Volume 22 **Jan - March 2014** **Number (1)**

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Journal of The Egyptian Society of Cardio-Thoracic Surgery

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Journal of Egyptian Society of Cardio-Thoracic Surgery (J. Egypt. Soc. Cardiothorac. Surg.)

Editorial Office

Please address all correspondence to:

Mohamed Abdel Raouf Khalil, MD, Editor

Journal of the Egyptian Society of Cardio-thoracic Surgery

330 El-Sudan St., Imbaba, Cairo, Egypt.

Telephone: (+202) 3303 6634

Fax: (+202) 3303 8054

E-Mail: jegyptscts@gmail.com

The Journal of the Egyptian Society of Cardiothoracic Surgery [ISSN 1110-578 X] is the official publication of the Egyptian Society of Cardio-thoracic Surgery. The journal is published every three months .

General Instructions

Every submission must include:

Cover letter, indicating the category of article, the ***Complete manuscript***, including title page, abstract, text, tables, acknowledgments, references, illustrations.

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General Information

Three copies of the Manuscripts should be sent preferably prepared in Microsoft Word, typed *double-spaced* throughout (including title page, abstract, text, references, tables and legends) with one (1) inch (2.5 cm) margins all around. Place Author name and page number in the upper right corner of each page.

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Arrange manuscript as follows: (1) title page, (2) abstract, (3) text, (4) acknowledgments, (5) disclosures if required, (6) references, (7) tables and (8) legends. Number pages consecutively, beginning with the title page as page 1 and ending with the legend page.

If your manuscript contains illustrations, in addition to submitting them online, you must send two sets of original illustrations to the editorial office labeled with manuscript number, first author, and figure number on back.

Tables and figures should be provided separate from the text while there position in the text should be marked on the manuscript.

Word Limits by Category of Manuscript

Original articles should not exceed 4500 words including title page, abstract of 150-200 words, text, figure legends *and references*. The combined total of illustrations and tables should not exceed 10 and the number of references should not exceed 40.

New Technology articles are limited to 2500 words including title page, abstract, text, figure legends and *references*. The number of tables should not exceed three; the number of illustrations should not exceed six if tables are included; eight if there are no tables. The number of references should not exceed 10.

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Images in cardiothoracic surgery are limited to 350 words including title and text and to two, possibly three figures. The entire contribution must fit on one printed page .

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Our surgical heritage articles are limited to 2500 words including title page, abstract, text, figure legends and references. Subtract 100 words for each illustration and 300 words for each table.

Correspondence (Letters to the Editor) and **commentaries** are limited to 500 words. Subtract 100 words for each illustration and 300 words for each table.

Editorials are limited to 2500 words including references. Subtract 100 words for each illustration and 300 words for each table.

Manuscript Preparation

Title Page (first page)

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Provide a structured Abstract, *no longer than 250 words*, divided into four sections: **Background, Methods, Results, Conclusions**. Avoid abbreviations and acronyms. Indicate the abstract word count below the abstract.

- New Technology

Provide a structured abstract, *no longer than 175 words*, divided into four sections:

Purpose, Description, Evaluation and Conclusions. Avoid abbreviations and acronyms. Indicate the abstract word count below the abstract. [Disclosure stating the source of all funds to the study, plus "freedom of investigation" which is defined as freedom from outside interests in controlling the study and having freedom to fully disclose all results;these statements are mandatory for all new technology articles only]

- ***Case reports, "how to do it"*** *articles,* ***review articles*** *and* ***our surgical heritage*** *articles*. Provide an unstructured abstract of 100 words.

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Text should be organized as follows: **Introduction**, **Material** (**or Patients**) **and Methods**, **Results**, and **Comment**.**Cite references, illustrations and tables** in numeric order by order of mention in the text.

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Measurements and weights should be given in standard metric units. **Statistical nomenclature and data analysis**. Follow the "Guidelines for Data Reporting and Nomenclature" published in *The Annals of Thoracic Surgery* (1988;46:260-1). **Footnotes**. Type footnotes at the bottom of the manuscript page on which they are cited. **Suppliers**. Credit suppliers of drugs, equipment and other brand-name material mentioned in the article within parentheses in text, giving company name, city and country.

Acknowledgments

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Identify references in the text using Arabic numerals in brackets on the line.. **Type references** *double-spaced* after text or acknowledgments beginning on a separate sheet. Number consecutively in the order in which they appear in the text. **Journal references** should provide *inclusive* page numbers; **book references** should cite *specific* page numbers. **Journal abbreviations** should conform to those used in *Index Medicus*. follow the formats outlined below:

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8. Jones DR, Stiles BM, Denlinger CE, Antie P. Pulmonary segmentectomy: results and complications. Ann Thorac Surg 2000;76:343-9. (List *all* authors if 6 or fewer; otherwise list first 3 and add "et al.")

Chapter in Book

12. Vinten-Johansen J, Zhao Z-Q, Guyton RA. Cardiac surgical physiology. In: Cohn LH, Edmunds LH Jr, eds. Cardiac Surgery in the Adult. 2nd ed. New York, NY: McGraw-Hill; 2003:53-84.

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3. 1996 NRC Guide for the Care and Use of Laboratory Animals. Available at: http://www.nap.edu/readingroom/books/labrats/contents.html. Accessed October 20, 2003.

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- *Single-journal submission affirmation .*
- *Conflict of interest statement (if appropriate).*
- *Sources of outside funding.*
- *Signed Statistical Collaboration .*

B] Complete manuscript

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- *References (double-spaced; separate pages).*
- *Tables (double-spaced; separate pages).*
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5 Keep table formatting simple and consistent. A common error is to place a column of separate items into a single table cell, with each item separated by a hard return: instead each data item should have a table cell of its own. Sometimes tables are formatted with tabs instead of cells: in this case, the key is to set the tab stops for the whole table so that one tab equals one column.

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7 Be prepared to send the data used to generate graphs. Some publishers will use the data to regenerate the graphs according to their own style rules. In such a case, it helps if you send only the data that are actually shown in the graphs – not the spreadsheet with all of the data generated in the study.

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The purpose of peer review for The *Journal of the Egyptian Society of Cardio-Thoracic Surgery* (JESCTS) is twofold. One is to evaluate objectively the science of the submitted paper and the other is to provide a constructive critique indicating how the paper could be or could have been improved by the authors. Reviewers should respect the authors' efforts and avoid disparaging or unpleasant comments. Reviewers are not asked to copyedit papers, but should comment if language editing is needed.

Acceptance of a Manuscript for Review

Reviewers should accept assignments to review manuscripts that are within their sphere of expertise, which they plan to review within the 21 day deadline. Reviewers should decline assignments for which a conflict exists between the reviewer and authors or between the reviewer and commercial products that are integral to the content of the article.

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General Requirements for Publication

The paper should conform to the format and restrictions for the category to which it belongs and be written in good, readable English. The paper should address an important or interesting subject and provide new and original information. Illustrative material should be well chosen and of good quality.

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.

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Short and Midterm Results of Surgical Repair of Aortic Coarctation In Syndromic Patients- A Single Center Prospective Study.

Cardiovascular

Elatafy E. Elatafy, MD[1] ,

Abdel-Hady M. Taha, MD[1],

Alaa Roushdy, MD, FSCAI[2],

Mohamed Abdelraouf Khalil, MD[3]

Background: **There is no sufficient data about the outcome of surgical repair of aortic coarctation in syndromic patients.**

Patients and methods: **This was a prospective observational study in which we reviewed the results of 13 patients who proved to be syndromic(Turner, Shone, Down or PHACE syndromes) and operated upon for repair of aortic coarctation with either resection withend to end anastomosis or extended end to end anastomosis.**

Results**: There was no intra operative mortality in this series of patients, however the early postoperative mortality was 7.7% (n=1).The maximum postoperative pressure gradient measured by echocardiogram was 35 mmHg which occurred in one patient. 69.2% of the patients (n=9) achieved pressure gradient less than 15 mmHg. No patient needed further intervention either catheter based or surgery for significant recoarctation during a follow up period of 12 months.**

Conclusion: **Aortic coarctation in syndromic patients is usually associated with element of arteriopathy, yet the short and midtermresults of surgical repair in this group are satisfactory. Nevertheless,these patients need regular follow up to determine the need for further intervention.**

Aortic coarctation is a common congenital lesion in children representing 4—6% of all types of congenital heart defects[(1)].It usuallyoccurs as isolated lesion, but it is also strongly linked with certain genetic defects, including Turner's syndrome and cases in which coarctationappears in more than one member of the samefamily[(2)]. Shone syndrome or its variants is one of the common syndromes that are associated with aortic coarctationin addition tosubaortic stenosis, parachute mitral valve and supramitral ring[(3)].

Despite the presence of several surgical approaches to repair aortic coarctation, questions remain about the best surgical technique.No technique is clearly superior or applicable in all cases of coarctation[(4)].Repair of aortic coarctation in syndromic patients has special challenge as this group of patients is usually characterized by atypical forms of coarctation with or without abnormal aortic wall.

Patients and method

This was a prospective observational study in which we reviewed and collected data of all syndromic patients with aortic coarctation who were referred for elective surgical repairin Misr Children Hospital in the period from June 2011 to June 2013.A custom made sheet was used to collect the demographic data of these patients including age at time of operation, body weight, gender as well as the data of their preoperative echocardiogram and other imaging modalities especially multi-detector CT when available.

The 13 patients included in the study were proved to be syndromic either by chromosomal assay or the presence of the clinical and echocardiographic stigmata of the syndrome. The operative details of each patient were recorded as well as any intra or perioperative complications. Short term follow up data was obtained from their in hospital postoperative echocardiogram.

(1) Department of cardiothoracic surgery, Tanta university, Egypt

(2) Department of Cardiology, Ain Shams University, Cairo, Egypt

(3) Department of Cardiothoracic surgery, Cairo University, Cairo, Egypt

Codex : o3/01/1401

Statistical analysis

All data were collected, tabulated, and statistically analyzed. Patient and procedural characteristics were tabulated and reported as frequencies or medians. Continuous variables were expressed as mean plus or minus standard deviation, and categorical variables were expressed as a percentage. Statistical significance was assessed by paired t-test. Values were considered significant when Pvalue was less than 0.05.

Results

There were 7 male and 6 female patients included in the study. The mean age at time of operation was 14.3±8.7 month and the mean weight 9.8±3.89 kgm. The mean preoperative pressure gradient was 57.3±9.9 mmHg.Six of these patients had Shone syndrome or one of its variants, 4 had Turner syndrome, 2 patients were triosmy 21(Down syndrome) and one patient was PHACE syndrome (Figure 1).Three patients (2 shone syndrome and 1 Turner) had bovine arch. Two patients with triosmy 21 had VSD with pulmonary hypertension. Two patients (1 Shone and 1 Turner) had bicuspid aortic valve (Table 1). In addition to the 3 patients who had bovine arch, multislice CT showed hypoplastic distal aortic arch in 4 patients and the left subclavian artery originated from the coarctation segment in 3 patients.

Syndrome	Number (%)	Associated anomalies	Number (%)
Turner	4 (31%)	Bovine arch	1
		Bicuspid aortic valve	1
Shone	6 (46%)	Bovine arch	2
		Bicuspid aortic valve	1
PHACE	1 (8%)	---	---
Trisomy 21	2(16%)	VSD Pulmonary hypertension	2

Table (1) Incidence of anomalies other than aortic coarctation in the studied group

Operative technique

All the patients were operated on through left posterolateral thoracotomy with right radial and femoral arterial lines. After incision of the mediastinal pleura, extensive mobilization of the descending aorta till the 7th or 8th posterior intercostal arteries

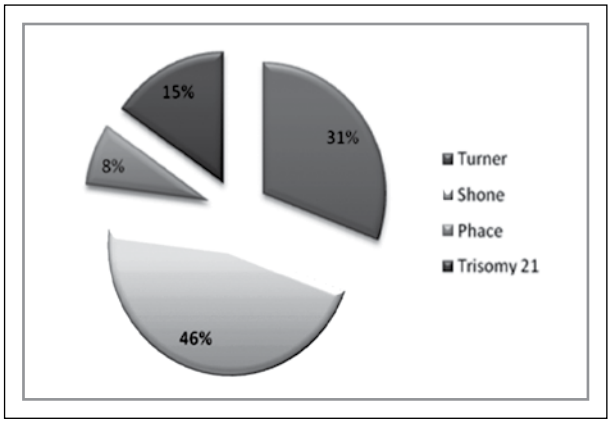


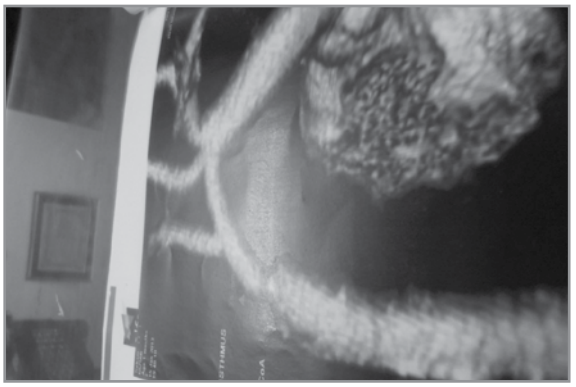
Fig 1. Distribution of the studied group according to the underlying syndrome

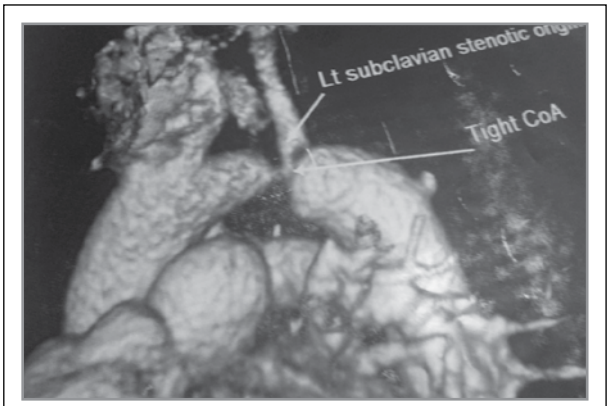
and mobilization of the whole arch and the distal portion of the ascending aorta was done. All the intercostal arteries were spared unless there was direct interference with the resection of the coarctation segment.The descision whether to do resection and end to end(4 cases) or extended end to end (9 cases) anastomosis was determined intra operatively depending on the anatomy of coarctation. Proximal and distal aortic clamps were applied and the resection and anastomosis was done.

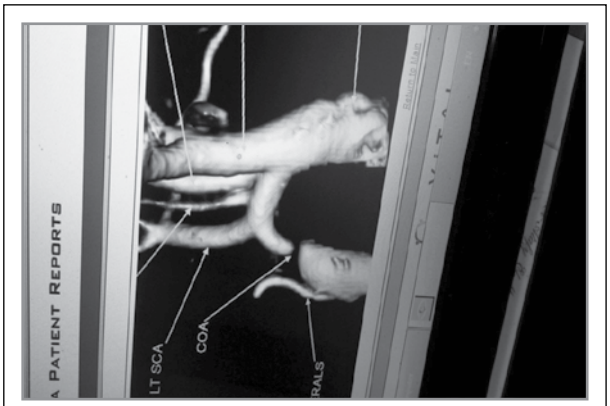
Atypical anatomy of coarctation and the abnormal aortic wall was noticed in Shone and Turner syndromes. In 2 patients with shone syndrome, the left subclavian artery was sacrificed because it originated from the middle of the coarctation segment with bovine aortic arch. After removal of aortic clamps and resuscitation, 2 patients with Down syndrome who had VSD and pulmonary hypertension underwent pulmonary artery banding.

Out of the 13 patient, one patient who had PHACE syndrome died early postoperatively due to low cardiac output. One patient (Shone) had early postoperative chylothorax 3days after the operation which necessitated delayed removal of the intercostal tube on the 8th day postoperative after a short time of parentral feeding. Another patient (Turner) had early postoperative fits and the follow up CT brain proved to be a normal study and the fits were controlled by medical treatment. Other than these adverse events there was no other major complication like paraplegia, renal affection, hand problem specially in the 2 patients in whom the left subclavian artery was sacrificed.

The pressure gradient across the coarctationdropped from a mean of 57.3±9.9 mmHg preoperatively to a mean of 3.32±5.07 mmHg in the operating room by direct measures of the pressure from the radial and femoral artery (P<0.001). The median follow up period of 12 month was done using echocardiography and if indicated cardiac MSCT.







On follow up, echocardiographic measurement of the pressure gradient revealed that it increased to a mean of 15±8.9 mmHg. During follow up, we had 3 patients (2 Shone and 1 Turner) with a pressure gradient of 25,25 and 35 mmHg respectively. The other 9 patients had pressure gradient across the repair area less than 15 mmHg ranging from 0 to 15 mmHg. No patient needed further intervention either catheter based or surgery for significant recoarctation during this follow up period.

Discussion

Recent epidemiological studies showed that about 30% of patients with congenital heart disease present with a genetic syndrome or an association of cardiac and extracardiac anomalies [5-7]. The exact incidence of aortic coarctation in syndromic patients is unknown; however there are some syndromes which are associated with arteriopathy including the aorta where the incidence of aortic coarctation is somewhat higher than the non syndromic patients with congenital heart disease.

Despite the impressive improvements in surgical repair of even the most challenging congenital heart disease, patients featuring genetic syndromes or extracardiac anomalies may show an increased risk for death or major complications, requiringdedicated care in the postoperative period [6-8].

The problem in dealing with aortic coarctation in syndromic patients is not only that most of them have atypical form of coarctation with affection of the aortic arch, but also for example in children with Turner syndrome and aortic coarctation, friability of the aortic wall with higher risk of hemorrhages has been reported at surgery [9,10]and after stent implantation [11]. However a recent study suggests that extracardiac anomalies and genetic syndromes did not increase the operativemortality for this cardiac defect but were predictors of apoor mid-term outcome [12]. This was in accordance with our results where we have only one patient who died early postoperatively due to low cardiac output.

In order to minimize the radiation exposure risk for our patients, we did not adopt routine follow up with MSCT unless it was indicated during the follow up with routine echocardiography. Till now we had only one patient who had a pressure gradient across the area of repair of 35 mmHg and another 2 patients with gradient of 25 mmHg while the remaining 9 patients has a gradient 15 mmHg or less, so there was no need for further investigations or interventional procedures. However, we recommend follow up for a longer time to allow for evaluation of the recurrence of coarctation or the progression of other associated pathologies.

The data about surgical repair of coarctation in syndromic patients in the literature is scarce;however, our results are comparable with others who performed coarctation repair including syndromic and non syndromic patients. Kaushal et al[13]studied 201 patients who underwent extended end to end anastomosis over a period of 16 years. They had a 2% early mortality among their patients. Also they had Reinterventions in 4.0% of their patients including three balloon angioplasties and five reoperations; 75% of the reinterventions occurred in the first postoperative year.They stated that the presence of aberrant right subclavian artery was the only risk factor for re coarctation a condition which we did not encounter in our study.

Unlike our series, Truong et al [14]reported the development of recoarctation necessitating balloon angioplasty in8% of their patients during a median follow up of 12.3 months. This may be explained by the fact that the median age of the study group in this series was much younger than ours (12 days versus 14 months). Cramer et al [15] stated that patients with Turner syndrome undergoing coarctationrepair may have a more challenging early postoperative course but experience outcomes similar to those of non-Turner syndrome patients. A statement which was confirmed in our series.

Study limitations

The study population, namely syndromic patients who had aortic coarctation and were referred for elective surgical repair had led to the relatively small number of patients, a prospective multicenter study should overcome this limitation and allow for studying possible underlying risk factors associated with mortality and morbidity in this group of patients. Longer period of follow up is also recommended to determine the true incidence of re coarctation and hence the need for re intervention in these patients.

Conclusion

Aortic coarctation in syndromic patients is usually associated with element of arteriopathy, yet the short and midterm results of surgical repair in this group are satisfactory. Nevertheless, these patients need regular follow up to determine the need for further intervention.

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Skeletonized Bilateral Internal Mammary Artery Is A Safe Technique For Total Arterial Coronary Revascularization

Saeed Elassy, MD

Background: **The clearly demonstrated benefits of the internal mammary artery on the clinical and angiographic outcomes encouraged the use of arterial grafts especially bilateral internal mammary artery for revascularization of coronary vessels.**

Objectives: **Reporting the experience with the usage of skeletonized bilateral internal mammary artery and whether there is a difference in the rate of mortality and morbidity especially the rate of postoperative infection and bleeding when compared with skeletonized left internal mammary artery.**

Material and methods: **During the period From January 2004 to July 2013, 576 ischemic heart disease patients have presented to coronary artery bypass surgery by single surgeon at Ain shams university hospitals, Ain Shams Specialised hospital, Nasser institute and Dorra hospital. Isolated CABG was selected and combined procedures were excluded along patients with incomplete data, to leave 451 patients for the study. The patients were assigned into two groups for comparison regarding rates of infection, bleeding, incidence of total arterial revascularization, morbidity and mortality in each group along with all descriptive data. Group I, included 356 patients in which unilateral mammary artery is harvested and Group II, included 93 patients in which bilateral mammary artery were harvested.**

Results: **The patients in group I were younger (mean 52.19 ± 7.28 versus 55.85 ± 8.61, P Value = 0.001), showed higher proportions of smokers (18.3 % versus 9.8%, P Value = 0.05), Diabetics (56.3 % versus 33.3 %, P Value = 0.005) and larger number of diseased vessels (mean 2.92 ± 0.42 versus 2.71 ± 0.62, P Value = 0.02). While Group II patients had more preoperative myocardial infarction (14 % versus 28.4 %, P Value = 0.02). There was Less incidence of using off pump method in Group I (1 % versus 9.6 %, P Value = 0.007). There was significantly longer cross clamp time in group I (51.18 ± 17 minutes versus 41.05 ± 14.73 minutes, P Value = 0.0001) than in group II. The number of the grafts per patient ranged from 1 to 5 and was significantly higher in group I (mean 3 ± 6.4 versus 2.76 ± 0.89, P Value = 0.004). There was more incidence of radial artery usage (83.1 % versus 34.8 %, P Value = 0.0001) and total arterial revascularization (95.7 % versus 14%, P Value = 0.001) in Group I. When Right internal mammary was harvested, it is used more frequently to revascularize the left system than the right system (87.1% versus 12.9%). There was more incidence of postoperative arrhythmias in Group I (11.8% versus 9.9 %, P Value = 0.023). The overall in-hospital mortality was 5.3% (n = 24). Four patients died in group I (4.3%) and 20 in group II (5.6%) with no statistically significant difference between the two groups in mortality. Multivariate analysis failed to isolate the use of bilateral internal mammary artery as independent predictor of either operative morbidity or mortality.**

Conclusions: **bilateral internal mammary utilization as a conduit for arterial revascularization is a safe technique with comparable morbidity and mortality to isolated left internal mammary artery usage.**

Department of cardiothoracic surgery, Ain shams university.

Codex : o3/02/1401

The most common open heart surgery procedure performed till today is the coronary artery bypass grafting (CABG).(1) The internal mammary artery (IMA) to the left anterior descending artery (LAD) is the graft of choice for those procedures due its inherent anatomical characteristics rendering it more resistant to atherosclerosis. (2 Those characteristics increase survival, freedom from major adverse cardiac effects (MACE) and re-interventions compared to a saphenous vein graft (SVG) to the same artery. (3 Studies using angiographic follow up to patients have also proven the superiority of the IMA over SVG as regards long term patency rate. (4)

The clearly demonstrated benefits of the IMA on the clinical and angiographic outcomes, encouraged the use of arterial grafts especially bilateral internal mammary artery (BIMA), for revascularization of coronary vessels. (5) However, despite such evidence, the total arterial revascularization concept has not gained enough popularity worldwide due to the fact that BIMA operation is a more technically challenging and requires more patience, and as immediate patient outcome is more anticipated than long-term prognosis, most surgeons prefer not to use BIMA.

Besides the benefits of skeletonization of the IMA, it emerged as an important adjunct for BIMA use, presenting preferable effects in preservation of collateral blood supply to the sternum leading to decreased rate of postoperative sternal dehiscence, higher conduit length to reach more distant targets and increased flow capacity to multiple vessels. Additionally, skeletonization simplifies construction of Y grafts, as well as enabling easier multiple distal anastomoses with one IMA. (6,7)

We sought of reporting the experience with the usage of skeletonized BIMA and whether there is a difference in the rate of mortality and morbidity especially postoperative infection and bleeding when compared with skeletonized left IMA.

Patients and methods

During the period From January 2004 to July 2013, 576 ischemic heart disease patients have presented to CABG surgery by single surgeon at Ain shams university hospitals, Ain Shams Specialised hospital, Nasser institute and Dorra hospital. Isolated CABG was selected and combined procedures were excluded along patients with incomplete data, to leave 451 patients for the study. The patients were assigned into two groups for comparison regarding rates of infection, bleeding, incidence of total arterial revascularization, morbidity and mortality in each group along with all descriptive data. Group I, included 356 patients in which unilateral mammary artery is harvested and Group II, included 93 patients in which bilateral mammary artery were harvested.

Mammary artery harvesting whether unilateral or bilateral was in skeletonized fashion using low dose electrocautery and ring forceps. After dissecting the reflection of the mediastinal pleura from the endothoracic fascia, the mammary artery is visualized. The fascia was incised just medially to the mammary artery for the whole length of the vessel, and it was pulled down on the pleura. A blunt dissection of the artery from the chest wall was performed by means of the tip of the cautery. The branches were controlled proximally using small-sized vascular clips applied just after the origin of the branches and distally with electrocautery. After heparinization, the IMA was clipped distally and the conduit was tested for flow visually and injected with 10 mL of a papaverine solution (1 mg/mL), clipped and allowed to dilate.

When a composite Y graft was constructed, the proximal anastomosis of the free arterial graft to the IMA was performed before starting cardiopulmonary bypass using 8/0 polyprolene sutures. In cases where multiple anastomoses with the same graft were performed, the first anastomosis was performed in side to side fashion and the last one was performed in an end to end fashion.

Operations were done using standard normothermic cardiopulmonary bypass techniques, with blood enriched cold crystalloid cardioplegia introduced through antegrade route. Standard off pump techniques using a stabilizer and occlusion sutures is used for anterior coronary vessels. The patients in whom RIMA was harvested the sternum was electively closed using bilateral Bonechek method in all patients.

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 unpaired Student's tests. Variables that were statistically significant in univariate analysis were introduced in a logistic regression model for calculation of independent predictors of mortality and postoperative morbidity. All tests were bilateral and a P value of 0.05 was the limit of statistical significance. Statistical analysis was performed by IBM SPSS statistical software package for Mac, version 21.

RESULTS

The patients in group I tend to be younger (mean 52.19 ± 7.28 versus 55.85 ± 8.61, P Value = 0.001), showed higher proportions of smokers (18.3 % versus 9.8%, P Value = 0.05), Diabetes (56.3 % versus 33.3 %, P Value = 0.005) and more diseased vessels (mean 2.92 ± 0.42 versus 2.71 ± 0.62, P Value = 0.02). The patients in Group II had more preoperative myocardial infarction (14 % versus 28.4 %, P Value = 0.02). Otherwise, there was no statistically significant difference between both groups in the preoperative data. Table (1) & (2) show the demographic distribution and preoperative data in both groups.

	Group I (93)		Group II (356)		P value*
	No.	%	No.	%	
Male sex	*84*	*90.3*	*299*	*84*	*>0.05*
Smoking	*17*	*18.3*	*35*	*9.8*	*0.05*
Hypertension	*61*	*73.5*	*220*	*61.8*	*>0.05*
Diabetics	*40*	*56.3*	*28*	*33.3*	*0.005*
Oral therapy	*22*	*23.7*	*137*	*38.5*	
Insulin therapy	*21*	*22.6*	*38*	*10.7*	
Diet control	*1*	*1.1*	*4*	*1.1*	
Ejection Fraction					*>0.05*
Good	*77*	*82.8*	*290*	*81.5*	
Fair	*15*	*16.1*	*63*	*17.7*	
poor	*1*	*1.0*	*3*	*0.8*	
Hypercholesterolemia	*31*	*33.3*	*150*	*42.1*	*>0.05*
Cerebrovascular accident	*7*	*7.5*	*0*	*0*	*>0.05*
COPD	*3*	*3.2*	*11*	*3.1*	*>0.05*
Unstable/recent Angina	*12*	*12.9*	*61*	*17.1*	*>0.05*
Previous Q wave infarction	*13*	*14*	*101*	*28.4*	*0.02*
Atrial fibrillation	*2*	*2.2*	*0*	*0*	*>0.05*
Congestive heart Failure	*3*	*3.2*	*5*	*1.4*	*>0.05*
Previous PTCA /stenting	*19*	*20.4*	*76*	*21.3*	*>0.05*
Previous surgical intervention	*0*	*0*	*3*	*0.8*	*>0.05*
Peripheral arterial disease	*3*	*3.2*	*3*	*0.8*	*>0.05*
Renal impairment	*1*	*1*	*12*	*3.4*	*>0.05*
S. Creatinine > 2 mg/dl	*1*	*1*	*7*	*2.0*	
On dialysis	*0*	*0*	*5*	*1.4*	
Extent of disease					
Single vessel	*-*	*-*	*17*	*4.8*	*-*
Two vessels	*12*	*12.9*	*91*	*25.6*	*>0.05*
Three or more vessels	*76*	*81.7*	*234*	*65.7*	*>0.05*
Left Main	*5*	*5.4*	*14*	*3.9*	*>0.05*
Emergency CABG	*7*	*7.5*	*25*	*7*	*>0.05*

Table (1) Showing the distribution of preoperative variables in both groups. Values are presented as number (%). (COPD) Chronic obstructive pulmonary disease. (PTCA) Percutaneous transcatheter angioplasty. (CABG) Coronary artery bypass graft.

	GROUP	Mean	Std. Deviation	P-value
Age at Surgery (years)	Group I	52.19	7.28	0.0001
	Group II	55.85	8.61	
Hemoglobin on admission (gm/dL)	Group I	13.19	1.18	0.2
	Group II	13.00	1.28	
Creatinine on admission (mg/dL)	Group I	1.01	0.19	0.2
	Group II	1.20	1.19	
Bilirubin on admission (mg/dL)	Group I	0.67	0.28	0.4
	Group II	0.67	0.28	
Height (cm)	Group I	171.02	5.89	0.1
	Group II	169.57	8.82	
Weight (kg)	Group I	85.53	11.53	0.4
	Group II	84.23	13.56	
NYHA class	Group I	2.09	0.41	0.2
	Group II	2.01	0.62	
Diseased vessels	Group I	2.92	0.42	*0.02*
	Group II	2.71	0.62	

Table (2) Showing the distribution of preoperative variables in both groups. Values are presented as Mean ± Standard deviation.

There was Less incidence of using off pump method in Group I (1 % versus 9.6 %, P Value = 0.007). There was significantly longer cross clamp time in group I (51.18 ± 17 minutes versus 41.05 ± 14.73 minutes, P Value = 0.0001) than in group II. The number of the grafts per patient ranged from 1 to 5 and was significantly higher in group I (mean 3 ± 6.4 versus 2.76 ± 0.89, P Value = 0.004). There was more incidence of radial artery usage (83.1 % versus 34.8 %, P Value = 0.0001) and total arterial revascularization (95.7 % versus 14 %, P Value = 0.001) in Group I. When right IMA was harvested (group I), it is used more frequently to revascularize the left system than the right system (87.1 % versus 12.9 %). There was more incidence of postoperative arrhythmias in Group I (11.8 % versus 9.9 %, P Value = 0.023). There was no other difference in the postoperative data between both groups. (Table 3)

The overall in-hospital mortality was 5.3% (n = 24). Four patients died in group I (4.3%) and 20 in group II (5.6%) with no statistically significant difference between the two groups in mortality. Causes of mortality are demonstrated in table 4.The use of BIMA was not isolated as a predictor of operative morbidity or mortality on either univariate or multivariate analysis. Right IMA usage to the right system was a predictor of morbidity on univariate analysis (P Value = 0.001), however after multivariable adjustment, it was no longer significant.

	Group I (93) Mean ± SD	Group II (356) Mean ± SD	P value*
Mean number of grafts	3 ± 6.4	2.76 ± 0.89	0.004
Mean CPB time (minutes)	83.91 ± 24	80.91 ± 27.57	0.3
Aortic clamp time (minutes)	51.18 ± 17.61	41.05 ± 14.73	0.0001
Stay on ICU (Hours)	47.88 ± 49.32	44.8 ± 53.29	0.6
Duration of ventilation (Hours)	10.99 ± 8.0	15.44 ± 31.46	0.2
Blood units used	1.52 ± 1.52	1.77 ± 2.47	0.3
Total Hospital Stay (days)	13.44 ± 13.86	11.13 ± 16.83	0.2

Table (3) Showing the distribution of operative and postoperative variables in both groups. Values are presented as Mean ± Standard deviation. (CPB) Cardiopulmonary bypass. (ICU) Intensive care unit.

	Group I (93)		Group II (356)		P value
	No.	%	No.	%	
OPCAB	1	1	34	9.6	0.007
Radial artery usage	*69*	*83.1*	*124*	*34.8*	*0.0001*
Total arterial revascularization	*89*	*95.7*	*50*	*14*	*0.001*
RIMA to left system	*81*	*87.1*	-	-	-
RIMA to Right system	*12*	*12.9*	-	-	
GIT Bleeding	*1*	*1*	*3*	*0.8*	*>0.05*
Arrhythmia	*11*	*11.8*	*32*	*9.9*	*0.023*
SVT	*4*	*4.3*	*26*	*7.3*	
VT/VF	*6*	*6.4*	*5*	*1.4*	
Herat block	*1*	*1*	*1*	*0.2*	
Pulmonary complications	*4*	*4.3*	*7*	*2*	*>0.05*
Pleural effusion	*3*	*3.2*	*4*	*1.1*	
Pneumothorax	*1*	*1*	*3*	*0.8*	
Renal impairment	*7*	*7.5*	*37*	*10.4*	*>0.05*
Without dialysis	*4*	*4.3*	*26*	*7.3*	
Required dialysis	*3*	*3.2*	*11*	*3*	
Neurological deficit	*3*	*3.2*	*13*	*3.7*	*>0.05*
Temporary	*2*	*2.1*	*10*	*2.8*	
Permanent	*1*	*1*	*3*	*0.8*	
Infection	*7*	*7.5*	*22*	*6.2*	*>0.05*
Superficial wound infection	*3*	*3.2*	*7*	*2*	
Deep wound infection	*1*	*1*	*7*	*2*	
Mediastinitis	*2*	*2.1*	*5*	*1.4*	
leg wound infection	*1*	*1*	*3*	*0.8*	
Reoperation	*5*	*5.4*	*27*	*7.6*	*>0.05*
Bleeding/Tamponade	*4*	*4.3*	*22*	*6.2*	
Cardiac arrest	*1*	*1*	*5*	*1.4*	
Inotropic support	*21*	*22.6*	*72*	*20.2*	*>0.05*
IABP	*1*	*1*	*17*	*4.8*	*>0.05*
ICU readmission	*7*	*7.5*	*16*	*4.5*	*>0.05*
Mortality	*4*	*4.3*	*20*	*5.6*	*>0.05*
Primary Cause of mortality					
Cardiac	*2*	*2.1*	*8*	*2.2*	*>0.05*
Multiorgan failure	*0*	*0*	*6*	*1.7*	
Neurological deficit	*0*	*0*	*5*	*1.4*	
Septicemia	*2*	*2.1*	*1*	*0.2*	

Table (4) Showing the distribution of operative and postoperative variables in both groups. Values are presented as number (%). (GIT) Gastro intestinal tract, (IABP) Intra-aortic balloon pump, (ICU) Intensive care unit, (OPCAB) Off pump coronary bypass, (RIMA) Right internal mammary artery, (SVT) supra ventricular tachycardia, (VT/VF) Ventricular tachycardia/ ventricular fibrillation.

Comment

The superiority of IMAs over SVGs can be attributed to its striking resistance to the development of atherosclerosis. Structurally its endothelial layer shows fewer fenestrations, greater anti-thrombotic molecules such as heparin sulfate and tissue plasminogen activator, and higher endothelial nitric oxide production, which are some of the unique ways that make the IMA impervious to the transfer of lipoproteins, which are responsible for the development of atherosclerosis. (2) Also it has thinner media with thinner muscular component explaining the less tendency for spasm. (8)

The long term advantages of BIMA usage over LIMA and SVG usage for CABG surgery had been proven through many observational and angiographic studies. Despite proven long term advantages of BIMA usage only 5-10% of patients actually receive bilateral IMA grafts. The most important reasons stated by surgeons for not routinely using both IMA grafts are a potential increase in perioperative mortality, morbidity, increased duration of operation and an increased risk of sternal wound problems especially with increased prevalence of diabetic patients presented for CABG (9). In the recently published largest meta-analysis of 27 studies involving over 79,000 patients long term survival benefits of BIMA and decreasing rates of short-term morbidity has been demonstrated. Moreover, the only randomized controlled study comparing usage of single IMA and BIMA (Arterial Revascularization Trial) (ART), first year results has denied any incidence of increased mortality or morbidity with BIMA. (1,10).

The Incidence of deep sternal wound infection has been reported to occur between 0.3% and 14% of BIMA procedures and is thought to be a result of the decreased sternal perfusion (1,11,12,13). Skeletonized harvesting has reduced the incidence of deep sternal wound infection when compared to BIMA operations performed with pedicled harvest (14). Therefore, although the complexity of the operation increases with a skeletonized versus a pedicled harvest, the benefits of a BIMA operation can be realized safely. In this series there were more incidences of diabetic patients in BIMA group; however there was no difference in the rate of deep sternal wound infection between the two groups. In addition, BIMA usage was not isolated as a predictor of sternal wound infection. Whether our strategy of sternal closure with bilateral Bonecheck technique in all BIMA patients is an efficient technique for lowering the rate of sternal dehiscence or not, needs further study, nevertheless, it seems logical prophylactic measure without any negative impact on the patient.

The patients in BIMA group tend to be younger as the desirable clinical outcome of long term patency rates for arterial grafts is specially emphasized in young patients; making selection of younger patients for BIMA harvesting is reasonable strategy in our series. BIMA group included more patients with three or more vessels that were translated to more grafts per patients and longer cross clamp time. This finding is explained by the fact that right internal mammary harvesting is essential for total arterial revascularization of three or more diseased vessels and may not be required in single or two diseased vessels as in group II.

Off pump technique was used less often in BIMA group as we tend to reserve this technique for simple one or two anterior vessel disease, which had fewer incidences in BIMA group. This strategy is justified by the fact that several prospective randomized controlled trials and many meta-analysis has failed to prove any significant advantage of off pump approach over traditional one. Moreover, long term follow up have suggested inferior long term clinical outcome related to less revascularization and lower graft patency rates.(15,16)

In this series when RIMA was used, a composite Y graft was constructed because it provides greater length of RIMA for more extensive arterial revascularization.(3) Also it avoids the problems of IMA proximal anastomoses to the aorta, reduces aortic manipulations and hence, the risk of stroke and this technique is particularly useful in off pump surgery.(17) These advantages of free RIMA grafting does not affect patency rate, Tatoulis et al. reported on 5,766 patients who underwent BIMA grafting using almost equal numbers of free and in situ RIMAs. The 991 angiograms done to symptomatic patients showed similar patency except for grafts to the right coronary artery where the free RIMA was superior (18). A randomized trial with mid-term angiographic follow up comparing BIMAs in Y composite or in situ configurations showed no difference in clinical outcomes or graft patency but the composite configuration achieved more arterial anastomoses (19). Calafiore et al. reported similar findings with excellent results in over 1,800 BIMA graft patients (20). Fukui et al. found no difference in clinical outcomes or graft patency except when the in situ RIMA was used as the inflow for other grafts, usually with an end to end anastomosis (21).

The right IMA was used predominantly to revascularise the left system (87 % of patients) and the right IMA was utilized to revascularise the right system in this series before the accumulation of evidence that graft patency rates of RIMA to the right coronary system are lower than left system and the impact of competitive flow appears greater. Additionally RIMA is believed to have lower patency rate than other conduits when used to revascularise the right system. (22,23)

In patients, whose BIMA was harvested, there were more Radial artery usage and associated complete arterial revascularization. Current literature suggests that there is no difference in patency rates between radial artery grafts and SVG over the first year. However, there are higher mid- and long-term patency rates for the RA in comparison to SVG that were translated to better clinical outcome. (24,25) The severity of stenosis in the native coronary artery is critical to both the short- and long-term patency of the RA, because of the potentially negative effects of competitive flow when the stenosis is below 70-80%.(26,27)

Although recent trials and registries proved strong survival advantage in favor of CABG for most patients with multivessel disease, it highlighted the relatively low use of multiple arterial grafts. The long term outcome of CABG surgery is the current competitive advantage over coronary stents and every effort should be exercised to maintain this advantage in the face of the technological evolution of coronary stents. Total arterial revascularization including utilization of the best known coronary graft, the IMAs should be more popularized.

Conclusion

BIMA utilization as a conduit for arterial revascularization is a safe technique with comparable morbidity and mortality to isolated left IMA usage.

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The influence of Levosimendan on Early Postoperative Outcome of Patients With Poor Left Ventricular Function Undergoing Coronary Artery Bypass Grafting Using Single Clamp Technique

Hamdy Singab, MD*;[1]

Mohamed El Shafei, MD; [2]

Mai Abdel-Fattah Madkour, MD [3]

Background: **Single clamp on pump coronary artery bypass grafting (CABG) technique is increasingly practiced than traditionally multiple cross clamp technique to prevent the risk of aortic manipulation during multiple clamp technique remarkably in patients with poor left ventricular function (LV). (1) Levosimendan, a calcium-sensitizing agent, is a newer inotropic agent that increases cardiac output, reduces afterload, and decreases cardiac filling pressures.(2&3)**

Aim of the work of our study is to emphasize that the use of Levosimendan in patients with poor Left Ventricular function undergoing coronary artery bypass grafting using single clamp technique would be associated with better hemodynamics and cardiac function.

