procedure is feasible due to its low perioperative mortality.
- Clinical status, as evaluated by NYHA functional class, is significantly improved.
- Significant volume reduction and improvement in the left ventricular ejection fraction are observed at the immediate postoperative echocardiographic evaluation.
- This improvement is still significant at 6 months follow up.
- 95.8% of patients are free from cardiac rehospitalization during the 6 month follow up period.

The overall early mortality of only one out of twenty five patients demonstrates the safety of surgical ventricular restoration .This result is similar to previous studies. The largest recent single-center experience published by **Menicanti et al.** showed 4.7% of early mortality **[8]. Vincent Dor**, reported that the hospital mortality of this technique was 87 hospital deaths out of 1150 patients operated upon (7.5%) **[9].** Similarly, **Urlik Sartipy** reviewed his single institution 10-years experience. He reported that early mortality was eight patients out of one hundred and one patients (7.9%) operated upon using Dor procedure **[10].**

On the other hand, **Hernandez et al.**, provided a report from the STS National Cardiac Database of 731 SVR procedures performed from 2002 to 2004. The mortality was twice the RESTORE study (**R**econstructive **E**ndoventricular **S**urgical **T**orsion **O**riginal **R**adius **E**lliptical shape) 33% of the patients suffered a major complication or mortality **[11].**

The present study confirms the beneficial effect of surgical ventricular restoration on clinical status with improvement of NYHA functional class, by an average of one class. This improvement continued in the 6 month follow up period.

The beneficial effect of SVR on the clinical status is accompanied by a significant improvement in the left ventricular systolic function with increase in the left ventricular ejection fraction by an average of 10%, as well as significant reduction in the left ventricular volumes, with reduction in left ventricular EDVI and ESVI. **Menicanti's** experience study showed improvement of NYHA functional class from 2.8 ± 0.8 preoperatively to 1.6 ± 0.6 postoperatively. This was associated with improvement of left ventricular ejection fraction from 27 ± 6% preoperatively to 36 ± 9% postoperatively. End-diastolic and end-systolic volumes decreased from 211 ± 73 ml to 142 ± 50 ml and 145 ± 64 ml to 88 ± 40 ml, respectively **[8]. Dor et al.,** in their retrospective study reported improvement in ejection fraction of around 15%, as well as improvement of functional class **[9].**

Furthermore, **Sartipy et al.** in their serial studies on the Dor procedure, reported that there was a significant improvement in functional status judged by NYHA class, six minute walk test and health-related quality of life. Cardiac function judged by ejection fraction also improved from 24% to 37% postoperatively, that was associated with significant decrease in left ventricular EDVI and ESVI from 110 ± 27 ml/m^2 to 90 ± 26 ml/m^2 and 75 ± 28 ml/m^2 to 52 ± 26 ml/m^2, respectively **[10].**

This was confirmed in our study, which showed significant correlation between the post operative reduction of the left ventricular ESVI and the improvement in the NYHA functional class as well as the left ventricular ejection fraction.

Until recently, SVR was being increasingly performed and a large number of reports drawn on various data sets from registries studies have shown that left ventricular restoration is effective and relatively safe with a favorable 5-years outcome.

To determine the effectiveness of SVR in patients with ischemic disease. (STICH) trial was performed in randomized patients and the results were published. That article may potentially alter treatment of congestive heart failure (CHF) after ICM following MI.

The STICH trial involved 127 sites in 26 different countries, enrolling patients with CAD and an LVEF less than 35% who had a dominant area of anterior akinesia or dyskinesia of the LV **[7].**

This study of 1000 patients randomized to CABG alone or CABG + SVR showed no difference in perioperative mortality, long term mortality, NYHA functional class improvement, or 6-minute walk test. The authors concluded that SVR did not improve HF over CABG alone and postulated that the lack of benefit is related to the impaired diastolic distention that results from the SVR procedure. Furthermore, length of ICU stay was longer, hospital cost was higher and there was no difference in postoperative quality of life **[12].**

The STICH trial has been strongly criticized also because there were too many expectations from these long-awaited results. In fact, several limitations have led to substantial clinical uncertainty in making such results widely generalizable.

Menicanti in his criticism for the STICH trial stated that only 49% of the STICH patients were in New York Heart Association class III/IV, indicating a population more representative of ischemic patients independently of heart failure; in other words, the study shifted from a heart failure population to a broad horizon of ischemic patients **[13].**

Furthermore, the design of the STICH trial initially excluded patients with a LVESVI less than 60 ml/m2. As the STICH study evolved, due to the empirical nature of the entry criteria, it was decided to liberalize inclusion criteria to include patients amenable to SVR surgery in the opinion of the investigators. This led to the inclusion of patients with a broad range of baseline LVESVI in the STICH population (ranging from 22 ml/m2 to 231 ml/m2), reinforcing the question of which ventricles have been randomized. Changing the inclusion criteria was an effort to apply the concept of SVR to a larger population with low ejection fraction, in which SVR has unknown effects **[14].**

STICH measured volume in only 161 of 490 SVR patients and concluded that SVR is not better than CABG. Unfortunately, no evaluation could be made in 66% of SVR patients whose volume was not measured **[15].**

The next criticism was that the volume reduction achieved by the STICH surgeons was not enough. LV volume was reduced by 19% in SVR patients to reach a volume endpoint that reflects an inadequate repair, as determined by the Surgery Therapy Committee whose "acceptable STICH procedure" guideline required a 30% ESVI decrease at the 4-month MRI measurement. SVR procedure may have reflected a small LV plication **[14].**

On the other hand **Dor et al.** performed a study on patients who would not have been eligible for the STICH trial, as those with no coronary vessel suitable for coronary artery bypass grafting, patients within a month of myocardial infarction, those with acute heart failure, patients receiving intravenous inotropes, IABP or both. He reported that with minimal associated mortality, SVR produces durable improvement in the left ventricular function in that patient group, and he concluded that considering those patient would have been excluded from the STICH trial, care should be taken not to expand that results too widely so as to inappropriately deny selected patients an effective treatment for ischemic cardiomyopathies **[16].**

Considered all together, it seems that the results of the STICH trial should be interpreted with caution; further data analyses, if ever possible, will be necessary before drawing definitive conclusions. In the mean time, the choice to add SVR to CABG should be based on a careful evaluation of patients, including symptoms (heart failure symptoms should be predominant over angina), measurements of the LV volumes and assessment of the transmural extent of myocardial scar tissue **[13].**

An important limitation in our study is the lack of postoperative invasive studies or cardiac magnetic resonance imaging, which are needed for detailed analysis of left ventricular volume, geometry and performance.

CONCLUSIONS

On the basis of our study, surgical ventricular reconstruction for patients with post-infarction left ventricular aneurysm or scar, can be performed with a low operative mortality and acceptable early postoperative morbidity.

Surgical ventricular restoration resulted in a high degree of freedom from re-admission for heart failure, on the short-term scale. As well as the functional status improvement over the six-month follow-up period.

Our study suggest that meticulous selection for patients for such procedure is the keystone for its success and to get good results.

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Early experience with Epsilon- Aminocaproic Acid (EACA) in urgent CABG

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Backgroun: **Aim of the study is to evaluate prospectively the blood sparing effect and the drawbacks of treatment with Epsilon-aminocaproic acid(EACA) in patients on antiplatelet medication (aspirin, clopidogrel or both) requiring emergency coronary surgery for acute coronary syndrome or critical left main disease.**

Methods: **Perioperative data on 120 patients consecutively operated on from December 2009 until July 2011 for coronary artery disease on an emergency basis were analysed . During the first 9 months 60 patients were operated on and received no antifibrinolytic treatment (control group). The next 60 patients (EACA group) received EACA according to our protocol . Mortality and morbidity including postoperative bleeding, blood and blood products transfusion were compared between the two groups.**

Results: **The demographic data and operative risk in both groups were similar. Postoperative drainage was lower in the EACA group (560 ml ±380 vs. 1040 ml ±1020). The blood, fresh frozen plasma and platelet transfusion requirements were not statistically different between groups (blood 1.5 units ±2.1 vs. 2.5 units ±3.1, p = 0.07, fresh frozen plasma 1.1 units ±1.6 vs. 1.7 units ±2.7, p = 0.2, platelets 1.6 units ±2.6 vs. 1.4 units ±3.5, p = 0.3). There were no deaths in the EACA group and 4 deaths in the control group. Myocardial infarction occurred in 3 (5%) and 10 (16.7%) patients respectively (p = 0.03). Strokes occurred in 2 patients (3.3%) in both groups . Two patients (3.3%) from the treatment group and 5 (8.3%) from the control group required exploration for bleeding.**

Conclusions: **Perioperative administration of EACA reduces postoperative bleeding but does not influence the requirements for blood and fresh frozen plasma in patients undergoing emergency coronary artery bypass grafting.**

KEYWORDS: **Acute Coronary Syndrome- EACA - antiplatelets**

In recent years a trend towards a higher percentage of patients who require an emergency operation for acute coronary syndrome (ACS) or critical left main disease is observed. Emergency myocardial revascularization is associated with increased morbidity and mortality. Post operative excessive hemorrhage is serious and potentially lethal [1]. Standard pharmacological therapy in these high-risk patients includes antiplatelet agents, the dosage of which may be increased in acute coronary syndromes. Stopping these agents may expose the patients to an increase in thrombotic complications prior to surgery, especially in those who have recently undergone cardiac catheterization [2-4]. Antiplatelets increase the risk of postoperative bleeding complications, and the administration of blood and blood products . In addition to this, the effects of cardiopulmonary bypass mediate extensive Systemic Inflammatory Response and activate blood cells like platelets causing major complications as bleeding [5-8], so perioperative platelet transfusion is advised in such patients . Other measures to minimize postoperative blood loss include antifibrinolytic medications. Aprotinin (serine protease inhibitor)was often employed previously, but it was withdrawn from the market by the manufacturer following doubts concerning its safety [9]. Epsilon-aminocaproic acid (EACA) is a synthetic inhibitor of plasmin-plasminogen system with antifibrinolytic activity. It works by the direct inhibition of plasminogen activators, thus stopping its conversion to plasmin. [10].

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Our aim was to examine what kind of influence EACA administration has on postoperative bleeding, the consumption of blood and blood products, and what the side effects of such therapy are in patients on antiplatelet medication (aspirin and clopidogrel) who urgently require surgery.

Material and methods

The study is based on a prospective analysis of data collected from 120 patients operated on in Cairo University Hospitals between December 2009 and July 2011 for coronary disease on an emergency basis for acute coronary syndrome (e.g. unstable angina, Non ST segment elevation MI and early post infarction angina) or left main disease. Double antiplatelet medication (aspirin and clopidogrel) was continued until the operation day. Our own protocol for Epsilon-aminocaproic acid administration was developed and introduced into routine practice in September 2010. All patients (n = 60) operated on after that date were treated with EACA and were included in the treatment group of this study. Patients operated on before that date (n = 60) did not receive EACA and were included in the control group. The anaesthesia and cardiopulmonary bypass protocols remained unchanged during the study. Cardiopulmonary bypass (CPB) was used in all cases. All the patients received 300 IU of heparin per kg of body weight before aortic cannulation. The adequacy of anticoagulation was confirmed with ACT. During the cardiopulmonary bypass a temperature drift to 34°C was allowed. Intermittent warm blood cardioplegia was administered into the aortic root. The internal thoracic artery and vein grafts were used in most patients but 9 of them also received radial artery grafts. All the patients received protamine (3 mg per kg) after the completion of cardiopulmonary bypass. The pericardium was left open and two 32F drains were inserted into the mediastinum or into the pleura if it was open. The drains were put on suction after the operation .All patients were scheduled to receive aspirin 6 hours after surgery if chest tube output was less than 100 ml/h .

Epsilon-aminocaproic acid(EACA) administration protocol; Three- dosing- regimen[11] was adopted. Patient received 150 mg/kg at induction, the same dose on bypass and the last one after coming off bypass repeating the above mentioned dose.

The demographic data (patients' age, sex, body mass index [BMI], logistic EuroSCORE [LES], left ventricle ejection fraction [LVEF]) of patients from both groups were compared.

The postoperative results were analyzed by comparing mortality, time of hospitalization, incidence of myocardial infarction, atrial fibrillation, cerebrovascular strokes, acute renal failure defined as a necessity of implementation of renal dialysis, respiratory failure requiring mechanical ventilation for more than 24 hours and exploration for bleeding. The total drainage in all patients was noted and compared between both groups. The transfusion of blood and blood products was also compared between groups. Blood was generally transfused when the haemoglobin was found to be lower than 8g%. Platelets, plasma and clotting factors were prescribed for coagulation disorders. Platelets count, ACT pre-CPB, PT, INR and PTT were measured.

Descriptive statistics for the groups are presented as mean standard deviation or as a simple percentage. Differences within and between groups were analysed using the unpaired or paired Student's t-test or Fisher's exact test as appropriate. The Mann-Whitney U test was used to compare postoperative blood loss and transfusion requirements, which do not follow a Gaussian distribution. A p value < 0.05 was considered as statistically significant. Data were analyzed by Microsoft Office 2003(excel) and Statistical Package for Social Science (SPSS).

Results

The demographic and operative data are presented in Table I. Both groups were similar in mean age, sex, LES and LVEF. The operative risk calculated with logistic EuroSCORE was not statistically different. The EACA group had a higher percentage of diabetic patients. The mean cardiopulmonary bypass time and cross-clamp time were longer in the control group. The mean number of grafts was not statistically different between groups and the haemoglobin levels were similar. It was found that the mean creatinine level before the operation was higher in the EACA group

	EACA group	Control group	P value
male/female	45/15	46/14	0.5
age (years)	64.2±8.8	62.8±9.4	0.4
operative risk (LES)	10.4 ±9.6	9.6 ±13.0	0.1
ejection fraction (% EF)	46.9 ±10.4	46.2 ±13.0	0.8
BMI	29.4 ±3.6	27.7 ±3.8	0.01
haemoglobin levels (mg %)	7.7 ±0.8	7.6 ±0.7	0.5
creatinine levels (mg/dL)	1.2 ±0.8	1.0 ±0.8	0.01
CPB time (min)	69.9 ±14.1	78.8 ±15.7	0.001
cross-clamping time (min)	48.1 ±8.2	52.5 ±9.3	0.01
number of coronary grafts	3.2 ±0.8	3.2 ±0.7	0.9
diabetes mellitus	18 (30%)	13 (21.6%)	0.02

Tab. I. Demographic and operative data

Although there were no deaths in the EACA group there were 4 deaths among the control group.

The cause of death in three cases was low cardiac output syndrome,and one patient died after reexploration

for bleeding with persistent hypoxia and signs of respiratory failure. Myocardial infarction occurred in 3 patients from the EACA group and in 10 control group patients (5% vs. 16.7%; p = 0.03). Atrial fibrillation occurred in 17 and 10 patients respectively (28.3% vs. 16.3%; p = 0.09). Stroke occurred in 2 (3.3%) patients from both groups. Renal dialysis was necessary for 3 and 4 patients (5% vs. 6.7%; p = 0.05) following acute renal failure. Respiratory failure (intubation longer than 24 hours) occurred in 3 and 5 patients (5% vs. 8.3%; p = 0.03). Two (3.3%) patients in the EACA group and 5 (8.3%; p = 0.02) in the control group needed to be reoperated on for bleeding. Among the patients who needed exploration for bleeding, in two EACA patients surgical bleeding was identified, whereas in the control group patients it was general oozing in 4 out of 5 patients. Mean postoperative drainage was lower in the EACA group(560 ml ±380 vs. 1040 ml ±1020; p = >0.0001). Blood and blood products usage was not statistically different between groups: average packed red cells transfusion was 1.5 ±2.1 in the EACA group vs. 2.5 ±3.1 units in the control group (p = 0.07), fresh frozen plasma 1.1 ±1.6 vs. 1.7 ±2.7 units (p = 0.2) and platelets 1.6 ±2.6 vs. 1.4 ±3.5 units, p = 0.3. It was found that the creatinine levels after the operation were not different. The average time spent in hospital was similar for both groups. The postoperative data from both EAC A and control groups are presented in Table II.

	EACA group	Control group	p value
mortality	0	4 (6.7%)	>0.0001
hospitalisation time (days)	8.8 ±2.6	9.0 ±5.2	0.6
myocardial infarction	3 (5%)	10 (16.7%)	0.03
atrial fibrillation	17 (28.3%)	10 (16.7%)	0.09
stroke	2 (3.3%)	2 (3.3%)	…..
Renal failure	3 (5%)	4 (6.7%)	0.05
respiratory failure	3 (5%)	5 (8.3%)	0.03
re-operation for bleeding	2 (3.3%)	5 (8.3%)	0.02
postoperative bleeding (ml)	560 ml ±380	1040 ml ±1020	>0.0001
packed red blood cells PC (u)	1.5 ±2.1	2.5 ±3.1	0.07
fresh frozen plasma FFP (u)	1.1 ±1.6	1.7 ± 2.7	0.2
platelet concentrates PLT (u)	1.6 ±2.6	1.4 ±3.5	0.3
creatinine (mg/dL)	1.6 ±1.5	1.27 ±0.87	0.1

Tab. II. Postoperative data

Discussion

Every surgeon accepting a patient suffering from an acute coronary condition to undergo an emergency operation has to bear in mind the influence that antiplatelets have on such patients. This is due to the fact that in such circumstances platelets are used in much higher doses than in patients with chronic and stable coronary disease. The fear of increased levels of postoperative bleeding in patients may persuade the surgeon to stop the antiplatelets and postpone the operation by a few days, until the platelet function recovers. In some patients,however, exacerbation of their clinical condition may follow. Patients who have had implanted stents placed into their coronary arteries in the last 12 months are at an especially high risk of developing stent thrombosis [12].

The results of our study show that EACA administration during cardiopulmonary bypass emergency operations leads to a reduction of postoperative bleeding. Therefore it allows a timely surgical intervention, since no time delay is necessary in order to stop the clopidogrel. The blood sparing effect of tranexamic acid(another anti fibrinolytic) has been summarized by Ngaage's meta-analysis of studies performed between 1995 and 2009[13]. Our results show a similar effect of EACA on the reduction of blood loss. The fact that no reduction in platelet transfusion was observed may be explained by the fact that platelets were used in most of our patients, whose platelets were blocked with antiaggregants. Similarly we have also noted the reduction of reoperation risk in EACA patients. Patients who needed to be reoperated on for bleeding were found to have an increased mortality in our material. This was also noted by Choong [14]. the doses of EACA used in the several studies have varied widely. Daily and colleagues used 10 g of EACA before surgical incision, 10 g in the cardiopulmonary bypass (CPB) phase, and 10 g after protamine reversal of heparin [15]. Hardy and colleagues gave a 15 g bolus over 20 minutes, followed by a 1 g/h infusion [16]. Significant reductions in blood requirements were seen only when EACA was given as a loading dose followed by infusion or as 3 sequential doses as it was used here in our study,rather than as a single dose. There was no difference in blood loss or blood requirements when EACA was given either as a loading dose followed by 6-hour infusion or as 3 sequential doses [10]. However, Brown stated that there were no significant differences between patients receiving high and low dosage groups of antifibrinolytics[17].

Owing to the fact that no higher risk of adverse effects of EACA treatment was noted either in our or in previous studies, we would like to suggest that EACA should be considered for patients under the effect of antiplatelet medication who require an emergency cardiac operation. Similar data were collected in metaanalyses mentioned above [13, 17]. We did not observe higher incidence of renal failure in the EACA group.

Conclusion

Our conclusion is that EACA should be considered for routine use during all emergency coronary operations performed with cardiopulmonary bypass because it can safely lower postoperative drainage without increasing morbidity. The topic needs to be further explored in order to prove the safety and efficacy of such treatment in a larger population.

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Outcome of Delayed Sternal Closure After Cardiac Operations

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Background: **Open chest management and delayed sternal closure has been described as a useful method in treatment of severely impaired contractility, uncontrollable hemorrhage, intractable arrhythmias, reperfusion myocardial edema or when either ventricular assist devices or transthoracic intra-aortic balloon pump.**

Patient and methods: **From January 2010 to December 2010, thirty patients (1.25%) left the operating room with open chest after cardiac operations. Delayed sternal closure was performed after hemodynamic improvement. Analysis of indications, mortality and postoperative complications were done.**

Results: **Open chest with delayed sternal closure was used in 30 patients (1.25%) out of 2387 patients. There were 20 men and 10 women, with an average age of 50.9±8.6 years. In 16 patients, primary sternal closure was not possible as a consequence of postoperative low cardiac output, and in 14 patients due to bleeding/ coagulopathy. Emergency operations (46.7%) and aortic dissection surgery (20%) were more frequent. Delayed sternal closure was done after 14.3±9.9 hours. Extubation was done after 46.4 ± 34.7 hours. Eighteen patients were weaned from inotropic support and discharged from the intensive care unit an average of 3.8±1.9 days. One patient had mediastinitis and required sternal refixation.**

Conclusion: **Delayed sternal closure can be beneficial when all attempts to optimize cardiac function and hemostasis have failed.**

KEY WORDS: ***Delayed sternal closure (DSC), open chest management (OCM).***

Open chest management (OCM) and delayed sternal closure (DSC) for cardiac surgical patients was described in the late 1970s. It has been described as a useful method in the treatment of severely impaired heart[1,2,3], uncontrollable hemorrhage [4], intractable arrhythmias [2, 5], reperfusion myocardial edema or when either ventricular assist devices [2] or transthoracic intra-aortic balloon pumps (IABP) [6] are required after cardiac surgery. In these instances, OCM may relieve cardiac compression and provide rapid access for the control of hemorrhage or arrhythmias. Delayed sternal closure can subsequently be carried out after the patient's condition has improved.

A concern that prolonged open sternotomy would result in infectious complications caused early hesitancy to use this technique. With evidence for low sternal morbidity, and a growing population of patients with complex cardiac disease, DSC will be an increasingly important management option for the cardiac surgeon. OCM with a delayed closure has become a routinely used tool, with a current incidence of 1.2–4.2% in the adult cardiac surgical literature [7]. We have tried to identify the risks and benefits of this technique and variables associated with the outcome.

Patients and methods

From January 2010 to December 2010, 2387 cardiac operations were performed in adults in our department. Standard anesthesia, cardiopulmonary bypass (CPB) and surgical techniques were employed. Thirty patients (1.25%) left the operating room

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with open chest. We wanted to analyze indications, mortality and postoperative complications.

Preoperative characteristics of these patients include a mean age of 50.9 ± 8.6 years), 20 patients were males (66.7%), emergent or urgent operations in 14 patients (46.7%), and redo cardiac operation in 5 patients (16.7%). Operations included coronary artery bypass grafting (10), valve surgery (10), aortic dissection (6), combined coronary artery bypass grafting and valve replacement (3) and repair of postinfarct ventricular septal defect (1) of the series. Our patient population has a much larger proportion of high risk patients.

Standard anesthesia, cardiopulmonary bypass, and surgical techniques were employed. For myocardial protection, cold crystalloid hyperkalemic cardioplegia was infused into the aortic root (or directly into the coronary ostia in cases of aortic valve surgery) in addition to topical hypothermia with ice slush or antegrade warm blood cardioplegia in most coronary artery bypass grafting surgery. The sternum was left open in 30 patients (1.25%). In cases of DSC, broad spectrum intravenous antibiotics were continued until the removal of the mediastinal drains.

Indications

OCM was performed if all attempts to achieve hemodynamic stability were unsuccessful. Measures taken to stabilize the patient included optimization of preload and afterload, inotropic support and IABP. Ventricular function was routinely determined by transesophageal echocardiography. Hemodynamic instability was the major indication for OCM in all patients. In some patients, this instability manifested after a trial chest closure, but not all patients underwent trial closure. Additional indications that influenced the surgeon's decision to leave the chest open included bleeding/coagulopathy, cardiac edema, and arrhythmias with hemodynamic compromise. Sixteen patients became hemodynamically unstable upon attempted sternal closure despite maximum inotropic support and in ten patients intra aortic balloon counterpulsation (IABP) was used. Forteen patients had massive coagulopathic postoperative bleeding, which prevented safe closure of the sternum. The wounds were packed with sterile laparotomy pads, and frequent dressing changes were done while coagulation factors were replaced. In the intensive care unit (ICU), all patients were ventilated and sedated until the time of chest closure.

Methods of mediastinal isolation

We used sterile laparotomy packing with Steri-Drape and dressing changes were routinely performed every 8 hours. Povidone-iodine (Betadine) preparation of the entire chest wall was done. Full sterile technique was used to inspect the cardiac activity and apply new dressings. A sternal retractor was left in place in cases of extreme myocardial edema or hemodynamic instability. The wound was then covered with Steri-Drape plastic film.

Delayed sternal closure

Timing for delayed closure was determined by periodic inspection of the heart, dressing soaking and need for frequent new dressings, evaluation of the level of pharmacological support, and determination of the response to temporary reapproximation of the sternum. Wound closure was done in the operating room. Sternum was closed and the subcutaneous tissue and skin were reapproximated. Sternal, neurologic, renal, respiratory, coagulation, and infectious morbidity were recorded. Sternal morbidity was defined as deep sternal infection, dehiscence, or nonunion.

Results

Open chest with delayed sternal closure was used in 30 patients (1.25%) out of 2387 patients. There were 20 men and 10 women, with an average age of 50.9 ± 8.6 years. The incidence of open chest and delayed sternal closure according to type of operation is depicted in table 1.

Type of surgery	Number of cases
CABG	10
Redo MVR	4
DVR	3
DVR+TR	2
Redo TV surgery	1
CABG+ MR	3
Aortic dissection surgery	6
VSD closure	1

CABG: coronary artery bypass grafting, MVR: mitral valve replacement, DVR: double valve replacement, TR: tricuspid repair, TV: tricuspid valve, MR: mitral repair and VSD: ventricular septal defect.

Table 1. Types of surgery

In 16 patients, primary sternal closure was not possible as a consequence of postoperative low cardiac output (LCO), and in 14 patients due to bleeding/ coagulopathy. Postoperative LCO was defined as systolic blood pressure < 90 mmhg inspite of requiring combined maximum pharmacologic inotropic support (dopamine, dobutamine, epinephrine and amrinone) administered intravenously with or without additional IABP. Emergency operations (46.7%) and aortic dissection surgery (20%) were more frequent in patients treated with OCM and DSC.

A sternal retractor was employed for additional hemodynamic stability in some of the patients. Open sternotomy

provided easy accessibility to the myocardium and rapid access for resuscitation in patients who experienced cardiac arrest. Just before DSC all the patients whom required IABP were still on IABP support, but less inotropic support was needed as compared with when open chest was established. Delayed sternal closure was done after 14.3 ± 9.9 hours. Seven patients deteriorated after the first delayed closure and had the sternum reopened an average of 1 day after the first DSC, but only three of these patients survived. Extubation was done after 46.4± 34.7 hours. Eighteen patients were weaned from inotropic support and discharged from the intensive care unit an average of 3.8 ± 1.9 days (range, 2 to 11 days). Hospital stay was 10.9±8 days. Perioperative patient results are shown in table (2).

Variable	Mean (X-)	SD
Age (yrs)	50.9	± 8.6
OCM (hrs)	14.3	± 9.9
ICU (d)	3.8	± 1.9
Vent. (hrs)	46.4	± 34.7
AC (min)	83.4	± 25.4
TBT (min)	138	± 45.8
H. stay (d)	10.9	± 8

OCM: open chest management, ICU: intensive care unit, vent.: ventilation, AC: aortic cross clamp time, TBT: total bypass time, H.: hospital, yrs.: years, hrs.: hours, d.: days, min.: minutes.

Table 2. Perioperative results

Survival

Eighteen patients (60%) from this series were discharged from the hospital in good condition at 16.1 ± 6.1 days postoperatively. The overall survival rate after delayed sternal closure was 60%. Survival rate according to the cause of open chest was 50% for hemodynamic instability and 28.5% for intractable bleeding. DSC in patients with IABP support was more likely to be successful. The mortality rate in patients with IABP was 40% (2/5) compared with 54.5% (6/11) when IABP was not required. Table (3) shows mean of different variables according to outcome.

Variable \ Outcome	Died n(12) X- ± SD	Home n(18) X- ± SD	T	P
Age(yrs)	48.2±9.4	52.6±7.8	1.34	> 0.05
OCM(hrs)	16.8±14.1	12.5±5.7	1.01	> 0.05
ICU(d)	3.2±1.7	3.9±2.1	0.43	> 0.05
Vent.(hrs)	56.4±44.3	39.8±25.7	1.17	> 0.05
AC(min)	89.7±29.4	79.3±22.2	1.04	> 0.05
TBT(min)	160±55.1	123.3±32.3	2.08	< 0.05
H.stay(d)	3.2±1.7	16.1±6.1	8.49	< 0.001

OCM: open chest management, ICU: intensive care unit, vent.: ventilation, AC: aortic cross clamp time, TBT: total bypass time, H.: hospital, yrs.: years, hrs.: hours, d.: days, min.: minutes.

Table 3. Means (X-) ± SD of different variables according to outcome

Variable \ Outcome	Died n(12) No	%	Home n(18) No	%	Total No	%	Z	P
Males	8	66.7	12	66.7	20	66.7	0	> 0.05
Females	4	33.3	6	33.3	10	33.3	0	> 0.05
Emergency op.	6	50.0	8	44.4	14	46.7	0.22	> 0.05
Complications								
-Multi-organ	7	68.3	4	22.2	11	36.7	1.6	> 0.05
-High support	2	16.7	2	11.1	4	13.3	0.41	> 0.05
- Card. arrest	3	25.0	0	0.0	3	10.0	2.23	<0.01
-Chest inf.	0	0.0	1	5.6	1	3.3	0.83	> 0.05
- Bleeding	0	0.0	1	5.6	1	3.3	0.83	> 0.05
- Pulm. Emb.	0	0.0	1	5.6	1	3.3	0.83	> 0.05
- Renal	0	0.0	1	5.6	1	3.3	0.83	> 0.05
IABP	4	33.3	6	33.3	10	33.3	0	> 0.05
Re-opened	4	33.3	3	16.7	7	23.3	0.93	> 0.05
D.M.	7	58.3	11	61.1	18	60.0	0.1	> 0.05
Late compl.		_	13	72.2	13	43.3	3.91	< 0.01
-chest inf.		_	6	33.3	6	20	2.24	< 0.01
-Renal		_	6	33.3	6	20	2.24	< 0.01
-Wound inf.		_	1	5.6	1	3.3	0.83	> 0.05

Op.: operation, card.: cardiac, inf.: infection, pulm. Emb.: pulmonary embolism, IABP: intra aortic balloon pump, D.M.: diabetes mellitus.

Table 4. Different variables according to outcome among the study group

One patient of this group of patients had mediastinitis and required sternal refixation. Delayed sternal closure was carried out in 30 patients at a mean of 14.3 + 9.9 hrs. The causes of deaths were: multisystem organ failure in 7 patients, low cardiac output in 2 patients and cardiac arrest in 3 patients. The incidences of major postoperative complications are presented in Table (4).

Discussion

Closure of the chest at the end of the operation was unnegotiable in earlier cardiac surgery because of the fear of mediastinal infection. Several reports have described prolonged OCM and subsequent DSC as a life-saving procedure in patients with uncontrollable hemorrhage, myocardial edema, low cardiac output and arrhythmias postoperatively [1, 2].

Riahi and colleagues [8] were the first to bring the problem of tight mediastinum (cardio-mediastinal disproportion) to attention in 1975. They used upward traction on the closed chest, which then might be weaned as the patient improved. Mediastinitis and sternal morbidity have been less frequent than anticipated since the initial description of OCM in the late 1970s [3, 5, 7]. Open chest management has now gained acceptance as a technique in the management of hemodynamically unstable patients where cardiac compression by sternal closure is not tolerated. Patients may further benefit because of ready access to the mediastinum for clot evacuation and electrical cardioversion. In this study we have evaluated our outcome using OCM in patients with hemodynamic instability and bleeding after cardiac operations.

Sternal closure has been shown to result in a significant decrease in cardiac output and diastolic filling, despite preserved velocity of fiber shortening, even in patients with good cardiac performance [9]. These effects are magnified in the presence of poor ventricular compliance secondary to ischemia, reperfusion, and edema. Furnary and associates [2] have demonstrated that LCO can be improved by opening of the sternum. After the sternal incision had been re-opened, there was a 59% increase in cardiac index and 18% rise in systemic blood pressure, without significant change in cardiac filling pressures [2, 7].

Severe bleeding after cardiopulmonary bypass and excessive blood transfusion, and marked increase in heart size, resulting in severe ventricular dysfunction and arrhythmias are often associated with a prolonged perfusion time and poor myocardial preservation [4]. DSC in these cases allows time for recovery of the heart and for the bleeding to stop, while totally isolating the myocardial structures from the outside environment. In addition, it provides easy access to the mediastinum for evacuation of blood clots, thus preventing cardiac tamponade [10].

Patients who required open sternotomy were a higher risk group than the general population of patients undergoing heart operations as stated by furnary and colleagues. This is reflected by the high percentages of emergency (46.7%) and aortic dissection (20%) operations in our patients. Most were in a severely compromised condition after the operation. These patients have an increased frequency of systemic complications including renal failure, respiratory failure, disseminated intravascular coagulation, gastrointestinal bleeding, neurologic sequelae, and death. The use of open sternotomy in these critical situations may be beneficial [2].

The overall incidence (1.25%) of open sternotomy after open heart operations in our study concurs with that of three large series [1, 2, 3]. But it was lower than that of Boeken and colleagues (3.5%) [11]. The overall incidence (4.2%) of OCM after cardiac operations described by Christenson and associates is slightly higher than ours and his earlier reported series (1.7%). The high proportion of high risk patients (redos, diffuse coronary artery disease and extremely poor preoparative left ventricular function) in their patient population may explain the relatively high incidence of OCM and DSC in this series [7].

Multiple factors have to be examined when determining the timing of DSC [11, 12]. Tran-esophageal echocardiography is used in the operating room for any unstable patient to give continuous information about ventricular function and response to different therapeutic maneuvers. Further considerations regarding timing of closure include inotrope requirements, degree of fluid mobilization, and level of dependency on IABP therapy. Although the decision of when to close is made individually, patients who are successfully closed are generally on low epinephrine and in negative fluid balance.

Our results indicate that successful closure is more likely to be achieved after 14 hours while Furnary and colleagues took 48 hours to do so which allowed for extra time to achieve negative water balance. The prolonged bypass times, initial markedly positive mean water balance, and subsequent diuresis in surviving patients suggest that myocardial edema is an important underlying factor [2]. Many reports described a variety of methods to isolate the mediastinum from the external environment. These included an array of synthetic materials [3, 5, 9], skin closure, skin zipper [12], and open packing with foam tape [4]. We found sterile packing and Steri-Drape isolation of the mediastinum to be preferable. This method is easy to apply, provides rapid access to the myocardium, permits continued use of a sternal retractor. It is of note that the duration of OCM did not have a significant impact on subsequent sternal morbidity.

Sternal infection rates for patients undergoing routine cardiac operations are in the range of 1% to 2%. It is our policy to keep patients on broad-spectrum antibiotics while the chest is open. It is therefore interesting to note that, in our series, the incidence of wound infections, mediastinitis and sternal dehiscence after OCM and DSC was not significantly different from a control population that had primary sternal closure. The incidence of mediastinal infection after routine

cardiac operations is reported to be greater than 1.5%. Low incidence of sternal morbidity after DSC has also been reported by others[1,2,4]. The group of patients undergoing DSC are particularly at risk for infection because they have predisposing factors such as: prolonged CPB time, LCO, excessive bleeding, and the need for multiple re-explorations of the chest [11].

Hospital survival in our series of 30 patients was 60% which compares well with Anderson and associates earlier reports which have ranged from 48% to 66% while it was less than that of his later series which was 76% [13].

In summary, DSC is an important management procedure in patients with postoperative LCO with severe hemodynamic instability and excessive bleeding. This procedure can be performed in patients with a relatively low incidence of sternal morbidity.

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Surgical Intervention for Moderate Anterior Paravalvular Leakage after Mitral Valve Replacement. Is it always necessary to replace the valve?

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Background: **Postoperative paravalvular leak (PVL) is one of the common complications following post-rheumatic prosthetic mitral valve replacement (MVR). The surgical solution needed for each type of PVL must be individualized according to its size, location, as well as the presenting clinical symptom(s). This study is a trial to assess the value of a simple and reproducible surgical procedure for single moderate (≤ 4 cm) anterior paravalvular leak (APVL) in absence of infective endocarditis IE versus classic mitral valve re-replacement.**

Patients and Methods: **This comparative analytic study was conducted between 2005 & 2010 in the Departments of Cardiothoracic Surgery and Cardiology of Faculty of Medicine Cairo University, El Mouwasat Hospital (KSA) as well as the Medical International Center (KSA) after obtaining the approval of the local ethical committees. Thirty patients who developed single moderate (≤ 4 cm) anterior paravalvular leak (APVL) without IE following isolated primary MVR were enrolled. Patients were allocated in 2 groups of equal number and matching preoperative risk factors. Group A contained prospective data of 15 patients in whom APVL were repaired by 2-5 pledgeted stitches between LA wall & valve's prosthetic ring. Group B contained retrospective data of 15 patients in whom the prosthetic mitral valve was replaced. All patients were followed-up over the first PO year by regular clinical examination and transthoracic echocardiography (TTE).**

Results: **In group A, APVL was diagnosed after a mean time of 68 ± 10 days (range 3 weeks - 6 months); whereas in group B, it was detected after 105 ± 3 days (range 5 weeks – 9 months) (P=NS). The anterior mitral annulus was the site of PVL in all patients. In group B, the total operative time, CPB time, and aortic cross clamp time were markedly prolonged compared to group A with high statistical significance. Intraoperative weaning off-CPB was more smooth using less inotropic support in group A patients. In group A, there was no mortality; whereas 3 patients died (20 %) in group B. Mortality in 1st. patient occurred in PO day 25 due to chest infection; 2nd. one to occurrence of sudden valve stucking; and the 3rd. to progressive LV dysfunction ending by CHF and death. Morbidity complications occurred in 6 (40 %) of group B patients; versus only 2 (13 %) in group A (p < 0.001). Following surgery, group A patients showed a faster improvement in clinical symptoms (SOB, easy fatiguability) as reflected by NYHA clinical class assessment. Mean duration of ICU and hospital stay was longer in group B patients.**

Conclusion: **We concluded that surgical closure of postoperative single moderate (≤ 4 cm) APVLs occurring without IE following MVR can be done effectively and safely using Teflon pledgeted stitches taken between valve sewing ring and the adjacent area of the left atrial septal wall. Mitral replacement in this context is not advisable as it is associated with higher morbidity & mortality.**

KEY WORDS & ABBREVIATIONS: ***APVLs: Anterior Para-Valvular Leaks. IE: Infective Endocarditis MVR: mitral valve replacement. LA: Left Atrium PO: postoperative. NYHA: New York Heart Association. TEE: Transesophageal echocardiography TTE: Transthoracic echocardiography LVEF%: Left ventricular ejection fraction %. SD: standard deviation Statistical Significance was detected if P < 0.05***

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Isolated primary mitral valve replacement is a well-established and safe procedure. It is usually accompanied with a low morbidity and mortality rate in skilled hands [1]. The relative incidence of PVLs after mechanical and bioprosthetic replacement is still debated [2]. However, many surgeons reported incidence of primary paravalvular leak following mitral valve replacement with rates varying between 12.5-17 % [3-6].

It was found that running monofilament suture techniques[4] and presence of endocarditis [4] have been implicated in the development of PVLs. Moreover, many surgical groups reported that around 22 % of patients with PVLs leaks are diagnosed within the 1st. week following MVR, whereas another 52% are diagnosed within 1st. PO year [5][6].

Patients requiring urgent operative repair are usually older, having more symptoms of CHF, hemolytic anemia, and "larger-size" leaks [5]. Surgical intervention to repair the leak improves symptoms of CHF, augments the hematocrit value, decreases the need for blood transfusion as it stops PVLs-induced hemolysis. Surgery is also an independent predictor of long-term survival when compared with conservative or medical therapy [5][6][7]. Choice of operation involves either direct suture repair of the "relatively-smaller" leak site, which carries a failure rate of 13%; or replacement of the valve, which carries a failure rate of up to 35% and poses the technical challenge of a safe redo-surgery [6][7].

Objective: This study is a trial to assess the value and effectiveness of a simple and reproducible surgical procedure to close moderate (≤ 4 cm) single anterior mitral annulus paravalvular leak in absence of infective endocarditis compared to mitral valve replacement.

Patients and Methods

Study conduct: This comparative analytic study was conducted between 2005 & 2010 in the Departments of Cardiothoracic Surgery and Cardiology of Faculty of Medicine Cairo University, El Mouwsat Hospital (KSA) as well as the Medical International Center (KSA) after obtaining the approval of the local ethical committees.

Study population: Thirty patients who developed single small (≤ 4cm) anterior annulus paravalvular leak (APVL) after isolated primary MVR were enrolled in two groups each containing 15 patients. Patients of both groups were adequately-matched for age, gender, morphology, size, location, number, NYHA class III SOB, LV function (EF %).

Inclusion Criteria: Patients who underwent isolated primary mitral valve replacement using metallic prostheses that was followed by new holosystolic regurgitant murmur with presence of single small (≤ 4 cm) anterior annulus paravalvular leak (APVLs) in absence of infective endocarditis (IE). Diagnosis was according to clinical examination and both transthoracic (TTE) and trans-oesophageal echocardiography (TEE) examination.

Exclusion criteria: Patients in-need for other valve replacement surgery; those having multiple leaks or those having well-diagnosed infective endocarditis.

Study groups:

- ***Group A (repair group):*** Contained prospective data of 15 patients in whom PVLs were controlled using 2-5 pledgeted sutures between atrial wall and the valve's prosthetic ring.
- ***Group B (replacement group):*** Contained retrospective data of 15 patients in whom the prosthetic mitral valve was re-replaced. All patients were followed-up over the first postoperative year by regular clinical examination sessions and transthoracic echocardiography.

Preoperative clinical characteristics demonstrated no statistically-significant difference between both groups in either

Variable	Group A (n=15) (Repair only)	Group B (n=15) (MV Replacement)	P Value
Age (mean in years)	36 ± 2.5	34 ± 1.5	0.41*
Sex (female %)	11/15 (73 %)	9/15 (60%)	0.33*
Diabetes Mellitus	5 (33 %)	7 (46 %)	0.54*
Clinical Symptoms:			
- NYHA Class III-IV SOB	9 (60 %)	6 (40 %)	0.34*
- Major Fatiguability	15 (100 %)	15 (100 %)	0.23*
- Vertigo	15 (100 %)	15 (100 %)	0.98*
- Hematurea	7 (46 %)	8 (53 %)	0.63*
Lab tests for *haemolysis	7 (46 %)	8 (53 %)	0.44*
Preoperative Diagnosis Time :			
- mean time (days)	68 ± 10	105 ± 3	0.21*
- range **(Weeks-to-Months)**	3 w – to – 6 m	5 w – to – 9 m	-

*Values are expressed in mean ± SD. PASP: Pulmonary Artery Systolic Pressure NYHA: New York Heart association *: Data is not statistically-significant *Lab tests positive for hemolysis = high LDH + low hematocrit value*

Table (1) Preoperative Patient Data

Variable	Group A (n=15) (Repair only)	Group B (n=15) (MV Replacement)	P Value
LA Dilatation & AF	7 (46 %)	5 (33 %)	0.53*
Mean LVEDD (mm)	57 ± 4.6	55 ± 2.5	0.45*
Mean LVESD (mm)	37 ± 9	35 ± 8	0.33*
LV dysfunction (EF < 50 %)	5 (33 %)	6 (40 %)	0.22*
Mean LVEF (%)	54 ± 5.5	57 ± 4.2	0.56*
Elevated PASP	7 (46 %)	5 (33 %)	0.68*
Mean PASP (mmHg)	48 ± 11.7	39 ± 14.5	0.82*
Criteria of PVLs:			
- Location **(AMA) anterior annulus**	15 (100 %)	15 (100 %)	0.55*
- Number (single)	15 (100 %)	15 (100 %)	0.55*
- Size (≤ 4 cm)	15 (100 %)	15 (100 %)	0.55*
- mean size	2.6 ± 1.21	2.5 ± 0.91	0.21*
- MR mean distance **(cms)**	2.3 ± 1.5	2.1 ± 1.3	0.87*
- Diagnosis time:			
- mean (days)	68 ± 10	105 ± 3	0.54*
- range **(weeks-months)**	(3 w- 6 m)	(5 w - 9 m)	-

LV: Left Ventricle LVEDD: End-Diastolic Dimension (mms) LVESD: End-Systolic Dimension LVEF%: Left ventricular ejection fraction PASP: Pulmonary Artery Systolic Pressure LA: Left Atrium SOB: Shortness of Breath AF: Atrial Fibrillation. AMA: Anterior Mitral Annulus

Table (2): Preoperative Echocardiographic Patient Data

cardiac or non-cardiac factors. The anterior mitral annulus was the site of PVL in all patients and was diagnosed by auscultation of a new holosystolic murmur of MR combined with detection of PVL by TEE within time interval between 1 week to 1st. PO year ***(Mangi et al)*** [6]. In group A, APVL was diagnosed after a mean time of 68 ± 10 days (range 3 week- 6 months); whereas in group B, it was detected after 105 ± 3 days (range 5 weeks - 9 months) (P=NS).

Surgical Technique(s)

Group A (repair group): APVL was repaired using the surgical technique reported in 2004 by Mangi et al (6) which consisted of the following steps:

The operation is conducted during continuous intraoperative transesophageal echocardiography (TEE) commencing by standard ascending aorto-bicaval cannulation using antegrade intermittent cold blood cardioplegia. In some cases, the femoral route was used for arterial cannulation. For mitral valve exposure, a standard superior septal incision was made but when both atria were significantly enlarged, the prosthesis was approached solely through the interatrial septum. This yielded excellent exposure of the anterior part of the mitral prosthesis that abuts the interatrial septum and is proximate to the posteromedial commissure of the native mitral valve. Clear communication between the surgeon and the Echocardiographer was always assured for accurate detection of location of the PVL using standardized reference points. Depending on the extent of the leak, the first pledget-supported, braided polyester stitch is placed as a horizontal mattress stitch through a fold of the LA wall and is then brought directly into the sewing ring at the most posterior aspect of the leak. The remaining sutures are placed in similar fashion through the interatrial septum from the right side to the left and then directly though the sewing ring (Figures 1 & 2). The LA is then closed with a continuous 4-0 Prolene suture *(Ethicon, Inc, Somerville, NJ)* starting on the atrial dome and suturing caudad onto the interatrial septum. The RA is then closed after removal of the aortic clamp.

Group B (replacement group): Patients underwent standard cardiopulmonary bypass similar to group A. Mitral valve re-replacement was done after excising the existing prosthetic valve. The newer valve was secured in place using about 10– to—13 interrupted 2 º Ethibond stitches put in a transverse mattress pattern all on Teflon pledgets.

The surgical decision was mainly influenced by the combined committee formed by the surgeon and the cardiologist and was according to their own experience as well as the patient's clinical symptoms.

Statistical Analysis

The continuous variables were expressed as mean ± stanstandard deviation and the qualitative variables as percentages. The x2-test was used for qualitative variables and Student's t-test for continuous variables. Values were considered to be statistically significant if the $p < 0.05$.

Results

Operative Data: In group B, the total operative time, cardiopulmonary bypass (CPB) time, and aortic cross clamp times were markedly prolonged compared to group A with high statistical significance. Intraoperative weaning off-CPB was more smooth needing lesser inotropic support in group A patients **(Table 3)**.

Times are expressed as mean duration in minutes

PO course: Group B patients needed longer times for PO mechanical ventilation, inotropic support, ICU and hospital stay. Group A patients demonstrated more favorable improvement of clinical NYHA Class & echocardiographic parameters **(Tables 4 & 5)**.

Mortality and Morbidity

In group A, there was no mortality; whereas 3 patients died (20 %) in group B. The 1st. patient died on 25th. PO day due to chest infection; 2nd. to occurrence of sudden valve stucking; & the 3rd. due to progressive LV dysfunction ending by CHF and death. Morbidity complications occurred in 6 (40 %) of group B patients; versus only 2 (13 %) in group A ($p < 0.001$). Following surgery, group A patients showed a faster improvement in clinical symptoms (SOB, easy fatiguability) as reflected by NYHA clinical class assessment and the time needed until the patient returned to productive life.

Variable	Group A (n=15) (Repair only)	Group B (n=15) (MV Replacement)	P Value
Total Operative time	170 ± 9	220 ± 6	< 0.05
Cardiopulmonary Bypass time	81 ± 2	118 ± 3	< 0.03
Aortic Cross Clamp Time	45 ± 2	79 ± 2	< 0.02
Weaning Off-Bypass:			
- DC shocks only	12 (80 %)	7 (46 %)	< 0.03
- DC + inotropics	3 (20 %)	8 (53 %)	< 0.02

Table 3. Operative data

Variable	Group A (n=15) (Repair only)	Group B (n=15) (MV Replacement)	P Value
ICU Stay time (mean in hours)	38 ± 4.5	72 ± 15.5	< 0.05
Mechanical ventilation time (Hours)			
- Mean	7 ± 1.2	17 ± 4.2	< 0.03
- Range	(5 - 11)	(12-28)	-
Inotropic support time (Hours)			
- Mean	10 ± 4.5	34 ± 5.2	< 0.01
- Range	(9 - 17)	(14 - 31)	-
Hospital Stay Time (mean in days)	7 ± 1.5	18 ± 2.1	< 0.04

Table 4. Postoperative in-Hospital Data

Variable	Group A (n=15) (Repair only)	Group B (n=15) (MV Replacement)	P Value
LA Dilatation & AF	2 (13 %)	4 (26 %)	< 0.05
Mean LVEDD (mm)	48 ± 1.5	50 ± 2	< 0.04
Mean LVESD (mm)	30 ± 2	34 ± 3	< 0.05
LV dysfunction (EF < 50 %)	2 (13 %)	4 (26 %)	< 0.05
Mean LVEF (%)	59 ± 3	58 ± 0.2	0.56*
Mean PASP (mmHg)	33 ± 3.5	30 ± 1.5	0.82*

*LA: Left atrium AF: Atrial Fibrillation LV: Left Ventricle LVEDD: End-Diastolic Dimension (mms) LVESD: End-Systolic Dimension LVEF%: Left ventricular ejection fraction PASP: Pulmonary Artery Systolic Pressure mm: Millimeter *: Value is Statistically non-significant*

Table 5. Echocardiographic Follow-up Data

Variable	Group A (n=15) (Repair only)	Group B (n=15) (MV Replacement)	P Value
Mortality	**None**	**3 (20 %)**	-
- Fulminant chest infection **(PO day 25)**	-	1 (6.6 %)	-
- Sudden valve stucking	-	1 (6.6 %)	-
- Progressive LV dysfunction & CHF	-	1 (6.6 %)	-
Morbidity	**2 (13 %)**	**6 (40 %)**	**< 0.001**
- Prolonged Mechanical Ventilation	1 (6.6 %)	2 (13 %)	0.05
-Low CO + prolonged inotropic support	-	1 (6.6 %)	-
-Transient Ventricular tachycardia	-	1 (6.6 %)	-
- Reopening for hemostasis	-	1 (6.6 %)	-
- Wound sepsis	1 (6.6 %)	1 (6.6 %)	0.34*
Time before returning to Work (mean in days)	25 ± 2.5	49 ± 2.5	< 0.02

CO: Cardiac Output LV: Left Ventricle CHF: Congestive Heart Failure

Table 6. Mortality and Morbidity

Discussion

Mitral valve replacement confers considerable benefits in patients who have post-rheumatic chronic valvular diseases in terms of improved cardio-physiological function and increased survival [3]. The MVR procedure is not, however, free of complications such as thromboembolism, anticoagulation-related haemorrhage, prosthetic valve endocarditis, and mechanical valve dysfunction [4]. For bioprosthesis other factors like infection and or tissue failure may cause dysfunction [5]. A unique type of dysfunction, causing postoperative recurrence of mitral regurgitation is para-prosthetic leakage, which is considered of serious impact not only on surgical results but also on patient's survival [6].

The surgical correction for paravalvular leaks is usually indicated in patients who complain of severe symptoms or in those who require blood transfusion for persisting or severe intravascular haemolysis [7-9]. However, future prognosis of patients with less symptoms and or in those who do not need blood transfusions is still not well-known [7]. In our study, all patients were diagnosed preoperatively according to criteria of diagnosing PVL mentioned above. Anemia, intravascular hemolysis, holosystolic murmur and detection by TEE were the key factors for preoperative diagnosis. According to the known tolerance of the Egyptian population, some of our patients came with little or scarce symptoms and despite that serious APVL was confirmed by investigations. In view of the uncertainty to predict the precise impact of the pathology in this patient subset, we found it crucial to emphasizes the importance of regular PO echocardiographic follow-up sessions during the first PO year no matter is the patient symptomatology. Similar recommendations for the necessity of regular echo check-ups during the first year following MVR in rheumatic patients were reported by other surgeons [6],[8-12].

Many surgeons stated that the underlying disease of the mitral valve usually influences the interval between mitral valve replacement and diagnosis of PVLs. They added that presence of infections (eg: IE) worsens the PO prognosis in rheumatic heart disease patients [13-17]. In our study, the mean intervals of 68 ± 10 days in group A and 105 ± 3 days in group B (range 3 weeks – 9 months) after primary MVR was somewhat longer than that reported in other publications [8-10]. This can be explained by the inclusion of IE cases in their series. However, our mean time for diagnosing PVL was shorter than that reported in other series [11-14]. This is explainable by the regularity of our tri-monthly echo follow-up visits done by our cardiologist.

Paravalvular leaks are the most common reason for repeated mitral valve replacement surgery [4-9]. The preoperative variables significantly related to an increased incidence of dehiscence of the mitral prosthesis necessitating reoperation were a degenerative disease; or an infective endocarditis of the native valve, both causing mitral regurgitation [10]. The development of a paravalvular leak in the early postoperative period in a patient with infective endocarditis, or sustained positive blood cultures despite adequate antibiotic therapy indicates a failure to control the infective process [11]&[12]. For these patients, prolonged antibiotic therapy is mandatory following the diagnosis of a PVL prior to any surgical intervention [1-4]. Rheumatic etiology, age of the patient, type of the prosthesis, supra or subannular insertion, and operative year, were not significant, neither were calcificaion that are probably neutralized by the routine use of special surgical techniques [12-14]. In our post-rheumatic patient population, we diagnosed APVL with no IE using the same methodology mentioned above. Unfortunately, and due to our institution's financial policy, availability rules controlled the indication for using bioprosthesis in the mitral position, and

hence we were not able to study PVLs following bioprosthetic replacement as other researchers like Hammermeister [15], and Von Segesser [14] who reported a lower incidence of PVLs after implantation of bioprosthesis.

In our institutions, we operated on 450 patients with post-RHD mitral valve pathology necessitating MVR during the time period between 2005 and 2010. Among them, 30 patients (6.6%) were discovered to have postoperative PVL, and we chose to study PVL due to defects lying opposite the anterior annulus. Despite PVLs may occur anywhere around the entire prosthetic circumference, they are predominantly noticed around the mitral commissural area in as much as 75% of cases [16-18]. Our preoperative patient studies located that all PV defects were located in the anterior annulus near the PM commissure and that was the most important inclusion criteria in our patient subset.

Different incidence rates of APVLs in RHD patients were reported by different surgical groups ranging from 12.5-17%[3-6]. Our subset of patients (30 patients) having PVL was fewer (6.6 %) compared to the previously-mentioned studies and this was because we chose patients having anterior annulus defects only. On the other hand, the higher incidence rates in other series may be attributed to the inclusion of all types of PVL (anterior and posterior parts of the mitral valve annulus); the longer follow-up periods; in addition to the ready availability and the elaborate use of perioperative TEE. Despite the fewer number, an important remark concerning our Egyptian patient population who developed APVL (6.6%) had younger mean age. Due to prevalence & susceptibility concerns, they suffered more attacks of rheumatic activity (detected by clinical exam and lab studies). Unfortunately, this was due to financial and commercial availability reasons. Most of these patients were hence not consistent with the monthly LA penicillin shots. The lower rates reported in other series like Dhasmana et al [4]&[15] is usually due to the exclusion of all patients with IE as the underlying reason for MVR. Some surgeons strangely observed that the majority of late PVLs did not occur in association with recurrent infection [7],[8]. They considered it helpful as this allowed a conservative repair of the valve without the need to replace it. Our trend to exclude patients having IE aiming to decrease surgical hazards was also endorsed by others like Stanford et al [13] who proved it by finding only 5/60 patients with late PVL due to annular abscess on initial surgery.

Some old series [3],[4], suggested the use of monofilament suture in a continuous suture technique for MVR. Others [6-9] considered it as a contributing factor in the development of a PVL. In our patients we did not use continuous sutures. Instead, we as well as others [1],[3],[6-9], prefer to use a pledgeted 2° Ticron (or Ethibond) stitches in an interrupted transverse mattress technique. In their series, Stiles et al [5], recommended that pledgets markedly-increased the holding strength of mattress sutures, although figure of eight and simple interrupted sutures had a similar effect, suggesting that the perpendicularity of the direction of suturing versus that of tissue fibers is critical. They added that the posterior leaflet is the problem area for suture disruption from the mitral annulus as it exhibited less holding strength than the anterior leaflet for all suture techniques. It was for this reason that we opted to test the technique of surgical repair for anterior annulus PVL lesions. An essential surgical step is that repair of the leak must be undertaken with the apposition of healthy, full-thickness, atrial septal tissue against the denuded sewing ring of the valve as described. In all cases Teflon-pledgeted stitches must only be used as Teflon-pledgetting spreads the suture tensile strength over a wider zone adding more security to annular bondage hence preventing suture "cut-through".

Different groups reported variable rates for PO mortality in redo-mitral valve replacement like Jindani et al [10] who reported 22 % ; Rizzoli et al [20] who reported (30 %). Our early mortality rate was 20 % in the replacement group and was compatible with these series. Others who reported lower rates like Syracuse et al [18] (9.4 %) ; Genoni et al [19] (12 %); and Pansini et al [3] (8.7 %) attributed it to be due to reliance on performing repair only rather than replacement. In agreement with their opinion, absence of mortality in our repair group stood in favor of the effectiveness of the repair concept. Moreover, the longer operative, ICU, and hospital times (with its higher costs) as well as the higher rate of PO morbidity (40 %) added more solidification and rational to the trend for repair despite both the repair and the replacement techniques were done equally-early in the postoperative period. It is equally-important to emphasize the need for early echocardiographic evaluation of PVLs (once clinically-suspected) and for the necessity to follow LA penicillin prophylaxis as, in the literature, higher mortality rates occurs commonly after critical preoperative cardiac functional status and or IE.

Conclusion

Surgical closure of postoperative single moderate (≤ 4 cm) anterior annulus PVLs occurring without IE following MVR can be done effectively and safely using Teflon pledgeted stitches taken between valve sewing ring and the adjacent area of the left atrial septal wall. Mitral replacement in this context is not advisable as it is associated with higher morbidity & mortality.

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Usefulness of awake off pump coronary artery bypass grafting on patient outcome

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A 52 year old man complaining of ischemic heart disease with a medical history of hypertension was scheduled for off pump single vessel coronary artery bypass grafting (CABG) under thoracic epidural anaesthesia (TEA) and sedation, the patient weight and height was 80kg, 172cm respectively, preoperative investigations were within normal range, preoperative echocardiography showed a normal contractility with EF of 66%.

After taking a written informed consent from the patient, epidural catheter was inserted at the night before surgery (12 hours before surgery), under aseptic technique using local anesthesia, epidural catheter was inserted in T2-T3 space, 3 ml of lidocaine was injected as a test dose then the patient was transferred to the ward.

On the day of surgery, the patient was premedicated with 3 mg midazolam, 2 gm ceftriaxone, and on arrival to the surgical room, monitoring of the patient with ECG, oximetry, capnography, temperature and invasive blood pressure was done. Oxygen 3L/min was administered by face mask, 16G peripheral venous canula,18 G right radial arterial canula and right internal jugular vein central venous line was inserted under local anesthesia.

Injection was started in the epidural catheter with a mixtutre of bupivacaine 0.5% and fentanyl 2ug/ml starting with 5 ml as abolus then increments of 2ml were given to achieve the target level of block after reaching a dose of 9 ml complete sensory block between C6 to T12 was done. After confirming the target block the mixture of bupivacaine and fentanyl was started at a rate of 4 ml/h. Propofol was infused in a sedating dose of 25 ug/kg/min.

Coronary artery bypass grafting on the beating heart reduced the use of cardiopulmonary bypass and its considerable side effects (1, 2). Avoiding general anesthesia and mechanical ventilation seems to be another way to decrease the invasiveness of the entire procedure. This anesthetic approach was first described by Karagoz et al in 2000, presenting five patients undergoing single-vessel CABG via minithoracotomy with high thoracic epidural anesthesia (TEA) alone while fully awake and breathing spontaneously (3).

The anaesthetic technique is based on a combination of transthoracic epidural anaesthesia and sedation with a wide variety of drugs. High-thoracic epidural anaesthesia (HTEA) has been used for cardiac surgery for more than 20 years (4,5). Although it has been used as a technique in many centers worldwide, it has not gained widespread use. Perhaps the greatest limitation to use has been a fear of increased risk of epidural haematoma associated with anticoagulation for cardiopulmonary bypass. Cases of epidural haematoma have been published, but are rare (6,7). The main benefits of HTEA are: improved analgesia [8], reduced ventilation time (8–10), better pulmonary function(11), coronary vasodilation or cardioprotection(12,13), lowered stress response(14) and reduced psychological morbidity (8). There have been mixed results with reduction of atrial fibrillation (8, 11), and of hospital length of stay (9,15).

The benefits and potential risks of HTEA for cardiac surgery have recently been extensively reviewed by Chaney (7).

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The most recent estimation of risk of epidural haematoma has been performed by Bracco and Hemmerling (16) and is 1: 12 000 with 95% confidence intervals (CIs) of 1: 2100 to 1: 68 000. The risk assessment has progressively improved over the last 20 years as the number of reported cases increased. It is possible that there are cases of haematoma which have not been reported (alluded to by Chaney in 2006 but equally there are also probably many cases of HTEA performed that have not been reported, matching the numerator and denominator. There have not been any further reports of epidural haematoma associated with cardiac surgery in the past 2 years, despite the publication of large case series (7).

Surgical details

The patient is positioned in supine position with the non-dominant upper extremity is prepared and draped on an arm board abducted to about 70º from torso. The arm board is attached to the operating table. A pulse oxymeter probe is attached to the index of the side from which radial artery is to be harvested.

After the patient is properly positioned, he is scrubbed as in the ordinary way in CABG patients involving all of the chest, abdomen, both lower limbs, and the non-dominant upper extremity from which Radial artery may be harvested, then standard median sternotomy was done using the oscillating saw in order to avoid opening of the pleura.

The pedicled Left internal mammary artery was harvested without opening of the left pleura, then the pericardium was opened and suspended by silk sutures.

Inspection and palpation of the Left anterior descending artery revealed good caliper vessel with healthy wall, then the LIMA was anastomosed to the LAD on off-pump beating heart using 8/0 prolene suture.

The intraoperative course was smooth without any hemodynamic instability.

After the operation was done successfully, the wound is closed in layers over one retrosternal chest tube.

Total operative time was 90 minutes, and at the end of surgery the patient was transferred to the ICU fully conscious, pain free with stable hemodynamics and stayed in the ICU for 24 hours then epidural catheter was removed and the patient was transferred to the ward where he stayed for another 24 hours then the patient returned to home.

Results

Preoperative, intraoperative, and postoperative hemodynamics were recorded including preoperative, with skin incision, sternum opening, after Left anterior descending (LAD) artery closure, during anastomosis to LAD, after anastomosis, at the end of surgery and every 6 hours postoperative for 24 hours which was described in (table 1) and (figure 1).

Post operative chest radiograph was performed every day for 2 days showed a clear both lung fields

Arterial blood gases performed every one hour intraoperative and every 12 hours postoperative showing a normal results.

After surgery the patient stayed in ICU for one day and in the ward for another day then returned home.

	Preoperative	Skin incision	Sternum opening	After LAD closure	Anastomosis to LAD	After anastomosis	End of surgery	After ICU transfer	After 6 hours	After 12 hours	After 18 hours	After 24 hours
HR	80	84	77	71	75	80	81	90	77	70	80	79
Systolic ABP	108	109	100	104	104	120	124	116	120	120	130	122
Diastolic ABP	65	64	60	57	60	58	62	49	80	60	90	68
Mean ABP	81	81	75	73	76	83	86	69	92	79	101	89
Oxygen saturation	98	98	97	98	98	98	97	100	100	100	100	100

Table 1. Hemodynamics during the procedure

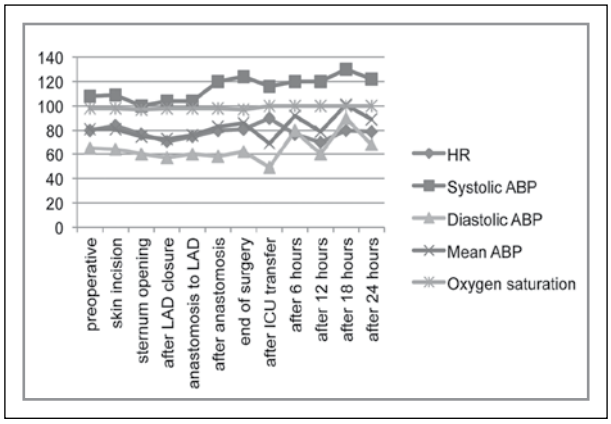

Fig 1. Hemodynamics during the procedure

Discussion

Awake open heart surgery was recently introduced to cardiac surgery to reduce stress of surgery and decreasing hospital stay with greater hemodynamic stability, the results of the previous studies performed forced us to start performing awake off pump coronary artery bypass grafting in Cairo university.

A great hemodynamic stability has been noticed throughout the procedure with heart rate ranging between 75 to 85 bpm during surgery while the patient is sedated and increased to 90 bpm during transfer to the ICU, then returned to its preoperative value.

Arterial blood pressure also was stable with a systolic blood pressure between 100 mmhg to 110 mmhg from the start of surgery till the end of LAD revascularization at which systolic blood pressure was increased to 120 mmhg and remain stable the same changes occurred for diastolic and mean arterial blood pressure.

The effect of epidural anesthesia on hemodynamic stability showed that it causes a great hemodynamic stability also the result of revascularization of ischemic heart can be noticed easily through increasing blood pressure values which occurs after the anastomosis because of abolishing the effect of general anesthetics and inhalational agents on the heart.

Keeping the pleura intact maintain a satisfactory respiratory pattern of the patient with no interference with the surgeon during harvesting the mammary with normal arterial blood gases and clear both lung fields in postoperative x ray.

Continuous sedation reduced the stress of surgery and keeps the patient calm and sleeping throughout the procedure also no pain had detected all through the procedure and postoperative period.

High thoracic epidural allow the anesthetist to perform the targeted block using low dose of local anesthetics also has the advantage of blocking the upper limb allowing harvesting the radial artery of the non dominant hand when needed.

The hospital stay and ICU stay was shorter which had been aided by avoiding intra operative and postoperative ventilation, intact pleura, postoperative analgesia, hemodynamic stability and avoiding cardiopulmonary bypass.

Finally, from the surgical point of view, awake off pump CABG carries no extra load for the surgeon during the procedure.

Conclusion

Awake off pump open heart surgery has the advantages of great hemodynamic stability, short ICU stay and hospital stay with a greater comfort to the patient however it still has the risk of difficult dealing with hemodynamic instability if occurred during revascularization or during manipulating the heart because of the time needed for ventilating the patient, this risk can be reduced by preparing ready and accessible airway devices and anesthetic machine for emergent intubation and ventilation.

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Combined Transaortic and Transmitral Myectomy For Hypertrophic Obstructive Cardiomyopathy

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Objective: **A novel technique of combined transaortic and transmitral myectomy, coupled with pericardial patch enlargement of the anterior mitral leaflet, is proposed as an alternative to the classic transaortic myectomy, in the treatment of hypertrophic obstructive cardiomyopathy. This study is intended as an evaluation of our early experience with this technique.**

Material & methods: **Twelve consecutive patients with hypertrophic obstructive cardiomyopathy were operated upon with the proposed technique. There were 8 males (66.6%) and 4 females (33.3%). The mean age was 41 years (± 15.6). Eleven patients (91.6%) were in functional class III and only one (8.3%) was in class II. The mean functional class was 2.91. The mean septal wall thickness was 20.5 (± 0.12) mmHg. The peak gradient across the left ventricular outflow tract had a mean value of 78.7 (± 23.2 mmHg). Seven patients (58.3%) had grade III mitral regurgitation, 2 (16.6%) had grade II and 3 (25%) had grade I mitral regurgitation. The mean grade of mitral regurgitation was 2.33 (± 0.36). One patient (8.3%) required concomitant coronary artery bypass grafting.**

Results: **There was one operative mortality (8.3%) in this series. Follow-up ranged between 3 and 22 months with a mean of 12.8±7 months and was 100% complete. One patient (8.3%) developed delayed severe aortic regurgitation. At latest follow-up, there were significant reductions in the mean values of the peak gradient (11.7 mmHg postoperatively, p=0.01) and mitral regurgitation grade (0.36 postoperatively, p=0.0004). There was a trend towards lower mean septal thickness (16.2 mm, p=0.09) and lower mean functional class (1.18, p=0.4), but both trends did not reach statistical significance.**

Conclusion: **The technique of combined transaortic and transmitral myectomy, coupled with pericardial patch enlargement of the anterior mitral leaflet, is effective in eliminating left ventricular outflow tract obstruction and mitral regurgitation, in patients with hypertrophic obstructive cardiomyopathy.**

KEY WORDS: **Hypertrophic obstructive cardiomyopathy, myectomy, pericardial patch enlargement, isoprenaline.**

Hypertrophic obstructive cardiomyopathy or HOCM is a genetic anomaly occurring in 0.2% of the population (1). It is characterized by asymmetric hypertrophy of the interventricular septum (IVS) and systolic anterior motion (SAM) of the anterior mitral valve leaflet leading to left ventricular outflow tract (LVOT) obstruction. Symptomatic patients on maximal medical therapy have been offered non-surgical treatment modalities, which are dual chamber pacing, and transcatheter alcohol septal ablation. To this day, however, surgical myectomy remains the best option for these patients (2).

