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Journal of The Egyptian Society of Cardio-Thoracic Surgery

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Journal of The Egyptian Society of Cardio-Thoracic Surgery

Volume 15 **Jan - Jun 2009** **Number (1-2)** **ISSN 1110-578X**

Guidelines for Authors

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

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The Journal of the Egyptian Society of Cardio-Thoracic 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 and illustrations .

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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.
Manuscripts written in 12 point Arial or Times New Roman fonts are preferred (Note: Do not submit your manuscript in PDF format it causes problems in processing your submission.)
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.

Case reports and **"The way I do it"** articles are limited to a total of 1500 words including title page, abstract, text, references and figure legends. For each illustration subtract 100 words and for each table subtract 300 words from the word limit. References are limited to eight. A "how to do it" article should be a description of a useful surgical technique and contain descriptive, illustrative material.

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 .

Review articles are limited to 6500 words including title page, abstract, text, figure legends and all references. The total number of references should not exceed 80. Subtract 100

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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

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The title is limited to 100 characters and spaces for original manuscripts and to 80 characters and spaces for all other categories of manuscripts. The title may not contain acronyms or abbreviations. All submissions, must have a title.

Running Head. Supply a short title of 40 characters and spaces.

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Abstract Page (Second page)

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

Case reports, "the way i do it" articles, review articles and our surgical heritage articles. Provide an unstructured abstract of 100 words.

Images, correspondence, commentaries, editorials and updates. No abstract is required.

Text
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.

Avoid abbreviations. Consult the American Medical Association Manual of Style, 9th edition, for recommended abbreviations. Define abbreviations at first appearance in the text. If 8 or more abbreviations or acronyms are used, provide a separate table of abbreviations and acronyms.

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 of drugs, equipment and other brand mentioned in the article within parentheses , giving company name, city and country .

Acknowledgments
Grants, financial support and technical or other assistance must be acknowledged at the end of the text before the references.

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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:

Journal Article
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.

Internet Address

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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Tables should be typewritten double-spaced on separate sheets (one to each page). Do not use vertical lines. Each table should be numbered (Arabic) and have a title above. Legends and explanatory notes should be placed below the table. Abbreviations used in the table follow the legend in alphabetic order. Lower case letter superscripts beginning with "a" and following in alphabetic order are used for notations of within-group and between-group statistical probabilities.

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You must send two sets of original illustrations to the editorial office labeled with manuscript number, first author, and figure number on back.

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Line art should be at least 1200 DPI .

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For Date of acceptance : letter is provided from the editor.

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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 avoid unpleasant comments.

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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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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.

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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 and relationship of the results to the existing literature 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.

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- '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 . 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 . 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.
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- References should be properly cited, reasonably current, accurateand in proper format.

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Articles describing new technology are necessarily descriptive and do not pose or test a hypothesis. These articles evaluate new devices, systems, 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 .

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, The Way I 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 se-

lective rather than inclusive.

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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 . 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 .

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

Footnote

The reviewer remains anonymous . The reviewer should direct his or her critique to the authors in the style and format that suits them best. The recommendation to the editor is made separately with or without additio

Events of Interest

The 17th Annual Conference of the Egyptian Society of Cardiothoracic Surgery
Cairo - Egypt (National Heart Institute)

Timing : ..... **8-10 April 2010**
Location: ..... **Cairo J.W Marriot**
Email : ..... **jegyptscts@gmail.com**

55th Annual Conference of the American Society for Artificial Internal Organs (ASAIO)-Dallas, Texas---May 28-30, 2009

For more information on this meeting, contact ASAIO, Inc, 980 N Federal Hwy, Suite 212, Boca Raton, FL 33432; telephone: (561) 391-8589; fax: (561) 368-9153; e-mail: info@asaio.com; website: www.asaio.com.

17th European Conference on General Thoracic Surgery-Krakow, Poland---May 31-June 3, 2009

For more information on this meeting, contact European Society of Thoracic Surgeons,PO Box 159, Exeter EX2 5SH, United Kingdom; telephone: + 44 1392-430761; fax: + 44 1392 430671; e-mail: sue@ests.org.uk; website: www.ests.org.

The International Society for Minimally Invasive Cardiothoracic Surgery (ISMICS) 2009 Annual Scientific Meeting-San Francisco, California---June 3-6, 2009

For more information on this meeting, contact ISMICS, 900 Cummings Center, Suite 221-U, Beverly, MA 01915; telephone: (978) 927-8330; fax: (978) 524-0498; e-mail: ismocs@prri.com; website: www.ismics.org.