Patient and methods: **A total of 60 patients of both sexes with ischemic heart disease with poor cardiac function undergoing elective cardiopulmonary bypass grafting were non randomly allocated for the study as 2 equal groups each of 30 patients Group (L): Levosemindan group and Group (A): Adrenaline-Tridil group.However In both groups, infusion of Levosimendan and Adrenaline resulted in significant increase in both the systolic blood pressure and the diastolic blood pressure .The systolic blood pressure increased significantly (p = 0.001) in Levosimendan group and the diastolic blood pressure increased significantly (p=0.003) in Levosimendan group after bypass compared to the same time in Adrenaline group.In both groups, infusion of Levosimendan and Adrenaline resulted in significant increase in both stroke volume and cardiac output starting after CPB and continuing until the end of the study.**

Conculusion: **our results indicated that levosimendan infusion is the best choice for patients with poor Left Ventricular function undergoing coronary artery bypass grafting using single clamp technique as it associated with better early postoperative haemodynamics,cardiac performance and clinical outcome in terms of rapid recovery of postoperative myocardial stunning period of ICU stay and need for further inotropic agent better than use of the classical inotropic agents period.**

KEY WORD: **Levosimendan, ICU stay, Postoperative Haemodynamics, CABG with Poor LV Function**

1 Lecturer of Cardiac Surgery, Ain Shams university.

2 Assistant Professor of Anaesthesia, Ain Shams university.

3 Lecturer of Anaesthesiology, Cairo University

Codex : o3/03/1401

Single clamp On pump coronary artery bypass grafting (CABG) technique is increasingly practiced than traditionally multiple cross clamp technique in an effort to prevent the risk of aortic manipulation as well as it is remarkably used in patients with poor left ventricular function (LV) than off pump technique to avoid the harmful effect of haemodynamic compromise during cardiac positioning, as the atrial displacement below the corresponding ventricle during the exposure of the posterior or the lateral wall will result in remarkable increasing of the atrial pressure and decrease of the cardiac output (COP).(1)

However catecholamine improve the myocardial performance in terms of contractility and COP through increasing of the free intracellular Ca concentration and cyclic adenosine monophosphate, it increases the myocardial oxygen consumption that increase the risk of development of postoperative arrhythmias and ischemia.(2)

Levosimendan, a calcium-sensitizing agent, is a newer inotropic agent that exerts its effects by binding to troponin C, which increases the sensitivity of contractile proteins to calcium. Levosimendan increases cardiac output, reduces afterload, and decreases cardiac filling pressures.(3)

Standard inotropic agents as Adrenaline acts by binding of catecholamines to β_1-adrenergic receptors on the surface of myocytes activates adenylate cyclase, which generates cAMP from ATP. cAMP activates protein kinase A.

Administration of levosimendan enhances cardiac performance both in patients with low-output heart failure and poor LV function, a 24-h administration of levosimendan (0.1–0.2μg. kg^{-1}. Min^{-1}) increased cardiac output by 1.09 l/min and decreased pulmonary capillary wedge pressure (PCWP) by 7 mmHg.(4)

Although Ca^{2+} sensitizers carry a potential risk of worsening diastolic function, levosimendan decreased the isovolumic relaxation time which indicating improvement rather than deterioration of diastolic function. (6)

Because levosimendan decreased PCWP more effectively than dobutamine, it may be of value in patients with reversibly increased pulmonary pressures or right ventricular dysfunction which may occur in ischemic heart patient with severly impaired left ventricular function. Levosimendan has favourable effects on coronary blood flow by overriding the normal auto-regulatory mechanisms of coronary circulation and thus dilates coronary vessels.(5)

Levosimendan improves the coronary autoregulatory mechanisms and dilate the coronary vessel so it increase the coronary blood flow without increase in the myocardial oxygen demand.(7)

Patients and methods

After the approval of the ethical committee in our institute(Ain shams university hospital and dar el foaud hospital) and obtaining an informed consent from the patients, a total of 60 patients of both sexes with ischemic heart disease with poor cardiac function <40% measured by Transthoracic echocardiography undergoing elective cardiopulmonary bypass grafting were randomly allocated for the study.

Patients were excluded from the study if they had pre-existing renal failure, thrombocytopenia or history of pre-operative use of inotropes or cardiopulmonary rescussitation.

Patients were non randomly allocated into 2 equal groups each of 30 patients as follows :

Group (L): Levosimendan group

Group (A): Adrenaline-Tridil group.

All routine investigations were done including CBC, Coagulation profile, liver function tests, kidney function tests, blood grouping, Chest X-ray, recent echocardiography and cardiac angiography.

Preoperative medications

All patients were given Midazolam 0.05mg/Kg prior to cannulation. In the preparation room all patients were monitored using 5 lead ECG electrodes placed on the back, non invasive arterial blood pressure and pulse oximetry. Oxygen was administered via a nasal cannula using 3L/min.

The radial artery of the non- dependant hand was cannulated using a 20 G arterial cannula under local anaesthetic (Lidocaine 2%) and a baseline arterial blood gases (ABG) sample, Random blood sugar (RBS) and activated clotting time (ACT) were done.

The right internal jugular vein was cannulated under local anesthesia using the anterior approach technique with a triple lumen central venous catheter. Patients were then transferred to the operating room.

Induction

Anaesthesia was induced using Thiopental sodium 2-3mg/kg, Fentanyl 3-5 mcg/kg. Following induction of anaesthesia end- tidal CO2 cable was attached and oropharyngeal temperature probe was inserted. Tracheal intubation was facilitated using Succinyl Choline 1mg/kg followed by pancuronium 0.1mg/kg and anaesthesia was maintained by Sevofluorane 1-2% in O2/Air mixture and Fentanyl infusion 1-2 mcg/Kg/h.

Lungs were mechanically ventilated, where tidal volume and respiratory rates were adjusted to maintain end tidal CO2 35-45 mmHg and FiO2 maitained at 0.5.

A 7.5-MHz multiplane TEE probe and system (Vivid 3, GE Medical Systems, Milwaukee, Wis) will be used for all echocardiographic measurements. All patients underwent a complete transesophageal echocardiography examination (TEE) according to the American Society of Echocardiography/ Society of Cardiovascular Anesthesiologists (ASE/SCA) guidelines.

During re-warming and after release of aortic cross clamp, the selected patient to receive either Adrenaline (A group) a dose of 0.01-0.2 mg/Kg/min or Levosemindan (L group) loading dose 6–24µg/kg of bolus administration over 10

min, followed by a continous infusion of 0.05–0.2μg/kg/min .Heparin is reversed using protamine in a dose 1-1.5 times the heparin dose, the reversal of heparin is checked by ACT.

Preioperative Demographic data including age, gender, height, weight, BSA, hypertension,hyperlipedemia,diabetes, previous MI, use of β-blockers, ischemic time and bypass time were recorded for each patient. In addition to the standard anesthetic record, an independent observer recorded MAP, HR,PASP, COP and FS.

Transoesophageal echocardiography and hemodynamic data were collected at 4 intervals :

(1) Pre-CPB baseline before sternotomy (T0)

(2) 6 hours after completion of surgery (T1)

(3) 12 hours after completion of surgery (T2)

(4) 24 hours after surgery. (T3)

2. Cardiac output ml/min. The cardiac output was calculated with the aid of transesophageal echo-Doppler as follow

1. CO = Left ventricle stroke volume X heart rate

2. Stroke Volume = Stroke Distance (VTI) X cross sectional area (CSA)

3. VTI was calculated with continuous wave Doppler (CW) beam directed through aortic valve orifice from TG long axis or deep transgastric long axis view.

4. The CSA of the aortic valve was estimated by planimetry of equilateral triangle shaped orifice observed in mid-systole.

5. RV and PA Systolic Pressure. For quantitative assessment of RVSP, the peak tricuspid regurgitant (TR) jet velocity, obtained on continuous wave Doppler, was used to calculate peak pressure gradient between the RV and RA during systole using the modified Bernoulli's equation (1). RVSP was then calculated by adding estimated RAP to the measured gradient. PA systolic pressure (PASP) was deduced from this, because it would be equal to RVSP in the absence of pulmonic stenosis (PS).

6. Diastolic function of the RV was measured by the E/A ratio.

1. Left ventricular systolic function

2. Fractional shortening (FS) will be obtained in trans-gastric mid papillary short axis view. FS is obtained by measuring LV end-diastolic dimension (LVEDD) and LV end-systolic dimension (LVESD) on M-mode

F S(%) = ([LVEDD - LVESD] / LVED

Operative technique

Median sternotomy and pericardiotomy

All Patients were operated upon under cardiopulmonary bypass perfusion {CPB }after standard aortic and atrial double stages venous cannulation. moderate hypothermia (28 - 30 °c), The aorta was totally cross clamped and myocardial preservation was achieved via an antegrade cold enriched blood cardioplegia. A single clamp technique where both the distal anastmosis (graft to coronary) and the proximal anastomosis (graft to aorta) were done with only single aortic clamp and there are no need for the standard multiple partial aortic clamp. After finishing of each proximal anastomosis the aortic venting was stopped till we started to do the next distal anastomosis.

All patients had LIMA to LAD anastomosis.

After de-airing rewarming and aoric declamping we started mechanical ventilation and cardiac inotropic support was started as follows:

Group A: Adrenaline a dose of 0.01-0.2 mg/Kg/min

or

Group L: Levosimendan (L group) loading dose 6–24μg/kg of bolus administration over 10 min, followed by a continous infusion of 0.05–0.2μg/kg/min.

Heparin is reversed using protamine in a dose 1-1.5 times the heparin dose, the reversal of heparin is checked by ACT.

After completion of surgery, the patient was transferred to ICU for elective ventilation .

Postoperative variables including ICU stay and duration of ventilation were also measured, as well as postoperative Troponin, CKMB were measured at 6 hrs, 12hrs and 24 hrs after the end of surgery . Serial blood gases were done to measure serum lactate levels in ICU. Postoperative delayed sternal closure, rexploration for bleeding, need for increased intropes, IABP and total hospital stay were measured.

Statistical analysis was done using SPSS Statistics version 13. Data was presented as mean (±SD) or numbers (%).The distribution of categorical variables among patient groups analyzed by Chi-Square test or Fisher's exact test,were applied as indicated.. Means were compared with the unpaired or paired Student's test, as indicated. P values of 0.05 or less were considered as being statistically significant.

A priori power analysis is conducted prior to the research study, and is typically used in estimating sufficient sample sizes to achieve adequate power. The power is in general a function of the possible distributions, often determined by a parameter, under the alternative hypothesis. As the power increases, the chances of a Type II error occurring decrease. Based on power analysis a minimum of 15 patients per group should be recruited

to detect the difference between the two groups. All continuous data were collected, analyzed using the Statistical Package for Social Sciences "SPSS" version 17. T-test, Chi square, Mann-Whitney and Fisher's exact tests were used when applicable. P Value 0.05 < was considered statistically significant.

Results

However the use of noradrenaline in L group was significantly higher than A group intraoperatively,The other demographic and intra-operative data were comparable between without any significant differences between both groups

There was no significant differences in the baseline hemodynamic values among groups.

However In both groups, infusion of Levosimendan and Adrenaline resulted in non significant increase in both systolic blood pressure and the diastolic blood pressure in both groups in the early postoperative hours, there was a significant increase in both The systolic blood pressure and the diastolic blood pressure in Levosimendan group at 24 hour after bypass compared to the Adrenaline group at the same time (p = 0.001& p=0.003 respectively).

In both groups, infusion of Levosimendan and Adrenaline resulted in a non significant increase in both stroke volume and cardiac output in the early hours postoperatively there was a significant increase in the stroke volume and the cardiac output starting after 12 hour of cessation of the bypass and continuing until the end of the study (p=0.001&p=0.001 respectively)

In both groups, the VTI started to increase significantly post – bypass (relatively to the baseline) and reach its maximum at the end of our study(24hours post-bypass), this occurred without any significant differences between the both groups throughout the study .

The PASP decreased significantly post-bypass in both groups and reaching its lowest value at 24 hours post-bypass, with a non significant difference among both groups.

In both both groups, the fraction shortening increased significantly post-bypass and reaching its maximum at (24 hours post-bypass) the end of study with no significant difference between the two groups .

However In both groups $ScvO_2$ increased progressively starting from post-bypass till the end of our study,it was maintained throughout the procedure with a non significant difference between the two groups except at the end of the study it shows a significant difference between the two groups (p=0.005).

There were no significant differences in the perioperative troponin, CKMB and serum lactate levels between the two groups.

Postoperative data were comparable between both groups, without any significant differences between the 2 groups, however, IABP and needs of more inotropes increased significantly (p=0.005) and (p =001) respectively in Adrenaline group after bypass compared to the same time in Adrenaline group. The reopening and hospital stay shows no significant difference between the 2 groups throughout the study.

Variables	Group A 30 patients	Group L 30 patients	P value
Age	55±6.3	53±8.1	0.28
Gender Male: Female	24/6	20/10	0.12
Height in meter	160±15.8	156±17.2	0.37
Weight in Kg	85±10.9	86±10.2	0.161
BSA	1.9±0.31	1.82±0.26	0.98
Diabetes	22	24	0.407
Hypertension	22	24	0.151
Hyperlipedemia	24	16	0.121
Previous MI	8	6	0.67
Unstable angina	6	7	0.64
EF	36±3.4	38±2.3	0.65
LVEDD	6.5±o.9	6.3±0.804	0.142
LVESD	5.45±0.902	5.4±0.88	0.1
Single vessel	0	0	0.6
Two vessels	10	12	0.705
Three vessels	20	18	0.704
Use of B blockers	25	26	1
Use of ACI inhibitors	12	14	0.72

Table (1) Preoperative demographic criteria

Variables	Group A (30 patients)	Group L (30 patients)	P value
Aortic cross clamp Time (in minutes)	55 ± 21.27	58.3 ± 12.24	0.2
Total Bypass time (in min)	80.12 ± 21.51	76 ± 12.65	0.06
Adrenaline (% of patient)	100%	0	
Nor adrenaline (% 0f patient)	6.7%	60%	0.02 †
Levosemindan	0	100%	
LADgrafts	100%	100%	
D1 grafts	80%	60%	0.08
OM grafts	63%	72%	0.34
RCA grafts	14%	12%	0.71
PDA grafts	64%	66%	1.02
Ventilation time (in hour)	10.5±1.5	10±1.9	0.17
ICU stay (in days)	4.5±0.7	4.3±0.8	0.06

Table (2) Operative variables

variables	Group	T0 (Baseline)	T1 (6 h)	T2 (12h)	T3 (24h)
SBP(mmHg)	A	105±7.8	95±5.5	97±6.6	105.5±9.3 †‡
	L	108±6.5	97±4.5	98.5±5	120±8*†
P value		0.608	0.167	0.94	0.001
DBP(mmHg)	A	52± 5.1	55±2.6	40.5±4.7	43.5± 4.2
	L	54± 6.3	56±3.5	45.5±3.2	52±6.1*
P value		0.52	0.55	0.11	0.003
MAP(mmHg)	A	75±8.03	80±5	79±9.3	84±6.3
	L	80±8.5	75±6.8	80±8.3	85±5.9
P value		0.12	0.22	0.94	0.24
HR	A	67±12.8	98±15	101±17	95±12.4
	L	65±12.9	92±19	95±16	98±12
Pvalue		0.729	0.42	0.288	0.17
VTI (cm/sec)	A	7.53±5.7	8.35± 5.7	10.6±7.9 †	12.1±9.8 †‡
	L	7.32±5.5	7.35±1.08	11.7 ±5.5†	10.95±7.3 †‡
P value		0.212	0.67	0.142	0.05
SV (ml/min)	A	11.6±2.3	10.7±4.9	12.8± 7.5 †	14.5±9.8 †‡
	L	10.1±1.7	10.9±2.8	17.6 ±11.78 *†	22.7± 9.2 *†‡
P value		0.42	0.141	0.001	0.001
COP (litres)	A	4.96±0.76	5.13±0.s64	5.32±0.96 †	5.89±0.25 †‡
	L	5.13±0.63	5.22±0.42	6.66±0.75 *†	6.84±0.55*†
P value		0.5	0.46	0.0001	0.001
PASP (mmHg)	A	55±13.03	52.5±4.5	45± 2.7 †	40±6.2 †‡
	L	60±10.6	62±4.9	50±4.8 †	38± 7.5 †‡
P value		0.212	0.21	0.78	0.121
$ScvO_2$ %	A	60±2.7	58±3.7	68.5±4.7 †	75.5±8.2†‡
	L	63±3.2	61.5±3.6	66±5.7 †	72.5±8 †‡*
P value		0.67	0.41	0.05	0.005
FS	A	18±1.86	18.7±2.3	25±3.2 †	31.5±2.6†
	L	17.5±2.6	22±2.5	23.55±2.3†	33.8±4.9†‡
P value		0.221	0.54	0.6	0.12

**statistically significance (p<0.05) comparing the two groups at the same time ‡ statistically significance (p<0.05) comparing T_2 to T_3 in same group + statistically significance (p<0.05) comparing T_1 to T_2 in same group*

Table (3) Postoperative & Hemodynamic variables

variables	Group	T1 6 h	T2 12h	P value
SBP (mmHg)	A	95±5.5	97±6.6	NS
	L	97±4.5	98.5±5	
DBP (mmHg)	A	55±2.6	40.5±4.7	NS
	L	56±3.5	45.5±3.2	NS
MAP (mmHg)	A	80±5	79±9.3	NS
	L	75±6.8	80±8.3	NS
HR	A	98±15	101±17	NS
	L	92±19	95±16	NS
VTI (cm/sec)	A	8.35± 5.7	10.6±7.9 †	0.001
	L	7.35±1.08	11.7 ±5.5†	0.004
SV (ml/min)	A	10.7±4.9	12.8± 7.5 †	0.001
	L	10.9±2.8	17.6±11.78 †	0.005
COP (litres)	A	5.13±0.s64	5.32±0.96 †	0..001
	L	5.22±0.42	6.66±0.75 †	0.002
PASP (mmHg)	A	52.5±4.5	45± 2.7 †	0.001
	L	62±4.9	50±4.8 †	0.001
$ScvO_2$ %	A	58±3.7	68.5±4.7 †	0.003
	L	61.5±3.6	66±5.7 †	0.001
FS	A	18.7±2.3	25±3.2 †	0.001
	L	22±2.5	23.55±2.3†	0.001

Table (3 a) **Comparing T_1 to T_2 in same group**

variables	Group	T2 (12h)	T3 (24h)	P value
SBP (mmHg)	A	97±6.6	105.5±9.3 †‡	0.001
	L	98.5±5	120±8*†	0.024
DBP (mmHg)	A	40.5±4.7	43.5± 4.2	NS
	L	45.5±3.2	52±6.1	NS
MAP (mmHg)	A	79±9.3	84±6.3	NS
	L	80±8.3	85±5.9	NS
HR	A	101±17	95±12.4	NS
	L	95±16	98±12	NS
VTI (cm/sec)	A	10.6±7.9	12.1±9.8 ‡	0.001
	L	11.7 ±5.5	10.95±7.3 ‡	0.003
SV (ml/min)	A	12.8± 7.5	14.5±9.8 ‡	0.001
	L	17.6 ±11.78	22.7± 9.2 ‡	0.001
COP (litres)	A	5.32±0.96	5.89±0.25 ‡	0..001
	L	6.66±0.75	6.84±0.55 ‡	0.002
PASP (mmHg)	A	45± 2.7	40±6.2 ‡	0.001
	L	50±4.8	38± 7.5 ‡	0.001
$ScvO_2$ %	A	68.5±4.7	75.5±8.2 ‡	0.001
	L	66±5.7	72.5±8 ‡	0.0024
FS	A	25±3.2	31.5±2.6 ‡	0.005
	L	23.55±2.3	33.8±4.9 ‡	0.001

‡ statistically significance ($p<0.05$) comparing T_2 to T_3 in same group

Table (3 b) **Comparing T_2 to T_3 in same group**

variables	Group	T0 (Baseline)	P value
SBP(mmHg)	A	105±7.8	NS
	L	108±6.5	
DBP(mmHg)	A	52± 5.1	NS (0.52)
	L	54± 6.3	
MAP(mmHg)	A	75±8.03	NS(0.12)
	L	80±8.5	
HR	A	67±12.8	NS(0.729)
	L	65±12.9	
VTI (cm/sec)	A	7.53±5.7	NS (0.212)
	L	7.32±5.5	
SV (ml/min)	A	11.6±2.3	NS (0.42)
	L	10.1±1.7	
COP (litres)	A	4.96±0.76	NS(0.5)
	L	5.13±0.63	
PASP (mmHg)	A	55±13.03	NS(0.212)
	L	60±10.6	
$ScvO_2$ %	A	60±2.7	NS(0.67)
	L	63±3.2	
FS	A	18±1.86	NS(0.221)
	L	17.5±2.6	

Table (3c) Comparing the hemodynamic variables between 2 groups Pre-CPB baseline before sternotomy (T0)

variables	Group	T1 (6 h)	P value
SBP(mmHg)	A	95±5.5	NS(0.167)
	L	97±4.5	
DBP(mmHg)	A	55±2.6	NS (0.55)
	L	56±3.5	
MAP(mmHg)	A	80±5	NS (0.22)
	L	75±6.8	
HR	A	98±15	NS (0.42)
	L	92±19	
VTI (cm/sec)	A	8.35± 5.7	NS(0.67)
	L	7.35±1.08	
SV (ml/min)	A	10.7±4.9	NS (0.141)
	L	10.9±2.8	
COP (litres)	A	5.13±0.s64	NS(0.46)
	L	5.22±0.42	
PASP (mmHg)	A	52.5±4.5	NS(0.21)
	L	62±4.9	
$ScvO_2$ %	A	58±3.7	NS(0.41)
	L	61.5±3.6	
FS	A	18.7±2.3	NS(0.54)
	L	22±2.5	

Table 3d: comparing the hemodynamic variables between 2 groups6 hours after completion of surgery (T1)

variables	Group	T2 (12h)	P value
SBP(mmHg)	A L	97±6.6 98.5±5	NS (0.94)
DBP(mmHg)	A L	40.5±4.7 45.5±3.2	NS (0.11)
MAP(mmHg)	A L	79±9.3 80±8.3	NS (0.94)
HR	A L	101±17 95±16	NS (0.288)
VTI (cm/sec)	A L	10.6±7.9 11.7 ±5.5	NS (0.142)
SV (ml/min)	A L	12.8± 7.5 17.6 ±11.78	0.001
COP (litres)	A L	5.32±0.96 6.66±0.75	0.0001
PASP (mmHg)	A L	45± 2.7 50±4.8	NS (0.78)
$ScvO_2$ %	A L	68.5±4.7 66±5.7	NS (0.05)
FS	A L	25±3.2 23.55±2.3	NS (0.6)

Table 3e: comparing the hemodynamic variables between 2 groups12 hours after completion of surgery (T2)

variables	Group	T3 (24h)	P value
SBP(mmHg)	A L	105.5±9.3 120±8	0.001
DBP(mmHg)	A L	43.5± 4.2 52±6.1	0.003
MAP(mmHg)	A L	84±6.3 85±5.9	NS (0.24)
HR	A L	95±12.4 98±12	NS (0.17)
VTI (cm/sec)	A L	12.1±9.8 10.95±7.3	NS(0.05)
SV (ml/min)	A L	14.5±9.8 22.7± 9.2	0.001
COP (litres)	A L	5.89±0.25 6.84±0.55	0.001
PASP (mmHg)	A L	40±6.2 38± 7.5	NS(0.121)
$ScvO_2$ %	A L	75.5±8.2 72.5±8	0.005
FS	A L	31.5±2.6 33.8±4.9	NS (0.12)

Table 3f: comparing the hemodynamic variables between 2 groups24 hours after surgery. (T3)

(A)

Variables	Group	T1 Baseline	T2 6 h	T3 12h	T4 24h
Troponin (ng/ml)	A L	1±0.60 1.2±0.67	1.3±0.67 1.24±0.56	1.1±0.76 1.26±0.19	0.76±0.15 0.82±0.24
P value		0.7	0.121	0.2	0.2
CK MB	A L	42.2±3.5 41±3.3	47.2±2.8 46±2.1	31.6±4.2 29.8±1.3	21.6±3.2 23.2±1.2
P value		0.121	0.5	0.40	0.12
Serum lactate	A L	2.1±0.45 1.8±0.49	2.5±0.95 2.2±0.57	2.2±1.1 1.8±0.46	2.1±0.75 1.9±0.65
P value		0.11	0.281	0.26	0.42

(B)

Variables	Group A	Group L	P value
IABP	15%	22%	0.005
Needs of inotropes	45%	13%	0.001
Delayed closure of sternotomy	30%	28%	0.67
Reopening	14%	15%	0.7
(Hospital stay(days	5.46±8	5.8±7	0.6

Table (4) Postoperative variables

Discussion

In spite of myocardial preservation during CABG there was a variable degree of postoperative myocardial stunning, which appeared as a state of prolonged post-ischemic myocardial dysfunction that was rescued by myocardial reperfusion (8). however several literatures noted that the early postoperative myocardial dysfunction in the first few hours postoperatively disappeared spontaneously over 24-48 hours, the period of temporary postoperative myocardial stunning need an inotropic agent to improve its function. (9&10)Unlike Several classical inotropic agents used for myocardial support in the early postoperative period included adrenaline and nor adrenaline that act by binding of catecholamines to β_1-adrenergic receptors on the surface of myocytes that activate the adenylate cyclase, which generates cAMP from ATP. cAMP activates protein kinase A., Levosimendan, a calcium-sensitizing agent, is a newer inotropic agent that exerts its effects by binding to troponin C, which increases the sensitivity of contractile proteins to calcium without increasing its intracellular concentration. Levosimendan increases cardiac output without an increase in the myocardial oxygen consumption, reduces

afterload by systemic vasodilatation as a result of activation of k ATP channel associate with decreasing of calcium sensitivity and decreases cardiac filling pressures. (3&12)recent studies demonstrated that Levosimedndan increase the coronary blood flow and reduce the coronary vascular resistance.(13) although Levosimendan has a short half life(1hour), its active metabolite has a long life (70-80 hours). Administration of Levosimendan enhances cardiac performance in patients with low- cardiac output, a 24-h administration of Levosimendan ($0.1– 0.2\mu g. kg^{-1}. Min^{-1}$) increased cardiac output by 1.09 l/min and decreased pulmonary capillary wedge pressure (PCWP) by 7 mmHg.Because Levosimendan decreased PCWP more effectively than dobutamine,it may be of value in patients with reversibly increased pulmonary pressures or right ventricular dysfunction which may occur in ischemic heart patient with severly impaired left ventricular function.(12,13,14)

Levosimendan advantages over the classical inotropes are long drug effect after 24 hour infusion up to 9 days, lack of postoperative arrhythmias, absence of drug induced postoperative myocardial ischemia, promote the recovery of stunned myocardium and decrease the size myocardial infarction of as a result of k (ATP) channel activation in the ventricular and arterial wall. (15)

Most of Levosimendan disadvantages are dose related and include headache, hypotension dizziness and nausea. A profound hypotension after a bolus dose of Levosimendan was noted as the main disadvantage of its using and demanding avoiding of its bolus dose.(16)

In our study we give a loading dose 6–24µg/kg of levosimendan over 10 min, followed by a continous infusion of 0.05–0.2µg/kg/min in levosiemndan group. Noradrenaline infusion to maintain MAP > 70 mmHg was significantly required patient of L group to maintain MAP > 70 mmHg.

Our results are in agreement with the findings reported by recent studies in the same issue that show a significant increase of COP produced by levosimendan as a result of its combined actions of reduced after load and increased cardiac contractility in comparsion of classical inotropic agents.

Our study has several limitations, the cardiac index, systemic vascular index and pulmonary capillary wedge pressure were not measured.

In conclusion, our results indicated that Levosimendan infusion is the best choice for patients with poor Left ventricular function undergoing coronary artery bypass grafting using single clamp technique as it associated with better early postoperative hemodynamics, cardiac performance and clinical outcome in terms of rapid recovery of postoperative myocardial stunning period of ICU stay and need for further inotropic agent better than use of the classical inotropic agents period.

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Impact of the Interaction Between Risk Factors on Outcome of Neonatal Modified Blalock- Taussig shunts

Ashraf A.H. El Midany[1], MD,

Ghada A. Hassan[2], MD;

Assem A. Moharram[3], MD

Objectives: **The modified Blalock-Taussig shunt continues to play an important role in the management of neonates with cyanotic congenital heart disease. The outcome is unpredictable and many risk factors have been identified. The interaction between such factors may play an important role. Herein we tried to study the interaction between some factors and its impact on immediate outcome.**

Methods: **A factorial design was used to study the significant factors that affect the immediate outcome and analyze its interactions. 36 neonates (mean age 28.5 days) who underwent modified Blalock-Taussig shunt, from December 2009 to June 2013 were studied. Mechanical ventilation duration has been chosen to be the primary endpoint as a clinical variable of the immediate outcome.**

Results: **Shunts were constructed using variable graft sizes. Mean preoperative O_2 saturation was 55±9.2% and mean preoperative hemoglobin was 12.3±1.3 gm/dl. Heparin was used in 18 cases. The overall early mortality was 13.8%. No shunt related complications were encountered. Mechanical ventilation duration was 89.5±6.86 hours. Incremental risk factor for prolonged mechanical ventilation response was heparin administration as a single factor. The interaction between the studied factors revealed that if no perioperative heparin given, the graft size significantly affects the mechanical ventilation response. Higher preoperative hemoglobin and O_2 saturation levels tends to prolong mechanical ventilation in bigger shunt size. However, in cases of heparin administration, there is a strong interaction between preoperative O_2 saturation and hemoglobin at both graft sizes. Mechanical ventilation response varied from decreasing at a low hemoglobin level to constant at a high level when graft size 3.5 mm was used and from constant at a low hemoglobin level to increasing at a high level when graft size 4 mm was used.**

Conclusion: **The current study showed that studying single factor at-a-time is a defective strategy because it does not take the interaction between the studied factors into account. However, such interaction is needed to correlate the affecting factors in order to reach the optimum preoperative condition to achieve the best outcome in such high risk patients.**

KEY WORDS: **Congenital Heart Disease, Neonate, MBT Shunt, Outcome.**

1 Department of Cardiovascular & Thoracic Surgery, Ain Shams University, Cairo, Egypt

2 Department of Anesthesia and Critical Care, Menoufeya University, Menoufeya, Egypt.

3 Department of Anesthesia and Critical Care, Ain Shams University, Cairo, Egypt.

Codex : o3/04/1401

In spite of the ongoing trend towards the primary surgical repair of complex congenital heart diseases in neonates, systemic-to-pulmonary artery shunts are still required as a palliative surgical management with the diminutive pulmonary blood flow before definitive surgical repair.

The original Blalock-Taussig shunt was described in 1945 representing the first palliative surgical treatment of cyanotic congenital heart disease (1). The modified Blalock-Taussig (MBT) shunt uses a polytetrafluoroethylene (PTFE) interposition graft between the subclavian artery (SCA) and the pulmonary artery (PA) to reduce many of the disadvantages of the classic Blalock-Taussig shunt and has been adopted by most institutions as the procedure of choice. It is regarded as a safe, reliable, and effective mean of increasing pulmonary blood flow in such patients (2-5).

In spite of continuous improvement of operative and postoperative management, overall mortality after the MBT shunt from neonatal to older patients ranged from 2.3% to 16.0% (6).

Many risk factors for morbidity and mortality after the MBT shunt have been identified such as shunt size, use of heparin, and preoperative O2 saturation (1, 7, 8). However, the reports which studied the interaction between these risk factors are scarce.

In this study, we have conducted statistically designed experiments to analyze our results in an attempt to identify the interaction between the risk factors and its effect on mechanical ventilation as an indicator of the immediate outcome after neonatal MBT shunt surgery.

Materials and Methods

After approval of local ethics committee and written informed consents from parents or guardians, a retrospective study was designed to include thirty six neonates who underwent modified Blalock-Taussig shunt, from December 2009 to June 2013, at pediatric cardiac surgery unit, Ain Shams University. Demographic data is presented in table (1).

Variable	
Gender (n=36)	
Male	18 (50%)
Female	18 (50%)
Age (days)	28.5 (20 – 30)
Weight (kg)	3.4 (2.5-4)

Data are presented as a median (interquartile range), or number (%).

Table 1. ***Demographic and preoperative data***

Patients in whom an anastomosis was found to be technically difficult, or have desaturation and hemodynamic instability at the time of pulmonary artery clamping before attempting the anastomosis, and needs to be done on cardiopulmonary bypass were excluded from this study.

All patients were diagnosed by echocardiography, and routine preoperative laboratory tests including complete blood picture, liver and renal function tests were done.

The MBT shunt was performed using the sternotomy approach. The right subclavian artery was dissected at its proximal part sufficient for clamping and the right pulmonary artery was dissected at its proximal part between ascending Aorta and superior vena cava sufficient for clamping and avoiding upper lobe branch compromise.

An interposition Gore-Tex polytetrafluoroethylene (PTFE) tube graft (WL Gore, Elkton, MD, USA) was used between right SCA and RPA using 6-0 or 7-0 polypropylene (Prolene; Ethicon, Inc., Somerville, N.J., USA) continuous suture for both anastomoses. However, the size of the grafts was either 3.5 mm or 4 mm according to the sizes of SCA and RPA.

Heparin was not routinely used in all patients. However, if used, it was administered at a dose of 1mg/kg intravenously before clamping of the subclavian artery.

Patent ductus arteriosus (PDA) was not ligated in all patients, yet, in patients who were receiving prostaglandin E1 infusion; it was discontinued in the operating room after MBT shunt placement.

Postoperatively, all patients were mechanically ventilated with adjustment of fraction of inspired oxygen as low as possible down to 30% which maintains oxygen saturation more than 75%. They were extubated when hemodynamically stable with satisfactory arterial blood gas levels.

Epinephrine 50-150 ng·kg–1·min–1 infusion was used to maintain systolic pressures over 100 mm Hg to ensure shunt patency which was assessed by auscultation of shunt murmur and blood gases levels and echocardiography in doubtful cases. Nitroglycerin 1-2 μg·kg–1·min–1 infusion was used in cases of overshunting. Postoperative heparin was not used in all patients, however, it was used as 10 units·kg–1·min–1 infusion in all patients who received intraoperative heparin and when shunt patency was suspected. All patients were discharged on aspirin 5 mg/kg daily.

Clinical variables (age, sex, diagnosis) and peri-operative variables (preoperative O2 saturation, preoperative hemoglobin (Hb), the diameter of the graft, branch pulmonary artery size, inotropic drug administration, postoperative O2 saturation, mechanical ventilation (MV) duration, and peri-operative heparin administration) were reviewed.

The MV duration has been chosen as the outcome variable to be studied based on its importance on reflecting the shunt function. In other words, the criteria for extubation of the patients carry the meaning of balanced shunt flow in terms of good oxygenation saturation, within normal PaCo2, no acidosis and no signs of the shunt overflow or blockage. MV duration also is the main point in ICU stay and hospital stay with its subsequent costs.

Statistical analysis

A factorial design, 2k, where k=4, was used to optimize the most significant factors that affect the MV duration. The experiments were carried out for neonate patients. The design matrix of the factorial design with 16 experimental runs and the levels of each factor are shown in Table 2. For each run, the MV duration was determined. The statistical software package Design-Expert (Stat-Ease Inc., Minneapolis, USA) was used

for regression analysis of experimental data and to plot contour graphs. The analysis of variance (ANOVA) tables was generated and the effect and regression coefficients were determined. The significance of all terms was judged statistically by computing the F-test within 95% confidence interval. Normally distributed numerical data were presented as mean and standard deviation and Categorical data were presented as number and percentage. Non-normally distributed numerical data were presented as median and interquartile range.

Parameter	Unit	Symbol	(-)	(+)
Preoperative o2 saturation	%	A	40	75
Preoperative hemoglobin	gm/dl	B	10	15
Graft size	mm	C	3.5	4
Preoperative heparin administration	mg/kg	D	0	1

Table 2. ***2^4 Factorial Design (FD) Experimental Runs Factor levels***

Results

The preoperative diagnosis, of the 36 patients, was one of five categories, as shown in table (3). Also, table (3) shows the results of the studied preoperative and operative data.

Variable	
Diagnosis (n=36)	
PA, intact interventricular septum	10 (27.6%)
Univentricular heart complex	8 (22.2%)
TOF	8 (22.2%)
TGA, VSD, PS	6 (16.6 %)
TA, PA	4 (11.4%)
Preoperative O_2 saturation (%)	55.5 (9.2)
Preoperative hemoglobin (gm/dl)	12.3 (1.3)
MBT shunt (n=36)	
PTFE (3.5 mm)	20 (55.5%)
PTFE (4 mm)	16 (44.5%)
Branch pulmonary artery size (mm)	3.9 (3.5-5)
Dose of epinephrine (ng/kg/min)	75.9 (29.3)

Data are presented as a median (interquartile range), mean (SD), or number (%).PA= pulmonary atresia, PDA=patent ductus arteriosus, TGA= transposition of great arteries, VSD=ventricular septal defect, PS=pulmonary stenosis, TA= tricuspid atresia, TOF= tetralogy of Fallot, MBT= modified Blalock-Taussig, PTFE= polytetrafluoroethylene.

Table 3. ***Preoperative and operative data***

The PDA was ligated in 17 patients and not ligated in 19 patients. The mean postoperative oxygen saturation was 80.9±6.3 %. Postoperative inotropic support in form of epinephrine infusion was used in 23 patients in mean dose of 75.9±29.3ng/kg/min.

No shunt related complications were encountered in this study. There was no intraoperative death, yet, there were 5 early postoperative deaths within 30 days of surgery with an overall early mortality of 13.8%. All mortalities were due to overshunting that ended up by left ventricular failure and death.

The analysis of the experimental results (i.e. ANOVA—the analysis of variance) according to full factorial design (FFD), within 95% confidence interval is given in Table (4) for MV duration. The mean, R-Squared, and the standard deviation of the MV duration are: 89.5, 0.9942, 6.86 respectively. The R-squared suggested that there is an excellent agreement between the experimental and predicted values obtained from the model.

Source	Sum of Squares	Degree of Freedom	F Value	Prob > F
Model	16139.75	13	26.35	0.0371
A	72.25	1	1.53	0.3413
B	132.25	1	2.81	0.2359
C	121.00	1	2.57	0.2502
D	2652.25	1	56.28	0.0173
AB	6084.0	1	129.10	0.0077
AC	1980.25	1	42.02	0.0230
BC	420.25	1	8.92	0.0962
BD	484.00	1	10.27	0.0851
CD	506.25	1	10.74	0.0818
ABC	961.00	1	20.39	0.0457
ACD	1849.00	1	39.24	0.0246
BCD	121.00	1	2.57	0.2502
ABCD	756.25	1	16.05	0.0570
Residual	94.25	2	47.12	
Cor Total	16234	15		

A: Preoperative O_2 saturation, %, B: Preoperative hemoglobin, gm/dl , C: Graft size, mm, D: intra-operative heparin administration, mg/kg.

Table 4. ***Mechanical ventilation duration (hours), Analysis of variance (ANOVA) [Partial sum of squares]***

The ANOVA analysis shows that the main factor (D) and the studied factors interactions (AB, AC, ABC, ACD) are significant model terms within 95% confidence interval.

The Model F-value of 26.35 implies the model is significant. There is only a 3.71% chance that a "Model F-Value" this large could occur due to noise.

Values of "Prob > F" less than 0.0500 indicates model terms are significant. Values greater than 0.1000 indicate the model terms are not significant.

The results of design analysis are shown in figures (1, 2) which represent the contour plots of the effect of preoperative O2 saturation and preoperative Hb changes on postoperative mechanical ventilation duration.

Figure (1"a") showed that the Hb changes from low to high level, at high preoperative O2 saturation (around ~75 %), the MV duration varies within 40 hours range while at low preoperative O2 saturation (around ~40%), the MV duration varies within 24 hours range which is 60% reduction in the required time for mechanical ventilation. This reflects that at graft size 3.5 mm and no perioperative heparin cover, the effect of preoperative Hb is more significant than preoperative O2 saturation on MV duration especially at high O2 saturation.

Figure (1"b") showed that at graft size 4 mm and no perioperative heparin cover, the low values of preoperative O2 saturation and Hb (12.5 gm/dl and 57 %, respectively) have insignificant effects on MV duration. However, at low O2 saturation level, the MV duration has a tendency to decrease with higher Hb concentration as reflected by the MV duration decrease from 79 to 57 hours when Hb increased from 10 to 15 gm/dl. While, at high O2 saturation level, higher Hb tends to prolong MV duration which was increased from 57 to more than 105 hours. A similar trend was observed at low Hb levels where higher preoperative O2 saturation is associated with decreased MV duration and increased MV duration at high Hb levels. In other words, the lower MV duration is observed at two conditions; high O2 saturation with low Hb levels and high Hb with low O2 saturation levels.

Figure (2"a") showed that at graft size 3.5 mm and perioperative heparin was received, the effect of preoperative O2 saturation is more significant than preoperative Hb on MV duration. However, the significance of preoperative O2 saturation decreases with increasing Hb levels as reflected by the variation in MV duration at low Hb level (around 10 gm/dl) which reaches about 70 hours (from 79 hours at O2 saturation around 75% to 142 hours at O2 saturation around 40%). While, at high Hb level (around 15 gm/dl) the variation in MV duration was insignificant reaching about 4 hours only (which is less than the standard deviation) indicating nearly negligible effect of O2 saturation in such situation.

It's also noticed that increasing Hb at high O2 saturation (more than 57 %) had increased MV duration within 30 hours range (from 79 to 108 hours) while at low O2 saturation (below 57 %) had decreased MV duration within 20 hours range (from 142 to 121 hours).

So, it is clear that the lowest MV duration was obtained at high preoperative O2 saturation and low Hb levels.

Figure (2"b") showed that at graft size 4 mm and perioperative heparin cover, the effect of preoperative O2 saturation is more significant than preoperative Hb on MV duration. However, on the contrary to the previous condition (Figure 2"a"), the effect of O2 saturation is more evident at high Hb level (around 15 gm/dl) where the variation in MV duration reaches about 70 hours (from 57 hours at O2 saturation around 40% to 121 hours at O2 saturation around 75%). While, at low Hb level (around 10 gm/dl) the variation in MV duration was insignificant reaching about 6 hours only (which is less than the standard deviation) indicating a nearly negligible effect of O2 saturation in such situation.

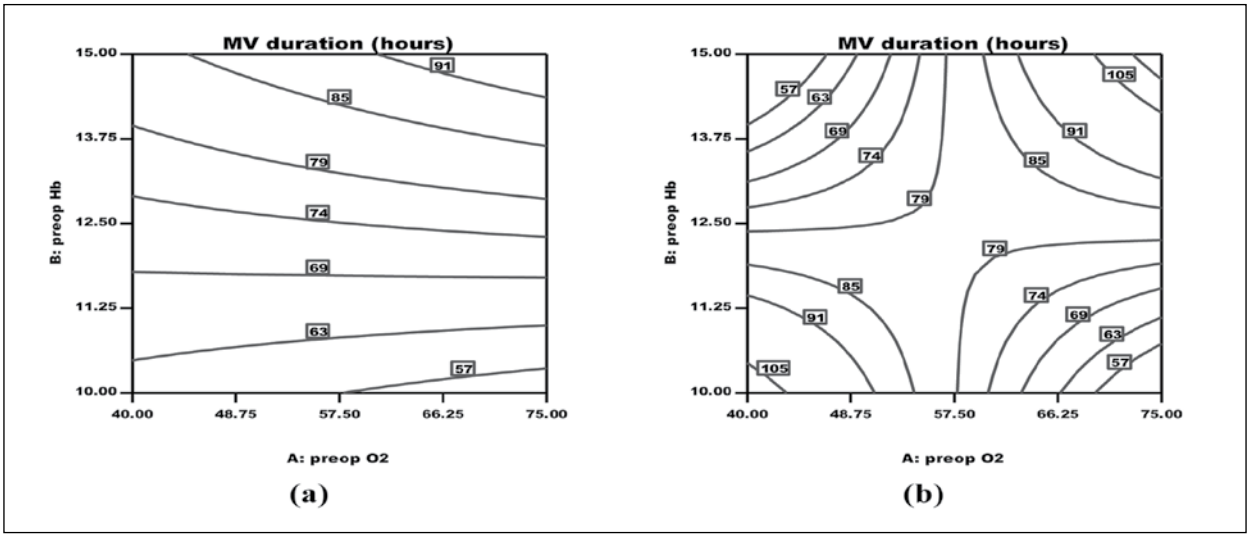

Fig 1. Contour plots for the effects of preoperative O2 saturation and Hb on the MV duration (no heparin doses, a) graft size = 3.5 mm and b) graft size = 4 mm).