The standard operation for HOCM is still recognized to be the classic transaortic myectomy first proposed by Morrow and colleagues starting in the 1960s(3). Another approach, namely through a left atriotomy, was introduced around the same period by Lillehei and Levy, but it did not gain immediate popularity (4). A renewed interest in the selective use of a transatrial approach has emerged in recent years, due to two factors. The first is the fact that the Morrow operation is a relatively difficult procedure, hampered by a steep learning curve. The transaortic route often provides limited

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exposure, especially in mid-cavitary and apical obstructions, and in small aortic roots. It is also fraught by a number of complications like damage to aortic and mitral valve leaflets, heart block, ventricular septal rupture due to overzealous resection and residual obstruction following an incomplete myectomy (5). For these reasons, Matsuda and colleagues revived the transmitral route as a method of enhancing accessibility in surgical myectomy (6).

The other motivation in the search for an alternative approach to the septal myectomy is an accumulating body of evidence that, in HOCM, intrinsic abnormalities of the mitral apparatus itself exist, independently of the septal hypertrophy, and which can be more easily dealt with through the left atrium. Examples of these abnormalities include abnormally long or abnormally tethered leaflets, restrictive chordae tendinae, and papillary muscles, which are hypertrophied or abnormally connected to the ventricular wall or directly attached to the leaflets (7,8,9). Several manoeuvres have been devised to tackle the mitral valve component of the disease such as anterior leaflet plication (1), anterior leaflet augmentation (5,10), chordal replacement (11,12), retention plasty (13), and papillary muscle reconstruction (14).

Of the previously mentioned interventions on the mitral valve, Carpentier has adopted a technique of anterior leaflet extension, performed through a left atriotomy, which he added to the traditional transaortic myectomy in selected cases with pronounced mid-cavitary obstructions, severe mitral valve deformities, or patients requiring a second pump run to complete an inadequate resection (10). We, however, made a choice to routinely use this technique for all our cases. In the following report, an account is made of our initial experience with the systematic use of a combined transaortic and transmitral myectomy, coupled with anterior mitral leaflet augmentation in HOCM.

Material and methods

Between June 2010 and December 2011, twelve consecutive patients with HOCM were operated upon. Their preoperative characteristics are described in table I.

All patients were managed by a standard anesthetic protocol. After sedation with midazolam 0.02 - 0.07 mg/Kg, local anesthesia was used for the insertion of a wide bore peripheral intravenous cannula and a radial arterial catheter. Induction of anesthesia was accomplished with sodium thiopental 2-3 mg/kg, fentanyl 7-10 µg/kg and pancuronium 0.12 mg/kg. Anesthesia was maintained with isoflurane 0.6 - 1% in 100 % oxygen. Continuous monitoring included ECG, pulse oxymetry, invasive arterial and central venous pressure measurements, urinary catheter output, and nasopharyngeal temperature. Intra-operative trans-esophageal echocardiographic (TEE) assessment was carried out before cardiopulmonary bypass by the anesthesiologist with a Hewlett-Packard Sonos 5500 machine (Hewlett-Packard, Palo Alto, California).

Total number	12
Males	8 (66.6%)
Females	4 (33.3%)
Age range	25-62 years
mean	41 years (± 15.6)
Chief symptom	
dyspnoea	3 (25%)
chest pain	6 (50%)
dizziness	3 (25%)
NYHA class	
II	1 (8.3%)
III	11 (91.6%)
Peak LVOT gradient	78.7 mmHg (±23.2)
IVS thickness	20.5 mm (±0.12)
MR grade	
I	3 (25%)
II	2 (16.6%)
III	7 (58.3%)
Coronary artery disease	1 (8.3%)

(NYHA = New York Heart Association, LVOT = left ventricular outflow tract, IVS = interventricular septum, MR = mitral regurgitation. Values are expressed as percentage or as mean ± standard deviation.)

Table I: Preoperative patient characteristics.

A comprehensive examination was performed with special emphasis on the morphology and thickness distribution of the IVS, the length of the anterior and posterior mitral leaflets, the point of leaflet coaptation, the degree of systolic anterior motion of the anterior leaflet, the presence of any abnormal chordal attachments or abnormal papillary muscle, the mechanism and severity of mitral regurgitation (using the vena contracta width for grading of the severity of mitral regurgitation) and the direction of the regurgitant jet. Continuous wave Doppler measurement of the LVOT gradient was obtained in the transgastric and deep transgastric long axis views.

After median sternotomy, cardiopulmonary bypass at moderate hypothermia (32°C) was conducted through standard cannulation of the ascending aorta, direct selective cannulation of the superior vena cava and low transatrial cannulation of the inferior vena cava. Myocardial protection was achieved

by intermittent antegrade cold blood cardioplegia, delivered first into the aortic root, then directly into the coronary ostia for additional doses. An oblique aortotomy was performed, and the area of septal myectomy was delineated by two parallel vertical incisions, the first of which being in line with the nadir of the right aortic cusp. The second vertical line was made at the level of the intercoronary commissure. The two lines were then joined at the top by a horizontal incision running about 5 mm below the aortic annulus.

At this stage, the attention was diverted to the mitral valve, to which the access was done via a standard left atriotomy in the first three cases. Due to the realization that the left atrium is usually small in this pathology, the approach was switched to a trans-septal incision in all subsequent cases. The anterior leaflet of the mitral valve was then detached from the annulus by an incision running 2-3 mm from the annulus and extending into both commissural areas. The leaflet was then allowed to drop into the ventricle by gravity, exposing the IVS. Any abnormal tethering chordae were severed and any pathologically hypertrophied papillary muscles were trimmed at their base. The septal myectomy was then completed to a level between the two papillary muscles, making an effort to remove 8-10 mm of muscle thickness. An additional resection was routinely performed to the left of the original myectomy, removing a block of left ventricular free wall, guided by the fibrous plaque resulting from friction with the anterior leaflet. An extended myectomy, to the right of original resection was deemed necessary in only one patient. All the time, the depth of resection was controlled by one finger inserted through the tricuspid valve and another passed through the mitral valve. The gap between the anterior mitral leaflet and the annulus was then closed by an autologous pericardial patch, previously fixed in a glutaraldehyde solution for 8-10 minutes and trimmed into an ovoid shape. The suturing was done with 5/0 polypropylene in a continuous locking manner, to avoid a purse string effect on the patch. Testing of the mitral valve was performed by saline injection, after placement of a small wet gauze to temporarily seal the aortotomy incision. One patient with associated coronary artery disease required concomitant coronary artery bypass grafting (CABG).

After closure of the interatrial septum, right atriotomy and aortotomy, de-airing was done under TEE guidance. Echocardiographic evaluation was carried out after separation from cardiopulmonary bypass. Special attention was focused on the gradient across the LVOT, the residual septal thickness, and the persistence of SAM or any MR (mitral regurgitation). A record was also made of the systolic blood pressure and the heart rate. All echocardiographic and hemodynamic observations were repeated after provocation with an intravenous bolus injection of 20 μg of isoprenaline.

Transthoracic echocardiography was arranged for every patient one week after surgery, then every 3 months after hospital discharge by their treating cardiologists. The patients were followed up by the surgeon in the outpatient clinic after one month, then at 3- months intervals.

Statistical analysis

Data are expressed as percentages or as mean values ± standard deviation. The paired Student's t-test was used to compare preoperative and postoperative findings. P values lower than 0.05 were considered significant.

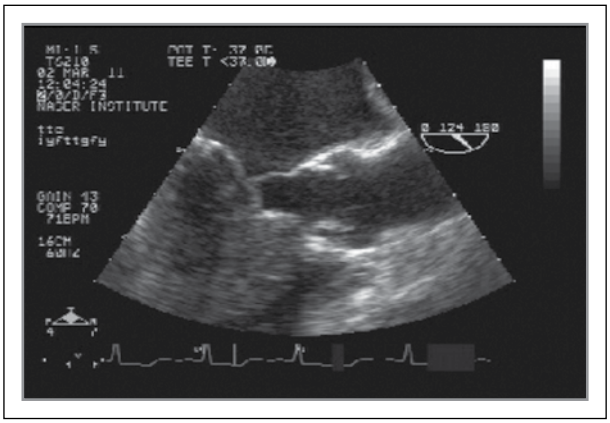

Fig 1.

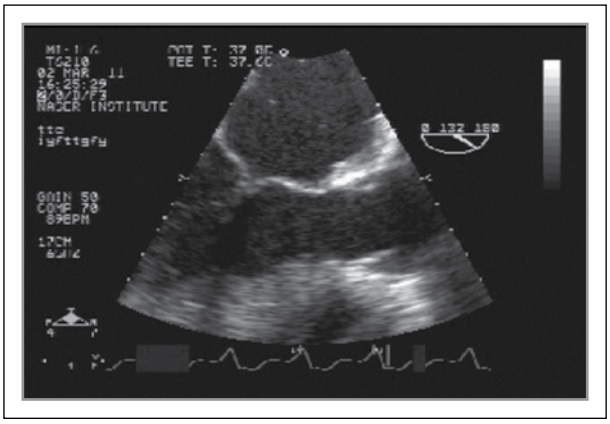

Fig 2.

Intraoperative transoesophageal echocardiographic systolic frame, in the long axis view, shows LVOT obstruction due to septal hypertrophy and SAM prebypass in figure 1. The disappearance of SAM, the posterior displacement of the mitral valve closure line and the less prominent septal bulge are evident postbypass in figure 2.

(LVOT = left ventricular outflow tract, SAM = systolic anterior motion)

Results

Separation from cardiopulmonary bypass was achieved in all patients without inotropic support. No patient required a second pump run for a residual gradient, persistent MR or SAM. The hemodynamic measurements after provacation with

isoprenaline are summarized in table II. Cardiopulmonary bypass was briefly re-established in one patient to control bleeding from the left atriotomy.

There was one operative mortality in this series (8.3%). It was a 27- year old male who died of acute pulmonary oedema due to an unrecognized mitral patch dehiscence on the 4th postoperative day. There was one incidence of sternal wound infection (8.3%), which occurred in the patient who had concomitant CABG. It was successfully managed by sternal debridement and reclosure. One patient (8.3%) developed infective endocarditis of his mitral valve 2 months after surgery. TEE showed one small vegetation on the atrial surface of the leading edge of the pericardial patch, associated with grade 3-4/4 MR. He was subjected to a 6-week course of intravenous antibiotics with resolution of the vegetation. At 8 months of follow up, his MR improved to grade 2/4 and he remains in NYHA class II. A third patient (8.3%) developed severe aortic regurgitation 6 months after surgery with prolapse of the right coronary cusp, presumably because the myectomy was carried out too close to the aortic valve annulus. In spite of that, she remained asymptomatic but died a non-cardiac death at 1 year of follow up, from peritonitis complicating a cholecystectomy operation. There was no incidence of complete heart block or ventricular septal defect.

Change in heart rate	Change in SBP	Increase in peak LVOT gradient	Provocable SAM or MR
20±4 beats/min	– 24±6 mmHg	8±3 mmHg	0

(SBP=systolic blood pressure, LVOT=left ventricular outflow tract, SAM=systolic anterior motion, MR=mitral regurgitation. Values are expressed as mean ± standard deviation)

Table II: Hemodynamic changes after isoprenaline injection post-bypass.

Clinical and pertinent echocardiographic data at the latest follow up are summarized and compared to the preoperative values in table III. Follow up was 100% complete and ranged between 3 and 22 months with a mean of 12.8±7 months. Nine out of 11 survivors were in NYHA class I (81.8%) and two patients were in NYHA class II (18.1%). The mean NYHA class dropped from a preoperative value of 2.91±0.28 to a mean of 1.18±0.4 at latest follow-up, but this drop did not reach statistical significance (p=0.4). The peak systolic gradient showed a mean of 11.75±6.2 mmHg, which represented a significant improvement over the preoperative level (p=0.01). The mean septal thickness remained statistically unchanged (16.2±0.9mm postoperative, versus 20.5±1.2 mm preoperative, p=0,09). Eight patients (72%) had no MR, 2 patients (18%) had grade 1 MR and one patient (9%) had grade 2 MR. The mean grade of MR was significantly reduced from a baseline of 2.3±0.88 to a postoperative value of 0.36±0.6 (p=0.0004).

	Preoperative	Postoperative	P value
NYHA class	2.91	1.18	0.4
LVOT peak gradient	78.7 mmHg	11.7 mmHg	*0.01*
IVS	20.5 mm	16.2 mm	0.09
MR grade	2.33	0.36	*0.0004*

(NYHA = New York Heart Association, LVOT = left ventricular outflow tract, IVS = interventricular septum, MR = mitral regurgitation. Values are expressed as mean ± standard deviation.)

Table III. Postoperative findings at last follow- up, compared to preoperative characteristics.

Discussion

Transaortic septal myectomy for hypertrophic obstructive cardiomyopathy is a well-established procedure. However, the satisfactory relief of the gradient across the LVOT and the abolishment of SAM necessitate a generous myectomy, which is often technically difficult, may result in septal perforation or damage to the conductive tissue, and may require a second pump run to achieve (5). Consistent results have been reported primarily in high volume referral centers that specialize in this disease entity, such as the teams from Mayo (1) and Cleveland (15). Smedira et al, from the latter team, reported on a series of more than 300 patients undergoing isolated transaortic myectomy with no mortality, and with a decrease in the mean septal thickness from 2.3 mm to 1.6 mm. This was achieved at the cost of 2 surgically induced septal defects and 22 permanent pacemaker implantations (15).

Our choice of a combined transaortic and transmitral myectomy, coupled with pericardial patch extension of the anterior mitral leaflet has proven to effective in eliminating the gradient across the LVOT, as well as abolishing SAM as witnessed by the significant decrease in mitral regurgitation. This was achieved by an apparently less than optimal myectomy of 4.3 mm in average. Although the postoperative septal thickness of 1.6 mm in the present series corresponds to the result reported by Smedira and associates, our average resection falls obviously short of the 10 mm proposed by Morrow (3). The mechanism by which the patch enlargement technique seems to compensate for the incompleteness of the resection is by backward displacement of the line of coaptation of the mitral valve towards the posterior annulus. This, on one hand, allows the anterior leaflet to escape the drag caused by the maldirected jet pushing it against the septum in systole and, on the other hand, clears the LVOT of obstructing redundant mitral valve tissue. (See figures 1 and 2).

We have observed a significant reduction in the degree of MR that appeared to be stable over the period of follow-up. This was obtained without the use of a mitral ring, contrary

to the recommendation of Carpentier who favors a rigid ring annuloplasty to decrease the cinching effect of the mitral valve orifice in many of these cases with small and hyperkinetic ventricles (10), or the group from Leipzig who favors a flexible posterior band (12). We feared that ring or band implantation would lengthen the procedure and displace the coaptation line anteriorly towards the septum, if incorrectly measured, defeating the purpose of the patch augmentation.

The marked reduction in pressure gradients across the LVOT and in the degree of mitral regurgitation in our patients were reflected in an observed trend towards a reduction the NYHA class, from a mean of 2.91 to a mean of 1.18. Although this trend did not reach statistical significance, we are confident that this significance would be easily reached in a larger sample size.

A word of caution however must be emphasized about the proposed technique of anterior leaflet augmentation. We have encountered two added complications directly attributed to the technique: patch dehiscence and patch endocarditis. In a series of 29 patients, van der Lee et al reported one occurrence of patch dehiscence, an incidence of 3.4%, which in their case was readily recognized and successfully reoperated upon (5). In our case however, the diagnosis was unfortunately delayed, resulting in one mortality. Therefore, we have found out that this technique has its own learning curve, and that the advantages it portends in terms of enhanced visualization and effectiveness in abolishing SAM and LVOT gradients must be weighed against the possible complications.

One particular appeal for the transmitral approach in HOCM is that it can be performed as a totally endoscopic procedure, as proposed by Casselman and Vanermen (16). This trend nevertheless has not yet encountered widespread enthusiasm in the literature and appears to be still far away from our local surgical reality.

Our choice of isoprenaline for pharmacologic challenging after the surgical correction was based on its potent, nonselective, β-adrenergic agonist activity, which is devoid of any α-adrenergic effect. Elesber and associates described its use for the preoperative elucidation of latent gradients in the catheter lab (17). In a case report by Riddell and coworkers, it was used intraoperatively for one patient who was originally scheduled for CABG with an equivocal pre-operative dynamic LVOT obstruction, which was a pre-procedural use (18). To our knowledge, the present study represents the first systematic post-procedural administration of isoprenaline after the surgical correction of HOCM. The absence of provocable gradients, MR or SAM that was encountered seems to correlate well with the durability of the repair at one year of follow-up.

Conclusion

In the end we conclude that combined transaortic and transmitral myectomy, coupled with pericardial patch extension of the anterior mitral leaflet, is an effective procedure for the elimination of LVOT gradients, SAM and mitral regurgitation in patients with HOCM, especially in the hands of the occasional myectomy surgeon. These results appear to be stable over a follow up period of one year. A larger number of patients are necessary to confirm the benefit it conveys in functional improvement. Moreover, a prospective randomized study is needed to compare it to the traditional isolated transaortic myectomy, considering that both techniques require their own learning curves. Finally, the use of isoprenaline for hemodynamic challenging of the surgical correction is found to be a good predictor of midterm durability.

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Effect of Intrathecal Morphine-Fentanyl on Early Extubation After on Pump Coronary Artery Bypass Graft

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Postoperative analgesia is necessary after surgery specially cardiac surgery to decrease patients discomfort and decrease ICU and hospitals stays.

Aim of study: **The aim of this study was to show the effect of intrathecal morphine-fentanyl preoperatively on time of extubation, postoperative analgesia, postoperative blood gases and time of stay in intensive care unit after on-pump coronary artery bypass grafting (CABG).**

Patient and Methods: **Thirty two patients prepared for on pump CABG were randomized to receive intrathecal morphine 200 ug + 25 ug fentanyl group(ITMF) or intrathecal normal saline (placebo group). The following data was recorded; intraoperative midazolom –fentanyl given to the patients, number of the patients goved dobutamine, nitroglecrine. extubation time in (I.C.U), postoperative blood gases, postoperative morphine requirement and length of stay in I.C.U. postoperatively, and post operative nausea, vomiting, pruritis, headache, respiratory depression and urinary retention.**

Results: **Intraoperatvie doses of midazolam and fentanyl were significantly less in ITMF group (P = 0.014), (P = 0.028) respectively, the dose of morphine used during 24 hs after operation is more in placebo group in comparison to ITMF group (34.85±6.88 mg)and (25.65±4.9 mg) respectively (P = 0.019). The time of extubation was more significant by prolonged in placebo group (P = 0.023). The visual analoge score after extubation within 24 hs at 6, 12, 18, 24 h showed significant better result in (ITMF) group in comparison to placebo group. The length of stay in I.C.U. and hospital is more significant in placebo group (P = 0.004), (P = 0.005) respectively. Post extubation PaO2 and sPO2 was significantly higher in (ITMF) group compared to placebo group but no significant difference between two groups as regard $PaCO_2$.**

Conclusion: **The administration of intrathecal 200ug morphine- 25ug fentanyl was safe and effective in maintaining comfort for on pump CABG for patients in postoperative period. It is also reduce the required of postoperative analgesia, decrease time needed for extubation , better gas exchange post-extubation , decrease length of stay in I.C.U. and hospital.**

Postoperative pain relive by analgesia during cardiac surgery is necessary to prevent patient discomfort, also it may decrease the cost, postoperative intensive care unit length of stay and decrease morbidity[1,2]. The obtain of optimal pain relief after On Pump CABG surgery is difficult because pain may be associated with many interventions as sternotomy, pericardiotomy and chest tube insertion.[1] inadequate postoperative analgesia during the postoperative period may increase the morbidity by causing hemodynamic, haemostatic and metabolic alteration[3]. So aggressive control of postoperative pain must be done to improve outcome in high-risk patients after on pump CABG surgery[4]. Postoperative analgesia after on pump CABG surgery has been obtained by I.V. opioids. However I.V. uses is associated with definite complications and longer-acting opioids may delay tracheal extubation during the immediate postoperative periods[5]. Intrathecal morphine-fentanyle produce intense and prolonged analgesia by acting on opioid receptors in the substantia gelatinosa of the posterior horn, intrathecal fentanyl-proved rapid and profound analgesia. The range of intrathecal fentanyle doses reported is 10-40ug[6].

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Codex : o3/11/1209

This study investigating the safety and efficacy of intrathecal200ug morphin and 25ug fentanyl for the on pump CABG operations.

PATIENTS AND METHODS

After we had obtained institutional approval and informed consent 32 adult patients between age of 40 – 77 years. These patients scheduled for elective on pump CABG in Zagazig University Hospitals in the period from 1-8-2011 to 1-8- 2012. The following criteria were met patients and excluded from this study. (1) Patients used recent thrombolytic drugs, (2) Patients on I.V heparin preoperatively, (3) Any contraindication of regional anesthesia, (4) Platelet count < 100.000/mm^2, (5) History of alcohol abuse, (6) History of bleeding disorder. Patients were randomly classified into two groups each included 16 patients as follow.

Group I: Intrathecal morphine-fentanyl (ITMF).

Group II: Intrathecal normal saline (Placebo).

All patients were pre medicated with oral diazepam 5 mg 2 hours before operation. Patients were putting in the sitting position and prepared with antiseptic solution. After that subarachnoid space was entered at the level of L3-4 or L4-5 with 27 gauge spinal needle once clear cerebrospinal fluid (C.S.F) was obtained morphine 200ug plus 25ug fentanyl diluted in 4 ml normal saline were injected in the subarachnoid space for group 1while group 2 received equal volume of normal saline. After injection patients were occupied supine position and given 2-5 mg midazolam I.V. before cannulation with arterial line and two large bore venous line. Stander monitoring as (B.P., pulse oximeter, H.R) was instituted before induction of anesthesia. Induction was done with propofole 2-3 mg/kg, pancuronium 0.08 mg/kg, midazolam 30ug/kg and fentanyl 8-10ug/kg. After intubation central venous catheter (three-lumen) was inserted in the right internal jugular vein. Maintain anesthesia with O_2 100% and sevoflurane. Vasodilator (Nitroglycrine) and inotropic (dobamine or dobutamine) drugs were administrated at the discreption of the attending anesthesiologist. After strenotomy and conduit harvesting heparinization was initiated to maintain ACT above 480 sec.

- CBP is established with ascending aortic canulation and placement of a single venous cannula.
- Antegrade intermittent blood cardioplegia provide adequate myocardial protection for 30 patients of our cases.
- Combination of antegrade and retrograde rout was used in 2 patients one of them was severily ischemic patient and the other had severely stenotic LAD.
- Construction of distal coronary anastomosis begins after the first dose of cardio plagia has been delivered.
- Although the order of revascularization is not of critical importance during on-pump CABG. The first graft performed in usually to inferior circulation followed by lateral wall, the diagonal system, the left anterior descending artery "LAD".
- The epicardium is incised over selected area of the diseased coronary artery with special rounded blade.
- The anterior surface of the artery is cleaved by gentle brushing.
- The anterior wall of the artery is opened longitudinally by scalpel No. 11 gently. The blade must enter the artery obliquely a superficially to avoid damage of the posterior wall.
- The incision is enlarged with angled scissors to length of 4-6 mm for end to side anastomosis & 3-5 mm for side to side anastomosis.
- The artery may be sized and proximal and distal patency assessed by passing measuring probes into it.
- The distal end if the conduit is incised longitudinally approximately 20% longer than coronary arteriotomy, creates the desired "cobra head" appearance.
- Using of 7-0 poly propylene and no-touch technique in which intima of the coronary and of the conduit are never grasped and the geometric distribution of sutures at the anastomosis was performed .
- Proximal anastomosis are constructed at once after completion of distal anastomosis.
- Proximal anastomosis are constructed into the ascending aorta.
- Conduit is occluded with a light bulldog clamp, spatuilated at its proximal end and anastomosed to aorta using 6.0 polypropylene.

Intra-operative graft assessment

One objective method of assessment is to gently probe each anastomosis at critical points during construction to ensure proximal, distal, conduit patency, rule out purse sting effect that may go unrecognized if too larger or too few bites are taken around anastomosis .

Weaning from CPB

Preparation of the patient for weaning from CPB involve routine but thorough assessment of Cardiac, pulmonary and metabolic system, a chosen temperature for weaning and re warming the patients, once the condition was satisfactory the patient weaned from CPB. De cannulation of venous followed by arterial cannulae after first dose of protamine has been administrated.

After completion of graft bypass; heparin was reversed with protamine sulphate. After skin closure sevoflurane was discontinued and patients were transferred to I.C.U. In I.C.U,

patients were ventilated with synchronized intermittent mandatory ventilation (SIMV) at rate 10-12/min, tidal volume 7-8 ml/kg and FiO_2 80% titrated to keep O_2 saturation >92%. At time of weaning criteria for extubation were fulfilled as the patient was normothermic , hemodynamic stable, awake, alert and follow commands PaO_2 ³ 50 mmHg, $PaCO_2$ £ 50 mmHg, FiO2 £ 50% , SPO_2 > 90%, maximum inspiratory pressure ³ 25 cmH_2O. Postoperative pain was relived by morphine 5 mg I.V.

The study criteria consisted of the following measurements: (1) Total doses of intra operative fentanyl and midazolam used for each patient , (2) number of patients needed dobutamine or nitroglycerine (3) time to extubation, (4) postoperative morphine requirement during the first 24 h. (5) length of stay in I.C.U. and Hospital, (6) Post extubation PaO_2, $PaCO_2$ and SPO_2, (7) pain assessed by 0-10 visual analogue scale where 0 represented no pain and 10 represent sever pain and recorded after extubation then at 6, 12, 18 and 24 hours after extubation, (8) side effect of opioid such as nausea and vomiting, pruritis, headache and delayed respiratory depression, and urinary retention was recorded.

Statistical analysis

Statistical analysis was done using SPSS version 9 for window. quantitative data were expressed as mean ± standard deviation. Student's t- test (two-tailed) was used to test the difference between means in the two groups. qualitative data were compared using chi-squared(x^2) test or fisher´s exact test according to the expected count. A P-value of less than 0.05 was considered statistically significant and P-value of less than 0.001 was highly significant.

RESULTS

This study was done on 32 patients divided into two groups 16 patients in each group. There were no differences between groups as regard demographic data of all patients (Table 1). Group 2 in which patients received subarachnoid normal saline was considered as control group (blacebo). The total doses of intra operative fentanyl and midazolam were significant by decrease in ITMF group in comparison to placebo group (P = 0.014) and (P = 0.028) respectively (Table 3). Number of patients who needed vasodilator (nitroglycrine) or inotrop (dobutamine) were less in group1 than group 2 (Table 2) but not reach statistically significant difference. The dose of morphine used during the first 24 hs. after surgery was more significant in placebo group in comparison to ITMF group (P = 0.019) (Table 4). ITMF patients were extubated significantly earlier than placebo patients (P = 0.023) (Table 4) .

One patient in ITMF group needs ventilation for 24hs due to hemodynamic instability.

Postoperative arterial blood gases show highly significant increase in post extubation PaO_2 (P<0.001) in ITMF group . Also ITMF group show significant increase in SPO_2 (P = 0.021) and insignificant decrease in $PaCO_2$ (P = 0.98) in comparison to placebo group. although patients in both groups received similar FiO_2 in the post extubation period (Table 5). The length of stay in I.C.U. and hospital was significantly less in ITMF group (P = 0.004) and (P = 0.005) respectively (Table 5). Also assessment of postoperative pain with VAS show highly significant decrease in ITMF group immediately after extubation up to 24 hours post extubation in comparison to placebo group (Table 6). As regard complication, there was no respiratory depression, none of the patients developed urinary retention after removal of urinary catheters. Three patient in ITMF group were experienced mild pruritus which respond to chlorepheniramine 5 mg I.V. Two patients in each group developed headache which is treated by paracetamole 500 mg t. Also patients who experienced nausea or vomiting were treated with ondansteron 8 mg I.V. (Table 7).

Variable	Group IITMP (n = 16)	Placebo group (n = 16)	P-value
Age (yr±SD) (Range)	65±15 (40-77)	63±16 (42-70)	NS
Gender (Male/ Female)	10/6	9/7	NS
Height (cm±SD)	170±8	167±8	NS
Weight (kg±SD)	90±12	86±18	NS

NS = non significant difference between two groups.

Table 1. Demographics data of patients in both groups.

Variable	Group IITMP (n = 16)	Placebo group (n = 16)	P-value
Dobutamien use (n)	8	10	NS
Nitroglycrine use (n)	10	12	NS

NS = non significant difference (P>0.05).

Table 2. Number of patients needed dobutamine and nitroglycerine in both groups.

Variable	Group IITMP (n = 16)	Placebo group (n = 16)	P-value
Total midazolam (ug/kg)	105.00±8.86	124.00±17.98	0.014*
Total fentanyle (ug/kg)	22.42±3.70	30.03±8.73	0.028*

** = statistical significant difference (P<0.05).*

Table 3. ***Amount of supplementary drugs needed intra operatively in both groups.***

Variable	Group 1 (n = 16)	Group 2 (n = 16)	P-value
Morphine used in the first 24 h after extubation (mg)/ patient	25.65±4.90	34.85±6.88	0.019*
Extubation time (min)	190±24.82	255±25.01	0.023*

** = significant difference (P<0.05).*

Table 4. Postoperative extubation time and amount of I.V morphine used after extubation(values are mean±SD).

Variable	Group 1 (n = 16)	Group 2 (n = 16)	P-value
Postextubation PaO_2 (mmHg)	124±9.38	92.03±6.44	0.001**
Postextubation $PaCO_2$ (mmHg)	41.35±2.61	45.03±3.08	0.098
Postextubation SPO_2 (%)	96.42±3.12	92.20±2.58	0.021*
Length of stay in ICU (h)	32.62±4.36	44.85±5.25	0.004*
Length of stay in hospital/day	7.3 ±2.2	10.2 ±4.1	0.005**

** = significant difference (P<0.05).*

*** = highly significant difference between groups (P<0.001).*

Table 5. Post-extubation parameters and length of stay in ICU and hospital (values are mean ±SD).

Variable	Group 1 ITMF (n = 16)	Group 2 Placebo (n = 16)	P-value
Immediately after extubation	2.02±0.44	3.65±0.76	<0.001**
After 6 hours	3.75±2.63	6.80±2.2	<0.001**
After 12 hours	3.61±1.55	7.46±2.33	<0.001**
After 18 hours	2.81±0.85	4.15±0.90	<0.048*
After 24 hours	0.76±0.28	1.60±0.65	<0.024*

** = significant difference (P<0.05).*

*** = highly significant difference between groups (P<0.001).*

Table 6. ***Postoperative pain scores (VAS) (values are mean±SD).***

Variable	Group 1 ITMF (n = 16)	Group 2 Placebo (n = 16)	P-value
Nausea (n)	5	4	NS
Vomiting (n)	2	3	NS
Pruritus (n)	3	0	<0.001*
Headache (n)	2	2	NS
Resp. depression (n)	0	0	NS
Urine retention (n)	0	0	NS

** = highly significant difference. NS = non significant.*

Table 7. Postoperative complication.

DISCUSSION

This study demonstrated that postoperative analgesia for outcome must received much attention, It has been established that proper postoperative pain relive affects the outcome of patients undergoing on pump CABG surgery , by decrease the incidence of myocardial ischemias[7,8,9]. This study show that the total intraoperative doses of fentanyl and midazolam were decreased in ITMF group in comparison to placebo group. Shroff et al.[10] found that the combination of intrathecal morphine and fentanyl decreases the use of intra operative opioid´s can facilitate early extubation and early discharge from I.C.U. without increase myocardial ischemia or compromising analgesia. When added fentanyl to intrathecal morphine. This decrease the use of intraoperative opioid due to rapid onset of action of fentanyl. Also patients who received intrathecal morphine-fentanyl were reduced postoperative morphine requirements. This is attributed to the opioid-sparing effect of central neuraxiual morphine administration and this has been previously demonstrated by other investigators[9].

Extubation time was prolonged among patients who received intrathecal normal saline (plaebo group). Kulkami and collegues[11] reported that extubation time was prolonged (later) in patients who received intrathecal morphine but still significantly les than placebo group. This prolongation attributed to large dose of morphine (8-10ug/kg) they used. Smaller doses of intrathecal morphine would conceivable be safer with regard to the risk of respiratory depression compared with larger doses particularly that respiratory depression in conjunction with intrathecal morphine occurs in a dose-dependent fashion[2]. As regard number of patients required vasodilator (nitroglycerin) and inotrope (dobutamine) no differences between both groups during operation or in the postoperative period. Post-extubation SPO_2 and PaO_2 were significant higher in ITMF group in comparison to placebo group. This can be explained by good postoperative analgesia and decreased atelectasis. The level of

comfort reported by patients was significantly higher in ITMF group as evidenced by visual analog pain score´ Jean and his colleagues[2] found that when they gave intrathecal morphine 6ug/kg found the same results. Shroff and his colleagues[10] reported that discharge from I.C.U. and hospital was earlier in ITMF group as in our study.

The incidence of nausea and vomiting were similar in both groups. Three patient in ITMF group has mild pruritis. As regard urinary retention no patients experienced it after removal of urinary catheter. Also no patients experienced ventilator depression after tracheal extubation in both groups.

CONCLUSION

Intrathecal morphine-fentanyl technique is safe and effective in controlling postoperative pain in patients for on pump CABG. Also, this technique is offers promise as a useful adjunct in decreasing the use of intra operative opioids. This dose (200ug morphine + 25ug fentanyl) appears to be effective dose that would provide significant analgesia without delaying tracheal extubation , better gas exchange post-extubation , decrease length of stay in I.C.U. and hospital.

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Hepatitis C Viral (HCV) Infection as a Novel Risk Factor for Severe Coronary Artery Disease: A Prospective Angiographic Study

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Background: **The link between coronary artery disease (CHD) and chronic hepatitis C virus (HCV) infection has been shown in many studies. However, the effect of chronic HCV infection on the extent of coronary artery disease (CAD) has not been determined so; the aim of the present study is to determine the effect of HCV infection on the severity and the pattern of CAD in Egyptian patients.**

Patients and Methods: **This study group included two groups of patients with angiographically documented CAD; 25 HCV seropositive patients as test group and another 25 HCV seronegative patients as control group. Both groups were comparable as regard, age, sex, hypertension, and diabetes mellitus, and smoking. A detailed qualitative coronary angiographic analysis and SYNTAX score were used to assess the extent and severity of CAD.**

Results: **The presence of total occlusion was significantly higher in the HCV seropositive group ($p<0.05$) and the SYNTAX score was higher (14.86 ± 6.64 vs. 10.86 ±7.28, $p <0.05$). After adjustment, HCV seropositivity still represented an independent predictor for severity of coronary atherosclerosis demonstrated by higher SYNTAX score ($p<0.05$).**

Conclusion: **HCV infection is an independent predictor for severe coronary atherosclerosis, as demonstrated by higher syntax score. It also associated with higher incidence of totally occluded coronaries.**

KEY WORDS: ***Coronary Atherosclerosis; Hepatitis C infection; Inflammation; novel risk factors***

Several previous studies have studied the link between atherothrombotic disease and persistent infection or seropositivity of certain microorganisms, such as Chlamydia pnuemoniae, cytomegalovirus, Helicobacter pylori, and herpes simplex virus [**1–4**]. The possible role of certain infectious agents in atherogenesis has been suggested by recent observations that viable microorganisms or remnants of them are present in atherosclerotic plaque [**5**] and that a positive antibody status against some infectious organisms is associated with atherosclerotic diseases [**6**]. Beside this, other several investigators have reported experimental and epidemiological evidence that suggests activation of an inflammatory process, rather than the specific infectious agent, is responsible for the development and promotion of atherosclerotic disease [7-**8**]. Infective agents may have a proinflammatory effect and thus a crucial role in atherothrombosis [**9**].

One of these infectious agents is hepatitis C virus (HCV), which infects approximately 170 million individuals worldwide and about 22 percent of Egyptian populations are infected with this virus; highest prevalence all over the globe [**10**]. This infection remains a severe life-threatening medical and public health problem. In the current literature, there are very few data on the relationship between HCV infection and coronary atherosclerosis. However, recent results indicate that seropositivity for HCV shows a positive association with carotid artery plaque and carotid intima – media thickening, independent of other risk factors for atherosclerosis [**11**].

The aim of this study is to evaluate whether seropositivity for HCV is associated with a more severe coronary artery disease as assessed by previously validated angiographic score, SYNTAX score and qualitative angiographic analysis or not?

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Patients and Methods

Case selection and study population

This is a prospective angiographic study including two main groups of patients with symptomatic coronary heart disease (CHD); **(a)** ***Group 1*****:** HCV seropositive patients as a test group which include 25 patients, 22 males, and 3 females; mean age 55.3 ± 5.5 yrs **(b)** ***Group 2*****:** HCV seronegative patients as control group which include age and sex-matched 25 patients. Both groups were selected from patients who undergone coronary angiography in the period from January 1, 2011, until June 30, 2011 in Medical Specialized Hospital (MSH), Mansoura University, Egypt.

Informed consent

After thorough explanation of the technique and possible procedural risks and benefits, all patients signed a written consent for coronary angiography and possibility of intervention either PTCA or emergency CABG and acceptance to share in this study.

All patients underwent thorough clinical evaluation and review before the procedure, a 12-lead resting electrocardiography (ECG), and basic laboratory tests.

Anti HCV antibodies serologic test:

Venous blood samples were collected from the patients under standardized conditions after an overnight fast and were centrifuged within 15 min of collection. Serum samples were immediately analyzed for antibodies against HCV using a third-generation enzyme immunoassay (EIA) laboratory technique that detects antibodies directed against various HCV epitopes. Recombinant antigens were used to capture circulating anti-HCV antibodies onto the wells of microtiter plates, microbeads, or specific holders adapted to closed automated devices. The presence of anti-HCV antibodies was revealed by anti-antibodies labeled with an enzyme that catalyzes the transformation of a substrate into a colored compound. The specificity of third-generation EIAs for anti-HCV is reported as greater than 99%. The sensitivity of third-generation EIAs is more difficult to determine, given the lack of a gold standard method, but it is excellent in HCV-infected immunocompetent patients. EIAs can be fully automated and are well adapted to large-volume testing (**12**).

Angiographic analysis and study definitions

Coronary arteriography using **the radiographic equipment** (AXIOM Artis (FC/BC, AXA 4-100.620.05.01.02, SIEMENS, GERMANY with software; DICOM compliant.) was performed in all patients by the Judkin's technique and all angiograms of the study groups were reviewed by 2 interventional cardiologists who had no knowledge of the patient's clinical history or laboratory results. A detailed qualitative angiographic analysis was done; especially presence of lesion lumen irregularity, thrombus, total occlusion, bifurcational lesion using the same definitions mentioned below.

We used SYNTAX score to assess the severity of CHD among the whole studied patients. The SYNTAX score has been developed to prospectively characterize the coronary vasculature with respect to the number of lesions and their functional impact, location, and complexity **(13)**

Definition of the coronary tree segments and SYNTAX score algorithm:

By this system, the arterial tree is divided in 16 segments and as such has been adopted in the SYNTAX score (Fig-1) and SYNTAX score algorithm in (fig-2)

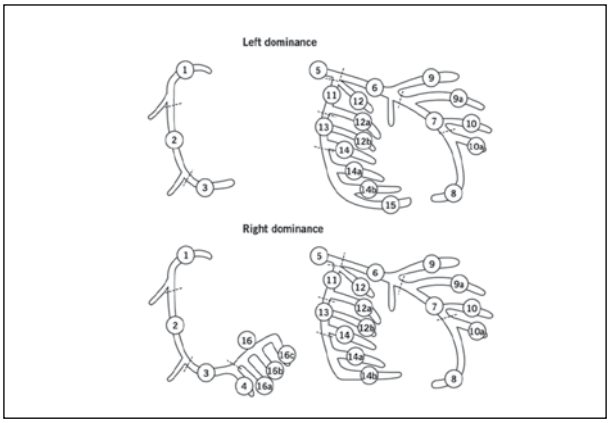

Fig 1. *Definition of the coronary tree segments.*

1. *RCA proximal..*

2. *RCA mid .*

3. *RCA distal.*

4. Right *Posterior descending artery.*

16. *Posterolateral branch from RCA*

16a. *Posterolateral branch from RCA.*

16b. *Posterolateral branch from RCA.*

16c. *Posterolateral branch from RCA.*

5. *Left main.*

6. *LAD proximal: Proximal to and including first major septal branch.*

7. *LAD mid.*

8. *LAD apical: Terminal portion of LAD.*

9. *First diagonal: The first diagonal originating from segment 6 or 7.*

9a. *First diagonal a: Additional first diagonal .*

10. *Second diagonal.*

10a. *Second diagonal a: Additional second diagonal originating from segment 8.*

11. *Proximal circumflex artery.*

12. *Intermediate/anterolateral artery: It belongs to the circumflex territory.*

12a. *Obtuse marginal a: First side branch of circumflex*

12b. *Obtuse marginal b.*

13. *Distal circumflex artery.*

14. *Left posterolateral: Running to the posterolateral surface of the left ventricle.*

14a. *Left posterolateral a: Distal from 14 and running in the same direction.*

14b. *Left posterolateral b: Distal from 14 and 14a and running in the same direction.*

15. Left *Posterior descending*

1. *Dominance*
2. *Number of lesions*
3. *Segments involved per lesion Lesion Characteristics*
4. *Total occlusion*
   - i. *Number of segments involved*
   - ii. *Age of the total occlusion (>3 months)*
   - iii. *Blunt Stump*
   - iv, *Bridging collaterals*
   - v. *First segment beyond the occlusion visible by antegrade or retrograde filling*
   - vi. *Side branch involvement*
5. *Trifurcation*
   - i. *Number of segments diseased*
6. *Bifiurcation*
   - i. *Type*
   - ii. *Angulation between the distal main vessel and the side branch <700*
7. *Aorto-ostial lesion*
8. *Severe tortuosity*
9. *Length >20mm*
10. *Heavy calcification*
11. *Thrombus*
12. *Diffuse disease/small vessels*
    - i. *Number of segments with diffuse disease/small vessels*

Fig 2. *The SYNTAX score algorithm (syntaxscore.com).*

Definitions:

Dominance:

a) Right dominance: the posterior descending coronary artery is a branch of the right coronary artery (segment 4). b) Left dominance: the posterior descending artery is a branch of the left coronary artery (segment 15). Co-dominance does not exist as an option at the SYNTAX score.

A **lesion** is defined as significant when it causes **≥ 50%** reduction in luminal diameter in **vessels ≥ 1.5mm.**

Total occlusion: TIMI 0 flow: no perfusion; no antegrade flow beyond the point of occlusion

Bridging collaterals: Small channels running in parallel to the vessel and connecting proximal vessel to distal and being responsible for the ipsilateral collateralization

Trifurcation: A junction of three branches, one main vessel and two side branches. Trifurcations are only scored for the following segment junctions: 3/4/16/16a, 5/6/11/12, 11/12a/12b/13, 6/7/9/9a and 7/8/10/10a

Bifurcation: A junction of a main vessel and a side branch of at least 1.5mm in diameter. Bifurcations are only scored for the following segment junctions: 5/6/11, 6/7/9, 7/8/10, 11/13/12a, 13/14/14a, 3/4/16 and 13/14/15.

Bifurcation lesions may involve one segment (types A, B and E), two segments (types C, F and G) or three segments (type D).

Aorto-ostial: A lesion is classified as aorto-ostial when it is located immediately at the origin of the coronary vessels from the aorta (applies only to segments 1 and 5, or to 6 and 11 in case of double ostium of the LCA).

Severe tortuosity: One or more bends of 90° or more, or three or more bends of 45° to 90° proximal of the diseased segment.

Length >20mm: Estimation of the length of that portion of the stenosis that has ≥ 50% reduction in luminal diameter in the projection where the lesion appears to be the longest. (In case of a bifurcation lesion at least one of the branches has a lesion length of >20mm).

Heavy calcification: Multiple persisting opacifications of the coronary wall visible in more than one projection surrounding the complete lumen of the coronary artery at the site of the lesion.

Thrombus: Spheric, ovoid or irregular intraluminal filling defect or lucency surrounded on three sides by contrast medium seen just distal or within the coronary stenosis in multiple projections or a visible embolization of intraluminal material downstream.

Diffuse disease/small vessels: More than 75% of the length of the segment has a vessel diameter of 2mm, irrespective of the presence or absence of a lesion.

After the completion of the algorithm in the web site ***SYNTAXscore.com*** a report is automatically generated summarizing all the adverse characteristics, and the individual scoring of each lesion as well as the total SYNTAX score. The SYNTAX score is calculated by a computer program consisting of sequential and interactive self-guided questions. All the above mentioned definitions are projected in a side window when the signal (i) indicating information, available for each questions, is pointed with the cursor. A Total score of 0-22 is considered **low score**; 23-33 as **intermediate score** and >33 as **high score**. Higher SYNTAX scores, indicative of more complex disease are hypothesized to represent a bigger therapeutic challenge and to have potentially worse prognosis **(13)**.

Statistical Analysis

Data were analyzed with SPSS software version 13 for Windows (SPSS Inc, Chicago, IL, USA). Continuous data are presented as means ±SD. Differences in continuous variables between groups were determined by Student's t-test (normal) or

Mann-Whitney U-test (non-normal). Categorical variables are presented as percentages and compared with chi-square test or Fisher's exact test. The Pearson correlation was calculated to evaluate the association between 2 continuous variables. For factors that were found to be related to the severity score in the univariate analysis, multivariate regression analyses were performed to determine their impact independently. P<0.05 values were accepted as statistically significant.

Results

Baseline clinical characteristics of both groups:

Both groups were matched and comparable as regard all clinical variables and left ventricular ejection fraction as summarized in table 1.

Characteristics	HCV group (n = 25)	Control group (n = 25)	P value
Age (years) (*Mean ± SD*)	55.3±5.5	54.4±5.83	0.569
Gender			
Male (*n, %)*	22 (88%)	18 (72%)	0.157
Female (*n, %*)	3 (12%)	7 (28%)	
Diabetes (*n, %*)	12(48%)	9 (36%)	0.39
Hypercholesterolemia (n, %)	12 (48%)	12 (48%)	1.0
Smoking			
Smoker (*n, %)*	15 (60%)	12(48%)	0.395
Non-smoker (*n, %)*	10(40%)	13 (52%)	
Hypertension (*n, %)*	21(84%)	20 (80%)	0.71
LVEF (%) (Mean ± SD)	56.8±9.12	57.1±6.7	0.903

LVEF (left ventricular ejection fraction)

Table (1): Baseline clinical characteristics of both groups

Qualitative coronary angiographic analysis in both groups

When we compared the 2 groups according to angiographic pattern and specific coronary artery segment involved we found that no significant difference was present as regard lesion irregularity, Calcification, Bifurcation lesion, Trifurcation lesion, severe lesion touristy and the presence of Small vessel disease. On the other hand, the presence of thrombus and total occlusion is more frequent among HCV seropositive group table 2

Characteristics	HCV group (n = 25)	Control group (n = 25)	P value
Presence of thrombus (n, %)	***2 (8%)***	***0 (0%)***	**-**
Presence of irregularity (n, %)	17 (68%)	18(72%)	0.75
Calcification (n, %)	8 (32%)	7 (28%)	0.75
Total occlusion *(n, %)*	*9(36%)*	*3 (12%)*	***<0.05***
Bifurcation (n, %)	6(24%)	2(8%)	0.123

Table .2 Qualitative coronary angiographic characteristics in both groups:

Coronary artery disease severity calculated by SYNTAX score

There is no significant difference was present as regard specific arterial segment involvement by the disease in both group. The syntax score was significantly higher in the HCV seropositive group than in the control group (14.86 ± 6.64 vs. 10.86 ±7.28, p<0.048) Table 3.

Characteristics	HCV group (n = 25) Mean (%)	control group (n = 25) Mean (%)	P value
LAD :			
Proximal segment	14 (56%)	9(36%)	0.15
Diagonals	5(20%)	2(8%)	0.2
Mid segment	14(56%)	11(44%)	0.39
Distal segment	1(4%)	4(16%)	0.157
LCX:			
Proximal segment	6 (24%)	4 (16%)	0.48
OM branch	4 (16%)	6 (24%)	0.48
Distal segment	2 (8%)	0 (0%)	0.149
RCA:			
Proximal segment	5 (20%)	5 (20%)	1.0
Mid segment	8(32%)	10(40%)	0.55
Distal segment	3(12%)	3(12%)	1.0
SYNTEX SCORE *(mean ± SD)*	14.86 ± 6.64	10.86 ±7.28	**<0.05**

Table (3) Coronary artery segments involved and coronary artery disease severity calculated by SYNTAX score in both groups.

Discussion

In the present study, we found that HCV seropositivity was independent predictor of increased severity of coronary atherosclerosis, as evidenced by higher thrombus-containing lesions and totally occluded coronaries and a higher SYNTAX score than the control group.

Whereas proof that bacteria or viruses can cause atherosclerosis remains elusive, it is quite plausible that infections may potentiate the action of traditional risk factors, such as hypercholesterolemia. Based on the vascular biology of atherosclerosis, a number of scenarios might apply. **First**, cells within the plaque itself may harbor infection. **Second**, extravascular infection might also influence the development of atheromatous lesions and provoke their complication. The acute-phase response to an infection in a nonvascular site might affect the incidence of thrombotic complications of atherosclerosis by increasing fibrinogen or plasminogen activator inhibitor or otherwise altering the balance between coagulation and fibrinolysis. Such disturbance in the prevailing prothrombotic, fibrinolytic balance may critically influence whether a given plaque disruption will produce a clinically inapparent transient or nonocclusive thrombus or sustained and occlusive thrombi that could cause an acute coronary event. **Finally,** acute infections might also produce hemodynamic alterations that could trigger coronary events. For example, the tachycardia and increased metabolic demands of fever could augment the oxygen requirements of the heart, precipitating ischemia in an otherwise compensated individual. These various scenarios illustrate how infectious processes, either local in the atheroma or extravascular, might aggravate atherogenesis, particularly in preexisting lesions or in concert with traditional risk factors**(14)**.

Hepatitis C virus (HCV), infects approximately 170 million individuals worldwide and about 22 percent of Egyptian populations are infected with this virus; highest prevalence all over the globe [**10**]. The mechanisms responsible for the pathogenesis of chronic HCV infection are not well known. Similarly, there are very few data about the possible relationship between HCV infection and its association with coronary atherosclerosis.

The first evidence for an association between HCV seropositivity and CAD was reported by **Vassalle et al.,** they showed that in addition to other conventional atherogenic risk factors (age, sex, smoking habit, hypertension, diabetes, and dyslipidemia), HCV seropositivity was associated with the presence of CAD (**15**). However, **Arcari et al.,** investigated the association between HCV seropositivity and acute myocardial infarction using a well-established cohort of young men in the US military and found no evidence to support this association**(16)**.

No data are available in the current literature with regard to the association between HCV infection and severity of atherosclerosis. In the present study we investigated the association between HCV seropositivity and the severity of coronary atherosclerosis using qualitative coronary angiographic analysis and SYNTAX score system and found that HCV seropositivity is an independent risk factor for increased atherosclerosis demonstrated by higher thrombus-containing lesions, higher total occlusions and a higher SYNTAX score. HCV infection may also stimulate inflammatory and immune-mediated responses, leading to increased inflammation, or it may increase levels of oxidative stress on atherosclerotic plaque. In other words, increased atherosclerosis in HCV seropositive subjects might be related to increased oxidative stress on atherosclerotic plaque and more inflammation.

This is in agreement with what was reported by **Amit Asija et al.,** who found that Patients undergoing coronary angiography for chest pain have a significantly higher prevalence of obstructive CAD, if they are seropositive for hepatitis C virus than if they are seronegative for hepatitis C virus **(17)**.

In conclusion,

We have demonstrated an association between HCV infection and the severity of coronary atherosclerosis as evidenced with a higher incidence of thrombus-containing lesions, total occlusions and a higher SYNTAX score among patient with HCV seropositive compared to HCV seronegative patients.

Study limitations

This study included only HCV seropositive patients without clinical liver disease or cirrhosis. Therefore, the cumulative effect of HCV infection on the severity of coronary atherosclerosis was not determined. In addition, our study population was too small to reach a conclusion. Large-scale studies demonstrating more exactly the effect of HCV infection on the severity of atherosclerosis are needed.

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Early Results of Combined Carotid Artery Stenting With Coronary Artery Bypass Grafting

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Although current guidelines state that carotid endarterectomy is probably recommended before or concomitant to coronary artery bypass grafting (CABG) in patients with carotid stenosis, significant controversies to this recommendation still persist. Carotid artery stenting has been recently introduced as an alternative revascularization modality in high-risk patients. The aim of this study was to define, if carotid artery stenting is beneficial in this setting.

Methods: **a study will be done involving 30 patients with concomitant ischemic heart disease requiring surgical intervention and internal carotid artery stenosis. The stenting procedure was performed the same day of the operation. A 30 days follow up period following CABG will be held to assess the incidence of stroke, MI, bleeding, or death. Results: there were 23 males and 7 females enrolled in our study, the mean age was 66,93 years. 20 patients had right ICA stenosis, while 10 had left ICA stenosis warranting intervention. There was no major or minor strokes or MI during the follow up period, 1 patient had drop of blood pressure following carotid stenting, 1 patient had postoperative bleeding following CABG, and there was only 1 mortality 12 days after CABG due to cardiac problems.**

Conclusion: **Planned carotid stenting followed by staged CABG is a viable method of treatment for patients with coexistent carotid and coronary atherosclerosis.**

It is well established that the presence of carotid artery stenosis is a significant predictor of poor outcomes inpatients undergoing coronary bypass graft surgery (CABG) (1). The incidence of coexisting coronary and carotid artery disease varies between 2% and 14% and approximately 8% of patients undergoing CABG have a significant stenosis in an extracranial carotid artery(2). Current guidelines state (Class IIa; Level of Evidence C) that carotid endarterectomy (CEA) is probably recommended before CABG or concomitant to CABG in patients with symptomatic carotid stenosis or in asymptomatic patients with a unilateral or bilateral internal carotid stenosis of 80%(3). A combined or staged surgical approach has a composite stroke, myocardial infarction, or death rate of > 10% (4). The concept of performing CAS before open heart surgery is not novel. In a retrospective analysis, investigators at the Cleveland Clinic in Ohio compared the outcomes of patients undergoing CAS before open heart surgery (n=56) and those undergoing a combined surgical approach (n=111) and showed favorable results for the partially endovascular approach (5).

Patients and methods

30 patients were enrolled in this study. There were 7 patients with symptomatic carotid artery disease in the form of transient ischemic attacks, with 1 patient with previous history of minor stroke. 23 patients were asymptomatic and carotid stenosis> 70% unilateral or bilateral was discovered during routine preoperative carotid duplex study prior to CABG. Tirofeben infusion was started one hour before the stenting procedure, and was maintained for 4 hours after, then discontinued 2 hours before surgery. All patients underwent on pump CABG, and dual Clopidogrel and asprin antiplatelet regimen was started once postoperative bleeding was not suspected. All patients were monitored for the usual postoperative parameters, including neurological deficits. All patients were discharged home at a mean of 6 days postoperatively.

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Codex : o3/15/1209

Results

There were 23 males (76.7%) and 7 females (23.3%). The mean age was 66.93 years. 17 patients were diabetics (56.7%), and 13 patients were hypertensives (43.3%). Peripheral vascular disease was present in 6 patients (20.0%). As for the coronary affection, 5 patients had left main disease (16.7%), 14 patients had triple vessel disease (46.7%), and 14 patients had proximal LAD disease (46.7%). One patient had concomitant aortic valve replacement with CABG.

			Side		
			Right	Left	Total
Sex	Male	Count	17	6	23
		% within Side	85.0%	60.0%	76.7%
	Female	Count	3	4	7
		% within Side	15.0%	40.0%	23.3%
Total		Count	20	10	30
		% within Side	100.0%	100.0%	100.0%

Table 1. Demographic data

			Side		
			Right	Left	Total
Diabetic	Yes	Count	11	6	17
		% within Side	55.0%	60.0%	56.7%
	No	Count	9	4	13
		% within Side	45.0%	40.0%	43.3%
Total		Count	20	10	30
		% within Side	100.0%	100.0%	100.0%

Table 2. Diabetes

			Side		Total
			Right	Left	
hypertensive	Yes	Count	8	5	13
		% within Side	40 %	50%	43.3%
	No	Count	12	5	17
		% within Side	60%	50%	56.7%
Total		Count	20	10	30
		% within Side	100%	100%	100%

Table 3. Hypertension

			Side		
			Right	Left	Total
PVD	Yes	Count	3	3	6
		% within Side	15.0%	30.0%	20.0%
	No	Count	17	7	24
		% within Side	85.0%	70.0%	80.0%
Total		Count	20	10	30
		% within Side	100.0%	100.0%	100.0%

Table (4) peripheral vascular disease

			Side		
			Right	Left	Total
LMD	Yes	Count	3	2	5
		% within Side	15.0%	20.0%	16.7%
	No	Count	17	8	25
		% within Side	85.0%	80.0%	83.3%
Total		Count	20	10	30
		% within Side	100.0%	100.0%	100.0%

Table (5) left main disease

			Side		
			Right	Left	Total
Tripple_ Vessel	Yes	Count	10	4	14
		% within Side	50.0%	40.0%	46.7%
	No	Count	10	6	16
		% within Side	50.0%	60.0%	53.3%
Total		Count	20	10	30
		% within Side	100.0%	100.0%	100.0%

Table 6. Triple vessel disease

			Side		
			Right	Left	Total
Prox#_ LAD	Yes	Count	8	6	14
		% within Side	40.0%	60.0%	46.7%
	No	Count	12	4	16
		% within Side	60.0%	40.0%	53.3%
Total		Count	20	10	30
		% within Side	100.0%	100.0%	100.0%

Table 7. Proximal LAD

The mean ejection fraction for patients who had right internal carotid artery (RICA) stenting was 51.55%, while for those with left internal carotid artery (LICA) stenting the mean ejection fraction was 53.00% (statistically insignificant). The mean ejection fraction for all patients was 52,03% which indicates that all patients had good LV function prior to surgery. Patients who had RICA stenting (20 patients) had a mean stenosis of 80% on this side with a mean of 38% in the contralateral side. Patients who had LICA stenting (10 patients) had a mean stenosis of 83% on this side together with a mean of 37% in the contralateral side (statistically insignificant).

The follow-up period of our study was the 1st 30 days following CABG surgery. 29 patients completed the follow-up period. One patients, who had a RICA stent prior to a concomitant surgery for aortic valve replacement and CABG, died during the follow-up period, 2 days postoperatively due to intractable arrythmias. This patient was also reopened the same day of surgery due to the bleeding for which no surgical source was found. One patient suffered some drop of blood pressure following stenting of RICA, prior to surgery. However, this patient had CABG surgery after stabilization of the blood pressure with no complications postoperatively. There was no incidence of major or minor strokes during the follow-up period, and none of our patients had postoperative myocardial infarction.

Side		Age	LDL	Serum_Creat#	Ejection_Fraction	Right_ICCA	Left_ICCA
Right	Mean	66.65	195.15	1.18	51.55	0.80	0.38
	Std. Deviation	3.83	24.19	0.15	5.59	0.08	0.29
	Minimum	60.00	150.00	1.00	44.00	.60	.00
	Maximum	74.00	250.00	1.50	60.00	.95	1.00
	N	20	20	20	20	20	20
Left	Mean	67.50	194.40	1.34	53.00	0.37	0.83
	Std. Deviation	2.51	15.56	0.24	6.99	0.16	0.04
	Minimum	63.00	173.00	1.10	38.00	.15	.75
	Maximum	72.00	220.00	1.90	60.00	.60	.90
	N	10	10	10	10	10	10
Total	Mean	66.93	194.90	1.23	52.03	0.66	0.53
	Std. Deviation	3.42	21.42	0.20	6.01	0.24	0.32
	Minimum	60.00	150.00	1.00	38.00	.15	.00
	Maximum	74.00	250.00	1.90	60.00	.95	1.00
	N	30	30	30	30	30	30

Table 8. Lesion side

Major stroke

			Stroke_Major	Total
			No	
Side	Right	Count	20	20
		% within Stroke_Major	66.7%	66.7%
	Left	Count	10	10
		% within Stroke_Major	33.3%	33.3%
Total		Count	30	30
		% within Stroke_Major	100.0%	100.0%

Minor stroke

			Stroke_Minor	Total
			No	
Side	Right	Count	20	20
		% within Stroke_Minor	66.7%	66.7%
	Left	Count	10	10
		% within Stroke_Minor	33.3%	33.3%
Total		Count	30	30
		% within Stroke_Minor	100.0%	100.0%

Postoperative myocardial infarction

			MI	Total
			No	
Side	Right	Count	20	20
		% within MI	66.7%	66.7%
	Left	Count	10	10
		% within MI	33.3%	33.3%
Total		Count	30	30
		% within MI	100.0%	100.0%

Blood pressure drop post stenting

			Dec#_BP_Post_PTA		Total
			Yes	No	
Side	Right	Count	1	19	20
		% within Dec#_BP_Post_PTA	100.0%	65.5%	66.7%
	Left	Count	0	10	10
		% within Dec#_BP_Post_PTA	.0%	34.5%	33.3%
Total		Count	1	29	30
		% within Dec#_BP_Post_PTA	100.0%	100.0%	100.0%

Bleeding

			Bleeding		Total
			Yes	No	
Side	Right	Count	1	19	20
		% within Bleeding	100.0%	65.5%	66.7%
	Left	Count	0	10	10
		% within Bleeding	.0%	34.5%	33.3%
Total		Count	1	29	30
		% within Bleeding	100.0%	100.0%	100.0%

Mortality

			Death		Total
			Yes	No	
Side	Right	Count	1	19	20
		% within Death	100.0%	67.9%	69.0%
	Left	Count	0	9	9
		% within Death	.0%	32.1%	31.0%
Total		Count	1	28	29
		% within Death	100.0%	100.0%	100.0%

30 days follow-up period

			@30_Days_ Follow_Up		Total
			Yes	No	
Side	Right	Count	19	1	20
		% within @30_Days_ Follow_Up	65.5%	100.0%	66.7%
	Left	Count	10	0	10
		% within @30_Days_ Follow_Up	34.5%	.0%	33.3%
Total		Count	29	1	30
		% within @30_Days_ Follow_Up	100.0%	100.0%	100.0%

Discussion

Despite limited evidence of the benefit of carotid revascularization before or together with coronary artery bypass grafting (CABG), patients with advanced carotid and coronary disease are frequently treated by a combined or staged carotid/coronary surgical revascularization. The calculated stroke rate for an asymptomatic patient with severe unilateral carotid stenosis is 3.0%, which increases to 5.2% and 11% if bilateral disease and contralateral occlusion are present, respectively. Symptomatic patients are associated with an 8.2% incidence of stroke (6) The surgical removal of this plaque is known as carotid endarterectomy (CEA). This procedure can reduce the risk of future stroke in selected patients, likely as a result of addressing both embolic and hemodynamic mechanisms. The benefit of CEA has been conclusively proven to reduce the risk of future stroke in symptomatic patients (7).

In a systemic review of 6 studies with 277 patients reporting carotid stenting followed by staged CABG, The majority of patients were male (78%) with a mean age of 69 years. There was an overall high prevalence of cardiovascular risk factors in most studies; diabetes was present in 36%of patients, 70% had hypertension; all (except hypertension) were conforming to our study. In this review, The combined prevalence of death and any stroke was 12.3% (8).

Investigators from Nieuwegein in the Netherlands studied in a large group of patients (n=356) carotid artery stenting (CAS) followed by CABG. The rate of death, stroke, or myocardial infarction (MI) from the time of CAS to 30 days after cardiac surgery was (6.8%) (9). Our lower rate of these complications is obviously related to the limited number of patients in our study. A population-based analysis performed in the United States detected a combined death and stroke rate of 17.7% among 226 procedures (10).

How can we identify the best management strategy (optimal medical therapy, endarterectomy, or stent) for patients with severe asymptomatic carotid stenosis that requires open heart surgery? The perfect but unrealistic solution would be a randomized trial; however, the target population is too small. In a nationwide US survey, among the population of patients undergoing CABG, those undergoing combined CEA-CABG accounted for only 1.1% in 1993 and 1.6% in 2002 (11). A randomized trial testing noninferiority between CABG only, CEA (carotid endartrectomy)-CABG, and CAS (carotid artery stenting) followed by CABG would be relevant clinically. However, such a study would require an enrollment of ≈4000 patients to be adequately powered. It is unlikely that this will ever take place, because even CEA versus CAS trials, which address a much broader patient population have had to be stopped recently because of slow enrollment and lack of funding(12).

Conclusion

The best revascularization strategy for patients with advanced coronary and carotid disease should be suggested on a case-by-case basis by a multidisciplinary team that includes neurologists, surgeons, and interventionists who take into account the comorbidities of the patient, the degree of urgency of cardiac surgery, and local expertise. Prospective, randomized studies are warranted to fully elucidate the best therapeutic approach in this growing patient population. However , and despite the limited number of patients in our study, carotid artery stenting can be considered a safe procedure and less invasive than surgical endartrectomy for management of patients with combined carotid and coronary artery disease.

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Early Results of Bilateral Internal Mammary Arteries Revascularization of The Left Coronary System Versus Radial Artery

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Total arterial revascuarization offers a potential to avoid the problems associated with vein graft failure. The long term patency of the internal mammary arteries have been well proven, whike there are still concerns about the radial artery long term performance. There are still hindering factors with total arterial revascularization , mainly the prolonged operative time needed for bilateral IMA harvesting as well as the technical difficulties of the procedure. The aim of our study is to compare the early postoperative results of using composite arterial grafting of the left coronary system using bilateral IMAs versus the use of radial artery with the LIMA. Our study included group of 50 patients who had CABG surgery with bilateral IMA grafting of the left system compared to another group of 50 patients who had arterial grafting using the left radial artery in addition to the LIMA. The early results showed significant longer operative time for the BIMA (bilateral mammary) group, however the ischaemic time didn't make a statistically significant difference. The mechanical ventillation time, ICU stay, blood loss , blood transfusion and hospital stay were all higher in the BIMA group tahn in the RA (radial artery) group. There were no mortalities in our study, however the morbidities in the BIMA group were more than the RA group.

***Conclusion*: LIMA-RA composite grafts (as T or Y configuration) allowed safe and adequate arterial myocardial revascularization of the left coronary system, compared to composite skeletonized RIMAs(as T or Y configuration)in the early term. Our result supports the effectiveness and safety of its use and recommends its application in CABG surgery to improve the early surgical outcome.**

Cardiovascular

Total arterial revascularization offers a potential to avoid the problems associated with vein graft failure.

Many supporters stated that, grafting more arterial conduits or performing total arterial revascularization ,results in better postoperative results of surgery by virtue of the post-CABG more prolnged and event-free patient survival [1-5] .Revascularization with 2 arterial conduits offers better midterm event-free survival than a single arterial graft, irrespective of which second choice arterial conduits is used(radial artery or right thoracic artery), the simultaneous use of saphenous vein grafts, and the patient age [6].

The left internal thoracic artery (LITA) grafts has been in use for long owing to their favorable long-term freedom of arteriosclerosis and hence long –term patency at late follow-up periods. For the previous reasons, a pedicled LIMA graft, became the first choice for left descending coronary artery occlusion, especially in diabetic or young patients [4,5].

Bonacchi and colleagues [7] reported that patients who had received bilateral internal thoracic artery (ITA) grafts for left coronary system revascularization showed improved early and late outcomes and decreased risk of death, reoperation, and angioplasty. However, they stated that despite the good, short-and long-term patency and possibility of improved survival bilateral ITA recruitment is associated with higher incidence of sterna wound complications especially in diabetics having a high body mass index(BMI>30).