35th Annual Meeting of the Western Thoracic Surgical Association-Banff, AB, Canada---June 24-27, 2009

For more information on this meeting, contact Western Thoracic Surgical Association, 900 Cummings Center, Suite 221-U, Beverly, MA 01915; telephone: (978) 927-8330; fax: (978) 524-8890; e-mail: wtsa@prri.com; website: www.westerthoracic.org.

Mayo Clinic International Vascular Symposium-Budapest, Hungary---June 27-30, 2009

For more information on this meeting, contact Mayo School of Continuing Medical Education, 200 Frst St SW, Rochester, MN 55905; telephone: (507) 284-2509; fax: (507) 284-0532; e-mail: cme@mayo.edu; website: www.mayo.edu/cme/jun2009.html.

6th Annual Echo Alaska: Appropriate Use of Cardiovascular Ultrasound in Clinical Cardiology-Alaskan Cruise---August 2-9, 2009

For more information on this meeting contact Corporate Travel Solutions, 340 Cedar St, Suite 1200, St Paul, MN55101; telephone: (651) 287-4900; fax: (651) 287-4991; e-mail: ultraecho@ctsinc.com; website: www.ctsinc.

com/echoalaska2009.htm.

23rd Annual Meeting of the European Association for Cardio-thoracic Surgery-Vienna, Austria---October 17-21, 2009

For more information on this meeting, contact EACTS Executive Secretariat, 3 Park St, Windsor, Berkshire SL4 1LU, UK; telephone: +44-1753-832166; fax: +44 1753 620407; e-mail: info@eacts.co.uk; website: www.eacts.org.-

56th Southern Thoracic Surgical Association Annual Meeting-Marco Island, Florida-November 4-7, 2009

For more information on this meeting, contact Southern Thoracic Surgical Association, 633 N Saint Clair St, Suite 2320, Chicago, IL 60611; telephone: (312) 202-5800; fax: (312) 202-5801; e-mail: mail@stsa.org; website: www.stsa.org.

5th International Meeting of the Onassis Cardiac Surgery Center: Current Trends in Cardiac Surgery and Cardiology-Athens, Greece--- November 12-14, 2009

For more information on this meeting, contact Triaena Tours & congress, 206 Sygrou Ave, 176 72 Kallithea, Greece; telephone: +30 210 7499353; fax: +30 210 7705752; e-mail: lianae@triaenatours.gr; website: www.ocsc2009.com.

International Joint Meeting on Thoracic Surgery-Barcelona, Spain---November 25-27, 2009

For more information on this meeting, contact Oriol Seto, Acto Serveis, C/ Bonaire, 7, 08301 Mataro, Barcelona, Spain; telephone: 34-937-552-382; fax: 34-937-552-383; e-mail: thoracic.surgery@actoserveis.com; website: www.thoracicsurgery2009.org.

Editorial

Face Lift

Dear colleagues professor and readers I wish you all to enjoy reading our journal hoping to find diversity of material and updated scientific researches fulfilling your expectations from our society journal

Lately we tried to rise to a higher standard by avoiding previous difficulties and mistakes whether from reviewing or editing, thriving to improve the content we are providing by generating more effort in articles selection and correction

In accordance with the Society's Board recommendations which stressed on improving the statistical methodology used by most of the junior authors which showed lately to be deficient in certain aspects; we as Journal Board decided to allocate two of our eminent professors in Cardio Thoracic Surgery with wide experience and solid knowledge in medical statistical analysis ; Professor Doctor Ahmed Deebis Professor of Cardio Thoracic Surgery Zagazig University and Professor Doctor Ahmed Hassouna Professor of Cardio Thoracic Surgery Ain Shams University

As the two of them volunteered freely to provide technical statistical support to both the junior Authors and to the journal Board as well ,in that context we welcome them thankfully hoping that their participation will be fruitful to all of us.

We want also to make emphasis that the instructions conveyed to us from the Society's board represented by its Head Professor Doctor Magdi Mostafa is to ease the conditions for publications for all the members without affecting the excellence of the scientific content nonetheless the proper format of the articles ;and this as part of the continuous encouragement and support given by our Society to its Members which it serve through the different activities including the Journal .