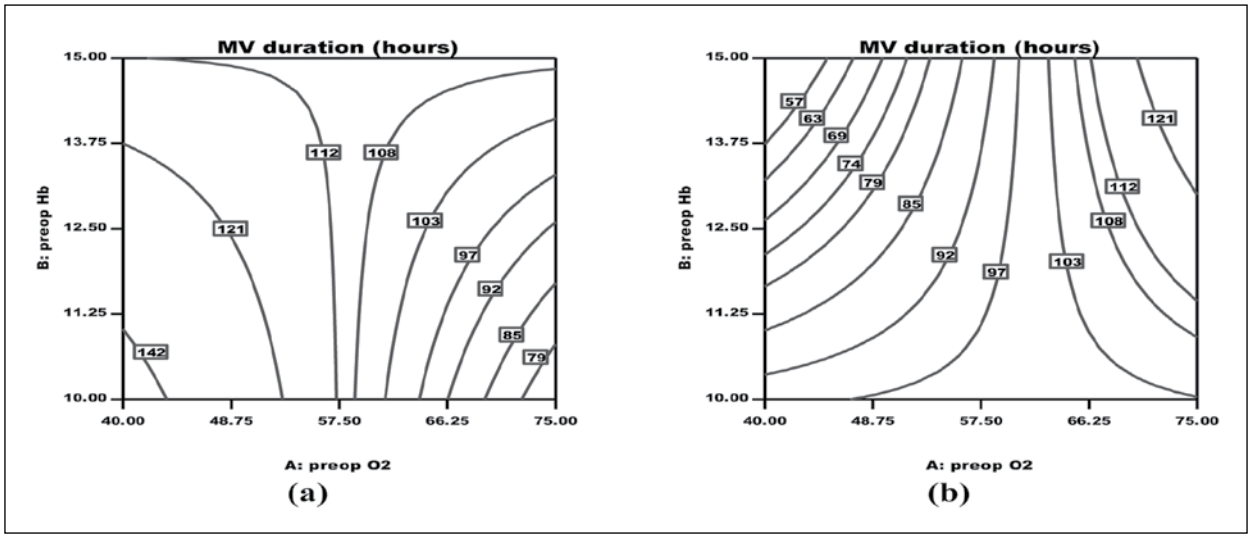

Fig 2. Contour plots for the effects of preoperative O2 satuartion and Hb on the MV duration (heparin dose= 1mg/kg and infusion 10 units·kg–1·min–1, a) graft size = 3.5 mm and b) graft size = 4 mm).

It's, also, noticed that increasing Hb at high O2 saturation (more than 62 %) had increased MV duration within 20 hours range (from 103 to 121 hours) while at low O2 saturation (below 62 %) had decreased MV duration within 40 hours range (from 97 to 57 hours).

So, it is clear that the lowest MV duration was obtained at high preoperative Hb and low O2 saturation levels.

One of the most important features of the statistical design is that it takes into consideration the interaction between variables. It's worth mentioning that the intersection between the lines in the interaction plot indicates strong interaction as in figures (3"b", 4). On the other hand parallel lines indicate no interactions as in figure (3"a").

Figure (3) represents that in absence of perioperative heparin administration, the graft size significantly affects the mechanical ventilation duration with the changes in preoperative O2 saturation and Hb levels. In other words, at graft size 3.5 mm, the variation of Hb from low to high level (10-15 gm/dl) at various O2 saturation levels (from 40-75 %) indicated very slight change in the slope of the response lines at each level. It shows that at low Hb level, the MV duration decreases from 63 to 59 hours while at high Hb level the MV duration increase from 87 to 92hours, as shown in figure (3"a"). On the other hand, at graft size 4 mm, the slope of the response was changed completely to the reverse with strong interaction appears from the intersection of the two lines (high and low level lines). It shows that at low Hb level, the MV duration decrease from 110 to 50 hours and the trend is reversed at high Hb level as MV duration increases from 40 to 118 hours, as shown in figure (3"b").

Figure (4) represents that when heparin was administered, there is a strong interaction between preoperative O2 saturation and Hb at both graft sizes (3.5 and 4.0mm). However, the trend of variation in MV duration changes from decreasing at the low Hb level to constant at high levels when graft size 3.5 mm was used and from constant at a low Hb level to increasing at a high Hb level when graft size 4 mm was used.

Comparing figure 3 with figure 4 shows the effect of heparin administration on the mechanical ventilation response. It is clear that presence of perioperative heparin cover increases the MV duration especially at graft size 4 mm.

In addition, in absence of heparin cover, It is noticed that the graft size significantly affects the mechanical ventilation duration with the changes in preoperative O2 saturation and Hb. At smaller graft sizes, The variation of Hb from the low level to high level (10-15 gm/dl) at various O2 saturation levels (from 40-75 %) indicated very slight change in the MV duration. At bigger graft sizes, the change in the Hb from low level to high level has changed the MV response completely to the reverse with strong interaction. However, both trends showed MV duration decrease at the low Hb level, and MV duration increase at high Hb level.

In summary, as a single factor, the perioperative heparin is a significant risk factor affecting the mechanical ventilation duration.

As an interacting factors, the lower MV duration can be identified in the following situations:

1. At graft size 3.5 mm, with no perioperative heparin cover, low Hb levels, and high preoperative O_2 saturation levels with the effect of Hb is more significant than the effect of O_2 saturation.

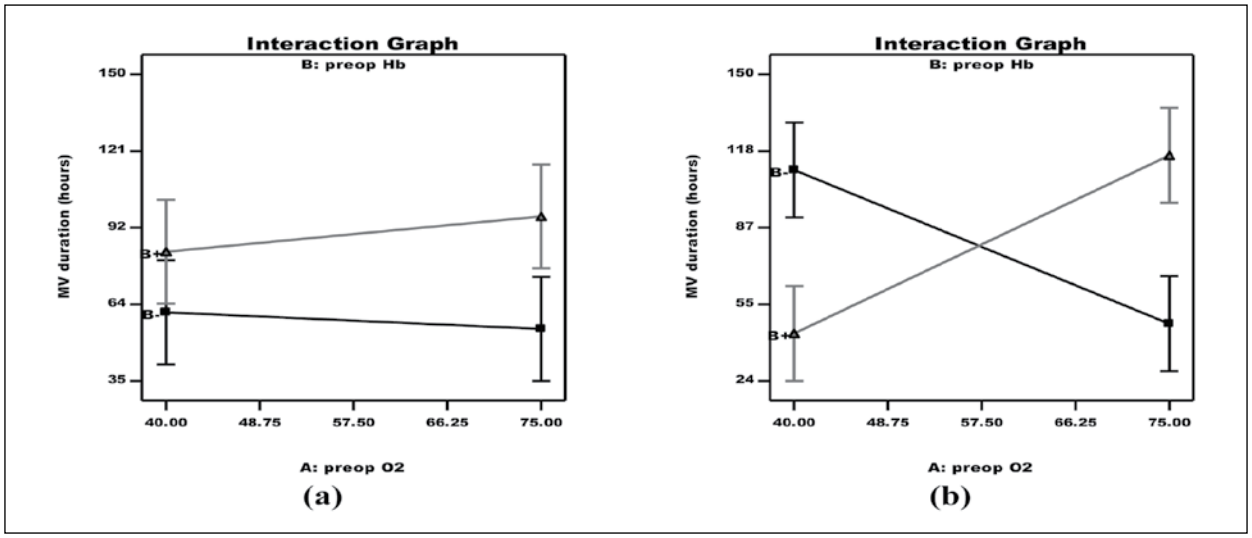

Fig 3. Interaction graph for the effects of preoperative O_2 saturation and Hb on the MV duration (no heparin doses, a) graft size = 3.5 mm and b) graft size = 4 mm).

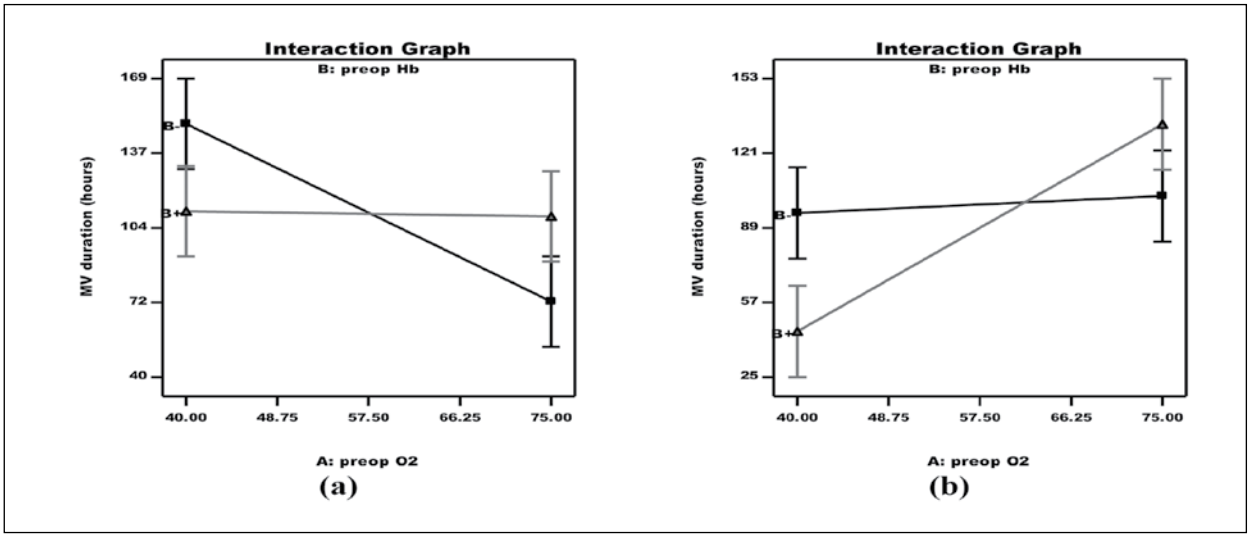

Fig 4. Interaction graph for the effects of preoperative O2 saturation and Hb on the MV duration (heparin dose= 1mg/kg and infusion 10 units·kg–1·min–1, a) graft size = 3.5 mm and b) graft size = 4 mm)

2. At graft size 4 mm, with no perioperative heparin cover, low Hb levels and high preoperative O_2 saturation levels or high Hb levels and low preoperative O_2 saturation levels with an equal effect of Hb and O_2 saturation.

3. At graft size 3.5 mm, with perioperative heparin cover, low Hb levels, and high preoperative O_2 saturation levels with the effect of O_2 saturation is more significant than the effect of Hb.

4. At graft size 4 mm, with perioperative heparin cover, high Hb levels, and low preoperative O_2 saturation levels with the effect of O_2 saturation is more significant than the effect of Hb

Discussion

The MBT shunt continues to be one of the most commonly performed neonatal procedures, comprising 6.4% of all reported procedures in neonates (10).

It is now widely used as an alternative to the classic Blalock-Taussig shunt and it's considered to be the technique of choice, regardless of patient age, because of its main advantages: preservation of the integrity of subclavian artery avoiding acute and chronic ischemic sequelae in the upper extremity; simple to insert and to take down; allow pulmonary artery growth with less distortion of the pulmonary arteries; and lower shunt failure rate (2, 3, 5, 9-11).

In earlier era, before the improvements in perioperative management, the studies reported relatively high mortality. The study done by Tamisier and coauthors, reported an overall mortality of 21% (about 17% if corrected to neonatal mortality) (12). However, the recent era showed a better outcome as reported by Rao and coworkers with an overall operative neonatal mortality of 10.9% and Petrucci and coworkers who suggested that neonatal MBT shunt continues to be a relatively high-risk procedure with an overall mortality of 7.2% (6, 11).

Compared to these studies, the mortality was relatively high, in this study. It was about 13.8%, and this may be attributed to the differences between centers in resources and the standards of the perioperative care of patients.

Shunt graft sizes used for neonates varies widely according to surgical preference and the center experience, however, it's usually between 3.5 and 5mm.

The effect of shunt size on outcome is still a debatable issue. Many authors tend to use larger shunt sizes; Ibawi and colleagues, in a study on 30 neonates with a mean age of 8.8 days and a mean weight of 3.14 kg, used 5-mm grafts in 21patients and 6mm in 9 patients and they reported low hospital mortality (3.3%) and Actuarial functional life of the shunt was 91% at 3 years' follow-up (4). This was supported by the study conducted by Tsai and his colleagues on 86 patients of different age groups (from 15 days to 22 years old) with a result of one year shunt patency rate 90% and they reported that the age of the patient and the graft size were risk factors for shunt patency (16).

However, Dirks and coworkers studied 32 patients with median age and weight were 10.5 days and 2.9 kg, respectively. They reported 9% mortality and they concluded that bigger shunt size/kg of body weight was a significant risk factor for mortality (17).

On the contrary, Rao and coworkers studied 46 neonates. They used 3.5mm in 13 patients, 4mm in 31patients, and 5mm in 2 patients and they reported one case of shunt blockage in each shunt size group and they concluded that smaller grafts doesn't increase in the incidence of shunt blockage. (11)

Abou Ellela and colleagues supported the same conclusion in their studies on 29 patients with mean age and weight were 3 ± 3 weeks and 2.9 ± 0.7 kg, respectively who received 3.5mm shunt size, and 60 patients with mean age and weight were 9 ± 8.6 weeks and 4 ± 2 kg, respectively who received 4mm shunt size and they suggested that shunt size does not affect the short-term outcome, but rather the bigger shunt size has led to better growth of branch pulmonary arteries (18).

In addition, the study conducted by Sivakumar and colleagues on 20 neonatal patients, concluded that the overall shunt patency rate was about 80% on intermediate term follow-up and smaller graft size has not been associated with shunt blockade or operative mortality (19).

In this article, the surgical preference was toward smaller shunt sizes (3.5 or 4mm) to avoid the overshunting and to minimize the pulmonary artery distortion that may occur with larger shunt sizes. The small shunt size didn't affect the short term outcome in terms of mechanical ventilation duration and intervention for shunt blockage.

The role of heparin in MBT shunt is still controversial. Berger and colleagues, in their study on 60 patients undergoing 67 consecutive graft procedures in a 3.5-year period, suggested that the use of heparin leads to an increased risk of perigraft seroma (7).

Mullen and coworkers conducted a study on 23 patients who underwent MBT shunt and they concluded that avoidance of postoperative heparin is a safe practice and may reduce bleeding problems and the incidence of perigraft seromas . They suggested that shunt thrombosis is more likely related to intraoperative technical difficulty or extremely small pulmonary artery size (20).

However, Rao and colleagues stated that shunt block can be a problem even in a technically well performed shunt and other factors may play a role and they recommended the judicious use of postoperative heparin in patients with small pulmonary arteries or those with a high hematocrit to reduce the incidence of shunt blockage (11).

In our study, heparin was used as a single intraoperative dose (1 mg/kg) in 16 cases and postoperative heparin infusion (10 units·kg–1·min–1) was used in 18 cases. The other 18 cases were done without heparin cover. The results revealed that heparin use was a significant risk factor for MV duration which was prolonged in cases of heparin administration.

The studies of the effect of preoperative O2 saturation and Hb on the outcome are few in the literature.

Chetpaophan and coworkers found that the increase in postoperative oxygen saturation was significant and is inversely related to preoperative O2 saturation (1).

The study done by Gedicke and colleagues, on 76 children who received MBT shunt sizes from 3 to 6 mm with a median age and weight of 37 days of 3.75 kg, respectively, revealed that one of the main risk factors for blockage were preoperative high hemoglobin (21).

Sahoo and coworkers studied the effect of hemodilution in cyanotic congenital heart disease patients undergoing MBT shunt surgery. The study group received 6% hydroxyethyl starch solution to bring down the hematocrit to 45%. They concluded that hemodilution in such cases has beneficial effects including improved shunt patency and less postoperative blood loss, and they attributed their results to the lower viscosity produced by hemodilution (22).

Prior literatures have discussed the effect of individual risk factors on the outcome of MBT shunts. However, the nature of this article was to study not only the individual factors but also the role of the interaction between these factors on the outcome.

An important finding is that the lower MV duration was observed at graft size 3.5 mm with no heparin administration at low Hb and high preoperative O2 saturation levels. It is also noticed that when the graft size increases to 4 mm, the increase in preoperative O2 saturation is manipulated by a decrease in Hb and vise versa to reach the lower MV duration.

In addition, the results revealed that perioperative heparin administration as a single factor increases MV duration, especially at smaller graft size, and this was expected as it may play a role in the increased shunt flow by its anticoagulation effect which may result in overshunting which needs longer MV duration till adaptation of pulmonary circulation.

In conclusion, this study revealed that one factor at-a-time is not a good strategy in such studies due to the strong interaction between the studied factors. It also showed that the relation between the studied factor is not straight forward. In addition, the change of graft size and/or heparin administration significantly affects the MV response.

Therefore, studying the risk factors affecting the outcome of neonatal MBT shunt altogether with their interaction may add more data and answer some debatable questions which may give a clearer approach to such high risk patients for a better outcome.

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Early Results of Mitral Valve Replacement on Beating Heart in Patients with Chronic Severe Mitral Regurgitation and Left Ventricular Dysfunction

A. Elshemy[1];

Elatafy E. Elatafy, MD[2];

Abdel-mohsenHammad, MD[2];

H. Fawzy, MD[2];

Ehab A. Wahby, MD[2]

Background: **beating heart valve surgery is safe and may be more beneficial than traditional technique specially for high risk patients.**

Aim of the work: **the aim of this work is to evaluate the results of mitral valve replacement on beating heart in patients with chronic severe mitral regurgitation and left ventricular dysfunction.**

Patients and methods: **Sixty patients underwent surgical correction of mitral insufficiency were prospectively randomized to 30 patients (group 1) mitral valve replacement using cold crystaloidcardioplegia, and 30 patients (group II) mitral valve replacement using beating heart technique.**

Results: **none of group 2 patients needed high doses of inotropic support while 43.3% of group 1 needed. Group 2 patients had shorter ventilation time and ICU stay time than group 1. P value (0.003 and 0.049 respectively). Also group 2 patients had less incidence of LCO status after surgery than Group 1 (p value 0.007). group 2 patients had lower level of postoperative cardiac enzzymes and also had better LV ejection fraction and fractional shortening than Group 1.**

Conclusion: **Beating heart mitral valave replacement looks to be associated with better LV function early postoperatively than conventional mitral valve replacement using cold crystalloid cardioplegic arrest. This together with the absence of related perioperative mortality and the major complications suggests that it is safe and beneficial to LV function.**

Still, in spite of improvements in myocardial protection techniques, some perioperative adverse effects of myocardial ischemia caused by aortic cross-clamping, cardioplegia, and reperfusion remain [1,2]. Therefore, great effort is made to prevent these deleterious effects [3].

Any technique that avoids the ischemic component of cardioplegia and an arrested heart by keeping the heart beating will go a long way in reducing iatrogenic damage to the heart [4]. Introduction of off-pump beating heart operations has enabled major technological and procedural advances in coronary artery bypass grafting [5,6]. Many authers have considered the possibility of conducting valvular operations on the beating heart similarly. Although this procedure cannot be performed without using CPB, it eliminates the ischemic component by keeping the heart beating throughout the operation[7].

In addition to its myocardial protecting benefit (Perfused myocardial muscle, the heart is not doing any work, appropriate pH, effective delivery of substrates, removal of acid metabolites and no reperfusion injury), on-pump beating heart valvular operations may have other advantages and utilities [4,8].

Patients and Methods

This is a prospective study conducted in cardiac surgery department in national heart institute to compare the outcome of mitral valve replacement using two different modalities of myocardial protection i.e., beating heart technique “beating group”

1 National Heart Institute, Imbaba, Egypt.

2 Department of Cardiothoracic Surgery, Tanta University Hospital, Tanta, Egypt.

Codex : o3/05/1401

and cold crystaloidcardioplegic technique "control group" in patients with chronic severe mitral regurgitation.

Sixty patients underwent surgical correction of mitral insufficiency were prospectively randomized to 30 patients (group 1) mitral valve replacement using cold crystaloidcardioplegia, and 30 patients (group II) mitral valve replacement using beating heart technique. Complete data from these patients were collected for analysis.

Patients with pure mitral stenosis redo heart surgery, associated coronary heart disease requiring coronary artery bypass surgery, aortic valve disease necessitating aortic valve replacement, patients with infective endocarditis and patients with severe co morbidities e.g. (hepatic, renal, central nervous system) affecting the results or contraindicating the surgery were excluded from the study.A written concent was obtained from each patient after explaining for him/her the details of each technique.

All patients in the study were subjected to routine full laboratory study, ECG, X ray for the chest, echocardiography and cardiac catheterization when indicated.

Results

Intraoperative Data

The Aortic cross clamp time the range was 25– 55 minutes in group I with mean 35.75 ± 4.54 but in second group aortic cross clamp was momentary applied with myocardial perfusion by antegrade coronary perfusion through aortic root cannula so the heart was not ischemic, we compensate for it statistically by the mitral surgical time (from beginning of bypass till finishing left atrial closure); its range was 40-65 minutes with mean 44.50 ± 9.59, on the other hand in the first group the mitral surgical time (from Appling cross clamp till finishing left atrial closure) its range was 18 – 33 with mean 28+4.59. It was significantly longer in group II compared to group I as $P < 0.001$.there was no significant difference between the two groups as regard to the total bypass time (Table 1).

The need for inotropic support; none of the patients in group 2 needed high doses of inotropic support while 17 patients in the conventinal group needed high doses of inotropic suppport. There were no patients needed intra-aortic balloon pump counter pulsations in early post-operative period (Table 2).

	Control	Beating	t. test	p. value	SIG
Total bypass time (min)	67.50±12.64	63±12.97	0.536	0.441	NS
Mitral surgical time(min)	28±4.59	44.50±9.59	8.499	0.001	HS
Ischemic Clamp time (min)	35.75±4.54	0	-	-	-

Table 1. Ischemic Cross clamp time (groups I) and mitral surgical time (group II)

Therapeutic dose High dose		Support No			Total
Control	N	17	13	0	30
%	56.7%	43.3%	0%	100.0%	
Beating	N	27	0	3	30
%	90.0%	0%	10.0%	100.0%	
Total	N	44	13	3	60
%	73.3%	21.7%	5.0%	100.0%	
Chi-Square X^2			18.273		
P-value			0.001 HS		

Table 2. Need for Support in the studied groups

Immediate (early) Postoperative Data:

Mechanical ventilation patients in the beating heart group had a shorter time of mechanical ventilation and ICU stay postoperatively while there was no significant difference between the two groups as regard to the hospital stay time (Table 3).

Cardiac Enzymes

Serial measurements of cardiac enzymes (total CK, LDH) after 3 hours, 6 hours, and 12 hours in both groups revealed significant difference between two groups in favor of group II. Table (4)

There were 12 patients in group I (40%) who had post-operative low cardiac output while only 3 patients in group II (10%) had post-operative low cardiac output.

There was significant difference between the two groups in favor of group II as P value was 0.007. Table (5)

	Control	Beating	t. test	p. value	SIG
Ventilation hours	13.43±5.01	9.26±4.98	3.262	0.003	S
ICU stay(days)	3.60±1.19	2.40±0.68	1.336	0.049	S
Hospital stay(days)	14.87±0.50	14.53±0.50	0.639	0.244	NS

Table 3. Mechanical ventilation hours, ICU stay and hospital stay:

	Control	Beating	t. test	p. value	SIG
Total CK 3H	2091.8±574.9	1361.7±155.8	6.325	0.001	HS
LDH 3H	1182.5±459.9	832.3±71.01	4.254	0.001	HS
Total CK 6H	2662.9±2712.5	1337.8±187.2	2.632	0.010	S
LDH 6H	1182.5±437.6	839.1±107.1	4.256	0.009	S
Total CK 12H	2237.5±681.5	1320.2±214.3	7.263	0.001	HS
LDH 12H	1226.2±463.2	864.7±126.9	4.253	0.005	S

Table 4. Total CK, LDH 3, 6, 12 hours postoperatively in the studied groups.

		Low CO		Total
		Yes	NO	
Control	N	12	18	30
%	40.0%	60.0%	100.0%	
Beating	N	3	27	30
%	10.0%	90.0%	100.0%	
Total	N	15	45	60
%	25.0%	75.0%	100.0%	
Chi-Square X^2		7.200		
P-value		0.007 S		

Table 5. Low cardiac output in the studied groups:

Early postoperative Echocardiographic data:

Early postoperative Left Ventricular End Diastolic Diameter (LVED).

	Control	Beating	t. test	p. value	SIG
Early Post EDD	6.44±0.58	6.17±0.60	1.710	0.093	NS
Early Post ESD	4.87±0.50	4.53±0.50	2.601	0.012	S
Early Post FS	22.96±3.22	25.83±3.88	3.966	0.009	S
Early Post EF%	45.86±6.16	50.96±7.27	2.985	0.019	S

Table 6. Early postoperative end diastolic diameter, end systolic diameter, fractional shortening, and ejection fraction in the studied groups

Early postoperative left Ventricular End Systolic Diameter (LVESD).

There was no significant difference in the LvEDD in the two groups while patients in group 2 had a smaller LVEDD and higher FS and EF.

Discussion

Continous perfusion of the heart in the beating group II in our study was kept by performing the surgery without aortic cross clamp which was similar to that done by Katircioglu et al.(9), Cicekcioglu et al.(10) and Thompson et al. (11)

The mitral surgical time in the beating group II was shorter than that of Gersak (6) (67.39 minutes) and of. Matsmumoto et al.(7) (68 ± 11). Katircioglu et al (8).,Cicekcioglu et al (10). and Thompson et al (11). did not specify the surgical time from the total bypass time. Our total bypass time in the beating group II was longer than that for Katircioglu et al(8) (57.4 ± 18.4 minutes) and was shorter than that for Suzuki et al (12) (71 ± 27 minutes), Matsmumoto et al. (7) (100.5 ± 31 minutes), Cicekcioglu et al. (10) (85 ± 30 minutes), Thompson et al.(11) (83.6 ±43.1 minutes) and Gersak(6)(100.34 minutes).

Regarding the need for support; the beating group II needed significantly lower doses of support as none of the beating group patients needed high doses of inotropic support while 43.3 % in group I needed high doses of inotrops.

In our study there was significantly longer mechanical ventilation time in cold group I compaired to beating group II.

The time in group II was nearly similar to that of Suzuki et al(12) (10 ±7.7 hours) but was shorter than for Katircioglu et al.(8)(12.2 ± 3.5 hours), Cicekcioglu et al.(10)(13.6 ± 6 hours) and far shorter than Thompson et al.(11)(44 hours).

Regarding cardiac enzymes serial measurements of cardiac enzymes (total CK, LDH 3 hours, 6 hours, and 12 hours) in both groups revealed significant difference between them in favor of beating one.

Gersak et al(6) reported that the values for creatinin kinase (Ck) and LDH for beating group were lower than the values for arrested heart group.

There was significant difference between the two groups in our study regarding the occurrence of low cardiac output as the percentage of patients who developed low cardiac output was lower in beating group II (10%) than cold group I (40%) which was in accordance with Matsmumoto et al(7), Katircioglu et al132, Cicekcioglu et al(10) and Suzuki et al(12).

The mean ICU stay was significantly longer in cold group I (3.60±1.19) in comparison to beating group II (2.40±0.68).

So, the ICU stay of beating group was similar to that of the results of Suzuki et al(12). (2.9±.1.9 days) and Cicekcioglu et al(10) (2.8 ± 6.4 days) but was longer than Katircioglu et al(8). (1.3 ± 1.6 days) and shorter than Thompson et al.(11) (4days).

The difference between the cold group I and beating group II regarding this early postoperative course (ventilation hours and ICU stay) may be explained by the delaying effect of hypothermia on the recovery of cerebral, cardiac and other organ function

The comparison between the effects of the beating heart technique and cold crystalloid cardioplegic techniques on the LV myocardial function was mainly determined by the postoperative echocardiographic results.

While there were no significant differences between the preoperative echocardiographic parameters of the two groups in our study. The postoperative echocardiographic results showed a significant difference on LV myocardial function in favor of the beating technique (group II) over the cardioplegic technique (group I).

The early (in hospital) postoperative echocardiography showed that significant difference was present in the postoperative left ventricular ejection fraction (LVEF) and left ventricular fraction shortening (LVFS) between two groups in favor of the beating one as both FS% and EF% did not decrease postoperatively but even increased in group II (beating) while decreased significantly in group I (control).

The early postoperative improvement was similar in the two groups regarding left ventricular end diastolic diameter (LVEDD) with no significant differences between them, but regarding left ventricular end systolic diameter (LVESD) significant difference between two groups in favor of the beating one was present.

As a completion of the early postoperative echocardiography, short term postoperative echocardiography (6 months later) was done which showed similar results; as the short term postoperative improvement was also similar in the two groups regarding left ventricular end diastolic diameter (LVEDD) but a significant difference was also present in the postoperative left ventricular end systolic diameter (LVESD) in favor of beating group.

There was significant difference as regard left ventricular ejection fraction (LVEF) and left ventricular fraction shortening (LVFS) between beating group II and cold group I in favor of the beating one II as both FS% and EF% did not decrease postoperatively and even increased in group II but decreased in cold group I.

In our study, there was no operative mortality nor major complications such as cerebrovascular stroke CVS or prioperative myocardial infarction in either group. This is concordant w ithKatircioglu et al (8) study in which the one year survival was 96% and Matsumoto et al (7) who reported no mortality or major complications. Gersak (6) reported three non-cardiac related mortalities. Even in redo cases the results of the beating technique were good as Cicekcioglu et al(10) had no operative mortality, while Suzuki et al (12) and Thompson et al (11) had 13% and 6.4% 30 day mortality respectively.

Left atrial dilatation associated with mitral incompetence together with the relatively weak myocardial contraction help the surgeon to operate on the beating heart with technical satisfaction. However, it should be mentioned that we faced by some difficulties in some cases that did not affect the surgical adequacy except in one case (not included in the study) in which we shifted to the warm cardioplegic technique when we became not sure of the surgical quality. These difficulties were mainly due to flooding the field with blood and inability to deal safely with the contracting annulus.

The significant differences in EF and FS in favor of beating group II over cardioplegic techniques in early and late postoperative echocardiographic results explains the generally better course of patients of this group in hospital and during the early follow up period; this together with the absence of related perioperative mortality and the lower major complications suggests that it is beneficial to LV function.

In the other studies there was no recorded date about the EF, FS between beating group and the other techniques.

Conclusion

Beating heart mitral valave replacement looks to be associated with better LV function early postoperatively than conventional mitral valve replacement using cold crystalloid cardioplegic arrest. This together with the absence of related perioperative mortality and the major complications suggests that it is safe and beneficial to LV function.However, long term follow up of these patients is needed to judge the benefit of this approach latter on after replacement.

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Outcome of Surgical Correction of Ascending aorta and/or Proximal Arch Dissecting Aneurysm: Seven Years Experience of Two Specialized Centers.

Ayman Sallam, MD; [*]

Osama A. Hassan, MD [**]

Objectives: **The current retrospective study aimed to present 7-year experience of 2 Cardio-vascular centers in treating cases with acute ascending aorta and/or proximal aortic arch dissecting aneurysm.**

Patients & Methods: **Data extracted included patients' demographics, frequency of associated risk factors and/or medical co-morbidities. Pre-operative clinical data included mode of presentation, main presenting symptoms, and grading according to EuroSCORE I guidelines. Operative data, intra-operative and early post-operative (PO) events and their management and outcome were obtained. Duration of follow-up and its concomitant events and their outcome were also obtained.**

Results: **The study included 40 patients managed on emergency basis; 31 males and 9 females with mean age of 60.4±9 years. Pre-operative risk factors included hypertension (72.5%), diabetes mellitus (60%) and smoking (67.5%). Additional preoperative morbidities included coronary artery disease (17.5%), renal impairment (10%), chronic obstructive pulmonary disease (7.5%), peripheral artery disease (7.5%) and previous cerebro-vascular accident (5%). Pre-operative ECHO showed a mean ejection fraction (EF) of 43±10.9. Twenty-three patients presented by chest pain, 6 by neurological dysfunction and 11 patients had syncope, and 18 patients had hemodynamic instability. Ascending aorta and aortic arch pathology were corrected with graft interposition in 25 patients (62.5%) and modified Bentall operation for aortic valve and root involvement in 15 patients (37.5%); all surgeries were conducted uneventfully. Early PO events included atrial fibrillation (37.5%), acute myocardial infarction (10%), acute kidney injury (27.5%), neurological events (35%) and acute respiratory failure (2.5%). Six patients (15%) required re-operation for bleeding that was controlled but one patient died intraoperatively (2.5%). Mean total hospital stay and follow-up period were 19.3±5.9 days and 42.8±14 months, respectively. Three mortalities occurred during follow-up.**

Conclusion: **Ascending aorta and/or aortic arch dissecting aneurysm could be corrected using interposition graft or modified Bental's operation on emergency basis with minimal early PO morbidities and low mortality rate. Frequency of development of morbidities or mortality was mainly dependent on preoperative clinical status of patients.**

KEYWORDS: **Ascending aortic aneurysm, Surgical correction, Intraoperative events, Postoperative morbidity, Mortality**

[*] Cardio-thoracic Surgery Department, Tanta University, Egypt.

[**] Department of Cardio-thoracic Surgery, Beni_Suef University.

Codex : o3/06/1401

Aneurysms and dissection constitute the main aortic diseases, which can be subjected to common principles and surgical treatment techniques. Surgical management remains a challenge in elective procedures as well as in emergencies. The decision on surgery is based on the balance between the risk and the chance of surgical aortic rupture, which can be particularly difficult in elective cases. Furthermore, among patients with thoracic aortic rupture, mortality is extremely high, reaching above 94% [1,2].

Ascending aortic aneurysm is generally treated by resection and replacement of the aneurysm. Replacement of the ascending aorta is the most frequently performed procedure for thoracic aortic aneurysm and dissection. However, this operation is still associated with substantial perioperative mortality and morbidity. Moreover, the management of mild to moderate dilatation of the ascending aorta of less than 5 cm is controversial. In these cases, some surgeons favor a "watch and wait" approach, until surgery is indicated. A less radical operation than graft replacement, such as reduction aortoplasty with excision of the aneurysmal wall and external wrapping of the ascending aorta is another therapeutic alternative [3, 4].

Despite advances in diagnostic and therapeutic procedures, operative morbidity and mortality after aortic aneurysmal repair remains considerably high and has been reported to be up to 25%. Long-term outcome primarily depends on age, comorbidities, and peri-operative complications, and in 5–39% of cases redo aortic surgery becomes necessary with secondary aortic root dilatation being the main indication. Operative mortality of a redo procedure is 13–41% and exceeds the mortality of the primary surgery. Graft dehiscence is a very rare post-operative complication occurring usually after an average time interval of more than 60 months after the initial procedure[5-7].

The current retrospective study aimed to present 7-year experience of two Cardio-vascular centers in treating cases with acute ascending aorta and/or proximal aortic arch dissecting aneurysm.

Patients & Methods

The current retrospective study was conducted at two Cardio-vascular surgery departments, KSA. The study relied on collection and analysis of data concerning patients with acute dissecting aortic aneurysm involving the proximal aortic arch and/or the ascending aorta with/without involvement of the aortic valve and were operated upon in the centers. The examined files must include all data required for the study and the preoperative patients or near-relative written fully informed consent. The study protocol was approved by the Local Ethical Committee. Files were included in the study irrespective of patients' outcome as regard survival.

Data extracted included patients' demographics: age, gender, weight, height and body mass index. History of associated risk factors and/or medical co-morbidities and history of previous cardiac surgery procedures. All preoperative clinical data including mode of presentation, main presenting symptoms, preoperative evaluation of functional status using NYHA score were analyzed. Preoperative parameters were defined according to EuroSCORE I guidelines [8].

The technique used briefly entailed: Standard cardiopulmonary bypass (CPB) either through the femoral vessels and/or the right atrium and/or ascending aorta with left ventricle venting through the right superior pulmonary vein. During gradual cooling (1°C/5 min), using pH management of alpha-stat, pump flow was adjusted to levels of 2.2–2.4 l/min/m^2 with a 'temperature gradient' (blood-nasopharyngeal) not exceeding 7°C. When bladder temperature was 18°C, the circulation was arrested. With the heart in cold blood cardioplegic arrest, retrograde cerebral perfusion (RCP) was started with blood flow 5 ml/kg/min and an infusion pressure <20–25 mm Hg in order to avoid brain edema. The head was packed in ice to prevent warming of the central nervous system (CNS). During this period, the distal anastomosis in the aortic arch was constructed. Myocardial protection was performed using a low-volume cardioplegic solution (Cardioplexol®) as induction cardioplegia with intermittent modified Buckberg cold blood cardioplegia every 20–30 min. Before coronary reperfusion, a modified Buckberg warm blood cardioplegia was administered. After re-establishing full CPB through a side branch on the distal aortic graft, the prosthesis was de-aired and clamped, and the patient was gradually re-warmed. During re-warming, any remaining correction of the ascending aorta, aortic root and/or aortic valve was undertaken. Intraoperatively and during CPB, thiopental sodium (7 mg/kg) and hydrocortisone (15 mg/kg) was administrated. Mannitol (30 g) was added to the prime of all patients. At the beginning of the operation, all patients received tranexamic acid as anti-firibinolytic therapy (50 mg/kg). After weaning from cardiopulmonary bypass, reversal of heparin with protamine ratio 1:1 (1 mg protamine per 100 IU heparin) was performed. In all operations, prolene suture reinforced with strip Teflon was the standard suture utilized.

Collected intraoperative data included approach and duration of CPB, ischemia time, conducted operative procedure, total duration of surgery, frequency of intraoperative events. Collected postoperative data included duration of mechanical ventilation, duration of ICU stay and the frequency of early in-hospital mortality and complications involving all body organs; cardiac, neurological, renal and/or respiratory. The frequency of development and progress of early PO complications and total duration of hospital stay were recorded. Late outcome was defined as the late mortality rate and the frequency of redo surgery.

Results

The study included 40 patients managed on emergency basis; 31 patients were males and 9 patients were females with mean age of 60.4±9; range: 36-72 years. Evaluation of associated risk factors defined 29 patients hypertensive, 24 patients were diabetic, 11 patients were still smokers, 16 patients were ex-smokers, while 13 were never smokers (Table 1).

Data			Findings	
Age (years)	Strata	<40	2 (5%)	36±1.4 (35-37)
		40-50	4 (10%)	47.3±1.7 (45-49)
		>50-60	11 (27.5%)	56.7±1.7 (54-59)
		>60-70	18 (45%)	65.1±2 (62-68)
		>70	5 (12.5%)	71.8±0.4 (71-72)
	Total			60.4±9 (36-72)
Gender	Males		31 (77.5%)	
	Females		9 (22.5%)	
Body mass data	Body weight (kg)		89±3.6 (79-94)	
	Body height (cm)		167.5±2.7 (162-172)	
	Body mass index (kg/m^2)		31.7±1.5 (28.7-34.3)	
Frequency of risk factors	Smoking	Never	13 (32.5%)	
		Ex-smoker	16 (40%)	
		Still smokers	11 (27.5%)	
	Diabetes mellitus	Yes	24 (60%)	
		No	16 (40%)	
	Hypertension	Yes	29 (72.5%)	
		No	11 (27.5%)	

Data are presented as mean±SD & numbers; ranges & percentages are in parenthesis

Table 1. Patients demographic data

Clinical presenting manifestations included chest pain in 23 patients, neurological dysfunction in 6 patients and 11 patients had syncope. As regards associated medical co-morbidities; 7 patients had coronary artery disease diagnosed by CT-angiography, 4 patients had renal impairment, 3 patients had chronic obstructive pulmonary disease, 3 patients had peripheral artery disease and two had previous cerebro-vascular accident. Functional grading according to NYHA defined 17 patients of grade II, 14 patients of grade III and 9 patients of grade IV. Twenty patients had EURO score in range of 11-15, 11 had EURO score in range of 16-20, 7 patients had EURO score in range of 21-25 and 2 patients had EURO score of ≥25. Preoperative evaluation included ECHO examination that showed a mean EF of 43±10.9; range: 34-59%. Six patients had EF% of ≤30%, 13 patients had EF% in range of >30-40%, 10 patients had EF% in range of >40-50% and 11 patients had EF% of >50%. Thirty-five patients had CT examination and 21 patients were diagnosed using CT angiography for the coronaries. Eighteen patients had hemodynamic instability with mean SAP of 54.3±4.1; range: 45-60 mmHg, while the other 22 patients had mean SAP of 128.7±6.6; 115-142 mmHg (Table 2).

Ascending aorta and aortic arch pathology were corrected with an interposition graft in 25 patients and the modified Bental's operation was performed for aortic valve and root involvement in 15 patients. CBP was established with three cannulation approaches: distal ascending aortic cannulation and traditional CPB and aortic cross clamp in 23 patients, femoro-femoral bypass then hypothermia and circulatory arrest in 11 patients, and subclavian artery cannulation and selective antegrade cerebral perfusion in 6 patients. Mean CPB time, irrespective of approach, was 4.8±1.2; range: 3-8 hours. Mean ischemia time was 3.7±0.7; range: 3-5 hours. All surgeries were conducted uneventfully within a mean total operative time was 7.3±1.1; range: 6-10 hours and no intraoperative mortality (Table 3).