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Since its reintroduction by Acar and colleagues [8], the radial artery(RA) has generated significant interest as an alternative arterial conduit for coronary artery bypass grafting. The RA is an attractive conduits as it may be harvested simultaneously with internal thoracic artery (ITA) and bilaterally if additional conduit is required. Its thick wall and diameter facilitate the performance of anastomosis, and its length is sufficient to accommodate most distal targets. Although first described as an aortocoronary conduit by Carpentier and associated, the RA is used extensively as a composite graft with the predicted ITA in a T or Y graft configuration [9] and was proved to be effective and safe in CABG [10].

Objective:

Evaluation of the benefits of using composite grafts in T and Y fashion: free RA implanted on intact full pedicle LIMA ;versus using skeletonized RIMA implanted on intact skeletonized LIMA for adequate revascularization of left coronary artery branches.

Patients and methods

Patient population

This randomized prospective comparative study enrolled 100 male patients with ischemic heart disease undergoing elective isolated on pump coronary artery bypass graft (CABG) surgery using conventional CPB and intermittent antegrade warm blood cardioplegia.

Inclusion criteria

Age of the patients included ranges between 40-65 years old, having multivessels disease and fair contractility who underwent elective CABG

Surgery using composite free RAs on pedicled left internal mamary artery (LIMA) grafted to the left anterior descending coronary(LAD)vessel, versus composite free skeletonized RIMAs and intact skeletonized LIMAs with a free saphenous vein graft for the right coronary circulation using conventional CPB, intermittent antegrade warm blood cardioplegia for cardiac arrest.

Exclusion criteria

Patients having unstable anginal pain, left ventricular ejection fraction <40%, patient needing surgery for another concomitant cardiac pathology ,in addition to any general factor or disease contraindicting surgery (e.g. uncontrolled DM {glycosylated HB > 7.5 %}, hepatorenal insufficiency disease, or disseminated malignancy).

Patients groups

Patients were randomly –allocated into either of two groups;

Group A ; (LIMA+ RA group) encompassed 50 patients in whom free full pedicle RA is grafted to left coronary artery branch(es), then anastomed (in a T or Y fashion) to intact full pedicle left internal mammary artery (LIMA) which is grafted end-to-side to the LAD coronary vessesl. Preoperative modified Allen test for RA examination was performed and verified in group A candidates.

Group B ; (LIMA+ RIMA group) included 50 patients in whom free skeletonized right internal mammary (RIMA) is grafted (in a T or Y fashion) on left coronary artery branch(es) before anastomosing it to skeletonized LIMA vessel which is implanted end-to-side to the LAD coronary vessesl. Preoperative modified Allen test for RA examination was performed and verified although in this group.

Data collection

Data were prospectively collected in the two groups both intraoperatively and during the in-hospital patient stay.

Patients Follow-up

Follow-up was complete for all cases . Patient's results were analysed during in-hospital stay, using clinical assessment and special investigations (ECG, Lab Enzymes, and echocardiography).

Statistical analysis

The patient characteristics and hospital outcomes were compared using t test for continuous variables and the Fisher ŝ exact test for categoric variables. Data results were presented as means ± SD , P value < 0.05 was considered of clinical significance.

Patient population, preoperative risk factors:

All patients were males with mean age of 48 ± 2.4 years (range 41-64 years). Due to proper matching , our patients had nearly similar patient criteria and preoperative surgical risk factors (Table 1).

Lesions in the branches of left coronary artery

Critical lesions involving other branches of the left coronary circulation were diagnosed as follows: critically-stenotic lesions involving the left anterior coronary branch necessitating surgical revascularization were preoperatively-detected involving all patients of both groups(100%); a diagonal branch in 13 group A patients (26%) versus 15(30%) in group B; Obtuse marginal branch 1of the circumflex artery in 21 group A patients (42%),versus 19 group B patients (38%); Obtuse marginal branch 2 of circumflex artery in 17 of group A patients (34%) versus 18 (36%) of group B patients.

Varibles	Group A (LIMA+RA for LCA) +(SVG for RCA)	Group B (LIMA+RIMA for LCA) +(SVG for RCA)	P value
Age (years)			
• Mean	46 ± 1.5	44 ± 2.2	NS
• Range	41-64	42-61	_
Male sex	50(100%)	50(100%)	NS
Mean body surface area	1.47±0.11 m2	1.44±.2	NS
Surgical Risk factors			
• BMI > 30	15(30%)	13(26%)	NS
• Diabetes Mellitus	24(48%)	20(40%)	NS
• Hypertension	26(52%)	22(44%)	NS
• EX-smoking	33(66%)	29(58%)	NS
• Previous MI	8(16%)	5(10%)	NS

BMI:Body mass index MI:Myoccardial infarction NS:Statistically non-significant results

Table 1. Preoperative patient data

Lesions in the branches of the right coronary artery

Critical lesions involving other branches of the right coronary circulation were diagnosed as follows: main trunk in 4(8%)of group A patients ,versus 3 (6%) of group B patients; and Crux segment in 24(48%) of group B patients (40%);the posterior descending branch in 18 of group A patients (36%), versus 24 patients in group B (48%);and the posterolateral branch in 4 group A patients(8%),versus 3 of group B patients (6%).

Due to the proper patient matching, no differences of statistical significance were present between patient members of both groups (Table 2).

The conduits used

Arterial grafts : We used 100 arterial grafts in each group. In group A we used 50 intact full –pedicle LIMA +50 free –pedicle RAs: while in group B we used 50 skeletonized RIMAs and 50 intact skeletonized LIMAs.

Venous grafts : In each group, we used adequate –lengths of free venous grafts taken from the superficial saphenous venous system of the left leg.

Variable	Group A (LIMA+RA for LCA) +(SVG for RCA)	Group B (LIMA+RIMA for LCA) +(SVG for RCA)	P value
LCA lesions			
• Left anterior descending	50(100%)	50(100%)	NS
• Diagonal branch	13(26%)	15(30%)	NS
• Obtuse marginal 1 of Cx	21(24%)	19(38%)	NS
• Obtuse marginal 2 of Cx	17(34%)	18(36%)	NS
RCA lesions			
• Main trunk	4(8%)	3(6%)	NS
• Crux segment	24(48%)	20(40%)	NS
• Posterior descendingbranch	18(36%)	24(48%)	NS
• Posterolateral branch	4(8%)	3(6%)	NS

Table (2) :Preoperative coronary angiographic data

Variable	Group A (LIMA+RA for LCA) +(SVG for RCA)	Group B (LIMA+RIMA for LCA) +(SVG for RCA)	P value
Arterial conduits			
• Intact full-pedicle LIMAs	50(100%)	_	_
• Intact skeletonized LIMAs	_	50(100%)	_
• Free full-pedicle RAs	50(100%)	_	_
• Free skeletonized RIMAs	_	50(100%)	_
Venous conduits			
• Free saphenous vein	50(100%)	50(100%)	NS

Table 3. Conduits used , anastomotic point fashioned

Results

Operative data: The mean total operative time was 3±0.7 hours (range 3-4.5 hours) for group A, versus 4.5± 0.6 hours (range 4-5.5 hours) for group B. The mean cardiopulmonary bypass time was 70±30 minutes (range 65-120 minutes), versus 75 ± 25 minutes (range 69 -127 minutes) in group B. The mean aortic occlusion (ischemic) time was 48±4 minutes (range 33-39 minutes) for group A, versus 52±6 minutes (range 40-102 minutes) for group B. In group A , 3±0.02 distal anastomotic points were fashioned in each patient versus 3±0.04 in group B. The operative data is displayed in table (4).

Postoperative course and events

According to clinical examination, ECG monitoring, and laboratory enzymatic analysis, there was no operative incidence of new ischemic pain: perioperative myocardial infarction; cerebral stroke, Renal failure or neurovascular hand complication. There was no need for Inotropic support or IABP during the post operative course. Patients of group B needed a longer ICU time (statistically significant) with a mean of 42±3.2 hours (range 30-49 hours); versus 33±3.5 hours (range 24±38 hours). The time spent by the patient on mechanical ventilation was longer (statistically significant) in group B patients with a mean of 8±1.5 hours ranging between 6-10 hours : versus mean of 13 ±4.5 hours ranging between 8-14 hours for group

Variable	Group A (LIMA+RA for LCA) + (SVG for RCA)	Group B (LIMA+RIMA for LCA) +(SVG for RCA)	P value
Total operative time (hours)			
Mean	3±0.7	4.5±0.6	<0.04
Range	3-4.5	4-5.5	-
CPB time(minutes)			
Mean	70±30	75±25	NS
Range	65-120	69-127	-
Ischemic time (minutes)			
Mean	48±4	52±6	NS
Range	33-99	40-102	-
Distal anastomotic points			
Mean	3±0.02	3±0.04	NS
Inotropic Support	_	_	_
IABP Support	_	_	_

Table (4): The operative data

Types of venous conduit, target coronary revascularization	Group A (LIMA+RA for LCA)	Group B (LIMA/RIMA for LCA)	P value
ICU time (hours)			
Mean	33 ± 3.5	42 ± 3.2	< 0.04
Range	24-38	30-49	-
Mechanical ventilation time (hours)			
Mean	8 ± 1.5	13 ± 4.5	<0.05
Range	6-10	8-14	-
Mediastino-pleural blood loss (mls)			
Mean	460 ± 163.195	688 ± 248.990	< 0.001
Range	300-1000	500-1500	
Blood transfusion (Units)			
Mean	0.90 ± 0.61	1.26 ± 0.853	0.017
Range	1-3	1-4	
Total hospital stay time (days)			
Mean	5 ± 2.2	9 ± 4	<0.03
Range	5-12	8-14	-
Inotropi Support	–	–	–
IABP Support	–	–	–
Myocardial infarction	–	–	–
Acute renal failure	–	–	–

P value was statistically significant if <0.05

Table 5. Postoperative outcome and events.

A patients. The amount of pleuro-mediastinal blood loss was more (statistically significant) in group B patients with mean of 688 ± 248.990 mls ranging between 500-1500 mls : versus mean of 460 ± 163.195 ranging between 300-1000 for group A patients . The amount of blood transfusion was more (statistically significant) in group B patients with mean of 1.26 ± 0.853 units ranging between 1-4 units : versus mean of 0.90 ± 0.61 ranging between 1-3 for group A patients. The total hospital time was longer (statistically significant) in group B patients ranging from 5-12 days with a mean of 5 ±2.2 days; versus 8-14 days with a mean of 9±4 days , the postoperative course, events is displayed in table (5).

Morbidity and Mortality

Mortality : No mortality occurred in both groups of patients.

Morbidity: Total 13 patients (13%): 11 in group B (22%) and 2 (4%) in group A.

Group B: Four of group B patients (8%) complained of frequent attacks of atrial fibrillation (AF), were managed by antiarrhythmic drugs (Cordarone) by IV followed by the oral route. Deep sternal wound infection occurred in 3(6%) patients: all of them were treated by omental flap. Reopening for bleeding occured in 4 patients (8%).

Group A: One of group A patients (2%) showed superficial forearm wound infection that was managed by selective antibiotic therapy and frequent dressing. None of our patients complained of ischemic hand complications. Reopening for bleeding occurred in 1 patient (2%) .The mortality and morbidity complications are displayed in table (6).

Event	Group A (LIMA+RA for LCA)	Group B (LIMA/ RIMA for LCA)	P value
Mortality	–	–	–
Morbidity			
• Attacks of Atrial fibrillation	-	4(8%)	-
• Superficial hand wound infection	1(2%)	-	-
• Mediastinitis.	-	3(6%)	-
• Reopening for bleeding.	1(2%)	4(8%)	-

Table (6): Postoperative morbidity and mortality complications

Discussion

In recent years, the policy used for choosing the "the proper conduit" for coronary revascularization has changed. Formerly, autologous GSV grafts were solely used. The development of progressive peculiar form of atherosclerosis in vein grafts (much slower and lesser in arteries) encouraged investigators to pay attention to arterial grafts.

The internal mammary artery (IMA) was the arterial graft initially used. More recently, other arterial grafts, e.g. radial artery, gastroepiploic artery and inferior epigastric artery were brought to join the collection of the arterial grafts utilized .

Implanting the left ITA to the left anterior descending coronary artery has been proved to be the golden standard and the fundamental part of the surgical procedure [11] and some reports have shown that long-term survival with both ITAs is better than that with a single ITA [12,13].

It was stated that the use of LIMA alone is not associated with increased incidence of sternal wound infection in patients with diabetes [2] ,the harvesting of bilateral LMAs (BIMA) was noticed to be associated with increased incidence (2.45 to6.9%) of sternal wound infection especially in elder diabetic, or obese patients [3,4]. Added to that, some surgeon expressed concern as to the fact that using bilateral ITA may be not practical for use because its harvesting increases operative time, and potentially increases morbidity rates and the technical complexity of the operation [14,15].

Many researches proved that use of bilateral IMA grafting doubles the odds ratio of risk compared with the use of a single mammary graft, whereas the combination of diabetes and double IMA grafts increased the odds ratio 13.9 fold [5,7].

Others added that the "in-situ" right internal mammary artery (RIMA) is shorter and usually does not reach the target arteries such as the posterior descending artery, the posterolateral left ventricular branches, and the obtuse marginal branches [4].

Others added that the free RIMA grafts to the right coronary artery have the limitation of lower long-term patency rates, about 75%when evaluated at a mean period of 94 months [5,7].

We like others [16-19] agree with the trend for limited use of bilateral IMAs in patients subsets at higher risk.

However, the need for arterial revascularization to the left coronary system with its well-reputed longevity in our relatively-young patients subset, led us to choose bilateral IMA grafts in group B cases. To minimize the vascular deprivation to the thoracic wall, we performed bilateral IMAs' skeletonization, Despite all that, group B cases showed a longer operative time, a longer ICU and hospital stay. Those patients needed longer convalescence before resuming their professional work following hospital discharge.

The negative effect alleged from using bilateral IMAs, have inspired many surgical groups in different centers to direct their research searching for other types of arterial graft as an alternative especially to the right ITA[19].

Following the revival of its use by Acar et al [9,14,20], the RA has gained popularity as a conduit of extended longevity ,for coronary bypass grafting and it is now considered by many surgeons as a valid option to the right ITA as a second arterial bypass graft [21].

According to Lemma et al[22], as well as many others[8,23-26], the RA is merited as an attractive arterial conduit due to many reasons: first its straightforward preparation not needing much dissection or retraction; second the fact that it is harvested simultaneously with the left ITA hence shortening total operative time; third it has thick vessel wall and large diameter facilitating needle-passage and easy performance of coronary anastomosis ; fourth it has enough length to accommodate sequential grafting for even distal targets; and fifth is that it negates bilateral sternal vascular deprivation) by harvesting bilateral IMAs)causing the potential of grave consequences of mediastinitis especially in elders and diabetics; and last avoidance of painful leg incision(s) is of much help as it allows early ambulations of the patient [8, 22 -27].

It has also been reported that composite grafts of LIMA and RA have higher free flows compared to LIMA flow alone[11]. The disparity of the arterial conduit size in relation to the aortic wall, was claimed responsible for the accelerated failure of

implantation[8]. The patency of the LIMA-Aorta anastomoses have been reported to range from 80 to 90% [16,17].In a trial to reach an effective and practical compromise, various composite arterial grafts combinations were used [9,14,16-18,20].One of them was the composite pedicle graft based on the proximal LIMA using the RA with its reported benefits [8].

Many surgeons [1-4], used LIMA pedicle to provide inflow for the RA coronary conduit. They reported a 91% patency rate with a T graft configuration; versus Calafiore and colleagues [9] who reported a 93% patency for anastomosis of the RA to the left ITA .

In our study , we choose ` to construct a composite LIMA-RA T-Y graft due to the RA's well-known ease of harvesting ,its favorable handling characteristics and the fact that it can be harvested simultaneously with the LIMA.

Other studies, provided evidence indicating that flow reserve of feeding LIMA (in composite grafts) might increase significantly with time [16,20], and that the surgeon would expect such subtle ischemia to improve and come down to good control.

Composite arterial conduits (branched, lenghthened, or both) constructed using one or both IMAs and RA was claimed to make them suitable to reach and revascularize all myocardial territories [9]. In this study, RA based proximally on the LIMA was used both to obtain adequate length (thus permitting revascularization with two arterial conduits), and to avoid anastomosis of the RA arterial conduit directly to the aorta. We share the concern of Calafiore and colleagues [9] that placement of what normally functions as a third or fourth order artery on the aorta could impose abnormal and potentially harmful sheer stress on the conduit.

The RA may be either used as an aortacoronary graft or, in order to extend as much as possible the number of distal targets, can be proximally anastomosed to the pedicled left ITA as a composite Y or T graft. Anastomosing the RA to the left ITA can bring the RA as much as 10 cm more closer to the coronary arteries, allowing it to reach most targets. This surgical strategy is more technically demanding than RA anastomosis to the ascending aorta and must be performed with extreme caution applying high accuracy and precision .Being usually performed on the pleural aspect of the left ITA, the process of anastomosing RA to target coronaries must avoid any degree of torsion along its path [8,23-27].

In group B, we used bilaterally skeletonized IMAs to revascularize the left coronary tree. This was associated with some negative aspects as was shown by detecting deep mediastinal infection in 3 of our "early" group B cases . On the other hand, no sternal complications occurred with the use of free radial artery (RA) grafts implanted on full-pedicle LIMAs as a combination for arterial inflow to left coronary artery branches. This supported the value of LIMA –RA combination in preserving blood supply to the right hemisternum (supplied by RIMA in group B patients)and thus reducing the incidence of postoperative mediastino-sternal infection [7].

Similar to the previous reports [9,14,16-18,20] , we performed the "RA-to-LIMA" T or Y anastomosis after the distal "RA to target coronary" anastomoses and during cardiac standstill by cardioplegic arrest. This provided our group ample chance to work in a more comfortable surgical field and to obtain a perfect RA and left ITA graft length between the T or Y anastomosis and their first coronary target, avoiding both the risk of kinking of the grafts and traction on the coronaries. We admit the fact that RA anastomosis to the ascending aorta is quite a simple procedure because its thick vessel wall and the large diameter of the aortic wall make the anastomotic procedure easy to perform, and avoid the previously mentioned technically more difficult consideration of RA-LIMA composite grafting. However, the advantage offered by avoiding the implantation of RA to the aortic wall (containing an atherosclerotic plaque or calcification), merits the price of an extra surgical effort. Moreover , It was reported that problems related to anastomosing a "thin walled "vessel to the "thicker " aortic wall ,may produce stenosis and thrombosis even with arterial grafts like right ITA [23,27],the inferior epigastric artery [24] and gastroepiploic artery [25].

The propensity to spasm of the RA is clearly related to the histologic structure of this vessel. RA is a "muscular" artery with a thick media layer in its wall [8,26,28]. This media contains a high density of leiomyocytes ready to escape through the fenestrated elastic lamina (helped by the undue mechanical trauma of stretching during harvesting/preparation) towards the lumen where it reacts by proliferation (in addition to the instantly-produced spasm) hence adding more to the reduction of the lumen size and further augmenting vascular occlusion [8].Therefore, harvesting a spasm –free RA is vitally important as its vascular endothelium secretes a number of EDRFs that play a role in vasorelaxation and inhibition of platelet aggregation [29].

In an attempt to overcome the tendency of the RA towards spasm [4], researchers reported the use of different pre and post harvesting solutions as systemic as well as local use of Calcium channel blocking drugs e.g : Verapamil [8]; VG solutions e.g: Hong-Kong university solution consisting of verapamil hydrochloride; Nitroglycerine; Heparine; and sodium bicarbonate/diluted within 10% Ringer's lactate solution [28]; and Papaverine/ warm blood mixture only-[26].In the present study, we preferred and used the Hong-Kong solution after He et al [4].

Owing to the well-known clinical and angiographic short and mid-term follow up results of the RA[8,28]. The present study shows that the composite way of using the RA does not influence perioperatively, early and mid-term clinical results. Perioperative myocardial infarction and low cardiac output did not occur concomitant to its use. Of special concern, was the finding that acceptable amounts of blood loss were detected in the postoperative period . This was not the case following bilateral IMAs where the more extensive chest wall dissection

resulted in more blood loss (and transfusion by whole blood and its products), in addition to the more prolonged mechanical ventilation, ICU and hospital stay times. The same findings were observed by others [8,23-27].

Supplying most of the coronary circulation through a single source of inflow may be worrisome and concerns about this technique center on the possible inefficiency of the left ITA to fully respond to the coronary system flow demand, particulary at short term after the operation. It has been shown however that soon after the operation the left ITA used as Y graft with the RA can efficiently adapt to increase in flow demand, keeping normal the O2 supply-to-demand ratio [30].Morever ,there is evidence that the flow reserve of the left ITA used as a composite graft increases after 6 months from the operation [29].Although others have cautioned against the potential dangerous effects of acute hypoperfusion resulting from inadequate left ITA flow [31],this was not a clinically evident problem in our study cases as none of our patients experienced any new postoperative attacks of anginal pain.

We, as well as many surgeons[21,22,27], believe that hypoperfusion is more likely related to technical errors, such as conduits injury or kinking than to inadequate flow reserve of the ITA. Postoperative follow-up of our patients by clinical and echocardiographic examination, showed a good graft-patency rate for LIMA-RA patients without any type of myocardial morbidity .Although AF occurred only in 4 of group B patients (8%), no myocardial ischemia was postoperatively observed.

The mean number of the distal anastomotic points performed (3±0.02 points in group A, versus 3±0.04 in group B) , was also compatibly reported by surgeons using the same graft combinations like Calafiore et al [9],who reported as 3.9±0.4 and 3.5± 0.2 per patient respectively, as well as Tector et al [32] who reported 3.1± 0.3 and 2.9±0.3 points respectively.

Study limitations

Our study has few limitations of including a relatively small number of male patients who were followed up for the short period spent during hospital stay.

Conclusion

We concluded that LIMA-RA composite grafts (as T or Y configuration) allowed safe and adequate arterial myocardial revascularization of the left coronary system, compared to composite skeletonized RIMAs(as T or Y configuration)in the early term. Our result supports the effectiveness and safety of its use and recommends its application in CABG surgery to improve the early surgical outcome.

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How Safe is The Reciprocating Saw For Sternal Re-Entry?

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Objectives: **Contrary to a prevailing practice advocating the use of an oscillating saw for safe sternal re-entry, some surgeons elect to use a reciprocating saw routinely for resternotomy. The aim of this work was to compare the incidence of saw-related injuries with both types of sternal saws during resternotomy.**

Methods: **Between March 2003 and April 2010, the practice of surgeons routinely using the reciprocating saw for resternotomy (Group 1, N=158) was retrospectively compared to the practice of those using the oscillating saw (Group 2, N=337). Our primary endpoint was the incidence of injury leading to catastrophic hemorrhage. This was defined as bleeding that necessitated urgent institution of cardiopulmonary bypass (CPB) through alternative cannulation strategies.**

Results: **The difference in the incidence of catastrophic injuries on sternal re-entry was not found to be statistically significant (0.6% in Group 1 versus 0.8% in Group 2, $p = 0.76$). Early mortality was comparable in both groups (10.1% versus 9.5 %, $p = 0.82$). None of the early deaths was saw related.**

Conclusion: **The reciprocating saw was used safely with results comparable to using an oscillating saw. Instead of promoting one particular type of saw, the emphasis should be directed to identification of patients at high-risk for injury, and implementation of necessary protective measures.**

Keywords: ***Reoperation, cardiac, sternotomy.***

Cardiac reoperations necessitating redo-sternotomy (RS) are associated with potential major complications. Injury to the heart, great vessels or previously implanted patent coronary bypass grafts can lead to massive hemorrhage and/or myocardial ischemia and infarction [1-5].

Given these potential risks, many techniques have been described to increase the safety of sternal re-entry. Most of the published reports however, share a common view that an oscillating saw should be used routinely to ensure a safe RS [1, 4,6-10]. The current paradigm gaining widespread acceptance among cardiac surgeons, demonizes the reciprocating saw in cases of RS without producing much supporting evidence. Against such notion, some surgeons continue to use the reciprocating saw in RS cases.

The purpose of this article is to compare the results of RS using a reciprocating saw against the results using an oscillating saw. The primary endpoint being examined is the incidence of injuries sustained on sternal re-entry resulting in catastrophic hemorrhage. Although the latter was previously defined as exsanguination requiring administration of blood products [2], like other authors, we found such a definition lacking in accuracy and elected to define it as bleeding that necessitated urgent institution of cardiopulmonary bypass (CPB) through alternative cannulation strategies [4].

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Material and Methods

1. Patient population and data

The study was approved as an audit by our institutional review board and individual consent was waived. Between March 2003 and April 2010, 513 consecutive redo

patients were identified in our prospectively collected cardiac surgery database. Patients' case notes were thoroughly reviewed for pre-operative characteristics as well as operative reports and post-operative complications. On reviewing the operative notes, any mention of an injury on sternal re-entry or initial dissection before cannulation was considered an injury. All injuries were recorded detailing the site of injury, whether it was related to sternal re-entry or to pre-pump dissection, and whether it resulted in a catastrophic hemorrhage. 17 patients were excluded due to RS within the same hospital admission or RS performed within less than 30 days of the previous sternotomy. Another case was also excluded because of institution of cardiopulmonary bypass (CPB) prior to RS, as a calcified pulmonary graft was judged to be firmly adherent to the back of the sternum on pre-operative CT. the remaining 495 patients were divided into two groups; Group 1 (N=158 patients) operated by surgeons routinely using the reciprocating saw for sternal re-entry and Group 2 (N=337) operated by surgeons using the oscillating saw.

The indication for reoperation was as follows: coronary artery bypass grafting in 121 patients (24.4%), valve procedure in 318 patients (64.2%), coronary bypass and a valve procedure in 23 patients (4.6%), aortic surgery in 13 patients (2.6%), other procedures in 20 patients (4 %).

Post-operative data collected included in-hospital mortality, myocardial infarction, re-exploration for bleeding, stroke, renal failure, deep sternal wound infection, duration of mechanical ventilation, use of inotropes, and length of ICU and postoperative hospital stay.

In-hospital mortality was defined as death within the same hospital admission regardless of cause. Post-operative myocardial infarction was defined as a new Q-wave in two or more contiguous leads on an electrocardiogram or significant rise in cardiac enzymes combined with hemodynamic and echocardiographic signs of myocardial infarction. Re-exploration for bleeding was defined as bleeding that required surgical re-operation after initial departure from the operating theatre. Post-operative stroke was defined as a new focal neurological deficit and/or comatose states occurring post-operatively, that persisted for > 24 hours after its onset and was noted before discharge. Renal failure was defined as patients with a post-operative creatinine level greater than 200 mmol/L or patients requiring dialysis.

2. Pre-operative evaluation

Preoperative contrast-enhanced computed tomography (CT) was only offered to patients with prior use of prosthetic patches and/or conduits involving the aorta or the right ventricular outflow tract, and patients with patent coronary bypass grafts.

3. Operative technique

In Group 1 the sternal wires were cut and removed. Superiorly blunt dissection was performed around the sternal notch with the finger. The linea alba was then divided for a few centimeters inferiorly from the xiphoid process. Upward traction was maintained on the xiphoid process and 5 to 6 cm of the retrosternal space was cleared of adhesions mostly by blunt dissection along the posterior sternal table. Prior to sawing the sternum, ventilation was stopped allowing the pleura and adjacent soft tissues to fall back away from the sternum. The sternum was then divided along the previously defined midline with a reciprocating saw (Aesculap AG, Tuttlingen, Germany) from the xiphoid upwards. At this point, two technical details are crucial to avoid injury to the underlying structures. The first is ensuring the saw is snugly lifted against the sternum and slightly tilted backwards. This allows the protective foot piece of the saw to further develop a safe plane retrosternally ahead of the sternal cutting. It also prevents the saw from cutting freely into any underlying soft tissue structures. Secondly, the saw is to be advanced in a to and fro motion rather than a continuous one to allow the protective footpiece of the saw to disengage from substernal adhesions creating a safe pathway for sawing. Following sternal division, hemostasis is achieved along the posterior aspect of the sternum and further dissection is carried out in the regular fashion.

In Group 2, the oscillating saw was used to divide both sternal plates while leaving the sternal wires in place until sternal sawing was complete.

4. Statistical analysis:

Data were entered and managed by a computerized database using the Statistical Package for Social Sciences for Windows (SPSS Inc, Chicago, Ill). Continuous data are presented as mean ± standard deviation. Intergroup comparison was done with the 2-tailed Student t-test and chi-square test for continuous and discrete variables, respectively.

Results

The median time between redo and previous operation was 155 months in the study population (80 months – 286 months). The preoperative and operative characteristics are summarized in Table 1. There was no statistically significant difference in preoperative characteristics between both groups except for a higher incidence of hypertension in Group 2. CPB times and aortic cross-clamp times were slightly longer in Group 2, however this still attained statistical significance. The proportion of patients deemed "high-risk" at sternal re-entry due to more than one previous sternotomy, previous mediastinitis, patent grafts was comparable in both groups; but there was a statistically significant difference in the number of patients requiring a right-sided intervention at the time of redo surgery (17% in Group 1 versus 5.6% in Group 2, p <0.01).

Injuries

44 injuries occurred in 36 (7.2%) patients. Most injuries (32 injuries, 72.7% of all injuries) occurred after sternal re-entry, and were not related to the use of the sternal saw. Catastrophic hemorrhage occurred in 11 cases (2.2%) patients with only four of these occurring during sternal re-entry. There was no statistically significant difference in the occurrence of any type of injuries between both groups (Table 2).

Table 3 shows the early outcomes in both groups.

	Group 1 (N= 158)	Group 2 (N= 337)	*P* value
Age	66.5 ± 9.7	64.8 ± 10.1	0.53
Males	103 (65.1)	216 (64.0)	0.79
Diabetes	39 (24.6)	85 (25.2)	0.90
Hypertension	83 (52.5)	134 (39.7)	0.04
Hyperlipidemia	92 (58.2)	184 (54.5)	0.54
COPD	22 (13.9)	51 (15.1)	0.72
PVD	15 (9.4)	34 (10.1)	0.83
Renal Impairment	21(13.2)	49 (14.5)	0.71
EF<30%	13 (8.2)	36 (10.7)	0.06
Previous myocardial infarction	40 (25.3)	89 (26.4)	0.79
Non-elective Surgery	44 (27.8)	98 (29.1)	0.77
Euroscore	11.0 ± 5.8	10.7 ± 6.2	0.60
More than 1 prior sternotomy	21(13.2)	52 (15.4)	0.53
Previous Mediastinitis	1 (0.6)	3 (0.9)	0.76
Patent Grafts at RS	19 (12.0)	33 (9.8)	0.54
Right-sided intervention	27 (17.0)	19 (5.6)	<0.01
CPB time (min)	138 ± 45	147± 39	0.02
Aortic Cross-clamp time (min)	92 ± 36	100± 43	0.03

Continuous variables are shown as mean ± standard deviation. Categorical variables are shown as number (%).

Table 1. Patient Characteristics.

	Group 1 (N=158)	Group 2 (N=337)	*P* Value
Saw-related Catastrophic Hemorrhage	1 (0.6)	3 (0.8)	0.76
Saw-related minor injuries	2 (1.2)	6 (1.7)	0.81
Non Saw-related Catastrophic Hemorrhage	2 (1.2)	5 (1.4)	0.74
Non-saw related minor injuries	9 (5.6)	16 (4.7)	0.63

Table 2. Injuries.

	Group 1 N = 158	Group 2 N=337	*P* value
Mortality	16 (10.1)	32 (9.5)	0.82
Re-exploration for bleeding	8 (5.0)	15 (4.4)	0.76
Myocardial Infarction	6 (3.7)	7 (2.0)	0.26
Stroke	5 (3.1)	8 (2.3)	0.66
Renal Failure	18 (11.3)	26 (7.7)	0.04
Deep sternal infection	2 (1.2)	5 (1.4)	0.84

Table 3. Postoperative morbidity and mortality.

Discussion

Despite interventional advances, the number of patients undergoing RS for cardiac reoperations continues to rise [12, 13]. RS remains a part of current cardiac surgical practice, and despite the large number of articles tackling the topic, the evidence supporting any particularly safe technique for sternal re-entry remains sparse. Early work recommended the use of a Lebshe Knife or reciprocating saw after partial sharp dissection of the retrosternal space [14]. Later, Garrett and Mathews reported the use of an oscillating saw with the sternal wires left in place, without incident in 50 patients [6]. The type of saw used for RS continued to be of relevance as other techniques like direct vision RS [11], institution of CPB prior to RS [15], or video assisted dissection [16], were variably adopted in limited numbers of patients. The actual benefit, and cost-effectiveness of such additions remain unclear [17].

The questionnaire circulated by Dobell and Jain was probably the first evidence of a changing paradigm embracing the oscillating saw for RS. The majority of responders preferred the use of an oscillating saw with only one out of 131 surgeons indicating a preference for the reciprocating saw [1]. Another questionnaire, showed that a larger number (153 out of 1116 surgeons) continue to use the reciprocating saw in RS, without further portrayal of the exact techniques used [2]. The reported higher incidence of injury on sternal re-entry, among these surgeons, is obviously subject to a multitude of potential bias.

Despite the lack of proper evidence to support such a notion, recent articles continue to recommend the oscillating saw as the standard tool in cases of RS [3, 4, 9, 10]. The actual incidence of adverse events with different types of saws is largely absent from the literature. Morales et al examined 12 retrospective studies and found an incidence of catastrophic hemorrhage of 0.5 -3.6% [17]. In parallel with these results, only 11 patients (2.2 %) in our series suffered catastrophic hemorrhage during RS. Despite a higher number of patients considered high-risk due to right-sided lesions requiring intervention, the rate of injuries in Group 1 remained comparable to Group 2. The different type of saw used in both groups did not seem to influence the incidence of any type of injuries during RS. Echoing the findings of other contemporary authors [5, 9], most major injuries (7 out of 10 injuries) occurred during pre-pump dissection rather than during sternal re-entry. The impact of injury on post-operative morbidity and mortality continues to be debatable [4, 9]. Because of the relatively low incidence of catastrophic hemorrhage in our series, further statistical analysis of its impact on post-operative outcome would have lacked adequate power. The single incidence of saw-related catastrophic hemorrhage in Group 1 involved the right ventricle while the three incidences in Group 2 involved the right atrium (2 patients) and the right ventricle (one case). Catastrophic hemorrhages that occurred after sternal re-entry (7 cases) involved injury to the left innominate vein (3 cases), injury to the aorta (2 cases), injury to the right ventricle (2 cases). Only 2 out of the 11 incidences of catastrophic hemorrhage resulted in a mortality. Both injuries were non- saw related. The first occurred in a patient belonging to Group 1 with an injury to the left innominate vein. The second occurred in a patient belonging to Group 2 with an injury to the aorta. All other injuries were salvaged. Among patients sustaining injury to patent grafts, only one patient who sustained injury to a patent left internal mammary graft suffered a non-fatal myocardial infarction and was discharged home on the 9th postoperative day without further complications. The incidence of mortality and major complications was comparable in both groups, with the exception of a higher incidence of renal failure in Group 1 (Table 3). Despite the low incidence of mortality related to catastrophic hemorrhage, the in-hospital mortality was relatively high (9.6%) in our series. This is probably explained by the pre-operative characteristics of these patients who represent a higher risk group. The mean Euroscore in the studied patients was 11.0 in Group 1 and 10.7 in Group 2, with a large proportion of these patients undergoing non-elective surgery (Table 1).

In view of the available literature, it seems reasonable to assume that the type of saw used for RS is a parameter of minor influence on the occurrence of injury during sternal re-entry. In cases where the aorta, right ventricle or patent bypass grafts have become firmly adherent to the back of the sternum, injury would likely occur whether an oscillating or a reciprocating saw is being used as a routine even with adequate experience and attention to technical details. The technical tips permitting the safe use of reciprocating saws in RS as detailed in our operative techniques, have been previously reiterated by Diethrich, as he narrates how the reciprocating saw was being originally developed to avoid injury of the dura mater during craniotomy [18]. Other factors such as multiple previous re-sternotomies, a patent internal mammary artery graft, or history of mediastinal radiotherapy, seem more important variables as predictors of injury at time of RS [5].

Attention should thus be directed to identification of these high-risk patients and instituting protective measures preemptively, specially when rescue measures at the time of injury largely depend on the experience of the operator, and are often unsuccessful [5, 9]. In this regard, pre-operative CT is proving to be a useful tool allowing optimum planning of redo operations [19]. Future studies should further define the value of various protective strategies and their role in decreasing the incidence of injury or the adverse outcomes associated with it.

There are some limitations that are inherent to this report. As with any retrospective study, it is likely that only injuries that were judged to be severe enough by the operating surgeon were recorded in the operative report. The decision for or against instituting urgent CPB at the occurrence of injuries as well as the timing of such a decision is a product of surgical experience and may have affected outcomes. Another important limitation is that even with careful examination of patients' case notes, identifying whether any protective measures such as pericardial closure at the first operation, was not possible in most cases.

In conclusion, the use of the reciprocating saw in cases of RS is not associated with an elevated risk of injury or catastrophic hemorrhage. In our experience, most injuries occurred during pre-pump dissection, rather than at the time of sternal re-entry. Consequently, instead of promoting one particular type of saw, it would seem more beneficial to emphasize the importance of identifying patients at high-risk for injury in whom necessary protective measures should be implemented.

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Impact of Previous Stenting on The Outcome of CABG In Multivessel Disease

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Aim of the study: **To determine if previous coronary stenting has an impact on the outcome of subsequent CABG.**

Materials and methods: **Between May 2009 and January 2011, 200 patients who were candidate for CABG, were prospectively divided into two groups Group A had previous PCI (n = 100, mean age 52.9 ± 7.6 years, 27 women) and Group B (n = 100, mean age 57.2 ± 8.5, years 10 women) had no prior PCI. Group A patients presented with higher incidence of previous MI (p value=0.001) and higher mean NYHA class (P = 0.012).**

Results: **In Group B there was higher mean total number of grafts (P value=0.001) and higher incidence of total revascularization (P value=0.001). In Group A there was a higher incidence of inotropic support usage (P value = 0.001), incidence of arrhythmias (P value = 0.026), incidence of bleeding (P value = 0.002), wound infection (P value = 0.002) and the mean hospital stay (P value = 0.001). Postoperative echo after 3 months showed , more improved parameters of myocardial function in Group B, as evidence by statistically significant more decrease in LVEDD (P<0.001) and LVESD (P=0.015), a significant more improvement in LV paradoxical motion (P<0.001) as well as a non-significant improvement in LVEF %.**

Conclusion: **Prior PCI increases the morbidity and reduces the improvement of cardiac function after subsequent CABG in multivessel disease patients.**

Since the introduction of percutaneous coronary intervention (PCI) for treatment of coronary artery disease (CAD), there has been a shift from its primary indication for isolated single vessel lesion to multivessel disease. (1) Moreover with increased experience, aggressive repeated PCI therapy has become more common. Results from randomized controlled trials and registries comparing PCI and coronary artery bypass graft (CABG) have shown that PCI is inferior to CABG as regards the need for repeat revascularization and recurrence of angina particularly in patients with diabetes mellitus and complex triple-vessel disease even in the era of drug eluting stents (DES). (2,3,4,5,6,7) Combining the previous facts, will conclude that there is an increasing number of patients with multivessel or triple-vessel disease in whom PCI is initially performed before subsequent CABG. There is some evidence that previous PCI has a negative impact on subsequent CABG (8, 9, 10), however this topic needs further investigations especially on the impact of PCI on the complexity of coronary disease. We therefore sought to determine whether previous PCI has a prognostic impact on surgical outcome of subsequent CABG.

Materials and methods

This study included 100 patients who benefited from CABG after successful primary PCI (group A) and 100 patients who benefited from primary CABG (group B) at Eldemardash hospital, Ain shams specialized hospital and National heart institute, in the period between May 2009 and January 2011. In group A, 46 patients benefited from bare metal stent and 54 patients benefited from DES. The number of implanted stents varied from 1 to 5 (1.89 $\pm$ 0.8 stents), with 36 patients benefited from 1 stent, 45 patients benefited from 2 stents, 16 patients from 3 stents, 2 from 4 stents and only 1 patient benefited from 5 stents. Common to both groups, our inclusion criteria were: patients age between 40 and 70 years, of both sexes, undergoing CABG for multi-vessel

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disease, with or without the need for surgery for ischemic mitral valve disease. Redo cases, cases presenting with organic valvular heart disease, patients undergoing CABG for single vessel disease as well as those patients needing emergency CABG after failure of PCI were excluded from this study.

	Patient groups		P value*
	A (100 patients)	B (100 patients)	
Age (years)	52.9± 7.6	57.2± 8.5	0.001
Female sex	27	10	0.002
DM	59	61	NS
Hypertension	37	27	NS
Dyslipidemia	39	47	NS
Smokers	49	49	NS
Family history of ischemic heart disease	15	10	NS
Previous MI	68	24	0.001
Recent MI	6	7	NS
Previous HF	0	2	NS
Left main disease	19	11	NS
Syntax score	18.8 ± 7.2	20.68 ± 7.6	NS
Euro score	2.1 ± 2.2	2.8 ± 5.4	NS
Preoperative Shock	2	0	NS
Unstable Angina	13	14	NS
Number of diseased vessels	3.3 ± 0.5	3.5 ± 0.5	NS
Ischemic MR	37	40	NS
NYHA FC	1.86 ± 0.94	1.55 ± 0.88	0.012
CCS FC	2.2 + 0.85	2.15 + 1.1	NS
Chronic renal impairment	7	2	NS
COPD	9	10	NS
Pulmonary hypertension	5	1	NS
Peripheral arteriopathies	6	16	0.027

*Values are presented as numbers (%) or mean ± SD. *= Chi-Square test / Fisher's exact test or unpaired Student's test, as indicated.*

Table 1: Comparison of preoperative variables between both groups: Group A undergoing primary CABG and group B undergoing CABG after PCI

As shown in Table 1, patients' demographic criteria and risk factors were comparable between both groups, with the exception of group A patients being significantly younger and including more females; compared to group B patients. However, patients with primary PCI presented in a more significantly advanced NYHA class, included significantly more patients with previous MI and a non-significant higher proportion of left main disease. On the other hand, group B patients had significantly higher proportion of peripheral arterial disease, compared to patients in group A. Angiograms were scored according to the SYNTAX score algorithm (www.syntaxscore.com)(11) by the Angiographic Core Laboratory (Cardialysis BV, Rotterdam, The Netherlands). Although SYNTAX score is statistically comparable in both groups preoperatively, the mean SYNTAX score in group A has increased from 10.96±6.28 in angiograms before PCI to 18.8±7.2 in angiograms before CABG. Also, it worth mentioning that when comparing pre PCI and pre CABG SYNTAX score, we have noticed that 20 patients have moved from low score category to intermediate and high score category after PCI. (Table 2)

Syntax score	Group A		Group B
	Pre stent (100 patients)	Preoperative (100 patients)	Preoperative (100 patients)
Low (0-22)	92	72	63
Intermediate (22-32)	8	24	29
High (>32)	0	4	8

Values are presented as numbers

Table 2: Number of patients in each category of SYNTAX score in both groups: Group A undergoing primary CABG and group B undergoing CABG after PCI

An echo was done within one month preoperatively, before discharge and 3 months after the operation. Table 3 shows the preoperative echocardiographic data, with group A patients showing significantly larger LVEDD, compared to group B patients. Other echocardiographic data; including LVESD, EF% and LV systolic wall motion abnormality were comparable between the 2 groups.

According to the surgeon's preference, patients were either operated with OPCAB with *ACROBAT™ Mechanical Stabilizer System* or under routine CPB with mild hypothermia and repeated infusions of antegrade warm blood cardioplegia. In all patients, the Left internal mammary artery was used to graft an Omni present LAD lesion. Total arterial revascularization was attempted whenever feasible, with the use of the right internal mammary artery and/ or radial artery of the non-dominant hand; otherwise additional coronary lesions were grafted with a suitable venous conduit. Patients with grade 3-4 ischemic mitral regurge were planned to benefit from mitral valve repair. Operative and postoperative data are presented in Table 4.

Statistical analysis

Data are presented as number, (%) or mean ± SD. The distribution of categorical data was compared with Chi-Square test or Fisher's exact test, as indicated. Means were compared with unpaired Student's test, as indicated. The means of the differences of recorded echocardiographic data (LVEDD, LVESD and EF %) were compared using unpaired Student test too. On the other hand, amelioration of LV systolic wall motion abnormality after surgery was compared in the 2 groups using the non-parametric McNemar test. A P value of ≤0.05 was considered as a limit of statistical significance. SPSS 19 statistical package was used for data analysis.

Results

As shown in Table 4, and compared to group A, Group B patients benefited from significantly higher number of grafts, total revascularization as defined by grafting all stenotic vessels greater than 1.5 mm and/or all stenotic main-branch vessels, was achieved in only 129 patients (64.5%): 50 patients in group A (50 %) and 79 patients in group B (79%) (P<0.001). Also, total arterial revascularization was achieved in 19 cases (9.5%): 1 patient in group A (1%) and 18 patients in group B (18%) (P<0.001). In addition, 4 patients with grade 3-4 mitral regurge benefited from annuloplasty using Mitral annuloplasty ring (Carpentier-Edwards Classic) (Edwards Life sciences, Irvine, Calif.) size 28 mm. In group A, more patients needed positive inotropic support, were re-explored for bleeding, developed superficial as well as deep wound infection, stayed for longer time in hospital and suffered from more incidences of arrhythmias compared to group B patients. Other operative and postoperative variables, including mortality and other morbidity figures were comparable between both groups of patients (Table 3).

As shown in Table 3, parameters of myocardial function were more improved in group B patients, as evidenced by statistically significant more decrease in LVEDD (P<0.001) and LVESD (P=0.015), a significant more improvement in LV paradoxical motion as well as a non-significant improvement in LVEF %, compared to group A patients (Table 3).

	Patient groups		P value*
	A (100 patients)	B (100 patients)	
LV ESD (cm)			
1) Preoperative	3.66 ± 0.8	3.86 ± 0.95	NS
2) Postoperative	3.5 + 0.76	3.45 + 0.75	NS
3) Mean of the difference	0.12 + 0.57	0.34 + 0.64	0.015
LVEDD (cm)			
1) Preoperative	5.2 ± 6.5	4.95 ± 0.9	0.21
2) Postoperative	5.1 ± 0.65	4.45 ± 0.98	0.001
3) Mean of the difference	0.11 ± 0.6	0.48 ± 0.67	0.001
EF%			
1) Preoperative	57 ± 9.1	54.57 ± 11.3	NS
2) Postoperative	58.3 ± 7	60 ± 5.67	NS
3) Mean of the difference	1.32 + 6.8	4.1 ± 9.1	NS
Paradoxical systolic motion			
1) Preoperative	58	45	NS
2) Postoperative	44	16	0.001**

*Values are presented as numbers (%) or mean + SD. *= Chi-Square test / Fisher's exact test or unpaired Student's test, as indicated, ** = McNemar test.*

Table 3: Comparison of echocardiographic data between both groups: Group A undergoing primary CABG and group B undergoing CABG after PCI

	Patient groups		P value*
	A (100 patients)	B (100 patients)	
Number of grafts:	2.47 ± 0.85	3.12± 0.73	0.001
a) Number of arterial grafts	1.07 ± 0.3	1.24 ± 0.5	0.001
b) Number of venous grafts	1.39 ± 0.9	1.89 ± 0.7	0.001
Total revascularization	50 (50%)	79 (79%)	0.001
Total arterial revascularization	1 (1%)	18 (18%)	0.001
Mitral valve repair for ischemic MR	0	4	NS
Surgical technique:			
1) OPCAB	35	27	
2) CPB	65	73	NS
ACC time (minutes)	62.7 ± 28.1	68.7 ± 25.6	NS
CPB time (minutes)	91.2 ± 42.6	102.1 ± 33.8	NS
Perioperative MI	18	17	NS
Use of positive inotropes	62	40	0.001
Use of IABP	13	11	NS
Duration of mechanical ventilation	13.2 ± 12.7	10.24 ± 11.9	NS
Arrhythmias	21	10	0.026
Postoperative heart failure	11	13	NS
Neurological complications	2	1	NS
Renal impairment	7	2	NS
Endocarditis	0	2	NS
ICU stay (days)	2.9 ± 1.44	3.4 ± 4.5	NS
Death	6	7	NS
Exploration	25	9	0.002
Endocarditis	0	2	NS
Dehiscent sternum	5	10	NS
Superficial wound infection	35	18	0.004
Deep wound infection	15	3	0.002
Organ failure	2	2	NS
Hospital stay (days)	11.3 ± 3.8	9.3 ± 3.8	0.001

*Values are presented as numbers (%) or mean + SD. *= Chi-Square test / Fisher's exact test or unpaired Student's test, as indicated.*

Table 4: Comparison of operative and postoperative variables between both groups: Group A undergoing primary CABG and group B undergoing CABG after PCI

Discussion

PCI is often preferred over CABG for its "less invasiveness" especially when both procedures are justified. This choice is reinforced by the belief that patients can be referred to surgery after PCI without a negative impact on subsequent CABG. However there is now cumulating evidence that prior PCI has a negative impact on subsequent CABG. It is associated with a higher early mortality (12,13) morbidity (12) and MACE rate (9,11,14) with impaired long-term outcome and quality of life (9) and with more unstable angina requiring hospitalization and repeated coronary revascularization during follow-up (8). Also it has been found to be associated with increased mortality and morbidity and reduced 2 years survival in diabetic patients. (15)

In the current study, although patients with previous PCI appears to have more advanced disease as evidenced by advanced NYHA class and more previous MI, all parameters of myocardial function were more improved after surgery in patients who underwent CABG without previous stenting. The operative results showed less total and arterial revascularization in previous PCI patients. Also, the postoperative outcome in the stent group was inferior to patients who underwent CABG without previous PCI as evidenced by higher rate of overall morbidity, usage of inotropes, arrhythmias, reoperation for bleeding and wound infection. The hospital stay was also significantly higher in stent group. However, our results showed similar rates of in-hospital mortality between the two groups.

Although statistical correlation does not imply causation, yet there are several rational hypotheses to explain the results. Peri-procedural infarction during previous PCI (16) may be the cause for higher incidence of preoperative MI and preoperative higher NYHA class in the stent group. PCI procedures initiate a sequence of local inflammatory reactions which lead to poor targets for grafting and this may explain less total revascularization and less number of grafts in the stent group. (17) Coagulopathy from adjunctive anti-platelet therapy especially after DES may explain higher incidence of re-exploration for bleeding in Group A.(18) There are other explanations to explain negative impact of stents on CABG as grafts being performed more distally due to the presence of stents (9), instent restenosis is associated with a higher risk of early venous graft failure (19), post stenting structural changes affecting the stented area and the coronary artery section distal to the stent which would be the target area of a subsequent bypass graft anastomosis. (17) These explanations are summarized and classified into intrinsic pathophysiology, acquired pathophysiology and technical sequelae by Rao and colleagues. (20)

To our knowledge this is the first study to use SYNTAX score in comparing the complexity of coronary disease between patients who underwent CABG without previous stenting and with previous stenting. Although there were no statistical differences between the two groups preoperatively, the results showed that after PCI patients where shifted to the intermediate and high risk score categories which means that when patients are referred for surgery after PCI they seem to have a more complex coronary disease and this might be one of the reasons for negative outcome of PCI on subsequent CABG. Moreover, this negative impact is more manifested with DES.

DES use is associated with increased risks of both early and late stent thrombosis, as well as death and MI. (21) DES impair endothelialization, leaving a potentially prothrombotic substrate within the vessel (22) and leave a further conflict for the surgeon in terms of control of antiplatelet medication and whether to perform bypass grafts to a coronary vessel with a DES without critical restenosis in patients who have multivessel disease.(23) In our study Group A patients included patients who had DES but in further study BMS could be compared with DES regarding their impact on subsequent CABG.

Although, we have not compared cost in our study, the fore mentioned clinical concerns are compounded by cost implications; not only are DES significantly more expensive than BMS, but new recommendations that patients remain on clopidogrel for at least a year, and possibly indefinitely, add significantly to overall costs.(23)

The conclusion from the findings that prior PCI increases the risk of subsequent CABG is to add to the supply of data against the false belief that CABG can always be safely postponed after an initial PCI in multivessel disease and any cardiac intervention especially in multivessel disease should be discussed by a multidisciplinary team including a surgeon rather than by the individual cardiologist.

Study limitations

This study has several limitations. It has been designed as a consecutive, observational, multicenter investigation. The number of enrolled patients limits the explanatory power of our study. Selection of patients of both groups may introduce an underlying bias .Finally we limited our analysis to short-term outcomes.

Conclusion

Prior PCI increases the morbidity and reduces the improvement of cardiac function after subsequent CABG in multivessel disease patients.

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Efficacy & Mid-term Results Of LIMA-LAD Coronary Revascularization after Endarterectomy; Versus LIMA On-lay Patch Reconstruction in CABG Surgery For Diffusely Diseased LAD

Tamer Farouk MD.

Background: **Surgical revascularization of patients having diffusely-diseased LAD vessel is a surgical challenge. Some surgeons perform LIMA-LAD anastomosis after LAD endarterectomy; while others prefer to implant LIMA as a long On-Lay patch only. The efficacy of using either techniques as an appealing alternative is still under debate and remains unsettled. In this study, we comparatively studied and evaluated our results in using both techniques to revascularize diffusely-diseased LAD. The study goals were surgical reproducibility, as well as mortality and mid-term postoperative morbidity.**

Patients and Methods: **This prospective comparative study was carried out starting from November 2006-untill-November 2009, in Kasr El Aini's University Hospitals, as well as other hospitals after the approval of the local ethical committees. The study encompassed 60 CABG patients who had IHD with diffusely-diseased LAD coronary vessel among other coronary atherosclerotic lesions. Patients were allocated in two groups well matched for age, sex, coronary lesions, as well as other preoperative parameters of surgical risks. All patients were submitted to elective surgery for coronary artery bypass graft surgery using cardiopulmonary bypass and warm antegrade intermittent blood-cardioplegia. In group A (30 patients) LIMA-to-LAD was done after LAD Endarterectomy; whereas in group B (30 patients) LIMA was implanted for LAD reconstruction by an "on-lay patch". Patients were followed-up for event-free survival over immediate and mid-term periods from 2009 till 2011 by clinical examination and echocardiography.**

Results: **Our statistical data analysis showed no statistical significance between the results of both groups as to surgical data (mean operative time, mean CPB time, mean aortic occlusion time), mean number of anastomotic points reconstructed; number of blood units transfused; and ease of weaning off-CPB. There was also no differences of statistical significance concerning ICU stay time (mean time for postoperative mechanical ventilation, inotropic support); and hospital stay time. There was no mortality in the study group. No patient suffered from postoperative myocardial infarction, CHF, or neurological complications. Overall non-fatal morbidity complications occurred in 10 patients (16.6 %). Morbidity in the Endarterectomy group (A) occurred in 6 patients (20%) as: reopening to hemostase bleeding in 2 patients (6.6%); reopening for subxiphoid closed system drainage of pericardial effusion in 1 patient (3.3%); prolonged ICU ventilation (for 27 hours) in 1 patient (3.3%); Intercostal tube thoracostomy for meta-pneumonic haemorrhagic pleural effusion in 1 patient (3.3%); delayed surgical debridement of an infected wound in 1 patient (3.3%). Morbidity in the LIMA patch group (B) occurred in 4 patients (13.3 %) as AF in 2 patients (6.6%); frequent recurrent episodes of supraventricular tachycardia in 1 patients (3.3%), all were medically controlled by antiarrhythmic drugs using Amiodarone by IV then oral routes; and re-admission for removal of painful sternal stainless steel wire in 1 patient (3.3%).**

Conclusion: **Our data analysis did not show any results of statistical significance in CABG surgery as to the efficacy of using LAD Endarterectomy compared to LIMA on-lay patch. Both techniques were safe and achieved adequate LAD revas-**

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cularization with no mortality and acceptable immediate postoperative and 2-years midterm follow-up.

KEY WORDS AND ABBREVIATIONS: IHD: Ischemic Heart Disease; CAD: coronary artery disease; LAD: Left Anterior Descending; LIMA: Left Internal Mammary Artery; MI: Myocardial infarction; CHF: Congestive Heart Failure; CE: Coronary Endarterectomy; CABG: Coronary Artery Bypass Grafting; CPB: Cardiopulmonary Bypass; OLPR: On-lay patch reconstruction .

Recently, the profile of the patient who is referred for coronary artery bypass grafting (CABG) is continuously changing being under the control of different factors like old age; concommittant comorbidities (diabetes, hypertension, heavy cigarette smoking, COPD, peripheral vascular disease) as well as diffuse coronary artery atherosclerosis [(1),(2)]. The performance of one or more surgical or catheter-based revascularization procedures, is the reason behind the increased number of patients present with advanced stage and diffuse CAD [(3),(4)]. It is because of these diffuse plaques, that vessels may not be graftable, and complete revascularization using conventional techniques may not be feasible [(5),(6)].

Incomplete revascularization may adversely affect short- and long-term outcomes [(1),(4-6)]. Coronary endarterectomy (CE) has been utilized as an adjunct to CABG in this patient subset to afford complete revascularization [(3),(6)]. However, many surgeons are still reluctant to use this technique because of previously reported increased postoperative mortality in the range of 3.2% to 10%, and myocardial infarction (MI) rates of 4% to 15%, as well as uncertainty regarding its long-term clinical efficacy [(6-9)].

However, CE was accused of carrying higher perioperative risks and inducing poorer long-term survival [(10)] , in addition to being a technically challenging procedure even when cardiopulmonary bypass (CPB) is used. Consequently, different surgeons recently adopted different means of LAD reconstruction using long-segmental anastomosis techniques have been introduced in this special subgroup of patients to afford complete myocardial revascularization [(10)].

Another point of view reporting the early results of LIMA on-lay patch reconstruction [(11-15)] suggested that this approach is comparable with conventional bypass techniques, and only a limited number of studies have reported the clinical outcomes, patency rates, and the incidence of cardiac-related events at long-term follow-up. Furthermore, the heterogenous nature of the patient populations in different studies renders more difficult the interpretation of the results and confuses the data analysis.

Objective: In this study, we comparatively studied and evaluated our results in using two techniques to revascularize diffusely-diseased LAD,LIMA to LAD after endarterectomy vs. LIMA to-LAD on-lay patch. The study goals were surgical reproducibility, as well as mortality and mid-term postoperative morbidity.

Patients and Methods

Patient population and Characteristics

This study is a comparative prospective study which included 60 IHD patients with diffusely-diseased LAD coronary vessel among other coronary atherosclerotic lesions. All patients were submitted to elective surgery for coronary artery bypass graft surgery within the time period from November 2006 till November 2009, in Kasr El Aini's University Hospitals, as well as other hospitals. All surgeries were done using cardiopulmonary bypass and antegrade intermittent warm blood-cardioplegia after obtaining the consent of the local ethical committees.

Criteria of inclusion: Presence of multi-vessel ischemic heart disease with diffusely-diseased LAD (as evident by angiocatheterization).

Criteria of exclusion: Presence of recent MI; congestive heart failure (CHF); left ventricular ejection fraction (LVEF%) ≤ 40 %; and presence of associated pathology eg: valvular disease, myocardial aneurysm…etc).

Patient groups

Patients were allocated in two groups well matched for age, sex, coronary lesions, as well as other preoperative parameters of surgical risks.

Group A (30 patients): CABG with LIMA-to-LAD was done after LAD Endarterectomy

Group B (30 patients): CABG with LIMA implanted for LAD reconstruction by an "on-lay patch".

Follow-up:

Patients were followed-up for event-free survival over immediate and mid-term periods from 2009-till-2011 by clinical examination and special investigations as needed especially ECG and echocardiography.

Statistics

Preoperative and postoperative data were gathered in table forms, then expressed as means ± SD. The Kaplan-Meier method was used to analyze actuarial survival and freedom from angina. Statistical analysis was performed using SPSS software (release 12.0.1 for Windows; SPSS, Chicago, Illinois). Statistic significance was assumed if a p value of 0.05 or less was achieved. The preoperative Demographic Data of the Study Patients are demonstrated in (Table1).

Variable	Group A (n=30) (CABG + CE)	Group B (n=30) (CABG + Onlay patch reconstruction)	p Value
Patient Number:	**30**	**30**	
Age (years)			
- Mean	54 ± 0.2	57± 0.1	0.34*
- Range	37 - 66	42 – 64	-
Female sex %	13 (**43**%)	16 (53%)	0.23*
Family history of IHD	14 (46%)	17 (56%)	0.51*
Previous MI	9 (30%)	6 (20 %)	0.53*
Unstable angina	10 (33%)	7 (23 %)	0.44 *
Mild MR	5 (16%)	4 (13%)	0.34*
Diabetes Mellitus	11 (36%)	9 (30 %)	0.67*
Ex-Cigarette smoking	26 (86%)	23 (76%)	0.14*
Hypertension	14 (46%)	19 (63%)	0.45*
Hypercholesterolemia	17 (56%)	13 (43%)	0.66*
Trunkal Obesity	19 (63%)	17 (56%)	0.78*
Previous Cerebral stroke	4 (13%)	6 (20%)	0.88*
COPD	5 (16%)	8 (26%)	0.44*
Peripheral vascular disease	4 (13%)	6 (20%)	0.22*
LV Ejection Fraction %			
- Mean	42 ± 1.1	41 ± 0.2	0.33*
-	-		
Left Coronary System	***30* (100%)**	***30* (100%)**	0.22*
- Left main artery	7 (23)	6 (20 %)	0.34*
- Left anterior descending artery	30 (100 %)	30 (100 %)	0.55*
- Left circumflex artery	16 (53 %)	12 (40 %)	0.12*
- Diagonal artery	6 (20 %)	7 (23 %)	0.45*
- Intermediate Trunk	3 (10 %)	6 (20 %)	0.33*
Right coronary artery	**17 (56 %)**	**13 (43%)**	**0.44***
- Main trunk	7 (23 %)	5 (16 %)	0.14*
- Posterior descending branch	5 (16 %)	6 (20 %)	0.61*
- Posterolateral branch	5 (16 %)	2 (6 %)	0.56*

**: Data is not statistically-significant*

Table 1. Preoperative Patient Characteristics

Definitions used for preoperative surgical decision-making (STS registry's definition[1].

(1) **Limiting (Unstable) Angina**: Patients undergoing either stenting or surgical bypass were assumed to have had limiting angina at least six weeks before the procedure, hence incurring a disutility that is correctable by surgery according to thallium studies [1].

(2) **MI**: Requires 2/3 criteria: (1) ischemic symptoms ± chest discomfort; (2) enzyme level elevation and (3) serial (2 or more) ECG showing changes from baseline or serially in ST-T waveforms or new Q-waves [1].

(3) **Poor distal Run-off:** Presence of severely limited distal flow (run-off) (vessel diameter<1 mm) determined at preoperative angiogram or intraoperatively. It usually precludes the use of an extended anastomosis technique (on-lay patch), and these patients underwent a coronary endarterectomy procedure [1].

(4) **Coronary Endarterectomy (CE)**: Selected for vessels with a pre-endarterectomy outer diameter of 1.5 mm or greater (expecting a post-endarterectomy luminal diameter ≥ 1.5 mm), supplying viable muscle with evidence of reversible ischemia, and in which diffuse atherosclerosis prevented satisfactory distal anastomosis. The final decision to endarterectomize a vessel was made intraoperatively based on the surgeon's own technical considerations. Complete occlusion on angiogram was not considered a definite indication for endarterectomy. Coronary endarterectomy was considered when no adequate segment of a vessel,

supplying viable muscle with reversible ischemia, was suitable for grafting. Apparently patent and therefore graftable segment on angiogram was on occasion found unsuitable due to severe narrowing or heavy calcification precluding effective anastomosis. Endarterectomy of the diseased vessel was only performed when the artery was completely or nearly occluded with heavily calcified plaques and long stenotic segments extending distally [3-7].

(5) **Extended Coronary artery reconstruction (On-lay patch):** defined as performing CABG anastomosis when there were extensive atheromatous plaques downstream from the first major proximal lesion. As reported by Fukui and colleagues the length of a long-segment anastomosis should be at least 2 cm. Generally, the determination of multiple stenosis downstream from the first major proximal lesion at the preoperative angiogram is an indication for performing a long-segmental LAD reconstruction. In some patients, however, especially those with spiral plaques, the preoperative angiogram may not be helpful and the decision is made intraoperatively for these cases [12].

(6) **Operative mortality:** Death occurring during hospitalization in which surgery took place within 30 days[1].

Surgical Techniques

(1) **Surgical revascularization (standard CABG):** In all patients, a midline sternotomy was started with followed by aortic root and common atrial cannulation to institute cardiopulmonary bypass. Distal anastomoses are done on a silent heart obtained by intermittent blood-enriched cardioplegia with a full dose before each distal anastomosis is done. A warm K-free dose of plegia (Hot Shot) is finally-given in the aortic root after LIMA-LAD anastomosis is secured patent. After regaining of myocardial contractility, proximal anastomoses were done on a beating heart aided by side-occlusion clamp.

(2) **Technique for Coronary Endarterectomy**: An arteriotomy "tailored-to-need" was performed (averagely 1-2 cms). The dissection plane between the atheromatous plaque and the adventitia was then developed using a fine spatula. Using continuous traction, the plaque was dissected proximally and distally and removed. The plaque was endarterectomized proximally as far as possible, especially if there was total occlusion. In cases of moderate (50% to 75%) occlusion, care was taken to sharply divide the proximal end of the LAD's plaque. The proximal extent of the endarterectomy was limited, and usually the plaque was divided 1 to 2 cm proximal to the anastomosis site. The specimen was inspected carefully, ensuring a smooth tapering distal end. If the distal end was irregular, or a residual plaque was felt to remain in the distal vessel, the arteriotomy was enlarged as necessary to allow complete removal of the plaque, converting the endarterectomy to an "open" technique. The endarterectomized vessel was irrigated was heparanized saline to remove residual small particles. LIMA was directly anastomosed to the endarterectomy site after being appropriately longitudinally-split. Antiplatelet agents (mostly aspirin) were started 6 hours postoperatively in all patients, in addition warfarin was used for six months postoperatively.

(3) **The Extended LAD Reconstruction (On-lay patch):** A pedicled LITA graft was used to reconstruct the LAD in all patients. A long superficial arteriotomy (≥ 2cms) was made along the diseased LAD, and the length of incision was decided at the operation. The tip of the arteriotomy incision was extended to the disease-free distal portion of the vessel. The LAD was also opened proximally until the healthy part of the vessel was reached. The LAD was not opened at the level of the first proximal lesion. The LIMA was then opened longitudinally, adjusting its length to the length of the LAD arteriotomy. Long-segmental LAD reconstruction was performed by covering the LAD arteriotomy with LIMA as an on-lay graft by using continuous, 7-0 polypropylene suture [8-13]. The presence of severely limited distal run-off (< 1 mm) determined at the preoperative angiogram or intraoperatively usually precludes the use of an extended anastomosis technique, and these patients underwent a coronary endarterectomy procedure [16].

Results

Operative Data: There was no statistical significance between the results of both groups as to surgical data (mean operative time, mean CPB time, mean aortic occlusion time), mean number of anastomotic points reconstructed; and ease of weaning off-CPB.

Anticoagulation and Platelet Inhibition

Our postoperative anticoagulation protocol was similar to other surgeons [14,15], consisting of lifelong baby aspirin (75 mg) 2 tablets single daily dose after a meal combined with warfarin for six months to keep INR around 2 in CE patients (group A) .

ICU time and Hospital stay time

There was also no differences of statistical significance concerning the mean ICU stay time (mean time of postoperative mechanical ventilation, mean time for inotropic support); and mean time for hospital stay **(Table 3)**.

Postoperative patient outcome

Mortality: There was no mortality in the study group. No patient suffered from postoperative myocardial infarction, CHF, or neurological complications.

Variable	Group A (n=30) (CABG + CE)	Group B (n=30) (CABG + Onlay patch reconstruction)	p Value
Total Operative Time (minutes)			
- Mean	180 ± 8	220 ± 5	0.22*
- Range	120 – 220	134 - 255	-
Cardiopulmonary bypass time (minutes)			
- Mean	103 ± 6	111 ± 8	0.34*
- Range	80 - 140	91 – 153	-
Ischemic Time (minutes)			
- Mean	51 ± 2	49 ± 3	0.55*
- Range	44 – 71	50 –99	-
Mean Number of Distal Anastomoses	2.3 ± 0.5	2.6 ± 0.7	0.67*
Regaining of Cardiac contractility & Weaning Off-Bypass:			
- Spontaneous after Hot shot	17 (56 %)	14 (46 %)	0.44*
- Spontaneous + DC Shock	7 (23 %)	10 (33 %)	0.12*
- DC Shock + inotropics	4 (13 %)	5 (16 %)	0.55*
- DC+Inotropics+ IABCP	2 (6%)	1 (3 %)	0.61*

**: Data is not statistically-significant*

Table 2. Surgical Data

	Group A (n=30) (CABG + CE)	Group B (n=30) (CABG + Onlay patch reconstruction)	p Value
-Number of blood units transfused	2.0 ± 0.5	1.9 ± 0.3	0.34*
-Mechanical ventilation time (Hours)	8 ± 5	10 ± 4	0.11*
-Inotropic Support Time (Hours)	12 ± 4.5	14 ± 2.2	0.43*
-ICU Stay time (mean in hours)	38 ± 4.5	42 ± 7	0.77*
-Hospital Stay Time (days)	10 ± 1.5	8 ± 2.1	0.45*

**: value is statistically-non-significant*

Table 3. Postoperative in-Hospital Data

Morbidity: Overall non-fatal morbidity complications occurred in 10 patients (16.6 %). Morbidity in the Endarterectomy group (A) occurred in 6 patients (20%) as: reopening to hemostase bleeding in 2 patients (6.6%); reopening for subxiphoid closed system drainage of pericardial effusion in 1 patient (3.3%); prolonged ICU ventilation (27 hrs) in 1 patient (3.3%); Intercostal tube thoracostomy for meta-pneumonic haemorrhagic pleural effusion in 1 patient (3.3%); delayed surgical debridement of an infected wound in 1 patient (3.3%). Morbidity in the LIMA patch group (B) occurred in 4 patients (13.3 %) as AF in 2 patients (6.6%); frequent recurrent episodes of supraventricular tachycardia in 1 patients (3.3%), and re-admission for removal of painful sternal stainless steel wire in 1 patient (3.3%). Patients suffering from arrhythmias were medically controlled by antiarrythmic drugs using Amiodarone by IV then oral routes **(Table 4)**.