Still there is wide margin for improvement ;at any time we are ready to accept your criticism , your comments and your help as well as part of our self Auditing process hoping to provide a better quality journal ,conform at certain stage with the different international medical publications.

Hope to see you soon in the next summer meeting in your best form challenging us with new suggestions and ideas.

Yours Sincerely

Yasser Hegazy MD , FRCS
Editor-In-Chief
Journal Of The Egyptian Society Of Cardio-Thoracic Surgery

Statistics

Clinically useful measures of trial outcomes (part two)

Ahmed A. Hossouna, MD.

The odds ratio is the ratio of the probability that the event of interest occurs to the probability that it does not. This is often estimated by the ratio of the number of times that the event of interest occurs to the number of times that it does not. In other words, the ODDS ratio provides an estimate for the relationship between two binary ("yes or no") variables and, as will be shown later, a confidence interval can be assigned to such an estimate.

Table 1: contains data from a cross sectional study showing the prevalence of hay fever and eczema in 11 year old children (1). The probability that a child with eczema will also have hay fever is estimated by the proportion 141/561 (25.1%) and the odds is estimated by 141/420 (probability "to have"/ "to have not" hay fever). Similarly, for children without eczema the probability of having hay fever is estimated by 928/14453 (6.4%) and the odds is 928/13525. We can compare the groups in several ways: by the Odds ratio = (141/420) / (928/13 525) = 4.89 and by the hazard (relative) risk which is the ratio of the proportions, (141/561) / (928/14 453) = 25.1%/6.4% = 3.91. The hazard risk (probability) of hay fever when there is eczema is 3.91 that when eczema is absent. In other words, one can understand that having Eczema will nearly quadruple the chance of 11 years old children to have hay fever as well.

Now, suppose we look at the table the other way round, and ask what is the probability that a child with hay fever will also have eczema? The proportion is 141/1069 (13.2%) and the odds ratio is 141/928. For a child without hay fever, the proportion with eczema is 420/13945 (3.0%) and the odds is 420/13 525. Comparing the proportions this way, the relative risk is (141/1069)/ (420/13945) = 4.38. The hazard risk (probability) of eczema when there is hay fever is 4.38 that when hay fever is absent. In other words, one can understand that having Hay fever will increase the chance of 11 years old children to have Eczema as well, by nearly four and half times. Unlike the relative risk, the odds ratio remains the same as calculated before and it equals (141/928)/ (420/13525) = 4.89. The odds ratio is the same whichever way round we look at the table, but the relative risk is not. This property among others, make the odds ratio a useful indicator of the strength of the relationship between 2 variables.

ODDS ratio (OR) and relative (hazard) risk:

Log OR:

Although a sample odds ratio has a skew distribution, its log has an approximately normal distribution. It also has the useful property that if we reverse the order of the categories for one of the variables, we simply reverse the sign of the log odds ratio: log (4.89) = 1.59, log (1/4.89) =-1.59. We can calculate a standard error for the log odds ratio and as it is normally distributed, we can assign a confidence interval. The standard error of the log odds ratio is simply estimated by the square root of the sum of the reciprocals of the four frequencies [1]. For the example, =

As any normal distribution, a 95% confidence interval for the log odds ratio is obtained as 1.96 standard errors on either side of the estimate. For the example, the log odds ratio is loge (4.89) = 1.59 and the confidence interval is 1.59 ± 1.96×0.103, which gives 1.386 to 1.790. We can antilog these limits to give a 95% confidence interval for the odds ratio itself, as exp (1.386) = 4.00 to exp (1.790) = 5.99. As the observed odds ratio (4.89) is not in the centre of the confidence interval because of its skewed nature, its graphs are often plotted using a logarithmic scale. Lastly, as an odds ratio of 1 means no relationship, we can test the null hypothesis that the odds ratio is 1 by

(b) Eczema	(a) Hay fever		Risk of having hay fever	Relative (hazard) risk	Odds	Odds ratio
	Yes n=1069	No n=13945				
Yes (n=561)	141	420	141/561= 25.1%	3.91	141/420	4.89
No (n=14453)	928	13525	928/14453= 6.4%		928/13525	
Risk of having eczema	141/ 1069= 13.2%	420/ 13945 = 3%				
Relative hazard (risk)	4.4					
Odds	141/928	420/13525				
Odds ratio	4.89					

Table 1: Association between hay fever and eczema in 11-years old children (n= 15522):
n= number of patients

the usual Chi-square test for a two by two table (2).