Mean duration of mechanical ventilation was 5.7±3.7; range: 3-19 days and mean duration of ICU stay was 10.7±4.3; range: 6-23 days. Early postoperative events are variable; 19 patients developed cardiac events, 15 patients had atrial fibrillation and 4 had acute myocardial infarction; only one patient did not respond to medical treatment of myocardial infarction and died on the 11th PO day. Six patients required re-opening for post-operative bleeding that was controlled but unfortunately one patient died prior to wound closure. Eleven patients had serum creatinine >2 mg/dl despite having normal preoperative serum creatinine and were considered to have acute kidney injury. Two of these patients required hemodialysis to allow decreasing serum creatinine, while the others responded to conservative therapy. Fourteen patients developed neurological events; 9 patients had transient ischemic attacks, 2 patients developed focal permanent neurological dysfunction; one had left hemiparesis and another had right hemiplagia. Unfortunately, one patient had heavy diffuse neurological deficit and required maintenance on mechanical ventilation but progressed to had ventilator-associated pneumonia and acute renal failure and died because of multiple organ failure on the 8th PO day. Another patient had decreased level of consciousness and was maintained on mechanical ventilation, but fortunately responded to medical therapy and regained consciousness with minimal neurological deficit. One patient developed acute respiratory failure secondary to having preoperative COPD and failed to respond and died on the 16th PO day. Mean total hospital stay was 19.3±5.9; range: 8-35 days (Table 4).

Throughout a mean follow-up period of 42.8±14; range: 20-68 months, there were four mortalities for a late mortality rate of 10%. The 1st was the only intra-operative death which occurred secondary to exsanguinations due to postoperative bleeding that necessitated re-operation and died during surgery.

Presenting symptom	Chest pain				23 (57.5%)	
	Syncope				11 (27.5%)	
	Neurological dysfunction				6 (15%)	
Associated co-morbidities	Renal impairment		Yes		4 (10%)	
		No	36 (90%)			
	Coronary artery disease		Yes		7 (17.5%)	
		No	33 (82.5%)			
	Chronic obstructive pulmonary disease		Yes		3 (7.5%)	
		No	37 (92.5%)			
	Peripheral artery disease		Yes		3 (7.5%)	
		No	37 (92.5%)			
	Cerebrovascular accident		Yes		2 (5%)	
		No	38 (95%)			
Clinical findings	NYHA grade		II		17 (42.5%)	
		III	14 (35%)			
		IV	9 (22.5%)			
	EURO score		Strata	10-15	20 (50%)	13.2±1.1 (11-15)
				>15-20	11 (27.5%)	18.1±1.4 (16-20)
				>20-25	7 (17.5%)	22.9±1.3 (21-25)
				>25	2 (5%)	28.5±0.7 (28-29)
		Total			17±4.7 (11-29)	
Preoperative diagnostic investigations	ECHO	EF (%)	Strata	≤30	6 (15%)	26.3±2.7 (23-30)
				>30-40	13 (32.5%)	36.5±1.3 (34-39)
				>40-50	10 (25%)	46±1.5 (44-48)
				>50	11 (27.5%)	57.1±1.2 (55-59)
			Total			43±10.9 (34-59)
	CT scanning				35 (87.5%)	
	CT angiography for coronaries				21 (52.5%)	
Preoperative hemodynamic status	Hemodynamic instability		Frequency		18 (45%)	
		Mean SAP (mmHg)		128.7±6.6 (115-142)		
	Hemodynamic stability		Frequency		22 (55%)	
		Mean SAP (mmHg)		54.3±4.1 (45-60)		
		Total			95.2±37.9 (45-142)	

Data are presented as mean±SD & numbers; ranges & percentages are in parenthesis

Table 2. Patients preoperative clinical data

Data			Findings
Operative procedure		Graft interposition	25 (62.5%)
	Modified Bentall	15 (37.5%)	
CPB data	Cannulation approach	Distal ascending aortic cannulation and traditional CPB + aortic cross clamp.	23 (57.5%)
		Femoro- femoral bypass then hypothermia and circulatory arrest.	11 (27.5%)
		Subclavian artery cannulation & selective antegrade cerebral perfusion	6 (15%)
	Time (hr)		4.8±1.2 (3-8)
Ischemia time (hr)			3.7±0.7 (3-5)
Total operative time (hr)			7.3±1.1 (6-10)
Intraoperative events		Morbidities	0
		Mortality	0

Data are presented as mean±SD & numbers; ranges & percentages are in parenthesis

Table 3. Operative data

Data			Findings
Observation times	Duration of mechanical ventilation		5.7±3.7 (3-19)
	Duration of ICU stay		10.7±4.3 (6-23)
	Duration of hospital stay		19.3±5.9 (8-35)
Early PO complications	Cardiac	Atrial fibrillation	15 (37.5%)
		Acute myocardial infarction	4 (10%)
	Renal	Acute kidney injury (creatinine >2 mg/dl)	11 (27.5%)
		Need dialysis	2 (5%)
	Neurologic	TIA or reversible neurologic deficit	9 (22.5%)
		Focal permanent neurological dysfunction	2 (8%)
		Heavy diffuse neurological deficit	1 (2.5%)
		Decrease level of consciousness or coma	1 (2.5%)
	Pulmonary	Chest infection	1 (2.5%)
		Acute respiratory failure	1 (2.5%)
	Bleeding required re-operation		6 (15%)
In-hospital mortality	Causes	Intraoperative death during re-operation for bleeding control	1 (2.5%)
		Acute respiratory failure	1 (2.5%)
		Acute myocardial infarction	1 (2.5%)
		Multiple organ failure	1 (2.5%)
	Total frequency		3 (7.5%)

Data are presented as numbers; percentages are in parenthesis

Table 4. Early postoperative events

The 2nd patient developed acute kidney injury on top of chronic renal impairment and patient died 20 month after hospital discharge. The 3rd patient developed acute myocardial infarction on top of chronic cardiac ischemia and could not respond to medical treatment and died at 3 years after surgery. The 4th patient was diabetic and developed hyper-osmolar attack with concomitant acidosis and failed to respond to treatment, but progressed to deep coma and failed to respond to treatment.

Discussion

The current study evaluated the outcome of surgical interference for acute dissecting aortic aneurysm; demographic data showed a higher frequency of male (77.5%) and had mean age of about 60 years and all had associated risk factors wherein 29 patients hypertensive, 24 patients were diabetic, 11 patients were still smokers and 16 patients were ex-smokers. As regards associated medical co-morbidities; 7 patients had coronary artery disease, 4 patients had renal impairment, 3 patients had chronic obstructive pulmonary disease, 3 patients had peripheral artery disease and two had previous cerebro-vascular accident. These findings indicated the liability of old males who were smokers and had risk factors and associated medical condition for development of aortic dissection with a high possibility of presenting as emergency case.

In line with these data the **National Center for Injury Prevention and Control** [9] documented that depending on age, aortic aneurysms are the 17th most common cause of death in the USA, with a peak incidence during the 6th and 7th decades of life. Moreover, **Harris et al.** [10] documented that men are two to four times more frequently affected than women and aortic dissection is diagnosed later in women; that is, the delay from onset of symptoms to diagnosis is longer than in male patients. **Cetin et al.** [11]**, (2012)** investigated whether cardiovascular risk factors, epicardial adipose tissue and vascular structure and functions are independently related to ascending aortic dilatation and found smoking, endothelial dysfunction, and increased epicardial adipose tissue may be suggested as risk factors for ascending aortic dilation due to local or systemic effects in hypertensive patients.

In the majority of cases (57.5%) distal ascending aortic cannulation was used for arterial return, in line with the feasibility of ascending aortic cannulation; **Taguchi et al.** [12] documented that ascending aortic cannulation for an antegrade central perfusion during surgery for type A aortic dissection is simple and feasible with no complications related to cannulation. Also, **Kanamori et al.** [13] reported that antegrade perfusion can be established safely and easily using the direct true lumen cannulation, which may be a promising standard arterial cannulation technique for the repair of acute type A aortic dissection.

In the remaining cases surgeries were performed under hypothermia and circulatory arrest in 11 cases and subclavian artery cannulation and selective antegrade cerebral perfusion in 6 cases. In line with the used approaches for cannulation, **Czerny et al.** [14] analysed the results after elective open total aortic arch replacement and documented that the sites of cannulation for arterial return were a direct cannulation approach via the native ascending aorta in 51.3% and the right axillary/subclavian artery was used in 41%.

Early PO events included atrial fibrillation (37.5%), acute myocardial infarction (10%), acute kidney injury (27.5%), neurological events (35%) and acute respiratory failure (2.5%). Six patients (15%) required re-operation for operative site bleeding that was controlled but one patient died intraoperatively (2.5%). Mean total hospital stay and follow-up period were 19.3±5.9 days and 42.8±14 months, respectively. Three mortalities occurred during follow-up.

These figures coincided with **Lohse et al.** [15] who reported that postoperative morbidity due to stroke was 6%, to bleeding 6%, and to myocardial infarction 4.4% after replacement of the ascending aorta in patients with true aneurysm. **Dunne et al.** [16] who recorded operative mortality rate of 3.3% and mortality rate of 12.3% through a mean follow-up period of 67.1 months. **Roh et al.** [17] reported that acute kidney injury was common after aortic surgery for acute dissection with or without moderate hypothermic circulatory arrest and worsened 30-day mortality and prolonged CPB and increased preoperative serum creatinine were independent risk factors for AKI, but moderate hypothermic circulatory arrest was not. Recently, **Mariscalco et al.** [18] reported that AKI after aortic root replacement operations with valve conduit for ascending aorta aneurysms occurred by a frequency of 16.7% and 2% require dialysis and is associated with increased utilization of health resources.

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Impact of Body Mass Index on the Outcome of Coronary Artery Bypass Grafting Surgery: A Prospective Observation Study

Ibrahim Kasb, MD;

Tamer Hamdy, MD

Objectives: **To analyze the effect of body mass index (BMI) on early outcome of patients after coronary artery bypass grafting (CABG) surgery**

Patients & Methods: **The study included all patients assigned for CABG surgery. Patients were categorized according to BMI index into underweight; normal weight, overweight, Obese class I-III. Preoperative demographic and clinical data and operative data were recorded. Postoperative (PO) data including duration of ICU stay, amount of chest tube drainage, frequency of PO events were recorded and categorized according to BMI of studied patients.**

Results: **Obesity was more predominant among females with significantly higher frequency of high BMI among females. Obesity was significantly associated with co-morbidities especially diabetes mellitus and dyslipidemia. There was non-significant difference between studied groups as regards age and left ventricular ejection fraction (EF). The frequency of GIT manifestations was significantly higher in overweight-obese patients compared to underweight patients. Fourteen patients developed PO pneumonia and 15 patients developed PO stroke with significantly higher frequency among underweight patients compared to normal weight and overweight-obese patients. Other morbidities and mortality showed non-significant difference between studied patients. Mean PO hospital stay was 9.6±1.9; range: 7-15 days with non-significant difference between studied groups.**

Conclusion: **CABG surgery in obese patients up to >40 kg/m² is feasible and safe procedure. The frequency of PO morbidities was non-significantly higher compared to normal weight patients. The GIT manifestations were the most frequent PO morbidities of obese patients. Underweighted patients were more risky candidates of CABG surgery and were more vulnerable to develop PO morbidities especially pneumonia.**

KEYWORDS: **Coronary Artery Bypass Grafting Surgery, Body Mass Index, Postoperative Morbidities, Mortality**

Coronary heart disease (CHD) is a condition in which there is an inadequate supply of blood and oxygen to a portion of the myocardium; it typically occurs when there is an imbalance between myocardial oxygen supply and demand. It is one of the leading causes of mortality and disability in both industrialized and developing countries. It was estimated that heart disease and stroke are projected to be the single leading cause of death by 2030 [1-3].

Obesity is a condition of excessive body fat, an individual must be considered obese when the amount of fat tissue is increased to such an extent that physical and mental health are affected and life expectancy reduced. Obesity is a worldwide epidemic with increasing importance in both industrialized and developing countries. Obesity and its co-morbidities are recognized risk factor for the development of coronary artery disease, poor cardiovascular health and shortened lifespan. These obese patients traditionally have been labeled as higher risk candidates for coronary artery bypass grafting (CABG) surgery and have been turned down for surgery [4-8].

Despite the medical hazards of obesity, recent reports examining body mass index (BMI) show an inverse relationship with morbidity and mortality in the surgical patient. This phenomenon is known as the 'obesity paradox'. The obesity paradox has been demonstrated in cardiac and in non-cardiac surgery patients. Underweight and

Banha Faculty of medicine, Banha University

Codex : o3/07/1402

morbidly obese patients displayed the worse outcomes, both postoperatively as well as at long-term follow-up [9, 10, 11].

The current prospective comparative study aimed to analyze the effect of body mass index (BMI) on early outcome of patients after coronary artery bypass grafting (CABG) surgery

Patients & Methods

The current study was conducted at Cardiothoracic Surgery, Benha University Hospital and Nasser Institute, Cairo since Jan 2010 till March 2013. After approval of the study protocol by the Local Ethical Committee and obtaining a written fully informed patients' consent all patients assigned for CABG surgery were enrolled in the study.

All patients underwent clinical evaluation for demographic data including age, gender, weight (Wt) and height (Ht) and calculation of BMI according to the equation: BMI= Wt (in kg)/ Ht (in meter^2) [12]. Patients were graded according to the international classification of BMI into: underweight (BMI<18.5); normal weight range (BMI=18.5-24.99); overweight (BMI=25-29.99); Obese class I (BMI=30-34.99); Obese class II (BMI=35-39.99), Obese class III (BMI>40)[13,14]. Preoperative clinical data included presence of associated co-morbidities, risk factors; functional status was assessed according to NYHA classification (Table 1[15]. Preoperative trans-thoracic echocardiographic (TTE) assessment of heart chambers' dimensions, left ventricular ejection fraction (LVEF) and valvular function was also conducted.

Operative data included number of grafted vessels, aortic cross clamping time, CPB time and total operative time. During the early post-operative period duration of ICU stay and amount of chest tube drainage, and the frequency of postoperative events including the frequency of perioperative morbidities and its management and/or mortalities were recorded and categorized according to BMI of studied patients.

The New York Heart Association (NYHA) Functional Classification in a Patient with Heart Disease [11]

Limitations on Physical Activity	Symptoms with Ordinary Physical Activity	Status at rest	Class
None	None	Comfortable	I
Slight	Symptomatic with ordinary activities	Comfortable	II
Marked	Symptomatic at less than ordinary activities	Comfortable	III
Unable to perform any activity	Discomfort with any activity	Symptomatic at rest	IV

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 (X^2 test). 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 434 patients; 33 patients were underweight with mean BMI of 18.1±0.2 kg/m^2, 38 patients were in normal weight range with mean BMI of 23.2±1.5 kg/m^2, 190 patients were overweight with mean BMI of 28±1.2 kg/m^2 and 173 patients were obese; 143 patients were of class I with mean BMI of 32±1.2 kg/m^2, 21 patients were of class II with mean BMI of 36.5±1.3 kg/m^2 and 9 patients were of class III with mean BMI of 42.3±2.2 kg/m^2, (Table 2).

Mean age of studied patients was 62.2±4.2; range: 43-74 years; obese class III patients were non-significantly younger than normal weight and underweight patients who were non-significantly older than normal weight patients. The study included 262 males and 172 females. The frequency of females was significantly higher among obese class II and III compared to normal weight and underweight patients, while was significantly lower among underweight compared to normal weight patients with non-significant difference in female frequency between normal weight, overweight and obese class I patients. The frequency of patients had previous history of CABG, MI, and cerebrovascular diseases was significantly higher among overweight and obese compared to normal and underweight patients with non-significant difference between normal and underweight patients. The frequency and number of associated co-morbidities were significantly higher in overweight and obese patients compared to underweight and normal weight patients. However, patients' distribution among NYHA class and the determined left ventricular ejection fraction showed non-significant difference among studied patients, (Table 3).

All patients had uneventful operative course without intraoperative complications or mortalities. Mean ischemia time was 57.2±9.5; range: 35-80 minutes, mean CPB time was 76.7±12.3; range: 45-110 minutes and mean total operative time was 188.9±21.5; range: 130-220 minutes. Mean number of grafted vessels was 3.8±0.9; range: 3-5 vessels. There was non-significant (p>0.05) difference between studied groups as regards operative data. Mean duration of postoperative mechanical ventilation was 4.8±1.2; range: 3-7 hours and mean duration of ICU stay was 61.1±20.2; range: 24-110 hours. Mean amount of chest tube drainage was 1070.7±123.8; range: 900-1400 ml, (Table 4).

BMI Class	Frequency	Weight (kg)	Height (cm)	BMI (kg/m^2)
Underweight	33 (7.6%)	52±1.5 (49-57)	169.3±2.1 (165-176)	18.1±0.2 (17.4-18.3)
Normal weight	38 (8.8%)	66.7±5.5 (52-75)	169.6±4.1 (163-178)	23.2±1.5 (18.9-24.8)
Overweight	190 (43.8%)	80.6±4.3 (69-93)	169.7±3.3 (163-178)	28±1.2 (25-29.8)
Obese class I	143 (32.9%)	91.5±4.5 (85-107)	169±2.6 (167-178)	32±1.2 (30-34.7)
Obese class II	21 (4.8%)	105.3±5.1 (98-118)	169.9±2.4 (167-177)	36.5±1.3 (34.1-39.1)
Obese class III	9 (2.1)	119.9±6.7 (109-132)	168.4±1.9 (165-171)	42.3±2.2 (40-46.2)
Total	434 (100%)	82.7±13.8 (49-132)	169.4±3 (163-178)	28.8±4.8 (17.4-46.2)

Data are presented as mean±SD & numbers; ranges & percentages; BMI: body mass index

Table 2. Patients' distribution according to their BMI data

		Under-weight	Normal weight	Over-weight	Obese class I	Obese class II	Obese class III	Total
Number		33 (7.6%)	38 (8.8%)	190 (43.8%)	143(32.9%)	21 (4.7%)	9 (2.1%)	434 (100%)
Age (years)		62.2±7.9	59.3±8.2	60.4±6.8	60.2±7.1	61.3±9.3	58.6±9.8	62.2±4.2
Gender	Male	27 (81.8%)	25 (65.8%)	108 (56.8%)	90 (62.9%)	9 (43%)	3 (33.3%)	262 (60.4%)
	Female	6 (18.2%)[a]	13 (34.2%)	82 (43.2%)	53 (37.1%)	12 (57%)[ab]	6 (66.7%)[ab]	172 (39.6%)
Smoking	Current	4 (12.2%)	9 (23.7%)	36 (20%)	23 (16.1%)	2 (9.5%)	1 (11.1%)	75 (17.3%)
	Ex	18 (54.5%)	14 (36.8%)	49 (25.8%)	29 (20.3%)	4 (19.1%)	1 (11.1%)	115 (26.5%)
	Non	11 (33.3%)	15 (39.5%)	105 (55.2%)	91 (63.6%)	15 (71.4%)	7 (77.8%)	244 (56.2%)
Previous history	CABG	1 (3%)	2 (5.3%)	24 (12.6%)	17 (11.9%)	2 (9.5%)	1 (11.1%)	47 (10.8%)
	MI	2 (6.1%)	4 (10.6%)	30 (15.8%)	32 (22.4%)	5 (23.8%)	2 (22.2%)	75 (17.3%)
	CVD	2 (6.1%)	3 (7.9%)	27 (14.2%)	16 (11.2%)	2 (9.5%)	2 (22.2%)	52 (12%)
	Total	5 (15.2%)	9 (23.7%)	81 (42.6%)[ab]	65 (46%)[ab]	9 (42.9%)[ab]	5 (55.6%)[ab]	52 (12%)
Associated co-morbidities								
DM		2	9	57	73	17	7	165 (38.5%)
Dyslipidemia		8	13	145	109	19	8	302 (69.6%)
Renal dysfunction		4	3	21	25	4	2	59 (13.6%)
COPD		0	1	5	9	2	4	21 (4.8%)
PVD		2	1	10	12	3	1	29 (6.7%)
Hypertension		16	13	146	119	14	6	314 (72.4%)
Valve disease		3	2	13	10	5	3	36 (8.3%)
AF		0	3	9	7	3	2	24 (5.5%)
Mean number of co-morbidities		1.06±1.12	1.18±0.8	2.13±0.7[ab]	2.55±1[ab]	3.2±0.7[ab]	3.67±0.5[ab]	
NYHA class	I	6 (18.2%)	7 (18.4%)	25 (13.2%)	17 (11.8%)	2 (9.5%)	1 (11.1%)	58 (13.4%)
	II	7 (21.2%)	8 (21.1%)	40 (21%)	16 (11.2%)	4 (19%)	2 (22.2%)	77 (17.7%)
	III	11 (33.3%)	13 (34.2%)	71 (37.4%)	62 (43.4%)	9 (42.9%)	4 (44.5%)	170 (39.2%)
	IV	9 (27.3%)	10 (26.3%)	54 (28.4%)	48 (33.6%)	6 (28.6%)	2 (22.2%)	129 (29.7%)
EF%	<35	7 (21.2%)	6 (15.8%)	14 (7.3%)	11 (7.7%)	3 (14.3%)	2 (22.2%)	43 (9.9%)
	35-44	6 (18.2%)	7 (18.4%)	57 (30%)	37 (25.9%)	5 (23.8%)	2 (22.2%)	114 (26.3%)
	45-54	11 (33.3%)	8 (21.1%)	57 (30%)	52 (36.3%)	8 (38.1%)	2 (22.2%)	138 (31.8%)
	55-59	8 (24.2%)	7 (18.4%)	37 (19.5%)	29 (20.3%)	4 (19%)	1 (11.1%)	86 (19.8%)
	60-69	1 (3%)	10 (26.3%)	25 (13.2%)	14 (9.8%)	1 (4.8%)	2 (22.2%)	53 (12.2%)
	Mean	47.7±10	49.4±12.2	49.3±9.5	49.1±9	48.4±8.6	47.7±11.1	49±9.7

Data are presented as mean±SD & numbers; percentages are in parenthesis; CABG: coronary artery bypass graft; MI: myocardial; CVD: cerebrovascular disease; DM: diabetes mellitus; COPD: chronic obstructive pulmonary disease; PVD: peripheral vascular disease; AF: atrial fibrillation; NYHA: New York Heart Association; EF: Ejection fraction; [a]: significant versus underweight; [b]: significant versus underweight

Table 3. Preoperative enrollment data of studied patients categorized according to BMI categories

	Under-weight	Normal weight	Over-weight	Obese class I	Obese class II	Obese class III
Ischemic time (min)	54.8±9.3	57.7±10.5	56.6±9.3	58.2±9.1	58.9±13.2	57.3±10.6
CPB time (min)	75.5±11.4	74±11.2	75.3±11	79.7±13.6	81±14.4	82.8±15.2
Operative time (min)	182.5±26	190.6±18.7	188.2±21.6	189.5±21	194±22.5	197±16.7
Number of grafted vessels	3.7±0.9	3.6±0.8	3.7±0.7	3.8±0.9	4.1±0.7	4±0.7
Sinus rhythm resumption	29 (88%)	34 (89.5%)	174 (91.6%)	128 (89.5%)	18 (85.7%)	8 (88.9%)
Need for defibrillation	4 (12.1%)	4 (10.5%)	16 (8.4%)	15 (10.5%)	3 (14.3%)	1 (11.1%)
Need for inotropic support	5 (15.2%)	5 (13.2%)	26 (13.7%)	23 (16.1%)	4 (19%)	2 (22.2%)
Re-operation rate	1 (3%)	2 (5.3%)	5 (2.6%)	4 (2.8%)	1 (4.8%)	1 (11.1%)
Duration of mechanical ventilation (hours)	4.7±1.3	4.6±1	4.7±1.1	5±1.2	5±1.1	4.8±1
ICU stay (hours)	69.3±18	65.6±13.7	68.2±9.3	64.7±19.7	66.9±17.7	67.3±17.4
Amount of chest tube drainage (ml)	1080±124	1081.6±125	1072.9±124	1062.2±119	1076.2±129	1066.7±187

Data are presented as mean±SD & numbers; percentages are in parenthesis; CPB: cardiopulmonary bypass; ICU: intensive care unit; [a]: significant versus underweight; [b]: significant versus underweight

Table 4. Operative and immediate postoperative data

Unfortunately, 14 patients developed postoperative pneumonia; 4 patients (12.1%) had BMI<18.5 kg/m^2, 9 patients (2.5%) had BMI >30 kg/m^2 and only one of normal weight (2.6%) patients. The frequency of PO pneumonia was significantly higher among underweight patients compared to normal weight and overweight-obese patients (X^2=9.306 & 10.562, respectively; p<0.01) with non-significantly (X^2=0.922, p>0.05) lower frequency in overweight-obese patients compared to that of normal weight patients. On contrary, GIT manifestations were more frequent in overweight-obese with significant difference compared both to underweight (X^2=3.723; p<0.05) and normal weight (X^2=3.582; p<0.05) patients with non-significant (X^2=1.416; p>0.05) difference between underweight and normal weight patients, (Fig. 1). Fifteen patients developed stroke; 4 of underweight patients (12.1%), 2 of normal weight patients (5.3%) and 9 of over-obese patients (2.5%) with significantly (X^2=10.562; p<0.01) higher frequency among underweight compared to overweight-obese patients with non-significantly higher between normal weight patients versus underweight (X^2=2.213; p>0.05) and over-obese patients (X^2=1.734; p>0.05). Eight patients developed deep sternal wound infection, all patients received appropriate antibiotic according to wound swab culture and sensitivity test concomitant with frequent wound dressing; 5 of these patients were diabetics and responded to intensive insulin therapy with non-significant difference between studied groups. Fourteen patients required re-operation and 9 patients developed postoperative AF with non-significant difference between studied patients as regards the frequency of re-operation or POAF. Mean postoperative hospital stay was 9.6±1.9; range: 7-15 days and was non-significantly (p>0.05) lower in normal weight compared to underweight and overweight-obese patients, (Table 5).

	Under-weight	Normal weight	Over-obese
Pneumonia	4 (12.1%)[a]	1 (2.6%)	9 (2.5%)[b]
GIT manifestations	1 (3%)	2 (5.3%)	43 (11.8%)[ab]
Stroke	4 (12.1%)	2 (5.3%)	9 (2.5%)[b]
Sternal wound infection	1 (3%)	1 (2.6%)	6 (1.7%)
AF	1 (3%)	1 (2.6%)	7 (1.8%)
Re-operation	1 (3%)	2 (5.3%)	11 (3%)
Hospital stay (days)	9.1±1.9	8.8±1.8	9.6±1.9
Mortality	3 (9.1%)	2 (5.3%)	10 (2.8%)[b]

Data are presented as numbers; percentages are in parenthesis; AF: atrial fibrillation; GIT: gastrointestinal tract; [a]: significant versus normal weight; [b]: significant versus underweight

Table 5. Postoperative morbidities and mortalities

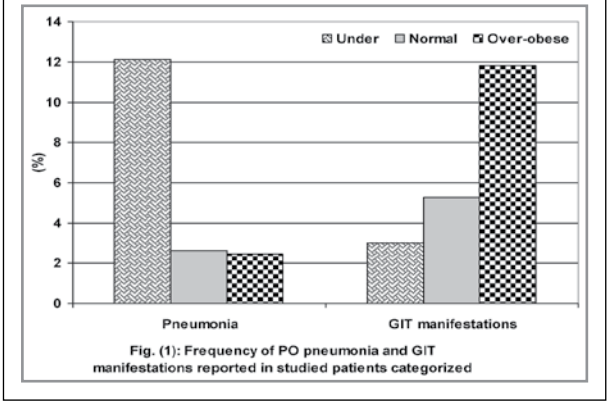

Fig. (1): Frequency of PO pneumonia and GIT manifestations reported in studied patients categorized

Discussion

The current study reported multiple interesting data concerning the relationship between body mass index (BMI) and outcome of CABG surgery. Firstly, there was non-significant difference between studied groups as regards age and left ventricular EF, while obesity was more predominant among females with significantly higher frequency of high BMI among females. Moreover, obesity was significantly associated with co-morbidities other than the cardiac lesion, especially diabetes mellitus and dyslipidemia.

Secondly, despite the high frequency of obesity associated co-morbidities, the frequency of surgery related PO morbidities and mortality was higher among underweight patients than in overweight and obese patients in relation to those of normal weight. These data indicated two facts; the first is that underweight patient is more vulnerable to PO complications than normal or overweight patients. The second is that high (Obese class II) and morbid (Obese class III) obesity could not be considered as a contraindication for CABG surgery and consequently any type of cardiac surgery even if CABG is combined with valve lesion surgery.

In line with these data, **Engel et al.** [16] documented that despite the co-morbidities that are often present with obesity, an obese BMI was not found to be an independent predictor of morbidity or mortality after CABG; on the contrary, the underweight patients are at greater risk for mortality and complications after CABG surgery. **Thourani et al.** [17] investigated the relationship between BMI and mortality after valvular surgery and found patients with BMI >35 were significantly younger and more likely to be female, but mean EF was similar among BMI groups. Patients with BMI in range of 25-35 had significantly shorter PO length of stay compared to those had BMI <25 or >35, while in-hospital mortality was significantly higher in patients had BMI <25 with significantly lower actual survival at 1, 3, 5, and 10 years compared to other BMI groups and concluded that a lower BMI was a significant independent predictor for both in-hospital and long-term mortality. **Demir et al.** [18] documented that obesity does not increase short-term mortality for open heart surgery.

Recently, **Wang et al.** [19] documented that obesity was common and was present in over a third of patients undergoing CABG with 13% of the entire cohort being morbidly obese, however, mortality and morbidity rates did not differ across BMI categories and obesity should not be considered a risk factor for adverse outcomes after CABG and should not be a contraindication for surgery. **Cassuto et al.** [20] reported that obesity and statin therapy are independently associated

with an enhanced dilator function of coronary arterioles in patients undergoing heart surgery, which may offer a potential mechanism for the better cardiovascular outcome described earlier as the obesity paradox. **Benedetto et al.** [21] found early mortality after CABG surgery was not affected by overweight, obesity, and morbid obesity, however, overweight status was not protective for late death as compared with normal weight patients, both obese and morbidly obese patients had a higher risk of late death.

In support of the safety of elective cardiac safety in obese patients, **Sun et al.** [22] found extreme obesity of >50 kg/m^2 is not a contraindication to elective cardiac surgery and did not emerge as a significant risk factor for operative mortality and other adverse outcomes; however, extreme obesity was a risk predictor for longer ICU stays with one-year survival rate of 82.5%. **Kocz et al.** [23] reported that patients who lost weight preoperatively faced a significantly increased risk of mortality than those who experienced no changes or gained weight after surgery and concluded that obesity confers a survival advantage in the setting of the CABG surgery and weight loss among all BMI categories of patients studied results in an adverse effect on postoperative survival

Thirdly, the frequency of GIT manifestations was significantly higher in overweight-obese patients compared to underweight patients. In line with this finding, **Demir et al.** [18] found that in patients undergoing open cardiac surgery, pulmonary and infective complications were significantly higher in extremely obese patients compared to non-obese reference patients based on crude confidence interval and by adjusting the effects of age, sex, co-morbidities (diabetes mellitus, hypertension, hyperlipidemia, chronic obstructive pulmonary disease), and smoking, the incidence of pulmonary and gastrointestinal complications and the discharge with morbidity were significantly higher in obese and extremely obese patients compared reference group.

It could be concluded that CABG surgery in obese patients up to >40 kg/m^2 is feasible and safe procedure. The frequency of PO morbidities was non-significantly higher compared to normal weight patients. The GIT manifestations were the most frequent PO morbidities of obese patients. Underweighted patients were more risky candidates of CABG surgery and were more vulnerable to develop PO morbidities especially pneumonia.

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Aortic Valve Replacement Using Size 19mm Mechanical Bileaflet Valve

Sameh Mostafa Amer

Background: Aortic valve replacement (AVR) in small aortic annulus present a dilemma and technical challenge to the surgeon. Choice of valve size is one of the most important decision for patient with aortic stenosis (AS), good sized valve offers more satisfactory results. Aortic root enlargement procedure by itself carry more complications so cost benefit ratio must be considered.

Aim: The aim of this study was to assess the outcome of patients with (AS) after implantation of size 19mm mechanical bileaflet valve, to detect the incidence of prosthetic patient mismatch (PPM) and to determine its effect on regression of left ventricular mass.

Patients and Methods: Between 2005 and 2013. Thirty four patients with small aortic annulus underwent aortic valve replacement (AVR) using size 19mm mechanical bileaflet valve in Mansoura university hospital and Damietta cardiology and gastroenterology center, there was 15 males (44%) and 19 females (56%) with a mean age of 27.44 ± 4.3 years. The body surface area (BSA) of these patients ranged from 1.1 m2 to 2.2 m2 with a mean of (1.56 ± 2.8). All patients were subjected to full history taking, clinical examination, routine laboratory tests, ECG examination and echocardiography examination which was done pre-operatively and post-operatively (one and six months later).

Results: Preoperatively 65% of our patients were in NYHA class III and IV, 6 month postoperatively 3% only were in class III & IV ($P < 0.001$). EF% showed initial non significant improvement reaching a mean of (58.3 ± 23%) versus (57.83 ± 4.6%) preoperatively while 6 months later there was marked improvement to reach (65.15 ± 33%) ($P < 0.001$). The mean LVM regressed from a mean of 371.92 gm to 336 ± 11.3 gm ($P < 0.05$) and 289.17 ± 4.1 gm ($P < 0.001$) 1 and 6 months postoperatively. These were reflected on LVMI which showed marked regression reaching 189.34 ± 22.5 gm/m2 6 months postoperatively versus 249.46 ± 36.2 gm/m2 preoperatively ($P < 0.001$). There was significant drops of the man PSPG reaching a mean of 18.9 ± 6.35 mmgh six months postoperatively versus 69.42 ± 13.3 mmHg preoperatively ($P < 0.001$). Moderate PPM occurred in 88% of our patients which sever PPM in the remaining 12% of patients. Patients with mean BSA of 1.3 m2 (56%) showed more prounuced figures of statistically significant improvement regarding reduction of LVM, LVMI and drops of PSPG while patients with a mean BSA of 2.1 m2 (12%) showed non significant reduction of LVM, LVMI but with significant drop of PSPG ($P = 0.05$), the remaining 32% of patient with mean BSA of (1.58 m2) showed intermediate figures of statistically significant improvement.

Conclusion: AVR using size 19mm mechanical valve provides regression of LVM, LVMI and satisfactory reduction of PSPG across the valve, the beneficial effect is more obvious in patients with BSA till 1.58m2 while this effect is attenuated in patients with BSA more than 2 m2. Large EOA may offer faster rate of left ventricular mass regression

Cardiothoracic Surgery Department, Mansoura University

Codex : o3/08/1402

Left ventricular hypertrophy occurs in Aortic stenosis (AS) as a physiological response to an elevated left ventricular pressure secondary to a gradient at the level of the aortic valve, correction of valve lesion produces regression of left ventricular hypertrophy (1).

Sever AS was defined as aortic valve of less than 0.6 cm2/m2 or a peak gradient more than 50 mmHg (2). Beyond the prolongation of life. The improvement of a patient's quality of life is also an important objective of Aortic valve replacement (AVR) (3). The appropriate choice of valve size is one of the most important decisions in surgery, a good choice is associated with reduction of the left ventricular mass (4).

Prosthetic patient mismatch (PPM) is present when the effective orifice area (EOA) of the inserted prosthesis is too small in relation to the body size its haemodynamic sequence is to generate higher than expected gradient through normally functioning prosthetic valve (5).

PPM is classified by EOA index categories in relation to body surface area :

- No PPM when EOA ³ 0.85 cm2/m2.
- Mild to moderate PPM where EOA ³ 0.65 to < 85 cm2/m2.
- Severe PPM when EOA < 0.65 cm2/m2 (6)

EOA of the prosthetic valve is defined in term of the geometric internal orifice diameter in millimeters crossponding to the manufacture's label size (7).

Patients has severe PPM with large body surface area, Complications such as persisting or even increasing of the LVM, harmolysis and sudden death are produced (8).

Many techniques have been developed to enlarge the aortic annulus, however these techniques sometimes are difficult to be achieved in calcified or fragile tissues that increases the risk in critically ill patient (9).

Aim of The Study

The aim of this study was to assess the outcome of patients with (AS) after implantation of size 19mm mechanical bileaflet valve, to detect the incidence of prosthetic patient mismatch (PPM) and to determine its effect on regression of left ventricular mass.

Patients and Methods

This study was conducted in Mansoura university hospital and Damietta cardiology and gastroenterology center from (2005 – 2013) including follow up period.

The study involved 34 patients with AS for whom AVR was done, Included in this study adult patients ³ 18 years with predominant AS who underwent isolated AVR for the first time with bileaflet mechanical aortic valve sizing 19mm, Patients with other than these criteria were excluded, also unsurvived patients were excluded.

All patients were subjected to preoperative full history taking, physical examination, routine laboratory investigation and ECG examination.

Echocardiography was the corner stone in the evaluation of all patients pre, 1 month and 6 months postoperatively.

In all patients ejection fraction (EF%) and peak systolic pressure gradient (PSPG) across the valve were obtained also left ventricular mass (LVM) & left ventricular mass index (LVMI) were calculated as follows:

- LVM (Gms) = 1.04 x [(LVEDP + IVSD + LVPWD) – (LVEDD)3]
- LVMI (Gms/m2) = LVM / BSA.

Where:

- LVEDD left ventricular end diastolic diameter (cm).
- LVSD left ventricular septal thickness (cm).
- LVPWd left ventricular posterior wall thickness (cm).
- BSA Body surface area (m2). (10)

The effective orifice area (EOA) of the prosthetic valve was the geometric internal orifice diameter in centimeters crosspoding to the manufacture's label size then the EOA was indexed to BSA giving EOAI which expressed in cm2/m2 (7).

All patients were operated upon electively through a classic standard median sternotomy. Routine cannulation and cardiopulmonary bypass with moderate systemic hypothermia (28ºC) were used. Left ventricular vent through the right superior pulmonary vein or pulmonary artery was inserted. We used cold crystalloid cardioplegia which was delivered in antegrade manner in the aortic root, myocardial cooling using packed iced saline slush was used. Cardioplegia was re-injected every 30 minutes or on return of electrical activity of the heart. A hocky stick aortotomy 2 cm above the aortic annulus was done. The leaflets of the aortic valve were excised.

Meticulus debridement of the aortic annulus was done in calcified valve. Interrupted ticron maltress sutures with or without Teflon pledgets were used. After proper sizing of the aortic valve prosthesis No 19mm valve was inserted, double layers of 4.0 prolene sutures were used to close the aortic incision after testing of the prosthesis.

We used HP (haemodynamic plus) and reduced ring valves design to increase the EOA of the used prosthesis.

Carbomedics, St judge and ATS valves were used randomly offering a mean EOA of (1.24 cm2).

No other surgical procedures were done in association with AVR.

Statistical analysis

Data were first tested for normality by Klomogorov-Smirnov test. Normally distributed continuous data were analyzed by using student t-test. Non-normally distributed continuous and ordinal data were analyzed using Mann-Whitey U test. Categorical data were analyzed by Chi-square or Fisher's exact test as appropriate. The results are presented as mean (SD), median (interquartile range), or number of patients as appropriate. A P value < 0.05 was considered statistically significant. Statistical analyses were performed using the SPSS for Windows, version 18 .

Results

The demographic data, etiology and clinical presentations are show in table I.

Age (mean ± SD) years	27.44 ± 4.3	
	No	%
Gender		
Male	15	44%
Female	19	56%
Aetiology		
Rheumatic	31	91%
Congenital	3	9%
Clinical presentation		
Dyspnea	16	47%
Angina	5	15%
Syncope	4	12%
Heart failure	1	3%
NYHA class		
I	1	3%
II	11	32%
III	16	47%
IV	6	18%

N.B: *Some patients had more than one sign and symptom.*
NYHA: *New York Heart Association.*

Table (1)

	Preoperative		**6 month post**		**c^2**	**P-Value**
	No	%	No	%		
I	1	3	27	79		
II	11	32	6	18		
					45.185	0.001
III	6	47	1	3		
IV	16	18	0	0		

P < 0.001 (S).

Table (2) Change of NYHA class 6 months postoperatively.

	Preoperative Mean ± SD	**1 month post** Mean ± SD	**6 months post** Mean ± SD
EF%	57.83 ± 4.5	58.3 ± 2.3 P = 0.02 (S)	65.15 ± 3.3 P1 < 0.001 (S)
PSPG mmHg	69.42 ± 12.3	23.2 ± 4.2 P = 0.001 (S)	18.9 ± 6.3 P1 < 0.001 (S)
LVM gm	3.71 ± 9.2	336 ± 11.3 P 0.05 (S)	289.17 ± 14.1 P = 0.001 (S)
LVMI gm/m2	249.46 ± 36	226.74 ± 32 P < 0.05 (S)	198.34 ± 22 P = 0.001 (S)
BSA m2	1.49	1.46 P (NS)	1.53 P1 (NS)

P Preoperative versus 1 month postoperative.
P1 Preoperative versus 6 months postoperative.

Table (3) Echocardiographic data.

Preoperative BSA m2 Mean ± SD	No	%	**Pre LVM** gm Mean ± SD	**6 months post LVM**	**P-Value**	**Pre PSPG** mmHg Mean ± SD	**6 months post**	**P-Value**
I	1.3 ± 0.42	19	56%	381 ± 6.2	357 ± 7.2	<0.001(S)	68.2 ± 11	16.3 ± 4	<0.001(S)
II	1.58 ± 0.33	11	32%	379 ± 5.2	366 ± 4.2	<0.05(S)	76.3 ± 12	23.3 ± 5	<0.001(S)
III	2.1 ± 0.52	4	12%	384.21 ± 6.3	375.2 ± 41	>0.05(NS)	71.2 ± 14	31.2 ± 6	<0.05(S)

Table (4) Relation between preoperative and changes of LVM and PSPG after 6 months postoperative.

PPM	No	%	NB	c^2	P-Value
Non exciting	0	0	-		
Mild to moderate	30	88%	Group I and II from table (4)	19.88	0.001
Severe	4	12%	Group III from table (4)		

Table (5) Incidence of PPM.

Discussion

AVR is the only effective treatment for patients with AS(12), AVR in small aortic annulus represents a surgical dilemma, whether to use a small prosthetic valve (size 19mm) or to enlarge the annulus which may increase operative mortality(13). The purpose of AVR is to eliminate left ventricular outflow tract obstruction and facilitate regression of left ventricular mass for patients with AS to relieve the symptoms, Ultimately, improvement in patients function of capacity and quality of life are desirable end points (14).

Improvement in clinical status could be monitored and assessed in our patients where 65% of patients were in NYHA class III and IV preoperatively, six months postoperatively there was significant functional improvement and 97% of patients were in class I and II Koch and colleagues (2005) reported improvement in patients. Functional quality of life after AVR for AS even in patients with severe PPM Also, they believed that there was marked improvement in NYHA functional class even in patients where size 17mm prosthetic aortic valve was inserted as factors rather than PPM influence functional quality of life early after AVR (14).

In our study there was improvement of the mean EF% from (57.83 ± 46) preoperatively to(58.8 ± 2.3) after one month and(65.15 ± 3.3) after 6 months, this matches with Abdallah who found marked improvement of EF% from poor to moderate in their patients receiving size 19mm mechanical bileaflet aortic valve (15).