Functional outcome over 2 years postoperatively: A favorable postoperative functional outcome was evident in both groups but without statistical significance. All patients showed clinical improvement (mean NYHA clinical Class & mean LVEF%). Mean LVEF (%) was 45 ± 0.5 in group A patients; versus 47 ± 0.2 in group B (p = non significant). Mean NYHA class was 1 ± 0.2 for group A; versus 1 ± 0.5 in group B (p = non-significant) **(Table 5).**

	Group A (n=30) (CABG + CE)	Group B (n=30) (CABG + Onlay patch reconstruction)	p Value
In-hospital Mortality:	**none**	**none**	
Non-fatal Morbidity:	**6 (20 %)**	**4 (13.3 %)**	**0.34***
- Reopening to hemostase bleeding	2 (6.6%)	-	-
- Reopening to drain pericardial effusion (1)	1 (3.3%)	-	-
- Prolonged ICU ventilation (27 hrs)	1 (3.3%)	-	-
- Intercostal tube thoracostomy (2)	1 (3.3%)	-	-
- Delayed infected wound debridement	1 (3.3%)	-	-
- New AF	-	2 (6.6%)	-
- Supraventricular tachycardia	-	1 (3.3%)	-
- Re-admission for painful wire removal	-	1 (3.3%)	-

**: value is statistically-non-significant*

(1) Subxiphoid closed system drainage

(2) For meta-pneumonic haemorrhagic pleural effusion

Table 4. Postoperative Morbidity and Mortality

Variable	Group A (n=30) (CABG + CE)	Group B (n=30) (CABG + Onlay patch reconstruction)	p Value
Mean LVEF (%)	45 ± 0.5	47 ± 0.2	0.34*
Mean NYHA class	**1** ± 0.2	1 ± 0.5	0.56*

**: value is statistically-non-significant*

Table 5. Functional Outcome after 2 years PO

Discussion

Many patients with diffuse LAD disease were formerly considered CABG-inoperable[10]. A crucial management dilemma is present if the patient's LAD is deemed non-graftable by angiography but not other targets and the referring physicians and surgeons may not wish to undertake CABG because of the presence of a non-graftable LAD [11]. As a proposed solution, patients with diffuse coronary artery disease may possibly be candidates for LAD-Coronary Endarterectomy (CE), or LIMA is use as a long on-lay patch for coronary reconstruction. Each of these two options was claimed as a proper adjunct to CABG presumably with favorable early and 2-year (mid-term) outcome.

Coronary endarterectomy (CE) was introduced for treating severe atherosclerotic coronary artery disease approximately 45 years ago [1], even before coronary artery bypass grafting (CABG) became the standard operative treatment of myocardial ischemia [2]. CE was shown to relieve angina symptoms, but early experiences reported high postoperative morbidity and mortality [2]. However, ultimately CE found its role as an adjunct to CABG, mainly in patients with diffuse coronary artery disease, to afford more complete revascularization[3]. Most studies on coronary CE report on the right coronary artery[4].

Many surgeons are still reluctant to use coronary CE primarily because of increased mortality and myocardial infarction (MI) rate postoperatively compared with CABG alone[5]. This has been especially the case for CE of the left anterior descending artery (LAD), because of the obvious importance of the LAD with its many branches that need to be addressed during CE [6]. Those surgeons reported another option which is the long LIMA-to-LAD On-Lay patch reconstruction[5].

In our study group A, LAD-CE was performed because we believe in certain group of patients, conventional CABG alone was not possible. Our indications for LAD-CE were clear and strict: coronary arteriotomy revealed an occluded LAD with no graftable vessel in a viable myocardium when a 1-mm probe could not be passed. Previously, the internal mammary artery (IMA) has been used cautiously as a conduit to an endarterectomized vessel because of concerns regarding mismatch of luminal diameter [10]. Following certain procedures

(eg: Off-pump CABG), several authors have now reported equal satisfactory early and late clinical outcomes and luminal patency of endarterectomized vessels grafted with either saphenous vein or mammary artery [13-19]. For its reported and well-known durability in terms of long-term patency compared to SVGs, we chose to use LIMA pedicled grafts in all our group A patients Our indications were also adopted by other surgeons like Loop et al (1986) [3]; Beretta et al (1992)[19]; Ladowski et al, (1991) [20], and Sommerhaug et al (1990) [21].

In our study group B, long-segmental LAD reconstruction with LIMA on-lay patch *reconstruction* has been chosen for patients with multisegmental LAD involvement, at least a 1-mm LAD diameter at the preoperative angiogram, and the presence of critical but nonstenotic septal or diagonal branches, or both, along the stenotic segment. Similar to data reported by some surgeons [13],[16], we did not use this approach in patients with ulcerated and fragile atheromatous plaques to avoid plaque-related complications. The presence of severely limited distal run-off (< 1 mm) determined at the preoperative angiogram or intraoperatively usually precludes the use of an extended anastomosis technique, and these patients underwent a coronary endarterectomy procedure. The same concepts were adopted by other surgical groups as indications for LIMA-LAD On-lay patch as Aranki et al (1993) [16], Sankar et al (1996) [11], Tasdemir et al (1996) [8], Santini et al (2002) [13], Fukui et al (2005) [12], and Ogus et al (2007) [10].

Surgical Technique

For CE, we used the Traction technique together with a relatively-long (2 or more cms) arteriotomy. It is our belief, as well as others [22-24] that it is the most reliable technique that offers the advantage of ensuring total plaque removal, despite the misfortune that it requires a longer aortic cross-clamp time because of the need to sew the long anastomotic point to the LAD-CE bed. Although the small arteriotomy with traction technique has the advantage of a shorter cross-clamp time, it has the disadvantage of the possibility to miss a part of the atheroma un-removed and hence the surgeon must be assured that the entire plaque is removed with proper distal tapering. If distal tapering is not observed, then the arteriotomy should be extended to ensure complete plaque removal. In our series, we used the long arteriotomy technique over the endarterectomized LAD vessel, as we found it relatively technically-easier and also to its reported reasonable postoperative patency as proved by the total disappearance of anginal pain. The same conclusions were also reported by others like Loop et al (1986) [3]; Beretta et al (1992)[19]; Ladowski et al, (1991) [20], and Sommerhaug et al (1990) [21].

As for the On-lay patch technique, the key to the success of the technique was that the length of the longitudinally-incised LIMA should be exactly matching the length of the superficial arteriotomy made along the diseased LAD so that the tip of the arteriotomy incision extends to the "disease-free" distal portion of the LAD vessel. The LAD was not opened at the level of the first proximal lesion. This crucial surgical hint was also emphathized by other surgeons like Aranki et al (1993)[16], Sankar et al (1996) [11], Tasdemir et al (1996)[8], Santini et al (2002) [13], Fukui et al (2005) [12], and Ogus et al (2007)[10]. In 2007, Ogus et al [10] emphathized the use of a long-segment anastomosis, as the ostia of septal and diagonal branches can be directly visualized intraoperatively and a secure anastomosis can be reconstructed. In their technique, they opened the diseased vessel, and the arteriotomy was extended to the nondiseased proximal and distal portions of the LAD. They added that the incorporation of healthy, disease-free parts of the LAD into the anastomosis decreases significantly the development of neointimal proliferation. We as well as others like Aranki et al (1993) [16], Sankar et al (1996) [11], Tasdemir et al (1996) [8] used the same technique. This technique, however, differs from that of Barra and colleagues (2000) [22], who exclude the atheromatous plaques from the lumen of the LAD. In their technique, the LITA has been settled inside the LAD to exclude the atheromatous plaques from the LAD lumen. At the end of the procedure, 75% of the newly formed LAD originates from the LITA and 25% originates from the native artery floor. The atheromatous plaques are left outside the lumen of the newly reconstructed LAD. We and others [8],[10],[11],[16], agree with Barra and colleagues' [22] statements that this the newly formed vessel has a greater diameter than the native artery but the presence of fragile plaques in the lumen may increase the incidence of plaque-related complications. However, we and the same group [8],[10],[11],[16],are convinced that the size and lateral extension of plaque formation are not homogenous along the arterial wall and it is not always possible to achieve the desired vessel diameter throughout the newly formed LAD. This was the reason to open the diseased vessel until the healthy proximal and distal portions were reached and put the plaques inside the anastomosis to avoid the narrowing of the diameter of the new LAD (formed now of both the LAD and LIMA) Because the new vessel generally has a greater diameter than the native artery, the size of the LIMA has no major significance.

We did not use SVGs patches to enlarge the LIMA and then implant LAD as Santini and colleagues [13] as we as well as Fitzgibbon et al [23] considered it more time consuming in addition to concerns regarding the degree of compliance of the three different components: the native artery, saphenous vein patch, and the LITA. As mentioned by Ogus et al [10] the compliance of saphenous vein patch may cause energy loss. In addition, the larger diameter of saphenous vein may adversely influence the flow patterns, and subsequent turbulence may, in turn, decrease the flow velocity. Vein graft atherosclerosis, which is a significant cause of recurrent angina, is another concern with a saphenous vein patch.

Several studies have documented that aspirin alone is required to maintain long-term patency in culprit vessels in the setting of disturbed coronary endothelium especially after CE [14-16]. It has been our regular practice to give our patients

warfarin for anticoagulation to keep INR around 2 for 6 months together with a life-long aspirin treatment in the dose of 2 tabs (75-mg baby aspirin) daily after a meal. Enough large-scale comparative studies on anticoagulation protocols after combined CABG+CE are not yet available [17,18].

Early and 2-year Mid-term postoperative Survival: This study demonstrated the safe feasibility to perform either of the two techniques whether CE or On-lay patch as an adjuvant surgical procedure combined with standard CABG in presence of advanced LAD atherosclerosis. In our study, the absence of operative and 2 years mid-term mortality in both procedures was a better result compared to that reported by other centers[4-11]. The higher mortality in the other series can be attributed to the larger patient sample included and the general patient selection (especially the relatively-younger age).The relatively-low operative mortality rate in our study reinforces the trend seen in recent studies on CE [4,5,6,8,11], as well as other areas of cardiac surgery, in which declining morbidity and mortality have been documented in several high-risk patient groups. All the previously-described surgical groups reported that reasons for the lesser-morbidity-mortality are multifactorial: Advances in patient selection, expert angiography performance and interpretation, proper surgical technique with equidistant stitches that avoid intimal cracking, dissection or disruption, effective myocardial protection, fully-prepared ICU management and facilities, in addition to strict postoperative anticoagulation and platelet-inhibition protocol probably explain the improved operative mortality rates.

In our study, the differences of operative data, ICU and hospital stay times were of no statistical significance, as well as the follow-up data concerning clinical condition and NYHA class. This was selectively-reported in different series like [6,8,10]. Postoperative dysrrhythmias was the sole morbidity occurring in the on-lay patch group. It was stated by some surgeons that addressing lesions close to the LV apex is arrhythmogenic in nature [2,4]. However, all were controlled using amiodarone by IV then oral routes. Being reversible without serious effects, we considered them acceptable.

In our study, none of our patients developed postoperative MI. Our rate is less than rates reported by other surgical groups like 3% [7]; 2.5 % [9]; and 5 % [17], and this may partly be due to the lesser number of our study cases. More-recent coronary CE studies have reported lower MI rates, similar to ours [9, 10]. This discrepancy may also be related to the definition used for MI in each study.

The Study Limitations

A limitation of this study is the relatively-fewer patient number and the relatively short postoperative follow-up (2 years).

Conclusion

Our data analysis did not show any results of statistical significance in CABG surgery as to the efficacy of using LAD Endarterectomy compared to LIMA on-lay patch. Both techniques were safe and achieved adequate LAD revascularization with no mortality and acceptable immediate postoperative and 2-years midterm follow-up.

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Below -Knee Vein Harvesting Versus Above Knee Vein Harvesting Wound Healing In CABG Patients Using ASEPSIS Score

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Background: **Lower limb vein harvesting wound is a significant source of morbidity in CABG patients. The aim of that study was to evaluate wound healing following harvesting of the long saphenous vein from the lower limb below and above knee in patients undergoing coronary artery bypass surgery. Using the ASEPSIS score system.**

Methods: **From January 2011 till February 2012, a total of 120 patients undergone CABG procedure using internal thoracic artery as a graft for LAD in all the cases, in addition to long saphenous vein grafts for the rest of coronary target vessels . Patients were divided into 2 groups: Group(A) include 60 patient undergone CABG with harvesting of the long saphenous vein entirely from one leg with extension of the leg incision above the knee. Group(B) also included 60 patients undergone CABG with harvesting of the long saphenous vein from both legs without extension of the leg incision above the knee. Our limit was the upper border of the patella.**

Results: **The Leg wounds were assessed daily using the ASEPSIS scoring system. The mean ASEPSIS score was significantly lower in group B than groups A. In group A ,25% of patients had an ASEPSIS score > 10 (satisfactory wound healing), compared to 5% of patients group B.** *Conclusion:* **The ASEPSIS score was reduced when the saphenous vein harvesting was restricted to below the level of the knee.**

Abbreviations: **LSV=long saphenous vein, CABG=coronary artery bypass grafting, CPB= cardiopulmonary bypass, SSIS=surgical site infections score, MIVH=minimally invasive vein harvesting, CVH= conventional vein harvesting**

Keywords: **saphenous vein, wound infection, *CABG***

Modern management of CABG patients emphasizes early return to normal activities. In this regard, early mobilization after surgery has an important role in improving the recovery of the patients. Although there have been many enthusiasms toward the use of arterial conduits, still saphenous vein remains the most common conduit used in most of cardiac surgery centers worldwide. Hence any reduction in the morbidity from saphenous vein harvesting will promote early mobilization and enhance the speed of rehabilitation. (1)

Harvesting of the great saphenous vein for CABG has traditionally been undertaken using a 'conventional' vein harvest (CVH) technique, with a continuous skin incision along the medial aspect of the lower limb. More recently, advances in surgical instrument technology, cameras, light sources and endoscopic instrumentation have led to the development of minimally invasive (endoscopic and non-endoscopic) techniques. These operations are performed through a limited number of smaller skin incisions, and therefore aim to reduce the wound related morbidity that these patients face in the postoperative period. (2)

The long saphenous vein may be harvested from one or both lower limbs depending on the length of vein required, and on the operating surgeon's preference. Vein dissection from the thigh involves working closer to the perineum and requires more tissue dissection as the vein is less superficial, and it may be of a larger caliber;

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Alternatively, dissecting the LSV below the knee involves less tissue dissection and less incidence risk of infection .(3)

The complications associated with varicose vein surgery are well documented in general surgery literature. Few studies, however, have addressed the issue in regard to coronary revascularization surgery, where the wounds are usually longer, and the focus of this part of the operation is obtaining a good conduit and not cosmetic, and often undertaken by a less experienced member of the surgical team.(4)

A reduction in wound healing disturbances has the potential to reduce wound-related morbidity, post-operative pain, length of hospital stay, and re-admission rate. This in turn has an implication not only on the time and cost of post-operative care that these patients receive, but their satisfaction with the operation, and therefore quality of life following. (2)

Patients and Methods

That study was approved by the ethical committee of our institute, informed consent was obtained from the patients. All patients undergone CABG surgery in Kasr ElAini hospitals, Cairo university, and in Banha university hospital ,in the period between January 2011 till February 2012. Patient's data were collected prospectively, and the follow-up of lower limb wounds was done on daily basis.

Inclusion criteria

Patients indicated for CABG operation that needed 3 length grafts or more to be harvested from the great saphenous vein.

Exclusion criteria

Patients who had total arterial revascularization for CABG operation were excluded. Patients had preoperative lower limbs inflammatory conditions, evidence of varicose vein, previous deep venous thrombosis or with history of lower limb ischemic vascular lesion were also excluded.

Surgical techniques

120 CABG patients were divided non randomly into 2 groups:

Group (A): Included 60 patients undergone CABG operations, receiving LIMA to LAD, and rest of grafts were done with venous grafts. Harvesting of the long saphenous vein was done from one lower limb with extension of the leg incision above the knee.

Group (B): Included 60 patients undergone CABG operation, receiving LIMA to LAD, and rest of grafts were done with venous grafts .Harvesting of the long saphenous vein was done from both legs without extension of the leg incision above the knee. Our limit was the upper border of the patella.

Routine pre-operative preparation was done for all patients. Legs were shaved the night before surgery, followed by a shower with Chlorhexidine antiseptic. The legs were painted with iodine-based antiseptic at the time of surgery and the groins were excluded with drapes. All the patients in both group received antibiotic prophylaxis 3rd generation cephalosporin routinely before surgery, which is continued for 5 days after surgery.

In both groups, vein harvesting was done by the full open 'conventional' technique. Harvesting of the vein was performed by the second assistant while sternotomy and LIMA harvesting were done concomitantly by the first assistant. A linear incision was made 1.5 cm above and anterior to the medial malleolus. The saphenous vein was dissected using sharp dissection. The incision was then continued upwards, staying over the vein and up to the length required. The vein was harvested without any subcutaneous tissue, taking care not to damage the saphenous nerve. The side branches were tied or clipped. The wound was closed in single or two layers depending on surgeon preference. A suction drain was placed if necessary.

Data collection

We carried out a prospective observational study comparing leg wound healing, and infection rates between both groups. In both groups dressings were left in place until the third post-operative day, when they were removed and the wounds left open to air. All leg wounds were assessed daily during the postoperative period .Wounds were scored until the day of discharge. Wounds were graded using the ASEPSIS system score . The name is an acronym for the variables assessed: **A,** additional treatment required; **S,** deep tissue separation; **E,** erythema; **P,** purulence; **S,** serous exudate; **I,** isolation of bacteria; **S,** prolonged hospital stay. The observer assigned a point score (0–10), based on the proportion of the wound exhibiting the characteristics of Asepsis SCORE greater than 5 mm. For example, scores of 0, 1, 2, 3, 4 and 5 were given for proportions of 0, 20, 20–39, 40– 59, 60–79 and .80% of the wound affected by each variable .The final ASEPSIS score was generated by adding the daily wound characteristic scores to the additional points. Table (1).

The final wounds score were then categorized: 0–10 satisfactory wound healing, 11–20 altered wound healing, 21–30 mild infection, 31–40 moderate infection, and > 40 severe infection.

Additional points were scored for surgical debridement, prolonged hospital stay, isolation of bacteria, and antibiotic treatment .Cultures were done in those how showed evidence of wound discharge, All the patients were treated conservatively, only one patient in group (A) needed wound drainage and debridement .(5)

Wound characteristic	Proportion of wound affected (%)					
	0%	<20%	20–39%	40–59%	60–79%	>80%
Serous exudates	0	1	2	3	4	5
Erythema	0	1	2	3	4	5
Purulent exudates	0	2	4	6	8	10
Separation of deep tissues	0	2	4	6	8	10

Table 1. Points scale for the daily wound inspection

The statistical methods

Data were statistically described in terms of mean ± standard deviation (± SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student *t* test for independent samples.

For comparing categorical data, Chi square (c^2) test was performed. Exact test was used instead when the expected frequency is less than 5. *p* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

Preoperative data

Preoperative data included, age, gender, diabetic status and body mass index (BMI) which is defined as the measurement of body fat based on height and weight that applies to adult men and women on admission .The two groups were similar in regard to preoperative demographics. There was no significant statistical difference between both groups regarding the age, gender, the prevalence of diabetes, as well as the body mass index. Table (2).

	Group A	Group B	*p* Value
No. of patients	60	60	
Age (years)	63.2 ± 9.3	65.1 ± 11.8	NS (0.6)
Female	22 (36%)	20 (33%)	NS (0.3)
Diabetes	30 (50%)	28 (46%)	NS (0.5)
Body mass index	27.3 ± 3.9	27.7 ± 4	NS (0.7)

Table 2. Demographic Data

Intra operative data

There was no significant difference between both groups with regards to the intra operative parameters as, the length of time to harvest the vein, aortic cross clamp time, cardiopulmonary bypass time, and total duration of the operation .Table (3).

	Group A	Group B	*p* Value
No. of patients	60	60	
Time for vein harvesting (min)	69.7 ± 39.8	70.8 ±31.8	NS (0.1)
Aortic cross clamp time(min)	76.4 ±24.2	81.4 ±33.5	NS (0.4)
CPB time (min)	95.2 ±20.4	99.7 ±25.1	NS (0.5)
Operative time (min)	199.4 ± 40.8	201.1 ± 51	NS (0.27)

***Table (3).* Intra operative Data**

Postoperative data

Patients in group (A) had a significantly higher mean ASEPSIS score than those patients in group (B). (6.5 ±3.23 vs. 1.7 ± 3.66, $p = 0.04$). There was also significant statistical difference between both groups as regards nu mber of patients with ASEPSIS score more than 10 (satisfactory wound healing), (Fifteen patients (25%) in group (A),compared to 3 patients (5%) in group (B) ,p value 0.009). No patient had ASEPSIS score > 40 in both groups. Patients in group A were more likely to have a suction drain used at the wound site (some patient with obese thigh needed surgical drains in the thigh). Total Hospital stay was more in group (A) 12.2±3.6 day, compared to group (B) 9.4±2.5 day with no statistical significance between both groups (p value 0.06) .Table(4).

	Group (A)	Group (B)	*p* Value
No of patients	60	60	
Mean ASEPSIS score	6.5±3.23	1.7±3.66	SIGN (0.04)
ASEPSIS score >10	15 (25%)	3 (5%)	SIGN (0.009)
Hospital stay	12.2±3.6	9.4±2.5	NS (0.06)

Table (4). **Postoperative Data**

Discussion

Impaired leg wound healing has been reported to occur from 1%to 25% of CABG patients. Intra-operative and postoperative complications as hematoma formation, saphenous neuropathy, infection, and cellulites can prolong recovery, and require frequent wound dressing, leading to difficulty in mobilization which can impair patient's quality of life.

Efforts must be paid to prevent complications of LSV harvesting wound .This efforts include intraoperative minimal dissection, careful homeostasis, and closure in layers. Wide excision and direct closure are necessary postoperatively in cases of development of skin slough, infection and tissue necrosis, to reduce the requirement for skin grafting.(6)

Surgical site infection is associated with poor cosmetic outcome. Patients who have wound infection, experience emotional distress and may have longer hospitalization and delayed return to work with its economic implications. In the vast majority of cases, surgical site infection heals on conservative management, but the impact can be quit devastating. (7)

Wound infection is aggraded phenomenon. At the earliest stages, patients may have just tissue edema and cellulites. At the worst, they may have a frank wound abscess that requires opening up for drainage and / or debridement. The ASEPSIS score is a very helpful scoring system in assessment and follow up of wound s postoperatively, but still other system can be employed as the CDC classification. (8)

In our study there was no significant difference in time spent in harvesting the saphenous vein between the two groups of patients, unlike the study which was conducted by Enoch et al. that document significant longer time in the group of patients in which vein harvesting was extended above the knee. Interestingly, the seniority of the surgeon harvesting the LSV vein did not appear to have an effect on the ASEPSIS score. Possibly, the incidence of altered wound healing in this study might have been changed if a greater proportion of grafts were harvested by a more skilled trainee. (9)

In this prospective study, patients in whom the saphenous vein was harvested from the leg with extension of the wound to the thigh had a significantly higher ASEPSIS score than those in whom the incision was limited to the leg below the level of the knee. This finding may be due to the close proximity of the wound to the groin, the greater dissection required for harvesting the vein. The study conducted by Blak.et.al. Demonstrated not only extended harvesting of the saphenous vein from the thigh increases the incidence of in hospital wound infection, but also contributes to higher rate of delayed wound infection.(10)

This study concentrated on in hospital wound infection, but it is well recognized that late infections occurring after hospital discharge may also be a significant cause of morbidity after CABG. Nevertheless, this study suggested that LSV harvesting should be limited to sites below the knee as much as possible.

In a study conducted by Garland et al. (4), Female gender, peripheral vascular disease, and postoperative intra-aortic balloon pump use were identified as significant independent predictors of major leg wound complications. Unlike the multiple logistic analysis, performed by Crouch et al which showed that open harvesting ($p \leq 0.0007$) and diabetes ($p \leq 0.0001$) were independent risk factors for wound infection.(1)

Wilson documented many factors the he believed to be the most important in the pathology of wound infection .Among these factors from the patient side :age, nutritional status, obesity and altered immune response .Other operative factors as : duration of surgery ,skin antiseptic / shaving, instrument sterilization and antimicrobial prophylaxis. Wilson suggested another procedure which may add another dimension to surgical prophylaxis, a new method of delivering topical antibiotics in the wound and the use of antiseptic-impregnated suture. (8)

Other risk factors identified for wound infection in lower limb include female gender, chronic steroid therapy, and diabetes mellitus, and malnutrition, post-operative use of blood products, lymph leak, post-operative edema, low pre-operative hematocrit, high pre-operative urea, and low serum albumin. Recent evidence suggested that two-thirds of wound infections occur in clean wounds following discharge and that these infections are not predicted by the recognized risk factors. (5)

In contrast, minimally invasive LSV harvesting techniques, which involve minimal tissue dissection, have been shown to reduce leg wound infection and postoperative pain.

The concerns with endoscopic harvest included: increased harvest time, additional expense and the potential for vein trauma. A number of prospective randomized trials and retrospective cohort studies have shown less leg wound complications, with the MIVH technique, however, speed of harvest was significantly slower. The quality of the veins harvested, appeared to be excellent. The difficulty with the endoscopic technique was the learning curve and cost of change; however, in the long term the technique may well prove to be superior.(3)

In a meta-analysis of randomized trials comparing leg wound infection rates between the MIVH and CVH techniques, a significant reduction in post-operative wound infection occurred with MIVH technique.

This may be because the MIVH technique involved tunneling rather than cutting through the layers of tissue covering the vein, and therefore resulted in a more localized inflammatory response for wound healing. But the incidence of hematoma was higher in the MIVH technique, as one of the advantages of CVH was that homeostasis was possible under direct vision before closing the wound. In that respect, endoscopic MIVH had the added benefit over non-endoscopic MIVH in that ligation of the branches of the great saphenous vein could be done under direct vision and the wound tunnel could be inspected more easily.(2)

We did not study the incidence of the various wound complications in regard to how the wounds were closed. However A number of studies have examined the role of either two layer (with subcutaneous layer) compared with single-layer closure or staples Overall, the findings support a single-layer closure and not using staples as the most favorable technique for lower limb wound closure.(5)

Limitation of the study

The major limitation of this study is the numbers of patients. However, the groups were matched in terms of demographic characteristics, in particular, body mass index. However, there is a need for a large prospective study.

Another limitation was the use of drains in the wound which was used more frequently in group (A). This may serve as a foreign material that's invite more infection as has been claimed by some authors. Our experience was that suction drainage actually decreased the ASEPSIS score due to a decrease in the presence of serous exudates.

Conclusion

The ASEPSIS score is reduced when the saphenous vein harvesting was restricted to below knee level, compared to extending the incision to above knee. With increasing number of older and sicker patients referred for CABG ,eliminating wound infection and pain would significantly reduce complications and hence the expenses of health care.

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Predictive Value of Postoperative Hyperglycemia For Outcome of Coronary Artery Bypass Grafting Surgery

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Objectives: **To determine the frequency of postoperative (PO) hyperglycemia in non-diabetic patients underwent Coronary artery bypass grafting (CABG) surgery and to evaluate its predictability for the outcome of these patients.**

Patients & Methods: **The study included all patients assigned for CABG surgery and had no previous history of diabetes mellitus with preoperative fasting blood glucose of <110 mg/dl. Hyperglycemia was diagnosed if random blood glucose (RBG) levels are >180 mg/dl. Patients were categorized according RBG into: Normoglycemics had RBG <180 mg/dl and Hyperglycemics had RBG <180 mg/dl. Intraoperative data included frequency of CABG with beating heart and number of internal mammary artery graft used, aortic artery clamping, CPB and total operative times. Postoperative data included the frequency of hyperglycemic patients, occurrence of PO morbidities and mortality. All hyperglycemic patients received insulin infusion adjusted to achieve RBG level of 126-179 mg/dl.**

Results: **All patients had significantly higher postoperative RBG levels compared to preoperative levels. Forty-three patients were hyperglycemic, while 57 patients were considered normoglycemic. Throughout ICU and hospital stay, 31 patients developed morbidities and 4 patients died with significantly higher frequency of additional morbidities and mortalities in hyperglycemic versus normoglycemic patients. There was positive significant correlation between the frequency of PO morbidities and mortality and extent of PO hyperglycemia, aortic clamping, CPB and total operative times. ROC curve and regression analyses showed that the extent of PO hyperglycemia, aortic clamping, CPB and total operative times are the significant predictors for morbidities and mortalities.**

Conclusion: **PO hyperglycemia showed deleterious effects on outcome of CABG patients manifested as increased frequency of morbidities and mortalities during ICU and hospital stay and the extent of hyperglycemia could be considered as independent predictor of worsened outcome. The applied management policy allowed reduction of blood glucose levels without inducing hypoglycemia with subsequent improved outcome.**

KEYWORDS: **CABG, postoperative hyperglycemia, additional morbidities, mortality.**

Diabetes mellitus (DM) and hyperglycemia are risk factors for adverse perioperative cardiac and non-cardiac events. In patients with known DM, each 1% increase in glycated hemoglobin (HbA 1c) level was associated with a 14% increase in the incidence of fatal and nonfatal myocardial infarction [(1)].

During the last decade, the emphasis has shifted from diabetes to new-onset hyperglycemia. Pre-diabetes represents a metabolic stage intermediate between normal glucose hemostasis and DM. Although DM has been recognized as an independent predictor of perioperative cardiovascular outcomes, the prognosis of non-diabetic patients with impaired glucose regulation is not clear [(2)].

Elevated blood glucose levels observed in the critically ill, a phenomenon denoted "diabetes of injury" has distinct pathophysiology from type 1 or 2 diabetes. The main

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cause of hyperglycemia in the critically ill is the release of counter-regulatory stress hormones (catecholamines, cortisol, glucagon, growth hormone), and pro-inflammatory cytokines that interfere with the insulin signaling cascade at the post-receptor level. Hyperglycemia in critically ill patients has many undesirable effects, such as increased oxidative stress, increased infectious complications, impaired cardiovascular function, prothrombogenic effect, endothelial dysfunction, ischemic renal injury, and others [3-5].

Cardiopulmonary bypass (CPB) plus cardiac arrest induces the greatest degree of ischemia-reperfusion injury. Despite advances in cardioprotection strategies, myocardial dysfunction after open heart surgery remains an ongoing problem in an increasingly vulnerable patient population. Insulin represents an attractive therapeutic intervention because it exerts a variety of beneficial metabolic and non-metabolic effects, including vasodilatory, anti-inflammatory, anti-oxidative, anti-fibrinolytic, and positive inotropic effects [6-8] **(Sato et al., 2011)**.

The current study aimed to determine the frequency of postoperative hyperglycemia in non-diabetic patients underwent CABG surgery and to evaluate the predictability of diagnosis of hyperglycemia for the outcome of these patients.

Patients and Methods

The current prospective study was conducted at Cardiovascular Surgery Department, King Fahad Medical City ,Prince Salman Heart Center ,Riyadh, KSA; from Jan 2010 till March 2012. All patients had no previous history of diabetes mellitus and assigned for CABG surgery were enrolled in the study. Inclusion criteria included preoperative FBG level <110 and blood HbA1c <5.7% to assure normal preoperative glycemic control.

Hyperglycemia was defined according to contemporary medical practice which stated that hyperglycemia under stress conditions should only be treated with insulin if blood glucose levels are >180 mg/dl [10]. Patients were categorized according to postoperative random blood glucose (RBG) into two groups: Normoglycemic group included patients who had RBG <180 mg/dl and Hyperglycemic group included patients who had RBG >180 mg/dl.

Preoperative data included age, gender, smoking, associated medical conditions and preoperative fasting blood glucose. Body mass data including weight, height and calculation of body mass index (BMI) according to the equation BMI = Wt (kg)/ (Height in meter)^2 [9]. Patients were categorized according to BMI into Average weight patients had BMI<25 kg/m^2, overweight patients had BMI range of 25-29.9 kg/m^2, Obese patients had BMI ≥30-35 kg/m^2 and Morbid obese group included patients had BMI >35 kg/m^2.

Intraoperative data included frequency of beating heart CABG and number of internal mammary artery graft used, aortic artery clamping time, CPB time and total operative time. Postoperative data included the frequency of hyperglycemic patients, occurrence of postoperative morbidities and frequency of postoperative mortality.

All hyperglycemic patients were assigned to receive insulin infusion adjusted at rate of 0.1 mU/kg/min to achieve target blood glucose level in range of 126-179 mg/dl. Patients responded to insulin therapy and had RBG level within the assigned range were shifted to subcutaneous insulin therapy using 6-hourly injection after estimation of blood glucose to prevent relapse of hyperglycemia. On ICU admission, all patients were fed continuously with intravenous glucose (200-300 g/24 hours). On the next day, total parenteral, combined parenteral and enteral, or total enteral feeding was instituted according to circumstances.

Statistical analysis

Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon; ranked test for unrelated data (Z-test) and Chi-square test (X2 test). Possible relationships were investigated using Pearson linear regression. Sensitivity & specificity of estimated RBG level as predictor for occurrence of morbidities and mortalities were evaluated using the receiver operating characteristic (ROC) curve analysis judged by the area under the curve (AUC) compared versus the null hypothesis that AUC=0.05. Regression analysis using Stepwise method was used to verify the evaluated parameters as predictors for morbidity and mortality. Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

Results

The study included 100 patients; 72 males and 28 females with mean age of 67±3.8; range: 58-72 years and mean BMI of 31±2.6; range: 24.4-34.9 kg/m^2. Eighty-seven patients were hypertensive and 9 patients had past history of previous PCI. Only 16 patients were never smokers, while 58 patients were ex-smokers and 26 patients were still smokers. No patient had history of diabetes mellitus and mean preoperative FBG level was 109.1±14.5; 78-127 (Table 1).

Only 10 patients had CABG with beating heart, while 90 patients had CABG with aortic cross-clamping. In 13 patients two internal mammary arteries were used , while in 87 patients only left internal mammary artery was used. Mean aortic artery clamping time was 81.4±3.3' range: 75-85 minutes. Mean cardiopulmonary bypass time was 104.9±3.1; range: 90-110 minutes. Total operative time was 180.7±24.8; range: 140-200 minutes, (Table 2).

All patients had significantly ($p<0.05$) higher postoperative RBG levels compared to their preoperative levels, (Fig. 1). However, 29 patients had postoperative RBG level <140 mg/dl, 28 patients had RBG level in range of 140- <180 mg/dl, 13 patients had RBG level in range of >180-200 mg/dl and 30 patients had RBG level >200 mg/dl, (Fig. 2). Thus, according to the applied definition for hyperglycemia, 43 patients were hyperglycemic, while the other 57 patients were considered as normoglycemic.

Throughout ICU and hospital stay, 31 patients developed morbidities in varied combinations; 17 hyperglycemic (39.5%) and 14 normoglycemic patients (24.6%) with significantly higher frequency of additional morbidities in hyperglycemic versus normoglycemic patients ($X^2=3.504$, $p<0.05$). Thirteen patients superficial sternal wound infection, 5 patients developed deep sternal wound infection and 7 patients developed urinary tract infection. Two patients developed deep venous thrombosis (DVT). Thirteen patients developed pulmonary complications; 9 patients had systemic immune response syndrome (SIRS), 4 patients developed pneumonia and one patient had adult respiratory distress syndrome (ARDS). Through the study period 4 patients died; one of the normoglycemic patients had died with a mortality rate of (1.8%) and 3 of the 43 hyperglycemic patients had died for a mortality rate 7% with significantly higher frequency of additional morbidities in hyperglycemic versus normoglycemic patients ($X^2=3.923$, $p<0.05$). One patient developed ARDS, 2 patients developed SIRS and one patient developed acute renal failure.

There was positive significant correlation between the frequency of PO morbidities and extent of PO hyperglycemia, aortic clamping time, CPB time and total operative time, while the correlation was positive but non-significant with age and preoperative blood glucose level. Similarly, there was positive significant correlation between the frequency of PO mortalities and extent of PO hyperglycemia, aortic clamping time, CPB time, total operative time and age, while the correlation was positive but non-significant with preoperative blood glucose level, (Table 3).

ROC curve analysis for evaluated parameters as predictors for development of postoperative morbidities showed that the extent of postoperative hyperglycemia, aortic clamping time, CPB time and total operative time are the significant predictors, (Fig. 3). While for prediction for postoperative mortality postoperative hyperglycemia, aortic clamping time, CPB time and age are the significant predictors, (Table 4, Fig. 4). To verify these predictors, Regression analysis defined development of postoperative hyperglycemia as significant predictor for both postoperative morbidity and mortality in three models, followed by duration of ischemia manifested as aortic artery clamping time in two models and both of CPB time and age in one model, (Table 5).

Data			Findings	
Age (years)	Strata	≤60	7 (7%)	58.9±0.4 (58-59)
		>60-65	23 (23%)	62.7±1.4 (61-65)
		>65-70	55 (55%)	68.6±1.3 (66-70)
		>70	15 (15%)	71.3±0.5 (71-72)
	Total			67±3.8 (58-72)
Gender	Males		72 (72%)	
	Females		28 (28%)	
Body mass data	Weight (kg)			87.2±7.2 (68-99)
	Height (cm)			167.8±1.6 (165-175)
	BMI (kg/m^2)	Average (<24.9)	1 (1%)	24.4
		Over weight (25-30)	32 (32%)	28.1±1.5 (25.2-29.8)
		Obese (>30)	67 (67%)	32.4±1.3 (30.1-34.9)
		Total		31±2.6 (24.4-34.9)
Smoking	Never smoker		58 (58%)	
	Ex-smoker		16 (16%)	
	Still smoker		26 (26%)	
Hypertension	Yes		87 (87%)	
	No		13 (13%)	
Previous PCI	Yes		9 (9%)	
	No		91 (91%)	
Preoperative FBG (mg/dl)				109.1±14.5 (78-127)

Data are presented as mean±SD & numbers; ranges & percentages are in parenthesis; PCI: percutaneous coronary artery intervention.

Table 1. Patients' enrolment data

Data		Findings
CABG with	Aortic cross-clamping	90 (90%)
	Beating heart	10 (10%)
Number of internal mammary artery graft used	One	87 (87%)
	Two	13 (13%)
Aortic clamping time (min)		81.4±3.3 (75-85)
Cardio-pulmonary bypass time (min)		104.9±3.1 (90-110)
Total operative time (min)		180.7±24.8 (40-200)

Data are presented as mean±SD & numbers; ranges & percentages are in parenthesis

Table 2. Operative data of studied patients

	Morbidity		Mortality	
	r	p	r	p
Age	0.156	>0.05	0.199	=0.048
Clamping time	0.257	=0.010	0.261	=0.009
CPB time	0.250	=0.012	0.227	=0.023
Operative time	0.202	=0.044	0.222	=0.027
Preop. BG level	0.111	>0.05	0.044	>0.05
PO hyperglycemia	0.273	=0.006	0.281	=0.005

Preop.: preoperative, PO: postoperative; CPB: cardiopulmonary time

Table 3. Correlation coefficient "r" between evaluated parameters as occurrence of postoperative morbidities and mortality

	Parameter	AUC	Std Error	Sig.	Confidence Interval	
					Lower	Upper
Morbidity	Age	0.615	0.064	>0.05	0.489	0.741
	Clamping time	0.648	0.058	=0.018	0.534	0.763
	CPB time	0.648	0.058	=0.018	0.534	0.763
	Operative time	0.632	0.064	=0.036	0.506	0.757
	Preop. BG level	0.558	0.062	>0.05	0.436	0.679
	PO hyperglycemia	0.668	0.058	=0.007	0.555	0.782
Mortality	Age	0.667	0.067	=0.027	0.535	0.799
	Clamping time	0.692	0.071	=0.011	0.552	0.832
	CPB time	0.680	0.075	=0.017	0.533	0.826
	Operative time	0.644	0.071	>0.05	0.506	0.783
	Preop. BG level	0.539	0.077	>0.05	0.388	0.690
	PO hyperglycemia	0.713	0.069	=0.005	0.577	0.849

AUC: area under curve; Std error: standard error; Sig.: significance; Preop.: preoperative, PO: postoperative; CPB: cardiopulmonary time.

Table 4. ROC curve analysis for evaluated parameters as predictors for postoperative morbidities and mortality

		Parameter	β	t	Sig.
Morbidity	Model 1	CPB time	0.263	2.886	0.005
		Clamping time	0.266	2.928	0.004
		PO hyperglycemia	0.289	3.169	0.002
	Model 2	PO hyperglycemia	0.286	3.041	0.003
		Clamping time	0.264	2.809	0.006
	Model 3	PO hyperglycemia	0.273	2.808	0.006
Mortality	Model 1	Age	0.231	2.513	0.014
		Clamping time	0.239	2.593	0.011
		PO hyperglycemia	0.293	3.187	0.002
	Model 2	Clamping time	0.256	2.716	0.008
		PO hyperglycemia	0.256	2.716	0.002
	Model 3	PO hyperglycemia	0.281	2.894	0.005

β: Standardized coefficient; Sig.: significance; PO: postoperative; CPB: cardiopulmonary time

Table 5. Regression analysis for evaluated parameters as predictors for postoperative morbidities and mortality

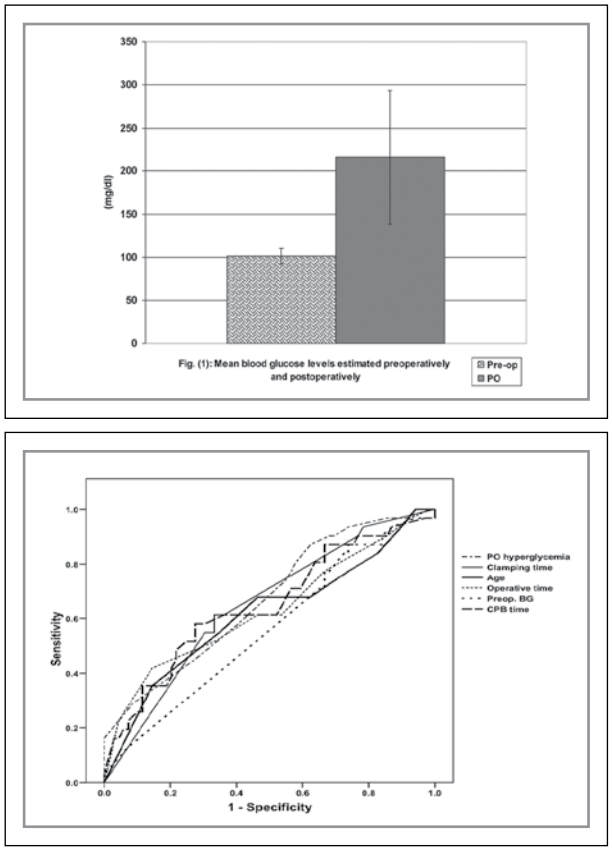

Fig 3. ROC curve analysis of evaluated parameters as predictors for development of additional morbidities of PO CABG patients

Fig. 4. ROC curve analysis of evaluated parameters as predictors for mortality of PO CABG patients

Discussion

Throughout the current study, postoperative hyperglycemia defined as RBG >180 mg/dl was detected in 43% of studied patients, despite the significantly higher postoperative RBG level compared to preoperative BG. These findings go in hand with **Verhoeven et al.** [11] who reported that hyperglycemia, defined as a glucose level >150 mg/dl was present in 52% of children undergoing cardiac surgery. **Giakoumidakis et al.** [12] reviewed 16 articles concerned with perioperative hyperglycemia and cardiac surgery and 12 studies significantly associated hyperglycemia and inadequate blood glucose control with increased mortality and concluded that peri-operative hyperglycemia is harmful for cardiac surgery patients.

The applied policy for glycemic control to achieve a target blood glucose in range of 127-179 mg/dl was in line with **Bhamidipati et al.** [13] who found moderate glycemic control was superior to tight glycemic control, with decreased mortality and major complications, and may be ideal for patients undergoing isolated coronary artery bypass grafting. **Haga et al.** [14] studied 7 randomized controlled trials concerning tight versus normal glycaemic control during and/or after cardiac surgery and found tight glycaemic control reduced the incidence of early mortality; of post-surgical atrial fibrillation; the use of epicardial pacing; the duration of mechanical ventilation and length of ICU stay. Recently, **Jacobi et al.** [15] reported a reduction in mortality in general ICU patients with glycemic control end point at blood glucose ≥150 mg/dl but absolutely <180 mg/dl with reductions in morbidity for postoperative cardiac surgery patients. **Agus et al.** [16] found tight glycemic control to a target blood glucose of 80-110 can be achieved with a low hypoglycemia rate after cardiac surgery in children, but it does not significantly change the infection rate, mortality, length of stay, or measures of organ failure, as compared with standard care. Also, **Desai et al.** [17] reported that as advocated by the Society of Thoracic Surgeons; maintenance of blood glucose for a target blood glucose range of 121 to 180 mg/dl is recommended for patients after CABG and lead to similar outcomes compared with a strict target range and was superior in glucose control.

Throughout ICU and hospital stay, 31 patients developed additional morbidities and 4 patients died throughout ICU and hospital stay with significantly higher frequency of additional morbidities and mortalities in hyperglycemic versus normoglycemic patients. These data indicated that the impact of PO hyperglycemia was not confined to development of additional morbidities but extended to increased mortality rate. In support of this finding, statistical analyses defined development of PO hyperglycemia as independent predictor of both morbidities and mortalities.

In hand with these findings; **Jones et al.** [18] reported greater complication rates, in the very high blood glucose patients underwent CABG surgery, in the form of prolonged ventilation, length of stay >14 days and mortality and concluded that patients with blood glucose values >200 mg/dl immediately after CABG had an increased risk of complications, including mortality, independent of a clinical diagnosis of DM. **Via et al.** [19] found in-hospital mortality of patients had primary percutaneous coronary intervention for ST-segment elevation myocardial infarction was higher in non-diabetic hyperglycemic patients compared to diabetic hyperglycemic, diabetic non-hyperglycemic and non-diabetic non-hyperglycemic patients. **Székely et al.** [20] found postoperative hyperglycemia is associated with increased in-hospital mortality in non-diabetic patients after coronary artery bypass graft surgery, while in diabetic patients, hyperglycemia was not associated with mortality. **Gianchandani et al.** [21] found mortality and other complication rates did not differ between post-cardiac surgery patients with diabetes and stress hyperglycemia. **McDonnell et al.** [22] reported that maintaining glycemic control (blood glucose <180 mg/dl) has been shown to reduce morbidity and enhance long-term survival in patients following CABG surgery.

Statistical analyses defined a positive significant correlation between age, prolonged clamping time, CPB time and PO hyperglycemia on one side and PO morbidity and mortality. A finding indicating a positive significant correlation between these studied parameter. Moreover, these four parameter were found to have predictability for outcome using both ROC curve and regression analyses.

These data indicted a fact that prolonged and extensive operative trauma in an aged patient could induce PO hyperglycemia which in turn could worsen the prognosis of such patient. In support of considering these factor as risk factors for bad prognosis, **Frioud et al.** [23] reported that glucose levels greater than 8.8 mmol/L (>150 mg/dl) on PO day 1 were predictive of mortality and morbidity among patients undergoing cardiovascular surgery. Recently, **Garg et al.** [24] reported that multivariate logistic regression analysis showed old age to be independently associated with hyperglycemia and hyperglycemic aged patients had more intraoperative and postoperative complications

In a trial to explain the deleterious effects of hyperglycemia **Christensen et al.** [25] experimentally reported that hyperinsulinemia concomitant with normoglycemia reduces plasma concentrations of tumor necrosis factor-alpha and the catabolic hormone glucagon in lipopolysaccharide-induced systemic inflammation in pigs and concluded that this dinging strongly supports the role of insulin as an anti-inflammatory hormone and the fact that glucose is toxic and inflammatory material. **Langouche et al.** [26] found prevention of hyperglycemia suppressed induced nitric oxide synthase (iNOS) gene expression in postmortem liver and skeletal muscle, possibly in part via reduced nuclear factor-κB activation, and lowered the elevated circulating nitric oxide (NO) levels and concluded that maintaining normoglycemia with insulin therapy during critical illness protects the endothelium, likely in part via inhibition of excessive iNOS-induced NO release, and thereby contributes to prevention of organ failure and death.

Digman et al., [27] attributed the deleterious effects of hyperglycemia to disruption of normal mitochondrial respiration, direct glucose toxicity, accumulation of asymmetric dimethylarginine, and impairment of immune cell function are among the possibilities implicated. **Worthley et al.** [28] reported an inverse significant correlation between admission blood sugar level and both platelet sodium nitroprusside response and asymmetric dimethylarginine levels and that insulin therapy resulted in a significant reduction in blood sugar level, improved platelet responsiveness to sodium nitroprusside and decreased superoxide and asymmetric dimethylarginine levels.

The obtained results and review of literature allowed concluding that PO hyperglycemia showed deleterious effects on outcome of CABG patients manifested as increased frequency of morbidities and mortalities during ICU and hospital stay and the extent of hyperglycemia could be considered as independent predictor of worsened outcome. The applied management policy allowed reduction of blood glucose levels without inducing hypoglycemia with subsequent improved outcome.

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Early Outcome of Coronary Artery Bypass Surgery in Patients With Poor Left Ventricular Function

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Background: **Surgical revascularization in patients with poor left ventricular function has historically carried a high mortality and morbidity rates. However, with advances in surgical techniques and myocardial protection, the safety of CABG in those patients has been demonstrated.**

Objectives: **The aim of this study is to investigate the early surgical outcome in patients with poor left ventricular function (EF < 35%) in comparison with patients having normal left ventricular function (EF > 50%).**

Material and methods: **This study included 155 patients with ischaemic heart disease, that were retrospectively grouped into, group I including 71 patients with a left ventricular function < 0.35 and group II including 84 patients with normal left ventricular function (> 0.50). All patients were subjected to conventional CABG with the use of cardiopulmonary bypass. There are more males in group I (63, 88.7%, P < 0.012), and patients in this group tend to be more obese, had more incidences of hypertension (43, 60.6%, P < 0.036), hypercholestermia (26, 36.6, P < 0.006) and Diabetes (40, 56.30%, P < 0.006). Also they tend to have more incidences of MI (46, 64.8%, P < 0.001), CHF (34, 66.7%, P < 0.001) and higher mean NYHA (*2.3 ±0.5,* P < 0.001). Otherwise, there was no statistically significant difference between both groups.**

Results: **The overall in-hospital mortality was 3.9 % (n = 6). Four patients died in group I (5.6%) and 2 in group II (2.4%). There was a significantly longer mean bypass time and cross-clamp time in group I (81.4 ±12 versus 66.6 ±12.1 minutes; P < 0.001 and 43.7 ±7.3 versus 36.5 ±5.9 minutes; P < 0.001, respectively). Also, Patients in group I had more prolonged ICU stay (58.3 ±11.2 versus 41.8 ±11.6 hours; P < 0.001), more patients needed IABP (24 patients, 33.8% versus 6 patients, 7.1%, P < 0.001); and more patients needed positive inotropic support (55 patients, 77.5% versus 39 patients, 46.4%, P < 0.001) compared to Group II patients. There was highly significant improvement in postoperative NYHA class in both groups (P < 0.001), however there were more improvement in group I (33.1, 95% confidence interval 26.22 to 39.98 versus 30.1, 95% CI 24.07 to 36.24). EF has significantly improved in group I postoperatively (P < 0.001), however, there were no statistical difference in group II. Other postoperative outcomes were insignificantly different between compared groups.**

Conclusions: **CABG in patients with poor function can be performed with low mortality and morbidity. Low ejection fraction does not preclude CABG provided careful patient selection is implemented.**

Coronary artery bypass grafting (CABG) in patients with multivessel coronary artery disease (CAD), especially with left ventricular dysfunction (LVD), remains the optimal therapeutic approach and superior to medical therapy. The Coronary Artery Surgery Study (CASS) demonstrated that only 38% of medically treated patients (EF <35%) were alive and free of moderate or severe limitations 5 years after the onset of treatment [(1)]. Passamani et al. followed a group of CABG patients with an ejection fraction (EF) less than 50% for 7 years and showed that 84% of the surgically treated patients were alive at 7 years, whereas only 70% of medically treated patients were alive [(2)]. O'Connor et al. has found

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that left ventricular dysfunction of ischemic etiology is associated with approximate 5-year survivals of 40% with medical treatment and 60% with CABG [3].

CABG is also superior to percutaneous coronary intervention (PCI) in this category of patients even in the drug eluting stents (DES) era [4,5]. Moreover, according to the STS data base up to 15% of patients who are candidates for (CABG), present with severely depressed LV function and this incidence is liable for increase with improvement of the management of the acute myocardial infarction [6].

The postoperative outcome of those patients has classically been reported to be worse compared with patients with good left ventricular function [7]. However, more recently, studies indicate that CABG can be performed with low mortality and morbidity in this category of patients. These studies also suggest that low ejection fraction per se is not a predictor of hospital mortality [1,8,9,10].

We sought of reporting our experience in this challenging group of patients by reporting early morbidity and mortality outcome and comparing them to patients with normal EF (> 50%).

Material and methods

Between the period from November 2006 till November 2012, 155 patients with ischaemic heart disease who were candidates for CABG were retrospectively selected from the pool of CABG patients at Ain Shams university hospitals. The selection criterion was based on the presence of complete data. The patients were assigned into two groups, group I comprised of 71 patients with ejection fraction equals or less than 35 and group II comprised of 84 patients with ejection fraction more than 50. All definition of morbidities and mortalities comply with Society of Thoracic Surgery (STS) data base definitions.

Patients who had previous CABG, associated with valvular disease, renal or hepatic impairment were excluded from the study. All patients with low function (group I) had preoperative viability check using either stress Thallium test or Dobutamine stress echo in order to rule out irreversible changes. Patients with no residual viability are excluded from this study.

All operations were done using standard on pump CABG techniques, with blood enriched cold crystalloid cardioplegia introduced through antegrade route.

The mean ejection fraction for group I was 31 ±2.6 and for group II was 57.0 ±5.9. There were more males in group I, and patients in this group tend to be more obese, had more incidences of hypertension, hypercholesterolemia and Diabetes. Also they tend to have more incidences of myocardial infarction (MI), Congestive heart failure (CHF) and higher mean NYHA. Otherwise, there was no statistically significant difference between both groups. Table (1) & (2) show the demographic distribution and preoperative data in both groups.

Statistical methods

Data were presented as numbers (%) or mean ±SD, as indicated. The distribution of qualitative data among groups was analyzed by Chi-Square test or Fisher's exact test, as indicated. Means were compared with the independent and paired samples T test. All tests were bilateral and a P value of 0.05 was the limit of statistical significance. SPSS software package version 20 was used for statistical analysis.

	GROUP	Mean	Std. Deviation	P-value*
Age at Surgery	Group I	54.2	5.9	N.S.
	Group II	55.7	5.4	
Hemoglobin on admission	Group I	12.5	0.8	0.02
	Group II	12.8	0.8	
Creatinine on admission	Group I	1	0.1	N.S.
	Group II	1	1.2	
Bilirubin on admission	Group I	0.7	0.1	N.S.
	Group II	0.7	0.1	
Height (cm)	Group I	169.5	5.3	N.S.
	Group II	168.4	5.9	
Weight (kg)	Group I	84.8	7.8	0.04
	Group II	87.5	8.3	
CCS class	Group I	2	0.5	N.S.
	Group II	2	0.4	
NYHA class	Group I	2.3	0.5	<0.001
	Group II	1.9	0.7	

*Values are presented as number (%) or mean ±SD, as indicated. * = Chi-Square test or independent samples T test, as indicated. (CCS) class Canadian cardiovascular society angina class, (NYHA) New York heart association functional class.*

Table 1. Showing the demographics and preoperative variables in both groups.

	Group I (71)		Group II (84)		P value*
	No.	%	No.	%	
Male sex	63	88.7	61	72.6	0.012
Smoking	26	36.6	20	23.8	N.S.
Hypertension	43	60.6	36	42.9	0.036
Diabetics	40	56.3	28	33.3	0.006
Oral therapy	24	33.8	13	15.5	0.009
Insulin therapy	16	22.5	14	16.7	N.S.
Hypercholesterolemia	26	36.6	14	16.7	0.006
Cerebrovascular accident	3	4.2	1	1.2	N.S.
COBD	1	1.4	3	3.6	N.S.
Unstable/recent Angina	13	18.3	12	14.3	N.S.
Previous Q wave infarction	46	64.8	25	35.2	<0.001
Congestive heart Failure	34	66.7	17	33.3	<0.001
Previous PTCA / stenting	21	29.6	19	22.6	N.S.
Extent of disease					
Two vessels	19	13.3	22	23.3	N.S.
Three vessels	52	83.3	62	73.3	N.S.
Main	2	1.4	3	3.6	N.S.

*Values are presented as number (%) or mean ±SD, as indicated. * = Chi-Square test or independent samples T test, as indicated; COPD: chronic obstructive pulmonary disease. PTCA: percutaneous transaortic coronary angiography.*

Table 2. Showing the demographics and preoperative variables in both groups.

RESULTS

There was a significantly longer mean cardiopulmonary bypass time in group I than in group II. The number of the grafts per patient was from 2 to 4 mean 3 ±0.7 in group I and 2.9 ±0.7 in Group II with no statistically significant difference between the two groups in any other operative variable. Table (3) shows the operative data.

The incidence of need for inotropic support, intra-aortic balloon insertion and the mean number of hours in the ICU were significantly higher in group I, all other postoperative events were comparable in both groups. Table (4) shows the operative data

There was a significant increase in the mean value of post-operative EF for group I (32.8 ±2.8) compared to preoperative mean value (31.0 ±2.6, P < 0.001). This increase in the post-operative mean value did not reach statistical significance for group II (Table 5).

As regards the mean values of the NYHA class, there was significant improvement in NYHA class in groups I and II (Table 5). However, the mean per cent change from the baseline of NYHA class in group I (33.1, 95% confidence interval 26.22 to 39.98) is more than the mean per cent change of NYHA in group II (30.1, 95% CI 24.07 to 36.24) (fig. 1).

The overall in-hospital mortality was 3.9% (n = 6). Four patients died in group I (5.6%) and 2 in group II (2.4%). All mortalities in group I was due to progressive and persistent low cardiac output that has led to multiorgan failure. One patient in group II died due to low cardiac output and the other due persistent arrhythmia that has ended with intractable ventricular fibrillation and arrest, although immediate bed side exploration of the grafts has been performed, no occluded grafts has been detected.

	Group I (71)	Group II (84)	P value*
Mean number of grafts	3 ±0.7	2.9 ±0.7	NS
Mean CPB time (min)	81.4 ±12	66.6 ±12.1	0.01
Mean aortic cross-clamp time (min)	43.7 ±7.3	36.5 ±5.9	< 0.001
Distal coronary anastomosis			
2 grafts	19 (26.7%)	22 (26.2%)	
3 grafts	33 (46.6%)	45 (53.6%)	N.S.
4 grafts	19 (26.7%)	17 (20.2%)	
Target vessels			
LAD	71 (100%)	84 (100%)	N.S.
Circumflex	71 (100%)	70 (83.3%)	N.S.
RCA	52 (73.2%)	65 (77.4%)	N.S.
Diagonal	19 (26.7%)	28 (33.3%)	N.S.

*Values are presented as number (%) or mean ±SD, as indicated. * = Chi-Square test or independent samples T test, as indicated. CPB: cardiopulmonary bypass; LAD: left anterior descending; RCA: right coronary artery.*

Table 3. Showing operative data in group I and group II (n.155).

Postoperative outcome	Group I (n. 71) No.(%)	Group II (n. 84) No.(%)	P value*
Ejection fraction	32.8 ±2.8	57.5 ±5.3	0.002
NYHA class	1.5 ±0.7	1.3 ±0.5	0.002
Arrhythmia	15 (21%)	9 (10.8%)	N.S.
Renal impairment requiring dialysis	3 (4.2%)	1 (1.1%)	N.S.
Neurological deficit	2 (2.8%)	3 (3.6%)	N.S.
Infection	5 (7%)	8 (9.6%)	N.S.
Reoperation for bleeding	5 (7%)	6 (7.2%)	N.S.
Inotropic support	55 (77.5%)	39 (46.4%)	<0.001
IABP	24 (33.8%)	6 (7.1%)	<0.001
Stay on ICU (Hours)	58.3 ± 11.2	41.8 ±11.6	<0.001
Total Hospital Stay (d)	8.5 ±2	8.3 ±1.63	N.S.
Duration of ventilation	14 ±9.1	13 ±4.4	N.S.
Mortality	4 (5.6%)	2 (2.4%)	N.S.

*Values are presented as number (%) or mean ±SD, as indicated. * = Chi-Square test or independent T test, as indicated. IABP: intra-aortic balloon pump.*

Table 4. Comparison of postoperative events between the study groups.

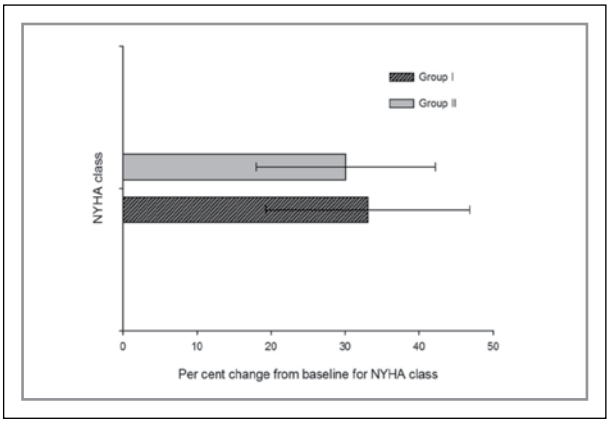

Fig 1. Showed the per cent change in NYHA class from the baseline. The degree of improvement in group I exceeds that of group II.

DISCUSSION

In general, the definition of LVD is unclear and variable across studies, and the choice of certain cut-off points of low EF, was not explained by those authors. Poor LV function (EF≤35%) was used in our study and other investigators [11,9,12]. Severe or advanced LVD (EF≤30% or <25%) cut off points were used by others [13,10]. The registry of the STS classified preoperative EF into 7 categories: Normal = >60%. Good function= 50-59%, mildly reduced = 45-49%, fair function = 40-44%, moderately reduced = 30-39%, poor function = 25-29%, severely reduced =< 25%.We have selected this cutoff point to include patients with both severely depressed and moderately depressed EF. [14]

BARI 2D trial has identified diabetes as a predictor of severity of left ventricular dysfunction in patients with coronary artery disease [15] and this might explain the higher incidence of diabetic patients in group I. Also the higher incidence of MI and heart failure in low function group provides logical explanation for LVD and confers with other studies.[16]

		Preoperative ±SD	Postoperative ±SD	Per cent change from baseline (95% CI)	P value for the difference Between groups
EF	*Group I*	31 ±2.6	32.8 ±2.8	6.9 (3.66 to 10.13)	<0.001
	Group II	57 ±5.9	57.5 ±5.3	1.8 (1.14 to 4.66)	Ns
NYHA	*Group I*	2.4 ±0.5	1.5 ±0.7	33.1 (26.22 to 39.98)	<0.001
	Group II	1.4 ±0.6	1.3 ±0.5	30.1 (24.07 to 36.24)	<0.001

95% CI = confidence interval.

Table 5. Comparison between Group I and group II as regards Ejection fraction and NYHA functional class.

None of the operations in this series was performed as an off-pump procedure. Avoiding global myocardial ischemia has certain theoretical advantages in the setting of severe LVD. However, meta-analysis of prospective randomized trials comparing on-pump and off-pump CABG has failed to document significant advantage of using the off-pump approach.[17]Moreover, off-pump CABG may increase late all-cause mortality. [18] Even observational clinical series focusing on the application of off-pump techniques in patients with low EF have found no difference in early morbidity and mortality between both techniques.[16]

There was an increase in the mean cardiopulmonary bypass time in group I compared to group II. This might be due to longer time needed for inotropes to reach full effect and/or time for intra-aortic balloon insertion before coming off bypass. Similarly, Wu et al. reported significantly longer cardiopulmonary bypass in patients with LVEF < 35%. However, other investigators did not find any significant differences in patients with poor function.[9, 10,19]

We tend to use IABP liberally in patients who tend to require high doses of inotropic agents which explain the higher incidence of IABP usage in group I. Preoperative IABP insertion was recommended in patients with LVD to effectively control perioperative myocardial ischemia.[20]

There was a higher incidence inotropes usage in Low EF group and this was reflected on higher mean ICU stay. Similarly, Nemec et al. and Chong et al. have found that low cardiac output syndrome has a significantly higher incidence in patients with left ventricular dysfunction who underwent coronary artery bypass grafting.[21,22] Mounsey et al. concluded that, the chance of a patient spending < 24 hours in intensive care could be predicted by the left ventricular end diastolic pressure. [23]

In our series, there was better clinical improvement in patients with LVD than patients with normal function as reflected by more improvement in NYHA class and EF. This difference may be attributed to the presence of more hibernating tissues as a result of advanced ischemia in LVD. Several other authors have shown statistically significant improvement in EF and NYHA in patients undergoing CABG with poor function; furthermore Beanlands et al. attribute the improvement of EF to early revascularization. Those authors reported that, left ventricular ejection fraction increased significantly after early revascularization.[24,25,26]

In the present study in hospital mortality rate in patients with LVD was 5.6%. This rate is compared to most series[11,10,27]. The improved mortality rate observed in most recent series is related to multiple factors, including patient selection with viability studies and perioperative management[28,29]. In our series all patients in group I were subjected to viability studies, lack of objective evidence of viable myocardium in a dobutamine echo stress test was considered a contraindication for surgical revascularization in these patients. Other key factors that may account for the low operative mortality include liberal use of IABP, cardiopulmonary bypass, myocardial protection, pharmacological agents and anesthetic techniques improvements and insisting on complete revascularization.[4,6,9,16]

We were unable to identify independent predictors of hospital mortality in patients with low EF due to sample size limitation and therefore unable to reach statistical significance in multivariate analysis. Several other investigators have isolated many predictors of mortality However; the results should be interpreted with caution because of the relatively small sample sizes of these studies.

Trachiotis et al. found that predictors of mortality were older age, female sex, diabetes, severity of angina class, hypertension, and CHF. Mickleborough et al. showed that predictors of decreased survival were advanced age, functional symptom class IV, and poorly visualized coronary vessels unsuitable for CABG.[11,13]

Filsoufi et al has isolated Congestive heart failure, hemodynamic instability and preoperative intra-aortic balloon pump as independent predictors of hospital mortality. Topkara et al. reported age, hepatic failure, renal failure, previous myocardial infarction, reoperation, emergent procedures, female gender, and congestive heart failure as independent predictors of in-hospital mortality in the low EF group.[16,1]

Although short term advantage of CABG over medical treatment alone, has been proved, long term advantage is still controversial. Several studies has proven long term survival benefits,[11,16,30] however STICH trial comparing medical therapy alone with medical therapy plus CABG in patients with coronary artery disease and LVD has found no significant difference between the two study groups with respect to the primary end point of the rate of death from any cause. However, the rates of death from cardiovascular causes and hospitalization for cardiac causes were lower among patients assigned to CABG.[31]

There are some limitations in this study, first, this is a retrospective observational study and conclusions are limited in their application. There is no intermediate and long term follow up of the patients, but this is related to difficulty in follow up in Egyptian society. Also exclusion of patients with advanced co-morbidities although isolate the real impact of depressed function on the early outcome, it may exclude important substrate of patients. Finally the number of patients included in this study is small; however, most studies including patients with LVD are small in number.

In conclusion, CABG in patients with poor function can be performed with low mortality and morbidity, despite a higher need for inotropes, IABP and longer hospital stay. A non-inferiority clinical trial is needed to put into evidence those comparable outcomes.