In order to evaluate a treatment effect, OR is simply calculated by dividing the odds (probability) of an event in a treatment group by the odds of the event in the comparison group. It is valuable in case-control studies where events are usually rare and the relative risk cannot validly be estimated directly. It also remains useful when researchers need to adjust for other variables in which logistic regression is the usual approach. Outside those 2 indications, OR should be evaluated with caution as an indicator or replacement of the relative risk. Although OR and RR go hand in hand in the same direction, OR tend to overestimate the effect of a treatment when outcome is common. The distortion is especially large when the event rate is high in only one group. The use of OR as an interpretation of RR in prospective studies, randomised trials and systematic reviews, has been criticised for the same reasons and it is generally advisable that OR should not be interpreted such unless the events are rare in both groups (say, less than 20-30%) [3].

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Myocardial Revascularization in patients with severe left ventricular dysfunction: Is on pump beating the preferable technique?

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Background: **It remains unclear how cardioplegic arrest affects surgical results after coronary artery bypass grafting . This study compares early outcome after on-pump beating-heart coronary revascularization and conventional revascularization in patients with ejection fractions of less than 30%.**

Methods: **From 2005 to 2008, 167 patients with ejection fraction less than 30% underwent CABG. On-pump beating-heart CABG was carried out in 75 patients (group 1) and 92 patients had the conventional technique (group2). Both groups were otherwise similar in their risk factors and the co-morbid conditions.**

Results: **In-hospital mortality was less in the on-pump beating-heart CABG group (4% versus 4.34%). Twelve patients in the conventional CABG group required insertion of intra-aortic balloon pump initiated intraoperatively or postoperatively, whereas only 2 patients required it in the on-pump beating-heart CABG group. The ventilation time in hours was longer in the conventional group (10± 12.3 versus 7.6±11.7). No significant difference was found in morbidity including stroke and renal failure. The incidence of postoperative atrial fibrillation was significantly less in on pump beating group compared to conventional group occurring in 6 versus 21 patients in group 2. The duration of intensive care unit stay and the hospital stay were significantly shorter in the on-pump beating-heart CABG group.**

Conclusions: **On-pump beating-heart CABG can be performed safely in high-risk patients. Use of cardiopulmonary bypass and the elimination of**

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cardioplegic arrest may be of most benefit to hemodynamically unstable patients.

Coronary artery bypass grafting (CABG) for patients with left ventricular dysfunction (LVD) remains superior to medical therapy from the long-term survival point of view[1]. Despite the previously reported high operative mortality in this group of patients, CABG still confers a significant reduction in long-term mortality and protects against future infarction and death even without postoperative improvement in ventricular function[2]. Many authors had reported the superiority in early and mid-term outcome of on-pump beating CABG procedures, compared with the conventional technique, in an unselected or a specific subgroup of patients[3]. The detrimental effects of aortic cross clamp might be more significant in patients with poor left ventricular function, where even the slightest damage to the myocardium can have significant clinical consequences. Myocardial protection in coronary artery bypass grafting (CABG) with severe left ventricular (LV) dysfunction is still a surgical dilemma [4]. On-pump beating-heart CABG technique is effective in protecting myocardial function in patients with severe LV dysfunction. The main advantage of the on-pump-beating heart technique is the ability to perform complete revascularization with low morbidity and mortality even in impaired LV function [5].

The purpose of this study is to define the early outcome and the survival in patients with left ventricular dysfunction (LVD) who underwent on-pump coronary artery bypass (OPB) compared to the conventional coronary artery bypass grafting (CABG).

Methods:

Between September 2005 and July 2008, 167 patients with coronary artery disease, impaired left ventricular function with ejection fraction (EF) less than 30 %who underwent coronary artery bypass grafting (CABG) were prospectively studied and retrospectively analyzed at King Fahad Cardiac Center, Riyadh, Saudi Arabia. 75 patients underwent CABG with on pump beating technique (group1) and 92 patients with conventional technique (group2).

The incidence of diabetes, hypertension, smokers, chronic obstructive pulmonary disease (COPD), cerebrovascular accident (CVA), peripheral vascular disease and congestive heart failure was comparable in the two groups. For each group, the clinical, angiographic characteristics, the operative and outcome data were compared. Patients who underwent combined surgery, redo surgery, emergency procedures, left ventricular aneurysm or aortic surgery were excluded from the study.