Kennedy and colleagues (1977) explained this finding as they said that an increase in EF% following removal of aortic obstruction is due to either improvement of left ventricular performance, or as a result of reduction of afterload (16).

Our patients showed significant drop of the mean PSPG across the prosthetic valve as its mean value was 69.69±12.3mmHg preoperatively reaching to a mean value of (23.2 ± 4.2 mmHg and 18.9 ± 6.3 mmHg) one month and six months postoperatively. This matched the study of Thomson and colleagues who reported marked drop of the mean PSPG after use of size 19mm bileaflet prosthetic aortic valve from 75.32mmHg preoperatively to 17mmHg six months following surgery (1). Also other investigators concluded that size 19mm prosthetic valve is enough and satisfactory for reduction of PSPG (17,18).

There was significant reduction of the mean LVM from 371 ± 9.2 gm to 336 ± 11.3 gm and 289.17 ± 14.1 gm 1 month and 6 months post AVR, This finding was reflected on the LVMI which showed significant reduction from 249.46 gm/m2 preoperatively to 226.74 gm/m2 after one month ($P < 0.05$) and 198.34 gm/m2 6 months postoperatively ($P = 0.001$).This findings matched with many studies stated that the significant reduction of LVM after AVR for patients with AS reflected on regression of LVMI compared with the preoperative values (18,19).

Many investigators concluded that the long term performance of size 19mm prosthetic valve is satisfactory and remodeling occurred in all patients irrespective of BSA (19,20).

Other investigators demonstrated that small sized valve creates failure of significant reduction of the ventricular hypertrophy (21, 22). Howell and colleagues (2) believed that the degree of the LV hypertrophy and its rate of regression is influenced by a number of genetic and environmental factors including, angiotensin-converting enzyme gene polymorphism, insulin-like growth factor, and hypertension rather than the size of the prosthetic aortic valve.

Regarding the relation between preoperative BSA and postoperative LVM and PSPG we found that:

1) Patients with a mean BSA of 1.3 ± 0.4 m2 recorded highly significant reduction of LVM and drops of the mean PSPG ($P < 0.001$) 6 months postoperatively, this finding matched with the study of Arto and colleagues who recorded marked reduction of LVM and PSPG across the prosthetic AV sizing 19mm in patients with BSA less than 1.45 m2 (23).

2) Patients with a mean BSA of 1.58 m2 reported less significant regression of LVM and less significant drop of PSPG ($P < 0.05$) and ($P = 0.001$) respectively.

3) Patients with a mean BSA of 2.1 m2 reported non significant reduction of LVM and significant drop of PSPG (P = 0.05).

These findings was similar to the opinion of Howell and colleagues who said that mismatch lead to attenuate the benefit obtained from the surgery (2). So, other investigators advised to avoid the use of 19mm mechanical valve in patients with BSA greater than 1.85 m2 (24).

Effective orifice area (EOA) of the prosthetic valve may be based on geometric diameter or functional performance, Geometric diameter presents the internal orifice diameter as labeled by manufacture's conventions (25) while functional size include (a) In vitro diameter which may be static with steady flow or dynamic with pulsatile flow and, (b) in vivo diameter which is affected by range of incompletely controlled conditions when measured by Echocardiography (26).

PPM is defined as not clinically present if EOAI ^{3} 85 cm2/m2, mild to moderate if between ^{3} 0.65,and < 0.85 cm2/m2 and severe if < 0.65 cm2/m2 (6). So, PPM may occur in all patients undergoing AVR with 19mm prosthetic valve but the influence may be less than previously hypothesized (27).

In our study the incidence of mild to moderate PPM was (88%) while severe PPM was (12%) which was comparable with many investigators who analysed patients' data receiving size 19mm prosthetic aortic valve Milano and colleagues (2002) who reported prevalence of severe PPM in 8.1% among their patients also Frapler and colleagues (2003) reported 11.2% severe PPM (25).

When stentless xenograft valve was used the incidence of severe PPM decreased to 3% (5).

Our patients with severe PPM (12%) showed non significant reduction of LVM 6 months post and attenuated significant drop of PSPG compared with patients whith mild to moderate PPM so we believed some authors who concluded that severe PPM not lead to increase rate of mortality but lead to attenuate the benefit derived from operation as the value of large EOA is to accelerate the rate of LVM regression (2).

Conclusion

AVR using size 19mm mechanical valve provides regression of LVM, LVMI and satisfactory reduction of PSPG across the valve, the beneficial effect is more obvious in patients with BSA till 1.58m2 while this effect is attenuated in patients with BSA more than 2 m2. PPM may occur in all patients undergoing AVR with 19mm valve mild to moderate occurred in 88% of patients while severe PPM occur in (12%) of the cases but the influence of PPM may be less than previously hypothesized so we thought that value of the large EOA may offer the faster rate of left ventricular mass regression.

Recommendations

- Use of HP and reduced ring valves to increase EOA of the used prosthesis.
- For patient with large BSA annular enlargement procedure must be considered to insert a valve size more than 19mm but the cost benefit ratio must be considered.

Limitation of the study:

- Not a randomized and does not examine all outcomes (exclusion of mortality).
- Small number of the studied patients and absence of control group.
- Use of different types of prosthetic valves with different EOA.

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Is it Beneficial to Repair Mild to Moderate Functional Tricuspid Regurge in Concomittant with Mitral Valve Replacement ?

Sameh Mostafa Amer

Background: Mild to moderate functional tricuspid regurge (FTR) has a variable natural history as it may regress after successful mitral valve replacement (MVR) without tricuspid repair, or may progress, so the decision to repair mild to moderate FTR in concomitant with MVR remains controversial.

Objectives: To evaluate surgical results in patients with mild to moderate FTR undergoing MVR either with or without concomitant tricuspid repair six months after surgery.

Patients and methods: This study was conducted in Cardiothoracic Surgery Department in Mansoura University Hospital and Damietta Cardiac and Gastroenterology Center from 2005 to 2013. Included 60 patients with mild to moderate FTR who underwent first time isolated MVR for rheumatic mitral valve disease. The patients were randomly divided into 2 groups: group (I) (N=32 patients) for whom tricuspid repair was done in concomitant with MVR and group (II) (N=28 patients) for whom MVR was done alone.

Results: There were 60 patients underwent MVR with mild to moderate FTR the patients were randomly divided into 2 groups: Group (I) (repair group) and group (II) (non repaired group). Preoperatively both groups were similar regarding age, gender, and NYHA functional class without statistically significant difference. Echo data were matched preoperatively in both groups, 6 months after surgery NHYA functional class improved significantly (P=0.01) in both group where (93.4%) patients in group I were in WYHA class I and II, and 94.3% of patients in group II were in NYHA class I and II. six months postoperative echo showed similar finding in both groups regarding left ventricular dimension and transvalvular gradient across the prosthetic mitral valve. Twenty two patients (71%) in group I and 5 patients (13%) of group II had trace or less than grade ITR while persistent more than grade II TR was present in 5 patients (18.3%) in group II. Higher pulmonary artery pressure and larger left atrial and left ventricular dimensions, ICU and hospital stay times were cross matched in both groups.

Conclusion: Concomitant tricuspid valve repair with mitral valve replacement offered better early postoperative tricuspid valve function in patients with mild to moderate functional tricuspid regurge underwent mitral valve replacement for chronic mitral valve disease.

KEY WORD: Tricuspid regurge, functional tricuspid regurge (FTR), Devaga annuloplasty, tricuspid repair with M.V.R.

FTR is not an intrinsic valve disease as the tricuspid leaflets and chordae tendeneae are normal but its main pathology is due to dilatation of right ventricular cavity and tricuspid annulus [(1)], annular dilatation occurs as a result of pressure overload on the right ventricle following raised left atrial pressure, this early pressure overload is accentuated by volume overload once the regurge sets in [(2)].

Concomitant tricuspid valve surgery at the time of mitral valve surgery has been recommended in patients with severe FTR to improve clinical outcomes [(3)]. Mild to moderate FTR presents a surgical dilemma during mitral valve surgery as it may regress after successful mitral valve surgery without repair or may progress requiring repair with increasing risk of redo cardiac surgery [(4)].

Department of Cardiothoracic Surgery, Mansoura University

Codex : o3/09/1402

Patients and Methods

The study was a comparative study conducted in Mansoura University Hospital and Damietta Cardiology and Gastroenterology Center from 2005 to 2013. Included 60 patients with mild to moderate FTR associated with rheumatic mitral valve disease underwent first time elective mitral valve replacement using bileaflet mechanical prosthesis. FTR was defined as tricuspid regurge without organic pathology includes leaflets and or subvalvular apparatus [5], so patients with tricuspid valve prolapse, Ebstein anomaly and organic tricuspid valve disease were excluded from the study. Also, patients underwent concomitant surgery rather than MVR, or redo cardiac surgery were excluded. Patients were divided into 2 groups: Group I (N= 32 patients) included patients underwent MVR with Devega tricuspid annuloplasty. Group II (N= 28 patients) included patients underwent MVR alone.

All patients were subjected to preoperative full history taking, physical examination, routine laboratory investigation and ECG. Echocardiography was the corner stone in evaluation of all patients pre and 6 months after surgery. The degree of tricuspid regurge was evaluated using the apical four chamber view and graded as mild, moderate or severe when the distal jet area was <5 cm^2 – 5:10 cm^2 or >10 cm^2 respectively. Tricuspid regurge grading system as mild TR = grade I TR, moderate = grade II and III TR, severe = grade IV TR [6].

The pulmonary artery systolic pressure was determined using the modified Bernovlli's Formula [2].

In all patients ejection fraction, left ventricular end diastolic diameter, left ventricular end systolic diameter and left atrial dimension were obtained.

Surgical procedures

All patients underwent mitral valve replacement on elective bases using conventional approach consists of median sternotomy approach, routine aortic and bicaval canulation with cardiopulmonary by-pass, moderate systemic hypothermia (28°C: 32°C), left ventricular vent through pulmonary artery. We used cold crystalloid cardioplegia injected in aortic root with myocardial colling using packed iced saline sluch, cardioplegia was re-injected every 30 minutes or in return of electrical activity of the heart. All patients received a bileaflet mechanical valve oriented in anti-anatomical orientation and we attempted to retain subvalvular apparatus when ever possible. In our patients tricuspid repair was done on a beating heart to reduce aortic cross clamp time and to avoid A-V block. Devaga annuloplasty was the technique of choice for tricuspid repair. For the annuloplasty a double row of pledgeted 2/0 ticron stitch starting at the septo-anterior commissure was continued to reach the postero-septal commissure then the two ends were tied over another pledget over a barrel of a 20-ml syringe which was satisfactory to reduce the orifice size without undue strain or excessive reduction of the orifice area, then the tricuspid completence was checked with saline instillated into the right ventricle.

Statistical analysis

Data were first tested for normality by Klomogrov-Smirnov test. Normally distributed continuous data were analyzed by using student t-test. Non-normally distributed continuous and ordinal data were analyzed using Mann-Whitney U test. Categorical data were analyzed by Chi-square or Fisher's exact test as appropriate. The results are presented as mean (SD), median (interquartile range), or number of patients as appropriate. A P-value <0.05 was considered statistically significant. Statistical analysis were performed using the SPSS for Windows, version 18.

Results

	Group I (N=32)		Group II (N=28)		T-test / c^2	P-Value
Age (y) mean ± SD	27.2±6.1		26.4±53		0.538	>0.05
Gender F/M	22/12		20/8		0.318	>0.05
	No.	**%**	**No.**	**%**		
NYHA class:						
I	0	0	0	0		
II	6	18.7	6	21.4	0.143	>0.05
III	23	71.8	20	71.4		
IV	3	9.5	2	7.1		
AF	13	40	11	39.3	0.011	>0.05
HF	1	3.1	1	3.6	0.009	>0.05

N.B: NYHA= New York Heart Association.

Table 1. Demographic data NYHA functional class

The 2 group were matched in the compared data (no statistical significant difference).

Item	Group I (N=32) No.	%	Group II (N=28) No.	%	T-test / c^2	P-Value
Mitral disease:						
Predominant stenosis	20	62.6	19	67.8		
Predominant regurge	6	18.7	4	14.4	0.251	>0.05
Mixed lesion	6	18.7	5	17.8		
Mean mitral valve area cm^2 mean ± SD	1.32±0.82		1.31±0.73		0.05	>0.05
Mean gradient of mitral regurge	2.2		2.1			>0.05
Tricuspid regurge:						
Mild	10	31.2	12	42.8	1.986	>0.05
Moderate	22	68.8	16	57.2		
Mean grade of TR	2.43±0.53		2.3±0.41		1.051	>0.05
EF%	58.3±3.2		57.9±4.2		0.418	>0.05
VEDD mm mean±SD	51.2±3.1		50.3±2.1		1.297	>0.05
LVESD mm mean±SD	39±2.1		38.2±3.1		1.183	>0.05
LAD mm mean±SD	49.4±6.3		47±6.1		1.494	>0.05
PSPG mmHg mean±SD	54.1±6.1		49.8±2.6		1.619	>0.05

The 2 groups showed no statistical significant difference regarding echo data.

N.B: TR= tricuspid regurge, EF= ejection fraction%, LVEDD= left ventricular end diastolic dimension, LVESD= left ventricular end systolic dimension, LAD= left atrial dimension, PSPG= peak systolic transpulmonary gradient.

Table 2. Preoperative Echo data

Parameters	Group I (N=32)	Group II (N=28)	T-test / c^2	P-Value
CBP time (min.) mean ± SD	78.4±22.1	73.2±14.3	1.065	>0.05
Aox time (min.) mean ± SD	46±17.3	47.6±15.1	0.379	>0.05
ICU stay (hours) mean ± SD	37.2±4.2	38.7±3.2	1.539	>0.05
Hospital stay (days) mean ± SD	8.23±3.2	8.7±4.1	0.498	>0.05
ICU mortality	1 (3.1%) persistent low cardiac output	1 (3.5%) fatal arrhythmia	0.009	>0.05
Complications:				
Bleeding and exploration	1 (3.1%)	1 (3.5%)	2.05	>0.05
Wound infection	1 (3.1%)	0 (0%)		
Chest infection	2 (6.2%)	2 (7%)		
Renal failure (need dialysis)	0 (0%)	1 (3.5)		

The 2 groups were matched in perioperative data.

N.B: CPB= cardiopulmonary by-pass, Aox= aortic cross clamp, ICU= intensive care unit.

Table 3. Perioperative data

NYHA	Group I		Group II	
	Pre (N=32)	Post (N=31)	Pre (N=28)	Post (N=27)
Class I	-	28 (90.3%)	-	24 (88.9%)
Class II	6 (18.7%)	2 (6.5%)	6 (21.4%)	2 (7.4%)
Class III	23 (71.8%)	1 (3.2%)	20 (71.4%)	1 (3.7%)
Class IV	3 (9.5%)		2 (7.1%)	
Statistics	$c^2 = 54.167$ P-Value = 0.001		$c^2 = 46.1907$ P-Value = 0.001	

Table 4. NYHA class 6 months after surgery compared with preoperative NYHA in both groups

Item	Group I			Group II		
	Pre (N=32)	Post (N=31)	P value	Pre (N=28)	Post (N=27)	P value
EF% mean±SD	58.3±3.2	63.2±1.1	0.05 S	57.9±4.2	61.8±4.1	0.05 S
LVEDD mm mean±SD	51.2±3.1	47.3±12.1	0.05 S	49.1±2.1	45±2.1	0.05 S
LVESD mm mean±SD	39±2.1	33.8±2.1	0.05 S	38.2±3.1	33.1±21	0.05
LAD mm mean±SD	49.4±6.3	44±2.9	0.05	47±6.1	42.2±3.3	0.05 S
PSPG mmHg mean±SD	54.1±6.1	24.3±9.1	0.05 S	49.3±2.6	28.1±3.2	0.05
Mean grade of TR ±SD	2.43±0.53	1.3±0.6	0.01 S	22.6±2.1	1.43±1.8	0.05 S
TR degree:						
Trace or no	-	22/31 (71%)	0.001 S	12/28	5/27 (18%)	0.05 S
Mild GI	10/32(31.2%)	5/31 (16%)	0.05 S	(42.8%)	13/27(48.1%)	0.08 S
Moderate						
GII	13/32 (40.6%)	4/31 (13%)	0.01 S	9/28 (32.1%)	4/27(14.8%)	0.09 NS
GII : GIII	9/32 (28.1%)	-	0.01 S	7/28 (25%)	5/27(18.3%)	0.13 NS
Mean gradient across prosthetic MV		6.3±1.2			6.41±0.9	>0.05 T=0.39

Table 5. Comparison between pre and 6 months postoperative echo data in both groups

Group (II) data of patients with postoperative TR > grade II compared with patients in the same group with TR < grade II

Parameters	**TR < grade II** (N=22)	**TRE > grade II** (N=5)	**T-test**	**P-Value**
LVEDD mm mean ± SD	4.7±0.7	5.5±0.8	**1.8**	**>0.05**
LVESD mm mean ± SD	3.4±0.53	4.2±0.71	2.87	**0.01**
EF% mean ± SD	60.9±2.2	61.3±3.1	0.341	>0.05
LAD mm mean ± SD	4.2±0.8	4.9±0.7	1.8	**0.05**
PSPG mmHg mean ± SD	27.31±6.3	41.4±5.2	4.634	**0.001**
AF	9/22 (41%)	2/5 (40%)	0.01	>0.05

Table 6. Subgroup analysis.

Discussion

Concomitant TV repair has been less commonly performed owing to the finding suggested that FTR will improve after successful correction of mitral valve disease [5]. Recent studies concluded that severe FTR must be repaired in concomitant with correction of mitral valve as uncorrected severe FTR is associated with poor term outcome [7, 8].

Management of mild and moderate FTR presents a surgical dilemma as there are 2 extreme opinions, first thoughts that mild and moderate FTR will regress after successful mitral valve surgery [4, 9]. Second opinion introduce term of prophylactic tricuspid annuloplasty in mild FTR as it will progress if left at the time of mitral valve surgery [10] due to may factors; (1) continuous expansion of right ventricle and tricuspid annulus, (2) persistent elevation of pulmonary artery pressure with subsequent right ventricular dilatation and/or dysfunction, (3) residual stenosis or regurge of the mitral valve (all prosthetic valves are stenotic and regurgitant), (4) right ventricular dysfunction due to persistent elevation of pulmonary artery pressure, myocardial fibrosis due to rheumatic activity, cardiac arrhythmia and dysfunction following intraoperative or postoperative ventricular ischemia [11]. Till now the decision to perform tricuspid repair specially in mild and moderate FTR depends on surgeon preference [5].

Devaga annuloplasty was the technique of choice for tricuspid repair in our study as it offers a readily available, technically less demanding and cheap alternative to annuloplasty ring, further more it is associated with good postoperative result as believed by many authors [5, 2]. Also, to avoid heterogenecity of different techniques on our results.

We did Devaga annuloplasty procedure in a beating heart as advocated by Abd El-Raouf and colleagues to avoid A-V block and to reduce aortic cross clamp time [12], so in our study the aortic cross clamp time was matched in both groups.

Six months postoperatively, most of our patients in the studied groups were in NYHAI functional class due to the positive effect of successful mitral valve replacement [13, 14].

Postoperative echo showed significant regression of LVEDD, LVESD, LAD in both groups also there was significant drops of PSPG in both groups. This finding can be explained by resolution of high left atrial pressure after successful MVR as postulated by Mahesh and colleagues [14].

The mean grade of tricuspid regurge was significantly reduced in both groups the resolution was more obvious in group I compared with group II (P=0.01) versus (0.05) in group II.

Patient of group I were found to have more patients with trace and less TR compared to group II, as trace TR was present in 71% of patients in group I versus 18% in group II (P=0.05), so we were in line with may studies (with similar patient criteria as our study) demonstrated this findings as Song and colleagues reported < grade I TR in 73% of patients underwent tricuspid annuloplasty with MVR 1 year post surgery [15]. Also Bernal and colleagues had reported excellent results in patients with Devaga annuloplasty in mid and long-term follow up period with 86% of patients with zero to mild TR denoting efficacy of Devaga procedure [8].

In group II (18%) of patients showed TR less than grade I this can be explained as outlines by Hannouch and colleagues who stated that the reduction of the degree of FTR with out repair is due to the impact of MVR on the pulmonary pressure, but its insufficient to produce complete resolution of the tricuspid regurge status [14].

There was persistent > grade II TR in 18.5% of patients in group II, the patient were found to have larger left ventricular diameter at both end diastole and systole this was explained by Fukuda and colleagues who postulated that altered left ventricular diameter affects directly the right ventricular function and geometry via interventricular septum or pericardium so the enlarged left ventricle may have a negative impact on the right ventricular function and tricuspid integrity [16].

On the other hand EF% in our study was preserved so we can not consider it as a predictive factor for persistent TR 6 months after surgery PSPG was found to be significantly more in patients with persistent >GII TR it was 41.4±5.2 mmHg versus 27.31±6.3 in patients with <GII TR (P=0.07, S), the role of pulmonary artery hypertension was documented as a predictor for persistent TR [17].

Left atrium was also larger among patients with persistent >GII TR and was found to be statistically significant (P=0.05). This finding was comparable with Motsuyama and colleague who recommended correction of FTR even if mild in patients with huge left atrium to prevent progression [4].

In our study the preoperative predictors for persistent tricuspid regurge could not be determined due to wide variation in individual response to decrease of left atrial pressure and left ventricular remodeling pattern among our patient. This finding was documented by Predhand and colleagues [2]. Also Mahosh and colleagues found that the preoperative tricuspid annular diameter could be considered as an accurate predictor for the fate of tricuspid regurge. They considered the preoperative left ventricular dimensions, left atrial dimensions and degree of pulmonary hypertension as cofactors that can augment the phenomena of postoperative persistent tricuspid regurge among non repaired group of patients [15].

Postoperative data regarding ICU stay, hospital stay times and total morbidity and mortality were comparable in both groups with no statistical significant difference.

Limitation of the study

Short period of follow up unable us to determine progression of FTR specially persistent TR after surgery. Also, we did not measure the preoperative tricuspid annular diameter.

Conclusion

Concomitant tricuspid valve repair with mitral valve replacement offered better postoperative tricuspid valve function in patients with mild to moderate functional tricuspid regurge underwent mitral valve replacement for chronic mitral valve disease.

Mitral valve replacement (in rheumatic patients) alone could decrease severity of mild to moderate functional tricuspid regurge with less resolution compared with repaired group as there were more patients with persistent regurge and less with trace regurge in comparison with repaired group.

Predictors of persistent moderate functional tricuspid regurge in non repaired group could be, postoperative large left ventricular dimensions, high pulmonary artery systolic pressure and large left atrium.

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Role of Age in Selecting Prosthesis in Valvular Heart Surgery

Abdulrahman M Hammad[(1)*];

Husain H Jabbad[(2)];

Khaled Alibrahimi[(2)];

Iskander Al-Githmi[(2)];

Osman O Al Radi[(2)];

Ragab S Debec[(2)];

Ahmed A Alassal[(3)];

Gamil Karam[(1)];

Medhat Alrifai[(1)];

Mohammed El-Sayed Moussa[(1)];

Mohammed Wael[(1)];

Ehab Kasem[(3)];

Zakareya El-Mashtuly[(1)];

Mohammed Abdulbaset[(1)]

OBJECTIVE: The rationale of this work is to compare the seven years outcome of bioprosthetic versus mechanical valve use in the term of mortality and main prosthesis complications related events (MPCRE) in adults with age less than 60 years.

METHODS: Ninety five patients aging less than 60 years, who had primary (single or double) isolated valve replacement with bioprosthetic or mechanical valve, were reviewed retrospectively. They were divided into group I (bioprosthetic) and II (mechanical). They were followed for seven years to assess mortality and MPCRE (structural deformity "SD", reoperation, infective endocarditis "IE", major bleeding, and thromboembolism "TE").

RESULTS: No statistically significant difference in seven years in survival (p = 0.835, 87.8 ± 8.1% with 95% CI: 76.79, 80.42 in bioprosthetic vs 85.3 ± 8.1% with 95% CI: 79.19, 84.13 in mechanical) and freedom from overall MPCRE (p = 0.627, 73.7 ± 14.5% with 95% CI: 73.06, 79.65 in bioprosthetic vs 76 ± 8.5% with 95% 74.65, 81.58 in mechanical), bleeding (p = 0.163, 100% in bioprosthetic vs 93 ± 3.9% in mechanical), TE (p = 0.232, 100% in bioprosthetic vs 93.3 ± 5% in mechanical), IE (p = 0.232, 100% in bioprosthetic vs 93.3 ± 5% in mechanical), redo (p = 0.645, 79.5 ± 15 % wit 95% CI: 77, 80.51 in bioprosthetic vs 95 ± 3.6% with 95% CI: 80.5, 84.53 in mechanical), and SD (p = 0.554, 71.6 ± 16.7% with 95% CI: 73.08, 79.8 in bioprosthetic vs 84.3 ± 8.9% with 95% CI: 78.05, 83.78 in mechanical).

CONCLUSION: Newer bioprosthetic implants are comparable to mechanical in the term of midterm mortality and MPCRE in patients less than 60 years old, especially if there's a concern about anticoagulation hazards or compliance. More cases and follow up is needed to justify the use of new bioprosthesis in younger age.

Nothing is better than native valves. Long lasting valve repair might be difficult in some extensive pathologies necessitating valve replacement. Choice of valvular prosthesis represents a big dilemma especially with increasing comorbidities. Traditionally valve replacement procedures give the patient chance to select one of the possible two options; less durable bioprosthetic valve with freedom from frequent visit and life lasting medications on the outlay of expected redo in the nearby future, or more durable mechanical valve with higher risk of bleeding, thromboembolic events, infective endocatditis (IE), and tissue growth. This debate is much evident and clearer in young patients. Surgeons started to lower the age cut off in use of bioprosthetic valve as they are less amenable to early structural failure which had been proved in elderly. **(1)** Average use of bioprosthetic valves is 36% which increased from 18% in 1991 to 59% in 2003. **(2)**

The aim of this work is to compare outcome in the term of survival and main prosthesis complications related events "MPCRE" (bleeding, thromboembolism "TE", infective endocarditis "IE", redo, and structural valvular deterioration "SD") of bioprosthetic versus mechanical valve replacement in adults with age less than 60y.

[*]Abdulrahman M Hammad, MD, Lecturer of Cardiothoracic Surgery, Faculty of Medicine, Al Azhar University, Cairo, Egypt. (Email: hammad_1300@yahoo.com)

Cardiothoracic Surgery, Faculty of Medicine, Alazhar University[(2)]

Cardiothoracic Surgery, Faculty of Medicine, King Abdulaziz University[(1)]

Cardiothoracic Surgery, Faculty of Medicine, Zagazig University[(3)]

Codex : o3/10/1402

Patients and Methods

A retrospective study was carried according to King Abdulaziz university hospital (KAUH) research ethics and committee on patients underwent valve surgery from Jan 2006 to Dec 2012. Ninety five consecutive patients in KAUH were eligible to the study.

Inclusion criteria: only elective cases with age less than 60y who presented with non repairable isolated primary valvular (single or double) pathology.

Exclusion criteria: age > 60y, repairable valve, associated non valvular cardiac pathology requiring intervention, IE, redo, perioperative mortality (same admission), previous cerebrovascular accident "CVA" (any documented neurological insult with or without residual deficit), renal impairment (on dialysis), hypoxic (arterial oxygen tension is less than 60 mmHg2) or hypercapnic (arterial carbon dioxide tension is more than 50 mmHg2) respiratory failure, and patients who are inconvenient in follow up with KAUH.

All cases passed through preoperative preparations protocol. All patient safety measures had been taken. All patients approached via median sternotomy with cold antegrade blood cardioplegia had been administered. All cases had either j shape aortotomy or conventional left atriotomy or both. All patients underwent interrupted horizontal mattress pledgeted 2-0 ethicon on 17 mm (aorta) or 25 mm (mitral) needle. Pros and cons of the procedure are discussed with the patients and their family.

After detailed discussion of pros and cons of implant types, choice of the valve was mainly the patient choice taking into consideration valve model availability, patient compliance, anticipated survival, child bearing probability, and patient preference. Commercially available valve implant were Medtronic Advancing The Standards "ATS" (Medtronic, Minneapolis, MN, USA), St. Jude Medical "SJM" valves (St. Jude Medical, St. Paul, MN, USA), CarboMedics valves (Sorin Biomedica, Via Crescentino, Italy), and Hancock valves (Medtronic, Minneapolis, MN, USA)

LMWH discontinued when INR 2 or more. In aortic position and If there's no warfarin contraindication, lifelong warfarin was given to achieve 2-3 INR in mechanical position or bioprosthetic with atrial fibrillation, otherwise 3 months is adequate if bioprosthetic with sinus rhythm. In mitral position and If there's no warfarin contraindication, lifelong warfarin was given to achieve 2.5-3.5 INR in mechanical position or bioprosthetic with atrial fibrillation, otherwise 3 months is adequate if bioprosthetic with sinus rhythm.

The patients were divided into two groups (I for bioprosthetic, II for mechanical) and assessed for primary end points at 7 years. The primary endpoints were mortality and MPCRE (bleeding, structural deformity, non structural deformity "thromboembolism, IE", and redo). In brief, stroke was defined as any documented neurological insult with or without residual deficit. Structural deformity defined as echo finding of new functional changes (regurge or gradient) due intrinsic (thickening, calcification, leaflet restriction or fracture) valve changes associated with clinical changes (NYHA) or not. Non structural deformity defined as echo finding of new functional changes (regurge or gradient) due extrinsic (thrombus, vegetation, tissue pannus) valve changes associated with clinical changes (NYHA) or not. Valve thrombosis defined as mass related to the valve interfere with its function without evidence of infection. IE defined as mass related to the valve interfere with its function with evidence of infection. Clinically significant bleeding was diagnosed if high INR associated with required surgical intervention, hospital admission, blood transfusion, critical location (intracranial, retroperitoneal), or caused death. Reoperation was defined as any operation of structurally deformed or infected previously implanted valve (redo cases were excluded from the study). **(3)**

The data were analyzed using statistical package of social science "SPSS, IBM, Chicago, Illinois, 6066-6307, USA". Kolmogorov Smirnov test was used to verify check the normal distribution of parametric data. Chi square used to compare non parametric data, independent T test in parametric data. Kaplan-Meier curve was used to compare mortality and MPCRE between both groups. Statistically significant difference occurred when $p \leq 0.05$.

Results

Total implanted valves were 120 in 95 cases. Overall implanted aortic valve cases were 56/120 "46.7%" (34 mechanical aorta, 22 bioprosthetic aorta) while entire implanted mitral valve patients were 64/120 "53.3%" (41 mechanical mitral, 23 bioprosthetic mitral). Isolated mitral implants were 39/95 "41%" (25 mechanical, 14 bioprosthetic). Isolated aortic implants were 31/95 "32.6%" (18 mechanical, 13 bioprosthetic). Double implants were 25/95 "26.4%" (16 mechanical, 9 bioprosthetic). Types of valve implanted were summarized in table (1) and figure (1) where most mechanical valves were ATS and SJ while bioprosthetic were SJ and Sorrin.

		Group I (bioprosthetic) (n = 36)	Group II (mechanical) (n = 59)
Site	n (%)		
Aorta		13/36 (36.1)	18/59 (30.5)
Mitral		14/36 (38.9)	25/59 (42.4)
Double		09/36 (25)	16/59 (27.1)
Company	n (%)		
ATS		0	36/59 (61.0)
SJM		15/36 (41.7)	20/59 (33.9)
Sorin		13/36 (36.1)	03/59 (5.10)
Hanckock		08/36 (22.2)	00/59
Mitral Size	n (%)		
25		01/23 (4.3)	04/41 (9.8)
27		10/23 (43.5)	12/41 (29.3)
29		08/23 (34.8)	13/41 (31.7)
31		02/23 (8.7)	09/41 (22)
33		02/23 (8.7)	03/41 (7.3)
Aortic size	n (%)		
19		04/22 (18.2)	08/34 (23.5)
21		11/22 (50)	12/34 (35.3)
23		07/22 (31.8)	10/34 (29.4)
25		00/22	04/34 (11.8)
27		00/22	00/34

ATS=Advance The Standard, SJM=St Jude Medical.

Table 1. Shows types of implanted valves:

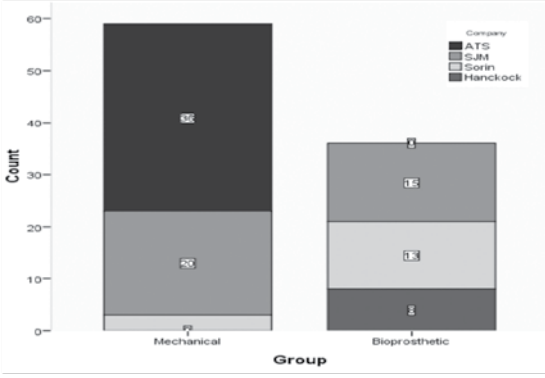

Fig 1. Shows types of implanted valves: ATS=Advance The Standard, SJM=St Jude Medical.

Apart from significantly (p = 0.029) lower age in group I (35.69 ± 9.97) than in group II (40.90 ± 12.71), other preoperative data was the same as shown in table (2).

		Group I (bioprosthetic) (n = 36)	Group II (mechanical) (n = 59)	*P*
Age	m ± SD	35.69 ± 9.97	40.90 ± 12.71	0.029*
F/M	n (%)	18 (50)	23 (39)	0.201
Height	m ± SD	161.5 ± 8.86	1.65 ± 9.27	0.091
Weight	m ± SD	66.74 ± 14.03	70.04 ± 16.85	0.307
BSA	m ± SD	1.72 ± 0.2	1.78 ± 0.23	0.208
BMI	m ± SD	25.55 ± 5.17	25.92 ± 6.36	0.757
Obesity	n (%)			
Underweight		1 (2.8)	4 (6.8)	
Normal weight		16 (44.4)	23 (39)	0.766
Overweight		11 (30.6)	16 (27.1)	
Obese		8 (22.2)	16 (27.1)	
DM	n (%)			
No		32	51	
NIDDM		3 (8.3)	6 (10.2)	0.941
IDDM		1 (2.8)	2 (3.4)	
HTN	n (%)			
No		35	48	
Controlled		1 (2.8)	10 16.9)	0.077
Uncontrolled		0	1	
Dyslipidemia	n (%)	2 (5.6)	3 (5.1)	0.631
UA	n (%)	1 (2.8)	2 (3.4)	0.680
Smoker	n (%)			
No		30	45	
Smoker		5 (13.9)	12 (20.3)	0.709
Exsmoker		1 (2.8)	2 (3.4)	
Pre EF	m ± SD	48.47 ± 9.21	46.68 ± 8.6	0.339
Properative AF	n (%)	7 (19.4)	12 (20.3)	0.568
Pre NYHA	n (%)			
I		14 (38.9)	12 (20.3)	
II		16 (44.4)	37 (62.7)	0.188
III		6 (16.7)	9 (15.3)	
IV		0	1 (1.7)	
EuroScore	m ± SD	1.19 ± 0.82	1.3 ± 0.92	0.542

**=Significant, n=Number, m ± SD=Mean ± standard deviation, F/M=Female/male ratio, BSA=Body Surface Area, BMI=Body Mass Index, DM=Diabetes mellitus, HTN=Hypertension, UA=Uric acid, EF=Ejection fraction, AF=Atrial fibrillation, NYHA=New York Heart Association.*

Table 2. Demonstrates preoperative characteristics in both groups

There was no statistically significant difference between both groups in the term of mortality or MPCRE as shown in table (3).

		Bioprosthetic (n = 36)	Mechanical (n = 59)	*P*
Mortality	n (%)	2 (5.6)	3 (5.1)	0.631
MPCRE	n (%)	4 (11.1)	8 (13.6)	0.496
Bleeding	n (%)	0	3 (5.1)	0.235
CVS	n (%)	0	2 (3.4)	0.383
IE	n (%)	0	2 (3.4)	0.383
Redo	n (%)			
No		32	54	
Aorta		2 (5.6)	2 (3.4)	0.871
Mitral		2 (5.6)	3 (5.1)	
Double		0	0	
Structural deterioration	n (%)	4 (11.1)	4 (6.8)	0.461
Follow up	m ± SD	62.25 ± 12.58	60.34 ± 12.49	0.472
Post EF	m ± SD	49.03 ± 5.77	47.73 ± 6.2	0.304
Post AF	n (%)	13 (36.1)	21 (35.6)	0.565
Post NYHA	n (%)	1 (2.8)	12 (1.7)	0.617
I		32 (88.9)	51 (86.4)	
II		4 (11.1)	7 (11.9)	0.727
III		0	1 (1.7)	
IV		0	0	
ACX time	m ± SD	113.86±51.01	98.64± 42.89	0.122
CPB time	m ± SD	149.42 ± 58.3	134.22±65.7	0.244

MPCRE= Main Prosthesis Complications Related Events, CVS=CerebroVascular Stroke, IE=Infective Endocarditis, EF=Ejection Fraction, AF=Atrial fibrillation, NYHA= New York Heart Association, ACX=Aortic Cross Clamp, CPB=CardioPulmonary Bypass.

Table 3. Shows no statistically significant different outcome between both groups

The mean follow up period was 62.25 ± 12.58 months in bioprosthetic and 60.34 ± 12.49 months in mechanical without statistical significance (p = 0.472). Seven years survival showed no statistical significant difference (p = 0.835) between mechanical (85.3 ± 8.1 %) and bioprosthetic (87.8 ± 8.1%). See figure 2.

Seven years freedom from MPCRE showed no statistical significant difference (p = 0.627) between mechanical (76 ± 8.5%) and bioprosthetic (73.7 ± 14.5 %). See figure 3.

Seven years freedom from bleeding showed no statistical significant difference (p = 0.163) between mechanical (93 ± 3.9%) and bioprosthetic (100 %). See figure 4.

Seven years freedom from TE showed no statistical significant difference (p =0.232) between mechanical (93.3 ±5%) and bioprosthetic (100 %). See figure 5.

Seven years freedom from IE showed no statistical significant difference (p = 0. 232) between mechanical (93.3 ± 5 %) bioprosthetic (100 %). See figure 6.

Seven years freedom from redo showed no statistical significant difference (p = 0. 645) between mechanical (95 ± 3.6 %) and bioprosthetic (79.5 ± 15 %). See figure 7.

Seven years freedom from SD showed no statistical significant difference (p = 0. 554) between mechanical (84.3 ± 8.9 %) bioprosthetic (71.6 ± 16.7 %). See figure 8.

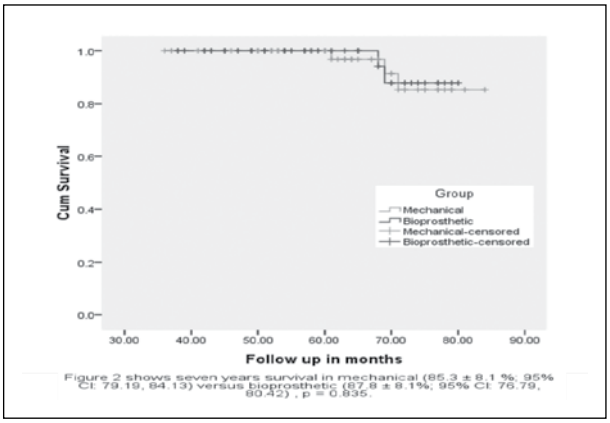

Figure 2 shows seven years survival in mechanical (85.3 ± 8.1 %; 95% CI: 79.19, 84.13) versus bioprosthetic (87.8 ± 8.1%; 95% CI: 76.79, 80.42) , p = 0.835.

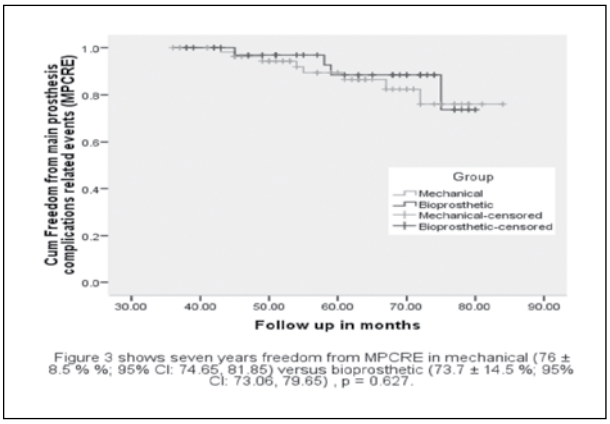

Figure 3 shows seven years freedom from MPCRE in mechanical (76 ± 8.5 % %; 95% CI: 74.65, 81.85) versus bioprosthetic (73.7 ± 14.5 %; 95% CI: 73.06, 79.65) , p = 0.627.

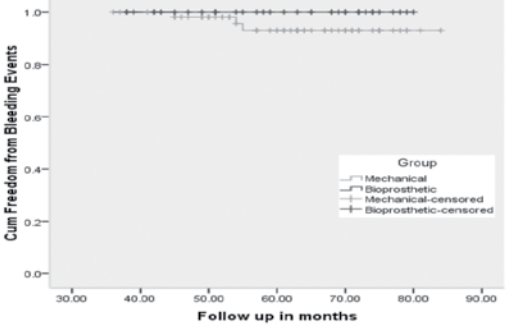

Figure 4 shows seven years freedom from bleeding in mechanical (93. ± 3.9 %) versus bioprosthetic (100 %), p = 0.163.

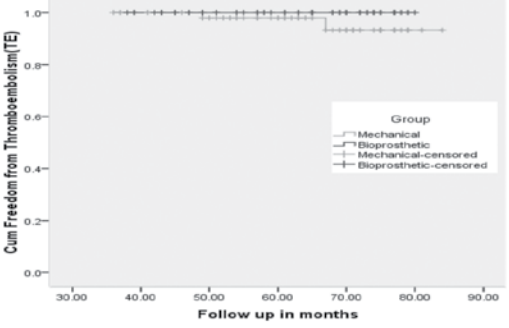

Figure 5 shows seven years freedom from thromboembolic events (TE) in mechanical (93.3 ± 5. %) versus bioprosthetic (100 %), p = 0.232.

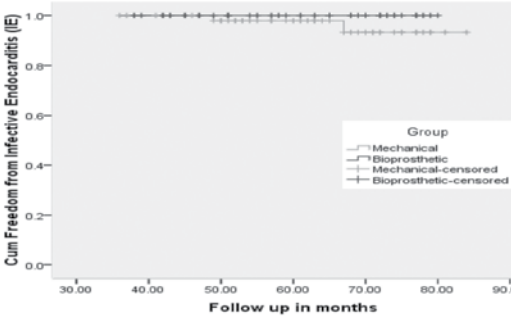

Figure 6 shows seven years freedom from TE in mechanical (93.3 ± 5. %) versus bioprosthetic (100 %), p = 0.232.