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Right Antero-lateral Thoracotomy Versus Sternotomy For Repair of Atrial Septal Defect in Young Females

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Background: **The right antero-lateral thoracotomy (ALT) is an alternative to median sternotomy with more acceptable cosmetic results in the repair of atrial septal defect (ASD).**

Objective: **To evaluate correction of isolated atrial septal defect through a right lateral thoracotomy in selected female patients and compare it to sternotomy approach.**

Patients and Methods: **Sixty patients underwent repair of ASD through anterolateral thoracotomy (ALT) or stenotomy, between January 2008 and December 2010, divided into 2 groups and each group included 30 patients. In ALT group, skin incision was made in the submammary fold and chest was entered through 4th intercostal space. Complete cannulation for cardiopulmonary bypass was performed via the same incision. Deairing of the cardiac cavities was done by filling the heart and by resuming the ventilatory valsalva maneuver by root vent cannula. Operative data and in-hospital morbidity for all patients were reported. The patients were evaluated for both the cardiologic results (ASD closure) and the cosmetic results.**

Results: **There was a significant decrease in ICU and hospital stay durations in ALT when compared to sternotomy group ($p<0.05$). There were no major post-operative complications in ALT group, while one patient (3.3%) had postoperative mediastinitis in sternotomy group. Superficial wound infection was found in one patient (3.3%) in ALT group and in 2 patients (6.7%) in sternotomy group. Follow-up ranged from 3 to 12 months in both groups. All patients had NYHA-class I in ALT group, while 2 patients (6.7%) in sternotomy group had NYHA-class II. In ALT group 27 patients (90%) perceived the cosmetic results as good or excellent, while good or excellent cosmetic results was reported in 20 patients (66.7%) in sternotomy group ($p<0.05$).**

Conclusion: **The right anterolateral thoracotomy incision provides a safe and effective approach for the correction of the ASD in female patients.**

KEYWORDS: **Atrial septal defect (ASD), antero-lateral thoracotomy (ALT), sternotomy.**

Atrial septal defect (ASD) is one of the common cardiac malformations, approximately 6.7% [1]. The incidence of ASD being twice as great in female as in male patients, surgeons have always been inclined to find a cosmetically and psychologically more satisfying approach than the standard median sternotomy, considered by many as the gold standard approach [2].

In young girls closure of atrial septal defects through median sternotomy, often leaves an ugly scar on the anterior chest wall, which is cosmetically unacceptable. Modifications to avoid this scar lead to the use of a right anterolateral thoracotomy (ALT) [3], a posterolateral thoracotomy [4] or a transxiphid approach without a sternotomy [5].

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The right anterolateral thoracotomy is well suited for access to both atria and is safely used in some cardiac procedures other than ASD closure [3, 6]. Here we present the technique and results of correction of isolated atrial septal defect through a right lateral thoracotomy in selected female patients and compare this approach to sternotomy.

Patients and Methods

The study included two age and sex matched groups of 60 patients underwent repair of ASD through anterolateral thoracotomy (ALT) or stenotomy, between January 2008 and December 2010, at Nasser Medical Institute, Ain Shams university hospital, and Al-Minia university hospital. The ALT group included 30 female patients with mean age of 15.6 ± 6.8 years (ranging from 3 to 30 years), and the sternotomy group included another 30 female patients with mean age of 18.3 ± 6.1 years (ranging from 6 to 30 years). The study included children, and adult female patients (age<30 years) with isolated ASD. Exclusion criteria in ALT group included: complex ASD (Ostium primum, hemi-anomalous pulmonary venous connection (HAPVC) of left pulmonary veins); presence of associated cardiac condition; Obesity; and chest wall deformity.

Anaesthesia was induced with fentanyl and midazolam. Patient was intubated using single lumen cuffed endo tracheal tube of adequate size. Monitoring lines included left radial 20 G cannula, right internal jugular triple lumen cannula, urinary catheter, standard ECG leads, nasopharyngeal and rectal temperature probes. The patient was placed in the 30-degree anterolateral position with the right arm positioned lateral to the chest; the right groin was usually draped for potential femoral cannulation. Patient was stabilized with straps, taking care of the pressure points.

In ALT group, skin incision was made in the submammary fold and chest was entered through 4th intercostal space. The right lung was retracted laterally and pericardium was opened longitudinally anterior to the right phrenic nerve. Exposure was facilitated with stay sutures. Complete cannulation for cardiopulmonary bypass was performed via the same incision. Cardiopulmonary bypass was established under mild hypothermia (32°C) and the caval tapes were snared. The aorta was cross clamped in all cases and cardioplegic arrest was induced by cold blood cardioplegic solutions through the root cardioplegic cannula.

Right atriotomy was done and atrial septal defect was closed. Suturing of the patch was started at the inferior aspect of the defect and was finished superiorly, with bleeding of the left atrial blood into the right atrium. Deairing of the cardiac cavities was done by giggling the heart and by resuming the ventilatory valsalva maneuver by root vent cannula. The atriotomy was then closed, the caval snares were released, ventilation was resumed, and an aortic needle vent was connected to suction.

Defibrillation was accomplished, either spontaneously or by electrical shock, with brief aortic cross-clamping. Patients were weaned from CPB, one drain was inserted in the pericardium and another one was inserted in the base of right pleural cavity. After weaning from cardiopulmonary bypass, the pericardium was partially closed and the thoracotomy was closed in the usual fashion after placement of ventricular pacing electrodes and pericardial and right pleural drains.

Operative data and in-hospital morbidity for all patients were reported. After approval was granted by the local medical ethical committee, all patients were evaluated postoperatively in the follow-up study. The patients were evaluated for both the cardiologic results (ASD closure) and the cosmetic results.

Data are expressed as mean ± standard deviation (SD) or number and percent as appropriate. Continuous data were compared using Student's t test for paired and unpaired samples when appropriate. Proportions were compared using Chi-square analysis. For all tests, $p<0.05$ was considered significant.

Results

In ALT group, the repaired defects included 27 ostium secundum (central type), and 3 sinus venosus, while in sternotomy group, the repaired defects included 20 ostium secundum (OS),4 sinus venosus(superior type) and 6 Low septal defect (LSD).

Table (1) showing postoperative clinical outcome. Mean bypass times were 12.7 ± 5 minutes in ALT group and 13 ± 4 minutes in sternotomy group. There was no operative or late mortality in both groups. The mean duration of ventilation was 12.1 ± 8.5 hours in ALT group and 13 ± 8.4 hours in sternotomy group. There was a significant decrease in ICU and hospital stay durations in ALT when compared to sternotomy group ($p<0.05$). The mean stay in the intensive care unit (ICU) was 1.4 ± 0.5 days and 1.8 ± 0.7 days in sternotomy group. Mean hospital stay was 3 ± 1.4 days in ALT group and 4 ± 2.2 days in sternotomy group. There were no major post-operative complications in ALT group, while one patient (3.3%) had postoperative mediastinitis in sternotomy group. Minor post-operative complications like only superficial wound infection were found in one patient (3.3%) in ALT group and in 2 patients (6.7%) in sternotomy group. Follow-up ranged from 3 to 12 months in both groups. All patients were in normal sinus rhythm and free of symptoms, in New York Heart Association functional (NYHA) class I in ALT group, while 2 patients (6.7%) in sternotomy group had NYHA-class II.

Table (2) showing cosmetic results. In ALT group, the wounds healed well without any restriction of limb movement. The patients' subjective impressions were at least commensurate with the objective findings. Most of the patients (27; 90%) perceived the cosmetic results as good or excellent in ALT group, while good or excellent cosmetic results was reported in 20 patients (66.7%) in sternotomy group ($p<0.05$). No serious psychological problems related to the scar were found in both groups.

Variables	*ALT (N=30)*	*Sternotomy (N=30)*	*P-value*
Bypass time (min.)	12.7 ± 5	13 ± 4	0.79
Duration of ventilation (hours)	12.1 ± 8.5	13 ± 8.4	0.68
ICU stay (days)	1.4 ± 0.5	1.8 ± 0.7	0.01*
Hospital stay (days)	3 ± 1.4	4 ± 2.2	0.04*
Mediastinitis	0 (0%)	1 (3.3%)	0.31
Superficial wound infection	1 (3.3%)	2 (6.7%)	0.55
NYHA-class I	30 (100%)	29 (96.7%)	0.31

*ALT = Antero-lateral thoracotomy. ICU = Intensive care unit. NYHA = New York Heart Association functional. * : significant difference.*

Table 1. Postoperative clinical outcome.

Variables	*ALT (N=30)*	*Sternotomy (N=30)*	*P-value*
Excellent	17	12	0.19
Good	10	8	0.57
Moderate	3	10	0.02 *

*ALT = Antero-lateral thoracotomy. * : significant difference.*

Table 2. Cosmetic results.

Discussion

The median sternotomy is the standard approach for most intracardiac operations. However, an unsightly midline scar can cause psychological distress in young female patients[7]. Principally for cosmetic reasons, alternative operative approaches have been developed with better aesthetic results[3]. Anterolateral thoracotomy is one of the most frequently used incisions for closure of ASD in young female patients [8-10]. This approach yields excellent visualization and cosmoses for female patients [3, 11, 12].

As confirmed in the current study, the major advantage of this approach is to avoid of sternotomy and its complications (mediastinitis, osteomyieltis etc.), and the ideal cosmetic results. Other advantages were less postoperative complications, shorter postoperative hospital stay and early return to pre-operative status than similar conventional surgery.

In agreement with our findings, Massetti and colleagues [3], concluded that right thoracotomy incision is a safe alternative approach to median sternotomy to repair isolated atrial septal defect in young female patients. In that study, the in-hospital morbidity included three postpericardiotomy syndromes with one operative drainage for a moderate pericardial effusion (subxiphoid approach); 6 patients had supraventricular tachycardia in the early postoperative period. One patient presented with a symptomatic supraventricular arrhythmia and was treated medically for atrial flutter or fibrillation. Breast volume and symmetry and the character of the scar were evaluated objectively by a physician and subjectively by a multiple-choice questionnaire completed by the same patients. The answers suggested that the patients' subjective impressions were at least commensurate with the objective findings. Most of the patients perceived the cosmetic results as good or excellent. No serious psychological problems related to the scar were found.

In the study by Grinda and colleagues [2], there was no operative or late mortality, and no morbidity directly related to the thoracotomy approach. De Mulder and Vanermen pointed out that patient with an anterolateral thoracotomy for ASD closure has less pericardial adhesions, which is advantageous in case secondary operations for acquired heart diseases are necessary [13]. Similar results were obtained by Panos and colleagues [11], who found neither operative nor early mortality. All defects were successfully corrected. Mean bypass times were 12.37 ± 4.9 minutes for ASD defects and 47.5 ± 6.4 minutes for SV defects. The mean stay in the intensive care unit was 1.3±0.5 days. Most of the patients (86.3%) were fully satisfied with the cosmetic result.

In conclusion, ASD repair through right anterolateral lateral thoracotomy in female patients gives not only satisfactory surgical results and reduced postoperative hospital stay but also excellent cosmetic results.

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Redo Coronary Artery Bypass Grafting in Patients with impaired left ventricular systolic function

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Background: **Redo coronary artery bypass (CABG) has been increasing in frequency.**

Objective: **To assess early and mid-term outcome in patients with impaired ejection fraction (EF <40%) undergoing redo-coronary artery bypass grafting (CABG).**

Patients and Methods: **The study included 30 patients who had redo-CABG with left ventricular dysfunction (LVEF <40%). A standard operative approach was used in all cases. Redo-sternotomy was performed. The assessed early events included mortality rate, cerebrovascular accident (CVA), acute myocardial infarction (AMI), and any other evident complication. Dobutamine stress echocardiography (DSE) was used to evaluate myocardial viability and ischemia.**

Results: **The study included 25 male and 5 female patients with mean age of 61±8.1 years. Mean NYHA class was 2.3±1.2, and mean ejection fraction was 34±7%. An ischemic pattern was observed in 5±3 segments during DSE. Mean operative time was 212±51 min., mean cardiopulmonary bypass time was 86±36 min., mean cross-clamp time was 57±13 min. The used graft was right internal mammary artery (RIMA) in 18 (60%), saphenous vein grafts (SVGs) in 17 (56.7%), left internal mammary artery (LIMA) in 3 (10%). A significant improvement (>5%) in EF occurred in 16 (53.3%) patients, and heart failure symptoms improved significantly after revascularization as NYHA class decreased from 2.3±1.2 to 1.9±0.8(p<0.05). The overall early and mid-term mortality rate was 13.3%. The early postoperative complications included: stroke in 3.3%, myocardial infarction in 3.3%, renal failure in 3.3%, delayed recovery and prolonged ventilation in 6.7%, and there were no patients with deep sternal infection or postoperative bleeding. Mean in-hospital stay was 5.2 ± 2.9 days, and mean ICU stay was 23.6 ± 18.3 days.**

Conclusion: **Satisfactory early and mid-term outcome of redo CABG can be achieved in patients with impaired ejection fraction if reasonable management was performed. Substantial myocardial viability is associated with improvement in LVEF, heart failure symptoms. Further prospective large multicenter studies are recommended.**

Keywords: **Redo coronary artery bypass grafting (CABG), low ejection fraction, left ventricular dysfunction.**

Redo coronary artery bypass grafting (CABG) compromises a growing proportion of CABG in the current era of revascularization [1, 2], because of an increasing number of CABG [3, 4].

Intimal hyperplasia at the site of anastomosis between left internal mammary artery (LIMA) and left anterior descending artery (LAD) is not infrequently reported causing severe ischemic symptoms in some patients [1]. Recurrent angina refractory to medical therapy in patients having undergone prior CABG is an indication for repeat surgical revascularization [5].

Coronary revascularization in patients with left ventricular dysfunction (LVD) represents a high risk procedure [6]. This risk is even higher in patients who have undergone a coronary artery bypass grafting (redo-CABG) previously than in patients

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who are undergoing their first CABG [7, 8]. Therefore, the purpose of this study is to assess early and mid-term outcome in patients with moderate to severe LVD who undergoing redo-CABG.

Patients and Methods

This study included 30 patients with left ventricular dysfunction (LVEF <40%) who underwent redo-CABG, from January 2008 to December 2010 at Nasser Medical Institute, Ain Shams university hospital, and Al-Minia University Hospital, after ethical committee approval and patients' written informed consent.

Preoperative Evaluation

Preoperative variables were collected as follows: age; sex; previous myocardial infarction (MI); ventricular dysfunction (Ejection fraction <40%) assessed by echocardiography; New York Heart Association (NYHA) class; unstable angina; diabetes; hypertension; and chronic obstructive pulmonary disease (COPD) on medical treatment. The interval between operations was 8 ± 3 years (1-15 years). The reasons for redo-CABG were graft failure in 28 cases and development of a new native coronary artery disease on a non-bypassed coronary artery in 2(in addition to graft occlusion) . During the previous operations, LIMA was used in 17 cases and SVG was used in 28 (including overlap).

Before revascularization, all patients underwent dobutamine stress echocardiography (DSE) to be evaluated for myocardial viability and ischemia. Standard parasternal and apical views of the left ventricle were obtained at rest and at the end of each step of dobutamine infusion. In all patients, the presence of 4 or more viable segments indicated a substantial amount of viable myocardium [6].

Anesthesiological Management

All patients received a standard premedication (morphine 0.1 mg/kg i.m.; scopolamine 0.25 mg i.m.; diazepam per os when necessary) administered 1 h before surgery, had one large-bore i.v. catheter and a radial artery cannulated before induction of anesthesia; pulse oximetry, 5 leads ECG with automated ST segment analysis, central venous pressure (three-lumen catheter), capnometry and urine output were monitored as well. Temperature was monitored with a bladder or rectal probe. Induction of anesthesia was performed with fentanyl-propofol (or sufentanyl-midazolam in the low ejection fraction group) and orotracheal intubation facilitated by pancuronium (0.1mg/kg) in both groups. Anesthesia was maintained with propofol (2-4 mg/kg/h) and isoflurane [end tidal concentration <1 minimum alveolar concentration (MAC)] and top up doses of fentanyl up to a total of 25 μg/kg. Heparin-bonded circuits were routinely used. Heparin 3 mg/kg was administered in order to keep an activated clotting time (ACT) >480s. Ante grade cardioplegia was used to arrest the heart, then cardioplegia is administered and given every 20 to 30 minutes during myocardial ischemia.

Operative Technique

A standard operative approach was used in all cases. Redo-sternotomy was performed and dissection was commenced at the base of the heart progressing upwards to expose the right atrium and aorta to allow cannulation for cardiopulmonary bypass, taking care not to damage previous bypass grafts. If patent pedicled arterial grafts were present they were identified and preserved but not occluded for the purpose of the operation. Radial artery grafts were only used if there was no venous conduit available to be harvested, explaining the small numbers employed in this series. Dissection was carried out with diathermy except near patent pedicled IMA grafts where sharp dissection was used.

Postoperative Care

At the end of surgery patients were maintained mechanically ventilated, sedated with propofol (2 mg/kg/h), and transferred to the Intensive Care Unit. Extubation and discharge from ICU followed clinical criteria. The assessed early events included mortality rate, cerebrovascular accident (CVA), acute myocardial infarction (AMI), and any other evident complication.

Statistical Analysis

All data were expressed as mean ± standard deviation (SD) or number and percent as appropriate. Continuous data were compared using Student's t test for paired and unpaired samples when appropriate. For all tests, $p<0.05$ was considered significant.

Results

Preoperative characteristics of redo-CABG are shown in Table 1. There were 25 male and 5 female patients with mean age of 61±8.1 years. Among the studied 30 patients, there were 26 (86.6%) had a history of previous AMI, 5 (16.6%) had unstable angina, 4 (13.3%) had diabetes, 18 (60%) had hypertension, 24 (80%) had hyperlipidemia, 4 (13.3%) had COPD, 6 (20%) had a history of smoking, 5 (16.7%) had left main disease, 3 (10%) had one vessel disease, 10 (33.3%) had 2 vessels disease, and 17 (56.7%) had 3 vessels disease. Mean NYHA class was 2.3±1.2, and mean ejection fraction was 34±7%. During DSE, an ischemic pattern (biphasic response or worsening of wall motion) was observed in 5±3 segments.

Operative details are listed in Table 2. The mean operative time was 212±51 min., mean cardiopulmonary bypass time was 86±36 min., mean cross-clamp time was 57±13 min. Mean anastomoses per patient was 2±1.1. The used graft was right

internal mammary artery (RIMA) in 18 (60%), saphenous vein grafts (SVGs) in 17 (56.7%), left internal mammary artery (LIMA) in 3 (10%). Bilateral internal mammary artery (BIMA) grafts were not used in any patient.

Early postoperative outcomes after redo-CABG are shown in Table 3. A significant improvement (>5%) in EF occurred in 16 (53.3%) patients, and heart failure symptoms improved significantly after revascularization as NYHA class decreased from 2.3±1.2 to 1.9±0.8; p<0.05). The early and mid-term mortality rate was 13.3%, operative mortality rate was 6.7%, and the cardiac mortality rate was 6.7%. The intra-aortic balloon pump was used in 20%, and the need for inotropes was reported in 86.7% of the studied patients. The early postoperative complications included: stroke in 3.3%, myocardial infarction in 3.3%, renal failure in 3.3%, prolonged ventilation in 6.7%, and there were no patients with deep sternal infection or postoperative bleeding. Mean in-hospital stay was 5.2±2.9 days, and mean ICU stay was 23.6 ± 18.3 days.

Variables	*Redo-CABG (N=30)*
Age (years), mean	61±8.1
Sex (M/F)	25/5
Previous AMI	26 (86.6%)
NYHA class, mean	2.3±1.2
Unstable angina	5 (16.6%)
Diabetes	4 (13.3%)
Hypertension	18 (60%)
Hyperlipidemia	24 (80%)
COPD	4 (13.3%)
Smoking	6 (20%)
Ejection Fraction, mean	34±7
Left main disease	5 (16.7%)
1 vessel disease	3 (10%)
2 vessels disease	10 (33.3%)
3 vessels disease	17 (56.7%)
Ischemic pattern on DSE	5±3

NS = non significant. Male = male, F = Female, AMI = Acute myocardial infarction, NYHA = New York Heart Association, COPD = chronic obstructive pulmonary disease. DSE = Dobutamine Stress Echocardiography.

Table 1. Preoperative characteristics of patients underwent redo-CABG.

Variables	*Redo-CABG (N=30)*
Operative time (min.)	212±51
cardiopulmonary bypass time (min.)	86±36
Cross-clamp time (min.)	57±13
Anastomoses per patient	2±1.1
LIMA	3 (10%)
RIMA	18 (60%)
SVG(s)	17 (56.7%)
BIMA	0 (0%)

NS = non significant. LIMA = left internal mammary artery; RIMA = right internal mammary artery; SVG(s) = saphenous vein graft(s); BIMA = bilateral internal mammary artery

Table 2. Operative data of redo-CABG.

Variables	*Redo-CABG (N=30)*
Postoperative improvement (>5%) in EF	16 (53.3%)
Postoperative NYHA class, mean	1.9±0.8
Mortality (any cause)	4 (13.3%)
Operative mortality	2 (6.7%)
Hospital mortality	2 (6.7%)
IABP	6 (20%)
Inotropes	26 (86.7%)
Stroke	1 (3.3%)
Myocardial infarction	1 (3.3%)
Renal failure	1 (3.3%)
Deep sternal infection	0 (0%)
Prolonged ventilation	2 (6.7%)
Bleeding	0 (0%)
ICU stay (hours), mean	23.6 ± 18.3
In-hospital stay (days), mean	5.2 ± 2.9

NS = non significant. ICU = intensive care unit. EF = Ejection fraction. IABP = Intra-aortic balloon pump.

Table 3. Early postoperative outcomes after redo-CABG.

Discussion

A redo CABG provides several technical challenges that distinguish it from primary CABG. These obstacles include repeat sternotomy, injury to previous grafts or the heart during dissection, quality and availability of conduits, a calcified ascending aorta, and more-advanced coronary disease involving the native vessels. As a result, operative morbidity and mortality are increased during a redo CABG, with an operative mortality in most series of re-operations 3 to 5 times that for a primary CABG [9-11]. It is of the utmost importance that this operation be carefully planned [9, 12].

In the present study, midterm survival was excellent after redo-CABG (86.7%). Despite these improvements, operative mortality in redo-CABG (6.7%) is still considerable, nearly twice greater than for primary CABG. Early mortality of redo CABG was reported in literature to range from 1.8% to 16.7% [13, 14]. Although surgical risk is decreasing as a result of improved surgical experience and new technical strategies, many authors still report higher mortality and morbidity in redo than in the primary operation [15-17].

Patients undergoing coronary reoperation may have multiple sources of coronary perfusion, making myocardial protection a challenge. Because ante grade cardioplegia will not reach areas of the myocardium whose coronary blood flow is supplied by in situ grafts or occluded coronary arteries, retrograde cardioplegia is extremely useful. Borger and colleagues [18] reported retrograde cardioplegia significantly decreased hospital mortality in patients undergoing reoperative CABG. We first use full dose ante grade cardioplegia to arrest the heart, then randomized dose of cardioplegia is administered every 20 to 30 minutes during myocardial ischemia. if a vein graft is performed to the right coronary artery, we administer ante grade cardioplegia through the graft. Patent in situ grafts are clamped while the aorta is clamped to avoid washing out the cardioplegia and warming the heart. If in situ grafts cannot be clamped, the patient is systemically cooled [19].

Careful myocardial protection is one of the reasons that left ventricular dysfunction is no longer a risk factor for patients undergoing primary and reoperative CABG. Davierwala and colleagues [20] have also reported the decreasing importance of left ventricular dysfunction as a predictor of hospital mortality in patients undergoing CABG. In addition to better myocardial protection, improved perioperative management and revascularization of patients with hibernating (viable but dysfunctional) myocardium have contributed to decreased risk in patients with left ventricular dysfunction.

In this prospective study on patients who underwent redo-CABG based on preoperative viability testing, it seemed that revascularization of viable myocardium was associated with improvement in LVEF and heart failure symptoms (Postoperative NYHA class decreased). These findings are important as LVEF is an important determinant of prognosis[21], and improvement in heart failure symptoms is extremely important in terms of quality of life [6].

The strengths of our study are the contemporary prospective nature of the data hence, there is low potential for bias, particularly in the selection of patients for redo CABG, and that it is multicenter study and is therefore more likely to reflect clinical practice. The main limitations are the relatively small number of patients included, the lack of a control group of patients treated medically, and the short period of follow-up providing data only concerning early and mid-term outcome.

In conclusion, early and mid-term mortality after redo-CABG has decreased with increasing surgical experience. Although risk of redo-CABG has been consistently greater than that of primary CABG as published in literature, the difference has narrowed considerably, and risk of redo-CABG approaches that of primary CABG. Further prospective large multicenter studies are recommended.

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Multidetector CT an Giography as A Noninvasive Tool to Assess Graft Patency of Surgically Reconstructed Diffusely Diseased Coronary Arteries

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***BACKGROUND*: Long reconstruction of the diffusely diseased vessel may be useful surgical option for patients with diffuse coronaryarterydisease. Close and careful follow up of such subgroup of patients is mandatory. Invasive graft angiography serves as the diagnostic standard for follow up of graft patency for such extensive procedure; however, because of the risks, discomfort, and costs of a hospital stay, a noninvasive diagnostic tool is desirable. MDCT angiography is a noninvasive and safe alternative to assess graft patency in patients after CABG with reconstructed diffusely diseased vessels.**

***METHODS*: 25 patients with the diffusely diseased LAD underwenta long-segmental reconstruction procedure with a LITA graft.The diffusely diseased LAD was extensively incised, additional endarterectomy was performed if necessary, and then the LAD was reconstructed with an ITA graft in a longon-lay fashion. Postoperative MDCT angiography as a non-invasive single tool wasperformed in 25 asymptomatic patients to assess graft patency.**

***RESULTS*: The cohort consisted of 23 men (92%) and 2 women (8%). The mean age was 58.5 ± 9.2 years. The mean length ofthe arteriotomy incision was 3.5 ± 1.2cm. Endarterectomy was performed in 3 patients (12%). Perioperative MI was recorded among 1 patient (4%). While all arterial grafts 27 (100%) were classified as patent, 51 venous grafts (89%) were considered as patent where 11% of venous grafts were considered as non patent. All the significant stenosis were found in the body of venous graft.**

***CONCLUSION*: Extensive reconstruction of the diffusely diseased LAD usingan ITA graft could be performed safely with very encouraging results. MDCT angiography is an excellent non invasive tool not only to evaluate graft patency in the reconstructed LAD but also to detect other findings in asymptomatic patients with diffuse coronary artery disease for better and more close follow up.To our knowledge, this may be the first study to examine surgically reconstructed diffusely diseased LAD with MDCT .**

Recent refinements in percutaneous techniques have resultedin an increase in the numbers of patients with diffuse coronaryartery disease who are referred to cardiac surgeons. Long-segmentalreconstruction of the diffusely diseased left anterior descending (LAD) coronary artery with the left internal thoracic artery(LITA) has been shown to be beneficial for patients with diffusecoronaryartery disease. In the year 2000, we reported 2 years follow up of LAD reconstruction using standard coronary angiography (1). Invasive graft angiography serves as the diagnostic standard for that purpose. However, because of the risks, discomfort, and costs of a hospital stay, a noninvasive diagnostic tool is desirable; Multidetector CT (MDCT) angiography is a noninvasive imaging technique that can be performed on ambulatory patients with extremely minimal risk and discomfort with lower cost of hospital stay than the standard angiography. To our knowledge, this may be the first study to examine this technique with such radiological modality.

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Methods

1. Study population and preoperative variables

This study is a prospective non-randomized study designed to assess the results of the coronary artery reconstruction using MDCT. 25 patients, 58±7 years old, of whom 2 were female, with diffuse and extensive disease of LAD were included in this study. Preoperative variables are shown in Table 1. Pre-operative intra-aortic balloon pump wasused in patients with severe LV dysfunction and or tight left main stenosis. There were no redo operations in thisseries.Preoperative echocardiogram showed severe LV dysfunction (EF below 35%) in 6 cases with 3 patients showed akinetic LAD territory but with preserved wall thickness. Pre-operative angiogram showed three-vessel disease in the majority of patients (88%) and 2 vessel- disease in only 3 patients (12%). Diffuse significant and extensive atheromatous lesions of the LAD were diagnosed before surgery and the reconstruction of LAD was planned in 22 patients (88%). There were 3 (12%) where extensive lesions were discovered at surgery and needed reconstruction.

2. Operative technique

CABG is the basis of the technique and reconstruction we prescribed before(1).A long arteriotomy is opened all along the diseased LAD .The ITA is prepared to carry out the anastomosis. The length ofthe ITA longitudinal incision is the same as the length of theLAD arteriotomy. Termino-lateral anastomosis betweenITA and LAD is made in such way as to reshape the LAD. The anastomosis part of the ITA is used as an arterial on-lay patch. Atheromatous plaques are excluded from LAD lumen andleft outside the anastomosis. It is not an endarterectomybecause atheromatous plaques are put outside the lumen of thereconstructed LAD and are not removed nor withdrawn from thearterial wall. The arterial suture line settles the ITA patchinside the LAD so that the major parts of the plaques are excludedfrom the LAD lumen. Finally, 75% of the new reconstructedLAD originates from the ITA wall and 25% from the native artery.The only modification that we adopted in our series is that the over and over running suture rather than the U-shaped running suture was employed, because we thought that the over and over suture was easier and faster than the U-shaped suture. Using such over and over suturing, we were careful not to disrupt the plaque with the needle. In 2 patients an open endarterectomy was necessary to complete the reconstruction in a proper way. The length of the CAR was 3.1±1.2 cm, Myocardial protection was antegrade/ retrograde cold blood cardioplegia with warm induction and hot shot. Postoperatively the patients were on aspirin and clopidogrel and prophylactic dose of enoxaparin for the hospital stay period and after discharging to home they were on aspirin and Plavix. Those with EF below 25% and those who underwent endarterectomy were on aspirinand oral anticoagulant.

3. Cardiac CT imaging technique and interpretation

All patients underwent postoperative cardiac CT using 64 multi-detector scanner (Light speed VCT; GE Healthcare, Milwaukee, WI, USA) with retrospective ECG gating in cranio-caudal direction (Table 1). A bolus of 80 ml of Iopromide (Ultravist 370 mg I/ml, Schering AG, Germany) was infused through 18-gauge intravenous anti-cubital vein catheter 'usually on the right arm' at a flow rate of 5 ml/s, followed by 50 ml of normal saline chasing bolus at a flow rate of 4 ml/s. The bolus tracking technique was used to synchronize the initiation of the scan with the arrival of contrast in the coronary arteries. During the monitor phase of the bolus tracking technique, axial scans were obtained at the level of the main pulmonary artery trunk and the cardiac scan was started when the degree of contrast enhancement in the ascending aorta just approached the level of enhancement in the pulmonary artery. The scanning volume extended from the level of the tracheal bifurcation down to the diaphragmatic surface of the heart. Retrospective ECG gating reconstruction was obtained in 10 cardiac phases of the R-R interval period using slice thickness = 0.625 mm and reconstruction interval = 0.625 mms. Volumetric imaging data was reviewed on external workstation (Advantage Workstation 4.5.; GE Healthcare, Milwaukee, WI, USA) using Card IQ Xpress software GE healthcare. Volume-rendered images were initially used to visualize the course of the grafts in relation to the coronary arteries. Curved multiplanar reconstructions were used to identify and to classify lesions into significantly diseased or not. Coronary arteries and grafts were evaluated for the presence of a haemodynamically significant stenosis which was defined as a reduction of the lumen diameter by ≥ 50%. All patients were in sinus rhythm. Heart rate below 70 beats per minute was achieved with only oral medication before CT angiography. Beta blocker administration was required in all patients to decrease the heart rate to the desired level. Ivabradine was added to beta blocker in some cases to achieve the desired heart rate. The mean heart rate of the patients was62 ± 3 beats/min.

Results

1. Study population

MDCT were performed without complications in any patient.The study population consisted of 25 patients with CABG who completed the MSCT protocol. A total of the 86 grafts, consisting of 59 venous grafts and 27 arterial grafts (24 LIMA and 3 RIMA grafts) were evaluated, all these grafts were assessed for patency and occlusion using 64-slice CT.3 patients(12%) had 2 grafts, 11patients (44%) had 3 grafts, 8 patients (32%) had 4 grafts, and 3 patients (12%) had 5 grafts.Average no of grafts per patient was 3.44.

Grafts, n	Patency rate, (%)
LIMA to LAD (24/27)	100%
RIMA to LAD (1/27)	100%
RIMA to Cx (2/27)	100%

LIMA = left internal mammary artery; Cx= left circumflex; RIMA = right internal mammary artery;

Table 1. Patency rate of arterial coronary grafts

Grafts, n	Patency rate, n(%), Total patency rate (89%)
SVG to Cx (39/57)	2 (5%)
SVG to RCA or PDA (15/57)	4 (26.5%)
SVG to Diagonal (3/57)	1/3 (33.3%)

RCA = right coronary artery; PDA (posterior descending artery), SVG = saphenous vein graft

Table 1. Patency rate of venous coronary grafts

2 . Patency rate of arterial grafts

Of the 27 arterial grafts, 25 (92%) grafts were anastomosed to the left anterior descending artery (LAD) and 2 (8%) were anastomosed to left circumflex coronary artery .The arterial grafts consisted of24LIMA to LAD as pedicled grafts. 3 RIMA as following, 2 RIMA to left circumflex, 1 as simple anastomosis and the other one was used to reconstruct short segment (2 cm) of obtuse marginal. The third RIMA was implanted into LIMA and used to reconstruct LAD .Of the 57 venous grafts, 39 were anastomosed to left circumflex, 15 to RCA and its tributaries, and 3 to diagonal coronary arteries.Radial arteries were not used in this series.

3. According to MSCT

All arterial grafts (100%) were classified as patent (Figure 1-2); while 51 venous graft (89%) were considered as patent. All the significant stenosis were found in the body of venous grafts (Figure 3). (Table1- table 2)

Discussion

The major goal of coronary artery bypass surgery is to achieve complete revascularization of diseased arteries. In the presence of diffusely diseased coronary arteries, it has been reported that incomplete revascularization of the left anterior descending artery (LAD) results in higher mortality than when other coronary arteries are left ungrafted(2). Conventional

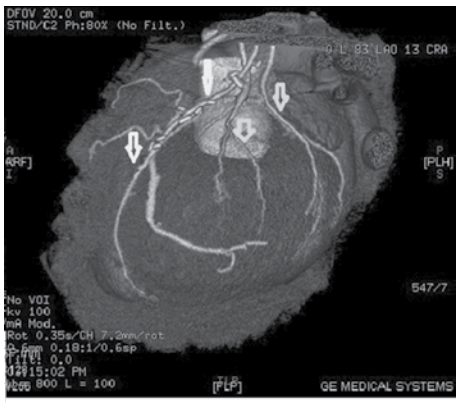

Figure 1. Volume-rendered image showing reconstructed segment of LAD (between the 2 yellow arrows). Green arrows show venous grafts to intermediate and OM coronary arteries.

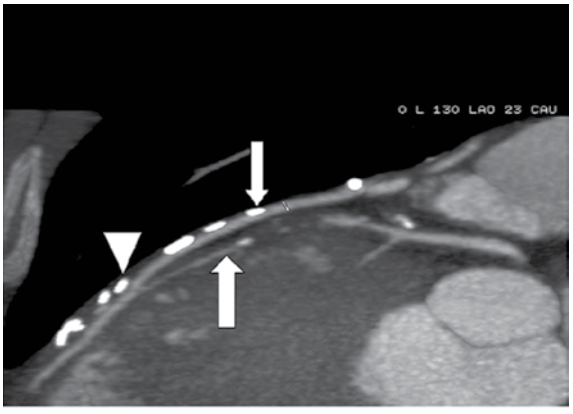

Figure 2. Curved multiplanar reconstructed image showing LIMA (down arrow),LIMA is joining LAD, start of reconstructed segment. Notice the smooth joining of LIMA to LAD (arrow head). Diffusely diseased LAD proximal to reconstructed segment (up arrow)

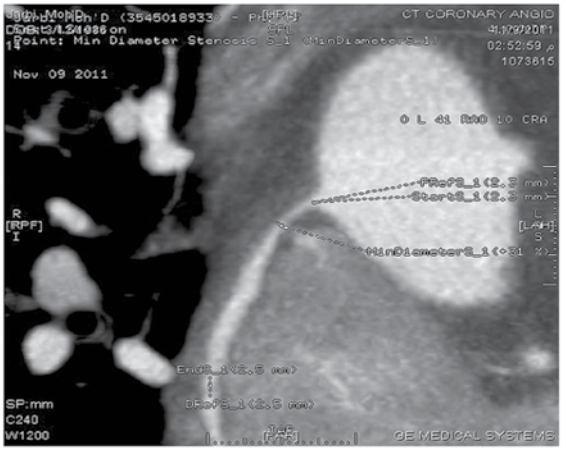

Figure 3. Curved multiplanar reconstructed image shows 70% proximal stenosis just after the hood of SVG bypassing the PDA.

grafting to the distal LAD alone would not perfuse the diseased and more proximal segments.

Although percutaneous coronary intervention has been progressively increasing, percutaneous implantation of bare-metal stents is associated with high rates of restenosis [3-5]. Although the use of drug-eluting stents (DES) has diminished the relationship between stent length and restenosis [6-8], however, very long segmental implantation of DES into a diffusely diseased coronary artery carries a risk of compromising the flow in the side branches with multiple stents. In particular, many diagonal and septal branches exist in the left anterior descending artery (LAD). Tsagalou and colleagues [9] reported that 16.6% of patients had in-hospital non–Q-wave myocardial infarctions after multiple DES implantations in the LAD. They also reported that 19.6% of patients had binary restenosis at the 6-month follow-up coronary angiography. For that reason, long reconstruction is one of the well known methods for treating severely or diffusely diseased coronary arteries [10-12]. The greatest advantage of this method is that the myocardium supplied by the side branches of the diffusely diseased coronary artery can be revascularized simultaneously.

Postoperative assessment of such surgical technique is important especially in symptomatic patients. Coronary angiography (CAG) is the current gold standard for the evaluation of bypass graft patency and stenosis. However, the main drawbacks of conventional coronary angiography for this purpose include invasiveness, patient discomfort, and risk of complications such as arrhythmia, graft dissection, myocardial infarction, and embolic events(13). Furthermore,in CAG, the engagement and visualization of venous and arterial bypass grafts frequently prolongs procedure time and is associated with larger contrast use and increased radiation exposure. Additionally, the cost considerations of a procedure unsuited for an outpatient setting makes CAG is not the ideal procedure for such purpose. For all these reasons, a less invasive imaging modality is desirable for evaluation of patients suspected of having graft stenosis or occlusion or to follow up complex surgical technique. Promising results for bypass patency evaluation were reported with the first-generation (four- and eight-section) multisection CT scanners, but there was a major limitation related to the presence of a large number of unassessable grafts because of motion artifact, presence of surgical wires or clips, and heavy calcification (14). The introduction of 16- and, more recently, 64-section scanners promises to reduce the number of unassessable grafts, improving the diagnostic accuracy of multisection CT for helping detect graft disease. Numerous studies comparing the accuracy of multi-detector (64-row) computed tomography (64-MDCT) assessment of coronary graft patency and stenosis with that of CAG have shown that 64-MDCT is a reliable diagnostic tool and less invasive than CAG.The reported performance of coronary CT angiography (CTA) using the current 64-MDCT scanners approaches that of invasive coronary angiography (15-16). The use of multi–detector row CT is gaining increasing acceptance for noninvasive cardiac imaging. Several studies have demonstrated successful application of multi–detector row CT angiography for assessment of coronary artery disease and evaluation of cardiac valves (6–10). Ropers et al (17) demonstrated feasibility of retrospectively ECG-gated multi–detector row CT angiography for evaluation of coronary artery bypass graft patency and stenosis. Although Ropers et al reported a high diagnostic accuracy; various artifacts prevented a large number of grafts from being evaluated diagnostically. Among other artifacts, motion-related artifacts are in general a critical issue when using retrospectively ECG-gated multi–detector row CT angiography for evaluation of the coronary arteries. When imaging coronary artery bypass grafts, this is especially true for the distal graft anastomosis, where analysis is often limited even with the high temporal and spatial resolution provided by multi–detector row CT angiography (17).

In our study, it was easy and practical option to perform CT angiography to evaluate surgical reconstruction technique to manage diffusely diseased coronary arteries. From the ethical point of view, it was not difficult to convince asymptomatic patients to accept such non invasive CT scan procedure as we explained to our patients the safety of the CT scan procedure and its great benefits to both the surgeon in one arm as a good and scientific feedback and to the patient on the other arm as reassuring tool regarding efficacy of the surgical procedure they have had received.

In our series, we got extremely successful results regarding the patency rate of LIMA to LAD anastomosis (100%) which could be deceiving results as we did only small number of patients with short term follow up. With more patients and longer follow up we could have occluded arterial grafts. However,this early extremely excellent results for such complex procedure, is encouraging to us and other surgeons who are reluctant to do such technique to adopt and continue performing such procedure.The incidental finding of stenosed or non patent SVG in otherwise asymptomatic patients could be of great benefits for close follow up of such patients

Conclusion

Extensive reconstruction of the diffusely diseased LAD using an ITA graft could be performed safely with very encouraging results. MDCT angiography is an excellent non invasive tool not only to evaluate graft patency in the reconstructed LAD but also to detect other findings in asymptomatic patients with diffuse coronary artery disease for better and more close follow up.

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Tricuspid Valve Annuloplasty With Two Flexible Prosthetic Bands

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This research is designed to evaluate early and mid-term results of applying two flexible prosthetic bands to the tricuspid annulus for repair of severe and moderate to severe tricuspid regurgitation. Between July 2007 and May 2009, 50 consecutive patients with significant tricuspid regurgitation and dilatation of the right-sided cardiac chambers underwent tricuspid valve annuloplasty with the two bands' technique and concomitant mitral valve surgery. Thirty patients (60%) were in NYHA class III or IV, and 24 (48%) had a history of right sided heart failure. Follow-up was 24 months. Two late re-operations were required, one for mitral endocarditis and the other for stuck mitral prosthesis in a pregnant lady. NYHA class decreased in survivors and the symptoms of right sided heart failure improved significantly after surgery. Tricuspid regurgitation was mild or absent in 44 survivors (88%), moderate in 4 (8%) and moderate to severe in 2 cases(4%). Regurgitation significantly decreased even in patients with risk factors for tricuspid repair failure or with persistent left ventricular dysfunction. The 2-years' follow up exhibited freedom from tricuspid regurgitation in 88% of the research population. Preoperative tricuspid regurgitation higher than grade II, right ventricular fractional shortening < 35%, permanent pacemaker and severer pulmonary hypertension constituted risk factors of recurrent moderate or severe tricuspid regurgitation.

KEYWORDS: Echocardiography; Heart valves; Mitral valve; Tricuspid valve.

Cardiovascular

Attacking significant tricuspid regurgitation (TR) consequent to left sided valve lesions-commonly mitral valve disease is a founded milestone in cardiac surgery , and the application of annuloplasty devices for tricuspid repair is no longer disputed (1). On the contrary of wide number of mitral valve repair devices, the choice of annuloplasty rings and bands used to repair regurgitant tricuspid valves is quite limited (2).

One of the simplest and most effective techniques to correct TR is the De Vega suture annuloplasty , although this technique was and still widely valid,yet it is very subjective and unclear how to size the final tricuspid orifice(3).

This study is a descriptive analytical research designed to evaluate early clinical and echocardiographic results of tricuspid valve annuloplasty with two flexible prosthetic bands , a technique applied to our group of patients with tricuspid incompetence secondary to left sided valve disease .

Patients and methods

From July 2007 to May 2009, 50 patients with severe or moderate to severe TR and dilatation of the right-sided cardiac chambers due to mitral valve disease (on maximum diuretic therapy) underwent tricuspid repair using the 2 bands' technique. Surgical indications were moderate or severe tricuspid regurge or any degree of tricuspid regurge in the presence of dilated right ventricle (>35 mm at TEE or TTE) and/or severe annular dilatation (>35 mm TTE). All patients had contemporary left sided valve surgery either repair or replacement.

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Concomitant left sided valve disease consisted of double valve disease in 17 cases (34%),isolated mitral stenosis in 15 cases(30%), isolated mitral incompetence in 6 cases (12%), and mixed mitral valve disease in the remaining 12 patients (24%). The etiology was rheumatic in 45 cases (90%), degenerative in 2 patients (4%) and failure of previous repair in 3 cases (6%). Thirty patients (60%) were in New York Heart Association (NYHA) functional class III or IV, and 24 (48%) had a history of right sided heart failure. Permanent or paroxysmal atrial fibrillation was recorded in 78% of cases. Additional demographic and clinical descriptors are shown in Table 1. Operative risk stratification was estimated by the logistic European System for Cardiac Operative Risk Evaluation (EuroSCORE) model.

Our work was conducted as a descriptive analytical research in which all patients were subjected to echocardiographic evaluation of the tricuspid valve and the right heart at 4 successive stations;

- Station 1: preoperative conventional transthoracic echocardiography [TTE].
- Station 2: intraoperative transesophageal echocardiography [TEE] at 2 time split interval [T1]&[T2].
- Station 3: early postoperative transthoracic echocardiography after transferring the patient from the ICU.
- Station 4: short term postoperative transthoracic echocardiography 6-12 month after surgery.

TEE data was collected at 2 intervals during surgery while keeping the mean blood preasure above 70 mmhg and the central venous preasure above 7 cm water.

[1] Pre-CPB after median sternotomy [before aorto-bicaval cannulation] [T1]

[2] Post-CPB 10 minutes after weaning from bypass [T2]

Echocardiographic data included:

- Jet area in cm^2
- Vena contracta which measures the narrowest distance of the tricuspid jet in mm
- Tricuspid annular plane systolic excursion (TAPSE),which measures the longitudinal systolic motion of the free edge of the tricuspid valve annulus.
- Tricuspid valve annular size at diastole.
- Peak and mean gradients across the tricuspid valve after weaning from bypass which are measured to insure the proposed technique did not induce tricuspid stenosis due to excessive annular downsizing .

Accordingly, tricuspid regurgitation was assessed using Doppler color-flow imaging and graded as follows:

- Grade 0 : absent (no tricuspid regurgitant jet).
- Grade I: mild (regurgitant jet area <4cm2);
- Grade II: moderate (regurgitant jet area >4 cm2 but <8 cm2);
- Grade III: moderately severe (regurgitant jet area >8 cm2);
- Grade IV: severe (regurgitant jet area >8 cm2 and reverse systolic blood flow into the hepatic veins).

Data	*Value*
Age	*42 ± 8.2*
Female gender	*32(64%)*
NYHA functional class II NYHA functional class III NYHA functional class IV	*20(40%)* *22(44%)* *8(16%)*
Palpable hepatomegaly	*42(84%)*
Jugular venous distension	*40(80%)*
Hepatojugular reflux	*20(40%)*
Peripheral edema	*21(42%)*
Pulsatile liver	*16(32%)*
Ascites	*16(32%)*
Atrial fibrillation	*37(74%)*
Permanent pacemaker	*3(6%)*
TR grade 1	-
TR grade 2	-
TR grade 3	*16(32%)*
TR grade 4	*34(68%)*
Right ventricular FS < 35%	*12(24%)*
Left ventricular EF	*52.4 ± 17.4*
PASP	*55.3 ± 13.2*
Urgent or emergency surgical priority Logistic EuroSCORE	*7.9 ± 6.7*

Values are absolute number of cases with percentages in brackets, or mean±S.D.

EF, ejection fraction; EuroSCORE, European system for cardiac operative risk evaluation;

NYHA, New York Heart Association; PASP, pulmonary artery systolic pressure; FS, fractional shortening

TR,tricuspid regurgitation.

Table 1. Research

All our research population stood in the range of grade III-IV regurgitation.

At operation, tricuspid sizing was performed using mitral sizer # 25 to gauge the tricuspid effective orifice while performing our 2 band technique as Calafiory did in his single long band technique (3). We used 2 bands made of (in most cases) PTFE adjusted to measure 2.5 cm(± 3 mm) each. selected annuloplasty band was then implanted onto the tricuspid annulus by U shaped 4-0 monofilament(prolene) sutures placed circumferentially along the hinge of the anterior and posterior leaflets.

Annular plication was obtained by passing the suture ends closer to each other onto the band compared to the corresponding bites in the annulus.The first prolene suture is passed through the tricuspid annulus at a level that is located 4-5 mm beyond the anteroseptal commisure towards the septal annulus, we did this to attach the whole repair composite to the fibrous skeleton of the heart which, as we thought,may offer better longevity and more stability to our technique.The rest of the septal annulus is spared to avoid injury to the conduction system and also because it is not expected dilate.

Competence of the tricuspid valve was then assessed intra-operatively both grossly by observing the cusps coaptation during the ventricular contraction as the heart is standardly deaired and aorta declamped in the middle of the procedure and radiologically by intra- operative trans–oesophageal echocardiography.

population pre-operative demography

Worth mentioning, concomitant surgical procedures were performed in all patients, By definition, all patients had a mitral procedure consisting of valve repair in 4 cases (8%), valve replacement in 46 cases (92%). In addition, aortic valve replacement was performed in all 17 patients with double valve disease (34%), and coronary artery bypass grafting in 3 cases(6%).

Statistical analysis

Values are expressed as absolute number of cases with percentage, or mean±S.D. Continuous variables were compared by the Student t or Mann–Whitney U-test, and categorical variables by using Fisher exact test where appropriate. Statistical significance was graded according to Blackstone and a P value < 0.05 is considered statistically significant.

Results

Two patients (4%) died within 10 days from operation, the cause being low cardiac output in one and multiple organ failure in the other. Their logistic EuroSCORE was 64.2%, 33.8%, respectively. Length of stay in the intensive care unit and total postoperative hospital stay for survivors averaged 2.2 ± 2.8 days (range 1–15, median 2) and 10.8 ± 7.5 days, respectively. One patient died of myocardial infarction one year after the operation, with no TR at the 6- months postoperative echocardiographic assessment.

The 2-year survival (including in-hospital deaths) was 96%. Two patients successfully underwent redo mitral valve replacement one for stuck mitral prosthesis in a pregnant lady 10 months after surgery and the other for bacterial endocarditis one year after valve replacement, in both cases, mild recurrent TR disappeared after redo surgery, atrioventricular conduction defect necessitating permanent pacing was encountered in a single case, but no other complications were recorded during follow-up.

TEE data	*Pre-CPB after median sternotomy (T1)*	*Post-CPB 10 minutes after weaning from bypass (T2)*	*P-value*
Jet area	*9.88 ± 2.487*	*1.02 ± 0.831*	*< 0.01*
Vena contracta	*8.08 ± 1.23*	*0.708 ± 0.55*	*< 0.01*
TAPSE	*16.28 ± 3.1*	*15.16 ± 2.6*	*0.03*
Annular size	*46.64 ± 3.65*	*26.12 ± 1.77*	*< 0.01*
PG		*5.6752 ± 2.14*	
MG		*3.4 ± 1.2*	

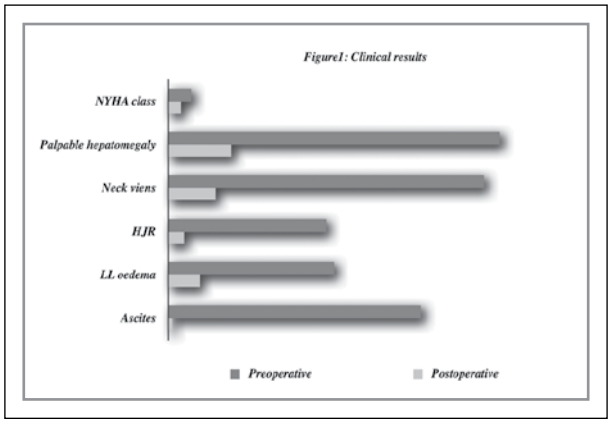
Values are mean±S.D. TAPSE; tricuspid annular plane systolic excursion .

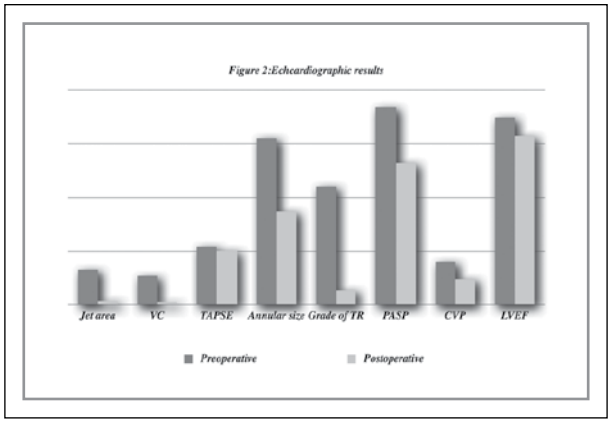
PG; peak gradient across the tricuspid valve, MG; mean gradient across the tricuspid valve.

Table 2: TEE intraoperative data

In survivors,(Fig.1) NYHA class decreased from 2.9 ± 0.6 to 1.6 ± 0.4 (P<0.0001). The symptoms of right heart failure improved significantly after surgery and almost vanished in 34 patients. Palpable hepatomegaly was still present in 4 patients (8% vs. 42% preoperative, P=0.034), jugular venous distension in 3 cases (6% vs. 40% preoperative, P=0.0051), hepatojugular reflux in one (2.0% vs. 20% preoperative, P=0.0079), and lower limb edema in

2 patients (4% vs. 21% preoperative, P=0.0029). Pulsatile liver and ascites were no longer seen after surgery (P=0.026). Three patients changed their atrial fibrillation into sinus rhythm,out of them two regained fibrillation rhythm during their hospital stay.





During follow-up, (Fig.2) the left ventricular ejection fraction decreased from 52.4 ± 17.4 to 47.3% ± 8.2% (P=0.063) and central venous pressure pressure from 12.1± 3.1 mmHg to

7.1± 1.8 mmHg (P<0.002). The pulmonary artery systolic pressure decreased from

55.3 ± 13.2 mmHg to 39.6 ± 8.9 mmHg (P=0.0075) . The mean grade of TR decreased from

3.3± 0.3 preoperatively to 0.4 ± 0.7 at follow-up (P<0.0001). The severity of TR persisted in 3 patients (6%). Regurgitation was mild or absent in 45 survivors (90%) and moderate in 2 (4%). By univariable analysis,the propable risk factors for repair failure or recurrence of TR include preoperative TR grade >2, right ventricular dysfunction(FS<35%), and permanent pacemaker (P=0.069, 0.056, and 0.1, respectively).

Two-year actuarial freedom from TR grade >1 was 90% . However,there was no significant statistical correlation between the degree TR and recession of manifestations of right sided heart failure.

For a long time it has been thought that functional tricuspid regurge was strictly related to the left sided lesions and could be reversed spontaneously after surgical correction of left sided pathology, however dilatation of the tricuspid annulus depends on many factors, mainly on right venticular dilatation , that can be totally or partially reversible or may not reverse at all, being additionally related to the pulmonary artery preasure (4). Dreyfus et al .demonstrated that 45% of patients who underwent isolated mitral valve surgery with grade 1/4 or 2/4 TR, showed an increase in the degree of TR of at least 2 grades after almost 5 years from surgery.(5)

Moreover,significant TR secondary to right ventricular dilatation and dysfunction associated with mitral valve disease is a risk factor for mortality and cardiac morbidity after mitral surgery (6) Satisfactory correction of left sided valve disease does not assure persistence or even worsening of TR (7). On the other hand, reoperations to correct residual or recurrent TR have been associated with high operative mortality & discouraging long term results (8).

When the extremes of severity are excluded , a single semiquantitative ultrasonographic assessment of regurgitation severity remains a cardinal but probably insufficient tool, as it is seriously affected by various variables such as the circulating blood volume, pulmonary vascular resistances, right ventricular volume and contractility and intensity of medical treatment. Perhaps, more weight should be given to historical clinical and echocardiographic assessment of tricuspid incompetence, to the history and the severity of symptoms of right heart failure, to the drugs and dosages necessary for their control, and to objective, direct (9) or ultrasonographic,measurements such as the dimensions of the right-sided cardiac chambers and tricuspid annulus, and to descriptors of right ventricular function. Still, tricuspid annular dimension, tricuspid valve tethering area, and right ventricular eccentricity index are generally considered good ultrasonographic parameters to grade the severity of tricuspid incompetence (10).

Criteria for anatomical correction are not well established, even if based mainly on annular dilatation that plays an important role in developing tricuspid regurgitation. However, other factors can be important and difficult to control. Fukuda et al. underlined the importance of tethering height >0.76 cm and tethering area >1.63cm2 in early failure after TR (11).

From the surgical point of view, several techniques are available to correct TR. The simple suture annuloplasty is easy and effective, but reports of recurrence approached 34% of survivors at midterm follow-up. Many authors nominated simple suture annuloplasty as a risk factor for tricuspid repair failure (12).

Perhaps, suture annuloplasty is reliable when used for minor degrees of TR in the absence of right heart dilatation. On the other hand, prosthetic annuloplasty remodels the annulus, decreases tension on suture lines, increases leaflet coaptation, and prevents recurrent annular dilatation (13), many reasons prefer prosthetic over simple suture annuloplasty in the presence of risk factors for tricuspid repair failure, such as significant right heart dilatation and dysfunction (14).

However, there are no reports in the literature demonstrating any differential effect of ring versus band designs and their mechanical properties on both the right ventricular function and the tricuspid valve efficiency. But it is now widely admitted that flexible band design corrects excess lengthening of the tricuspid annulus corresponding to the right ventricular free wall, i.e. along the anterior and posterior leaflets hinge, and theoretically allows annular and ventricular shape changes throughout the cardiac cycle(15). Spherical remodeling of the overloaded right ventricle may cause the septum-parietal dimension to preferentially increase, similar to what happens to the left ventricle with cardiomyopathy. That why some surgeons do prefer rigid rings in that setting(16).

The concept of using # 25 sizer to remodel the tricuspid annulus is attractive as the final orifice shows low gradient and good coaptation of tricuspid leaflets, however, we are aware that higher degrees of TR and severe annular dilatation are risks for return of TR and that is why we decided to use 2 flexible bands the length of each is adjusted to be 2.5 cm after tying the sutures to support annular downsizing and attach it to the fibrous skeleton of the heart .

The idea behind this is that the normal tricuspid valve annulus measures 78 mm, 18 mm of which is related to the septal leaflet which is not expected to dilate being an integral part of the fibrous skeleton of the heart, so after the repair we expect that the length of the tricuspid annulus will be more or less normal.

Conclusion

The proposed technique for tricuspid annuloplasty,although simple,yet,is cheaper and easier than ring repair, it preserves the valve normal dynamics in both annular & atrioventricular dimensions which is a drawback of the rigid rings, it also allows the surgeon to take the decision were to take the first stitch 4-5 mm beyond the anteroseptal commisure which achieving better annular downsizing and fixing the repair composite to the fibrous skeleton of the heart giving our technique its expected long term durability when compared to stitch annuloplasty & flexible incomplete rings.

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Midterm Result of Mitral Valve Surgery for Chronic ischemic Severe Mitral Regurgitation: Is Mitral Repair Superior To Replacement?

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BACKGROUND: **The aim of this study is to compare midterm survival rate following mitral valve repair and replacement for sever chronic ischemic mitral regurgitation due to left ventricular dysfunction (IMR).**

Methods: **From March 2010 to March 2012, a total of 50 patients with severe chronic ischemic mitral regurgitation underwent either valve repair (n =25) or valve replacement (n = 25). Patients to undergo repair and replacement had functional mitral regurgitation due to ischemic wall motion abnormality, they undergone coronary revascularization with concomitant mitral valve surgery using internal thoracic artery as a graft in all the cases in addition to saphenous vien.**

Results: **The mean cross clamp time was 71.68±9.978in the repair group and 86.76±9.584 in the replacement group the mean no. of grafts was 2.96 in the repair group versus 3.16in the replacement group there was one case of mortality in each group. Within the propensity-matched better-risk group, survivals after valve replacement and repair was comparable at 3, 6, and 12 months period after surgery as been documented by follow-up echocardiography.**

Conclusion: **Late survival is poor after surgery for ischemic mitral regurgitation. Most patients with ischemic mitral regurgitation benefit from mitral valve repair or replacement .Midterm survivals after mitral valve repair or mitral valve replacement in sever chronic ischemic mitral regurgitation are similar.**

Abbreviations: **IAB= intraaortic balloon IMR =ischemic mitral regurgitation**

Chronic ischemic mitral valve regurgitation is of great concern for cardiac surgeon recently not only because of the high risk of morbidity and mortality among these cases, but because also of lack of longer term results for such cases. These cases represent 10-15% of cases presenting with coronary artery disease [1], they Carry unfavourable prognosis and ultimately end with congestive heart failure. Chronic ischemic mitral valve regurgitation is a condition occurring more than one week after myocardial infarction (MI) in which echocardiography show evidence of significant wall motion abnormalities in addition to coronary angiographic findings of critical coronary artery lesions, with no structural abnormality in the mitral valve apparatus. In this term case with sever acute mitral regurgitation with cardiogenic shock and those presenting with concomitant structural valve disease as rheumatic affection with coronary artery disease are not included in this respect. [2]

Chronic mitral valve regurgitation can be accurately diagnosed with trasthoracic echocardiography, this form the corner stone for diagnosis and delineate the exact pathology of the mitral valve to differentiate between cases with functional mitral valve regurgitation and those having regurgitation due to structural abnormalities, the use of trasesophageal echocardiography is not mandatory preoperatively, but it is more helpful for better description of the valve pathology [3].

Most surgeons now a days would attempts to correct moderate and severe mitral regurgitation by repair or replacement of the mitral valve , However in sever chronic ischemic mitral regurgitation , the risk and benefits of repair versus replacement still need to be assessed and still is controversial, the results in previous studies have shown

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a wide range of variation, this has been explained by the fact that misclassification of mitral valve pathology was a factor the distinguishing between purely ischemic cases ,and those with coronary artery disease and concomitant degenerative valve pathology is very important, most of the result before 2001 did not differentiate between truly ischemic mitral regurgitation and mitral regurgitation coexistent with CAD.[2]

Our aim is to assess which technique of mitral valve surgery is more beneficial in patients with ischemic chronic severe mitral valve regurgitation defined as chronic mitral regurgitation resulting from LV dysfunction and or scaring in the absence of other pathological valve disease , all patients had to have clinical and angiographical evidence of CAD ,Ischemic mitral regurgitation was defined as chronic MR due to papillary muscle infarction , scarring, dysfunction or delayed rupture of papillary muscle or leaflet tethering by left ventricular dysfunction .[7]

Patients and Methods

All the patients undergone surgery in Kaser Elaini hospital and new Kasr Elaini teaching hospital between March 2010 till March 2012. Patients datum were collected prospectively, they follow-up was done in outpatient clinic.

50 patients were eligible for this study and were randomly assigned to one of 2 groups by means of card allocation. The first group include 25 patient underwent mitral valve repair and concomitant CABG; the second group also included 25 patients underwent mitral valve replacement and CABG. Conventional cardiopulmonary bypass was employed with warm blood cardioplegic arrest of the heart, mitral valve was approached though the classic left atriotomy,mitral valve repair was done with the use of restrictive annuloplasty technique in all patients only 2 patient needed additional quadrangular resection of redundant posterior leaflet annuloplasty ring used was Carpentier Edward ring size 26 in 13 patients 28 in 11 patient and 30 in 1 patient, intraoperative transesophgeal echocardiographic assessment was done.

In the replacement group all patients received mechanical bileaflet valve 16 patient underwent replacement using ST.Jude mechanical valve and 9 patient received carbomedics mechanical valve .Internal mammary artery and saphenous vein were used in all cases. Distal vein anatomises was done first followed by valve surgery, internal mammary anastomosies done last.

The 2 groups were similar regarding demographics, perioperative clinical data, cardiopulmonary bypass and aortic cross clamp times and outcomes. Preoperative EF% was estimated,all the patients were documented to have severe preoperative mitral valve regurgitation and no evidence of pathologic affection of the valve. Variable degree of annular dilation was proved in 72% of cases as all patients had regional wall motion abnormality with or without papillary muscle dysfunction. Immediate postoperative assessment of EF% was done as well as Post operative follow up in outpatient after 3, 6,and 12 months.

Exclusion criteria

One patient presented with cardiogenic shock were excluded also 3 patient with history of rheumatic mitral valve pathology were excluded from the study also those who had previous cardiac surgery were not included. 2 patients were excluded from the first group in whom intraoperatively mitral valve repair failed as documented by intraoperative echocardiography and the mitral valve was replaced.

All the patients have history suggestive of previous old MI with an average duration of 3 months, IMR was classified as papillary muscle related and left ventricular related. The study was to done to document the midterm mortality rate related to repair versus replacement.

The statistical paragraph in material and methods

Data were statistically described in terms of mean ± standard deviation (± SD), or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student *t* test for independent samples.

For comparing categorical data, Chi square (c^2) test was performed. Exact test was used instead when the expected frequency is less than 5. *p* values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

There was no significant difference between the 2 groups regarding the age, gender, as well as the prevalence of diabetes hypertension or dyslipidemia.

Table 1 summarizes the preoperative patients' characteristics; all the patients had symptomatic CAD. And 92% of the patients had NYHA class 2 or 3. 20 patients in both groups had class 2 angina, 27 class 3 only one patient had angina at rest who underwent mitral valve replacement.

The mean ejection fraction of the patient was 34.82% in the repair group and 36..94% in the replacement group(p value 1.000) .The end systolic diameter was4.044± 0.5370 in the repair patients versus4.280 ± 0.5123 in the replacement group (pvalue 0.118) . The end diastolic diameter was6.204 ±0.4954 in the repair group versus 6.788 ± 0.6167 in the replacement group.

	Class	Repair group	Replacement group	Total
NYHA	I	0	1	1
	II	10	7	17
	III	12	17	29
	IV	3	0	3
p value			0.145*	
Angina	I	2	0	2
	II	16	4	20
	III	7	20	27
	IV	0	1	1
p value			0.001*	

** Chi- square test p<0.05*

Table 1. Preoperative presentation

	Repair group	Replacement group	P value*
ESD (SD)	4.044 (0.5370)	4.280 (0.5123)	0.118
EDD (SD)	6.204 (0.4954)	6.788 (0.6167)	0.001
LVEF% (SD)	34.82 (3.940)	36.94 (3.982)	1.000

** Independent Sample t-test p<0.05*

Table 2. Preoperative clinical data

From these data we can notice that there was no significant difference between the 2 groups regarding the preoperative co-morbidities.

The mean number of grafts was comparable between the 2 groups 2.96 in the repair group and 3.16 in the replacement group (p value 0.258).The mean time of aortic cross clamp was 71.68 ±9.978 minutes in the repair group and86.76±9.584 minutes in the replacement group (p value 0.073).and consequently, the total bypass time was95.36 ±15.968 minutes in the repair group and 111.50±15.700 minutes in the replacement group. 6 patients in the repair group needed IAB support intraoperative while only 4 patient in the replacement group was in need to IAB intraoperatively. , Overall in-hospital mortality was 4% (2 patients). One patient died in the repair group, and 1 patient died in the replacement group (p value 1.000) .

Follow up was done by echocardiography immediately postoperatively and then 3, 6, and 12 months after surgery in each group. Generally there was a trend toward improvement but without significant difference between the 2 groups. Immediate post operative echocardiography showed a mean EF % of 38.56 in the repair group and 39.28 in the replacement group (p value 0.090). The mean EF % after 3, 6 and 12 months postoperative was 41.21, 44.54, and 47.25 in the repair group while in the replacement group it was43.04, 44.33and 48.08 respectively without statistical significant difference table 4 .

Two patients in the replacement group documented during follow up to develop anticoagulant related complication, one patient developed stroke after 9 month of mitral valve

	Repair group	Replacement group	Total	P value
Grafts (SD)	2.96 (0.611)	3.16 (0.624)	3.06 (0.620)	0.258*
Ischemic time (SD)	71.68 (9.978)	86.76 (9.584)	79.22 (10.017)	0.073*
Bypass time (SD)	95.36 (15.968)	111.50 (15.700)	103.43 (15.700)	0.159*
IAB	6	4	10	1.000**
Mortality	1	1	2	1.000**

**Independent Sample t-test p<0.05 **Chi- square test p<0.05*

Table 3. Operative data

	EF-PO	EF-3m	EF-6m	EF-12m
Repair group- mean% (SD %)-	38.56(3.675)	41.21(2.766)	44.54(3.822)	47.25(3.082)
Replacement group- mean% (SD %)-	39.28(5.458)	43.04(5.775)	44.33(5.738)	48.08(71.054)
p value*	0.090	0.527	0.883	0.312

**Independent Sample t-test p<0.05*

Table 4. Postoperative follow-up

replacement, the other had hemorrhagic massive pericardial effusion 2 month after replacement, one patient in the repair group had servere mitral valve regurgitation after 10 month follow-up denoting failure for which mitral valve replacement was scheduled.2mortality cases reported one in each group, one in the repair group after 4 month of surgery, the other one was in the replacement group after 10 month of surgery, the cause of death could not be determined.

Discussion

Ischemic mitral regurgitation (IMR) is common and associated with poor outcomes. It is observed in up to 50% of patients presenting with acute coronary syndromes and in 19% of patients undergoing elective cardiac catheterization. Approximately half of patients with IMR and recent acute coronary syndromes will develop associated heart failure. Overall, patients with IMR have much worse long-term survival and functional status than do patients with coronary disease without IMR[25].