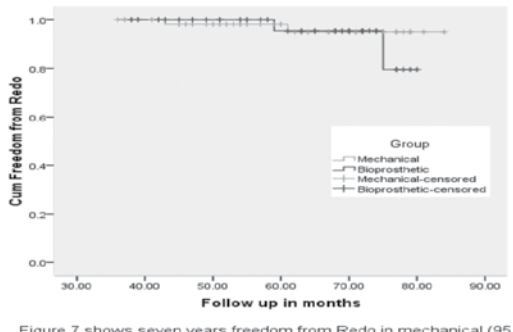

Figure 7 shows seven years freedom from Redo in mechanical (95 ± 3.6 % %; 95% CI: 80.5, 84.53) versus bioprosthetic (79.5 ± 15 %; 95% CI: 77., 80.51), p = 0.645

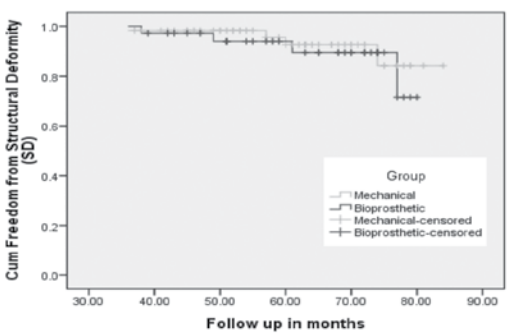

Figure 8 shows seven year freedom from structural deformity (SD) in mechanical (84.3 ± 8.9 %, 95% CI: 78.05, 83.78) versus bioprosthetic (71.6 ± 16.7% %, 95% CI: 73.08, 79.8), p = 0.554

Discussion

Traditionally in valve replacement surgery, the patient is asked to choose the least potential risk which jeopardizes his life quality (earlier risk of redo versus bleeding or TE hazards). Patients with expected prolonged life stay behind the redo risk in bioprosthetic valves. Classically, early use of bioprosthetic valves in non elderly patients "less than 60 years" demonstrated more SD due to higher calcium turnover, fatigue induced lesion, and collagen degeneration. Newer bioprosthetic generation revealed remarkable results. **(4)**

Ninety five patients were scheduled for this study. There were no statistically significant difference between both groups in the term of preoperative characteristics except for age where it's statistically significant (p = 0.029) lower in group I (35.69 ± 9.97) than II (40.90 ± 12.71).

Mortality was statistically non significant (p=0.631) higher in bioprosthetic (2/36, 5.6%) than mechanical (3/59, 5.1%). Survival was statistically non significant (p=0.835) higher in bioprosthetic (87.8 ± 8.1%) than mechanical (85.3 ± 8.1 %) at 7 years. Other consisting and contradicting reports were demonstrated in table (4). Neither implant type nor position was a significant predictor of survival difference. **(5, 6, 7, 8)** On the aortic position, age, renal or lung disease, DM, coronary disease, earlier year of surgery, AF, reduced EF, and redo in aortic position were independent predictors of reduced long term survival. **(5, 6, 7, 8, 9)** On the mitral position, age, coronary disease, earlier year of surgery, female gender, NYHA class, left atrial diameter, and AF were an independent predictors of reduced long term survival. **(6, 7, 8)**

Main prosthesis complications related events was statistically non significant (p=0.496) higher in mechanical (8/59, 13.6%) than bioprosthetic (4/36, 11.1%). Freedom from MPCRE was statistically non significant (p=0.627) higher in mechanical (76 ± 8.5 %) than bioprosthetic (73.7 ± 14.5 %) at 7 years. Other consisting and contradicting reports were demonstrated in table (4). AF, implants type, and age at surgery on the aortic position and female gender on the mitral position were independent predictors for reduced freedom of MPCRE. **(7, 9)** The redo risk of bioprosthetic valve outweights the anticoagulation related hazards of mechanical valve. **(7, 10)**

Bleeding was statistically non significant (p=0.235) higher in mechanical (3/59, 5.1%) than bioprosthetic (0/36, 100%). Freedom from bleeding was statistically non significant (p=0.163) higher in bioprosthetic (100%) than mechanical (93 ± 3.9 %) at 7 years. Other consisting and contradicting reports were demonstrated in table (4). Independent risk factors for major bleeding were mechanical implant on mitral (p=0.02) not aortic (p=0.74) position. **(6, 7)**

Thromboembolic was statistically non significant (p=0.383) higher in mechanical (2/59, 3.4%) than bioprosthetic (0/36, 100%). Freedom from TE was statistically non significant (p=0.232) higher in bioprosthetic (100%) than mechanical (93.3 ± 5 %) at 7 years. Other consisting and contradicting reports were demonstrated in table (4). Independent predictors of stroke on the aortic position were mechanical **(8)**, smoking **(7)**. Independent predictors of stroke on the mitral position were mechanical **(8) (7, 9, 10, 11)**, AF **(6, 8)**, smoking **(6, 8)**, female gender **(7)**. The addition of aspirin to warfarin anticoagulation had no significant effect on the incidence of embolic stroke in patients with mechanical valves, regardless of implant position or valve type. **(6)** Younger age shows less TE hemorrhagic complications than elderly. **(7, 11, 12)**

Infective endocarditis was statistically non significant (p=0.383) higher in mechanical (2/59, 3.4%) than bioprosthetic (0/36, 100%). Freedom from IE was statistically non significant (p=0.232) higher in bioprosthetic (100%) than mechanical (93.3 ± 5 %) at 7 years. Other consisting and contradicting reports were demonstrated in table (4). Independent risk factors for IE were mechanical implant (p=0.07) on mitral position. **(7)**

Structural deformity was statistically non significant (p=0.299) higher in bioprosthetic (5/36, 13.9% for aorta; 3/36, 8.3% for mitral) than mechanical (3/59, 5.1% for aorta; 4/59, 6.8% for mitral). Freedom from SD was statistically non significant (p=0.554) higher in mechanical (84.3±8.9%) than bioprosthetic (71.6±16.7%) at 7 years. Other consisting and contradicting reports were demonstrated in table (4).

Redo was statistically non significant (p=0.871) higher in mechanical (2/59, 3.4% for aorta; 3/59%, 5.1% for mitral) than bioprosthetic (2/36, 5.6% for aorta; 2/36, 5.6% for mitral). Freedom from redo was statistically non significant (p=0.645) higher in mechanical (95 ± 3.6 %) than bioprosthetic (79.5 ± 15 %) at 7 years. Other consisting and contradicting reports were demonstrated in table (4). Independent predictors of redo on the aortic position were younger age **(5)** and tissue prosthesis **(5)** (p=0.005) **(7)** and persistent left ventricular hypertrophy during late follow up (p=0.02) **(7)**. SD contributes by 83% of redo where stented tissue showed higher redo than homograft after 10y. **(6)** Patients with renal disease, lung disease (in patients more than age 60 years), EF less than 40%, or coronary disease had a life expectancy of less than 10 years. **(5)**

Table 4 shows few studies outcome of bioprosthetic and mechanical valves in < 60 years old after variable periods of follow up. MPCRE=Main Prosthetisis Complications Related Events, TE= Thromboembolism, SD= Structural deformity, IE= Infective Endocarditis, y=year (s), A=Aortic valve replacement, M=Mitral valve replacement, D=Double valve replacement, VT= Valve thrombosis, *=significant. Peterseim et al., 1999 retrospectively analyzed 841 cases underwent primary isolated AVR (429 tissue, 421 mechanical). Hammermeister et al, 2000 followed 575 cases underwent AVR or MVR (289 tissue, 286 mechanical) for 15 y. Carrier M et al, 2001 followed 521 cases underwent AVR ± CABG (158 tissue, 363 mechanical) for 10 y. Ruel et al, 2005 followed 500 cases (18-50y) valve ± CABG (184 tissue, 316 mechanical) for 15 y. Kulik etal, 2006 retrospectively analyzed 659 cases (50-65 y) primary valve ± CABG (131 tissue, 528 mechanical) for 18.3 y. Ruel et al, 2007 retrospectively analyzed 567 cases (< 60 y) primary valve ± CABG (306 tissue, 261 mechanical) for > 20 y.

Redo was a significant (p=0.05) predictor of dis satisfaction on aortic position only **(6)** On the aortic position, a significant higher (p=0.02) physical component scores of short form health status "either stented tissue or homograft" while a significant lower (p=0.03) disability even with adjusting to age, AF, EF, coronary artery disease "either stented or homograft" had been reported. A significant lower (p=0.04 in both positions) career affection (23% versus 25.2% on aortic position, 18.2% versus 55.6% on mitral position) even with adjusting to age, AF, EF, coronary artery disease "either stented or homograft" had been reported. Also, a non significant lower (p=0.12) HF independent of AF (p=0.1), EF (p=0.6), and prosthesis size (p=0.2) had been revealed. **(6)** Perchinsky and his colleagues reported comparable life quality in 200 patients with 51-65y old sorted into mechanical or bioprosthetic aortic valve. Bioprosthetic group was worried about redo surgery in the nearby future while mechanical group was concerned about frequent visit and blood test, lifestyle restriction, anticoagulant related hazards and valve sound. The same decision will be taken in 97% of both groups. **(7, 13)**

Variable results could be attributed to the sample volume and characteristics, follow up duration, patient age, inconsistent definitions, early perioperative primary and redo mortality out of standard (> 14%), different inclusion and exclusion criteria, variable prosthetic types (durability, flow characteristics, thrombogenicity), and optimal timing of operation.

	Survival	MPCRE	Bleeding	TE	Redo	SD	IE
Peterseim et al., 1999 **(5)**	*P* = .4	p=0.8	p=0.01*	p=0.9	p=0.02*	p=0.3	p=0.5
Tissue	54±3%	43±3%	97±1%	93±2%	83±3%	92±2%	96±1%
Mechanical	50±6%	41±5%	91±3%	94±2%	98±1%	91±3%	97±1%
Hammermeister et al, 2000 **(14)**	Mortality p=0.02* in A, p=0.3 M	P=0.26 A P=0.56 M	p=0.0001* A, p=0.01* M	P=0.66 A, P=0.96 M VT: P=0.33 A, P=0.95 M	P=0.004* A, P=0.15 M	P=0.0001* A, P=0.0002* M	P=0.45 A, P=0.37 M
Tissue	79±3% A 79±4% M	66±5% A 81±5% M	30±4% A 31±6% M	18±4% A 22±5% M VT: 1±1% A, 1±1% M	29±5% A 50±8% M	23±5% A 44±8% M	15±5% A 17±5% M
Mechanical	66±3% A 81±4% M	65±4% A 73±6% M	51±4% A 53±7% M	18±4% A 18±5% M VT: 2±1% A, 1±1% M	10±3% A 25±6% M	0±0% A 5±4% M	7±2% A 11±4% M
Carrier M et al, 2001 **(9)**	P=0.2	P=0.01*	P=0.4	P=0.03*	P=0.1	P=0.04*	P=0.01*
Tissue	75±4%	83±4%	99±1%	91±3%	93% ± 3%	92% ± 3%	95±2%
Mechanical	66±6%	90±7%	97±2%	92±7%	99% ± 1%	99% ± 1%	99±1%
Ruel et al, 2005 **(6)**	P=0.4 A P=0.9 M		P=0.05* A, P=0.002* M	P=0.7 A P=0.16 M	P=0.01* A, P<0.001* M		
Tissue (138 A, 42 M, 4 D)	79.2% A 57.7% M		HR 7.2 (1.0,56) A, HR 32 (3.5,99) M	10y cumulative incidence 6.4±2.9% in A, 3.1±3.1% in M	HR 0.3 (0.1,0.7) In A, HR 0.1 (0.05,0.4) in M		
Mechanical (171 A, 109 M, 36 D)	78.9% A 83.9% M		3.9	10y cumulative incidence6.3±2.4% in A, 12.7±3.9% in M, 16.1±9.4% in D			
Kulik etal, 2006 **(7)**	HR=1.3, P=0.55 in A, HR=0.7, P=0.34 in M	HR=1.3, P=0.42 in A, HR=0.8, P=0.57 in M					
Tissue	75.1±12.6% in A 77.9±7.4% in M	41.0±30.3% in A 61.2±9.2% in M	97.6±2.4% in A 97.8±2.2% in M	97.6±1.7% in A 87.6±6.0% in M	64.6±26.4% in A 78.7±7.8% in M		96.4±3.5% in A 92.4±4.2% in M
Mechanical	73.2±4.2% in A 74.1%±4.6% in M	70.2±4.1% in A 53.5±8.8% in M	97.1±1.3% in A 88.9±4.3% in M	79.2±43.9% in A 69.0±7.5% in M	96.0±1.8% in A 95.3±3.1% in M		95.9±2.4% in A 94.8±4.5% in M
Ruel et al, 2007 **(8)**	P=0.3 A P=0.5 M		P<0.02*		*P*<0.001* A P<0.001* M		
Tissue	51.7±4.8% A 33.8±5.3% M		97.9±1.2% A 96.1±1.9% M		11.4±3.5% A 15.8%±4.6% M		
Mechanical	41.2±5.2% A 40.8±5.9% M		83.9±4.9% A 85.6±5.3% M		73.0±4.9% A 65.0±9.6% M		
Current work	p=0.835	p=0.627	P=0.163	P=0.232	P=0.645	p = 0. 554	P=0.232
Tissue	87.8±8.1%	73.7±14.5%	100%	100%	79.5±15%	71.6±16.7%	100%
Mechanical	85.3±8.1%	76±8.5%	93±3.9%	93.3±5%	95±3.6%	84.3±8.9%	93.3±5%

Table 4.

To summarize, use of bioprosthetic valves is coming up and the age cut off is coming down. Longevity of tissue implants is affected by many factors including metabolic disorders, initial high gradient, and generation of tissue implants. Tissue implants in persons with expected long life is a good back up especially if there's a concern about compliance, bleeding and thromboembolic risk. Redo risk doesn't affect endurance badly. Higher number of patients, more follow up duration, and use of newer tissue valve generations will bring the end of this story.

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PROGRESSION OF MILD TO MODERATE TRICUSPID REGURGE AFTER MITRAL VALVE REPLACEMENT : ONE CENTER EXPERIENCE

Ayman Gabal, MD;

Ahmad Deebed, MD;

Alaa Brik, MD

Functional tricuspid regurgitation (TR) is the most common type of tricuspid valve pathology and is associated with mitral valve disease .Despite correction of left sided lesions, associated functional TR that was surgically ignored can persist.

Methods: Between January 2008 and June 2013, a total of 104 patients with mitral valve (MV) disease associated with mild to moderate functional tricuspid valve (TV) regurge, underwent mitral valve replacement divided into two groups according to associated tricuspid valve if repaired or not: (G A) tricuspid valve repair was neglected in 59 patients and (G B) tricuspid valve repair was done for 45 patients.

Results : Between 2008 and 2013, 104 patients underwent mitral valve replacement in cardiothoracic surgery department –ZagazigUniversity,the patients divided into two groups: group A without tricuspid valve repair (n=59), or with TR repair (n=45, repair group B). The mean age of all patients was 33.4±10.8.NYHA class III was the commonest among our patients in both groups(66.1% in group A, and 51.1% in group B). The underlying MV disease was mitral stenosis in 38 patients(36.5%),mitral regurgitation in 22 patients(21%),and mixed lesion in 44 patients (42.3%).The main outcome measure was postoperative TR grade and progression of TR in both groups.

Conclusion : The development of late significant functional tricuspid regurge after mitral valve replacement is not a rare event , with a negative impact on long term free survival from chronic heart failure. These findings support the strategy of correcting mild to moderate functional TR at the time of MV replacement to maintain TV function and improve clinical outcomes.

KEYWORDS : Mitral replacement, Tricuspid regurge, Progression.

The etiology of tricuspid regurgitation is generally divided into organic (with structural abnormalities of tricuspid valve apparatus), and functional in the absence of structural abnormalities of tricuspid leaflets.(1,2)

Functional tricuspid regurgitation (TR) is the most common type of tricuspid valve pathology and is associated with mitral valve disease. (3) Despite correction of left sided lesions , associated functional TR that was surgically ignored can persist.(4,5)

Which patient undergoing mitral valve surgery should also have the tricuspid repair is an important clinical question. It was proposed to treat TR independently from the grade of regurgitation when the annular dimension is over 21 mm/m2 or more than or equal to 3.5 cm at echocardiography measurement or when the intra-operative tricuspid annulus (TA) diameter is > 70 mm,(6)

The tricuspid valve has not received as much attention as the aortic valve or mitral valve, and hence has been referred to as the (forgotten valve). Significant tricuspid regurgitation may be clinically silent for a prolonged period , during which time progressive right ventricle dilatation and dysfunction may develop.(7)

The aim of this study was to report our experience in surgical treatment of mild to moderate TR after mitral valve replacement and to determine the impact of TR progression on late survival.

Cardiothoracic Surgery Department-Zagazig University

Ayman67gabal68@gmail.com

Codex : o3/11/1403

METHODS

Between January 2008 and June 2013, a total of 104 patients with mitral valve (MV) disease associated with mild to moderate functional tricuspid valve (TV) regurge, underwent mitral valve replacement divided into two groups according to associated tricuspid valve lesion if repaired or not: (G A) tricuspid valve repair was neglected in 59 patients and (G B) tricuspid valve repairwas done for 45 patients, at Cardiothoracic department, Zagazig University, Egypt.

Pre-, intra- ,and postoperative data were collected and retrospectively analyzed.All patients were investigated preoperatively by means of Doppler echocardiography.

The patients who had concomitant surgery apart from mitral or tricuspid valve during the first operation, Patients with severe or organic tricuspid valve disease ,and patients with endocarditis were excluded from this study.

Surgery: All patients were operated on with similar standard cardiopulmonary bypass with moderate hypothermia and cold blood cardioplegia. TV repair was performed with an annuloplasty ring in eight patientsand without a ring (De Vega) in 37 patients . The choice of repair technique was at the attending surgeon›s discretion.

Statistical analysis

Data were described as mean ± standard deviation. Paired t-test was used to compare the pre- and postoperative cardiac function.

All statistical analysis were performed using SPSS, P value < 0.05 was considered to be statistically significant.

RESULTS

Between 2008 and 2013, 104 patients underwent mitral valve replacementin cardiothoracic surgery department – ZagazigUniversity,the patients divided into two groups:group A without tricuspid valve repair (n=59), or with TR repair (n=45, repair group B). Patients characteristics for both groups are shown in Table 1. The mean age of all patients was 33.4±10.8.NYHA class III was the commonest among our patients in both groups(66.1% in group A, and 51.1% in group B). The underlying MV disease was mitral stenosis in 38 patients(36.5%),mitral regurgitation in 22 patients(21%),and mixed lesion in 44 patients (42.3%), with no significant difference between both groups. No significant difference was observed between both groups regarding AF (P 0.77). Group A showed a higher prevalence of mild TV regurge than group B (33 versus 16) patients (P 0.039). Six patients in group B had severe TR, compared with no patients with preoperative severe TR in group A, (P 0.005).Preoperative pulmonary artery systolic pressure was significantly higher in the repair group, mean PAS pressure was 44.7±9.1 and 51.6±12.7 for group A and B respectively, (P 0.0016).

Variable	Group A (No. 59)	Group B (No. 45)	P value
Age	34.6±10.0	31.9±11.0	0.19
Sex			
Male	25 (42.37%)	19 (42.2%)	0.98
Female	34 (57.6%)	26 (57.77%)	
NYHA Class			
III	39 (66.1%)	23 (51.1%)	0.12
IV	20 (33.9%)	22 (48.9 %)	
Atrial Fibrillation	13 (22.03%)	11 (24.4%)	0.77
Mitral valve disease			
Mitral stenosis	21 (35.6%)	17 (37.8%)	0.81
Mitral regurge	13 (22.0%)	9 (20.0%)	0.8
Mixed lesion	25 (42.4%)	19 (42.2 %)	0.98
Functional TR			
Mild	33 (55.9%)	16 (35.6%)	0.039
Moderate	26 (44.1%)	23 (51.1%)	0.47
Severe	Zero	6 (13.3%)	0.005
HTN	11 (18.6%)	7 (15.6%)	0.67
DM	6 (10.2%)	2 (4.4%)	0.47
Hepatic	9 (12.3 %)	8 (17.8%)	0.73

Table 1. Patient characteristics

Mean aortic cross clamp time was longer in the repair group (66.5±11.5 minutes), compared to the no repair group, (45.3±11.4 minutes). Mean cardiopulmonary bypass time was 69±18.9 minutes, and 88.7±24.1 minutes for group A and group B respectively with P value of (< 0.001). TV repair using De Vega-annuloplasty was performed in 37 patients (82.2%), a rigid ring was implanted in 8 patients (17.8%), (Table 3).No differences were observed with respect to the operative or postoperative complications , we have 4 death in both groups (3 in group A and one in group B).

The main outcome measure was postoperative TR grade and progression of TR in both groups. Completeness of follow up was 88.13% in group A , and 91.1% in group B, with a mean period of 30.7±14.5 months. (Table 4)

We have followed each patient according to TR severity over the study period.

Preoperatively in group A ,33(55.9%) patients had mild TR, and 26(44.06%), had moderate TR, postoperatively deteriorated to 30(57.69%) patients with moderate TR and 16(30.76%) with severe TR, P value was less than 0.001.(Table 5)

In the repair group (B), postoperative improvement was significant as we noticed only 5(12.19%), patients with mild TR and 2(4.87%) patients with moderate TR on follow up (P< 0.001). Significant reduction was observed during the postoperative period regarding EF and LVED , with P value < 0.001 and 0.012 respectively (Table 4).

Variable	Group A	Group B	P value
EF %	59.4±13.26	61.2±14.12	0.5
PAS pressure	44.7±9.1	51.6±12.7	0.0016
LVED (mm)	55.21±13.01	54.36±12.94	0.74
RVD (mm)	27.64±10.49	28.59±11.7	0.66
LA diameter(mm)	57.36±12.5	59.34±10.76	0.39

Table 2. Echo-cardiographic data

Variable	Group A	Group B	P value
CPB	69±18.9	88.7±24.1	< 0.001
Cross Clamp time	45.3±11.4	66.5±11.5	< 0.001
Repair of TR			
Deviga	0	37	< 0.001
Ring	0	8	< 0.001
Complications			
Bleeding	4 (6.85%)	3 (6.7%)	0.7
LCOP	5 (8.5%)	1 (2.2%)	0.35
Death	3 (5.1%)	1 (2.2%)	0.81

Table 3. Operative data

Variable	Group A	Group B	P value
Follow up period (month)	34.5±23.5	19.8±29	0.005
No. of patients followed	52 (88.13%)	41 (91.1%)	0.86
Echo. Data			
- Prosthetic MV function			
Good	50 (96.1%)	39 (92.85%)	0.75
Malfun.	2 (3.9%)	2 (4.87%)	
- Degree of TR			
Mild	6(11.5%)	5 (12.19%)	< 0.001
Moderate	30 (57.69%)	2(4.87%)	< 0.004
Severe	16 (30.76%)	0	< 0.001
EF%	57.6±12.1	69.2±10.9	< 0.001
LVED(mm)	55.3±14.2	49.1±9.1	< 0.012
RVD(mm)	33.2±11.4	29.8±8.7	< 0.09

Table 4. Postoperative findings and follow up

Degree of TR	Group A		Group B	
	Preoperative	Postoperative	Preoperative	Postoperative
Mild	33(55.9%)	6(11.5%)	16(35.6%)	5(12.19%)
Moderate	26(44.1%)	30(57.69%)	23(51.1%)	2(4.87%)
Severe	0	16(30.76%)	6(13.3%)	0
P value	< 0.001		< 0.001	

Table 5. Pre- and post-operative TV regurge degree

DISCUSSION

Tricuspid valve disease is not only under diagnosed but it is also often surgically ignored. This is particularly relevant in cases of functional regurgitation, which is characterized by its minimal clinical impact. TV repair in patients with functional tricuspid regurge does not add a lot of time or complexity to the operation. In patients with concomitant mitral valve disease, correcting the mitral valve lesion without treating the TV may improve or even alleviate mild tricuspid regurge.(7) However , uncorrected moderate and severe tricuspid regurge may persist or even worsen after mitral valve surgery, leading to progressive heart failure and death. In addition , reoperation for residual tricuspid regurge carries significant risks and may suggest a poor prognosis.(8,9)

The aim of the present study was to determine the progress of mild to moderate functional tricuspid regurge which was not corrected surgically among patients referred for mitral valve replacement.

Significant functional TR developing in patients who had undergone uneventful left sided valve surgery , is not a rare event. Moreover,its clinical impact and associated risk factors have not been adequately investigated . According to Song et al. , the overall incidence of late significant TR after successful left sided valve surgery was 7.7%, and those patients showed a significantly lower 8-year clinical event-free survival.(8)

In the current study, we followed our patients of mild to moderate functional TR underwent mitral valve replacement with or without tricuspid valve repair, we compared both groups for progress of tricuspid regurge.

Age , female gender, rheumatic etiology, AF and degree of TR were the most important independent risk factors in our study as well as in other published studies. Mean age for our patients without tricuspid valve repair (G A) was non significantly higher than those underwent TV repair after MV replacement (group B) ,(P 0.19).

According to previous reports , huge left atrium and AF are a predictors of significant late tricuspid regurge after mitral valve surgery without tricuspid valve surgery.(9,10)

Incidence of AF among our patients was 22.03% and 24.4% for group A ,and group B respectively ,with no significant difference between both groups (P 0.77).

In other studies , elevated pulmonary artery pressure at follow up was an important risk factor for the development of significant postoperative functional tricuspid regurge, and this was in agreement with our results .On the contrary , they did not find preoperative pulmonary hypertension to be associated with TR progression (9).

Repair of tricuspid regurgitation was ignored in 59 out of 104 patients with mild to moderate TR (56.7%) in this study.

We performed De vega repair in 37 (82.2%) patients, and prosthetic ring implantation in 8 patients (17.8%), for correction of functional TR in patients undergoing mitral valve replacement, De vega was simpler , quicker , and inexpensive with fewer complications. Kirali et al. recommended a TV De vega repair instead of implanting a prosthetic ring or band for the same reasons (11).

Dreyfus et al. described an increase in the degree of TR by more than two grades during follow up in 48% of patients undergoing mitral valve surgery without concomitant tricuspid valve repair , they observed a significant improvement of NYHA class along with lower late TR grade,if TR has been surgically treated.(12)

These results was in agreement with our results as we noticed significantly increased degree of TV regurgeamong our patients of mitral valve replacement without concomitant TV repair (G A),as the number of patients with preoperative moderate and severe TR in this group was 26 and zero respectively, this number increased on follow up postoperatively as follows (30 patients with moderate TR and 16 with severe TR), (P 0.001).

On the other hand degree of TR in the other group (repair group B) was significantly improved, as we have only 7 patients with persistent mild to moderate TR on follow up in this group, ($P < 0.001$).

According to Song et al. deterioration in TR grade occurred only in those patients having some organic involvement as a result of ongoing rheumatic process. They believe that when the left heart lesions are corrected , pulmonary hypertension and TR degree regresses.(8,13,14)

Dreyfus et al. have advocated repairing all cases of moderate TR because they believe that annular dilatation is an ongoing process regardless of the severity of TR.(12)(15)

In our study we tend to agree with this and believe that without repairing our cases with moderate functional TR, it may persist or deteriorates postoperatively regardless of any reduction in pulmonary artery pressure or right ventricular dimensions .(16,17)

Limitation of Study

This study was the experience of a group of surgeons who have their own preference for tricuspid repair or not, Therefore, the uniform opinion as to repair or not was not formed. Further, follow up was limited due to geographic and educational limitations.

CONCLUSION : The development of late significant functional tricuspid regurge after mitral valve replacement is not a rare event , with a negative impact on long term free survival from chronic heart failure. These findings support the strategy of correcting mild to moderate functional TR at the time of MV replacement to maintain TV function and improve clinical outcomes.

Controversy still exists on when to operate on TR , especially when it is concomitant with MR.

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Predictors of Morbidity and Mortality in Redo Mitral Valve Replacement For Prosthetic Mechanical Mitral Valve Dysfunction

Tamer Fouda, M.Sc.,

Ayman Gado, M.D.;

Mohamed Abul-dahab, M.D;

Hosam Fathy, M.D

Background: Recent decades showed steady increase in the number of cases referred for redo cardiac surgery with higher morbidity and mortality rates compared to the first-time operations.

We aimed to investigate the risk factors for hospital mortality and morbidity in patients who underwent mitral valve replacements for previous mechanical mitral valve dysfunction.

Methodolgy: Sixty patients underwent the study from July 2011 till June 2013. Preoperative, operative, and postoperative data were analyzed and evaluated for risk factors affecting hospital mortality and morbidity.

Results: The hospital mortality was 15%. New York Heart Association functional class, pulmonary hypertension, neurological event, total bypass time, cross clamp time and renal impairment are the most important risk factors for hospital mortality. These factors with hepatic dysfunction, overweight, left ventricular dysfunction and increased end systolic diameter > 3.9 cm are risk factors for postoperative hospital morbidities in patients undergoing redo mitral valve operation for prosthetic mechanical mitral valve dysfunction.

Conclusion: Once significant valve dysfunction is first noted, re-operation should be undertaken to minimize operative risk to avoid mortality and post-operative morbidities.

KEY WORDS: Mechanical valve, mitral, redo operation, functional class

Recent decades have seen a steady increase in the number of cases referred for redo cardiac surgery, which are associated with increased risk of morbidity and mortality compared to the first-time operations. Apart from older age and comorbidities, the presence of adhesions from previous surgery provides technical challenges for the surgeon, particularly to achieve safe re-entry, to prevent injury to previous grafts or adherent structures, and to obtain satisfactory myocardial preservation [1].

Mechanical mitral valve dysfunction is a serious complication associated with a high mortality rate particularly in obstructive cases. Mechanical valves dysfunction may be caused by suture line dehiscence leading to paravalvular regurgitation or breakage and separation of the valve components or valve obstruction leading to what is called stuck valve ***(Kardon, 2013)***. A variety of factors also, such as thrombosis, pannus formation, bacterial endocarditis, chordal debris, papillary muscle entrapment, etc. can cause mechanical malfunctions of prosthetic heart valves either perioperatively or long after the surgical replacement. Thrombosis or pannus formation is considered as the most common causes of prosthetic mitral valve obstruction [2]. Urgent diagnosis and treatment are then mandatory[2]–[4].

Patients and Methods

Through a prospective study, 60 patients undergoing redo mitral valve replacement for prosthetic mechanical mitral valve dysfunction in Kasr Eleiny teaching hospitals in the period from July 2011 till June 2013 were included in this study. Patients were evaluated starting from admission till discharge in order to assess the determinants

Department of Cardio-thoracic Surgery, Kasr El-Ainy Hospital, Faculty of Medicine, Cairo University.

Codex : o3/12/1403

of morbidity and mortality during hospital stay. Prosthetic mechanical valve dysfunction was defined as any change in the valve function causing significant stenosis or regurgitation [5] .

Inclusion criteria

All patients undergoing redo surgery for mitral valve re-replacement for having a confirmed diagnosis of prosthetic mechanical valve dysfunction in mitral position, as documented by clinical examination and investigations. Many factors contribute to prosthetic mechanical mitral valve dysfunction: thrombosis, pannus formation, paravalvular leak mechanical prosthesis failure and prosthetic endocarditis remain among the most important factors that contribute to prosthetic valve dysfunction causing significant valve stenosis or regurgitation.

Exclusion criteria

- Patients with associated surgical procedure other than prosthetic mechanical mitral valve re-replacement; e.g., associated ischemic heart disease necessitating CABG, high transaortic valve gradient necessitating replacement.
- Patients with history of ischemic heart disease; e.g., myocardial infarction, previous coronary artery bypass grafting, previous percutaneous
- transluminal coronary angioplasty.

Preoperative preparation:

Any patient with mechanical valve with acute onset of dyspnea or worsening of his general condition even with nonspecific symptoms presenting to the outpatient clinic or to the emergency department was considered to have mechanical valve dysfunction until proved otherwise. On presentation, all patients were evaluated by detailed medical history taking including checking the card given to the patient in which the valve type and size is registered and asking about the regularity of taking anticoagulants. The symptoms were analyzed carefully; e.g., FC with asking about the onset of each symptom. Many patients presented with symptoms varying from less than 1 day to more than 30 days. Detailed clinical examination was done including checking of the access of the operation, cardiac auscultation including the valve sounds, any abnormal sounds and murmurs. Checking vital signs plays a role in the suspicion of valve dysfunction. Heart rate and its regularity were assessed as tachycardia in a previously controlled patient's rate may signify a new event; heart failure or fever in PVE. Hypotension may occur in cases of cardiogenic shock. Auscultation of the chest should also be done to delineate the presence of pulmonary congestion, which may be the clue for prosthetic mechanical valve dysfunction in a previously well-controlled patient.

Routine laboratory investigations were done. Chest X-ray (postero-anterior and lateral views) is done to assess the chest condition, number of stainless steel wire of previous sternotomy and relation between the heart and the sternum. E.C.G. was done to detect rhythm of the patient's heart rate. Echocardiography was done to assess leaflet mobility, presence of thrombi, vegetations, paravalvular leak, valve dehiscence, pulmonary artery pressure, chamber dimensions, and ejection fraction. Fluoroscopy was done if the echocardiography is not conclusive for valve mobility. Blood culture was also done in suspected cases of endocarditis.

After the diagnosis of prosthetic mechanical valve dysfunction was confirmed, all patients were admitted in CCU where full monitoring is done and prompt preparation was done for urgent surgical intervention to do mitral valve replacement. We usually do not wait till the correction of INR especially in patients with poor status or pulmonary edema.

Operative technique

Under general anesthesia in supine position, all operations were carried out through median sternotomy using the oscillating saw after exposure of femoral artery and vein to be used if needed. The heart was mobilized. We used to open the left pleura instead to improve the exposure of the valve after atriotomy. Cannulas were put and cardiopulmonary bypass was initiated. Aorta was cross clamped and myocardial protection was done using intermittent antegrade cold blood cardioplegia solution and systemic hypothermia to 28c is also initiated. Topical cooling by ice slush is used too. Access to the valve was done through left atriotomy or trans-septal approach in cases with small left atrium. The valve was gently removed, together with any thrombus or pannus, the native ring was debrided from any previous stitches or fibrous tissue or vegetations (in case of infective endocarditis). The new prosthesis was inserted using interrupted transverse mattress 2/0 ethibond sutures with Teflon pledgets.

Post-operative care

Patients were transferred to I.C.U. on inotropic support if needed where they were monitored continuously. The amount of drainage was monitored hourly. The amount of drainage was monitored hourly. Postoperatively, all patients received permanent anticoagulation with warfarin if there was no evidence of active bleeding. In the first few days we used heparin in addition to warfarin till the INR become less than 2. The international normalized ratio (INR) was maintained between 2.5 and 3.5 in all patients. The patients' data will be monitored and registered during their hospital stay for detection of postoperative morbidity, e.g. renal impairment, chest infection, wound infection.

The variables analyzed in this study were: sex, age, body weight, NYHA FC, type of prosthesis, number of previous

operation(s), interval from implantation, cardiac rhythm, urgency of operation, diabetes, cerebrovascular accident, creatinine level, hepatic dysfunction (serum bilirubin value >2.0 mg/dL), presence of endocarditis, echocardiographic data; e.g. ejection fraction and pulmonary artery pressure, aortic cross-clamp time and bypass time.

Operative mortality was defined as death that occurs before hospital discharge [6]. Urgent operations were defined as operative procedures performed in patients whose accelerated symptoms prompted urgent hospital admission for evaluation and who were judged to be too unstable to discharge before operative intervention [7]. Patients with preoperative serum creatinine greater than 1.8 mg/dl were considered to have renal insufficiency. Post-operative renal failure was defined as requirement for dialysis in the post-operative period. Stroke was defined as a central neurologic deficit persisting for more than 72 hours [8]. Prolonged mechanical ventilation is ventilation that exceeded 18 hours while prolonged ICU stay is stay in the ICU for more than 72 hours. Sternal wound infections were defined as infections that required operative intervention [7]. Postoperative bleeding necessitating intervention means excessive postoperative blood loss (more than 1,000 mL in 24 hours or drainage 3-5 ml/ kg in 3 successive hours or compromising hemodynamic stability) that needs chest reexploration [9]. Body mass average body weight while a number above 25 kg/m2 indicates that the person is overweight.

Infective endocarditis refers to active endocarditis and included patients with organisms or inflammation documented on the valve specimen, or who did not fulfill those criteria but who underwent operation while still under prolonged antibiotic treatment for clinical endocarditis. Periprosthetic leak refers to leak due to a cause other than active endocarditis. Prosthetic valve failure (stuck valve) refers to all other causes of prosthetic valve dysfunction including valve thrombosis, tissue ingrowth and mechanical dysfunction [10].

Statistical analysis method

Obtained data were presented as mean ± SD, numbers and percentages as appropriate. Associations between categorical predictor variables and outcomes were analyzed using Pearson Chi-Square (χ^2) test for Independence. Associations of continuous predictor variables were tested using binary logistic regression. Statistical analysis was performed using Microsoft® Office Excel 2010 and SPSS (Version 20, 2011). *P* value < 0.05 was considered statistically significant.

Results

This prospective observational analytic study enrolled sixty patients who underwent surgery for PMVD (prosthetic mechanical valve dysfunction) in the department of cardio-thoracic surgery, Kasr El-Ainy hospitals, Faculty of Medicine, Cairo University, in the period from July 2011 to June 2013. The demographic and preoperative data are shown in table 1-3.

Preoperative Data	Count		%	Mortality cases		P value
Age (in years)	Mean 39.08 SD 10.139	60	100%	9	15%	
Sex	female	22	36.7%	4	18.2%	N.S.
	male	38	63.3%	5	13.2%	
BMI	normal	44	73.3%	7	15.9%	N.S.
	over	16	26.7%	2	12.5%	
NYHA_FC	I	2	3.3%	0	0.0%	0.021
	II	8	13.3%	0	0.0%	
	III	30	50.0%	3	10.0%	
	IV	20	33.3%	6	30.0%	
Type of prosthesis	Ball& cage	1	1.7%	0	0.0%	N.S.
	monoleaflet	6	10.0%	1	16.7%	
	bileaflet	53	88.3%	8	15.1%	
No. of previous operations	1	53	88.3%	9	17.0%	N.S.
	2	6	10.0%	0	0.0%	
	3	1	1.7%	0	0.0%	
Interval from implantation (in years)	Mean 5.88 SD 5.234	60	100%	9	15%	N.S.
AF	no	15	25.0%	2	13.3%	N.S.
	yes	45	75.0%	7	15.6%	

Urgency	Elective	16	26.7%	2	12.5%	N.S.
	Urgent	44	73.3%	7	15.9%	
DM	no	47	78.3%	7	14.9%	N.S.
	yes	13	21.7%	2	15.4%	
CVS	no	56	93.3%	6	10.7%	0.001
	yes	4	6.7%	3	75.0%	
DCL	no	57	95.0%	7	12.3%	0.01
	yes	3	5.0%	2	66.7%	
Renal impairment	no	38	63.3%	1	2.6%	<.0001
	yes	22	36.7%	8	36.4%	
Hepatic dysfunction	no	53	88.3%	7	13.2%	N.S.
	yes	7	11.7%	2	28.6%	
Pathology	endocarditis	16	26.7%	2	12.5%	N.S.
	PV leak	8	13.3%	0	0.0%	
	stuck	36	60.0%	7	19.4%	

BMI, body mass index; CVS, cerebrovascular stroke; DCL, disturbed conscious level

Table 1. Preoperative data of the patients

Preoperative Echo data		Count	%	Mortality cases	%	P value
EF	<50%	34	56.7%	6	17.6%	N.S.
	>50%	26	43.3%	3	11.5%	
LVEDD	< 5.3	27	45.0%	2	7.4 %	N.S.
	>5.3	33	55.0%	7	21.2%	
LVESD	<3.9	24	40.0%	2	8.3%	N.S.
	>3.9	36	60.0%	7	19.4%	
SPAP	<60mmHg	19	31.7%	0	0%	0.027
	>60mmHg	41	68.3%	9	22%	
Total		60	100%			

EF, ejection fraction; LVED, left ventricular end diastolic dimension; LVES, left ventricular end systolic dimension; SPAP systolic pulmonary artery pressure

Table 2. Echocardiographic findings of the patients

Intraoperative data		Count	%	Mortality cases	%	P value
Bypass time	< 120 mins	43	71.7%	0	0.0%	<0.0001
	>120 mins	17	28.3%	9	52.9%	
Aortic cross clamp time	<90 mins	50	83.3%	4	8.0%	0.001
	>90 mins	10	16.7%	5	50.0%	
Total		60	100%			

Table 3. Total bypass time and cross clamp time during operation

The number of patients that were operated upon urgently was 44 patients (73.3%) while 16 patients (26.67%) were operated upon electively. 2 patients only of the elective group had post-operative bleeding with percentage 12.5% in comparison to 8 (18.2%) patients of the urgent group patients. The full data are shown in tables 5 and 6.

The same happened also in 4 (57.14%) patients out of all the 7 patients with hepatic dysfunction which was of statistical significance.

In our study the number of cases explored for post-operative bleeding was more among patients with prosthetic mechanical stuck valve, followed by valve endocarditis and finally paravalvular leak patients. Only one patient among those who had more than 1 previous cardiac operation experienced post-operative bleeding.

Outcome	Count	%
Mortality	9	15.0%
Exploration for bleeding	10	16.7%
Chest infection	6	10.0%
Infective endocarditis	4	6.7%
CVS	5	8.3%
Prolonged mechanical ventilation	21	35.0%
Prolonged ICU stay	12	20.0%
Renal failure	5	8.3%
Total	60	100%

CVS, cerebrovascular stroke; ICU, intensive care unit

Table 4. incidence of mortality and morbidity after operation

Variables		Bleeding cases		total	P value
Age (in years)	Mean 39.08 SD 10.139	10	16.7%	60	N.S
Sex	female	4	18.2%	22	N.S.
	male	6	15.8%	38	
BMI	normal	7	15.9%	44	N.S.
	over	3	18.8%	16	
NYHA_FC	I	0	0.0%	2	N.S.
	II	1	12.5%	8	
	III	4	13.3%	30	
	IV	5	25.0%	20	
Type of prosthesis	Ball& cage	0	0.0%	1	N.S.
	monoleaflet	2	33.3%	6	
	bileaflet	8	15.1%	53	
No. Of previous operations	1	9	17.0%	53	N.S.
	2	1	16.7%	6	
	3	0	0.0%	1	
Interval from implantation (in years)	Mean 5.88 SD 5.234	10	16.7%	60	N.S
AF	no	2	13.3%	15	N.S.
	yes	8	17.8%	45	
Urgency	Elective	2	12.5%	16	N.S.
	Urgent	8	18.2%	44	
DM	no	9	19.1%	47	N.S.
	yes	1	7.7%	13	
CVS	no	8	14.3%	56	N.S.
	yes	2	50.0%	4	
DCL	no	10	17.5%	57	N.S.
	yes	0	0.0%	3	
Renal impairment	no	4	10.5%	38	N.S.
	yes	6	27.3%	22	
Hepatic dysfunction	no	6	11.3%	53	.002
	yes	4	57.1%	7	
Pathology	endocarditis	3	18.8%	16	N.S.
	PV leak	2	25.0%	8	
	stuck	5	13.9%	36	

BMI, body mass index; CVS, cerebrovascular stroke; DCL, disturbed conscious level

Table 5. Preoperative data and their relevance to excessive postoperative bleeding

Variables		Bleeding cases	%	total	P value
Bypass time	< 120 mins	4	9.3%	43	.015
	>120 mins	6	35.3%	17	
Aortic cross clamp time	<90 mins	7	14.0%	50	N.S.
	>90 mins	3	30.0%	10	

Table 6. Bypass time and cross clamp time and their relevance to excessive postoperative bleeding

The incidence of post-operative bleeding was more in patients with prolonged total bypass time >120 minutes (35.3%) and cross clamp time more than 90 minutes (30%); than those with bypass time less than 120 minutes and cross clamp time less than 90 minutes respectively (Table 6) with significance only in

Regarding post-operative ***renal failure*** necessitating dialysis, the total number of renal failure cases was 5 cases (8.33%).