The management of IMR is complex and depends in part on the severity of preoperative mitral regurgitation (MR). In patients with moderate MR (grade 2_), there is controversy about whether mitral valve surgery concomitant with coronary artery bypass grafting (CABG) is better than CABG alone. Although some advocate CABG alone, others have found that CABG with mitral valve surgery may reduce postoperative MR and cardiac-related mortality [25].

The mechanism of functional ischemic mitral regurgitation has been debated, it is probably a complex process produced by changes in annular, ventricular, and papillary muscle geometry and function. the mechanism differ according to the site and extent of previous infarction .Bulkley and Roberts suggested that isolated annular dilatation is a rare cause of ischemic mitral regurgitation[23], however, Dion believe that annular dilatation is an important component of functional ischemic mitral regurgitation .regardless the mechanism of ischemic mitral regurgitation, the most important point is that these patients have normal mitral leaflet and subvalvular apparatus, which allows treatment by annuloplasty alone.[24]

All patients in our study had mitral regurgitation caused by a previous myocardial infarction.

All our patients in the repair group receive restrictive annuloplasty technique in all patients only 2 patient needed additional quadrangular resection of redundant posterior leaflet

The decision to repair or to replace the mitral valve depends on many factors as the functional class of the patient, myocardial performance, and feasibility of the repair .many surgeon believe that replacing the valve will save the risk of future failure of repair as well as the future need for redo surgery, while other believe that persevering the native valve is the best option in these cases to preserve myocardial performance(13).

Gillinov demonstrated a minority of patients with ischemic mitral regurgitation have pathologic changes of the papillary muscle as elongated muscle. The term papillary muscle dysfunction should be used with caution, although papillary muscle dysfunction may contribute to transient mitral regurgitation in patient with intermittent ischemia, it does not explain the mechanism of functional mitral regurgitation [7]. Gorman found that large posterior infarction caused asymmetric annular dilatation and changes in papillary muscle geometry. [10]

Several investigators have suggested that repair is better than replacement, however, other documented equivalent late survival,, chordal preservation at mitral valve replacement may be an important factor in improving the results .[20] .

Our study indicates that prosthetic mitral valve replacement is associated with more postoperative complication mostly related to anticoagulant therapy.

Frater believes that undersizing annuloplasty compensates posterior left ventricular dilatation and hence improve leaflet coaptation, Boliing suggest that under sizing annuloplasty result in reversal of ventricular remodling ,a lot of studies suggest that ring annuloplasty is superior to suture annuloplasty in mainting proper leaflet coaptation(11).

Kron and associate have described another technique for the treatment for chronic IMR in which suture the posterior papillary muscle to mitral annuls and mitral ring insertion in the other hand[10] ,Fundaro devised a more simple technique incising the base of the posterior leaflet with transecting of the basal chordae ,after closing the posterior leaflet ,posterior annuloplasty band inserted .[17]

Almost all patients who underwent mitral repair in our study, had an annuloplasty ring the mean size of the ring was 28, Bolling and colleagues have established the concept of using a smaller ring size the so called restrictive annuloplasty to improve leaflet cooptation but still there is no long term result that document the benefit of this technique.[11]

Kron documented several risk factors for early and late death after surgery of ischemic mitral regurgitation. These included factors as old age, advanced NYHA functional class, sever left ventricular dysfunction, preoperative atrial fibrillation, and renal dysfunction. In addition, patients with inferior infarction had better survival. Chon and Dion concluded that the pathphysiology of ischemic mitral regurgitation and the presentation of the patient are important predictors of the results than the surgical method employed. [10]

The survival benefit in mitral valve repair was no longer evident on follow up at 3, ,6and 12 months period , Gillinov and colleagues noted a similar result with an early rate of death of 0.21 in favour of repair, they suggested that mitral valve repair was associated with lower operative mortality.[7]

In our study there were no difference in mortality between the 2 groups during short term follow-up, and during midterm follow-up, also Gillionov and colleagues concluded that there was no difference between repair and replacement on long term follow-up of patients .[7]

Grossi and associates and Trichon and associate compared mitral valve repair and replacement in patients with IMR and reporting different results. Grossi reported mortality hazard ratio of 0 .45 in favour of repair[6], on the other hand Trichon reported 0.72favoring repair ,The absence of advantage during long term follow-up in these studies may be related to the dynamic nature of ischemic mitral regurgitation[15], some studies as those conducted by AL-Radi et al. demonstrates the advantage of replacing the valve over repair based on the fact that continuous remodelling of the left ventricle after infarction and progression of coronary artery disease may contribute for the recurrence of mitral valve regurgitation following repair resulting in reoperation on the mitral valve in a total of 14% of patients with previous mitral repair. In comparison only 3% of valve which was previously replaced needed reoperation for valve related complications. [8]

Also AL-Radi et al reported that one of the most important predictor after mitral valve repair is the experience of the surgeon. [8]

Percutanous Alfieri repair or annuloplasty with concomitant coronary stenting may open doors to the future minimal invasive procedures of management of cases of chronic IMR.[21]

Limitation of the study

The most important limitation of the study was the small number of patients and short term results , also the primary end point of our study was to document overall time related survival, but secondary endpoints as ,reoperation ,bleeding ,and stroke incidence , neurologic deficit lasting more than 24 hours need to be more investigated .

Conclusion

In patients with chronic ischemic mitral regurgitation following previous myocardial infarction who are not presenting with cardiogenic shock, midterm result showed comparable survival benefit for both mitral valve repair and replacement .Although patient who underwent repair showed a trend toward better short term mortality , however some patient who present later on with failed repair with considerable risk for redo mitral valve surgery other hand long term risk associated with valve related complication of prosthetic mitral valve replacement is another concern for the surgeons. our study concluded that mitral valve repair and mitral valve replacement in case of chronic sever mitral valve regurgitation have the same survival rate on midterm follow-up.

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*** Is survival is better after mitral repair than replacement for ischemic severe mitral regurgitation //

**** is mitral repair superior to replacement in ischemic mitral regurgition

*** chronic ischemic severe mitral regurgitation Clinical inferences and Decision Making

Total Repair of Fallot Tetralogy in The First Year of Life

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Background: **Uncertainty surrounds both the timing and ideal form of early management of tetralogy of Fallot, here we present our result in the repair in the first year of life**

Patients and methods: **sixty one patients with tetralogy of Fallot were operated upon. Fourty nine patients were one year or less (group 1) and 12 patients were above one year (group 2).**

Results: **The early mortality for group one was 2.04% (1out of 49).5 patients (10.2%) in Group 1 (4.08%) have been reoperated for significant residual or recurrent right ventricular outflow stenosis, residual significant shunt, residual significant stenosis and residual significant shunt, and a permanent pacemaker implantation. That is in addition to one patient (2.04%) who had signinificant tricuspid regurgitation and 3 patients (6.1%) had significant postoperative pulmonary valve regurgitation.15/49 (30.6%) of Group 1 need a transannular patch as a part of the repair, only 3/12 (25%) in Group 2 were in need for a transannular patch**

Conclusion: **With advance in surgical technique, anaesthetic management and postoperative care, repair of fallot tetralogy in the first year of life has a good outcome inspite the increased need for the use of transannular patch.**

Uncertainty surrounds both the timing and ideal form of early management of tetralogy of Fallot. Some centers perform early complete repair in all patients regardless of age, symptoms and morphology. Others recommend a two-stage approach involving initial palliation in symptomatic neonates and young infants and those with unfavorable anatomy (anomalous coronary anatomy or hypoplastic pulmonary arteries).1) Alleviation of cyanosis, 2) Normal growth and organ development, 3) Removal of stimulus for right ventricular hypertrophy and 4) Avoidance of risks associated with initial palliation all are advantages of early total repair. With recent advances in anesthetic, operative and postoperative management, routine primary repair of tetralogy of Fallot in the neonate and young infant can be accomplished with excellent early and mid-term results.[1] However,young age, low weight, and the requirement for transannular patch reconstruction of the right ventricular outflow tract are, still factors that,[2,3] thought to adversely affect intracardiac repair of tetralogy of Fallot.

As, primary correction of tetralogy of Fallot in infancy, with restoration of normal pressures and flows, results in sustained increase in the diameters of the right and left pulmonary arteries. It allows for early normal development of the proximal pulmonary arterial system in most patients regardless of their age and symptomatic status at operation, so, early one-stage repair[4] of tetralogy of Fallot in infancy may be associated with a low rate of reinterventions.

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Codex : o3/28/1212

Patients and method

This a combined prospective and retrospective study of 61 patients with tetralogy of Fallot operated in the period between 2003 through 2006. Twenty eight (45,9%) male and 33 (54,1%) female, with a mean age of 9,92 ± 9,52 month ranging from 2 to 60 months, mean weight of 7,38±2,47 kg , ranging from 4 to 46 kg and a mean body surface area of 0,36 ±0,09 m^2 ranging from 0,22 to 0,74 m^2.

All patients were subjected to thorough clinical examination including measurement of peripheral oxygen saturation using pulse oximetery, 12 lead ECG tracing, plain X ray chest in the anteroposterior view and complete echocardiography study, 43 patients (70,5%) had a cardiac catheterisation study. Patients with suspected chromosomal abnormalities were subjected to chromosomal assay.

We classified our patients into two groups according to the age at which operation was done:

Group 1 : patients who aged one year or less at the time of operation.

Group 2: patients who aged more than one year at the time of operation.

Operative technique and postoperative follow up

Using cardiopulmonary bypass and moderate hypothermia, transatrial-transventricular repair of fallot tetralogy was achieved. The right atrium was opened and the anatomy was explored with a vent introduced through the interatrial septum. Right ventriculotomy was done with resection through the RVOTO. Back to the right atrium, passing three or four transverse matress sutures with pledgets which were passed through the Dacron patch for the VSD closure. Tying the stitches and passing to the right ventricle to continue closing the VSD in a continuous manner. Closing the ventriculotomy with a Gore-tex patch. Transannular patch and patching of the pulmonary artery or its branches was done when needed. At the end,, measuring the pressure in the RV and LV and the O2 saturation in the PA and RA to assess if there is a residual obstruction or residual VSD. All patients were subjected to postoperative follow up at 6 months after surgery using 12 lead ECG, chest X ray and echocardiography which is the cornerstone of follow up to evaluate the residual VSD, residual RVOTO, RVOT and pulmonary arterial tree measurements, PR, TR and RV function.

Statistical Method

The collected data was organized, tabulated and statistically analyzed using SPSS software statistical computer package version 12. For quantitative variables, the range, mean and standard deviation were calculated. The difference between two means was statistically analyzed using the students (t) test for comparing between two different groups and paired t test for comparison of pre and postoperative means. Wilcoxon singed rank test was performed to test mean values of pre and postoperative means when the observations were not found to follow the normal distribution. For categorical variables, the number and percent distribution was calculated. Chi square was used as a test of significance and when found inappropriate Fisher exact test was used. Significance was adopted at $p<0.05$ for interpretation of results of tests of significance.

Results

Forty nine patients out of 61 were one year or less of age (Group 1), while 12 patients were older than one year)Group 2). In Group 1, there were 23 male and 26 females, while in Group 2, there were 5 male and 7 females. (Fig. 1)

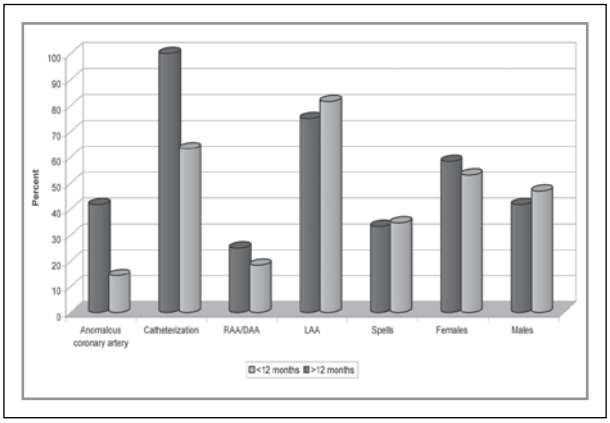

Fig 1. Comparison of studied preoperative variables, complications and outcome in relation to age in months

Preoperative characteristics

The incidence of cyanotic spells were not significantly different between the 2 groups, 17 (34.7%) of group 1 and4 (33.3%) of group 2 had preoperative cyanotic spells.

Seven out of 49 (14.3%) patients in Group1, and 5/12 (41.7%) in Group 2 patients had anomalous coronary artery anomaly including the presence of large conal branch crossing the RVOT.

A significant difference between the two groups as regard to the preoperative haemoglobin concentration and haemotecrite ratio, for Group 1 patients, preoperative Hb% and HCT levels were, 12.05±1.85 gm/ml and 36.24±5.83% respectively, while for Group 2 patients, they were, 13.75 ±1.67 gm/ml and 40.83±4.91% respectively.

The mean preoperative pulmonary annulus diameter showed a significant difference between the two groups, in Group 1 patients, it was 6.21±2.45 mm (Range, 2 to 11 mm) while in Group 2 patients, it was 8.08±3.12 mm (Range, 3 to 13 mm).However, there were no significant differences between the two groups as regard to the mean preoperative main pulmonary artery, right pulmonary artery or left pulmonary artery diameters, for Group 1 patients, they were, 7.66±3.18 mm (Range, 3 to 20mm), 6.08±1.91 mm (Range, 3 to 11 mm) and 5.85±1.75 mm (Range, 2.5 to 10 mm) respectively while for Group 2 patients, they were, 9.58±2.71 mm (Range, 6 to 15 mm), 7.25±2.1 mm (Range, 3.5 to 12 mm) and 6.75±2.17 mm (Range, 3 to 11 mm) respectively.

Operative variables: (Tab. 1)

There was no significant difference in the intraoperatively measured RVp/LVp between the two groups, while, it was 0.50±0.14 (Range, 0.25-1.1) for Group 1, it was 0.57±0.13 (Range, 0.35 to 0.75) for Group 2 patients.

Variables	≤12 months	>12 months	t	p
Pressure gradient:				
Range	40-100	45-100		
Mean	75.14	74.83	0.061	0.952
S.D.	16.03	14.53		
Total bypass time:				
Range	83-335	94.282		
Mean	152.06	170.08	1.193	0.238
S.D.	45.71	51.73		
Ischemic time:				
Range	45-153	48-135		
Mean	86.92	95.92	0.992	0.325
S.D.	27.15	32.28		
RVp/LVp:				
Range	0.25-1.1	0.35-0.75		
Mean	0.50	0.57	1.573	0.121
S.D.	0.14	0.13		

Table 1. Comparison of preoperative, pressure gradient, total bypass time, ischemic time and RVp/LVp in relation to age in months

*Statistically significant

On the other hand, there was a significant difference as regard to the need for a transannular patch between the two group, while, 15/49 (30.6%) of Group 1 need a transannular patch as a part of the repair, only 3/12 (25%) in Group 2 were in need for a transannular patch. In other words, among patients who needed a transannular patch in the whole group, 83.3% of the patients were one year or less while 16.7% were beyond one year of age.

Postoperative outcome

Early mortality

Out of 49 patients in Group 1, there was only one patient died (2.04%) while, no early mortality in Group 2 patients. (Fig. 2)

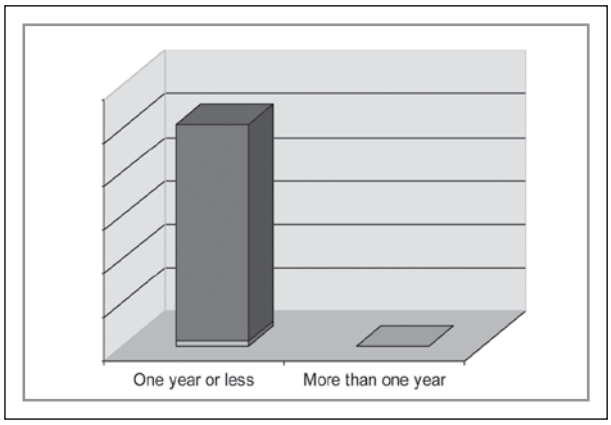

Fig 2. Early mortality inrespect to the age at repair Early complications

Two patients in Group 1 (4.08%) have been reoperated for significant residual or recurrent right ventricular outflow stenosis, one patient (2.04%) was reoperated for residual significant shunt, and one patient (2.04%) was reoperated for residual significant stenosis and residual significant shunt. That is in addition to one patient (2.04%) who had signinificant tricuspid regurgitation, one more patient (2.04%) needed a permanent pacemaker implantation, and 3 patients (6.1%) had significant postoperative pulmonary valve regurgitation. On the other hand, for Group 2 patients, there was only one patient who had been reoperated for postoperative restenosis and significant shunt, one patient who was operated for permanent pacemaker implantation, and other two patients who had insignificant restenosis to be followed up.

Haemoglobin concentration: Inspite of the significant difference between the two groups as regard to the preoperative Hb% concentration 12.05±1,85gm/ml and 13.75±1,67 gm/ml for Group 1 and 2 respectively, the postoperative values were not significantly different between the two groups 12.03±1.03 gm/ml and 12.50±1 gm/ml for Group 1 and 2 respectively. What is to be noted, while there was no significant difference between the preoperative and postoperative Hb concentration in Group 1 patients, there was a noticeable significant difference for Group 2 patients. (Tab.1)

Variables	≤12 months	>12 months	t	p
Preoperative Hb%:				
Range	8.5-17	12-18		
Mean	12.05	13.75	2.894	0.005*
S.D.	1.85	1.67		
Early postoperative Hb%:				
Range	10-14	10-13		
Mean	12.03	12.50	1.425	0.159
S.D.	1.03	1.00		
t	0.131	2.436		
p	0.897	0.033*		
Late postoperative Hb%:				
Range	10-14.5	10-13		
Mean	12.09	12.33	0.756	0.453
S.D.	1.00	0.94		
t	0.188	2.927		
p	0.851	0.014*		

**Statistically significant*

Table 1. Comparison of preoperative and postoperative Hb% in relation to age in months

Postoperative diameters

Pulmonary annulus diameter: Both groups showed significant increments in the postoperative pulmonary annulus diameter from preoperative values (6.21±2.45 mm and 8.08±3.12 mm for Group 1 and 2 respectively) to postoperative values (9.05±2.39 mm and 10.63±2.89 mm respectively. However, while there was a significant difference in the preoperative pulmonary artery annulus between the two groups, postoperatively, this difference did not exist. (Fig.3)

Main pulmonary artery diameter: There was significant difference between the preoperative and postoperative main pulmonary artery diameters for each group (7.66±3.18 mm and 10.15±2.45 mm pre and postoperatively for Group 1) and (9.58±2.71mm and 12.33±2.93 mm for group 2). However, while there was no significant difference in the preoperative main pulmonary artery diameters between the two groups, there was a significant difference in the postoperative values. (tab 4)

Left pulmonary artery diameter: The left pulmonary artery increased significantly postoperatively in both groups from preoperative values (5.85±1.75 mm and 6.75±2.17 mm for Group1 and 2 respectively) to postoperative values (7.12±1.45 mm and 7.67±1.83 mm for Group 1 and 2 respectively) with significant difference between the two groups. (Tab 4)

Variables	≤12 months	>12 months	t	p
Preoperative PA diameter:				
Range	3-20	6-15		
Mean	7.66	9.58	1.928	0.059
S.D.	3.18	2.71		
Postoperative PA diameter:				
Range	5-20	5-17		
Mean	10.15	12.33	2.659	0.010*
S.D.	2.45	2.93		
T	11.416	3.326		
P	0.001*	0.007*		
Preoperative R PA diameter:				
Range	3-11	3.5-12		
Mean	6.08	7.25	1.874	0.066
S.D.	1.91	2.10		
Postoperative RPA diameter:				
Range	4-11	5-13		
Mean	7.23	7.79	0.989	0.326
S.D.	1.62	2.26		
T	8.845	2.169		
P	0.001*	0.053		
Preoperative LPA diameter:				
Range	2.5-10	3-11		
Mean	5.85	6.75	1.511	0.136
S.D.	1.75	2.17		
Postoperative L PA diameter:				
Range	3-10	5.5-12		
Mean	7.12	7.67	1.107	0.273
S.D.	1.45	1.83		
T	8.845	2.250		
P	0.001*	0.046*		

**Statistically significant*

Table 2. Comparison of preoperative and postoperative pulmonary artery diameter in relation to age in months

Right pulmonary artery diameter: For Group 1 patients, there was significant difference between the preoperative and postoperative right pulmonary artery diameter (6.08±1.91 mm and 7.23±1.62 mm respectively), while, for Group 2 patients there was no significant difference between the pre and postoperative right pulmonary artery diameters (7.25±2.1 mm and 7.79±2.26 mm respectively). Also, there was no significant difference between neither the preoperative nor the postoperative values in between the two groups. (Tab 4)

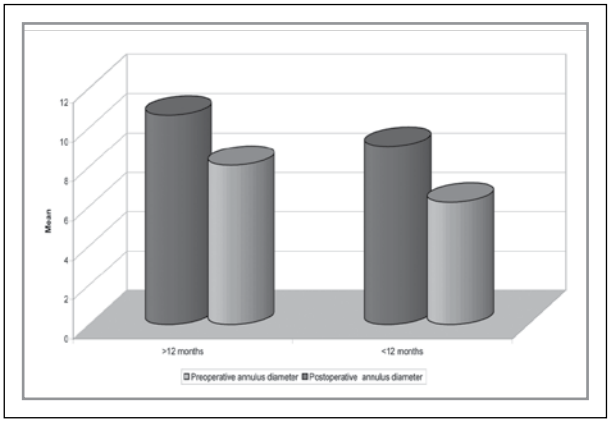

Fig 3. Comparison of preoperative and postoperative annulus diameter in relation to age in months

Disscusion

Despite of the continuous improvement in operative outcome the optimal timing for the repair of tetralogy of Fallot remains controversial [5]. However, there is a common accordance that, primary correction of tetralogy of Fallot in infancy, with restoration of normal pressures and flows, resulted in sustained increase in the diameters of the right and left pulmonary arteries. It allowed for early normal development of the proximal pulmonary arterial system in most patients regardless of their age and symptomatic status at operation [4]

Preoperative and operative variables

There was a significant difference in the incidence of anomalous coronary artery between the two groups (14.3% versus 41.7%) for Group 1 and 2 respectively. This may be a reason to delay the intervention in these patients, as anomalous coronary artery including large conal branch crossing the right ventricular outflow may be a motivation to wait for surgery provided the patient is clinically stable.

The median age of 43 patients Fallot tetralogy with anomalous coronary artery operated by Ruzmetov et al.[6] was 4.8 year. Kalra et al.[7] operated on 25 patients having anomalous coronary artery anomalies associated with Fallot tetralogy in a median age 3.6 years.

In our patients group, there was a significant difference between the two groups as regard to the mean preoperative pulmonary annulus diameter (6.21±2.45 mm and 8.08±3.12 mm) for Group 1and 2 respectively. This difference may be due the different ages between the two groups, especially that we used the crude figures of dimension and not indices.

There was a significant difference as regard to the need for a transannular patch between the two groups, while, 15/49 (30.6%) in Group 1 need a transannular patch as a part of the repair, only 3/12 (25%) in Group 2 were in need for a transannular patch. This was reported by many authors who adopted the strategy of early correction of Fallot tetralogy.

Lee et al.[8] reported the need for a transannular patch in 78/160 patients (49%). Also a transannular patch was inserted in 66% of 74 infant patients in a series operated by Politowska et al.[9] and 58/66 (88%) infant patients operated by Kolcz and Pizarro [5] received a transannular patch. However, Sadiq et al.[10] reported the use of a transannular patch in 44/56 patients operated beyond 18 years of age. Bisoi et al.[11] also reported the use of a transannular pericardial patch in 200/284 (70%) adult patients. Also, transannular patch was used in 65% of 88 patients operated by Amorim et al [12] at a mean age of 10±8 years.

This controversy in the published data makes the question, if the repair of Fallot tetralogy at younger age increases the need for transannular patch reconstruction or notto be unresolved till now.

Early mortality

However, many authors are convinced that younger age at operation is no more a risk factor for early mortality in paediatric cardiac surgery, in our patients group, we had 3 (6.1%) early mortality in Group 1 patients and no early mortality in Group 2 patients and because of the small number of patients we could not confirm if this difference has a significance or not.

Kolcz and Pizarro [5] reported 4.5% early mortality in 66 operated infant for total correction of Fallot tetralogy. Also, Alexiou et al.[13] reported 1.9% early mortality in a series of 160 infant younger than 1 year of age at the time of repair. Cobanoglu and Schultz [14] had 6% early mortality among 63 operated infant less than one year of age.Yilmaz et al.[15] reported no early mortality among 19 patients operated at a mean age of 5 ±2 years.

A mortality rate as 2.5% in neonatal correction of Fallot tetralogy have been reported by Lee et al.[8] who operated on 160 neonates. Ooi et al.[16] operated on 52 patients with a mean age at surgery 5 months and of whom 16 (30.8%) were less than 3 months old, including 2 neonates, 22 (42.3%) were 3-6 months old and 14 (26.9%) were 7-12 months old. They reported 1.9% early mortality caused by a cerebro-vascular accident.

Sadiq et al.[10] reported 6.9% early mortality among 58 patients operated on at a mean age 22.5±5 years. A retrospective analysis of 284 patients had been operated by Bisoi at al. [11] at a mean age of 19.4± 2.5 years and they reported 28 (9.9%) hospital deaths.

In the past, younger age at operation was a risk factor for hospital mortality in cardiac surgery, however, nowadays with the advancement in the preoperative care, surgical experience, anaesthetic management and postoperative care, younger age is no more considered as a risk factor in most of the paediatric cardiac operations including Fallot tetralogy. Our hospital mortality rate was coincident with others investigators in patients aging one year or less, and excellent in patients ageing more than one year. However, because of the small number of patients who had the event, it is statistically difficult to say that age less than one year could be a risk factor for early mortality.

Early complications and reoperation:

Two patients in Group 1 (4.08%) have been reoperated for significant residual or recurrent right ventricular outflow stenosis, one patient (2.04%) was reoperated for residual significant shunt, and one patient (2.04%) was reoperated for residual significant stenosis and residual significant shunt. That is in addition to one patient (2.04%) who had signinificant tricuspid regurgitation, one more patient (2.04%) needed a permanent pacemaker implantation, and 3 patients (6.1%) had significant postoperative pulmonary valve regurgitation.

On the other hand, in Group 2 patients, there was only one patient who had been reoperated for postoperative restenosis and significant shunt, one patient who was operated for permanent pacemaker implantation, and other two patients who had insignificant restenosis to be followed up. Apparently, it seems that patients one year or less have more postoperative events than older children (6 versus 2 reinterventions respectively). However, again and because of the small number of each event, a risk factor could not be confirmed.

Kolcz and Pizarro[5] retrospectively reviewed 66 consecutive patients with TOF and confluent pulmonary arteries, who underwent repair immediately after diagnosis and they reported freedom from reintervention at 1 month and 1 year 100 and 84.2 %

Alexiou et al.[17] reported 14 (15.7%) reintervention in 89 infant operated for total correction of Fallot tetralogy at a mean age of 6.3 ± 2.6 months. In Hirsch et al.[18] series, they reported 24 reoperations in 22 patients (36%).

In Lee et al.[8] series,(240 patients at a mean age 9 months), they reported 5 patients (2%) who required reoperations due to right ventricular outflow tract obstruction (n = 3), and residual VSD (n = 2), that is beside 9 patients (3.75%) underwent catheter intervention for branch pulmonary artery stenosis. In Politowska et al.[9] group (74 infants aged 1,5 to 6 months), only one child (1.3%) required reoperation, right ventricular outflow tract obstruction (RVOTO) more than 40 mmHg occurred in 2 infants(2.7%) and moderate pulmonary insufficiency was present in 38 infants (51%).

In another group of patients, Alexiou et al.[13] reported 19 re-operations (11.9%) for right ventricular outflow tract obstruction in 160 patients operated for Fallot tetralogy at a mean age of 195± 89 days. In Pozzi et al.[19] series (132 patients at a median age 15,5 months), there were 28 patients (21.1%) with early right bundle branch block. In Frazer et al.[20] series (133 patients at a median age 18 months and a median weight of 9 Kgm), they reported 3% reoperation after total correction of Fallot tetralogy.

Conclusion

With advance in surgical technique, anaesthetic management and postoperative care, repair of fallot tetralogy in the first year of life has a good outcome inspite the increased need for the use of transannular patch. Early restoring the normal anatomy and hemodynamics avoids complication of chronic cyanosis and allows for growth of pulmonary vascular bed.

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Coronary Artery Ectasia among Egyptian patients: Clinical and Angiographic Study

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BACKGROUND AND AIM: **Review of literature did not reveal an exclusive study on isolated Ectasia among Egyptian patients. We decided to analyze the clinical presentation and angiographic prevalence of this subset among patients who underwent coronary angiography at Mansoura university hospital catheterization laboratory.**

SUBJECTS AND METHODS: **This is a retrospective screening study, all patients who underwent elective coronary angiography at the catheterization lab. in Mansoura Medical Specialized Hospital, Mansoura University in the period between the first of January 2009 and thirty first of December 2011. We screened a total number of 2163 patients and we found; Eighty sex patients [86 (4%), 65 males and 21 females with mean age 54.2 ± 8.5 years] with Isolated_Coronary Artery Ectasia as group 1a. Fifty sex patients [56 (2.6%), 49 males and 6 females with mean age 55.2 ± 9.2 years] with atherosclerotic coronary artery Ectasia as group 1b. Seventy patients [70 (3.2%), 41 males and 29 females with their mean age 53.0 ± 8.0 years] with coronary slow flow as group 1c. We selected 25 patients (19 males and 6 females with mean age 54.1 ± 7.7 years) with obstructive coronary artery disease, age and sex matched done at the same period as control group (group 11). All patient`s data were collected from patients files which includes the clinical history findings in clinical examination, results of laboratory investigations, standard l2-lead ECGs tracing and echocardigraphic data. Angiographic Analysis included; site of the lesion, number of vessels affected, TIMI Frame Count (TFC), presence of thrombus and Ectasia analysis.**

RESULTS: **The incidence of isolated CAE in was 4.0 %, atherosclerotic Ectasia was 2.6 %, and coronary slow flow was 3.2%. Diabetes mellitus was significantly more common among patients with obstructive atherosclerotic CHD, while HCV seropositivity was common among patients with isolated CAE (52% vs. 23% and 26% vs. 8% respectively: p <0.05). Right coronary artery (RCA) involvement and 3-vessel coronary affection were significantly higher among patients with isolated CAE group in comparison to obstructive CAD (74% vs. 40% and 18% vs. 4%: p<0.05, respectively). A significant positive correlation between Ectasia ration and Ectasia diameter (r= 0.75 and P < 0.05), and a significant positive correlation between TIMI frame count and; Ectasia ratio, number of segments affected, and number of vessels affected (P < 0.05).**

CONCLUSIONS: **Coronary artery Ectasia is not rare among patients in our geographic area with incidence of 6.6% among patients who undergoes elective coronary angiography. They have a severe coronary disease with higher prevalence of three vessel affection and a higher prevalence of hepatitis C viral seropositivity compared to patients with classic obstructive CAD.**

KEY WORDS: **Coronary angiography, coronary artery Ectasia, coronary artery aneurysms.**

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Coronary artery ectasia (CAE) has been observed by pathologists and cardiologists for more than two centuries. This coronary anomaly was first described by Morgagni in 1761 **[1].** Bourgon was the first to describe the postmortem finding of right coronary artery (RCA) dilatation in a patient who experienced sudden death in 1812 **[2].** The term *ectasia* was first

used by Bjork in 1966 to describe dilated coronary arteries **[3].** The literature prior to this date consisted of only postmortem reports. Coronary angiography and new diagnostic tools have enabled clinicians to discover more cases of ectasia. However, not all patients with ectasia are symptomatic and receive coronary angiography examination; hence, the real incidence is unknown. The reported incidence is between 0.3% and 4.9% at autopsy and during coronary angiography **[4–6].** Sharma et al found an incidence as high as 12% in an Indian population **[7],** which may have different demographic characteristics. The proximal and middle parts of the RCA are most commonly affected by ectasia, although the reasons for this are not clear. Involvement of the left anterior descending artery and left circumflex artery is variable. The left main coronary artery is less commonly involved. Most cases of CAE involve only a single vessel. Disturbance in blood flow filling and washout are major characteristics of CAE. Delayed antegrade filling, a segmental back flow phenomenon, and local deposition of dye (stasis) in the dilated coronary segment have been observed during imaging **[8-0]**.

AIM OF THE WORK: It is the aim of this study to screen for the incidence of CAE among patients undergoing coronary angiography at Mansoura specialized medical hospital, assess clinical and angiographic characteristics of patients with CAE and to qualify and quantify CAE as regard severity and extent.

Subjects and Methods

Patients groups and study design: This is a retrospective screening study, all patients who underwent elective coronary angiography at the catheterization lab. in Mansoura Medical Specialized Hospital, Mansoura University in the period between the first of January 2009 and thirty first of December 2011. We screened a total number of 2163 patients and we found;

- Eighty sex patients [86 (4%), 65 males and 21 females with mean age 54.2 ± 8.5 years] with Isolated Coronary Artery Ectasia as **group 1a**
- Fifty sex patients [56 (2.6%), 49 males and 6 females with mean age 55.2 ± 9.2 years] with atherosclerotic coronary artery Ectasia as **group 1b**
- Seventy patients [70 (3.2%), 41 males and 29 females with their mean age 53.0 ± 8.0 years] with coronary slow flow as **group_1c**

We selected 25 patients (19 males and 6 females with mean age 54.1 ± 7.7 years) with obstructive coronary artery disease, age and sex matched done at the same period as control group **(group 11)**

Study definitions

Coronary artery ectasia: the diameter of the ectatic segment more than 1.5 times larger compared with an adjacent healthy reference segment ***(11).***

Aneurysm of coronary artery: localized dilatation exceeding the diameter of adjacent normal segments by 50%***(12).***

Types of Aneurysms: aneurysms are classified based on their internal diameter as small (<5 mm), medium (5–8 mm) or giant (≥8 mm) ***(13).***

Isolated coronary ectasia: coronary dilatations without the presence of significant obstructive coronary disease ***(14).***

Coronary slow-flow phenomenon (syndrome Y): angiographic finding, characterized by delayed progression of the contrast medium during coronary angiography in apparently normal epicardial coronary vessels ***(15).***

All patient's data were collected from patients files which includes the clinical history findings in clinical examination, results of laboratory investigations, standard l2-lead ECGs tracing and echocardigraphic data. All coronary cineangiographic data of the both studied groups were studied and analyzed by two experienced invasive cardiologists blind to the clinical data of the patients.

Angiographic analysis

The following items were analyzed for every patient:

1- **Site of lesions:** According to the definition of the coronary tree segments which is based on the classification proposed by the AHA 1975 and modified for the ARTS I and II trials ***(16)***. By this system the arterial tree is divided in 16 segments and as such has been adopted in the SYNTAX score.

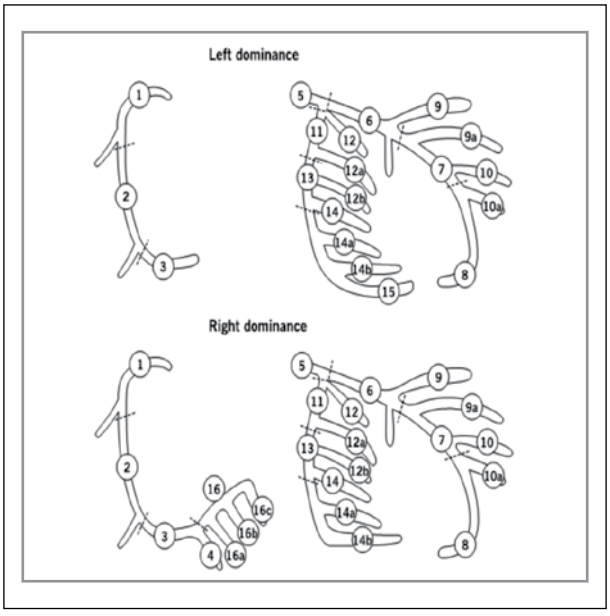

Fig 1. Definition of the coronary tree segments (16).

1. RCA proximal: proximal horizontal segment
2. RCA mid: mid vertical segment
3. RCA distal: distal horizontal segment till the origin of the posterior descending artery.
4. Posterior descending artery: Running in the posterior interventricular groove.
5. Left main: From the ostium of the LCA till bifurcation into left anterior descending and left circumflex branches.
6. LAD proximal: Proximal to and including first major septal branch.
7. LAD mid: LAD immediately distal to origin of first septal branch and extending to the point where LAD forms an angle (RAO view). If this angle is not identifiable this segment ends at one half the distance from the first septal to the apex of the heart.
8. LAD apical: Terminal portion of LAD, beginning at the end of previous segment and extending to or beyond the apex.
9. First diagonal: The first diagonal originating from segment 6 or 7.

9a. First diagonal a: Additional first diagonal originating from segment 6 or 7, before segment 8.

10. Second diagonal: Originating from segment 8 or the transition between segment 7 and 8.

10a. Second diagonal a: Additional second diagonal originating from segment 8.

11. Proximal circumflex artery: Main stem of circumflex from its origin of left main and including origin of first obtuse marginal branch.
12. Intermediate/anterolateral artery: Branch from trifurcating left main other than proximal LAD or LCX. It belongs to the circumflex territory.

12a. Obtuse marginal a: First side branch of circumflex running in general to the area of obtuse margin of the heart.

12b. Obtuse marginal b: Second additional branch of circumflex running in the same direction as 12.

13. Distal circumflex artery: The stem of the circumflex distal to the origin of the most distal obtuse marginal branch, and running along the posterior left atrioventricular groove. Caliber may be small or artery absent.
14. Left posterolateral: Running to the posterolateral surface of the left ventricle. May be absent or a division of obtuse marginal branch.

14a. Left posterolateral a: Distal from 14 and running in the same direction.

14b. Left posterolateral b: Distal from 14 and 14 a and running in the same direction.

15. Posterior descending: Most distal part of dominant left circumflex when present. It gives origin to septal branches. When this artery is present, segment 4 is usually absent.
16. Posterolateral branch from RCA: Posterolateral branch originating from the distal coronary artery distal to the crux.

16a. Posterolateral branch from RCA: First posterolateral branch from segment 16.

16b. Posterolateral branch from RCA: Second posterolateral branch from segment 16.

16c. Posterolateral branch from RCA: Third posterolateral branch from segment 16.

Ectasia analysis

A normal segment was described as a coronary artery segment without ectasia and stenosis according to coronary angiography. The normal segments show a sharp and smooth edge of the contour of the coronary artery, usually accompanied by natural tapering. Ectatic segments were classified as localized when they involved a discrete portion of the artery with an adjacent normal segment of the vessel within that segment and diffuse when the entire segment was ectatic with no normal portion within the segment. For calibration, the tip of the coronary catheter was used ***(17).***

A- Ectasia type: Ectasia was classified according to ***Markis et al. (18)*** into 4 types as shown in the following tableI and figure 2.

Type I	Diffuse ectasia of two or three vessels
Type II	Diffuse ectasia in one vessel and localized in another
Type III	Diffuse ectasia of one vessel only
Type VI	Localized or segmental Ectasia

Table I. Types of ectasia (18).

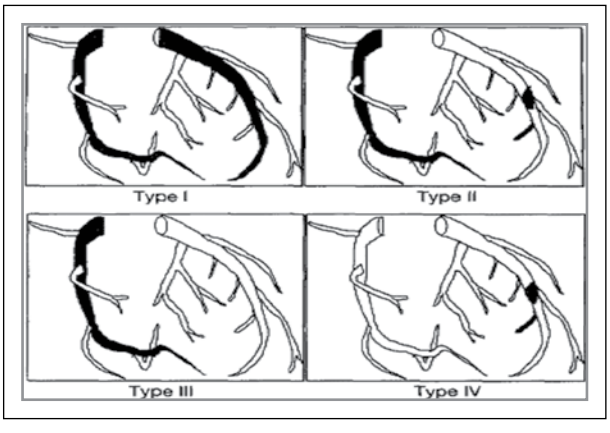

Fig II. Markis classification of CAE. Coronary artery ectasia classification. Drawing of coronary artery ectasia by Markis's classification of types I-IV. The shaded portions of the coronary arteries represent the distribution of ectasia (18).

B- Ectasia diameter: The maximum width of each ectatic segment was measured in the view in which it appeared largest. Coronary ectasia diameters were measured as the maximum diameter of each ectatic segment (in millimeters***(17).***

C- Ectasia ratio: Diameter of ectatic segment/diameter of the adjacent normal segment ***(17).***

D- Thrombus within the ectatic segments: *Thrombus: **defined as*** discrete, intraluminal filling defect with defined borders and largely separated from the adjacent wall, contrast staining may or may not be present ***(19).***

E- The TIMI frame count (TFC): The first frame in the TIMI frame count is defined by a column of contrast extending across > 70% of the arterial lumen with antegrade motion, the last frame counted is that in which contrast enters (but not necessarily fills) a distal landmark, these landmarks are as follows: the first branch of the posterolateral artery in the right coronary artery; the distal branch of the lateral left ventricular wall artery furthest from the coronary ostium in the circumflex system; and the distal bifurcation known as the ''whale's tail'' in the left anterior descending artery. in general, the TFC for the left anterior descending and the circumflex arteries is assessed in a right anterior oblique projection with caudal angulation (RAO caudal view) and the TFC for the right coronary artery (RCA) in a left anterior oblique projection with cranial angulation (LAO cranial view) ***(20)***.

Statistical Analysis

The tests were done using SPSS (V17) SPSS Inc, Chicago, IL, USA) statistical program. Variables are expressed as mean ± standard deviation. Significance of differences between groups was determined by one-way analysis of variance (ANOVA) and T test as appropriate. Differences between categorical variables were assessed by Chi-square contingency analysis. A P< 0.05 was considered to indicate statistical significance while NS indicates non-significant p value.

RESULTS

Study group	Number (%)
Isolated coronary Ectasia (CAE) (1a)	86 (4%)
Atherosclerotic Ectasia group (1b)	56 (2.6%)
Coronary slow flow group (1c)	70 (3.2%)

Table 1. Angiographic incidence of coronary Ectasia and slow flow among the all study group (2163 patients).

The incidence of isolated coronary artery Ectasia, atherosclerotic Ectasia and coronary slow is summarized in table 1.

As summarized in table (2); both groups were comparable as regard all clinical variables except that diabetes mellitus was significantly more common among patients with obstructive atherosclerotic CHD, while HCV seropositivity was common among patients with isolated CAE (52% vs. 23% and 26% vs. 8% respectively: p <0.05)

Data	Isolated CAE (86)	Obstructive CAD (25)	P
Age (years) mean ±SD	54.22 ± 8.529	54.08 ± 7.697	NS
Male [n (%)]	65 (75.6%)	19 (76%)	NS
Smoking [n (%)]	43 (50%)	10 (40%)	NS
Hypertension [n (%)]	62 (72.1%)	22 (88%)	NS
DM [n (%)]	**20 (23%)**	**13 (52%)**	**<0.5**
Family history of CHD [n (%)]	27 (31.4%)	6 (24%)	NS
Dyslipidaemia [n (%)]	37 (43%)	9 (36%)	NS
No of risk factors mean ±SD	3.01 ± 1.163	3.2 ± 1.118	NS
BMI mean ±SD	28.31 ± 4.738	27.0 ± 4.752	NS
HCV seropositive [n (%)]	**22 (26%)**	**2 (8%)**	**<0.5**
Clinical presentation			
CSA **[n (%)]**	106 (75.2%)	19 (76%)	
UA **[n (%)]**	16 (11.3)%	4 (16%)	NS
NSTEMI **[n (%)]**	0 (0%)	1 (4%)	
STEMI **[n (%)]**	1 (0.7%)	0 (0%)	
Dyspnea **[n (%)]**	15 (10.6%)	1 (4%)	
Angina class			
Class 1 **[n (%)]**	76 (88.4%)	25 (100%)	NS
Class 2 **[n (%)]**	3 (3.5%)	0 (0%)	
Class 3 **[n (%)]**	4 (4.7%)	0 (0%)	
NYHA class			
NYHA 1 **[n (%)]**	3 (3.5%)	0 (0%)	NS
NYHA 2 **[n (%)]**	10 (11.6%)	1 (4%)	

DM= diabetes mellitus, HTN= hypertension, BMI= body mass index, HCV= viral C hepatitis, CSA= chronic stable angina, UA= unstable angina, STEMI= ST elevation myocardial infarction, NSTEMI= Non ST elevation myocardial infarction, NYHA= New York Heart Association, HF= heart failure, CHD= coronary heart disease, **[n =number]**

Table 2. Comparison of clinical and demographic data of isolated CAE (1a) and obstructive CAD groups.

Data	Isolated CAE (86)	Obstructive CAD (25)	P
LMCA	3 (3.5%)	1 (4%)	NS
LAD total	52 (68.4%)	15 (60%)	NS
LAD + LCX	13 (15.1%)	4 (16%)	NS
LAD + RCA	13 (15.1%)	1 (4%)	NS
LAD Alone	10 (11.6%)	10 (40%)	NS
LCX Total	37 (43%)	7 (28%)	NS
LCX alone	4 (4.7%)	0	NS
LCX + RCA	4 (4.7%)	2 (8%)	NS
RCA Alone	31 (36%)	3 (12%)	NS
RCA Total	64 (74.4%)	10 (40%)	**<0.05**
LAD + LCX + RCA	16 (18.6%)	1 (4%)	NS
No of vessels			
1 vessel	42 (46%)	22 (88%)	
2 vessels	30 (34%)	2 (8%)	**<0.05**
3 vessels	16 (18%)	1 (4%)	

LMCA= left main coronary artery, LAD =left anterior descending, LCX=left circumflex, RCA= right coronary artery, NS= non significant

Table 3. Comparison of distribution of isolated CAE and obstructive CAD in the coronary tree.

- As shown in table (3); no significant difference between both groups as regard distribution of the lesions in the coronary artery tree except that: RCA involvement and 3-vessel coronary affection were significantly higher among patients with isolated CAE group in comparison to obstructive CAD (74% vs. 40% and 18% vs. 4%: p<0.05, respectively)
- As shown in fig 3; a significantly higher TIMI frame count in patients with slow flow than patients with atherosclerotic CAE and isolated coronary Ectasia patients (P<0.5).

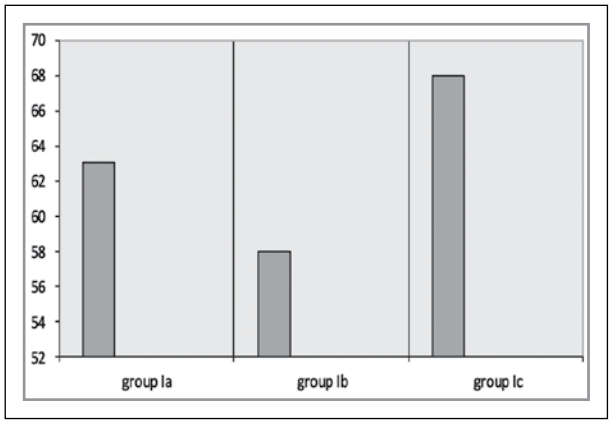

Fig . 3 Comparison of TIMI frame count in patients with CAE and patients with slow flow.

		Ectasia diameter	Ectasia ratio	TIMI count
Ectasia ratio	R	0.75		
	P	**< 0.05**		
TIMI count	R	0.119	0.212	
	P	NS	**< 0.05**	
No of segments affected	R	0.101	0.084	0.349
	P	NS	NS	**< 0.05**
No of vessels affected	R	0.107	0.069	0.277
	P	NS	NS	**< 0.05**

TIMI= Thrombolysis in Myocardial Infarction.

Table 4. Correlation between angiographic parameters of ectasia in patients with ectasia (Groups 1a and Ib) with each other.

As summarized in table (4); A significant positive correlation between ectasia ration and ectasia diameter (r= 0.75 and P < 0.05), and a significant positive correlation between TIMI frame count and; ectasia ratio, number of segments affected, and number of vessels affected (P < 0.05). Non-significant correlation between other ectasia parameters.

DISSCUSION

To the best of our knowledge, this is the first and the largest study to evaluate coronary artery Ectasia (CAE) in a large number of patients (2163 patients) at least in our geographic region, with detailed description of demographic, clinical and angiographic characteristics. We screened two thousands, one hundred and sixty three (2163) patients admitted for elective coronary angiography at the catheterization laboratory in Mansoura Medical Specialized Hospital, Mansoura University in the period from the first of January 2009 till thirty first of December 2011.

The main findings in this study are; 6.6% angiographic incidence of coronary artery Ectasia, higher incidence of HCV seropositivity among Ectasia group, higher incidence of more extensive coronary artery affection among Ectasia group and the right coronary artery (RCA) is the most common site of dilated coronopathy (CAE).

Incidence of coronary artery Ectasia (CAE)

Not all patients with CAE are symptomatic and undergo coronary angiography examination; hence, the real incidence is unknown. The angiographic incidence of CAE in our study is **6.6 %** (142 patients out of total 2163 patients) in patients who underwent diagnostic coronary angiography. This incidence seems to be intermediate as regard that reported in literature. A lower incidence was reported in studies from western countries; **3.2%** reported by Gulec et al **[21]**, **4.4%** by the same investigators **[22]** While a higher incidence **12%** was reported by Sharma et al **[7]** among Indian population. The nearest incidence to that reported among our study population was reported by Aslan et al **[23]** among Turkish patients who reported a **5.3%** incidence in their study. This may be explained partially by underlying genetic factors, variations in risk factors profile and regional inflammatory diseases.

Risk factor profile

It was interesting enough to found that patients with coronary artery Ectasia to be less likely diabetic, on the other hand, HCV seropositivity was significantly higher among patients with CAE in comparison to patients with obstructive CAD. It is quite plausible that infections may potentiate the action of traditional risk factors, such as hypercholesterolemia. A number of scenarios might apply; **first**, cells within the plaque itself may harbor infection. **Second**, extravascular infection might also influence the development of atheromatous lesions and provoke their complication. The acute-phase response to an infection in a nonvascular site might affect the incidence of thrombotic complications of atherosclerosis by increasing fibrinogen or plasminogen activator inhibitor or otherwise altering the balance between coagulation and fibrinolysis. Such disturbance in the prevailing prothrombotic, fibrinolytic balance may critically influence whether a given plaque disruption will produce a clinically inapparent transient or nonocclusive thrombus or sustained and occlusive thrombi that could cause an acute coronary event. **Finally,** acute infections might also produce hemodynamic alterations that could trigger coronary events. The tachycardia and increased metabolic demands of fever could augment the oxygen requirements of the heart, precipitating ischemia in an otherwise compensated individual. These various scenarios illustrate how infectious processes, either local in the atheroma or extravascular, might aggravate atherogenesis, particularly in preexisting lesions or in concert with traditional risk factors **(24)**. Hepatitis C virus (HCV), infects approximately 170 million individuals worldwide and about 22 percent of Egyptian populations are infected with this virus; highest prevalence all over the globe [**25**]. The first evidence for an association between HCV seropositivity and CAD was reported by **Vassalle et al. 2004 (26)** they showed that in addition to other conventional atherogenic risk factors (age, sex, smoking habit, hypertension, diabetes, and dyslipidemia), HCV seropositivity was associated with the presence of CAD. In a recent study **[27]** from our institute we investigated the association between HCV seropositivity and the severity of coronary atherosclerosis using qualitative coronary angiographic analysis and SYNTAX score system and found that HCV seropositivity is an independent risk factor for increased atherosclerosis demonstrated by higher thrombus-containing lesions, higher total occlusions and a higher SYNTAX score.

Angiographic data

- ***Number of vessels affected***

In our study, there was significant difference between groups regarding the number of vessels affected, with single vessel affection higher in patients with classic obstructive CAD whereas two and three vessel affection were higher among patients with coronary artery Ectasia. This could be explained in part by risk factors profile and higher incidence of HCV seropositivity in patients with CAE. HCV infection may also stimulate inflammatory and immune-mediated responses, leading to increased inflammation, or it may increase levels of oxidative stress on atherosclerotic plaque. In other words, increased atherosclerosis in HCV seropositive subjects might be related to increased oxidative stress on atherosclerotic plaque and more inflammation. This is in agreement with what was reported by **Amit Asija et al [28]** who found that Patients undergoing coronary angiography for chest pain have a significantly higher prevalence of obstructive CAD, if they are seropositive for hepatitis C virus than if they are seronegative for hepatitis C virus.

- ***Site of affection of coronary arteries in CAE:***

In our study, among patients with CAE the RCA was the most commonly affected vessel (73.34 %) followed by LAD (48.22 %) then LCX (34.04 %) and the LMCA was least affected (4.25 %). This is in agreement with that reported by Lin et al **[10]** the proximal and middle parts of the RCA are most commonly affected by ectasia, although the reasons for this are not clear. Involvement of the left anterior descending artery and left circumflex artery is variable. The left main coronary artery is less commonly involved.

Finally this study has some limitations which include; first, we did not study specific markers of different pathogenic mechanisms of CAE as inflammation, platelet malfunction, endothelial dysfunction, infectious agents or genetic factors, second, lack of study of systemic associations of CAE as carotid atherosclerosis, abdominal aortic aneurysms, other systemic vascular abnormalities or systemic atherothrombotic diseases. Lastly, there was no comparison between CAE patients and patients with normal coronary angiography.

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Alternative Approach in Deeply and Difficult Extracted Metallic Foreign Bodies in Bronchial Tree

Thoracic

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Background: bronchial foreign bodies remain problematic specially when become deeply impacted and distal and sometimes require thoracotomy. Traditional rigid bronchoscopy may not be successful to remove these foreign bodies in these situations so it often require dynamic thinking as well as pre-operative preparation to have all of the possible surgical tools available.

Patients and methods: In our department, difficult 18 cases collected with basal metallic foreign bodies(FB) ,Rigid bronchoscopy was performed and failed to extract these FBs. So alternative approach , rigid bronchoscopy guided by fluoroscopic C.Arm was used to extract these difficult conditions to avoid thoracotomy.

Results: This approach succeed to treat 17 difficult cases with basal metallic F.B in the period from April 2010 to December 2011 and only one patient need thoracotomy .

Conclusion: Deeply impacted and distal metallic foreign bodies should be exposed to rigid bronchoscopy guided by C-arm fluoroscopy or other alternative approach before decision of thoracotomy.

Key word: Metallic foreign bodies, Bronchial tress.

Deeply impacted and distal foreign bodies remain problematic and sometimes require thoracotomy. Many distal airway foreign bodies present as obstructive atelectasis and may be removed using instruments passed through rigid bronchoscopes[1].

Distal airway foreign bodies pose a unique challenge because they may be angulated or deeply impacted in surrounding inflammation. Traditional rigid bronchoscopic technique may not be successful. These situations often require dynamic thinking as well as pre-operative preparation to have all of the possible surgical tools available.

The right main stem bronchus is the site of object enlodgement in roughly 50–60% of cases , the left main bronchus (30–40%) and trachea (5–10%) comprising the majority of other locations[2].

Rigid bronchoscopy has been the procedure of choice used to remove foreign bodies from the airways of children, especially when the child has airway distress[3].

Flexible bronchoscopy has been described as a complementary procedure that may be helpful when the foreign body cannot be visualized or when it is distally impacted because the flexible bronchoscope can be guided more deeply into the airway than can a rigid bronchoscope[4,5].

Aim of this study

Purpose of this study is to discuss alternate approach in difficult extracted or deeply impacted metallic foreign bodies unsucceeded to be extracted by rigid bronchoscopy to avoid open surgical removal.

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Patient and methods

From April 2010 to December 2011 In our cardiothoracic department , faculty of medicine , Zagazig University, 18 case collected with difficult extracted or basal metallic foreign bodies(FBs) ,Rigid bronchoscopy was performed and failed to extract these FBs.

Inclusion criteria

1- Patients with deeply impacted metallic FBs.

2- Patients with difficult extracted metallic FBs.

Exclusion criteria:

1- Patients with FB in the trachea or main stem bronchus and those patients with easily extracted FB by rigid bronchoscopy.

2- Patients with organic FBs.

History of the patients was sufficient for the diagnosis and all patients had a radio opaque FB in their chest X-rays. The initial symptom was an intense cough. Sixteen patients were admitted to our clinic within the first 24hs, with a positive history of FB aspiration and two patients were admitted 2 days after the onset of the event. The average time from admition till extraction was 43hs ±7hs (range 24 –72 hs).

There was no specific physical examination finding, as this was a non-asphyxiating foreign body aspiration.

All patients had good oxygen saturations , normal respiratory frequencies, no fever or dyspnea and no pain during inspiration and expiration. There was a mild incidental cough.

In one patient there was hemoptysis (blood tinged sputum) after history of inhalation.

Pre-operative evaluation

Careful pre-operative evaluation is a key element to success. Review of the most recent radiography should aid with localization. It is important to note whether the object appears distal in the bronchus. Knowledge of the shape of the object can guide the endoscopiest in selecting the appropriate tools.

Chest radiography postero-anterior and lateral views are very helpful and usually performed before the bronchoscopy.

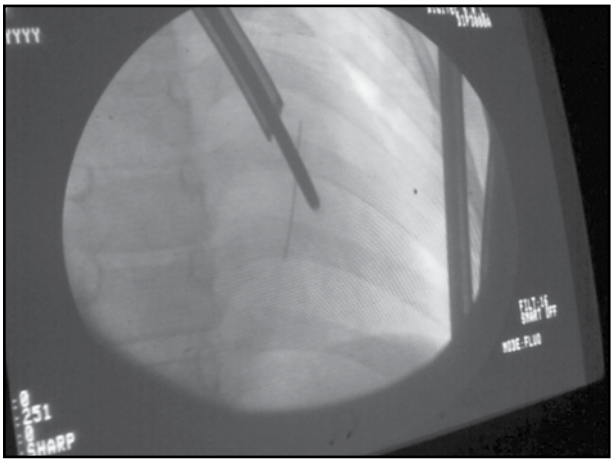
Chest radiography may identify: (a) the foreign body itself and its location. (b) emphysema in the region peripheral to the foreign body when there is no complete obstruction, leading in a valve mechanism; (c) atelectasis if the bronchus is completely obstructed; (d) pulmonitis, mainly in neglected cases.

In all patients rigid bronchoscopy under general anesthesia with muscle relaxants had been performed guided by C - Arm fluoroscopy, Intra-operative fluoroscopy was performed by an interventional radiologist .

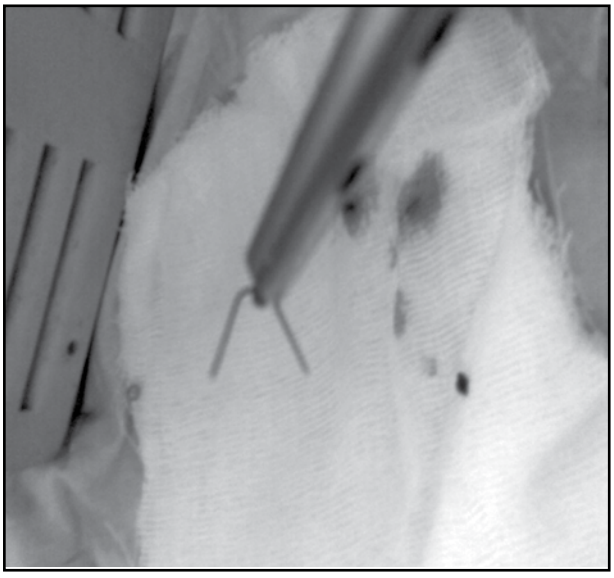
During bronchoscopy, an inspection of the total bronchial tree should be performed despite the finding of the foreign body.

Electrocardiogram and peripheral oxygen saturation were monitored continuously throughout the procedure. The patients were ventilated spontaneously using bronchoscopic attachment.

All surgical, anesthetic and nursing teams should wear protective coats to avoid hazard of radiation.



Fluoroscopic view show; rigid bronchoscopy and forceps grasping the foreign body .



Foreign body after extraction

Results

Most of foreign bodies were headscarf pins (16 case=88,9%) and only 2 different cases; one was old man inhaled 2 screws and the other was a child inhaled metallic tip of pen. So we have 18 patients and 19 FBs

As regard age and sex ; most of cases (16case; 88.9%) were female(adolescent girls)and two cases (11.1%) were male one of them was child 10 years old and the other was carpenter about 60 years old.

So the age ranged from 10 to 60 years with average age of 23.5 ± 5.8 years

Foreign bodies(FBs) were commonly located in the right (11cases ; 57..9 %).

It was followed by left (8cases ; 42.1 %).

	Number	Percent (%)
Types of FB		
- Headscarf pin	16	84.2
- 2 screws in one patient	2	10.6
- Metallic tip of pen	1	5.2
Site of location		
- Right bronchial tree	11	57.9
- Left bronchial tree	8	42.1

Table 1. Types of FB and site of location:

All of foreign bodies were extracted successfully from 17 cases by this approach (rigid bronchoscopy guided by C- Arm fluoroscopy), and only one case needs exploratory thoracotomy due to ulceration, inflammation and disturbed anatomy of opening of basal bronchi and deeply impacted FB and its extraction by this approach may be hazardous for the patient.

In one patient 2 foreign bodies (2 screws) inhaled, one in the right bronchial tree, and the other was in the left bronchial tree, the two foreign bodies extracted in the same setting.

A common complication during bronchoscopy is desaturation (decrease of O_2). Slight bleeding that may occur is usually well controlled. The edema, which can affect the larynx, trachea or bronchi , is treated with the use of steroids and antibiotics . No serious complications have occurred by performing the bronchoscopy for foreign body aspiration in this study.

Only one patient developed left pneumothorax, early diagnosis and rapid management using intercostal chest tube and under water seal succeeded to rescue this patient. Laryngo-tracheal edema was observed in two patients and they responded well to a local solution of 1/100,000 adrenaline and systemic steroids. Atelectasis appear in one patient in the second day after procedure and treated by chest physiotherapy, antibiotics, mucolytics, repeated naso-tracheal suction and fiber optic bronchoscopy (table 2).

Uncomplicated patients (10) were discharged the following day. The remaining cases (8) were followed for a few days more and discharged as follow, six patients discharged after three days, one patient (developed peumothorax) discharged after five days after removal of chest tube and the patient who needs thoracotomy discharged after ten days. We had no mortality.

	Number	Percent (%)
Laryngeal edema	2	11.1
Bleeding	3	16.6
pneumothorax	1	5.5
Atelectasis	1	5.5

Table 2. Complications:

Discussion

In our study the most cases were adolescent girls and the most of foreign bodies aspirated were headscarf pins, we live in Islamic country and most of the girls begin to wear headscarf from their puberty to the rest of their lives . Wearing a headscarf and attaching pins properly is a very complex task. Since both hands are busy with wrapping the headscarf around the head, four or five of these pins are held between the teeth and are then attached to the headscarf sequentially[6]. The history is the same in all cases; they have aspirated these pins while talking, laughing, deep breathing and coughing during these maneuvers[7].

Only one patient was child 10 years ago (5.5%)and one patient was 60 years old (5.5%) he was carpenter and aspirate two screws one in each lung multiple trials for extraction of these FB by rigid bronchoscopy done but failed so this patient prepared for staged thoracotomy , at this time ; I carefully research for alternative approach to avoid this patient bilateral thoracotomies and I perform the first trial for rigid bronchoscopy guided by C-Arm fluoroscopy and both FBs were extracted successfully in the same sitting and patient avoided bilateral thoracotomies. From this date difficult extracted FBs prepared for thoracotomy should be tried by this maneuver.

Foreign bodies were located more in the right bronchial system

Because the right bronchus is wider and more vertical than the left, airflow traveling into the right lung is, therefore, greater, and because of the slight left leaning character of the carina, an inhaled body is more likely to enter the right main stem bronchus [8,9].

Conclusion

This approach succeed to treat 17 difficult cases with basal metallic F.B and only one patient need thoracotomy, so we recommend;

Deeply impacted and distal metallic (radio-opaque) foreign bodies should be exposed to rigid bronchoscopy guided by C-arm fluoroscopy as alternative approach before decision of thoracotomy.

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ROLE OF THORACOSCOPY IN MANAGEMENT OF PLEURAL EFFUSION

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Background; The diagnosis of pleural diseases is one of the most frequent clinical problems encountered in pulmonary medicine. A variety of diagnostic tests are available for evaluating pleural effusion. It often depends much on the revealing results of pleural fluid cytology and histopathological examination of the visceral or parietal pleura. While cytology is highly specific for malignancy, still 30-50% of cases with definite pleural involvement by tumor remain cytologically negative. Thoracoscopy is able to establish a definitive diagnosis in about 95% of pleural effusions.

Aim of the work; The aim of this work was to evaluate the role of thoracoscope in management of pleural effusion.

Patients and Methods; The study included twenty patients with radiologically diagnosed pleural effusion evaluated by thoracentesis, closed pleural biopsy, and finally video thoracoscopy.

Results; In this study, the final diagnosis was achieved in 18 cases (90%), malignant pleura effusion in 16 cases (80%), and tuberculous effusion in 2 cases (10%). Among malignant cases, mesothelioma was present in 8 cases (40%), metastatic pleural malignancy was present in 8 cases (40%), adenocarcinoma from various organs was the most encountered metastatic malignancy. Pleural fluid cytology could achieve the diagnosis in 6 malignant cases (30%). The blind pleural biopsy by Abram's needle achieved diagnosis in 4 cases (20%), one of them was tuberculous, two cases were malignant, and one case was metastatic breast cancer, while the yield for pleural fluid cytology and Abram's needle biopsy together was 7 cases (35%). The corresponding figure for thoracoscopic pleural biopsy was 18 cases (90%) , among them 16 malignant cases (80%) and 2 tuberculous cases (10%). The malignant cases were 8 cases of malignant mesothelioma and 8 cases of metastatic malignancy.

Conclusion: Thoracoscope is a safe and accurate diagnostic procedure which can be performed under local anaesthesia with minimal or no complications. The overall diagnostic yield of thoracoscopy superceded other modalities including pleural fluid cytology and blind pleural biopsy. Although pleural fluid cytology is good in malignant pleural effusion, and Abram's needle biopsy in TB pleurisy, but both still of limited role in other types. Thoracoscopy should not replace pleural fluid cytology or Abram's needle biopsy as a routine diagnostic procedures , but it still a good adjuvant in the diagnosis.

Pleural effusion, pleural thickening and pneumothorax are frequently encountered in pulmonary practice and although the radiographic detection of pleural abnormalities may be obvious, determination of a specific diagnosis can present a challenge[(1)]. A variety of diagnostic tests are available for evaluating pleural effusion which often depends much on the revealing results of pleural fluid cytology and histopathological examination of the visceral or parietal pleura[(2)]. Blind pleural biopsy has been reported to yield abnormal findings in 37.5% to 76% of pleural carcinomas and in 45% -64% in tuberculous pleurisy[(3)], while CT-guided Abram's needle biopsy is a reasonable procedure if pleural thickening is the main abnormality[(4)]. Cytology is highly specific for malignancy, but still 30-50% of cases with definite pleural involvement by tumor remain cytologically negative. Added to the false negative results of cytology, it fail to identify the type and cell of origin of cancer involving the pleura[(5)]. Thoracoscopy is able to establish a definitive diagnosis in

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about 95% of pleural effusions[6]. It allow full exploration of the pleural cavity and much less invasive and incapacitating than thoracotomy, also complications are uncommon and rarely occur when the procedure is performed by one who mastered the technique[7].

Patients and methods

This study was carried on twenty patients with exudative pleural effusion of either sex, in Cardiothoracic Surgery Department in Menofyia University Hospital. Every patient was evaluated by; thoracentesis and cytology, closed pleural biopsy using Abram's needle and finally video assisted thoracoscope. Patients excluded from the study are those with transudative effusion, those with sever coagulation defect, unstable hemodynamic status, those who had their pleural space obliterated by sever fibrosis, and those with severely thickened pleura. Detailed history taking and thorough chest examination, then laboratory investigation (including routine investigations, ABG, sputum smear for acid-fast bacilli on three successive days) and plain x-ray chest and CT scanning of the chest, all preceded thoracentesis.

Diagnostic Thoracentesis[8]; every patient was premedicated with 0.5 mg atropine sulfate injected intramuscularly (IM) 30 minutes before the procedure. The patient was seated on a chair in the upright position and his arms rested on a raised bedside table in front of him. The sit for thoracentesis was selected in an area of dullness, diminished breath sounds and lost tactile vocal fremitus. The selected point was sterilized and dapped then local infiltration of the selected intercostal space was done by 10-15 ml of 2% lidocaine. Then the fluid aspirated was divided into three samples to be sent for chemical, bacteriological and cytological examination.

Closed pleural biopsy [9]; closed pleural biopsy was done to all patients at time of thoracoscopy. The needle used was first described by Mestitz et al. in 1957 and again by Abrams in 1958. The needle is a three-part needle consisting of a 4-mm-diameter outer cannula with a beveled notch near to its tip, a hollow inner cutting cannula that moves to and fro on a spiral guide with a clockwise/counterclockwise rotation, and an inner style. The inner cannula has a hexagonal grip and a knop pointing to the direction of the beveled notch. The site for biopsy was chosen as for thoracentesis, usually in the 5th the 6th or the 7th space in the mid-axillary line, and it was infiltrated by local analgesic. A 1 to 2 cm vertical incision was done in the skin and subcutaneous tissues for introduction of the needle. Samples obtained were placed in formalin for pathological examination and in saline for mycobacterial culture.

Video Thoracoscopy[10]; We used rigid thoracoscope with Hopkins Telescope 27015 B. Light is supplied from conventional cold light source. The system is adapted for photo-documentation with a camera, closed-circuit television. The scope is rigid and 50 cm long. The field of view is 120^{o} with a depth of field from 3 to 100 mm. The scope is inserted through plastic trocars of different diameters. The technique of thoracoscopy was described by Mitruka et al. in 1995 [10]. Examination of the pleural space was done through two ports of entry. The anatomical landmarks of the pleural cavity (the fissures, lobes, the diaphragm, the mediastinal structures, and the beating heart in the left side) were identified and systemically examined before sampling. If multiple lesions were encountered, multiple biopsies were taken. If the pleura seemed normal, biopsies were obtained from different sites of the parietal pleura.

Results

Twenty patients with radiologically diagnosed pleural effusion were enrolled in this study. The age of patients was ranged from 15 to 75 years, mean ± standard deviation (53.15 ± 15.52). Characteristics of these patients are listed in table (1).

		No. (n=20)	%
Sex	Males	9	45
	Females	11	55
Smoking	Smokers	8	40
	Non-smokers	12	60
History of malignancy			
	+ve	5	25
	-ve	15	75
History of exposure to carcinogen			
	+ve	3	15
	-ve	17	85
History of chest trauma			
	+ve	1	5
	-ve	19	95

Table (1): Characteristics of studied patients

Symptoms suffered by patients are listed in table (2).

	No. (n=20)	%
Dyspnea	20	100
Chest pain	14	70
Cough and expectoration	12	60
Fever	7	35
Hemoptysis	4	20
Site of pleural effusion		
Right	10	50
Left	10	50

Table (2): Clinical data of studied patients

Chest radiograph in the form of plain x-ray and CT scan were performed to all cases. The roentegraphic data are listed in table (3).

Radiographic findings	No. (n=20)	%
Encysted pleural effusion	4	20
Pleural mass	2	10
Pleural thickening	10	50
Hilar mass	2	10
Apical coin shadow	1	5
Shifting of mediastinum to the opposite side	12	60

Table (3): Roentegraphic data of studied patients

The results of biochemical analysis of pleural fluid were listed in table (4).

	Mean±SD	Range
Protein (gm/dl)	4.06 ± 0.07	3.10- 5.6
Glucose (mg/dl)	160.15 ± 101.01	63- 391
LDH (U/L)	818.4 ±1405.85	241- 6718
Total serum protein (gm/dl)	7.3 ± 0.236	7-7.6

Table(4) results of biochemical analysis of pleural fluid

As regards the etiology of pleural effusion, A definite histological diagnosis was reached in 18 cases (90%) using the three investigative tools that were used in this study (table 5). The diagnosis reached were the following:

a) Malignant etiologies:

- Eight cases of malignant pleural mesothelioma (40%).
- Eight cases with metastatic malignancy to the pleura (40%).

b) Non-malignant etiologies:

- Two cases of pleural tuberculosis (10%).
- Two cases of etiologically undiagnosed pleural effusion (10%).

Diagnosis	No.	%
A) Malignant conditions:	16	80
Malignant mesothelioma	8	40
Metastatic malignancy	8	40
B) Non-malignant conditions:	4	20
Tuberculous effusion	2	10
Undiagnosed etiology	2	10

Table(5): Distribution of studied patients according to final diagnosis

The diagnostic yield of thoracentesis and pleural fluid examination, closed pleural sampling by Abram›s needle, and video thoracoscopy were as follow:

1- Thoracocentesis:

[A] Pleural fluid cytology:

Pleural fluid examination for malignant cells yielded positive results in 6 cases (30%) (out of 16 cases totally diagnosed 37.5%) (table 6).

Diagnosis	No.	%
A) Malignant cells:	6	30
Malignant mesothelioma	2	10
Metastatic ovarian carcinoma	1	5
Metastatic breast cancer	1	5
Anaplastic carcinoma	2	10
B) No malignant cells	14	70
Total	20	100%

Table(6): Distribution of studied patients according to results of cytology in thoracentesis

[B] Bacteriology:

- Pleural fluid Z.N. stains for acid fast bacilli showed no tuberculous bacilli.
- Pleural fluid culture for mycobacterium tuberculosis on L-J medium showed no growth in any of the twenty cases including the two cases ultimately diagnosed as pleural TB. (table 7).

Diagnostic tool	Cases positive for TB	
	No	%
Thoracentesis	0	0
Abram's biopsy	1	50
Thoracoscopy	2	100
Total	2	100

Table(7): Results of diagnosis of TB by different diagnostic tools

2- Closed pleural biopsy (Abram's needle biopsy):

[A] Histopathological examination:

There were two cases that were diagnosed as malignant mesothelioma by means of Abram's needle (10%) (2 out of 8 cases = 25%) and one case of metastatic breast cancer (5%) (one out of 8 cases = 12.5%).

[B] Culture of obtained biopsy on L-J medium:

Among the twenty cases in the study, the Abram's needle biopsy were positive for culture on L-J medium in only one case (5%) (one out of two cases of TB =50%).

3- Video thoracoscopy:

[A] Histopathology of pleural samples:

a) Malignant etiology: Thoracoscopy was extremely helpful in the diagnosis of different malignant processes involving the pleura (primary or metastatic). The diagnosis was possible by means of thoracoscopy in 16 out of 16 cases of malignancy diagnosed in this study (100%). Of these there were eight cases of malignant pleural mesothelioma (40%) (8 out of 8 cases 100%) and eight cases of metastatic malignancy to the pleura(40%) (8 out of 8 cases 100%). (table 9).

b) Non-malignant etiology: There were two cases of pleural TB (10%) (2 out of 2 cases 100%) and two cases of undiagnosed pleural effusion in whom histopathological examination and culture for TB on L-J medium was negative. The thoracoscopic biopsies were positive for culture on L-J medium in only one case (5%) (one out of two cases was positive =50% of TB effusion).

Thoracoscopy has strong agreement with the final settled diagnosis (Kappa statistics = 1 , statistically significance if < 0.001).

Abram's Biopsy	Settled specific diagnosis						Total N= 18		Kappa statistic	P
	Non-malignant N=2		Mesothelioma N=8		Metastatic malignancy N= 8					
	No	%	No	%	No	%	No	%		
Non-malignant	2	100	6	75	7	87.5	15	83.5	0.133	<0.05
Mesothelioma	0	0	2	25	0	0	2	11.1		
Metastatic malignancy	0	0	0	0	1	12.5	1	5.6		
Total	2	100	8	100	8	100	8	100		

Table (8): Degree of agreement between Abram›s needle biopsy and settled specific final diagnosis

Thoracoscopy	Settled specific diagnosis						Total N= 18		Kappa statistic	P
	Non-malignant N=2		Mesothelioma N=8		Metastatic malignancy N= 8					
	No	%	No	%	No	%	No	%		
Non-malignant	2	100	0	0	0	0	2	11.1	1.0	<0.001
Mesothelioma	0	0	8	100	0	0	8	44.4		
Metastatic malignancy	0	0	0	0	8	100	8	44.4		
Total	2	100	8	100	8	100	18	100		

Table (9): Degree of agreement between thoracoscopic results and settled specific final diagnosis

Settled specific final diagnosis	Pleural fluid cytology		Abram's biopsy		Cytology and Abram's biopsy		Thoracoscopy	
	No	%	No	%	No	%	No	%
+ ve	6	30	4	20	7	35	18	90
- ve	14	70	16	80	12	60	2	10
Total	20	100	20	100	20	100	20	100

Table (10): The diagnostic yield of thoracoscopy compared to other tools in the study

[B] Thoracoscopic gross picture of the pleura:

a) Malignant pleural effusion: Mesothelioma (8 cases), metastatic adenocarcinoma (4 cases), metastatic squamous cell carcinoma (2 cases), metastatic mixed uterine carcinosarcoma (one case), and metastatic renal carcinoma (one case) are the encountered histopathology in 16 cases of malignancy, they presented grossly by multiple variable gross pictures including variable sized multiple nodules, diffuse pleural thickening, large pleural masses, and ulcerated areas.

b) Non-malignant pleural effusion: The two cases of TB pleural effusion showed hyperemia of pleural surface, thickened pleural adhesions, mucoid bands, and multiple sized nodules and calcification. The two cases of undiagnosed etiology presented with pleural thickening and multiple pleural adhesions.

In this work the diagnostic yield of pleural fluid cytology was 30%. Abram›s pleural biopsies were positive in 20%. By using both pleural fluid cytology and Abram›s pleural biopsy, the diagnostic yield was higher in all cases (35%). Table (10) shows that the diagnostic yield of Thoracoscopy was 90% . Compared to cytology and needle biopsy, the difference was statistically highly significant (P<0.001).

As regard the comparison of the diagnostic yield of pleural fluid cytology, Abram's needle pleural biopsy and thoracoscopic pleural biopsy in this study; pleural fluid cytology diagnosed 6 cases (30%) while Abram's biopsy diagnosed 4 cases (20%), the difference between both was statistically insignificant (P>0.05), both pleural fluid cytology and Abram's pleural biopsy diagnosed 7 cases (35%) compared to 18 cases (90%) diagnosed by thoracoscopy, the difference was statistically significant P<0.001).

Fair agreement exist as regard combined cytology and pleura biopsy with the final settled diagnosis(Kappa statistic=0.233, and P<0.001), so it was statistically significant. While thoracoscopy has strong agreement with the final settled diagnosis (Kappa statistic= 1 and P<0.001), so it was statistically significant strongly.

Discussion

Recent advances in endoscopic techniques and surgical instrumentation have contributed to the resurgence of thoracoscopy as a useful diagnostic and therapeutic modality[11]. Thoracoscopy involves the passage of endoscope through the chest wall and offer the clinician a window for direct visualization and collection of samples from the pleura, it is a valuable diagnostic procedure and in some cases it can also provide an opportunity for treatment[12]. In contrast to video-assisted thoracoscopic surgery (VATS), video-thoracoscopy under local anesthesia and sedation is utilized in the management of pleural effusions making the procedure less invasive[13]. The conditions of the pleura that might benefit from thoracoscopy includes pleural effusion, pleural masses or thickening, suspected mesothelioma, empyema, haemothorax and chylothorax. The thoracoscopic procedure that can be performed for pleural disease include pleural biopsy, drainage of pleural effusion, pleurodesis, pleurectomy, drainage and debridement for early empyema, ligation of thoracic duct for chylothorax, and exploration for haemothorax post trauma [14].

The aim of this work was to evaluate the role of thoracoscopy in relation to other diagnostic tools for the etiology of exudative pleural effusion. Patients were subjected to diagnostic thoracentesis and cytology, closed pleural biopsy using Abram›s needle and finally video-thoracoscopy using rigid thoracoscope.

A definite histological diagnosis was reached in 18 cases (90%) using one or more of the three investigative tools that were used in this study. The main diagnoses reached were divided into two categories: malignant or non-malignant (Table 5). There were 16 (80%) malignant conditions; (8 cases of malignant pleural mesothelioma MPM and 8 cases of metastatic malignancy), and 4 (20%) non-malignant conditions; 2 (10%) of tuberculous origin and 2 (10%) of undiagnosed etiology. The most commonly encountered malignant condition was MPM, eight cases (40%) have been diagnosed, three of them has positive history of exposure to asbestos fibers (Table 1). This results agree with the results of Maria and Comba[15]. They studied 40 patients with MPM; 20 patients had occupational

and enviromental exposure to asbestos fibers. Similar findings have been reported with Ascoli et al.[16] . They studied 100 patients with MPM, 30 of them were exposed to asbestos and they stated that the evidence of incidence of this tumor suggest that the occurrence of asbestos induced mesothelioma in some individuals but not in others, points to the existence of genetic predisposition.

As regard the protein content in the pleural effusion, our study revealed that no significant difference was found between the malignant effusion (4.15± 0.69) and non-malignant pleural effusion groups (3.72±0.75, P<0.05). Similar findings have been reported with Momi et al. [17] and Santiago et al.[18] . They found no significant difference between the mean value of pleural fluid protein in pleural effusion due to malignancy, TB, or parapneumonic effusion in 100 and 50 patients studied respectively.

In the present study, the diagnostic yield of pleural fluid cytology was 6 out of 20 cases (30%) of pleural effusion (table 6). The corresponding figure was 47% in the series of Graham et al.[19] and 60% in the series of Dines et al.[20], however, they reported that half of these cases were metastatic breast carcinoma which is well known by their ability to exfoliate in the pleural fluid. Anderson et al.[21] had pointed to the fact that the frequency of positive pleural fluid cytology differs according to the primary cause of pleural effusion. They reported high positivity rates among bronchial carcinoma and breast cancer (71% and 73% respectively). Our result doesn't coincide with that of Light[22], he obtained a positive diagnosis of cancer in 33 out of 43 patients (77%). Possible reasons for this high yield included the use of multiple techniques; cell spreads, membrane filter and cell block. Also our results disagree with the high rate of positive results (73%) obtained by Salyer et al.[23] who was attributed to the examination of multiple specimens, as they obtained 53% positive results in the first cytology and 20% more positive results in the subsequent examination. Light[22] noticed that the positivity of pleural fluid cytology might increase from 60% to 90% by repeating the examination for 3 times. In our work, malignant mesothelial cells were found in only 2 cases (10%) by pleural fluid cytology, metastatic adenocarcinoma cells were found in 2 cases (10%) and anaplastic carcinoma cells were found in 2 cases (10%). Materson et al.[24] reported that the diagnostic value of pleural fluid cytology is limited in cases of mesothelioma because of the subtle difference between benign and malignant mesothelial cells. Similar findings was obtained by Law et al.[25] on 80 patients with mesothelioma examined by pleural fluid cytology. In only 20 patients(25%) the fluid examination established that the patient had malignant disease, but in non, the definite diagnosis of mesothelioma could be established. Although diagnosis of mesothelioma can be reached by pleural fluid cytology it can not distinguish mesothelioma from metastatic adenocarcinoma. Immuno histochemical staining is often necessary for definitive identification because of visual similarities between adenocarcinoma and mesothelioma[26] .

Among 20 patients in this study, only 2 cases of TB (10%) were diagnosed as tuberculous pleurisy, the detection of acid fast bacilli on smear prepared from fluid of thoracentesis was negative (table 7). Also, culture of pleural fluid yield no growth of mycobacterium TB in L.J. medium in 20 cases. These results disagree with that of Sahn [27]. He studied 100 patients with TB effusion and reported that in 10% of cases the detection of acid fast bacilli on smear prepared fluid was positive and culture of pleural fluid yields growth of TB bacilli in about 10% of cases. The explanation of the low incidence obtained in our study is the low incidence of tuberculous pleural effusion due to small number of preselected cases of the study.

In the present study, Abram's pleural biopsy was positive in 4 out of 20 cases (20%), there were 3 cases of malignant effusion (2 of them were MPM and one case of metastatic breast cancer) and one case of tuberculous effusion. This results was obtained by using multiple specimens technique in the same setting, without repetition of the biopsy procedure. This results was lower than that obtained by Donohoe et al.[28], they reported 39% diagnostic rate in pleural biopsy obtained by the Vim-Silverman needle. Rabieh et al.[29] reported 50% diagnostic rate using Abram's pleural biopsy. Our results was higher than that obtained by Ahmed et al.[30] who reported 10% diagnostic rate in pleural biopsies obtained by Abram's needle. As regard the type of malignancy diagnosed in this study(it was positive in 3 out of 16 malignant cases, 18.75%), mesothelioma was proved in 2 out of 8 cases (25%) of MPM, metastatic adenocarcinoma was proved in 1 out of 8 cases (12.5%) of metastatic malignancy. These results disagree with Loddenkemper and Bautin[31]. They studied 95 cases with malignant pleural effusions and reported 50.3% positive needle biopsies, but this high yield was achieved in very advanced stage of the disease. Levine et al.[32] noticed that the yield can be improved slightly by submitting one of the biopsy specimens for culture. Closed pleural biopsies are of little value for the localized tumor, and of absolutely no use for tumors localized to the diaphragmatic, visceral or mediastinal pleura. In fact, the success of closed pleural techniques depends on tumor extent. The greater the extent of invasion, the more likely is closed pleural biopsy to be successful. This explains why centers dealing with more advanced cancers report higher success rates with needle biopsy[31]. As regard the comparison between the diagnostic yield of plural fluid cytology and Abram's pleural biopsy in malignant pleural effusion cases in this study, the pleural fluid cytology was diagnostic in (30%) of cases where Abram's pleural biopsy was diagnostic in (15%) of cases. This difference was statistically insignificant(P>0.001), and this could be due to the small number of studied samples. This result coincide with that obtained by Salyer et al.[23] who reported that, considering the focal nature of pleural involvement by metastatic tumor, it is not surprising that the success in the diagnosis for biopsy would be less than that of cytology. In the present study, by using both pleural fluid cytology and Abram's pleural biopsy, the diagnostic yield was higher (35%). These results were compatible with that obtained by Salyer et al.[23], who reported that, the Abram's pleural

biopsy provided the diagnosis when the pleural fluid cytology was less than diagnostic, making the results of both biopsy and cytology examinations much more profitable than either of the two alone. Prakash [33] reported that only 20 (7%) out of 281 patients with malignant pleural effusions had a closed pleural biopsy specimen reveal malignant disease when the fluid cytology study was negative. Negative thoracentesis and pleural biopsy give no assurance that serious disease is absent. However, it is recommended that thoracentesis and pleural biopsy initially be performed specially if tuberculosis is the primary consideration[34].

In this study, the diagnostic yield of thoracoscopy was 18 out of 20 cases of pleural effusion (90%) among them 2 out of 2 tuberculous cases (100%) and 16 out of 16 malignant cases (100%) was diagnosed (table 9). In malignant cases, thoracoscopy diagnosed all cases of mesothelioma, the only one case of metastatic renal carcinoma, one case of mixed uterine carcinosarcoma, all cases of metastatic adenocarcinoma(4 cases) and 2 cases of metastatic squamous cell carcinoma of the bronchus. Many investigators have confirmed the diagnostic accuracy of thoracoscopy in patients with pleural effusions. De Camp et al.[35] diagnosed 97% of 121 patients with carcinomatous pleural effusions, and Canto et al.[36] achieved 94% diagnostic accuracy in a similar clinical sitting. Baumagartner and Mark [37] reported 92% success rate in patients in whom previous thoracentesis and pleural biopsy had been non-diagnostic. The diagnostic accuracy of thoracoscopy was 100% in the work done by Rodgers et al. [38] and Guerin et al. [39]. Cataldi and Bianchi [40] diagnosed 90% of 20 patients with pleural effusion. In the present work, the low incidence of tuberculous pleural effusion (10%) compared to malignant pleural effusion (80%) doesn't reflect the real prevalence of the disease due to the small number of preselected cases of the study[27]. In our study, thoracoscopic sampling of pleural tissue for pathological examination for TB yielded the diagnosis in 2 cases (100%). Abram's needle also yielded tuberculous caseation and granuloma in 1 case (50%). The thoracoscopic biopsies were positive for culture on L.J. medium on only one case (50%), while both Abram's needle biopsies were positive also in one case (50%). Although we could diagnose only 2 cases of tuberculous effusion, in a retrospective study of 100 cases with tuberculous pleuritis, by means of thoracoscopy, the diagnosis of tuberculosis of the pleura was established in 94 cases (94%) by Loddenkemper et al [41]. Other authors have evaluated the yield of closed pleural biopsy versus thoracoscopy in 40 cases of tuberculous pleuritis. They found that the combined sensitivity of Abram's biopsy histology and culture was 86% and that of thoracoscopy was seldom needed for diagnosis of pleural tuberculosis [42].

The success in diagnosis by thoracoscopy in the present study cases howether tuberculous or malignant was superior to that of pleural fluid cytology alone, Abram›s pleural biopsy alone or both together owing to its allowing for direct visualization of pleural space and hence a guide for biopsy from the presumed affected site.

Conclusion

Thoracoscope is a safe and accurate diagnostic procedure which can be performed under local anaesthesia with minimal or no complications. The overall diagnostic yield of thoracoscopy superceded other modalities including pleural fluid cytology and blind pleural biopsy. Although pleural fluid cytology is good in malignant pleural effusion, and Abram's needle biopsy in TB pleurisy, but both still of limited role in other types. Thoracoscopy should not replace pleural fluid cytology or Abram's needle biopsy as a routine diagnostic procedures , but it still a good adjuvant in the diagnosis.

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Comparison Between Using Small Bore Catheter and Using The Traditional Chest Tube Application in The Management Of Malignant Pleural Effusion

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Background; **Malignant pleural effusion is the most frequent cause of exudative pleural effusion after age 60 years. This effusion traditionally means incurability and the methods of its management are controversial. Traditional chest tube thoracotomy is most prevalent method, however it has multiple disadvantages regarding its size ,the pain during insertion, drawback of rapid drainage and the discomfort while the tube in place.**

Objective; **This study aim to evaluate the usage of a small bore catheter (12Fr) as an alternative, effective and safe method to the traditionally large bore chest tube (24Fr) in the management of malignant pleural effusion.**

Patients and Methods**; Thirty patients with malignant pleural effusion were randomly grouped into two groups according to the method of drainage.**

Results**; Results concluded that there were insignificant difference in the results of both groups except for the length of hospital stay and the time from tube insertion to discharge.**

Conclusion: From the results of this study and other studies performed by others, we conclude that small-bore catheter is as effective, safe, and results in minimal complications as large bore chest tube in the treatment of malignant pleural effusions and deserve further evaluation in larger prospectively designed trials.

Malignant pleural effusion is the most frequent cause of exudative pleural effusion after age 60 years, this effusion traditionally means incurability and significantly alter their quality of life, these patients have a very poor prognosis with a short median survival range [(1)].

Symptomatic pleural effusion is one of the most distressing manifestations of advanced malignancy. Several treatment options are available including intermittent outpatient thoracentesis, placement of a pleuroperitoneal shunt, insertion of large bore 24Fr chest tube with instillation of pleural sclerosing agent, video-assisted thoracoscopy with instillation of talc and even thoracotomy and pleurectomy, each modality has its advocates[(2,3,4)].

AIM OF THE WORK

This is a comparative study regarding the effectiveness and safety of small-bore catheter 12Fr and large-bore catheter 24Fr in the management of malignant pleural effusion.

PATIENTS AND METHODS

This study included thirty patients with malignant pleural effusion admitted to chest or cardiothoracic surgery departments Alexandria main university hospital and Damanhour national medical institute meeting the following inclusion criteria;

* Documented or strongly suspected malignant pleural effusion in patients with or without known neoplasm.
* Large effusion defined by greater than one third opacification of the affected hemithorax.
* No prior intrapleural sclerotherapy.

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Exclusion criteria

- Bilateral pleural effusion.
- Minimal to mild pleural effusion.
- Presence of loculations.
- Poor general condition of patients.

The patients were divided into two groups according to the type of tube drainage:

Group I: included fifteen patients using large-bore traditional chest tube (24Fr) .

Group II: including Fifteen patients using small-bore pigtaill chest tube (12Fr) .

All patients were subjected to the following:

1- Complete history taking and clinical examination.
2- Chest X-ray(P-A and lateral).
3- Complete blood picture.
4- Ultrasonographic examination of chest in order to assess the presence or absence of loculations.
5- C.T. chest when needed.
6- Biochemical and cytological characteristics of pleural effusion.

Every patient had a predrainage base line chest x-ray. Patients of group II were placed in the setting position, after local anaesthesia with 2% xylocaine a small incision was made with scalpel before inserting 12Fr pigtail catheter which was typically placed in the midaxillary line at the 6th or 7th intercostal space, the catheter was sutured to skin to prevent its dislodgement. The evacuation was continued until about 20 ml/kg was drained, the catheter was then connected to one thousand milliliter chest bag with an under water seal. An ultrasound was taken to ensure that the catheter is in place properly, a follow up chest radiograph after 24hours from insertion was taken. The procedure of insertion of large-bore chest tube under local anaesthesia is well known. When the drainage was decreased to less than 100ml/day another chest x-ray was obtained to confirm complete fluid drainage.

Pleurodesis was performed by the same sclerosing agent in the two groups(20ml iodopovidone diluted with 80 ml 0f normal saline), after that the catheter was removed after performing chest x-ray in order to be sure that complete drainage and full lung expansion had been taken place and that chemical or inflammatory pleuritis had occurred . A follow up chest x-ray P-A view was done 30 days post sclerotherapy and was compared with the previous one that was done just after removal of the catheter.

Thirty days follow up consisted of clinical examination and chest radiograph for recurrence detection (recurrence was defined as re-accumulation of pleural fluid greater than that seen on the base line post-pleurodesis chest radiograph).

Results

The present study included thirty patients with documented or highly suspicious malignant pleural effusion . Cytological examination was done for all patients and it was positive in 21 patients (70%) . Ages of patients of the first group (treated with traditional large-bore chest tube) ranged from 44 to 74 years with a mean of 58.72 ± 8.68 years , while ages of patients of the second group (treated with small bore catheter) ranged from 43 to 85 with a mean of 62.53 ± 10.81 years (p=0.243).

Thirty patients were included in this study 17 females (56.7%) 7 of them in the first group (large-bore chest tube) and 10 in the second group. Thirteen male patients(43.3%), 8 in the first group and 5 in the second group(P=0.269).

	All patients		Group 1 (n=15)		Group (n=15)		Test of significance
	No	%	No	%	No	%	
No	30		15		15		
Gender							
Male	13	43.3	8	53.3	5	33.3	X2p = 0.269
Female	17	56.7	7	46.7	10	66.7	
Age							
Range	43 - 85		44 - 74		43 - 85		
Mean+ -SD	60.40 ± 9.87		58.27± 8.68		62.53± 10.81		P = 0.243
Median	60.0		59.0		62.0		
Prior chemotherapy	13	43.3	6	40.0	7	46.7	X2p = 0.713
Current chemotherapy	8	26.7	4	26.7	4	26.7	FEp =1.000

X2p : p value for Chi square test *FEp : p value for Fisher Exact test* *P : p value for student t-test*

Table(1):C0mparison between the two groups according to characteristics

Pathological diagnosis	Group 1 (n=15) No	%	Group 2 (no=15) No	%	FEp
Cancer breast	6	40	7	46.7	P=0.71
Non small cell lung cancer	3	20	2	13.3	1.ooo
Small cell lung cancer	1	6.7	1	6.7	1.ooo
Lymphoma	2	13.3	2	13.3	1.000
Others	3	20	3	20	1.000

Table (2) Comparison between the two studied groups according to diagnosis.

Thirteen patients had received prior chemotherapy 6 in the first group and 7 in the second group. Eight patients were receiving ongoing chemotherapy 4 in the first group and 4 in the second group.

No statistically significant differences were found between the two groups as regard patients characteristics(table-1).

There were no significant difference between the two groups as regard the pathological diagnosis.

	Group1 (no=15) No	%	Group2 (no=15) No	%	FEp
Mortality	0	0	0	0	-
Pneumothrax	1	6.7	2	13.3	P=1.000
Haemothorax	0	0	0	0	-
Infection	3	20	1	6.7	P=0.598
Dislodgement	0	0	1	6.7	1.000

Table(3) comparison between the two groups as regard complications

There were no significant difference between the two groups as regard the complications.

The mean time from tube removal to discharge was(3.53 ± 1.41) days for group I and (1.93 ± 1.79) days for group II (P=0.011), while the mean for the total length of stay was(10.27 ± 2.87) days for group I and (6.87 ± 5.49) days for group (P=0.042). So the difference between time from tube removal to the discharge and the total length of stay in the hospital in the two groups was statistically significant in favor of group II.

Thirty days follow up was used to detect recurrence one patient(6.7%)in group I developed dyspnea 22 days post pleurodesis, chest radiograph revealed reaccumulated large pleural effusion.

Time (in days)	Large tube (group 1) (n = 15)	Small catheter (group 11)	P
Time before pleurodesis			
Range	2.0 – 5.0	3.0 – 6.0	
Mean ± SD	3.87 ± 1.06	4.0 ± 1.07	
Median	4.0	4.0	0.734
Total tube duration			
Range	3.0 – 12.0	5.0 – 12.0	
Mean ± SD	6.73 ± 2.60	7.0 ± 1.93	0.725
Median	6.0	6.0	
Tube out to discharge			
Range	1.0 – 7.0	0.0 – 5.0	
Mean ± SD	3.53 ± 1.41	1.93 ± 1.79	0.011*
Median	4.0	2.0	
Total length of stay			
Range	1.0 – 16.0	0.0 – 14.0	
Mean ± SD	10.27 ± 2.87	6.87 ± 5.49	0.042*
Median	10.0	9.0	

*P: P Value for student t-test *: Statistically significant at p <0.05*

Table(4) Comparison between the two studied groups according to time before pleurodesis, total tube duration, tube out to discharge and total length of stay in days

	Group I (n=15) No	%	Group II (n=15) No	%	P
Recurrence	1	6.7	0	0	1.000

Table(5): Comparison between the two groups according to recurrence of effusion

Discussion

The development of malignant pleural effusion frequently heralds a poor prognosis . In addition , recurrent malignant pleural effusion can cause severe debilitating symptoms and impair quality of life [5].

In the vast majority of patients , the treatment of malignant pleural effusion is palliative and therefore, should be associated with a low morbidity and mortality rate. Treatment options are variable, for drainage and sclerotherapy, findings in some reports however, have demonstrated small-bore catheters (8-10.0 fr in one study & 7-24 fr in another) are as effective as large chest tubes in the treatment of malignant effusions [6,7]. In-patient drainage with large bore chest tube connected to wall suction followed by sclerosis is the most commonly used palliative intervention [8,9].

Interest in the use of small-bore catheters for effusion drainage and sclerotherapy is based on the premise that it may be less invasive as a procedure and thus better tolerated by patients compared to standard large bore chest tubes , with no compromise in efficacy [5,10]. Small-bore drainage of malignant pleural effusion was first found to be feasible by Talamonti et al [11]. They reported that satisfactory drainage was obtained in 8 of 12 patients with no demonstrable recurrence of the effusion after a mean follow-up of 8-5 weeks. In this study, a controlled randomized study on 30 patients with malignant pleural effusion was done, they were divided into two groups ; group I (15 patients) used large-bore chest tube drainage and group II (15 patients) used a small bore catheter, the two groups were comparable in their basic characteristics with no significant differences in ages genders , prior and current chemotherapy .

In our study , the two groups were comparable in their basic characteristics with no significant differences in ages, genders, prior and current chemotherapy.

Several studies [7,12-15] had compared the efficacy of small bore catheter versus standard large-bore chest tube and the results indicated that the pigtail catheter drainage and sclerosis were at least as successful as the traditional drainage with the standard chest tube, the success rate with small bore chest tubes used on an in-patient basis ranged from 62 to 95 %, moreover, the findings of these studies supported a role for small bore catheter with catheter durations and response rates nearly equivalent to those obtained with large chest tubes.

Parker et al.[6] compared the efficacy of small bore catheter drainage (pig tail catheter) to traditional drainage with standard chest tube followed by tetracycline sclerotherapy in a single institution in 24 malignant pleural effusions. Eight of 13 effusions were adequately treated using the small bore catheter , compared with 4 of 11 effusions treated with the standard large chest tube. The authors concluded that the pig tail catheter drainage and sclerosis was at least as successful as the traditional drainage with standard large chest tube.

Another trial had been published by Marom et al.[16] about treatment of malignant pleural effusion with small bore catheter and talc pleurodesis in 32 patients. Satisfactory results was obtained in 27 patients (84%) with tubes remained in place for 2-9 days (mean 4.9 ± 2.3), they concluded that the drainage and instillation through a small bore catheter were as effective as through large bore chest tube.

In our study , there was statistical difference between the two groups as regard the time from tube removal to discharge and the total length of stay in hospital . The findings of this study supported the data that was reported by Patz et al. [4] and by Louis et al. [5], they reported that using small-bore catheters was safe and effective alternative in management of symptomatic malignant pleural effusion with in-patients sclerosis to large-bore chest tube. The first reported that, tubes were in place 2-11days (mean 5.1 days), while the other found that the length of time for chest tubes had remained in place was similar for both the large-bore chest tubes and the small-bore chest tubes that ranged from 1-10days (mean 5.7 days).

The issue of relative safety of small catheter compared to traditional large bore chest tube is of great significance and importance. In the present study, complications including wound infection, pneumothorax, and recurrence within 30 days follow up were minimal and comparable in both groups. These findings supported the conclusion reported by Wendy et al. [10]. In their study on 102 cases with malignant pleural effusion they used small bore catheter for 58 cases and large bore catheter for 44 cases of malignant pleural effusion, they reported that there were no significant differences in time of recurrence, rate of infection or radiographically detected pneumothorax between both groups.

The largest case series was reported by Seaton et al.[15]. forty-seven patients underwent small tube drainage and doxycycline sclerotherapy, twenty-one patients had radiographic follow-up at 30 days and formed the study group , seventeen patients (81%) had a complete response and three patients (14%) had a partial response based on the 30-day chest radiograph, again the complication rate was low and consisted of symptoms such as pain and fever.

In our study the incidence of radiologically evident pneumothorax was very low with small bore catheter . Louis et al.[5] reported that pneumothorax rate was higher when seldinger technique was used as opposed to the trocar method of insertion. This can explain the low incidence of pneumothorax in our study due to usage of the trocar method . Walsh et al.[13] treated 15 consecutive patients with disseminated disease and symptomatic pleural effusion using a 9 Fr catheter , eleven of 12 patients who lived for 4 weeks had objective clinical responses, five patients had complete radiographic responses, another 5 had only slight re-accumulation or thickening. Complications were minimal, spontaneously resolving, small apical pneumothoraces developed in 4 of the 15 patients, one patient experienced re-expansion pulmonary edema before pleurodesis. Efficacy of

this method was confirmed in two other studies, both involving 21 patients , each study demonstrated success rate of 71% with minimal treatment-related morbidity[7,17].

Also Sourour et al.[18] in their comparative study of small bore catheter versus traditional chest tube in management of malignant pleural effusion supported the role of small bore catheter in the management of malignant pleural effusion. They reported that the small bore catheter is effective, safe, comfortable, well tolerated and has satisfactory response rates with minimal complications. They also reported that ambulatory sclerosis of malignant pleural effusion using a small bore catheter is a feasible alternative to inpatient sclerosis with a large bore chest tube, especially in patients with good performance for outpatient care. They followed up 22 patients of total 30 patients and reported that none of them had recurrent effusion by radiological follow up within 30 day.

In our study, thirty days follow up was used to detect recurrence. Only one patient (6.7%) in the large tube group developed shortness of breath 22 day post pleurodesis, this low rate may be due to short time of follow-up. However, Wendy P et al.[10] supported the result of our study. In their study they were unable to detect a significant difference in recurrence rates between small-bore catheters compared with large-bore chest tube in cancer patients with symptomatic effusions. Actuarial probabilities of recurrence at 6 weeks an 4 months were 45% and 53% for the small tubes vs 45% and 51% for the large tu bes.

No morality occurred related to pleural catheter placement or use. Specifically, no emergency operation for bleeding or intrathoracic injury occurred, this is supported by studies of Putnam et al.[3], Reinhold et al.[12], and Gammie et al.[14].

As regard the development of intercurrent wound infection during the time that the tube was in place, in the total 30 patients, 4 patients developed wound infection; 3 patients in the first group (large tube) (20%) and 1 patient in the second group (small catheter), this difference was not statistically different (p=0.598).

Wendy P et al.[10] supported the result of our study in their study, in a total of 102 cases, 11 patients developed infection; 6 (14%) in the large tube group (n=58) and 5 (9%) in the small tube group (n=44) and this difference was not statistically significant (p=0.42).

As regard bleeding, non of cases developed hemothorax post tube insertion. As regard tube dislodgement, in one patient, small bore catheter was dislodged after 1 day because the catheter was inadequately secured with excessive mobility of the patient. In this patient, re-insertion was done successfully using a new catheter with no subsequent complications.

Performance of sclerosis when last-day catheter output is approximately 100 ml is a common thought arbitrary decision based on past experience, in some studies sclerosis is performed when catheter output is below 100 ml per 24 hour [14,19], while in others when catheter output is slightly higher [15,20,21].

Another study was conducted in Alexandria Faculty of Medicine on 30 patients, pleurodesis was done on 15 patients through a thoracostomy tube, while in the other 15 patients pleurodesis was done through thoracoscopy. The success rates were 73% and 87% respectively [22].

Caglayan B et al. [23] studied the efficacy of iodopovidone pleurodesis and comparison of small bore catheter versus large bore chest tube. They did 43 pleurodesis in 41 patients. They concluded that iodopovidone is an effective, safe, inexpensive and easily available alternative in chemical pleurodesis in malignant pleural effusion . The success rates of pleurodesis were found to be similar regardless of the type of the tube inserted.

Mohsen AT et al. [24] reviewed 58 cases of malignant pleural effusion in which small-bore catheters were used and 44 cases in which large-bore chest tubes were used. The majority of patients had breast (n=56,55%) or lung cancer (n=29,28%). Actuarial probabilities of recurrence at 6 weeks and 4 months were 45% and 53% for the small tubes vs 45% and 51% for the large tubes. They were unable to detect any major differences in outcomes with the use of either size of chest tube.

Conclusion

From the results of this study and other studies performed by others, we conclude that small-bore catheter is as effective, safe, and results in minimal complications as large bore chest tube in the treatment of malignant pleural effusions and deserve further evaluation in larger prospectively designed trials.

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Why lateral muscle-sparing thoracotomy? Is it now time for new thoracotomy incision?

Hesham Mostafa Alkady,

Introduction: **The lateral muscle sparing incision has been used over the last years for a greater variety of procedures .This muscle-sparing thoracotomy is regarded as a reasonable alternative to the standard posterolateral approach.**

Patients and Methods: **This incision was used in 40 patients during the past 6 months for operations of pulmonary, pleural, and mediastinal diseases. The operations done through the lateral route consisted of 8 decortications, 6 lobectomies (4 upper lobectomies 1 middle lobectomy 1 upper & middle lobectomy) , 6 lung biopsies (wedge resections), 6 excision of anterior mediastinal masses, 9 resections of blebs or bullae, 2 mediastinal lymph node biopsies , 2 exploratory procedures for gunshots and 1 left pneumonectomy.**

Results: **Mean patient age at operation was 37 ± 5) years. Pathologic analysis revealed 8 malignant tumors, 29 benign lesions, and 1 carcinoid. There was no perioperative mortality. Morbidities occurred in the form of superficial wound infection in 4 patients (10%). One patient (middle lobectomy) (4%) developed late bronchial stump dehiscence with secondary hemorrhage.**

Conclusion: **Although no incision is ideal for all patients, we believe that this approach offers quite satisfactory results due to the advantages of minimum trauma and maximum preservation of chest wall function.**

Keywords: **Lateral thoracotomy, muscle-sparing, exposure, postoperative pain, earlier ambulation.**

Any surgical incision must be planned for the ease of access to the target area and must provide a sufficient working space.

Forty years ago, the usual and generally accepted thoracotomy incision was posterolateral with transection of the latissimus and serratus muscles as well as excision of a rib subperiosteally. In the intervening years there was an increasing use of an intercostal incision (without rib excision except in exceptional cases) and preservation of serratus muscle. Undoubtedly this was due to the increased technical competence and comfort of those doing thoracic operations, particularly with the advances in anesthesia in using unilateral endobronchial intubation.

But **why should the latissimus dorsi muscle be transsected if not necessary**? That was traditional, perhaps because it was done one or two generations ago by our teachers. But this is not sufficient reason for its continued use. Why should a patient face the possibility of increased postoperative pain and a"frozen shoulder," both of which are more likely after a posterolateral incison, if these can be avoided? [(1)]

The lateral muscle sparing incision has been used over the last years for a greater variety of procedures and its application has received considerable recent attention with its increasing use and familiarity[(2)]. This muscle-sparing thoracotomy, regarded as "a reasonable alternative to the standard posterolateral approach," is associated with reduced shoulder girdle disability, less postoperative pain, and improved respiratory function.[(3)]

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Technique:

The patient is positioned in a lateral decubitus position with pillows between the knees and padding under the elbows[a]. Skin incision is done over the fifth interspace curving posteriorly into the axilla[b]. The latissismus dorsi is then retracted posteriorly and the serratus is split in the direction of its fibers with careful preservation of the long thoracic nerve[c-e]. The pleural cavity is then entered by cutting only the intercostal muscles without rib resection[f]. Two rib retractors are then used, one with two short blades to retract the muscles, over which a second retractor is placed with two deep blades for the ribs[g]. Use of the lateral incision is considerably enhanced by unilateral endobronchial intubation.

Before closure 10cc 0.5% Xylocaine (Lidocaine) with 10cc Marcaine (Bupivacaine Hydrochloride) were used to block the intercostal nerves for two interspaces above and below the rib incision unless an epidural catheter was used before the operation. To close, the retractors are removed, heavy absorbable pericostal sutures are placed to approximate the ribs, and the digitations of Serratus muscle are approximated with continuous suture and finally subcutaneous tissue and skin are closed. (figure 1)

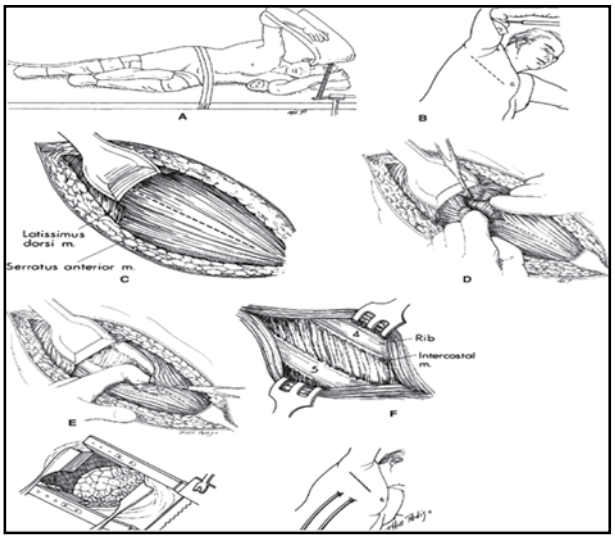

Fig 1. Technique of lateral muscle-sparing thoracotomy (Matthew G. Blum, Willard A. Fry, General Thoracic Surgery, 7th Edition, 2009[4])

Patients and Methods

This incision was used in 40 patients during the past 6 months for operations of pulmonary, pleural, and mediastinal diseases carried out by multiple surgeons in multiple hospitals (Kasr Alaini Hospital, New Kasr Alaini Hospital and Almanial hospital).

The operations done through the lateral route consisted of 9 decortications, 6 lobectomies (4 upper lobectomies 1 middle lobectomy 1 upper & middle lobectomy), 4 lung biopsies (wedge resections), 6 excision of mediastinal masses (4 anterior mediastinal masses and 2 posterior mediastinal mass), 9 resections of blebs or bullae, 2 mediastinal lymph node biopsies , 3 exploratory procedures for gunshots and 1 left pneumonectomy. (Chart 1)

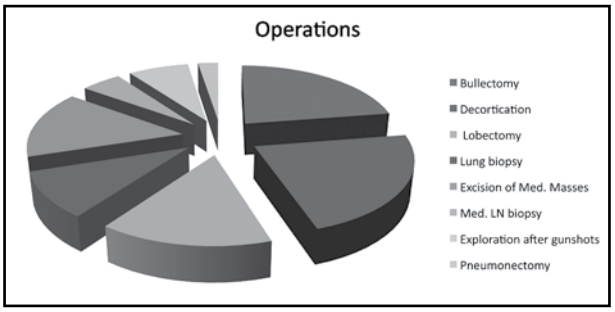

Chart 1: Distribution of operations

Results

The Mean and Standard Deviation of patient ages were 37 ± 5 years.

Pathologic analysis of the specimens sent after operations revealed 3 cases of lung cancer and 3 cases of bronchiectasis after the lobectomy operations. Carcinoid was found after the pneumonectomy operation. 6 cases of chronic pyogenic fibrous pleurisy and 2 cases of chronic tuberculous pleuritis were detected after the decortication operations. 2 cases of the anterior mediastinal masses were pericardial cyst, one case was lymphoma and one case was teratoma. The posterior mediastinal masses turned out to be a bronchgenic cyst and a benign neurogenic tumor. All cases of lung biopsies showed malignant tumors. Mediastinal lymph node biopsies revealed sarcoidosis in one case and lymphoma in the other case. (Table 1)

Operation	Pathology
Lobectomy	3 Lung cancer 3 Bronchiectasis
Pneumonectomy	Cacinoid
Decortication	7 Chronic pyogenic pleurisy 2 Chronic Tuberculosis
Anterior mediastinal masses	2 Pericardial cysts 1 Lymphoma 1 Teratoma
Posterior mediastinal masses	1 Bronchogenic cyst 1 neurogenic tumor
Mediastinal LN biosy	1 Sarcoidosis 1 Lymphoma

Table 1. Pathological results after operations

Only 4 patients (10%) required **blood transfusion** in the form of packed RBC's in whom Hematocrit level dropped below 27.

There was no **perioperative mortality**. The **Mean and standard deviation of operative time** were 150±40 minutes. (Chart 2)

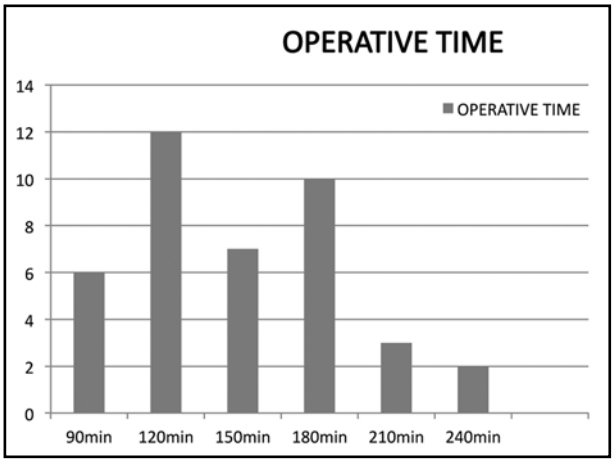

Chart 2: mean operative time among cases.

Morbidities occurred in the form of superficial wound infection in 4 patients (10%) which were managed by antibiotics and repeated dressing. The patient who underwent middle lobectomy developed late bronchial stump dehiscence with secondary hemorrhage which was managed by rethoracotomy and repair of bronchial fistula with coverage by pericardial flap.

All cases underwent resection operations (7 patients) stayed as routine in the **intensive care unit** for 24hours postoperatively. Other patients remained in the recovery room for one to two hours, and then were transferred to the department.

Hospital stay postoperatively was a mean of 5±2 days.

Discussion

The standard posterolateral thoracotomy provides wide operative exposure by transection of the large muscles of the chest wall but causes marked pain and impairment of the major muscle groups of the back and shoulder[5].

These, in elderly patients may contribute to postoperative complications. Even in young patients recovery of full activity to preoperative levels can be prolonged by the extent of muscle healing required[6].

The vertical axillary thoracotomy gives a cosmetically acceptable result with the scar covered by the arm and is specifically indicated in patients requiring less than the maximum intra-thoracic exposure provided by the posterolateral or anterolateral thoracotomy. But still the anterior serratus muscle is divided vertically[7] .

The present study assessed early clinical results in 40 patients underwent pleural, pulmonary and mediastinal operations by lateral muscle-sparing thoracotomy. The exposure provided by this incision was more than adequate for a lobectomy or pneumonectomy, and if more exposure is required, the incision can be converted easily and rapidly to the standard posterolateral thoracotomy by dividing the Latissmus dorsi muscle. Also Lateral thoracotomy leads to anterior extension of the intercostal incision, where the distance between the ribs is larger than in the dorsal part[8].

In none of our cases was there any compromise with regard to the extent of resection, or dissection. This incision requires the same time to open (the time from incision to retractor placement is called the opening time), but the time to close is less because time is saved in suturing the latissimus dorsi.

The blood loss and postoperative morbidity in our patients were been noticeably low. No patient developed early wound seroma, as our technique does not include skin flap as the technique of musle sparing thoracotomy described by Daniel M. Bethencourt et al 1988 [5]

Most patients were discharged on the 5th postoperative day as a result of improved arm motion, decreased postoperative pain, and earlier ambulation as well as functional recovery.

Our experience showed that the healing of this incision is excellent may be due to the fact that the incision passes along Langer's lines. The cosmetic result is also improved because the ridge formed by closing the latissimus is avoided.

Conclusion

Although no incision is ideal for all patients, we believe that this approach offers quite satisfactory results due to the advantages of minimum trauma and maximum preservation of chest wall function and is thus useful in selected patients to prevent the postoperative morbidity associated with posterolateral thoracotomy as in patients with severe limitation of cardiopulmonary reserve and in athletes requiring thoracotomy.

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Effectiveness of Thoracoscopic Electrocoagulation of Sympathetic Chain in Management of Hyperhidrosis

Nabil EL Sadeck [1]

and Bedir M.Ibrahim [2]

Background: **Primary hyperhidrosis of the palms, face, and axillae has a strong negative impact on social and professional life.**

Patients and methods: **A retrospective analysis of 47 thoracoscopic electro coagulation of the sympathetic chain performed for thirty patients in Aseer central hospital in Abha , Kingdom of Saudi Arabia was undertaken in order to determine the effectiveness of this procedure.**

Results: **The patients were 13 males and 17 females with a mean age of 24.1±6 years. All patients presented with craniofacial, axillary and / or palmer hyperhidrosis. Sympathectomy. Was performed unilaterally in 13 patients and bilaterally in the other 17 patients. Haemothorax occurred in two patients and pneumothorax in ten, none of them required chest tube insertion. One patient developed partial Homers syndrome which disappeared within three months.**

During the mean follow up period of about 2 years, no recurrence , but rebound hyperhidrosis in the lower half of the body occurred in seven patients, which was disappeared within one year.

Conclusion: **Thoracoscopic sympathectomy is a safe, effective and minimally invasive surgical treatment for hyperhidrosis.**

Key words: **Hyperhidrosis - V A T S - Electrocoagulation**

Palmar hyperhidrosis is a common condition in which the eccrine (Sweat). glands of the palms secrete inappropriately large quantities of sweat. The Condition may become socially and professionally debilitating. Idiopathic (primary) palmar hyperhidrosis begins in childhood and frequently runs in families [1] .

Management of primary hyperhidrosis includes non - operative and operative measures. In about 30 % to 40 % of patients medical management fails to afford any appreciable benefits. In such cases surgery can provide permanent benefit.

Operative measures include excision of axillary sweat glands , suction assisted lipolysis, and sympathectomy. Upper dorsal sympathectomy IS now the treatment of choice for intractable hyperhidrosis[2] .

More recently, with the development of minimally invasive surgery and video assisted thoracic surgery, thoracoscopic sympathectomy has been established as the least invasive technique with high success rates for treatment of palmar hyperhidrosis[3].

Video assisted thoracoscopy can usually give an excellent view of the upper dorsal sympathetic chain and simple diathermy coagulation of the chain can be achieved [4] .

In this study, we are presenting our experience with this technique for patients with primary palmar and axillary hyperhidrosis.

Patients and Methods

Thirty patients underwent thoracoscopic sympathectomy for hyperhidrosis in Aseer central hospital, Abha, Kingdom of Saudi Arabia were retrospectively studied.

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Codex : o4/05/1211

All patients were presented with intractable craniofacial and / or palmar and axillary hyperhidrosis.

All patients underwent full physical examination and investigations to exclude secondary causes of hyperhidrosis like endocrine conditions (hyperthyroidism, pheochromocytoma, diabetes mellitus, acromegaly, hyperpitutarism, or carcinoid syndrome), central neurological lesions, autonomic neuropathy, gout, or local lesions as chronic infection. Also patients were examined and investigated to exclude pleural and / or pulmonary pathology.

Procedure of V A T S

The procedure was performed under general anaesthesia using a double lumen endotracheal tube.

After occlusion of the ipsilateral lumen of the endotracheal tube, an artificial pneumothorax was established by insufflating 0.5 to 1 litre of carbon dioxide through a Veress needle in the fourth intercostal space anterior to the midaxllary line. C02 insufflated with automatic pressure set at 8 mm Hg.

A 10 mm port was then inserted in the anterior axillary line through which a 0.8 mm zero degree thoracoscope was introduced.

Another 5 mm port was introduced under vision in the second or third intercostal space in the mid- clavicular line, through which the diathermy hook was introduced. The dorsal sympathetic trunk was visualized under the parietal pleura running down over the necks of second, third, fourth, and fifth ribs.

Coagulation diathermy current was applied to the second, third, and fourth ganglia and intervening sympathetic chain. Gas was then disconnected, the pleural cavity deflated and the mid- clavicular port removed under vision. At this stage, the anaesthetist was asked to unclamp the ipsilateral lumen of the endotracheal tube and to hyperinflate the lung. With complete inflation of the lung, the anterior axillary port was removed and the stab wounds were closed with subcuticular 4/0 synthetic absorbable stiches. A chest tube was not left behind in any of the patients. At the end of the operation, the pupils of the patient were examined for light reflex and possible Homer syndrome.

A chest X - ray was done in the recovery room and repeated at the morning of the second day of operation.

All patients were reviewed after 2 weeks, then monthly for 6 months and then in irregular visits for a mean period of 18 months at outpatient clinic . All data were collected and subjected to statistical analysis using S P S S statistical Package. Comparisons were made by the log - rank test. $P < 0.05$ was considered significant.

Results

A total of 47 thoracoscopic sympathectomies were performed for 30 patients in Aseer central hospital during the period from January 1999 to October 2009 . There were 17 bilateral procedures and 13 unilateral procedures there were 1 3 male and 17 female patients. The mean age of the patients was 24.1 ± 6 years (range 18 - 35 years) . The indication for operation was troublesome craniofacial, axillary and (or) palmar hyperhidrosis. The patients came from different occupational backgrounds and with different sites and sides of hyperhidrosis. (Tables I and n) .

Variables	Number	Percentage.
Sex		
Male	13	(43.3 %)
Female	17	(56.7 %)
Occupation		
Student	13	(43.3 %) .
Soldier	5	(16.7 %)
Teacher	5	(16.7 %)
Secretory	4	(13.3 %)
Nurse	2	(6.7 %)
Driver	1	(3.3 %)
Indication for Surgery		
Palmar hyperhidrosis	18	(60 %)
Palmar and axillary hyperhidrosis	8	(26.7 %)
Palmar, axillary and craniofacial hyperhidrosis	4	(13.3 %)

Table I. Preoperative data

Side	Number	Percentage
Right	5	16.7 %
Left	8	26.7%
Bilateral	17	56.7 0/0
Total	30	100 %

Table II. Side of sympathectomy.

We had no mortality in this group of patients. Eleven patients suffered severe postoperative pain for three or more days. There was no significant intraoprative bleeding during any of the procrdures, but haemothorax occurred in two patients which was minimal and did not need draining.

One third of our patients had residual pneumothorax, which did not require drainage. The mean length of stay in the hospital was 5 days (range 2 - 11 days) .

The mean duration of operation was 50 minutes (30 - 75 minutes). One patient developed partial Horner s syndrome which disappeared within three months.

Over the mean follow up period of about 2 years, seven patients complained of a degree of rebound (reflex) hyperhidrosis in the lower half of the body after bilateral sympathectomy. This decreased in severity over time and disappeared in 6 to 12 months postoperatively. However, it did not affect the patients' satisfaction with the operation. All the patients had satisfactory dryness of the face , palms and axillae. (Table III) .

Variables	Number of patients	Percentage
Severe Pain	11	36.7 %
Haemothorax	2	6.7 %
Pneumothorax	10	33.3 %
Partial Homer's syndrome	1	3.3.%
Rebound hyperhidrosis	7	23.3 %
Dryness of face, palms and axillae	30	100 %
Duration of Operation in minutes (mean)	50 ± 3.1 S D	
Mean Postoperative hospital stay in days	5 ± 1.8 S D	

S D = standard deviation.

Table III operative and postoperative data

Discussion

Excessive sweating is a psychosocial nightmare. Between 0.5% and 2% of the population suffer from excessive sweating or hyperhidrosis The primary cause is unknown. It is characterized by excessive sweating beyond physiological needs, particularly in response to temperature and emotional stimuli. It is more common in young women, some of whom suffer severe and obvious dripping of the hands. This has an impact on various aspects of life including education, occupation, social interaction and psychological problems [2,28,33] .

Non Operative management, including topical agents offers only minimum and temporary relief [5]. Thoracic sympathectomy can predictably eliminate the disabling symptoms of palmar hyperhidrosis. and a variety of approaches have been described, including the posterior paraspinal incision, open thoracotomy, and thoracoscopy [4,29 ,32] .

With the introduction of high resolution videoendoscopy and closed rod - lens instrumentation, endoscopic thoracic sympathectomy has become the treatment of choice compared with the open procedure [6] .

Our patients were slightly predominantly females. This coincide with one study. [7]. While most of other studies documented marked female predominance [8,9]. This may because that most ladies in this area are house wives and don't seek medical advice for this problem. The mean age of our patients was 24.1±6 years. This was near to that reported in many series [2,4,8,9]. While it was older in other studies [7,10]. The thoracoscopic approach enables clear delineation of the sympathetic chain and the ganglia- including the collateral branches. Better visualization of the stellate ganglion and its preservation may avoid the sequel of Homer 's syndrome[2]. In our series we had 3.3% incidence of postoperative Horner' s syndrome. This coincide with many series [2,8,9,11]. This probably reffects our technique of applying Coagulatory diathermy to the second ganglion downwards. The innervation of head and neck region is TI to T 5 , while that of the upper extremities is from T 2 to T 4. Drott et al recommended ablation ofT 2 and T 3 sympathetic ganglia in the treatment of palmar hyperhidrosis, T 4 ablation in axillary hyperhidrosis and ablation or lower part of T 1 to treat facial involvement [12] . we ablated T 2 to T 4 in all our patients. For our 17 patients underwent bilateral sympathectomy, we performed. staged procedures for the first 9 patients, then we changed our system and in the other 8 patients, we performed both sides at the same time as we believe that this is better. Al Dohayan concluded that bilateral sympathectomy for patients save them another admission and another general anesthetic[13] .

We consistently used two ports for all our patients, which is in agreement with most authors. However, Krasna et al ; used an average of 2.9 ports for their patients [14]. Other authors reported the use of a single trans - axillary port with good results and better cosmoses [7 , 15 , 16, 17] .

There were studies to compare two thoracoscopic procedures: excision and electrocautery of sympathetic chain for hyperhidrosis [18, 19,20] .Collin reported recurrence in 4 of 54 patients underwent electrocautery of sympathetic chain(18). While Kuda et al; reported that there was no difference in recurrence between the two methods [20] . **Cruz** et al reported a high degree of patient satisfaction with electrocautery[30]

Some authors practiced clipping or clamping of the sympathetic chain with reportedly good results. Reisfeld et al; claimed better satisfaction in patients who had clipping versus electrocautery at 98 % versus 95.1 % [21]. While others reported

recurrence even after excision of sympathetic ganglia with division of rami communicantes[10] .

Aside from the simplicity, to minimize the surgical trauma, we used electrocautery in all patients. Our results showed no recurrence during the follow up period. This also coincide with the results of others [2,4] .

The mean length of operation and the mean length of stay in hospital in our series were similar to the average length reported in the literature [2,4].

Eleven of our patients suffered severe postoperative pain for three or more days. Gossot et al; reparted that most of their patients complained of pain in the postoperative period ranging from two to four weeks, many of whom needed morphine [23]. Kopelman et al; reported neurologic pain lasting up to few months with a mean (SD) duration of 2.8 (1.9) months[22] .

We encountered no serious intraoperative bleeding, while some authers reported an incidence of 0.08 % [24] . The incidence of post operative haemothorax was 6.7 % in our series, while it was 0.1 % by others[25] . Pneumothorax was found in 33.3 % of our patients, This was high compared with the reported ones of 0.5 - 9.1 % [25] . However, we did not insert a postoperative chest tube in any of our patients. Krasna et al; used chest tubes routinely in all patients at the end of the procedure [14] .

Compansatory hyperhidrosis is a potential problem irrespective of the surgical approach. This may begin within 6 months of sympathectomy, but its severity may also decrease spontaneously within 9 months in some patients (4,31) . This occurred in 23.3 % of our patients. Some authors reported rates as low as 1.2 - 6 %, others reported an intermediate rate of 33 %, while others reported rates as high as 85 - 86 % [13, 15,21,24,25]. The explanation for this phenomenon also varies widely. According to O· Riordan et al; restricting the extent of sympathectomy to the second dorsal ganglion and the adjoining chain reduces the amount of compensatory postoperative hyperhidrosis [25]. On the other hand, Lin and Wu proposed that preservation of the sympathetic tone to the head is the main influential factor in avoiding reflex oversweating [27]. Therefore ,they believe that T4 sympathectomy is an ideal procedure that can treat palmar and / or axillary hyperhidrosis without inducing reflex oversweating .

Conclusion

This study confirms that thoracoscopic electrocautery of the dorsal sympathetic chain is a suitable method of treatment for severe palmar hyperhidrosis but emphasize the need to offer the patient more informative information, especially regarding compansatory sweating which seems inescapable.

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Management of Severe Flail Chest Injuries: Analysis of the Results of 144 Patients

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Background : **The strategy for management of flail chest remains controversial.**

Patients and methods : **Clinical charts, operative reports and imaging data of 144 patients with severe flail chest managed in A seer central hospital in Saudi Arabia were reviewed retrospectively. We compared the clinical efficacy of surgical stabilization and internal pneumatic stabilization in severe flail chest patients who required ventilatory support to determine the advisability of surgery.**

Results : **The patient population represents male predominance. Surgical fixation was done in 58 patients, while the other 86 were treated by intubation and ventilation alone. The surgical group showed a shorter ventilatory period, shorter I C U stay, shorter hospital stay, less impairment of pulmonary functions, less morbidity and mortality than the non surgical group.**

Conclusion: **Surgical fixation of the flail chest is a reliable therapeutic option in selected patients and offers encouraging results.**

Flail chest is a major injury to the chest wall, occurring in the setting of a high – speed motor vehicle crash or fall from a considerable height. It is often associated with underlying pulmonary injury and can carry a high morbidity and mortality [1].

Flail chest is traditionally described as the paradoxical movement of a segment of chest wall caused by fractures of multiple, consecutive ribs in two or more places [2,3].

Management of flail chest still remains subject of controversy. Fractured ribs, if treated only with mechanical ventilation, can undergo progressive displacement and the patient can suffer from chest wall deformity, atelectasis and volume restriction [4,5].

Operative chest wall stabilization in patients with flail chest reduce ventilator time and avoid ventilator associated complications [6].

In this study, we compared the clinical efficacy of surgical stabilization and internal pneumatic stabilization in severe flail chest patients.

Patients and methods

A total of 234 adult patients with flail chest were admitted in Aseer central hospital in kingdom of Saudi Arabia during the period from 2001 to 2010.

We included 144 of them in this study. The remaining 90 were excluded because 72 of them had an associated injury of another system that dominated the outcome and 18 patients were not in need for mechanical ventilation and managed conservatively.

Of the 144 patients included in this study, 58 underwent surgical fixation of the flail segment (Using Kirschner wires, stainless steel wires, or both) (Group I) and 86 were treated by intubation and ventilation alone (group II).

All the patients were admitted to the intensive care unit and received identical respiratory management, including endotracheal intubation, mechanical ventilation {using the combination of intermittent mandatory ventilation (I MV) and positive end expiratory pressure (PEEP)}, Continuous epidural analgesia, chest physiotherapy, and

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aggressive pulmonary toilet (including frequent endotracheal suction and bronchoscopic suction if needed).

Intercostal chest tube was inserted for drainage of haemothrax and / or Pneumothorax .

All patients were evaluated clinically (General and local examination), radiologically and routine laboratory assessment. Of particular interest was arterial blood gas analysis. Surgical fixation was done for patients who were unable to be weaned from the ventilator after resolution of pulmonary contusion (secondary to the mechanics of flail chest), severe chest wall instability (Extensive anterolateral flail in order to prevent late chest wall deformity and consequent restrictive disorder), Progressive decline in pulmonary function testing (despite aggressive clearance of bronchial secretions, adequate analgesia and without pulmonary contusion) and when thoracotomy was indicated for other concomitant injuries.

Surgical stabilization of a flail chest was performed under general anesthesia with double lumen endotracheal tube if exploration of the pleural cavity and lung parenchyma was indicated.

The position of the patient and surgical incisions were related to the flail chest location and the presence of concomitant injuries that indicate thoracotomy.

For sternal fixation and fixation at costochondral, simple stainless steel sutures were taken using wires No 5 through vertical incisions (midline or parasternal) while the patient in a supine position.

For anterior and anterolateral flail segment, patients were placed in semi – supine position with the site to be operated on upper most. Injuries were approached with an anterolateral thoracotomy if there were concomitant injures and with a curve incision in the anterior wall vertically midway between the nipple and the midline in absence of other injuries.

For posterolateral flail segment : patients were placed in lateral position. L – shaped incisions as in thoracoplasty was used. Lateral thoracotomy was done if there were concomitant injuries.

We generally tried to avoid significant muscle division in order to preserve respiratory function as much as possible.

Before starting with the stabilization of the chest wall, thoracotomy in the middle of the flail segment was performed and the pleural cavity and lung parenchyma were explored.

Fluid or clotted hemothoraces were adequately drained. pulmonary lacerations were sutured. Largely destroyed lobes or segments were resected.

When the fractured ribs were adequately exposed, the more displaced segments were manually reduced. All the accessible non comminuted fractured ribs were pinned by Kirschner wires. Each wire was cut and divided into segments, each of them about 5 cm in length and 2 mm in thickness. Wire was passed through the cortex into the medulla 3 to 4 cm form the fracture site and driven across into the other fragment.

Simple stainless steel sutures using wires No 5 were taken either alone or in combination with the Kirschner wires to inforce the fixation and to achieve adequate stability.

Whenever it was possible, both fracture lines of a double fractured ribs were fixed. In some cases, only one site was fixed in every fractured rib, the idea was to convert the flail segment into a simple rib fractures. At the end of the operation, the wounds were closed in layers over a small subcutaneous drains.

In thoracotomy patients. The pleural cavity was routinely drained with two chest tubes (one apical and one basal).

Regular follow up for all the surgical patients were carried out including clinical supervision, chest x - ray and measurement of arterial blood gases.

Mechanical ventilation was usually continued for one or two days to support the fixation and to relieve any distress postoperatively.

The patients were discharged after radiographs showed resolution of traumatic pleuro – pulmonary injuries and after clinical evaluation demonstrated the absence of paradoxical movement of the chest wall.

All patients were followed regularly in outpatient clinics.

Chest x - ray and pulmonary functions were performed two or three months after discharge.

Statistical analysis

All data were collected and entered into the computer using E P I – info version 6.04 D statistical package and exported to S P S S for windows version 11 statistical package for the purpose of analysis. The P value less than 0.05 was considered significant. Quantitative data were presented as the mean ± standard deviation (S D).

Results

The general data of our patients at time of admission were equivalent in the two groups (Table I). The site of the flail segment was more anterolateral in group I, while it was more posterolateral in group II patients. There was no significant difference between the 2 groups in the other local data at time of admission (Table II).There were four indications for surgical stabilization of the flail segment in our patients (Table III). There was marked improvement of arterial blood gases after management in both groups (Table IV). The surgical group showed a shorter ventilatory period, shorter I C U stay, shorter hospital stay, less morbidity and mortality than the non surgical group (Table V).

The pulmonary functions indicated that the surgical group had less pulmonary restriction after management than the non surgical group (Table VI)

Variables	Group I (No = 58)	Group II (No = 86)	P – Value
Mean age (years)	48 ± 14.3	51 ± 14.8	> 0.05
Sex			
- Males	51 (87.9 %)	77 (89.5 %)	> 0.05
- females	7 (12.1 %)	9 (10.5 %)	
Mechanism of injuries			
Road traffic accident	52 (89.7 %)	75 (87.2 %)	> 0.05
falls	6 (10.3 %)	11 (12.8 %)	
General condition			
Shocked	11 (19 %)	24 (27.9 %)	> 0.05
Not shocked	47 (81 %)	62 (72.1 %)	

Table (I) General data of patients at time of admission.

Variables	Group I (N0 = 58)		Group II (No = 86)		Total (No = 144)	
	NO	%	NO	%	NO	%
* Site of flail segment						
- Anterolateral	29	50	17	20	46	32
- Posterolateral	11	19	60	70	71	49
- Anterior (at costochondral junction with or without sternal fracture)	18	31	9	10	27	19
- Bilateral flail	9	15.5	7	8.1	16	11.1
* > 7 ribs fractured	17	29.3	21	24.4	38	26.4
* Intercostal tube insertion	36	62	57	66.3	93	64.6
* Pulmonary contusion	24	41.4	46	53.5	70	48.6

Table (II) Local evaluation of patients at time of admission.