The creatinine level was elevated >1.8 mg% in 22 (36.7%) patients, 4(18.18%) of them had post-operative renal dialysis and this was statistically significant. Two of the 4 patients (50%) with cerebrovascular events before surgery had post-operative renal failure but this may be attributed to that these two patients had preoperative increased levels of creatinine > 1.8; giving significance statistically. It was found also that incidence of renal dialysis is 14.29% out of all the 7 patients (11.67%) with hepatic dysfunction.

Renal dialysis incidence was among patients with stuck valve (5.6%), while in cases of prosthetic valve endocarditis (18.75%). Among the patients who were operated upon urgently, 4 patients needed postoperative dialysis compared to one patient (6.3%) among the elective group; but with no statistical significance.

Regarding the preoperative echo data and post-operative renal failure, the results are shown in table 10 showing that there was no statistical significance.

The prolonged bypass time and the prolonged cross clamp time were found to be of statistical significance regarding post-operative need of renal dialysis. This may be due to the additional impact of hypotension during bypass on the kidneys already predisposed to preoperative low cardiac output state, making postoperative renal complications and the need of dialysis took place more (Table 7).

The total number of post-operative need of ***prolonged mechanical ventilation*** was 21 cases (35%). The functional class of the patients who had prolonged ventilation was 12(60%) with FC IV, 7 (23.33%) with F.C. III and 1 patient (12.5%) with FC II and only one patient out of the 2 patients with FC I (due to late recovery of conscious level) giving statistical significance towards high functional class (Table 8).

Variables		Renal failure		total	P value
Bypass time	< 120 mins	1	2.3%	43	0.007
	>120 mins	4	23.5%	17	
Aortic cross clamp time	<90 mins	2	4.0%	50	0.007
	>90 mins	3	30.0%	10	

Table 7. Bypass time and cross clamp time and their relevance to postoperative renal failure

Variables		Prolonged MV		total	P value
NYHA FC	I	1	50.0%	2	0.04
	II	1	12.5%	8	
	III	7	23.3%	30	
	IV	12	60.0%	20	
Renal impairment	no	9	23.7%	38	0.016
	yes	12	54.5%	22	
Hepatic dysfunction	no	16	30.2%	53	0.032
	yes	5	71.4%	7	

Table 8. Preoperative data and their relevance to postoperative prolonged MV

The creatinine level was elevated more than 1.8 mg% in 22 (36.7%) patients, 12(54.55%) of them had post-operative prolonged ventilation and this is statistically significant.

Regarding the echocardiographic data of these patients in relation to the duration of mechanical ventilation, it was found that there was no statistical significant relation between both of them.

The incidence of prolonged ventilation was more in patients with prolonged total bypass time more than 120 mins (58.82%) and cross clamp time more than 90 minutes (70%); than those with bypass time less than 120 minutes and cross clamp time less than 90 minutes with statistical significance. This is attributed to the poor functional state of these patients preoperatively that need both longer time for recirculation and postoperative mechanical ventilation (Table 9).

Regarding ***prolonged ICU stay***, the total number of post-operative prolonged ICU stay was 12 cases (20%). The patients with high BMI were 16 (26.7%) with 6 patients (37.5%) needed prolonged ICU stay; giving statistical significance. Three of the 4 patients (75%) with cerebrovascular events before surgery had prolonged post-operative ICU stay with statistical significance.

The number of patients that were operated upon urgently was 44 patients (73.3%) while 16 patients (26.67%) were operated upon electively. Three patients only of the elective group had prolonged ICU stay with percentage 18.75% in comparison to 9(20.45%) patients of the urgent group patients.

The incidence of prolonged ICU stay was more with patients having impaired contractility increased left ventricular end systolic diameter more than 3.9cm with statistical significance. Regarding pulmonary artery pressure and end diastolic diameter, there was no statistical significance (Table 10).

EF, ejection fraction; LVED, left ventricular end diastolic dimension; LVES, left ventricular end systolic dimension; SPAP systolic pulmonary artery pressure, ICU intensive care unit

The incidence of prolonged ICU stay was more in patients with prolonged total bypass time more than 120 mins (35.3%) and cross clamp time more than 90 minutes (50%); than those with bypass time less than 120 minutes and cross clamp time less than 90 minutes but with statistical significance only in prolonged cross clamp time more than 90 mins (Table 11).

Variables		Prolonged ICU stay		total	P value
EF	<50%	10	29.4%	34	0.037
	>50%	2	7.7%	26	
LVEDD	< 5.3	3	11.1%	27	N.S.
	>5.3	9	27.3%	33	
LVESD	<3.9	1	4.2%	24	0.012
	>3.9	11	30.6%	36	
SPAP	<60mmHg	3	15.8%	19	N.S.
	>60mmHg	9	22.0%	41	

EF, ejection fraction; LVED, left ventricular end diastolic dimension; LVES, left ventricular end systolic dimension; SPAP systolic pulmonary artery pressure, ICU intensive care unit

Table 9. Bypass time and cross clamp time and their relevance to postoperative prolonged MV

Variables		Prolonged ICU stay		total	P value
EF	<50%	10	29.4%	34	0.037
	>50%	2	7.7%	26	
LVEDD	< 5.3	3	11.1%	27	N.S.
	>5.3	9	27.3%	33	
LVESD	<3.9	1	4.2%	24	0.012
	>3.9	11	30.6%	36	
SPAP	<60mmHg	3	15.8%	19	N.S.
	>60mmHg	9	22.0%	41	

EF, ejection fraction; LVED, left ventricular end diastolic dimension; LVES, left ventricular end systolic dimension; SPAP systolic pulmonary artery pressure, ICU intensive care unit

Table 10. Preoperative echo data and their relevance to postoperative prolonged ICU stay

Variables		Prolonged ICU stay		total	P value
Bypass time	< 120 mins	6	14.0%	43	N.S.
	>120 mins	6	35.3%	17	
Aortic cross clamp time	<90 mins	7	14.0%	50	0.009
	>90 mins	5	50.0%	10	

ICU intensive care unit

Table 11. Bypass time and cross clamp time and their relevance to postoperative prolonged ICU stay

Variables		Chest infection		total	P value
Bypass time	< 120 mins	3	7.0%	43	N.S.
	>120 mins	3	17.6%	17	
Aortic cross clamp time	<90 mins	3	6.0%	50	0.021
	>90 mins	3	30.0%	10	

Table 12. Bypass time and cross clamp time and their relevance to postoperative chest infection

Regarding ***postoperative chest infection***, the total number of post-operative chest infection was 6 cases (10%). The patients with high BMI were 16 (26.7%) with 4 patients (25%); giving statistical significance. Post-operative chest infection incidence was more among patients with prosthetic valve endocarditis (12.5%) and paravalvular leak (12.5%) followed by stuck valve (8.3 %).

The incidence of postoperative chest infection was more in patients with prolonged total bypass time (35.3%) and cross clamp time more than 90 minutes (50%); than those with bypass time less than 120 minutes and cross clamp time less than 90 minutes but with statistical significance only in prolonged cross clamp time more than 90 mins (Table 12).

Regarding CVS we had only 5 cases (8.3%) with new event not present before operation (4 previously free cases and 1 with new event on top of previous CVS) that mostly occurred on top of dislodgement of thrombi or vegetations and by analysis of the data we found no statistical significance among the preoperative variables. Regarding postoperative wound infection, none of our patients had deep wound infection necessitating wound debridement or rewiring. Regarding thromboembolic manifestations rather than CVS postoperatively, none of our patients experienced any of them during hospital stay.

Regarding infective endocarditis, 3 cases had recurrence of infective endocarditis postoperatively while only one new case that was operated for stuck valve got early postoperative vegetations. However these patients were not enough for statistical analysis, being 3 of the four cases representing recurrence of infection, making significance only towards preoperative infective endocarditis which may give conflict of interest in the study.

Discussion

Rheumatic heart disease is still prevalent in developing nations. Surgery for rheumatic MV lesions is palliative [11]. Reoperations for valvular heart disease are associated with a higher overall mortality than in the primary operation. Reoperations are technically more difficult because of adhesions around the heart and the common association of pulmonary hypertension. Replacement operations are generally performed in a functionally compromised group of patients, so these patients tolerate complications poorly [11], [12]. Nevertheless, there is evidence that clinical outcomes following redo-valve surgery have improved which highlights the velocity of advancement in the field [13].

Throughout the years, the ***mortality*** associated with redo valve surgery has dropped significantly. Recent changes in the management of the cardiac surgical patient may explain the improvement in results in more recent series. During the 70s, the operative mortality rate in redo valve surgery was as high as 41% [14].

During the 90s, a significant reduction in overall hospital mortality, down to 10%, was observed[9]. In another series, a decrease in mortality from 16% in the early 80's to 8% in the early 90s was observed [6], possibly related to technical improvement and increased surgeons' experience. Jones and associates reported that mortality was 11.5% with redo valve replacement compared with 4.1% after repair and 15% after mitral valve replacement for the second time [15]. This is comparable to our study where the overall hospital mortality was 9 patients (15%).

In another comparable study, mortality was 4.2 % in mitral valve reoperations with 18.5% mortality rate in redo

prosthetic mitral valve replacements [16]. This is confirmed by Maciejewski and associates in 2011 where the early mortality rate was 18.6% [17]. Vohra and associates had presented their 10 year experience in redo mitral valve replacement. The in-hospital mortality was 12% for patients [13].

Functional class (FC) seems to be the most important predictor of hospital mortality. Wauthy and associates also considered NYHA FC as the most frequently quoted risk factor associated with death in redo valve surgery. This was due to that mortality in their study reached up to 30% with stage IV compared to less than 10% in stage II and III [12]. This is comparable to our study where the mortality among patients with F.C.I through III was 10% while it was 30% for patients with FC IV and this is statistically significant. NYHA functional class IV was also a risk factor in short term survival as mentioned by Akay and associates and others in many studies [17-20].

The high ***creatinine level*** cannot be passed without emphasize. The preoperative creatinine level was elevated >1.8 mg% in 8 of the mortality cases , the cause of this renal impairment is attributed to marked hemodynamic instability or due to renal microembolisation associated with endocarditis cases. This goes with the results found by others who demonstrated renal function as an independent risk for hospital mortality [12,17].

Long bypass time and cross clamp time were also important risk factors that have been associated with a high mortality in our study with statistical significance. McGrath et al stated that long bypass time and long cross clamp time are predictors of mortality [21]. Aortic cross clamp time and pump run time were significantly longer in the dead patients than in the survived group in other studies[12]. Brandão mentioned that among the intraoperative variables associated with higher hospital mortality was ECC time longer than 120 min [19]. The cause of this prolonged time for bypass was in most cases due to extra time needed for circulatory support due to associated left ventricular dysfunction. Global myocardial ischemic time alone was a strong predictor of hospital mortality in many studies [9,22,23]. Akins and co-workers abolished also such determinants by continuous suturing technique in mitral valve replacement in order to provide shorter cross clamp time and cardiopulmonary bypass [7]. This points to that these variables may not be independent variables.

The sex and age of patients in our study were similar to those described by Vohra et al, Brandão et al and Maciejewski et al which showed that sex and age did not affect the hospital mortality [13], [17], [19]. Others reported age alone as a non-significant predictor for the hospital mortality[8], [20]. Another study done by Awad and co-workers shows that 're-do' cardiac surgery in patients over the age of 70 can be undertaken with acceptable operative morbidity and mortality. It leads us to conclude that age alone should not be a contra-indication for re-operation [24].

Advanced age is however associated with decreased physiologic reserve and increased comorbid factors. Their functional reserve capacity is diminished compared with younger patients.

Akay and Beghi confirmed that females are significantly labile to mortality than males [18], [20]. In contrary, Jones et al described sex as a non-significant risk predictor by Jones and co-workers in this series and although age was not a risk factor in their univariable analysis, it was significant in the multivariable model [15].

Weight at the time of reoperation is not a significant risk factor for hospital mortality according to many studies [23] and this goes with our study.

Indications for re-operation in our study were thrombus formation over the prosthetic valve, prosthetic endocarditis, pannus formation and paravalvular leakage. The highest mortality was among patients having stuck valve (19.4%) followed by those with prosthetic endocarditis patients (12.5%). Brandao and Vohra mentioned that the indication for surgery had no impact on in-hospital mortality [13], [19]. This goes with our study in which the indication of reoperation is not found to be statistically significant. According to Mazzucco et al, Maciejewski et al and others; operative mortality was significantly higher in those patients who reoperated because of prosthetic endocarditis [17], [20], [25]. Presence of valve infection is also a predictor found by Potter and associates [8]. Other observations suggest that the factors responsible for higher mortality are active infective endocarditis and valve thrombosis [11].

Preoperative ***neurological condition*** in term of previous stroke, is a risk factor that was statistically significant in our study, like other studies as that conducted by Piehler and associates[23]. In contrary others had it as a non significant predictor for the hospital mortality. Moreover, 3 patients had disturbed conscious level due to severe hemodynamic instability and two of them died giving significance for this finding in absence of stroke and which was not found to be analyzed separately in previous studies.

Diabetes is not a risk factor in our study for hospital mortality. This goes in the same direction with other studies which reported that diabetes is not a risk factor [8,19].

Atrial fibrillation was observed in 45 patients (75%), this may be attributed to the fact that the main cause of the primary surgery for valve replacement was due to rheumatic affection but its effect on hospital mortality was not significant.

Atrial fibrillation has been identified as a risk factor for mortality and morbidity associated with valve surgery [17], as it may cause low cardiac output during the postoperative

period or predispose to thromboembolic events. In our series, atrial fibrillation was not identified as a risk factor for hospital mortality [19].

Although that the ***urgency*** of surgery is an important risk factor for mortality and the incidence was higher in emergency patients, in our study it was of no statistical significance regarding mortality. The reports conducted by Potter et al and others showed that the emergency of surgery was also an independent risk for mortality [8,20]. The degree of urgency is also a reported risk factor in many other studies in the re-operation for redo mitral valve replacement patients [12], [18]. The reported mortality risk of elective re-operation may be as low as 5.4% to 11%, while, for emergency procedures, it could be as high as 38 to 61.5% [12].

Although there was a trend to higher operative mortality with increasing ***number of prior cardiac operations***, this factor was not significant in multivariable analysis. Akins and others denied this too [7,19]. This lack of significance may be a result of the small number of patients having more than one prior cardiac operation [7]. The number of previous operations has been reported also as a risk factor in other series [12,20].

Our study suggests that ***left ventricular dysfunction*** was associated with higher hospital mortality but didn't reach statistical significance. This is also the same for ***LVEDD and LVESD*** which have no significant effect on the mortality rate. This goes with the studies which consider EF as a non-significant predictor for the hospital mortality [8], [19]. Low left ventricular ejection fraction (less than 35%) and increased LVEDD more than 50 mm have been reported of significance in mortality by Akay and associates [18]. According to Mazzucco et al and others operative mortality was significantly higher in those patients who were had impaired left ventricular function[17], [21], [22], [25]; while LVEDD and LVESD did not influence hospital mortality, as shown by Brandão et al [19].

Pulmonary artery pressure was another risk factor in our study, patients having higher pulmonary artery pressure showed higher hospital mortality rate with statistical significance, unlike the study that was done by and Brandão et al that showed that R.V.S.P. reflecting the pulmonary artery pressure did not influence operative mortality[19].

Many studies discussed postoperative morbidity in terms of the duration of hospital stay. However, even prolonged hospital stay is poorly described in studies of redo MVR[13].

In our study, we go with Piehler et al that different set of risk factors was found to correlate with length of hospital stay after reoperation because of the morbidities, although there was considerable overlap with the incremental risk factors associated with hospital mortality [23]. Regarding morbidities found in the post-operative period till discharge, we monitored ***postoperative bleeding*** in 10 cases (16.7%). Cohn et al reported bleeding in 5.6% of his patients [6]. Lytle et al had 8 % reopening for bleeding [10]. Pansini et al had excessive postoperative bleeding (more than 1,000 mL in the first 24 postoperative hours) occurred in 14.5% of the patients while re-exploration was done in only 8% of them [9].Vohra and associates reported 4% bleeding and re-exploration in his study [13]. Potter and co-workers reported 3.8% [8]. Akins et al reported 5.9%in mitral valve reoperations on top of failed bioprosthesis [7]. The higher incidence of postoperative bleeding in our study may be due to the non-usage of aprotinin (trasylol) in our hospitals which in turn may be due to the discontinuation of its production in our country. Akay and associates reported 7.1% incidence [18].

In our study, total bypass time and hepatic dysfunction are risk factors for postoperative bleeding. This may be due to hepatic congestion preoperatively which is due to valve dysfunction may alter the coagulation mechanisms. Moreover the negative effect of the bypass on the coagulation mechanisms which is already altered is exaggerated by prolonged total bypass. All of these increase the incidence of postoperative bleeding.

Prolonged mechanical ventilation (more than18 hrs) occurred in 21 (35%) patients while ***prolonged ICU stay*** (more than 48 hrs) occurred in 12 patients (20%). Prolonged mechanical ventilation occurred in 37% and long stay in the intensive care unit occurred in 25.7% of the survivors [9] and this copes with our results. NYHA FC, renal impairment, hepatic dysfunction with total bypass and cross clamp times are risk factors of significance for prolonged mechanical ventilation postoperatively; whereas high BMI, CVS, left ventricular dysfunction, increased ES more than 3.9 cm and prolonged cross clamp time are risk factors for prolonged ICU stay.

Chest infection occurred in 6 patients (10%). Potter et al reported 2% for post-operative pneumonia [8]. In contrary , Akay and associates reported 14.2% with postoperative pulmonary complications [18]. Regarding chest infection, high BMI and prolonged cross clamp time were found to be risk factors of significance.

Renal failure necessitating dialysis occurred in 5(8.3%) patients. Cohn et al reported 4.7% renal failure in redo valve patients [6]. In contrary , Akay and associates reported 14.2% with postoperative renal dysfunction [18]. Preoperative renal impairment, CVS, prolonged bypass time and cross clamp time are risk factors for postoperative renal dysfunction.

Patients with prior mechanical valves tended to be younger than patients with prior bioprosthetic valves. Despite this younger age, remote stroke was more common in patients with prior mechanical valves [8]. Regarding ***CVS*** we had only 5 (8.3%) cases with new events not present preoperatively. Potter in his study in 2004 documented 2.3% stroke in patients with repeated mitral valve replacement [8].

Regarding postoperative ***infective endocarditis***, 4 cases (6.7%) had infective endocarditis postoperatively. Preoperative infective endocarditis is a risk factor that cannot be confirmed due to the low event rate in our study and the need of more sample size. The same is for the analytical statistical significance for postoperative neurological events.

Regarding wound infection postoperatively, none of our patients had wound infection necessitating wound debridement or rewiring. Cohn et al reported 2.2% of his patients with sternal wound infection [6]. Akins reported that none of the redo mitral valve replacement patients had sternal wound infection in his study [7]. Potter et al reported also a low incidence (1%) of sternal wound infections [8].

We have some limitations in our study. Among these is the given relatively small sample size and low event rate in some morbidities. Moreover, the differences in the incidences of morbidities may be due to improvements in care in the western centers that have neutralized these factors or because of relatively small numbers and the low event rate in our series.

Many reports of redo valve surgery clearly suggests that when significant valve dysfunction is first noted, re-operation should be undertaken to minimize operative risk to avoid proceeding to higher FC [12].

In conclusion, NYHA functional class, pulmonary hypertension, preoperative neurological event, total bypass time, cross clamp time and renal impairment are the most important risk factors for hospital mortality in patients undergoing mitral valve redo operation for prosthetic mechanical valve dysfunction. NYHA FC, preoperative renal impairment, hepatic dysfunction, CVS, high BMI, prolonged bypass and cross clamp times, left ventricular dysfunction and increased LVEESD more than 3.9 cm are risk factors for postoperative hospital morbidities in patients undergoing mitral valve redo operation for prosthetic mechanical valve dysfunction. Once significant valve dysfunction is first noted, re-operation should be undertaken to minimize operative risk to avoid mortality and post-operative morbidities.

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Cardiac Myxoma, 68 Patients in 15 Years

Ahmed MA Bakry;

Ehab Sobhy;

Ehab Kassem

Background: Cardiac myxoma is considered the most common primary tumor of the heart and one of the cardiac surgical urgencies.

Objectives: Our objective is to summarize our experience in surgery for cardiac myxoma.

Methods: Sixty eight patients were collected between from January, 1998 till January, 2013; 42 females and 26 males.

Results: The mean age was 47.6±14.8 years; they range between 22 years and 72 years. Echocardiography was the cornerstone for diagnosis.

Conclusion: High suspicion seems necessary to detect cases with cardiac myxoma. Immediate surgical treatment yields best results and prevent sudden death and peripheral embolization.

KEYWORDS: Myxoma, Embolization, Cardiac tumor.

Cardiac myxoma is considered the most common primary tumor of the heart and one of the cardiac surgical urgencies. With an incidence of 6.5 per million population per year.[1] It is common in the middle age despite seen in all age groups with female preference. [2] It presents 0.3% of all cardiac operations on bypass.[2] Myxoma are localized in left atrium in 80%, in right atrium 7-20%, rarely biatrial, right ventricle, left ventricle and extra-rarely from the valve tissues. [3] The symptoms vary and it depends on the location, size and friability of the myxoma where the embolic manifestation (stroke) may be the only presenting symptom. The observed symptoms were related to valve obstruction causing congestive heart failure symptoms (dyspnea), or tachyarrhythmia. General constitutional symptoms were reported. None of these patients population was asymptomatic. [4]

Patients and Methods

This retrospective study was conducted using one institution data base aiming to summarize and re-evaluate our experience with surgical resection of cardiac myxoma over the last 15 years (*from January,1998 till January,2013*) at cardiac surgery unit, Nasser institute , Cairo. We collected 68 cases operated upon with a preoperative assessment based on transthoracic echocardiography. Preoperative data (see table no.1) were analyzed using SPSS Version 15.

Surgical approach

Surgical excision of the myxoma was performed under extracorporeal circulation through ascending aortic cannulation and bicaval cannula with moderate hypothermia. Median sternotomy was used in all. Left atrial mass was removed in 58 cases (85.3%) cases and right atrial mass was removed in 10 cases (14.7%) The tumor was removed through biatrial approach in all cases with cauterization of the pedicle site. Patch closure of the defect was done in 6 cases (8.8%). Macroscopically, Tumor size ranged between

*Cardiothoracic surgery department, Faculty of medicine, Zagazig University

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1.3-15 cm; mean 4.7cm. They were solid and encapsulated. With cut section showing gelatinous tissue appeared as brownish yellow. (Figure no.1)

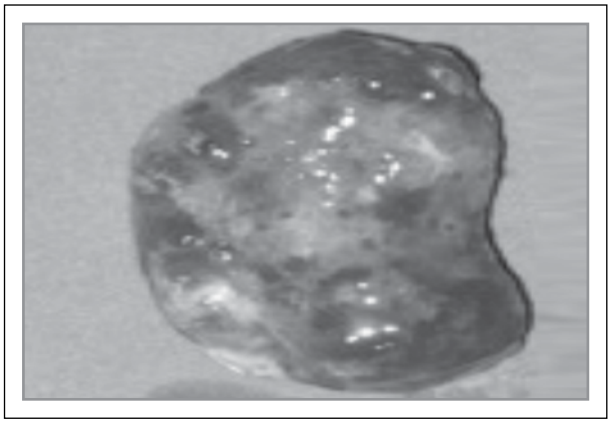

Fig. 1. Showing left atrial myxoma after surgical resection.

Intraoperative echocardiography was done in most of the cases, showed normal mitral valve function in all patients except in 1 case, we encountered severe mitral regurge in early postoperative period and the patient went back to operative room and prosthetic mitral ring annuloplasty was done. (Figure no.2)

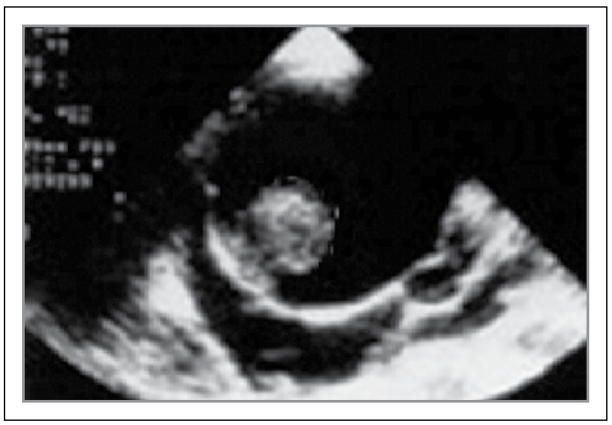

Fig. 2. Showing left atrial myxoma by echo cardiography.

Results

These patients included were 26 males (38.2%) and 42 females (61.8%). The mean age of the 68 patients at time of operation was 47.6± 14.8 years; they ranged between 22 years and 72 years. The most frequently observed symptoms were associated mitral valve obstruction (See table no.1). such an obstruction caused congestive symptoms in 5 patients (7.4%) and 23(33.8%) reported dyspnea,9(13.2%)suffered stroke and 8 (11.8%) had transient neurologic symptoms,2 patients (2.9%) had an acute peripheral embolism, in addition, constitutional symptoms and signs of generalized disease were reported. None of the patients had a family history of myxoma.

Variable		
Female gender	42	61.8%
Male gender	26	38.2%
Females mean age	47.1±13.8	
Males mean age	48.2±16.4	
Total mean age	47.6± 14.8	
Left atrial myxoma	58	85.3%
Right atrial myxoma	10	14.7%
Congestive symptoms	5	7.4%
dyspnea	23	33.8%
Preoperative AF	10	14.7%
Transient neurologic symptoms	8	11.8%
Stroke	9	13.2%
Constitutional symptoms	29	42.6%
Peripheral embolism	2	2.9%
X-clamp time	30 (15-140)	
Cardiopulmonary bypass time	50 (24-180)	

Table 1. Showing perioperative criteria.

Non-fatal complications were found in 25 patients (36.8%). (See table no.2) It included respiratory complications (atelectasis, bronchopneumonia, and pneumothorax), prolonged wound healing, transient bradycardia, atrial fibrillation, and cerebral complications (reversible hemiparesis). The postoperative embolic complications were treated with aspirin and warfarin.

Postoperative stroke	**1 (1.5%)**
Postoperative dysrrhythmia	15 (22%)
Postoperative respiratory complications	5 (7.4%)
Prolonged wound healing	3 (4.4%)
Reoperation for mitral valve	1 (1.5%)

Table 2. Showing post-operative criteria.

	Status				P value
	Alive (n=61)		Dead (n=7)		
	No	%	No	%	
Age					
<60	52	91.2	5	8.8	0.316
>60	9	81.8	2	18.2	
Sex					
F.	38	90.5	4	9.5	>0.099
M.	23	88.5	3	11.5	
Mean CBP	54.9		75.4		0.6

Table 3. Showing variables for mortality cases.

Discussion

Myxoma is the most frequent benign primary heart tumor as it accounts for 0.3% of open-heart surgery performed according to different groups worldwide. [2] The distribution among the present population revealed a female prevalence (61.8%) this result is similar to Garatti [5] This could be explained by the fact that approximately 75% of sporadic myxomas occur in females. Female sex predominance is less pronounced in familial atrial myxomas. [7] The mean age of myxoma patients at surgery was in the 5th decade (47.6±14.8), this is similar to Selkane[6] and in contrast with Garatti [5] who stated a prevalence in old aged patients.

The site of the mass was more common in the left atrium (85.3%) than the right atrium (14.7%) these results were similar to Garrati who stated that 75% of myxoma originated from right atrium. [5]

Cardiac tumors may produce a large variety of symptoms through one of the following: (1) obstruction of intracardiac blood flow by the mass or interferance with valve function; (2) arrhythmias or pericardial effusions with tamponade caused by invasion of the tumor; (3) embolization, causing systemic deficits when the tumor is on the left side of the heart; and (4) systemic or constitutional symptoms. [8] The clinical presentation of a myxoma consists of hemodynamic symptom related to blood flow obstruction with further tumor growth, left ventricular outflow tract obstruction occurs and embolic phenomena, patients are at increased risk for acute cardiogenic shock or sudden cardiac death.[9] Conversely, some myxomas produce no symptoms and only become evident as incidental findings. [10]

Most of our patients were presented to us by two or more symptoms but none were asymptomatic. The most frequent symptom in our study was dyspnea by 33.8% followed by stroke by (13.2%). Another study conducted in Armed Forces Institute of Pathology,USA,[11]revealed cardiac failure or malaise as the most common symptom (67%), constitutional symptoms (34%) with fever, weight loss, or symptoms resembling connective tissue disease followed by cerebral emboli with stroke (29%).

In our study we found that peripheral embolism occured in 2.9% which was contrary to study conducted in Qassim which revealed that Embolism occurs in 30–40% of patients. [12] The site of embolism is dependent upon the location (left or right atrium) and the presence of an intracardiac shunt. Embolization occurs more often from polypoid tumors floating in the blood stream than from solid round tumors. Tumor size may play role in embolization. [13]

It is speculated that patients may have an immune response reaction to the neoplasm or to the heart muscle that seems responsible to the constitutional symptoms. [14] Myxoma should be differentiated from other cardiac tumors and from thrombotic lesions.

Our results revealed that The median cardiopulmonary bypass time was 50 (24-180 minutes), with the median aortic cross clamp time being 30 minutes (15-140 minutes). Our findings were different from other studies whose findings were The median cardiopulmonary bypass time was 87 minutes (range, 28-228 minutes), with the median aortic cross clamp time being 61 minutes (16-175 minutes). [15,16] This could be surgeon related.

The prognosis for patients with solitary myxoma after surgical resection has been excellent.[17] Concerning our postoperative status it was found that 61 patients (89.7%) were alive and 7 patients died in hospital (10.3%) cause of the deaths included pericardial tamponde low cardiac output, mediastnitis and neurological complications. On the other hand, keeling[18] stated that postoperative The early mortality rate was 2.0% and the late mortality rate was 6.1% while Selkane[6] stated that postoperative mortality was 7.5%.

All current surgical techniques seem to provide low recurrence rates.[17] Cardiac myxoma seems to recur in young males, patients with family history and in multifocal myxoma cases.[19] Once it has been diagnosed, it should be operated upon. Crafoord in 1954 [20]combined transeptal extirpation with the removal of the lesion through left atriotomy. Kabbani and Cooly in 1973,[21] described the biatrial approach with the advantage of inspecting the four chambers with adequate irrigation.

The classic attitude of emergency management of cardiac myxoma is rarely questioned [3]. It is logical in acute symptomatic forms, such as heart failure with pulmonary edema [4], clapper-shaped tumor intermittently prolapsing into the mitral orifice, or a large, lobulated tumor suggesting a risk of embolism.

With the exception of real emergency situations, there is no reason why surgery for myxoma should not comply with the usual recommendations before any cardiac surgery. This

assessment should only take 1 or 2 days, which does not constitute high risk for stable patients, but allows surgery to be performed under better conditions, particularly in elderly patients.

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Congenital Diaphragmatic Hernia (Weaning From Mechanical Ventilation as a Predictor of Outcome)

Thoracic

Ayman Gabal MD[1];

Ashraf Hamed [2];

Moh M Alsharawy [1]

Background: **As one of the most common and serious congenital disorders in the neonatal intensive care unit (NICU), (congenital diaphragmatic hernia) CDH has been the focus of research programs from dozens of investigative teams internationally. The estimated incidence of CDH was 1 per 2,000-5,000 live births and affects approximately 1,100 infants annually in the USA.**

Material and methods: **This study was conducted at the NICU of King Saud Hospital Onaizah KSA. The medical records of 17 CDH patients, admitted to the NICU between 1 January 2005 and 31 December 2012, were reviewed retrospectively.**

Results: **A total of 17 patients underwent surgical repair of their congenital diaphragmatic hernia (2 Right sided and 15 Left sided hernias). 12 of the neonates were males and 5 were females. Gestational age of our patients ranged from 34 to 43 weeks (mean 39.7 ± 1.46 weeks), and their birth weight at the time of operation ranged from 2.2 kg to 3.1 kg (mean 2.5 ± 0.3Kg). Average age at time of operation was (40.88 ± 5.32 h) for patients in group A, and (204 ± 28.68 h) for those in group B. In group A postoperative average length of stay on controlled mechanical ventilation was (73.66 ± 27.05 h), and it was (40 ± 8.14 h) for those in group B. We have one case of mortality and it was in group (A).**

Conclusion: **Medical management and surgical strategies of CDH infants underwent many changes since 1990, including peri-operative stabilization with delayed repair. We found a relatively high length of stay on controlled mechanical ventilation (CMV), with longer hospital stay for those patients underwent early surgery before weaning from mechanical ventilation (group A), with good surgical outcome in both groups.**

KEYWORDS: **Congenital diaphragmatic hernia, Mechanical ventilation.**

Congenital diaphragmatic hernia (CDH) is one of the most challenging and perplexing malformations, associated with a high mortality (36% based on the CDH registry)[(1)].

As one of the most common and serious congenital disorders in the Neonatal Intensive Care Unit (NICU), CDH has been the focus of research programs from dozens of investigative teams internationally. The estimated incidence of CDH was 1 per 2,000 - 5,000 live births and affects approximately 1,100 infants annually in the USA[(2, 3)].

Many initial clinical characteristics associated with poor outcome in infants with CDH have been identified as risk factors and they include birth weight, the size of the diaphragmatic defect, a low 5-minute Apgar score, prematurity, an air leak, and the presence of other structural defects or chromosomal abnormalities. Moreover, in cases of isolated CDH, pulmonary hypoplasia and associated persistent pulmonary hypertension of newborn (PPHN) are the main causes of death[(1,3)].

The key to successful postnatal management of CDH is the use of mechanical ventilation and/or extracorporeal membrane oxygenation (ECMO) to manage the

(1) Cardiothoracic Surgery department Zagazeg University,

(2) Pediatric Surgery department Zagazeg University,

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pulmonary alveolar hypoplasia and the PPHN. Current management strategies consist of preoperative stabilization and delayed repair[4].

However, ECMO facilities are not available in most Asian countries. Various other treatment strategies were developed by different centers to improve outcome. Many centers are now using high frequency oscillatory ventilation (HFOV) as an alternative to conventional ventilation because this will reduce the amount of ventilator induced lung injury[3,4].

However, the relative rarity and clinical variability of CDH makes it difficult to conduct well-designed clinical studies at a single institution and to establish the most suitable treatment[5].

The epidemiology and outcomes of CDH are well described in developed countries, but few data exist for developing countries, particularly with respect to risk factors and outcomes such as morbidity, mortality, and hospital length of stay[1,2,6].

This study aimed to evaluate timing of surgery in patients with isolated congenital diaphragmatic hernia as well as the size of the defect on surgical outcome.

PATIENTS AND METHODS

This study was conducted at the NICU of King Saud Hospital Onaizah KSA. The medical records of 17 CDH patients, admitted to the NICU between 1 January 2005 and 31 December 2012, were reviewed retrospectively.

Data on patient demographics, underlying disease, procedures, and medications were collected for analysis.

Patients were classified according to the time of surgical interference into two clinical groups: Group A :Consisted of 9 patients underwent surgery before weaning from mechanical ventilation within the first 48 hours. Group B: Consisted of 8 patients underwent surgery after fulfilling criteria of weaning from mechanical ventilation within 10 days.

Exclusion criteria

1-Patients with congenital anomalies other than CDH. 2-Patients needed ECMO.

The presence of a high carbon dioxide level ($PaCO_2$>50 mmHg) or low oxygen levels, indicates a poor prognosis.

At our center, the in-utero diagnosis of a diaphragmatic hernia is made in approximately 25% of patients who present with CDH. 75 % of patients who ultimately present with a diaphragmatic hernia have a “normal” ultrasound.

The main advantages of prenatal detection of CDH was to rule out associated anomalies, and evaluating the need for referral to a specialist centre for proper management .

Our patients presented with severe immediate cardiorespiratory distress, with prominent hemithorax and minimal air entry on one side. Scaphoid abdomen may be noticed in some cases.

Chest radiograph and Computed tomography scan, were done to confirm the diagnosis, assess the contents of the hernia and evaluate the presence of any associated anomalies.

Contrast gastrointestinal studies (Barium meal or enema) were also used in some cases.

Once born, endotracheal tube and nasogastric tube were inserted to maintain air way and to keep stomach and intestines as free of air as possible. All infants in our centre were managed with a routine ventilator.

Surgical technique:

Approach:

- Left subcostal incision was performed in most of our patients(13 patients).

A transthoracic approach was used for two cases with right sided hernia.

- Thoracoabdominal approach was used for two cases with left sided hernia and this was to release adhesions inside the chest.

Frequently, the spleen, small intestine, and large intestine are herniated through the defect. Once the hernia is reduced, the edges of the diaphragm were clearly identified. This often involves unrolling and dissecting the posterior-medial diaphragm edge just cephalad to the ipsilateral adrenal gland. Interrupted non-absorbable sutures are used in a primary repair. Simple interrupted, mattress sutures, and pledgetted sutures have all been used with success. Prosthetic materials were not used in our study.

RESULTS

A total of 17 patients underwent surgical repair of their congenital diaphragmatic hernia (2 Right sided and 15 Left sided hernias). 12 of the neonates were males and 5 were females. Gestational age of our patients ranged from 34 to 43 weeks (mean 39.7 ± 1.46 weeks), and their birth weight at the time of operation ranged from 2.2 kg to 3.1 kg (mean 2.5 ± 0.3Kg) . Average age at time of operation was 40.88 ±5.32 h for patients in group A, and 204 ± 28.68 h for those in group B.

Surgical repair for 9 patients was carried out within the first 48 hours from birth (Group A), surgery for the other 8 patients was postponed after fulfilling criteria of weaning from mechanical ventilation (Group B), and this was done from 7 to 10 days.

13 neonates were managed successfully through a left subcostal incision, 2 patients was approached through right sided thoracotomy, and left thoracoabdominal approach was done for remaining two cases.

Herniorrhaphy was carried out primarily inspite of the relatively big size of the defect in most of our patients.

In group A postoperative average length of stay on controlled mechanical ventilation was (73.66 ± 27.05 h), and it was (40 ± 8.14 h) for those in group B, the difference was significantly high between the two groups ($P < 0.05$). We have one case of mortality in group (A).

Hospital stay for our patients in group A ranged from 2 to 8 weeks but in group B progress of the patients was well and their hospital stay range was from 3 to 5 weeks.

The follow up period for our patients ranged from 6 to 12 months and it was uneventful.

Pt. No.	Group A	Pt. No.	Group B
1	40h	1	168h
2	42	2	240
3	45	3	240
4	36	4	216
5	30	5	168
6	47	6	192
7	46	7	192
8	40	8	216
9	42		
Av	40.88h		204h
SD	5.32h		28.68h

Table (1): Average age at time of operation

Group A	Group B	P value
40	30	0.05
48	30	0.001
50	36	0.02
72	36	0.005
70	48	0.001
78	42	0.005
75	48	0.005
120	50	0.005
110		
Average:	73.66	40
SD :	27.0	8.14

Table (2): Postoperative length of stay on CMV in hours

	Group A		Group B		P value
	No.	%	No.	%	
Less than 15 days	5	55.55%	2	25%	0.005
More than 15 days	3	33.33%	6	75%	0.005
Mortality	1	11.11%	Zero	0%	

A value of $P < 0.05$ was considered statistically significant

Table (3): Length of hospital stay and mortality

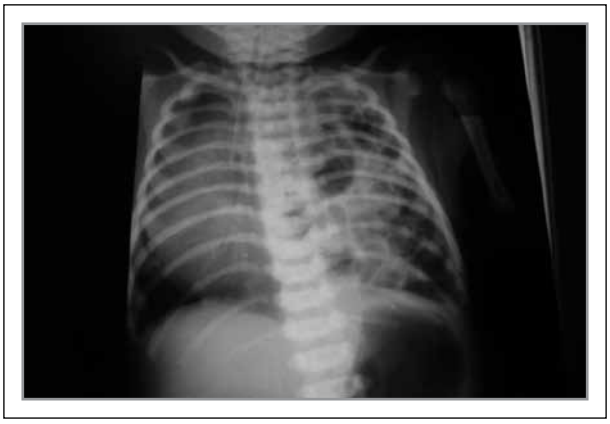

Fig. 1. CDH preoperative CXL

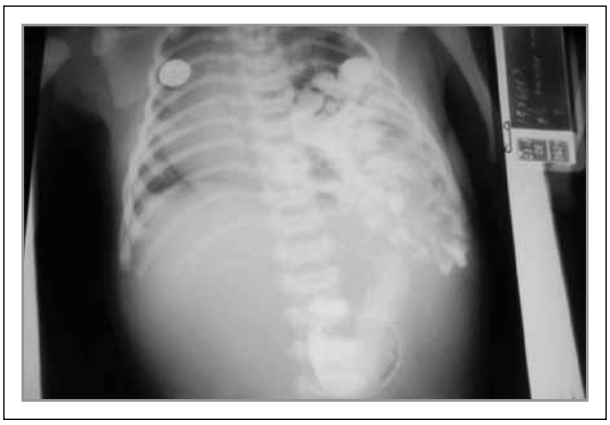

Fig. 2. CDH preoperative contrast study

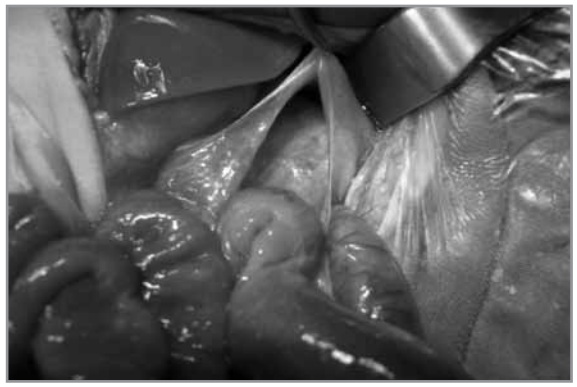

Fig. 3. CDH intraoperative finding

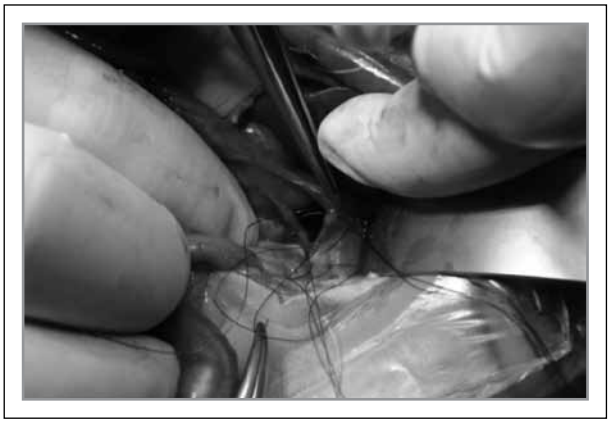

Fig. 4. Operative repair of CDH

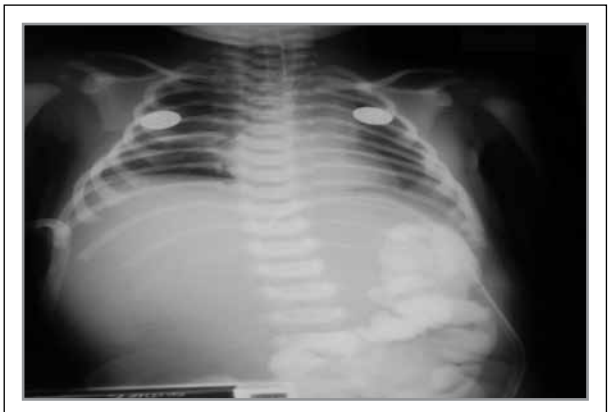

Fig. 5. Post of CXL after surgery for CDH

DISCUSSION

After the first successful repair of congenital diaphragmatic hernia in a newborn, the majority of pediatric surgeons treated this as a true emergency and the patients were rushed to the operating room a very short time after diagnosis. Subsequently, Moyer VA., and colleagues in 2010, and others, demonstrated that early operation actually worsened pulmonary compliance, which sparked a broader interest in delaying operation until the infant was stable. However, what has been reported as (delayed) operation has not been defined[7,8].