Indications for surgery	No	%
- failure of weaning after resolution of pulmonary contusion	12	20.7
- Severe chest wall instability	8	13.8
- Progressive decline in pulmonary function testing	17	29.3
- Thoracotomy for concomitant injuries	21	36.2

Table (III) Indications for surgery in group I patients.

Variables	Before management	After management	P – Value
Group I			
- P a O 2	59 ± 8.8	98.4 ± 9.1	< 0.001
- P a CO2	34.7 ± 5.9	31.8 ± 4.7	> 0.05
- O2 saturation	89.8 ± 3.1	98.1 ± 3.2	< 0.001
- PaO2/ FiO2 ratio	205 ± 7.9	341 ± 12.6	< 0.001
Group II			
- Pa O 2	54.1 ± 8.3	92 ± 7.1	< 0.001
- P a CO2	39.9 ± 3.6	31.3 2.7 ±	< 0.05
- O2 saturation	87.7 ± 2.6	95.9 ± 2.9	< 0.001
- PaO2 / FiO2 ratio	176.7 ± 8.1	301 ± 13.2	< 0.001

Table (IV) The A B G results in each group before and after management.

Variables	Group I (No = 58)	Group II (No = 86)	P – Value
Mean duration of ventilation (days)	4.3 ± 1.9	11.1 ± 4.8	< 0.001
Mean I C U stay (days)	10.4 ± 7.4	19.1 ± 13.3	< 0.001
Mean hospital stay (days)	15 ± 7.6	23.6 ± 7.1	< 0.001
Chest infection	7 (12.1 %)	4.2 (49 %)	< 0.05
Pneumothorax due to barotraumas	1 (2 %)	7 (8 %)	> 0.05
Pulmonary embolism	0 (0 %)	4 (5 %)	> 0.05
Chest wall deformity	3 (5.2 %)	39 (45.3 %)	< 0.05
Atelectasis	2 (4 %)	5 (6 %)	> 0.05
Mortality	7 (12.1 %)	21 (24.4 %)	> 0.05

Table (V) post management data.

Pulmonary functions	Group I	Group II	P – Value
F V C (%)	76.2 ± 6.8	67.1 ± 5.2	< 0.001
FEV_1 (%)	74.6 ± 6.2	73.9 ± 2.4	> 0.05
T L C (%)	92.4 ± 7.1	83.9 ± 9.6	< 0.001
FEV_1 : V C (%)	95.1 ± 3.1	91.2 ± 1.7	< 0.05
FEF_{75} (%)	66.1 ± 11.3	62.9 ± 9.8	> 0.05
P E F R (%)	93.4 ± 4.1	91.7 ± 2.8	> 0.05

F V C = Forced vital capacity.
FEV_1 = Forced expiratory volume in first second.
T L C = Total lung capacity.
FEF_{75} = Forced expiratory flows at 75 % of the vital capacity.
P E F R = Peak expiratory flow rates.

Table (VI) The mean percentage of pulmonary functions tests of both groups after management.

Discussion

Flail chest is an uncommon consequence of blunt chest trauma, but it continues to be an important injury and can carry a high morbidity and mortality (7, 8, 9).

The strategy for treatment of flail chest remains controversial. Mechanical ventilation is needed for patients with persistent respiratory insufficiency or failure after adequate pain control (9).

Surgical stabilization of the chest was rarely considered necessary in the past, but increasing numbers of reports of positive outcomes in more severe cases are now available in the world literature (2).

In this work, 144 patients with flail chest were studied. Fifty eight patients were managed surgically (Group I) and the other eighty six patients were treated by intubation and ventilation (Group II). The patient population appeared well matched in both groups. This coincide with some other studies (6 . 10 . 11).

The study population represents male predominance. This was in agreement with other studies (5 . 9). This may be a reflection of the general less active life of females in this area.

The mean age of our patients was 49.6±14.5.This was near to the mean age in another series (30). There was no significant difference in age between our two groups.

The mean numbers of fractured ribs in our study was 5.9 ± 2.1. This was in agreement with other studies who mentioned that, the mean numbers of fractured ribs were 6 ± 0.35 and 5.2 ribs respectively (5 . 12).

Road traffic accidents (R T A) were the cause of injuries in 88.2 % of our patients, while in the remaining 11.8 % it was due to fall from height. This was similar to other study (8). Another study reported R T A in 59.4 % and falls in 29.7 % of their patients (9).

The flail chest was bilateral in 11.1 % and the number of ribs fractured was more than seven in 26.4 % of our patients. It was 15.6 % and 21.8 % respectively in another study (9). We inserted intercostal tubes in 64.6 % of our patients at time of admission. It was inserted in 53.3 % and 59.4 % respectively in another two series (2 . 9).

Prolonged paradoxical motion of the chest wall, before spontaneous stabilization occurs, can lead to additional mechanical impact on the contused lung area by the flail segment. Early surgical stabilization can prevent additional injury as well as promote earlier weaning from the ventilator and less analgesia may be required postoperatively (29).

We operated for patients who were unable to be weaned from the ventilator after resolution of pulmonary contusion, patients with severe chest wall instability, progressive decline in pulmonary function testing and when thoracotomy was indicated for other concomitant injuries. This was in agreement with others, but some surgeons added strong chest wall deformity and persistent severe chest pain, flail chest without pulmonary contusion and internal pneumatic stabilization for ten days without improvement(1 . 6 . 9 . 10 . 13).

Patients with severe pulmonary contusion do not benefit from chest wall stabilization (1 . 6). So, we usually wait till the pulmonary contusion resolve, then we try to wean the patient from ventilator, if it fails, we usually operate.

Surgical stabilization is preferably applied to patients with severe flail chest who need ventilator support (11). We excluded patients who were managed conservatively without mechanical ventilation.

The severity of the accompanying trauma is the main determinant of the eventual outcome (8). We excluded patients who had an associated injury of another system that dominated the outcome.

The fixation of posterior fracture sites is less important for chest wall integrity than is fixation of the anterior ones. The exposure of posterior fracture lines is also more challenging because of the presence of large muscle fibers (13,14). Posterolateral flail segment was present in only 19 % of our surgical group and in 70 % of the non surgical group. This coincide with one series (9). But it was different in another one in which posterolateral was present in 70 % of all patients (5).

We tried to fix all ribs involved in the flail segment. Some surgeons prefer to fix every 2nd rib (13).

Fractured ribs form T4 to T10 should be fixed when involved. Fixation of ribs between T1 and T3 carry the risk of injury of subclavian vessels. T11 and T12 are not involved in significant paradoxical movement (14).

Different methods have been used for the stabilization of fractured segments, all of which have been reported to be successful (15, 16, 17, 18, 19).

We did not apply any struts or metallic fixation device to fractured ribs because they are expensive and difficult to obtain. It was easy to suture the tips of the fractured ribs and/or insert kirschner wires. Additional advantages of this method are the short operation time, no reoperation to remove a fixation device, no special postoperative maintenance, and applicability anywhere.

Surgical fixation of flail chest require ventilation for a short duration as compared with the duration in those treated by ventilation alone. This crucial factor influences all parameters, complications and mortality of patients with this injury (16).

The average duration of assisted ventilation, mean I C U stay and mean hospital stay in our group I patients (surgical group) were significantly shorter than durations in group II patients. This coincide with the results of many series (1, 20 , 21, 22 23,). Our surgical group had less morbidity and mortality than the non surgical group. This coincide with other results (1, 9 , 20 , 23) .

Barotraumas occurred because the need for a higher P E E P in non surgical group to attain adequate ventilation (16).

The prevalence of infection was related to the duration of ventilator support required by each group. It was also related to lung contusion and floods of the bronchial tree with thick secretions. The frequent suctioning of the bronchial tree by catheters through the endotracheal tube in patients receiving assisted ventilation exacerbates the condition by damaging the fragile bronchial mucosa and participating the infective process (16 , 20) ventilation alone may not be able to prevent rib cage distortion. Early reduction and fixation of the ribs restores the chest wall integrity and forestalls the development of permanently damaging sequelae (20).

The major causes of mortality and morbidity are A R D S and respiratory failure resulting from pulmonary contusion or laceration by a detached rib fragment. With large flail segment, mediastinal shift is possible, with accompanying decreased venous return to the heart. Depressed rib segments impact a crushing injury and may penetrate the diaphragm, lung, heart or aorta (20 , 24).

Hypoxia as the result of respiratory insufficiency was the most physiological disturbance after chest trauma. In flail chest injuries, the paradoxic movement and the pain originating from the movements of spiky fractured ribs resulted in shallow tidal volumes which led to collapse of alveoli, arteriovenous shunting and hypoxemia (25).

In this study, the arterial blood gases (A B G s) showed improvement after management in both groups. This was similar other reports (10 , 20 , 26).

Because chest wall injury is not a parenchymal lung disease, restoration of normal chest wall contour will maintain the lung function (16).

As regards the pulmonary functions, we observed in this study that the non surgical group, patients had some respiratory dysfunction, while the surgically treated patients had less restrictive pulmonary functions. This was in agreement with the results of many series (3 , 11 , 18 , 20 , 22 , 25 , 27 , 28).

Surgery allow excellent assessment of the intrathoracic trauma, removal of hazardous rib fragments, repair of visceral lacerations, control of bleeding and clear the pleural cavity of all clots and thus to produce full expansion of the lung and prevent the development of an empyema or dense pleural fibrosis (9 , 16).

Conclusions

After analysis and discussion of our results and results of other authors, we can conclude that :

1) Restoration of mechanics by early surgical fixation of the flail chest is a reliable therapeutic option in selected patients and offers encouraging results.
2) Early restoration of the chest wall integrity may be cost effective through the prevention of prolonged mechanical ventilation and thereby is associated with a shorter I C U time and less hospital cost.
3) Internal fixation resulted in speedy recovery, decreased complications, and better ultimate cosmetic and functional results.
4) Internal fixation offers the surgeon an opportunity to clear the pleural cavity and to deal with associated thoracic injuries to produce full expansion of the lung and prevent the development of complications.
5) The surgical fixation of flail segment allows the maintenance of the lung function or at least less impairment of pulmonary status.

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Management of Post-Intubation Tracheal Stenosis - Ten Years Experience

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Background: Management of tracheal stenosis can be a difficult condition depending on the cause, location, extent of the stenosis as well as patients co-morbidity. Endoscopic intervention is a corner stone in managing tracheal stenosis for initial evaluation and possible dilatation that can be effective in some cases, however frequent recurrence indicates tracheal resection and reconstruction.

Methods: Retrospective analysis of 87 consecutive patients with post-intubation tracheal stenosis that were managed between January 2002 and January 2012 at Cairo University Hospitals. All patients underwent bronschoscopic evaluation and dilatation, 26 patients underwent tracheal resection and end to end anastomosis due to repeated frequent re-stenosis or ineffective dilatation.

Results: There were 51 males (58.6 %) and 36 females (24.3 %), with a mean age of 34.1 years (range, 7 – 60). Eighty three (95.4 %) patients had cervical tracheal stenosis and 2 patients had cricotracheal stenosis and another 2 had thoracic tracheal stenosis. All patients were subjected to bronchoscopic dilatation with 26 patients (29.8 %) were referred to tracheal resection and reconstruction due to failure of repeated dilatation to improve symptoms. The mean length of stenosis was 24.5 mm and a mean diameter of 6.5 mm in all patients, however in 26 patients who were subjected to resection the mean length was 27 mm (range 20 – 42 mm). There was no morbidity in this series and a mortality due to pulmonary embolism not related to surgical procedure. There was one patient that presented 4 months after resection with re-stenosis and was managed by bronchoscopic dilatation.

Conclusion: Post-intubation tracheal stenosis resection can be performed safely with low morbidity and mortality for patients in whom bronchoscopic dilatation is not effective to achieve symptoms relieve and better quality of life. .

KEYWORD: Tracheal resection, bronchoscopic dilatation.

Post-intubation tracheal stenosis mostly occurs following prolonged intubation. As many as 10 % of intubated patients will suffer from cricotracheal stenosis, and although the risk appears to rise with prolonged intubation, subglottic injury has been demonstrated within hours of intubation [1]. Stenosis usually involves the cervical trachea, in one segment and less than one third of the trachea. Therefore, most cases can be successfully managed by resection and anastomosis [2]. A wide range of operative interventions are available for the treatment of tracheal stenosis including repeated bronchoscopic dilatation which may be successful for early and short strictures. However, definitive management may entail airway reconstruction with resection and anastomosis.

In this study we retrospectively, reviewed our results and complications utilizing different intervention for managing postintubation tracheal stenosis.

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Methods

This is a retrospective study that reviewed 26 patients who underwent tracheal resection and reconstruction for post-intubation tracheal stenosis.

All patients presented with shortness of breath and / or stridor. Pre-operative assessment included endoscopy, chest radiography, CT-scan with 3D tracheal reconstruction. Before surgery all patients received variable sessions of endoscopic dilatation, but those who failed due to frequent recurrent dilatation and unrelieved symptoms were referred to surgical resection.

The medical records were reviewed for patient's profile, causes of intubation, length of intubation, time interval between extubation and symptoms, type of symptoms, anatomical site and length of stenosis, initial management and number of bronchoscopic dilatation sessions, symptom free interval after dilatation, recurrence, type of resection, length of resection, hospital stay, morbidity and mortality, follow up and recurrence after surgery.

Results

There were 87 patients who were referred to our service due to tracheal stenosis following intubation for variable of time. There were 51 males (58.1 %) with a mean age of 34.1 (Table 1) shows patients data.

Variables	Range and mean value
Age	(7-60), 34.1 ± 12.8
Sex	51 males (58.6 %)
Length of intubation in days	(3-25), 13.3 ± 5.5
Interval between extubation and symptoms in days	(10 – 180), 95.3 ± 51.2
Co-morbidity	
1. DM	12 (13.7 %)
2. IHD	4 (4.5 %)
3. COPD	18 (20.6 %)
4. Asthma	4 (4.5 %)
5. Stroke and other neurological deficit	17 (19.5 %)

Table 1. Patient data

The main causes of intubation were trauma in 48 patients (55.1 %), followed by respiratory causes in 22 patients (25.2 %), and neurological causes in 17 patients (19.5 %).

Stridor was the main symptom in 69 patients (79.3 %), while shortness of breath without stridor was present in 18 patients (20.6 %).

Radiological evaluation showed precise site, length and diameter of the stenotic lesion (Table 2).

All patients underwent rigid bronchoscopic evaluation with the intention to dilate the stenotic part of the trachea. Dilatation was more than once in all cases with variable intervals. In 26 patients (29.8 %) symptomatic relief even after repeated dilatation did not occur and / or frequent recurrence at short intervals were the indications for tracheal resection and reconstruction (Table 3) shows dilatation data. All these 26 patients have tracheomalecia at the site of stenosis causing dilatation ineffective due to recoil of the stenotic part.

Variables	Range and mean
Site (no.= 87).	
1. Cricotracheal	2 (2.2 %)
2. Cervical trachea	83 (95.4 %)
3. Thoracic trachea	2 (2.2 %)
Length in mm	(7 – 42), 24.5 ± 9.7
Diameter in mm	(5 – 12), 6.5 ± 1.8

Table 2. Radiological data

24 patients underwent cervical tracheal resection and 2 patients required cricotracheal resection. The mean length of resected segment was 27 mm with a range of 20 – 42 mm. 2 patients needed laryngeal release. Chin-to-sternal stitch was done in all patients and removed after 10 days. All patients were extubated on table, and stayed overnight in the ICU. All patients left the hospital on the 10th day. In this study there was no morbidity and a single mortality, a female patient who had systemic lupus erthymatosis, and came back 4 weeks after discharge with severe dyspnea. Examination and investigations confirmed massive pulmonary embolism patient died 8 hours after admission. There was no complication following surgery and during follow up that extended for a mean of 43 month there was only one re-stenosis 4 months after resection that was managed with repeated endoscopic dilatation.

Variables	Tracheal endoscopic dilatation (no.=61).	Tracheal resection and reconstruction (no.=26).	p-value
No. of dilatation sessions	(1 – 6), 3 ± 1.47	(2 – 4), 2.6 ± 0.69	0.04
Intervals between dilatation sessions (days)	(30 – 356), 149.4 ± 94.3	(7 – 60), 25 ± 5.6	0.00001

Table 3. Bronchoscopic data

Discussion

In our series 87 patients with post-intubation tracheal stenosis were managed in our institute in the past 10 years. All patients received initial bronchoscopic dilatation. Sixty one patients were managed by repeated rigid bronchoscopic dilatation with a mean of 3 sessions and at longer interval between each session ranging from 1 month to a year and a mean 149.4 days. This modality allows stabilization of the dilated stenosis with symptom free and achieving normal activity at follow up. In 26 patients (29.8 %), repeated dilatation at a mean of 2.6 sessions and shorter intervals between sessions ranging from a week – 2 months could not improve patient symptoms or normal activity. These patients were offered tracheal resection and reconstruction with low mortality and morbidity. Our results agree with other series that concluded that the procedure can be done safely with good results [3]

All patients in our series have initial rigid and or combined rigid and flexible bronchoscopy. This initial step is the gold standard in providing a diagnosis, stabilizing the obstructed airway and evaluating respectability. Bronchoscopic dilatation is a palliative procedure that can be temporary or permanent relief for airway obstruction, providing marked improvement in symptoms and quality of life [4]. It's the modality of choice for patients in whom surgical resection is not feasible due to co-morbidities or anatomical limitations. In our series repeated session of dilatations at intervals depending on recurrence of symptoms was the rule as in other series [4]. Post –intubation tracheal stenosis results in a full thickness fibrous scar. Although dilatation or laser resection might produce a temporary improvement in symptoms, these treatment usually results in further inflammation with recurrent stenosis that after repeated dilatation might become more severe than the initial lesion. For that reason in our experience we use balloon dilatation (Maxforce TTS-Balloon, Boston Scientific, Watertown, MA), that is gentler on the mucosa than the shear forces exerted by rigid bronchoscopic dilatation [5].

In this series we did not stent any of our patients with benign post intubation tracheal stenosis, we believe that stenting should be restricted to patients in whom dilatation did not improve symptoms and surgical reconstruction is not feasible due to either anatomical or physiological cause, and this was not encountered in our series. Other series have applied stenting according to our rules and recommended a period of one month and up to 24 months to stabilize the airway before complete stent removal [5]. However, long term stent placement need strict maintenance and follow up of patients with regular bronchoscopy to removal encrustation. Complications of stent placement are well established and include retained secretions, dislocation and granuloma formation [6].

Resection and reconstruction of post-intubation tracheal stenosis was done in 26 patients in this series, 2 of which underwent cricotracheal resection and 24 underwent cervical tracheal resection through a U shaped collar incision. It was our rule of thumb to avoid any patient with chest infection before resection. These patients were subjected to intensive bronchoscopic toilets, inhaled bronchodilators and antibiotics. Infection is a direct cause for post resection re-stenosis [7]. The hyperextended neck position brings almost half the trachea in the neck. Meticulous surgical technique was followed during dissection as dissection is confined to the trachea and the scar tissue surrounding the stenotic part. Circumferential dissection was confined to 1-2 cm above and below the resected segment to avoid injury to the lateral blood supply and the recurrent laryngeal nerve [3]. The resected segment in our series varies from 20 – 42 mm in length and in 2 patients a laryngeal release was needed to gain length and avoid tension.

The resected segment was carefully removed and the fresh ends are re-anastomosed using 4:0 PDS simple sutures starting from the posterior surface, all knots were tied outside. While doing so the neck was placed in flexion and two tension sutures were placed on each side of the trachea at each end and approximated. These maneuvers were done to avoid tension while completing the suture line.

At the end the tension sutures were tied to reinforce the anastomosis line. In all patients the omohyiod muscle was prepared and used as a muscle flap around the suture line.

All patients were placed in cervical neck flexion position to allow healing and avoid dehiscence for ten days through placing a chin – sternal stitch.

Surgical resection and reconstruction for post-intubation trachea stenosis can yield excellent results. In our series we have one mortality case not related to the surgical procedure and one case of recurrence that was subjected to repeated bronchoscopic dilatation with good outcome. Our results co-inside with other reports [3,8,9].

In conclusion, post-intubation tracheal stenosis resection can be performed safely with low morbidity and mortality for patients in whom bronchoscopic dilatation is not effective to achieve symptoms relieve and better quality of life.

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Management of Morgagni Hernia, 15 Years Experience

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Background: Moragagni hernia (MH) is an uncommon type of diaphragmatic hernia. Although it is congenital in origin, it presents usually in adults with respiratory, abdominal symptoms or both, it may be also an incidental finding on chest x-ray with no symptoms. This study aimed to present our experience in diagnosis and management of MH.

Methods: Retrospective chart review of patients who underwent surgical repair of MH at our hospital between 1997 and 2011. Data were collected on patient characteristics, presenting symptoms, diagnosis, surgical approach, complications.

Results: We included 17 patients, the average age at time of surgery was 48.2 years, 11 cases were female (64.7%). Six patients were completely asymptomatic (35.3%), while the remaining patient complained of thoracic (23.5%) , abdominal (29.4%) or both (11.1%). Radiographic evaluation included computed tomography scans in 76.4% of the patients with a 100% sensitivity for diagnosis. 94.1% of the hernias were right sided, and the most common contents of the sac were omentum and colon. Laparotomy was our approach of choice in adults and performed in 14 patients, thoracotomy in 2 infants(11.7%)and a thoracoabdominal approach in one patient (5.8%). The sac was not resected and we did not use any prosthetic material. There was no recurrences during a 1 year to 10-year follow-up

Conclusions: High index of suspicion is needed when assessing patients with respiratory distress and with symptoms suggestive of gastrointestinal obstruction as missed diagnosis can lead to strangulation and gangrene, computed tomography is our test of choice, transabdominal approach is our preferred approach. Also we recommend not resecting the sac and that the use of the mesh is not necessary.

Key words: **Morgagni hernia, sac, diaphragm**

Congenital diaphragmatic hernias are a rare form of diaphragmatic hernias during adult life. They are characterized by their location. Bochdalek's hernias are located postero-laterally and Morgagni hernias are located anteriorly. They may be mono- or bilateral. The incidence is 1/5000 in every live birth. Ninety-eight percent of congenital diaphragmatic hernias are Bochdalek (posterolateral), and 2% are Morgagni (retrosternal or parasternal) hernias. [1] Though Morgagni hernia is a congenital hernia, it is rarely diagnosed during the early years of life. It is generally asymptomatic in adults and detected incidentally on the chest X-ray.[2]

Morgagni-Larrey hernia occurs as a herniation of intra-abdominal organs into the thorax through a parasternal or retrosternal defect of the diaphragm.[1]The hernia defect is formed as the result of failure of fusion of sternal and costal parts of the diaphragm.[3] was first described by Giovanni Battista Morgagni in 1769.[4] In 1828, Larrey described a surgical approach to the pericardial cavity through an anterior diaphragmatic defect.[5] The diaphragmtic defect described by both Morgagni and Larrey is a triangular space between the muscle fibers of the diaphragm that originate from the xiphisternum and the costal margin and insert on the central tendon of the diaphragm. This potential space is referred to as the foramen of Morgagni or the space of Larrey. The internal mammary artery passes through this space as it becomes the superior epigastric artery with its associated vein and lymphatics.[6] Direct herniation of abdominal contents into the

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thoracic cavity can occur through the defect. The hernias are referred to as foramen of Morgagni hernias, retrosternal hernias or Larrey's hernias when the hernia is located on the left sternocostal hiatus.[7] Herniation of abdominal contents is typically caused by an increase in intraabdominal pressure secondary to trauma, pregnancy, or obesity.[8] The majority of Morgagni hernias are right sided with only rare left-sided occurrences because of the protection provided by the pericardial sac.

Since many parasternal hernias become symptomatic only in adult life, it is uncertain whether the lesion is congenital or acquired. Increased abdominal pressure has been held to be a factor. Weakness may exist where the superior epigastric artery penetrates the diaphragm, although the intraparietal position of the vessel appears to detract from this hypothesis.[9] Moreover, separate hernia and arterial orifices have been described.[9]

Almost invariably the direction of herniation is into the thorax because of the pressure differential between the abdomen and the chest. For the same reason, spontaneous reduction is unlikely.[10] Reverse herniation of the lung into the abdomen has happened.[11]

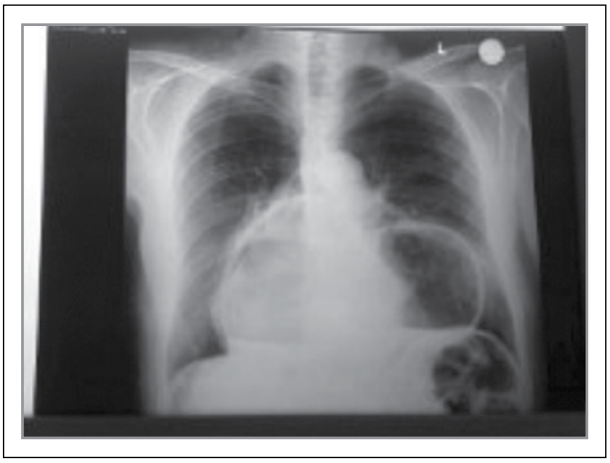
Complaints are related to the size and content of the hernia. In Morgagni hernia, the content of the herniation most frequently includes omentum and colon segments, however, stomach, liver and intestines might also be herniated. The symptomatology of Morgagni hernia is quite variable; the cases can be asymptomatic or may present with a clinical picture of acute respiratory distress.[1] Constipation, diarrhea, development retardation, vomiting, post-prandial distension resembling gall bladder disorders or peptic ulcer, as well as repetitious pulmonary infections. A decrease in respiratory sounds or presence of colonic sounds on chest examination is a significant finding in diagnosis.[4] Risk of complications is quite high, with the main complications being gastric volvulus and colonic obstruction.[2]

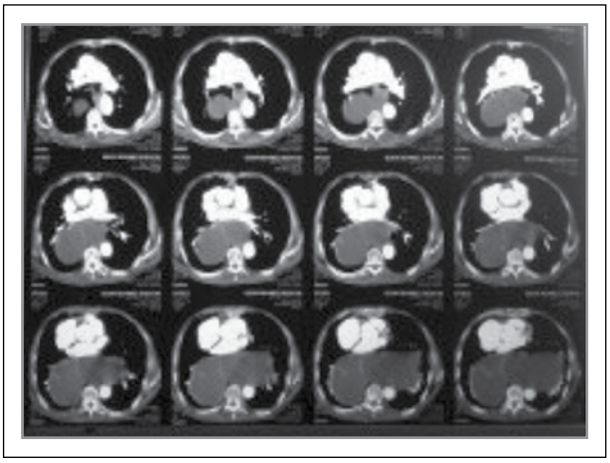
Plain chest x-ray, radiological studies of the gastrointestinal system with contrast material, computerized tomography and magnetic resonance imaging studies are helpful in diagnosis. Space occupying lesions of the anterior mediastinum such as pleuro-pericardial cysts, pleural mesothelioma, pericardial fat cushion, mediastinallipoma, diaphragmatic tumors or cysts, thymoma and front thoracal tumors should be considered in the differential diagnosis.[1]

We report our experience with the management of foramen of Morgagni Hernias over the past 15 years.

Patients and Methods

We performed a retrospective study on all patients admitted to surgery because of diaphragmatic hernia. From 186 patients, 17 patients had a MH and were included in this study. Data were collected on patient demographics, presenting symptoms, predisposing factors (pregnancy, trauma, chronic cough, chronic constipation and obesity), diagnosis, surgical procedure and





the approach performed for resection of the hernia sac. In this study, signs and symptoms were categorized into four groups: 1- Abdominal symptoms consisting of abdominal pain, cramps, epigastric tenderness and obstructive signs. 2- Respiratory manifestation including cough, dyspnea and pneumonia. 3- Both of them. 4- Asymptomatic.

Surgical repair

Repair of MH was performed through the abdomen or chest. Open transabdominal repair was performed through an upper midline incision. Adhesions were dissected and the contents of the hernia were reduced into the peritoneal cavity. The margins of the hernia sac were identified and the sac was not resected. All defects were closed primarily in the two layers ; first continuous layer with non absorbable sutures , and second layer of interrupted, no absorbable mattress sutures . For repair of defects, we did not use prosthetic material in our patients. In our patients, thoracotomy was performed in 2 infants. A thoraco-abdominal approach was performed in a child (four years old) with huge MH.

Results

Seventeen patients underwent surgical repair of foramen of Morgagni hernias between 1997 and 2011. Table 1.Displays the patient characteristics. The mean age was 48.2 ± 17.8 years (range from 2 month to 84 year). Most of patients were in the range of 60 to 80 years. Six cases were male (35.3%), 11 cases were female (64.7%). Five patients had abdominal symptoms, 4 had respiratory symptoms, 2 suffered from both abdominal and thoracic. Six patients were incidentally diagnosed by radiological findings for other problems and had no symptoms.

About 52.3 % of patients had no predisposing factors, 17.6% of patients had chronic cough and 11.7% of them had chronic constipation, 11.7% were obese and 38.3% of the females had delivered more than 3 times, they were also obese.

All patients in our series had abnormal chest radiographic findings, which ranged from an unidentified density in the right cardiophrenicangle to gas filled-loops of bowel within the right chest cavity consistent with a diagnosis of foramen of Morgagni hernia. One patient had hernia on both sides. One patient underwent a sonography. Barium enema was performed in 5 patients and esophagogastrrodudenography in 3 patients. CT scans were performed for 13 patients as part of their diagnostic workup. In all of the cases except one the preoperative diagnosis was MH, and in this case it was anterior mediastinal mass.

About 94.1% (16 cases) had a hernia on the right side and one patient had hernia on both sides. The preoperative diagnosis was MH in 15 cases, in the remaining 2 cases it was anterior mediastinal mass. Transabdominal surgical repair was performed in 14 cases. In two patients diagnosed initially as anteriomediastinal mass, Thoracotomy was done and repair was done through this approach. In one patient adhesions was extensive and needed a thoraco-abdominal incision after initial laparotomy. The hernia sac was not resected in all patients, we did not use any type of synthetic material. In 47% the contents were omentum and transverse colon. Omentum in 29.4%, small bowel and omentum in 11.7%, left lobe of the liver in5.8% and stomach in 5.8%.

Volvolus of the stomach occurred in one case where the main complaint was hematemesis . three patients presented with chest pain that mimicked myocardial infarction. Strangulation and gangrene of the small intestine happened in one case because the diagnosis was performed with delay. The contents of this MH sac were colon, small intestine and omentum and about 15 cm of small intestine were resected. Also in two cases, partial omentectomy was performed because the omentum had a fibrotic appearance. In the majority of the patients that had respiratory, abdominal or both symptoms and signs, the contents of the hernia sac were small intestine, colon and stomach. In asymptomatic patients it was omentum only.

Postoperative complications were infrequent. There was one resolving pneumothorax and one incisional hernia requiring operative repair. There was no reported recurrences of MH in any patient based on chest x-ray and CT scans.

Characteristic	
Female sex	11 / 64.7%
Age (years)	48.2 ± 17.8
Symptomatic	
Abdominal	5 / 29.4%
Respiratory	4 / 23.5%
Abdominal, respiratory	2 / 11.7%
Predisposing factors	
Chronic cough	3 / 17.6 %
Chronic constipation	2 / 11.7%
Obesity	2 / 11.7%
Frequent delivery	4/11 38.3%
Right sided hernia	16 / 94.1%
Presence of hernia sac	100%
Contents of hernia	
Omentum	5 / 29.4%
Colon, omentum	8 / 47%
Small bowel, colon and omentum	2 / 11.7%
Stomach	1 / 5.8%
Left lobe of liver	1 / 5.8%
Diagnostic study performed preoperatively	
Chest radiography	100%
Computed tomography	13 / 76.4%
Sonography	1 / 5.8%
Upper GI series	3 / 17.6%
Barium enema	5 / 29.4%
Method of Surgery	
Laparotomy	14/ 82.3%
Thoracotomy	2 / 11.7%
Thoracoabdominal approach	1 / 5.8%

Table 1. Patient Characteristics (n = 17)

Discussion

Hernia of Morgagni is caused by a congenital defect in the fusion of septum treansverses of the diaphragm and the costal arches. This weakness in the diaphragm later would be stretched by rise in intraperitoneal pressure giving rise to a hernia. Lev-Chelouche mentioned that it is for this reason that MH is usually not discovered in children.[2] They are detected more often in adults, in our series the usuall age at presentation is between 30-60 years, the youngest age operated upon was 2month and the oldest age was 84 years. The majority of the patients are diagnosed late because most patients are initially asymptomatic or present with non-specific respiratory and gastrointestinal symptoms and signs.

Morgagni hernia as a type of diaphragmatic hernias is uncommon at any age. Despite their congenital etiology, they are detected less often in children than in adults.[13] Overall, the

incidence of MH among all diaphragmatic defects in adults and children is 3-4%, it is the rarest type of diaphragmatic hernia(13) In our study we surveyed 17 patients with MH over 15 years.

For unknown reasons, women are more affected than men, in our study 64.7% were female and this agrees with most studies,[14,15,16] other study showed male to female ratio of 4:1.[3]

About 90% of the hernias occur on the right, 8 % are bilateral and only 2% are limited to the left.[13] In this study, 94.1% of hernias were on the right side. In Horton study, 91% of patients had a hernia on the right side.[15]

Berardi and associates reported that one third of patients are asymptomatic. The most frequent complaints of patients were chronic gastrointestinal symptoms such as pain or constipation.[16] Patients often complain only of vague epigastric or substernal fullness or dull right subcostal discomfort.[13] Complete obstruction, incarceration or strangulation with necrosis is rare.[13] In the series of Berardi et al, 12 patients had complete bowel obstruction and one had gangrenous intestine.[16] In the series of Loong and Kocher, 7 of 47 children and 12 of 93 adults presented acutely. The gastrointestinal symptoms and signs in our patients were 29.4%. Cardiopulmonary symptoms usually are shortness of breath and tachycardia, but are less common than abdominal symptoms occurring in 23.5% in our patients and six patients 35.3% were asymptomatic.

Any cause of increased intra-abdominal pressure can precipitate the onset of MH.[13] Predisposing factors in our patients were chronic cough and constipation, obesity and multiparity that were seen in 9 patients, (52.3%) In Horton's study, 21 patients, (41%) had predisposing factors.[15]

Diagnosis was made by chest radiography showing right, left or bilateral pericardiophrenic angle density, depending on the contents of the hernia-omentum, stomach, small intestine, colon or liver- it can appear, differently on chest radiography and the diagnosis can be missed. For example, if omentum is present in the sac, a solid paracardiac shadow will appear. Differential diagnosis would be an intrathoracictumour, atelectasis, pneumonia, or pericardial cyst. This might affect the decision to operate and the type of operation carried out.[18] Also a missed diagnosis can lead to life-threatening complications such as obstruction and strangulation.[13] Contrast examination carried out can also be absolutely normal.[14] The use of the computed tomography as a diagnostic tool has increased the reliability of preoperative diagnosis. In our series CT was performed in 76.4% and it can be considered to be an accurate, non-invasive method of diagnosing MH. A mass with a density consistent with fat may be all that is detected on CT scan, and leads to a differential diagnosis of a MH containing omentum versus a lipoma or a pericardial fat pad. However, the presence of fine linear or curvilinear densities within the fatty mass radiating from the parasternal aspect of the diaphragm is consistent with the presence of omental blood vessels and is strongly suggestive of MH.[19] Other investigations such as magnetic resonance imaging (MRI) and radionucleotide liver scan may help with diagnosis but the cost is difficult to justify. We recommend CT scan for diagnosis of MH and we used it with radiography. In the study of Kilicservey et al,[16] as with our study, diagnostic methods were CT scan, radiography and contrast radiography. Follow up after operative repair can be done with a chest radiograph at three months and one year.

Traditional teaching states that repair of MH is indicated immediately after diagnosis because of the risk of incarceration or strangulation of abdominal organs.[1,14]It is generally agreed that even asymptomatic cases should be repaired surgically.[1] In our series two patients diagnosed somewhere else and were followed up medically, were referred to us with acute symptoms, on exploration volvulus of stomach was found in one patient and in the other patient strangulation and gangrene of a segment of small intestine was found and needed resection of 15 cm. Therefore, we believe that prompt surgical repair is paramount in managing these hernias to avoid unnecessary patient morbidity.

Foramen of MH repaired through the abdomen and chest has been described. We prefer the transabdominal approach in adul patients due to the well formed fibrotic edges of the rent facilitates good exposure and repair of it. Transthoracic approach was performed in infancy and childhood because of premature formation and development of rent.

Prosthetic material has been used in other series,[18] we did not use any type of synthetic material for repair of MH and we did not have any complications such as difficulty for repair and recurrences.

Minimally invasive approaches such as laparoscopic and thoracoscopic approaches for treatment of MH were reported by Kuster et al, Rau et al,[20,21] but we did not use them.

The results of surgical repair of foramen of MH are excellent. Operative mortality and morbidity are low, especially for elective repairs. There was no mortality in our series, and complications was one resolving oneumothorax and incisional hernia in one patient which needed surgical repair, and atelectasis in one patient.

In conclusion, MH is a rare surgical disease. Patients are usually asymptomatic and present with an anterior mediastinal mass on chest radiographs. The preoperative diagnosis of these hernias may be aided by the use of CT scans. Once diagnosed, these hernias should be referred for surgical repair. The transabdominal approach with interrupted nonabsorbable sutures remains the preferred method of repair. Early surgical intervention is preferred in all cases to prevent life-threatening complications such as obstruction and strangulation.

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Midterm Outcome After Video Assisted Thoracoscopic Sympathectomy: Cairo University Hospitals Experience

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Background: **Bilateral video assisted thoracoscopic (VATS) sympathectomy is currently the most effective modality in the treatment of primary palmar hyperhidrosis. In this retrospective study we reviewed the efficacy and complications of this procedure.**

Methods**: Between 2005 and 2009, fifty eight patients with primary palmar hyperhidrosis were referred for bilateral VATS sympathectomy. Their medical records including the relevant demographic, physiologic and clinical data were reviewed. Subjective changes were assessed before and after the procedure at 6 months and 1 year using quality of life index questionnaires.**

Results**: Palmar hyperhidrosis was improved post procedure and patients mentioned mild to moderate symptoms. Forty five patients (77.5%) had scored I and in 13 patients (22.4 %) had scored II. In 27 patients (46.6%) compensatory (CS) was a complaint of which 20 patients (74 %) mentioned that this was intolerable and in 7 patients (25.9 %) mentioned that this was tolerable. However dissatisfaction of the operation was mentioned by 23/58 patients (39 %). Slight improvement in patients compensatory sweating over time was seen.**

Conclusion: **VATS sympathectomy is a safe procedure with controlled complications and we can depend upon as a solution for palmar hyperhidrosis with postoperative compensatory sweating as the main and most significant complication that should be explained well for the patients.**

KEYWORD: **Hyperhidrosis, video assisted thoracoscopic sympathectomy.**

Primary hyperhidrosis is an idiopathic condition characterized by excessive sweating beyond physiological needs and occurring in up to 1% of the population. It most often affects the palms of the hands, the axillae, or the face. The excessive perspiration poses serious psychological, social and occupational problems (1, 2). Medical management is often frustrating. The prescription of topical lotions, topical antiperspirants, oral medications or botulinum toxin injections has a low success, low durability and non-compliance. VATS sympathectomy is a minimal invasive procedure that avoids the historical open approaches with its high morbidity (4). Video technology offers excellent anatomical exposure without the need for a morbid incision (2). It has been proven safe, reliable, cost effective, offering long term relief of symptoms (5, 6). The aim of the present retrospective study was to evaluate the mid-term outcome and effectiveness of simultaneous bilateral thoracic sympathectomy using VATS.

Methods

58 consecutive patients underwent thoracic VATS sympathectomy for palmar hyperhidrosis between July 2005 and November 2009 were included in this review. All patients were referred due to palmar hyperhidrosis after variable period of trying conservative treatment including (aluminum chloride hexahydrate application), oral medication (beta blockers, anxiolytics and anticholinergics). All patients complained that their symptoms severely affect their occupational and social activity.

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All patients were subjected to routine laboratory investigations, ECG and chest x-ray.

Outcome and patient satisfaction was measured using outcome score index questionnaire (OSi). The questionnaire was given to all patients preoperatively and postoperatively at 3, 6 and 1 year follow up to evaluate the palmar hyperhidrosis. The questionnaire was translated into Arabic to be validated in our community. Procedure associated side effects were evaluated and patients were asked to comment on trocar site pain. Compensatory sweating and gustatory sweating were evaluated using the OSi score.

Outcome score index questionnaire

Score 1: Scanty sweating and never affects daily activity.

Score 2: Tolerable sweating and sometimes affects daily activity.

Score 3: Barely endurable sweating and frequently affects daily activity.

Score 4: Intolerable sweating and always affects daily activity.

Score of 1-2 was considered as mild to moderate symptoms, while score of 3-4 was considered as severe symptoms.

Simultaneous bilateral VATS sympathectomies were done with the same steps in all patients. Under general anesthesia and using a double lumen endo-tracheal tube for lung isolation. A two 5mm ports were used. The camera port is placed in the 5th intercostals space anterior axillary line, while the instrument port is placed in the 3rd intercostal space midaxillary line. The lung is retracted with the camera while rotating the table at the working side slightly up (45 °). A hook diathermy is introduced to severe the sympathetic chain below the 2nd rib and above the 4th rib. The hook diathermizes 4 – 5 cm along the 2nd, 3rd and 4th ribs to make sure that all accessory fibers are included. The instrument port is closed. And lung inflation under vision is observed while taking the camera out. The camera port is also closed with a suture under a Valsalva's maneuver. No chest drain is used. Immediate effect is noted with warm, dry hand and change in the pulse oximetery due to change in circulation. The other side is simultaneously done as mentioned before. The port sites are injected with local anesthetic (xylocaine and marcaine). Patients are transferred to the recovery room and observed for one hour. They are then sent for a chest radiograph to exclude pneumothorax. Patients who live in Cairo are usually discharged same day, while those living outside Cairo are offered overnight stay to be discharged next day morning.

Results

58 patients with a mean age of 28.3 years ± 7.39 (range, 18– 42). There were 35 males and 23 females with a body mass index (BMI) of 23.28 ± 2.6. In this study the mean operative time was 36.13 min ± 4.16 and hospital stay was 16.27 hours ± 6.9. There was no mortality and complications include minimal pneumothorax in 2/58 patients (3.4 %) that required no intervention. These patients were instructed to come back to the hospital if they develop respiratory distress.

At one week follow up the chest x-ray showed fully expanded lungs. Hyperesthesia at the incision site was the complaint of 5/58 patients (8.6 %), which responded to gabapentin in an escalating dose starting at 100 mg and reaching 400 mg three times daily. Only one patient was referred to pain clinic and received paravertebral block. At follow up pain was reduced with time and at 4 months the 5 patients were pain free.

The primary symptom (palmar hyperhidrosis) was improved post procedure and patients mentioned mild to moderate symptoms in all patients. Forty five patients (77.5%) had scored I (negligible symptoms) and in 13 patients (22.4 %) had scored II (tolerable symptoms). In 27 patients (46.6%) compensatory (CS) and gustatory sweating (GS) was a complaint of which 20 patients (74 %) mentioned that this was intolerable and in 7 patients (25.9 %) mentioned that this was tolerable. However dissatisfaction of the operation was mentioned by 23/58 patients (39 %) of which 13 (22.4 %) regretted undergoing surgery. Table 1, 2 shows outcome at 3, 6 and 1 years respectively.

	Preoperative	Postoperative	
	Palmar hyperhidrosis (58 patients)	Palmar hyperhidrosis (58 patients)	Compensatory sweating (27/58 patients)
Score I	0	45 (77.5 %)	0
Score II	0	13 (22.4 %)	7(25.9 %)
Score III	8 (13.7 %)	0	2 (7.4 %)
Score IV	50 (86.2 %)	0	18 (66.6 %)

Table 1. Outcome after 3 months follow up

	Compensatory sweating at 6 mo. (27 patients)	Compensatory sweating at 1 year. (27 patients)
Score I	0	0
Score II	9 (33.3 %)	10 (37%)
Score III	3 (11.1 %)	3 (11.1%)
Score IV	15 (55.5 %)	14 (51.8 %)

Table 2.Outcome after 6 and 1 year follow up

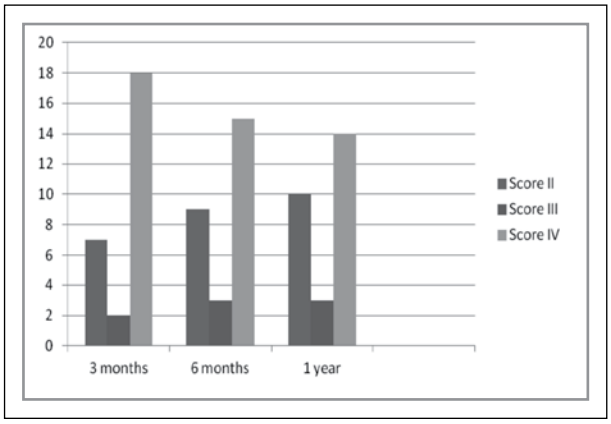

Fig 1. Change of compensatory sweating over follow up period

Slight improvement in patients compensatory sweating over time was seen, however this was not reflected in the overall patient satisfaction after the operation. Fig 1 shows changes of patient symptoms over the follow up period. After one year follow up there was no deterioration in the palmar hyperhidrosis after surgery.

Discussion

Minimally invasive thoracic surgery has evolved significantly over the last decade and has become a mainstay in the technical repertoire of the modern thoracic surgeon (4).

Palmar hyperhidrosis is the main indication for minimal invasive VATS sympathectomy in our report.

Hyperhidrosis is an idiopathic excessive secretion of sweat beyond the physiological needs of thermoregulation. Patients thought medical advice when the condition interferes with social and occupational activities. Medical treatments of hyperhidrosis are often unsuccessful (13).

Local commercial non medical antiperspirants which act to reduce sweating from both eccrine and apocrine glands are not useful enough to control hyperhidrosis. One exception to this is Aluminum Chloride in high concentration found in over the counter products. In general topical antiperspirants have to be applied at nights and work best if used with plastic gloves for maximal effect(3).

Medical treatment for hyperhidrosis includes prescription topical lotions, iontophoresis, topical antiperspirants, biofeedback, oral medications, and most recently, botulinum toxin injections. The success and compliance rates with medical treatments are often dismally low, especially for those patients with life-long or moderate to severe hyperhidrosis(4).

Oral medications like anticholinergic medications have variable success in treating hyperhidrosis. Unfortunately these medications have severe side effects such as excessive dryness of the mouth, constipation, urinary retention, and blurry vision. Propranolol is a beta-blocker that has generalized anti sympathetic activity. It has been used to treat stress-induced hyperhidrosis(3).

Botulinum toxin type A (BTX-A) is a medication that is injected subdermally into the skin to treat hyperhidrosis. Botox acts by temporally blocking neurotransmitters that stimulate sweat production. It works well for axillary hyperhidrosis. A decrease in sweating is noted after the injections. However repeat treatments are needed every 4-6 months.Botox injections also have been used to treat palmar and facial hyperhidrosis with some success, but due to the need for repeated injection and the cost many patients are reluctant to use it. Palmar injection is sometimes associated with temporary paralysis of the palmar muscles(1).

Injections in the hands can also be very painful, so it is not an attractive medical treatment for patients afflicted with hyperhidrosis Palmaris(4).

Advancement in surgical techniques had made operative approaches such as dorsal, supraclavicular and thoracic approaches a historical operation for thoracic sympathectomy. VATS sympathectomy has simplified the approach allowing a day case minimal invasive safe intervention to be carried out(4).

Thoracic sympathectomy, particularly a videothoracoscopic procedure appears to be the optimal treatment of choice with a success rate ranging from 94 to 98% in the management of upper limb hyperhydrosis (1–3).

The evolution of thoracoscopic sympathicotomy, as a procedure whereby the nerve is divided at two levels, effectively mimics the historical operation in which a segment of the nerve is resected. At present, this approach of sympathicotomy appears to be the standard(4).

In our study there were more males than females but with no statistical significant difference, which coincides with others studies.

Ishy stated that, there is no evidence for any difference in the prevalence of PH between the genders(8).

In our retrospective study, the success rate following VATS sympathectomy to control patient primary symptom (palmar hyperhidrosis) was 100 % success with 77.5 % of patients had scanty sweating, while 22.4 % of patients had tolerable symptoms that sometimes interfere with their daily activity. During our follow up period we could not elicit deterioration of palmar symptom over time. However, we reported 23/58 patients (39 %) who were dissatisfied from the operation and 13/58 patients (22.4 %) regretted that they underwent the operation. The main reasons were the development of sympathectomy related side effect particularly compensatory and gustatory sweating.

The significant improvement in the QOL index, seen in more than 90% of Kwong and his colleagues' patients, is perhaps a reflection of careful patient selection for surgical treatment. The majority of their patients who are offered surgery have had a long-standing history of hyperhidrosis symptoms and have tried on average at least two medical treatments in the past without any alleviation of symptoms(4).

Compensatory sweating is the most common side effect seen in Kwong series, as is also uniformly found in other series as well. Interestingly, there appears to be a much higher incidence of compensatory sweating in the reports from Asian countries compared with those of Western countries(4).

The incidence of compensatory sweating is between 40% and 60% in the Western countries compared with 80% and 90% in the Asian countries. In one Asian review, it has even been reported as high as 97% (10). The reasons for this discrepancy are unknown. Kwong and his colleagues have observed that compensatory sweating can be exacerbated by warmer temperatures and humid weather—conditions more prevalent in the Asian countries(4).

In the surgical Group of Ambrogi and his colleagues they explained the decrement of the score (quality of life questionnaires) with the onset of compensatory sweating, which affected the answers in all the questionnaires used in the study. At any result, the presence of compensatory sweating had a minor influence on quality of life compared with the effect of the reprise of palmar sweating(9).

Tetteh and his colleagues said, compensatory and gustatory sweating appear to be more permanent postsympathectomy complications in most of the 200 papers that have been published in the English literature over the past 25 years. The reported frequencies of compensatory sweating vary considerably, however, despite a seemingly similar operation(10).

While most papers describe this side effect in 30% to 70% of patients, some investigators claim that they have not encountered compensatory sweating after sympathectomy (2), and others see it in almost all patients (11).

Tetteh and his colleagues stated that their results demonstrate that compensatory sweating is a very common side effect, occurring in almost 89% of patients; and in 35% it was so severe that they often had to change their clothes during the day. Apparently, the majority of their patients accepted compensatory sweating as a side effect, because their answer to the question on the results of the operation was excellent or satisfactory(10).

Tetteh and his colleagues stated that gustatory and compensatory sweating are frequent side effects after thoracoscopic sympathectomy, and they believe it is crucial to inform patients thoroughly before surgery(10).

Finally, compensatory sweating may vary with the intensity of questioning and the thoroughness of follow-up, and may be affected by geographic location, working environment, humidity, temperature, and season (10).

Horner's syndrome is a dreaded potential complication of thoracic sympathetic chain surgery. Fortunately, this is rarely found in most centers with extensive experience performing these procedures(4).

Tetteh and his colleagues stated that, during the immediate postoperative period, chest pain, hemothorax, pneumothorax, and Horner's syndrome may occur, but in most reports these complications are considered rare, transient, and self-limiting(10).

The risk of Horner's syndrome was reduced with VATS compared to open sympathectomy through the transaxillary or supraclavicular approach (12).

In our study we have no patients with postoperative Horner's syndrome.

Georghiou and his colleagues, also did not use intercostals tube postoperatively as there was no need for a chest tube (because the lung was inflated under direct vision), recovery was rapid, and the patients were ambulatory already a few hours after surgery(13).

We also did not used intercostal tubes postoperatively and we had no complications regarding stressful pnemothorax.

In conclusion VATS sympathectomy is a safe procedure with controlled complications and we can depend upon as a solution for palmar hyperhidrosis with postoperative compensatory sweating as the main and most significant complication that should be explained well for the patients.

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Small-Bore Catheter for Draining Most Types of Pleural Effusions: Upper Egypt Experience

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Background and aim of the study **Tube thoracostomy remains the standard of care for the treatment of pneumothorax and simple effusions in most hospitals (2, 8). Placement of a large-bore chest tube is an invasive procedure with potential morbidity and complications and therefore the use of small-bore catheter may be desirable (3). The objective of this study was to evaluate the efficacy and complications of using small-bore catheters (8.3-12 fr.) in drainage of pleural effusion as a less invasive alternative to traditional chest tube insertion.**

Patients and methods**: This prospective study was conducted between January 2010 and september 2012, at Sohag university hospital, El-Helal Inssurance hospital in Sohag, and Qena university hospital (tertiary hospitals in upper Egypt). We evaluated the efficacy and safety of small-bore catheters (8.5–12 French) insertion in cases of pleural effusion of various etiologies. Tow hundred and sixty (260) small-bore catheters were placed in 241 patients. Mean age was 48.4 years (18 to 77 years). There were 152 males and 89 females. The reasons for small-bore catheter drainage were: malignant effusion (n=61), parapneumonic effusion(n=33), transudative effusion(n=46), exudative effusion (hepatic failure and renal failure) (n=68), T.B effusion(n=11),traumatic hemothorax(n=14), and postoperative (n=27).**

Results **Duration of drainage of pleural fluid was 2-15(mean=6.9) days. The Overall success rate was 82.3%. The success rate was highest when the drain was used to treat massive transudate effusions (86.9%) and exudative (post renal and hepatic failure) pleural effusions (83.8%), followed by malignant effusions (82%), T.B. effusion (81.8%),, then post operative effusion (81%), parapneumonic pleural effusion (75.7%), and finally post traumatic hemothorax which yielded the lowerist incidence of success (10 out of 14, 71%). Among the eight cases of empyema, the procedure was successful only in five of them (success rate 37.3%). There were no major complications related to catheter insertion. Complications included pain at the insertion site requiring analgesia in 38 patients (14.6%), pneumothorax in 72 (27.6%) patients, failure to drain properly in 60 patients (23%), fever in 10 cases, and infection in 3 patient (1%). 46 out of 260 catheter placements were not successful, 16 due to loculated effusions, 17 due to obstruction and blockage of the catheter, 5 cases with advanced parenchymatous lung disease, and 5 due to rapid re-accumulation of the fluid after removal of the catheter. If the cases of loculated pleural effusions and advanced lung disease are excluded, the success rate increases to 90% (235 out of 260).**

Conclusion: **Small-bore catheter insertion is an effective and safe method for draining pleural fluid of most etiologies. We recommend its use for all cases of pleural effusion requiring chest drain except for hemothorax, empyema and other loculated pleural effusions that yield low success.**

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Tube thoracostomy remains the standard of care for the treatment of pneumothorax and simple effusions in most hospitals [1, 2]. Placement of a large-bore chest tube is an invasive procedure with potential morbidity and complications, and therefore the use of small-bore catheter may be desirable [3].

The use of small-bore catheters in the treatment of fluid collection in the pleural space has been reported in the radiology literature sporadically for almost 20 years. The therapeutic indications for catheter placement have included treatment of empyema, pneumothorax, and drainage of pleural effusions, with or without sclerotherapy. The experience to date suggests that the use of small-bore catheters is effective, safe, and well-tolerated [4,5,6].

The objective of this study was to evaluate the efficacy and complications of using small-bore catheters (8.3-12 fr.) in drainage of pleural effusion as a less invasive alternative to traditional chest tube insertion.

Materials and methods

We conducted a prospective study of patients treated at Sohag university hospital, El-Helal Inssurance hospital in Sohag, and Qena university hospital (tertiary hospitals in upper Egypt), between January 2010 and september 2012.

In our study all patients with pleural effusions planned to have chest tube insertion were included. Informed signed consent was obtained from all patients. The diagnosis of pleural effusion was based on clinical and chest X-ray findings, and confirmed by a diagnostic thoracocentesis (less than 50mL).

Small sized catheters (central venous catheters: certofix BUO, and dual lumen dialysis catheter) had the size of 8.5–12 French (2.8–4 mm in diameter) were used in the study.

All procedures were done at the bedside under local anesthesia and without radiologic guidance. Insertion of catheters was done using the modified Seldinger technique[7]. Salient technical aspects of catheter insertion include appropriate use of local anesthetic and needle insertion that barely "walks over" the top of the rib to avoid the intercostal bundle. We typically employ a small (22 gauge) "finder needle" before inserting the larger needle provided with the kit. Pleural fluid should be easily withdrawn with the needle, and passage of the guide wire into the pleural space should be virtually effortless. Development of an adequate tract with the dilator and insertion of the catheter so that the sideholes are well within the pleural cavity are important for proper function. The catheter is attached to a standard thoracic drainage system. The catheters were removed as soon as the drainage was less than 100 mL per day for 3 consecutive days.

The therapy was considered successful if the opacity cleared on chest radiograph and confirmed on chest ultrasonography of the thorax and also if there was no need for a second intervention (repeat catheter placement, tube thoracostomy, or operation) within 72 hours after removal of the catheter.

Patients were given, beside catheter insertion, the standard therapy according to the cause of pleural effusion. For malignant pleural effusion, pleurodesis was done using bleomycin (0.75 mg/kg was administered as a single dose), for tuberculous pleural effusion, standard antituberculous chemotherapy and corticosteroids were given, For parapneumonic effusions, antibiotics were given, and For cases of heart failure, antifailure treatment and diuretics were given.

Results

Tow hundred and sixty (260) small-bore catheters were placed in 241 patients over a 33 months period (from January 2010 to september 2012). Mean age was 48.4 years (range 18 to 77 years). There were 152 males and 89 females.

Etiologies of effusions included: 61 was malignant pleural effusion (20 cases secondary to breast cancer, 13 cases secondary to bronchogenic carcinoma, 7 cases secondary to mesothelioma, 12 secondery to gastrointestinal cancer, 7 cases secondary to lymphoma, and tow cases with ovarian malignancy). 11 patients had tuberculous pleural effusion. 33 patients had parapneumonic effusion: 8 of them had empyema. 14 cases had bloody pleural effusion post trauma. 46 patients had transudative effusion (21 secondary to heart failure, and 25 had nutritional). 17 secondary to renal failure. 51 secondery to hepatic failure. and 27 patients post operative serosangunious effusion. Age and sex of the patients are shown in Table (1). Etiologies and clinical data are shown in table (2).

age	19 – 77 yrs	Mean : 48.4 yrs
sex	Male	152 (63%)
	Female	89 (37 %)

Table 1. Age and Sex of patients

Cause of effusion	NO.	%
Malignant effusion:	61	22
Breast cancer	20	
Bronchogenic carcinoma	13	
GIT malignancy	12	
Lymphoma	7	
mesothelioma	7	
Ovarian malignancy	2	
Tuberculous effusion	11	4
Parapneumonic effusion	33	12
Empyema	8	
Blood post traumatic	14	5
Transudative	46	17
heart failure	21	
nutritional	25	
Exudative Hepatic failure	51	20
Exudative renal failure	17	6
Serosangunious post operative	27	10

Table 2. Etiologies and clinical data

The duration of drainage of pleural fluid using the small-bore catheter ranged between 3 and 15 days (mean: 6.9 days). There were no major complications related to the catheter insertion. Complications of the catheter included pain at the insertion site requiring analgesia in 38 patients (14.6%), pneumothorax in 72 (27.6%) patients, failure to drain properly in 60 (23%) patients (due to blockage of the catheter in 17 patients, dislodgement in 18 patients, kinking in 15 patients, disconnection in 10 patients), fever in 10 patients, and infection in 3 patients. Pneumothoraces were resolved spontaneously through the same catheter. In kinked, dislodged, and disconnected catheters, re-insertion was done with good results. Blockage of the catheters and infection were associated with procedure failure.

Small-bore catheter drainage of pleural effusion was successful in 214 out of 260 cases with a success rate (82.3 %). The success rate was highest with transudative pleural effusion (40 out of 46, 86.9%), followed by exudative effusion (secondary to Hepatic and Renal failure) 57 out of 68 (83.8%), malignant pleural effusion (50 out of 61, 82%), tuberculous effusion (9 out of 11, 81.8%), then post operative effusion (22 out of 27, 81%), and finally parapneumonic pleural effusion (25 out of 33, 75.7%), and finally post traumatic hemothorax which yielded the lowerist incidence of success (10 out of 14, 71%). Among the eight cases of empyema, the procedure was successful only in five of them (success rate 37.3%).

Forty six (46) out of 260 catheter placements were not successful. Among the 46 cases of failure,16 of them were due to loculated effusions (7 with parapneumonic effusion, 2 with malignant effusion, 4 with hepatic failure, 2 with renal failure, and one T.B), 17 due to obstruction or blockage of the catheter (4 traumatic hemothorax with frequent clotting, 5 thick purulent discharge, 3 bloody malignant effusion with clotting, and 5 post operative with thick debris), 5 cases with advanced parenchymatous lung disease and entrapment, 5 were due to rapid re-accumulation of the fluid after removal of the catheter, and 3 due to infection at the site of insertion. In both parapneumonic and tuberculous pleural effusion groups, most failures were associated with presence of loculations and diseased lung (Table 3). If the cases of loculated pleural effusions and advanced lung disease are excluded, the success rate increases to 90% (235 out of 260).

Cause of failure	NO.	Clinical data
Blockage (obstruction)	Total :17	
	3 Malignant	Bloody with frequent clotting
	5 Parapneumonic	Thick purulent discharge
	4 post trauma	Clotting
	5 post operative	Thick debries with clotting
Failure to drain properly	Total : 26	
	5 Malignant	2 loculations 3 massive amount >1000 a day
	9 Parapneumonic	7 loculations 2 diseased lung
	4 Hepatic failure	4 loculation
	3 Renal failure	2 loculations 1 entrapped lung
	2 heart failure	2 Massive amount > 1000 a day
	3 T.B	1 loculations 2 entrapped lung
Infection	1 Heart failure 2 Hepatic failure	3 Infection at site with removal of the catheter

Table 3. Clinical data of failure cases

Discussion

Tube thoracostomy remains the standard of care for the treatment of pneumothorax and simple effusions in most hospitals [2,8]. Placement of a large-bore chest tube is an invasive procedure with potential morbidity and complications and therefore the use of small-bore catheter may be desirable [3].

There is a strong believe that the small-bore catheter (8.3 fr) causes substantially less pain than traditional tube thoracostomy, by virtue of its size in relation to the normal intercostal space. The average intercostal space in an adult (measured at the 5th intercostal space in the mix-axillary line) is 8.8 ±1.4 millimeters. A 24 F chest tube (the smallest size commonly used for the described indications) has an outer diameter of 8 mm, while a 32 F chest tube has an outer diameter of just under 11 mm. Chest tubes, with their excessive size, cause pain by compressing the neurovascular bundle at the top of the interspace, as well as by levering open the interspace. In contrast, the 8.3 F small-bore catheter has a diameter of only 2.8 mm and does not impinge on the neurovascular bundle or alter the geometry of the intercostal space [9,10].

In our study, the mean duration of pleural fluid drainage using small bore catheter was 6.9 days (3–15 days). which is more or less similar to the results in other studies, where Bediwy AD and Amer HG [8] reported a mean duration of drainage of 5.8 days (3-14 days). Parulekar et al. [11] reported a mean period of drainage of 6 days (three to 21 days). Liu et al. [12] reported a mean duration of drainage of 6.1 days. Gammie et al. [10] found a mean duration of drainage of 97 hours.

In the present study, there is no recorded serious complications (organ perforation, massive hemothorax….etc), complications of small bore catheter insertion included pain at the insertion site requiring analgesia in 38 cases (15%), pneumothorax in 72 cases (27%), blockage of the catheter in 17 cases (6%),, failure to drain properly in 43 (16.5%%) patients (due to dislodgement, kinking, and disconnection), and infection (1%). Pneumothoraces were resolved spontaneously through the same catheter. In kinked, dislodged, and disconnected catheters, re-insertion was done with good results Blockage of the catheters and infection were associated with procedure failure.

In other studies, it was found that the small bore catherter insertion is usually safe with little chance for complications. Roberts et al. [3] found that five percent of pigtail catheter placements were associated with serious complications (hemothorax, pnuemothorax, and hepatic perforation) and the overall complications of catheter use occurred in 20% of patients and included failure to drain, dislodgement, kinking, empyema, and disconnection.

Walsh et al. [14] found minimal complications with the use of pigtail catheter for pleural effusion drainage. Spontaneously resolving, small, apical pneumothoraces developed in four of the 15 patients. One patient experienced reexpansion pulmonary edema.

Seaton et al. [15] found that the complication rate was low and consisted of symptoms such as pain and fever with using small tube drainage and doxycycline sclerotherapy.

The incidence and significance of pneumothorax after small-bore catheter placement for malignant pleural effusions was examined by Chang et al. [16] in a retrospective review of 88 patients treated over a two-year period. Twenty-seven patients (31%) developed a pneumothorax. Resolution occurred in 22 patients. No complications such as tension pneumothorax or respiratory distress were reported. In another study, Morrison et al. [17] found that pneumothorax occurred in 19% of cases with malignant pleural effusion treated with pigtail catheter insertions. All pneumothoraces were insignificant and authors attribute them to the use of Seldinger technique.

Warren et al. [18] used pigtail catheter in 202 patients with symptomatic malignant pleural effusions on an outpatient basis. Reaccumulation of the pleural effusion occurred in 3.8% of cases. The incidence of infection was 2.2%. The incidence of blockage was 4.8%.

In the present study, the over all success rate of small-bore catheter drainage of pleural effusion was (82%) of cases. The success rate was highest with transudative pleural effusion (86.9%), followed by exudative effusion (post renal and hepatic failure) (84%), malignant pleural effusion (82%), tuberculous effusion (81.8%), then post operative effusion (81%), and finally parapneumonic pleural effusion (77%). Among the eight cases of empyema, the procedure was successful only in five of them (success rate 37.3%).

The success rate in our study were comparable to the Success rates of using small-bore catheter in other studies. Where Bediwy AD and Amer HG [8], in their study found that the success rate 82.35% . The success rate was highest with transudative pleural effusion (85.71%), followed by tuberculous effusion (83.33%), then malignant pleural effusion (81.81%), and finally parapneumonic pleural effusion (80%).

Liu et al. [12], in another study found that the success rate of pigtail catheter insertion was highest when the drain was used to treat massive transudate effusions (81.6%) and malignant pleural effusions (75.5%), followed by parapneumonic effusions/empyemas (72.2%), hemothoraces (66.6%), and pneumothoraces (64.0%).

In another study, Liang et al. [19] found that the success rate of ultrasound-guided pigtail catheter drainage of pleural effusions in the ICU was highest when used to treat traumatic hemothorax (100%) and postoperative pleural effusions (85%); drains inserted for empyema were more likely to fail (overall success rate, 42%). No significant insertion complications, such as hollow organ perforation, were caused by this procedure.

Gammie et al. [10] found that clinical success rates of pigtail catheter insertion for drainage of pleural effusion were 86% with no reported complications.

Grodzin and Balk [20] demonstrated that the use of a small indwelling pleural catheter was more cost-effective when used in place of a closed tube thoracostomy for drainage of large-volume pleural effusions.

In accordance with the results of our study, Sartori et al.[21] reported a success rate of 84.3% with using a nine-French intrapleural catheter insertion under sonographic guidance followed by bleomycin pleurodesis in 160 patients with rapidly recurrent malignant pleural effusion.

Seaton et al. [15] studied the use of small tube drainage and doxycycline sclerotherapy for malignant pleural effusion and reported a success rate of 81%.

In a retrospective study, Parulekar et al. [11] found that small-bore catheter 12 French was as effective as standard chest tube for drainage of malignant pleural effusion and pleurodesis without significant differences in the rate of complications.

In our study, 64 out of 260 catheter placements were not successful. Among the 64 cases of failure, 16 of them were due to loculated effusions, 17 due to obstruction or blockage of the catheter, 5 cases with advanced parenchymatous lung disease, and 5 due to rapid re-accumulation of the fluid after removal of the catheter. In both parapneumonic and tuberculous pleural effusion groups, most failures were associated with presence of loculation. If the cases of loculated pleural effusions and advanced lung disease are excluded, the success rate increases to 90% (235 out of 260).

We found Comparable results In other studies. where Bediwy AD and Amer HG [8], found that among the nine cases of failure, five of them were due to loculated effusions, and four of them were due to rapid reaccumulation of the fluid after removal of the catheter. And with the exclusion of patients with preplacement evidence of loculated effusions, the success rate was 91.3% for effusions treated by pigtail catheter drainage.

And in the study done by Gammie et al. [10], there were eleven out of 77 pigtail catheter placements for pleural effusions were not successful. Four failures were associated with loculated fluid collections that required either operation or radiographically guided drainage for resolution. In two cases, pigtail catheters were removed when they were draining in excess of 1000 mL of fluid per day, and the underlying effusions reaccumulated. They reported that exclusion of patients with preplacement evidence of loculated effusions and postponement of pigtail removal in the face of excess drainage would have yielded a success rate of 94% for effusions treated by pigtail catheter drainage.

Conclusion

Small-bore catheter insertion is an effective and safe method for draining pleural fluid of most etiologies. We recommend its use for all cases of pleural effusion requiring chest drain except for hemothorax, empyema and other loculated pleural effusions that yield low success.

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