Prenatal diagnosis if possible is very important as it is preferable that the fetus and mother be managed at higher center which can apply newer techniques of newborn respiratory support[9,10]. It was very important and helpful to us in our hospital to follow this policy for transferring our risky patients to a higher specialized center when early diagnosed.

In this study our patients had CDH without any other congenital anomalies, and regarding the timing of surgery it was after stabilization of ventilatory state of the patients or when the patients were smoothly taken off the ventilator,as pulmonary gas exchange and respiratory compliance often improves after the first 24 hours after birth, and this was consistent with other published studies[9,11,12].

In our study stabilization of the patients was easier than other studies as all our patients having isolated CDH and the only risk factor was respiratory distress and the need for high frequency rate of mechanical ventilation, and for the same reason our mortality rate (11.11%) in group A was also much less than other studies as their patients had more risk factors.

The size of the defect has been described by previous investigations to be a risk factor for poor outcome of congenital diaphragmatic hernia[5,6]. The size of the diaphragmatic defect, and its site did not affect outcome in this study, and this was similar to other studies which did not confirm that the defect size is a predictor for morbidity or mortality[10].

Some studies evaluated the potential advantages of a lengthy delay before surgical repair, allowing a physiologic change in the patient's condition. The average age at operation in a study of Datin and his associates for eighty two congenital diaphragmatic hernia patients was 173 h(5), in our study the average age at operation for our patients in group (B) was 204 hours.

In our study the average age at operation was 40.88 ± 5.32h for group A, and was 204 + 28.68 h for group B.

In this study we avoid emergent operation for our patients and this was concomitant with other studies that employing a strategy of delaying correction of the defect for some time to optimize respiratory function and allow full clinical and cardiac assessment[13,14,15].

Length of hospital stay for our patients in group A was less than 15 days for 55.55%, and it was more than 15 days for 33.33% , but in group B 25 % of the patients stayed for less than 15 days and 75 % stayed more than 15 days.

Regarding the length of hospital stay our results was not comparable with results in other studies as their patients as we mentioned before had more risk factors and stayed in the hospital for long time.

COMMENT

Medical management and surgical strategies of CDH infants underwent many changes since 1990, including perioperative stabilization with delayed repair. The optimal time to perform surgical correction remains unclear ,either after the condition of the infant has been stabilized or immediately after birth .We conclude that delaying surgery until the infant has been stabilized appears to be associated with better post-surgical outcome, with no effect of the defect size ,but a major multicenter clinical trials is required .

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Comparison between mistletoe and bleomycin in pleurodesis in patients with malignant pleural effusion

Marwan H. El Kassas;

Morsi A. Mohamed;

Hany A. El-Domiaty

Objective: **To compare between mistletoe and bleomycin as chemical agents in pleurodesis in malignant effusion patients.**

Subjects and Methods: **Patients were divided into 2 groups on random basis into two groups, group A in which pleurodesis will be done with Mistletoe and group B pleurodesis will be done with Bleomycin. Pleurodesis will be done using Mistletoe in group (A) using 100mg (5 amp.) repeated for two to three times (according to response) and injected every other day. In group (B) pleurodesis will be done using Bleomycin 1 iu/kg average (4 amp.), 60 units.**

Results: **Most of the patients among both groups show complete remission defined as no effusion detected within four weeks of pleurodesis (72% and 56% among bleomycin and Viscum groups respectively). Statistically significant difference was found between both groups regarding number of patients showing no success was more among Viscum album group 20% versus 8% in bleomycin group ($P < 0.05$).**

Conclusion: **Both bleomycin and Viscum album are effective and safe agents for chemical pleurodesis, however bleomycin has some advantages over Viscum album due to its lower incidence of failure, and being more economic and for the shorter hospital stay.**

KEY WARDS: **Malignant pleural effusion, mistletoe, bleomycin, pleurodesis.**

Malignant pleural effusion cause considerable morbidity for patients affected with cancer, patients who develop such effusions experience a reduction in the quality of life owing to symptoms such as dyspnea, chest pain and cough, thus effective control of malignant pleural effusions can greatly improve the quality of life of the cancer patient [1-3].

The aim must be permanent resolution of the pleural effusion and improvement of the clinical situation. A number of different techniques have been used. The most common method is pleurodesis (obliteration of the pleural space), Pleurodesis is done to prevent recurrence of pleural effusion, and it can be done chemically or surgically. The instilled chemicals cause irritation between the parietal and the visceral layers of the pleura achieving symphysis between them and preventing further fluid accumulation [2, 4, 5].

Chemicals such as bleomycin, tetracycline, povidone iodine, doxycycline, and talc, can be introduced into the pleural space and all can be used [4-12].

However, the success rate between these agents varied greatly, some of them had good results others had negative impact, none of them is superior or have hundred percent effectiveness or convenient, with different adverse effects such as toxicity, pain, dyspnea and fever. More over some are expensive others not easily available. The multiplicity of treatment and chemicals confirms the lack of an optimal therapy [3-12].

Treatment of cancer with extracts from mistletoe was introduced at the beginning of the 20th century by Rudolf Steiner as part of anthroposophically-extended medicine [13-15].

Cardiothoracic Surgery Department, Suez Canal University

e-mail marocardioth@hotmail.com

Codex : o4/02/1402

Today preparations from mistletoe extracts frequently used as so-called complementary and alternative methods (CAM) [16], and the commercially available mistletoe extracts are prepared from the semi-parasitic plant Viscum album Loranthaceae (Viscum album L. or European mistletoe) [17].

A number of investigations have shown that intrapleural instillation of the Viscum album L. (mistletoe) extract is effective [18,19] in reducing the number of malignant cells in malignant pleural effusions. The efficacy was suggested to be due to the cytotoxic and immunomodulatory properties of the intrapleurally applied mistletoe extract.[19-23]

These observations suggest that the elimination of tumor cells in the malignant pleural effusion by a non-specific activation of immune competent cells might led to pleural sclerosis [20,21]. Intrapleural administration of mistletoe extracts is reported to result in pleurodesis, with overall response rate of 72%, and only 1.2% side effects according to the World Health Organization classification [18], so that the local treatment not only aims to induce pleurodesis but also to treat the malignant disease itself [19].

Antony et al., [22,23] proved that the immune system play rule in pleurodesis and that activation of certain chemotactic molecule and interleukins in the pleural fluid itself are essential for successive pleurodesis, all these evident raise the issue of why not to use an immunomodulator agent as a chemical sclerotherapy in malignant pleural effusion.

Here by we conducted this study to evaluate the results of mistletoe as a new chemical agent for pleurodesis in malignant pleural effusion and comparing its result with well established chemical as the bleomycin.

Materials and Methods

Study Population

In this study 50 patients with pathologically confirmed, symptomatic, malignant pleural effusion irrespective of the primary tumor were studied at Suez Canal University hospital in the period of two years from January 2010 to December 2012.

Patients with documented, symptomatic, malignant pleural effusion of both sexes were included in the study while Patients with previous history of tube thoracostomy, pleurodesis or thoracotomy, other causes of pleural effusion rather than malignancy, severely ill Patients were excluded.

Examination Technique and Study Variables

All of the studied patients were subjected to history taking, lines of management of primary lesion, operations, radiotherapy and chemotherapy, and complications, and any other chronic illnesses.

Basic investigations were done including laboratory investigations, pathological confirmation of the diagnosis and radiological investigations, CT scan of the chest if needed.

Intercostal tube size 32fr. were inserted in 5th intercostal space mid-axillary line under local anesthesia for all patients in both groups for gradual evacuation and assessment of physical, chemical and pathological characters of the effusion .

Pleurodesis will be done when there is less than 100mls drainage per day, a chest X-ray is performed to ascertain whether the pleural effusion has resolved or not.

Pleurodesis was done using Mistletoe in group (A) using 100mg (5 amp.) repeated for two to three times (according to response) and injected every other day. In group (B) pleurodesis was done using Bleomycin 1 iu/kg average (4 amps).

Symptoms that was associated with the injection of the sclerosing agent was treated accordingly, opioids was used for pain management based on the severity, paracetamol was used as antipyretic for fever control.

Late postoperative follow-up includes postero-anterior and lateral chest radiography done after one week, month and 3 months. Then the outcome is determined through Follow up of patient condition for symptoms of respiratory discomfort and radiological evidence of recurrence of pleural effusion.

Complete remission is defined as there is no pleural effusion four weeks from the pleurodesis, partial remission is defined as recurrence of pleural effusion with in four weeks after pleurodesis that did not required further interference neither tube thoracostomy nor thoracentesis, failure or no response if no change had happened and if the patient still need further interference despite pleurodesis [4, 5, 6, 10].

Results

A total number of 50 patients equally randomized to the two treatment groups for pleurodesis. Patients in both groups were more or less matched as regarding age and sex. More than half of the studied patients in both groups were males (60% and 52% among bleomycin and Viscum groups respectively) with no statistically significant difference table (1).

Most of the studied patients in both study groups have no co-morbid diseases. The most common diseases were diabetes mellitus and hypertension. About 8-12% of the patients in both groups were either diabetics or hypertensive with no significant difference, dyspnea and cough was evident among all patients in both groups at time of presentation table (1).

The most common malignancies among the studied patients as an average were breast cancer (32%), bronchogenic carcinoma (18%), and mesothelioma (14%). No statistically significant difference was reported between both groups, except as regard the renal cell carcinoma group was significantly higher in the bleomycin group, detail pathology presented in table (2).

Before pleurodesis all patients have been subjected to thoracentesis at least once. But the percentage of patients that had thoracentesis twice were (44% and 36% among bleomycin and Viscum groups respectively), no statistically significant difference was reported between both groups as regard numbers of thoracentesis setting before pleurodesis.

Regarding history of previous surgery there is no statistically significant difference between both groups. The most common surgery was mastectomy that was performed among 32% of the studied patients table (3).

Two (8%) patients in the bleomycin group had fever, while only one (4%) had fever in the Viscum group, as regards pain only two (8%) patients suffered of pain in the bleomycin group but no one in the Viscum group had pain, and in those patients narcotics were given for pain control.

Most of the patients among both groups showed complete remission defined as no effusion detected within four weeks of pleurodesis (72% and 52% among bleomycin and Viscum groups respectively). But there were higher success rate among the Bleomycin group with statistically significant difference. Regarding number of patients showing no success was more among Viscum group 28% versus 8% in bleomycin group with significant difference table (4).

Among our patients we found that the period of hospital stay was shorter in patients of the bleomycin group with a mean of (6.2) days but those of the Viscum group had hospital stay of (12.6) days showing significant statistical difference table (4).

		Bleomycin group (n=25)		Viscum group (n=25)		P Value
		No.	%	No.	%	
Mean age		52 years(±0.9)		54 years(±1.3)		NS (0.8)
Sex (Male)		15	60%	13	52%	NS (0.4)
DM		3	12%	2	8%	NS (0.3)
Hypertension		3	12%	2	8%	NS (0.3)
Chronic liver disease		2	8%	1	4%	NS (0.19)
Chronic renal disease		1	4%	1	4%	NS
Presenting symptom						
	Dyspnea	25	100%	25	100%	NS
	Cough	25	100%	25	100%	NS
	Sleeplessness	23	92%	22	88%	NS (0.8)
	Loss of appetite	20	80%	20	80%	NS
	Easy fatigability	7	28%	6	24%	NS (0.9)

Table 1: Demographic distribution of the studied patients and co-morbidity.

Pathological Diagnosis	Bleomycin group %	Viscum group %	P Value
Breast cancer	28%	36%	0.16
Bronchogenic carcinoma	16%	20%	0.27
Mesothelioma	16%	12%	0.29
Renal cell carcinoma	12%	4%	P < 0.001
Hepatocellular carcinoma	8%	4%	0.19
Lymphoma	4%	4%	NS
Uterine carcinoma	8%	8%	NS
Bladder carcinoma	4%	8%	0.19
Ovarian carcinoma	4%	4%	NS

Table 2: Studied patients according to primary malignancy

Tumor therapy before pleurodesis	Subcategory	Bleomycin group (n= 25)		Viscum group (n=25)		P Value
		No.	%	No.	%	
Radiotherapy		5	20%	4	16%	0.3
Chemotherapy		13	52%	15	60%	0.4
Surgical management						
	Mastectomy	7	28%	9	36%	0.7
	Nephrectomy	2	8%	1	4%	0.3
	Cystectomy	1	4%	1	4%	NS
	Hysterectomy	2	8%	2	8%	NS

Table 3. Tumor therapy prior to pleurodesis

Outcome (after 4 weeks)	Bleomycin group		Viscum group		P Value
	No.	%	No.	%	
Complete remission	18	72%	13	52%	P < 0.003
Partial remission	5	20%	5	20%	NS
No success	2	8%	7	28%	P < 0.001
Mean hospital stay	(6.2) 6days(±0.8)		(12.6) 12days(±1.2)		P < 0.006

Table 4. Outcome of pleurodesis

Discussion

Malignant pleural effusion is considered an indicator of advanced disease with a poor prognosis, and with rare chance of long term survival. Palliative treatment includes repeated thoracentesis, catheter thoracostomy with sclerotherapy, or rarely pleuro-peritoneal shunt creation [1-5].

Treatment options for malignant pleural effusions are determined by the symptoms and performance status of the patient, the primary tumor and its response to systemic therapy, lung re-expansion after pleural fluid evacuation, and expected survival [2, 3, 5]

The present study was conducted aiming at describing the difference in the efficacy of pleurodesis between Mistletoe versus Bleomycin in management of patients with malignant pleural effusion in Suez Canal University hospital.

A total of 50 patients with malignant pleural effusion were enrolled in the study after meeting our inclusion and exclusion criteria. They were equally randomized to one of two treatment groups for pleurodesis. The first group was subjected to intra-pleural instillation of bleomycin while in the second group Viscum album was used.

Traditionally, the most common approach for a persistent, recurrent malignant effusion has been large-bore chest tube drainage followed by instillation of a sclerosing agent, Chemical pleurodesis is a palliative treatment intended to obliterate the pleural space. A previous systematic review by **Walker-Renard P et al**., [5] and **F. Rodriguez-Panadero** [4] for patients with recurrent, symptomatic, malignant pleural effusions treated with chemical pleurodesis showed that tetracycline, doxycycline, bleomycin, and talc have been the agents most commonly used to produce pleurodesis.

Among our patients in the bleomycin group the mean age was 52 years with (60%) men. While in the study of **Ruckdeschel JC and colleague*s*** [6], the mean age for patients in bleomycin group was 61 years with 17 men (44%) and 21 women (56%). While mean age among bleomycin group in the study of ***Zimmer and colleagues*** [7] was 68 years, and in the study held by ***Diacon and colleagues*** [8] in a total of 31 patients was 69.3 years.

Dyspnea and cough was evident among all our patients at time of presentation, while the least common presenting symptom was easy fatigability (28%). ***Zimmer and colleague*** [7] reported that the most common presentation of their patients is gradual onset of dyspnea and 30% had bilateral effusion. While according to ***Ruckdeschel and colleagues*** [6] over three-fourths of their patients were presented with dyspnea, also ***Patz and colleagues*** [10] reported that most of their patients present with progressive dyspnea, cough, or chest pain that compromises their quality of life.

Among our patients the most common malignancies in the bleomycin group were breast cancer (28%), bronchogenic carcinoma (16%), mesothelioma (16%), renal cell carcinoma (12%) and (24%) of other primary tumor. And also in the study of ***Patz and colleagues*** [10] Twenty patients (38%) had breast carcinoma, (15%) had lung carcinoma, and (10%) had ovarian carcinoma. So regarding type of primary malignancy, breast cancer was the commonest primary malignancy followed by bronchogenic carcinoma in our study and the study of ***Patz and colleague*** [10]. While in the study of ***Ruckdeschel JC and colleagues*** [6] bronchogenic carcinoma patients were (34%), more than breast cancer patients, but this reflects that these types of tumors are the most common types causing malignant pleural effusion .

Regarding history of previous surgery, the most common surgery in our study was mastectomy that was performed in 28% of the studied patients. While the most common form of tumor therapy performed for our studied patients prior to pleurodesis was chemotherapy (52% among bleomycin groups).

According to ***Patz and colleagues*** [10] none of their patients had systemic chemotherapy immediately prior to or during the 30-day interval following sclerotherapy, while 68% of the patients in ***Ruckdeschel and colleagues*** [6] study had previous surgery prior to pleurodesis, 42% had previous irradiation but not during the last two weeks before pleurodesis, and 45% had chemotherapy.

Most of the other published papers of all previous studies give no idea about history of previous tumor therapy prior to or after pleurodesis, however this is an important issue as surgery, and irradiation and/or chemotherapy have an impact on the prognosis of the disease and the general condition of the patient.

For all our patients, Intercostal tube size 32fr. was inserted in 5th intercostal space mid-axillary line under local anesthesia in both groups for gradual evacuation. Pleurodesis was done when there is less than 100mls drainage per day, a chest X-ray is performed to ascertain whether the pleural effusion has resolved or not.

Among our patients we found that the period of hospital stay was shorter in patients of the bleomycin group with a mean of (6.2) day. Chest tubes were removed within 5 days in 79% of patients in the study of ***Patz and colleagues*** [10] (mean, 4.6 days; range, 2 to 11 days). According to ***Zimmer and colleague*** [7], the mean hospital stay was 6.5 days among bleomycin group, while in ***Diacon and colleagues*** [8] study the mean hospital stay in bleomycin group was 7.7 days.

The period of hospital stay in most patients in all studies were in the range of 5 days to 1 week reflecting the short hospital stay, when combined to high efficacy, total costs in most of the previous studies favored bleomycin pleurodesis, as the main cost-driving factor, was the shorter time spent in the hospital.

Most of our patients show complete remission defined as no effusion detected within four weeks of pleurodesis (72% among bleomycin groups), with 8% failure rate.

The success rate in our study is higher than ***Patz and colleagues*** [19] among the patients in bleomycin group, this may be due to our good patient selection as we have excluded severely ill patients, patient with encysted pleural effusion and patients with associated pleural thickening.

To us what makes the results with bleomycin pleurodesis in the study done by ***Ruckdeschel and colleagues*** [6] better than that done by ***Patz and colleagues*** [10] is that in the first study they have selected their patients to be ***Eastern Cooperative Oncology Group (ECOG)*** performance status 0 to 2 and to have no evidence of severe congestive heart failure, this means that patients with bad general condition were excluded.

Mistletoe extracts are commonly used in cancer patients; review of 16 trials investigating the efficacy of mistletoe extracts in cancer patients claimed that they improve quality of life (QOL), psychological measures, performance index, symptom scales or the reduction of adverse effects of chemotherapy [13,16].

In healthy adults increasing numbers of blood granulocytes were noted after application of a lectin-rich mistletoe preparation, as well as an increased production of granulocyte-macrophage colony-stimulating factor (GMCSF) [23, 24], and the induction of tumor necrosis factor- alpha (TNF-alpha) [22] . There is clear evidence that the application of mistletoe extracts induced IgG anti-lectin antibodies [19-22].

Mistletoe preparations (Viscum album L.) were used for pleurodesis and found to be of low side effects and simple in administration [18, 19]. Lectin induce apoptosis, the natural cell death, viscotoxins lead to cell lyses so that the local treatment not only aims to induce pleurodesis but also to treat the malignant disease itself [18-20].

Kim and colleagues [18] compared Viscum album with doxycycline for pleurodesis in patients with malignant pleural effusion in the Internal Department of the University Hospital Seoul, Korea.

According to ***Kim and colleagues*** [18] 30 patients with malignant pleural effusions with the following primary tumors: lung cancer (23 patients) (77%), breast cancer (4 patients) (13%), cancer of uterine cervix, gastric cancer and unknown primary cancer (1 patient each) were included in the study , and in the translated published paper they give no data about sex and age groups of the patients .

But in our own study we had 25 patients in the Viscum group, 13 men (52%) and with mean age of (55) years. among our Viscum group we had (36%) with breast cancer, (20%) with bronchogenic carcinoma, (12%) with mesothelioma.

When we came to compare their results to ours we found that the success rate according to ***Kim and colleagues*** [18] was 81 % of the patients treated with Viscum showing a complete response, while it was 52 % of the patients in our study.

But due to the previous differences and shortage of data available on the methodology of their study, we couldn't determine what makes their results better than ours.

As regard the post pleurodesis side effects, (8%) of the patients in the bleomycin group had fever and at the same percentage others had pain, which is similar to other study as **Ruckdeschel JC and colleague*s*** [6], reported that (9%) of his patients in the bleomycin group had fever and (7%) had pain, mean while the only side effect in the Viscum group was fever in one patient (4%) and no one had pain.

If we reviewed the results of other studies we will find that it differs greatly from one to other as **Sahn SA** [3] in his review reported that lung cancer is the most common cause of malignant effusion, dyspnea and cough were the most common presentation, talc poudrage or slurry was the most successful, but fever and pain was a common post instillation complaint, **F. Rodriguez-Panadero** [25] reported in another study that talc instillation some time is associated with high incidence of failure due to activation of fibrinolysis process and **Harrison LH Jr** [26] said it should be avoided in some cases.

Although bleomycin appears to be effective in clinical practice, its main drawbacks are cost and systemic absorption, with risk of significant toxicity [6, 7, 12].

Antony and others used tetracycline and proved to be effective but its parenteral form is no longer available and the remaining stock is decreasing rapidly, and it had high incidence of post instillation pain and some times fever requires heavy analgesia [5, 11, 12]. Moreover, a relatively high rate of late recurrences has been reported [4].

While the alternative of tetracycline; the Doxycycline, has average effectiveness of 72% but it often requires repeated doses, sometimes for more than 2 weeks, which is seen as a drawback and high incidence of local chest pain after instillation [9, 10].

Balassoulis G et al., reported a complete response was seen in (48%) patients, a partial response was seen in (31%), and (21%) patients did not respond to pleurodesis by Erythromycin which is also is another newly used agent. Also he denoted that chemical pleurodesis can be palliative for symptomatic malignant pleural effusions, and the extent of the successful is a function of tumor bulk, pleural fluid pH, and the choice of sclerosing agent [27].

Sahn SA [3] reported that thirty percent of non responder had a pleural fluid PH < 7.3, and we should mention that other studies [28, 29] highlighted the importance of the PH of the effusion as one of the factors that determine the efficacy and the response, but unfortunately we did not include this issue in our study and this should be considered as one of its limitation.

At last we should clear that although mistletoe is considered as an agent with anticancer property, its result is a little bit lower than the bleomycin, and it seams that the hypothesis reported by **lynch TJ** [2] that the effectiveness of a chemical sclerosing agent in pleurodesis is related to the ability to produce pleuritis rather than its antitumor effect.

In conclusion: pleural effusions still have a significant negative draw back on the quality of life in patients with malignancy. Therapy in these patients should be simple, safe, efficacious, and cost-effective, while minimizing the over all hospital stay. Chemical pleurodesis has become a common palliative approach and effective with a variety of agents.

Both agents used in our study are effective in pleurodesis with comparable effect. However bleomycin has the upper hand regarding incidence of complete remission with statistically significant result, and it showed nearly the same universal results of the many previous studies and with shorter hospital stay.

While Viscum has satisfactory over all result (complete and partial 72%) in preventing further thoracentesis or thoracostomy but it has a higher rate of failure and need repeated instillation with longer hospital stay.

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Pulmonary Sequestration: Surgery of No Mistake

Akram Allam, MD;

Ahmed Saleh, MD

Abstract: **Pulmonary sequestration is a congenital malformation characterized by non-functioning embryonic lung with vascularization of an abnormal systemic artery. They are classified as intralobar (75%) and extralobar (25%) and are more common in the left lung and lower lobes (60-90%). The aim of this study is to assess the diagnostic tools and surgical treatment for this rare anomaly, and highlight the origin of the bronchial artery feeding the sequestrated lobe. We report 8 cases of pulmonary sequestration located in the lower lobe of the left lung except one in lower lobe of right lung. All patients had recurrent infections for which after performing imaging tests, their diagnosis was pulmonary sequestration, with an afferent arterial branch to the malformation from the aorta. A conservative resection of the sequestrated lobe with sparing of lower lobe was performed and dividing the aberrant bronchial artery prior to resection. A single thoracic chest tube was placed and removed on postoperative day 2 and the patients were discharged on the next day. In all cases, the pathology examination revealed intralobar pulmonary sequestration in 6 patients and 2 patients were extrapulmonary. Pulmonary sequestrations are uncommon malformation that can be operated on using minimally invasive techniques, thereby permitting early diascharge and a low rate of complications.**

KEY WORDS: **Sequestration, Intralobar, Extralobar, Bronchial Artery**

Pulmonary sequestration is a relatively rare entity comprising 0.15-6.4% of all congenital pulmonary malformations.[1] Typically, it consists of a systemic arterial supply to an associated anomalous lung segment with various forms of venous drainage. These segments have no connection to the tracheobronchial tree. Sequestrations are typically divided into intralobar and extralobar forms, with the former being defined as a lung segment contained within the native pleural lining while the latter exhibits its own pleural investment.[2]

Sixty percent of these lesions are diagnosed within the first decade of life and are more common in males by a 3:1 ratio.[3] Symptoms may vary and typically are related to chronic respiratory infection although sequestrations may be discovered incidentally on radiographic studies. The arterial supply is variable with 74% being supplied by the thoracic aorta, while the remainder originates from the abdominal aorta and its branches including the gastric or splenic arteries.[1,2] Typically, venous drainage from these lung segments is via the pulmonary venous system, although systemic drainage has been noted as well.[4]

A bronchopulmonary sequestration (BPS) consists of a section of nonfunctional pulmonary tissue, does not communicate with the normal bronchial tree, and is vascularized by an aberrant systemic artery. Its venous drainage is through the pulmonary veins, the azygos system, or the inferior vena cava.[4] In intralobar sequestration (ILS), the sequester is located inside the normal pulmonary tissue. Its predominant site is the lower lobe, more often left than right. Although normally no communication with the bronchial tree exists, anomalous connection with other bronchi or lung parenchyma regularly occur. When this happens, recurrent infections are often seen .[5]

Department of Cardiothoracic surgery, Faculty of Medicine, University of Alexandria, Egypt.

Codex : o4/03/1402

Extralobar sequestrations (ELS) are located inside their own visceral pleura and mostly found between the lower—foremost left—lobe and diaphragm or in the upper abdomen. There is separation with other lung tissue and therefore infections are uncommon.

Attempts have been made to fit sequestrations into a continuum of congenital bronchovascular disorders which include primary parenchymal anomalies (for example, bronchial stenosis, bronchial cysts, and cystic adenomatoid malformation) as well as classic sequestrations and disorders of pulmonary venous drainage. Currently, the traditional term of "sequestration" is most commonly utilized to describe this entity.[4-8]

Many theories have been suggested to elucidate the embryologic mechanism responsible for sequestrations. Rokitansky and Rektorzik[4] received credit for making the first attempt in 1861 with their "Fraction Theory" which hypothesized that during lung development, an insult to the developing pulmonary arterial blood supply occurs leading to retention and proliferation of the nascent systemic capillary network.[4] In fact, the embryology of these defects remains uncertain.

Aim of the Work

To assess the diagnostic tools and surgical treatment for this rare anomaly, and highlight the origin of the bronchial artery feeding the sequestrated lobe.

Patients and Methods

This study is a retrospective cross sectional study, done in Alexandria University hospitals, Department of Cardiothoracic Surgery, Alexandria, Egypt.

We reviewed 8 patients diagnosed with pulmonary sequestration who presented to Alexandria University Hospitals during the period June 1999 to June 2013. Recorded variables included age, sex, medical history, presenting signs and symptoms, radiologic and diagnostic tests, treatment, pathologic description and short-term outcome. Operative treatment and findings including exact location of the sequestrated lobe and abnormal feeding artery were evaluated.

Preoperative Evaluation: recorded data about history taking, and complete physical examination that were done for all patients. Plain Chest radiographs as well as Computerized tomography were done for all patients.

Statistical Analysis: After data collection, the results were tabulated as frequency distribution for different qualitative and quantitative values, it was assessed with SPSS 22.0 (IBM Inc., Chicago, IL). The statistical analyses was carried out using t-test for independent samples and $\chi 2$-test.

Results

Our sample of 8 consecutive patients operated for pulmonary sequestration had a mean age of 7 years (range 2-46), 5 males and 3 females were included in our study. No statistical significance between gender and histopathological type. 3 children and 5 adults. The average age of surgical interference was 4 years and 26 years in the children and adult population respectively. most common presentations were dyspnea, cough and hemoptysis. The presenting signs and symptoms of pulmonary disease was present in all patients, recurrent pneumonia in 5 patients, dyspnea in 2 patients, hemoptysis in 2 patients, chest pain in 2 patients. Two cases had secondary infection with Aspergillus umigatus. All patients were selected on the basis of Chest X-ray, computerized tomograpghy of the chest and all diagnosis were confirmed by histopathology. (Table 1, Fig, 1)

Sex	
Male	5 (62.5%)
Female	3 (37.5)
Age	7.0 (2.0 – 46.0)
Site	
Right	1 (12.5)
Left	7 (87.5%)
Bronclial artery	
Well identified	6 (75.0%)
Embedded in lung tissue	2 (25.0%)
Type	
Intrapulmonary	6 (75.0%)
Extra pulmonary	2 (25.0%)

Data represent as Median (Min. – Max.)

Table 1. Distribution of studied cases according to different studied parameters

Six cases were intralobar and 2 cases were extralobar. At gross examination, the size of the specimen varied from a diameter of 3 cm to a big lesion measuring 12X10X7 cm. The feeding artery varied from 5 mm in the smallest instance to 15 mm in the largest sequestration. This abnormal bronchial artery arose from the thoracic aorta in 90% and from the thoracoabdominal aorta in 10% of cases (Fig 2). One adult male patient (46 years) the bronchial artery was calcified and meticulous care was given during dissection and division of

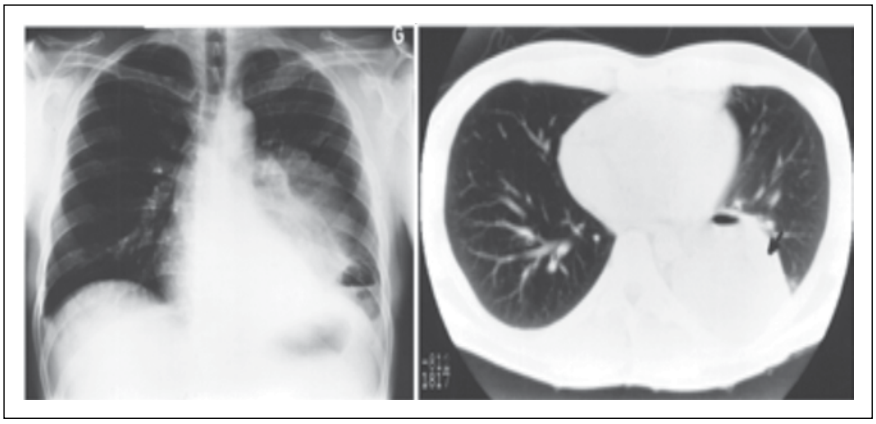

Fig. 1. Chest x-ray with radiodensity in the left lower zone, CT showing the mass in the same patient

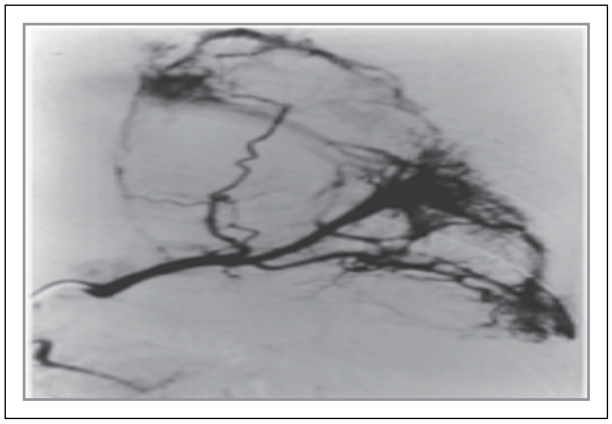

Fig 2. Thoracic Angiography showing aberrant artery to the sequestrated lobe

the artery to avoid rupture and massive hemorrhage from the descending thoracic aorta. Venous drainage was through the hemiazygous and superior vena cava as well as the pulmonary vein. All the sequestrations were found at the level of lower lobes 7 on the left and one on the right.

Treatment differed according to time of surgery, in the early period 2 patients underwent lobectomy, after that six patients had simple excision of the lesion with ligation and cutting of the feeding artery. There was no mortality. Complications included prolonged need for intercostal tube in one patient for pneumothorax which resolved after 5 days. There were no cases of malignant transformation of the sequestration either intra or extra-pulmonary.

Discussion

There are several theories regarding the aetiology of intralobar pulmonary sequestration. Gallagher, Lynch, and Christian (1957),[9] have summarized them and, together with most recent authors, accept the theory of Smith (1956)[10] as explaining most of the features of the disease. The primary fault is probably a failure of the pulmonary artery to develop sufficiently to supply the furthest parts of the lung. The arterial supply to the lung from the dorsal aorta, a supply that normally regresses during embryological development, persists to that part of the lung inadequately supplied by pulmonary arterial blood. The pulmonary loculus, sequestered from its normal blood supply, develops abnormally, perhaps because it is subjected to systemic arterial pressure.[11] The basal segmental areas of the lower lobes, particularly the left lower lobe, are furthest from the pulmonary hilum and the origin of the pulmonary artery, and this might account for the fact that the lesion is commonest in the left lower lobe. The pulmonary artery to the lobe harbouring the sequestration is always smaller than normal (Smith, 1956).[10] Lemmon, Kirklin, and Dockerty (1954),[12] have shown, by the use of coloured vinyl acetate injection techniques, that the anomalous systemic artery is distributed only to the sequestration, and the pulmonary artery supplying the lobe in which the sequestered segment lies is distributed only to normal, aerated parts of that lobe. The vessels in the sequestration are systemic in type and thick-walled, and lie in the centre of the abnormal area where disorganization is most advanced, perhaps suggesting a relationship. There is no significant anastomotic circulation between the systemic arteries supplying the sequestered segment and the pulmonary arterial supply to the parent lobe.

The constant abnormality is an artery of considerable calibre entering the lung from the systemic circulation. The commonest site of intralobar pulmonary sequestration is the left lower lobe, in the vicinity of the posterior basal segment, and the abnormal artery usually arises from the descending thoracic aorta, entering the lung by traversing the pulmonary ligament. (Fig.2) Right lower lobar intrapulmonary sequestration is less common than left lower sequestration (the proportion is about 2: 1 in the reported cases) and there are rare examples of sequestration else-where in the lung (Cohn and Hopeman, 1955).[13]

In our series whether in the left or right the feeding artery arises directly from the aorta. The abnormal pulmonary tissue usually occupies about two-thirds of the lower lobe. The mass was polycystic in 3 cases, the cysts containing glairy mucus or pus (Cases 3-5); in some of the remaining cases most of the sequestration is represented by a single large cyst, sometimes containing air (Case 2) and sometimes pus (Case 7), and in either instance the single cavity is surrounded by compressed and fibrotic lung. A polycystic mass with one large and several smaller cysts may also be found (Case 1). Occasionally the sequestered mass contains recognizable bronchi branching parallel to the ramifications of the systemic arterial supply. A sharp line of demarcation between the poly-cystic variety of sequestration and the rest of the lobe may be found, and demarcation may be so clearly defined that the abnormal lung can be cut cleanly from the normal (Case 5). The absence of pigment in the sequestered loculus is evidence of absence of function in common with the rest of the lung (Pryce et al., 1947). [14] In 10 to 15% of reported cases a bronchogram has outlined bronchi within the sequestration.(12) In the remainder, bronchial tissue, although sometimes recognizable histologically within the abnormal mass, does not communicate with normal lung, and significant air leaks do not result when the sequestration is amputated from the rest of the lobe. For this reason lobectomy is probably an extravagant resection, justifiable only in an adult when the aerated pulmonary tissue in the affected lobe is little more than a shell about the sequestration, and particularly to be avoided in a child in whom the remaining part of the lobe is likely to grow. Alveoli are not recognizable histologically within a sequestration.[12,13,14]

The route whereby the sequestered segment becomes infected is evident in those cases in which communication with the bronchial tree can be demonstrated; the remainder probably become infected by contiguity of tissue, by lymphatic extension, or by haematogenous dissemination. Infection is an almost constant feature. Exceptionally an air-containing cyst in a lower lobe may be found by chance in a symptomless patient. Communication, however indirect, with the bronchi of the parent lobe must be present in such cases, but may not be bronchographically demonstrable.[15]

The diagnosis is most consistently achieved before operation when the possibility of encountering the lesion is kept in mind. A history of recurring pulmonary infections, the site and nature of the pulmonary opacity, the broncho-graphic findings, and awareness of the clinical entity will usually enable an accurate diagnosis to be made. Additional evidence of diagnostic value may be obtained by aortography (Kenney and Eyler, 1956),[16] or by angiography (Gerard and Lyons, 1958),[17] but these diagnostic adjuncts are not necessary and carry some risk to the patient. Where, however, the condition of pulmonary hypoplasia related to a deficiency of pulmonary arterial supply is suspected from plain films and bronchograms, angiography will probably clarify the diagnosis. Pus may be aspirated from within the sequestration, so that the demonstration of pus does not confirm the diagnosis of empyema, and the accidental production of a pneumothorax, while of some diagnostic value, exposes the patient to the risk of pleural infection. Similarly, should the lesion prove to be a pulmonary tumour, diagnostic thoracentesis is equally undesirable, because of the concomitant danger of the dissemination of tumour in the pleural space and in the chest wall. On principle a patient with a persisting pulmonary opacity of unknown nature requires diagnostic thoracotomy, and this is a safe procedure. The diagnostic procedures outlined, without aspiration, aortography, and angiography, will have given sufficient lead to the diagnosis to avoid accidental injury of the abnormal systemic artery to the sequestration, an event recorded in earlier cases as a cause of death.[11] When the lesion is recognized, the resection of choice should be the most conservative one.

The definitive treatment of every patient with pulmonary sequestration, both intralobar and extralobar, is surgical resection of the mass. Traditionally, the open approach through posterolateral thoracotomy has been employed, as it offers adequate exposure. Because pulmonary sequestration is a benign disease, it is believed that partial lung resection is more appropriate than lobectomy,[5] especially if the mass is confined within a lung segment.[6] Special attention needs to be paid to the aberrant artery, since its path through the diaphragm needs to be identified before it is ligated and divided.[11] The advent of minimally invasive techniques made VATS gain special role in the treatment of this pathologic entity.[18-21] VATS offers an important alternative to the open approach for pulmonary sequestration, with minimum surgical trauma morbidity, post-operative pain, and hospitalization. It is characteristic that patients were discharged home on the second post-operative day in an excellent condition.[18,19] Our experience has shown that patient undergoing thoracotomy for the same disease usually stay in the hospital from 3 to 5 days, mainly for surgical site pain management. Also, VATS has been shown to better preserve lung function during the recovery period.[18,20]. An important note, if VATS is employed for the resection of intralobar pulmonary sequestration, is that extensive pre-operative

work-up is needed for the identification of the aberrant artery. Its connection to the thoracic or abdominal aorta can be identified with the use of computed tomography (CT) with intravenous contrast or even CT angiography.[11,20]

Patients with ELS usually show early signs of respiratory distress during childhood, while patients with ILS are more commonly diagnosed during adolescence or adulthood and show recurrent pneumonias or hemoptysis.[6] The diagnosis can be suspected on a chest radiograph, showing a dense mass or an air-fluid level. Best diagnostics, though, are obtained through a CT angiography, showing the aberrant artery and venous drainage.[11,20] The gold standard for treatment of BPS is a surgical resection.[3] In ELS, a resection of the sequester is performed by means of video assisted thoracoscopic surgery (VATS) or a conventional thoracotomy. Both techniques can be used to perform a segmental resection or a lobectomy in ILS.[18,19] However, during the last decade a new technique has emerged. Arterial embolization as a treatment of arterial bleedings has rapidly become the treatment of the first choice for a wide range of indications.

Conclusions

After this inadvertent result, questions raised as whether to primarily treat such patients with endovascular techniques. After a second patient presented with IPS, we proceeded with a thoracotomy rather than an embolization. Clinical outcome of the surgical approach was successful in both cases. This experience emphasizes our conviction that surgical resection remains the unique treatment for bronchopulmonary sequestration. It is the only treatment in which the abnormal lung tissue gets totally removed thus giving no opportunity for complications like ischemic infarction or abscess formation.

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