Echocardiography and thallium-201 myocardial scintigraphy were preoperatively performed to measure the left ventricular function and to assess myocardial viability. This viability study was done when indicated in some patients according to their clinical , echocardiography and coronary LV angiography data. Clinical variables were prospectively entered into the data base registry.

Patient demographics , risk factors, operative information and postoperative outcome data were retrospectively analyzed. Additional information was obtained from patient charts when necessary. In addition, the logistic EuroSCORE was used for risk stratification. Outcome measures for this study included hospital mortality, major postoperative complications (respiratory failure, renal failure, bleeding requiring reoperation, arrhythmia, stroke, duration of inotropic support, length of mechanical ventilation , length of ICU and hospital stay). Hospital mortality was defined as death after the procedure before patient's discharge regardless of the

duration of hospitalization. Patients who died after discharge from hospital but within 30 days after the procedure were also considered as hospital deaths. Respiratory failure was defined as prolonged ventilator therapy (>72 hours) or need for re-intubation or tracheostomy. Renal failure was defined as creatinine greater than 200 mmol/L or the need for dialysis. Stroke was defined as a new permanent neurologic event occurring perioperatively or postoperatively.

On-Pump beating Coronary Revascularization:

All procedures were performed through median sternotomy. The left internal mammary artery (LIMA) and long saphenous vein were harvested by standard techniques. Patients were heparinized with a dose of 2-3mg/kg body weight with activated clotting time (ACT) above 360 second. Total cardiopulmonary bypass was established, and body temperature was maintained at 34-

35°C. Coronary stabilizer and cardiac positioning devices were used to access the coronary arteries under beating heart conditions; Octopus (Medtronic, Inc., Minneapolis, MN, USA) was used as the mechanical stabilizers in all the patients. The oxygen blower was used to assist in anastomosis. Hemodynamic monitoring was performed by Swan-Ganz catheter. Continuous monitoring of arterial pressure, central venous pressure, mean pulmonary artery pressure, pulmonary capillary wedge pressure, cardiac index and systemic vascular resistance were done. The right coronary artery (RCA) was usually the first artery to be grafted, followed by grafting of the vessels on the posterior wall and lateral wall. Left anterior descending (LAD) artery was grafted as the last coronary artery as a routine. For exposure of the circumflex vessels, Star-fish positional stabilizer (Medtronic, Inc., Minneapolis, MN, USA) was used to pull the heart vertically. Inotropes, vasopressors and careful volume loading were used when necessary during surgery. The target vessel was occluded proximally using a 4-0 polytetrafluoroethylene suture passed twice beneath the artery to prevent direct contact between the suture and the coronary artery wall. All distal anastomosis were performed with running sutures of 7-0 or 8-0 prolene. Proximal anastomoses were performed in standard technique using partial clamping of ascending aorta.

Techniques of CABG on CPB

After systemic heparinization with an activated clotting time level of at least 400 seconds, CPB was instituted between the ascending aorta and the right atrium using a single venous cannula. After cross-clamping the aorta , high potassium blood cardioplegia was administered in an antegrade fashion for myocardial protection. Systemic hypothermia 28-30°C was used .Cardioplegia was repeated after every distal anastomosis. Distal anastomoses were completed first, followed by proximal anastomoses using the single aortic cross-clamp technique or partial clamp. Aortic cross-clamp was released and the patients were weaned from CPB after a short reperfusion. After the completion of CPB, protamine was given depending on the heparin level.

The intra-aortic balloon pump was inserted in patients with haemodynamic instability.

All vital signs, hemodynamic variables, ventilation data, chest tube drainage and urine output were measured every hour in the intensive care unit. Intravenous continuous infusion of furosemide was given to the patient with low urine output below 0.5 mL/kg /hour lasting for 3 hours. Continuous hemofiltration started when urine output did not increase or renal shutdown occurred in spite of using diuretics. We analyzed the clinical results, mortality rate, morbidity rate, and blood chemistry data between the two groups retrospectively.

Statistical Analysis

Data were analyzed using a statistical software package (Graph Pad In Stat® version 3.00 for Windows, Graph Pad Software Inc., San Diego, California, USA) and presented as mean (SD), numbers or ratio as needed. Data were analysed using the student t test; Variables that are not normally distributed were compared using the Mann-Whitney test. Non parametric data were analyzed using Chi-square test or the Fiesher exact test as appropriate. Two-tail P values < 0.05 were considered significant.

Results:

Overall hospital mortality rate in both groups was 4.19 % (7 out of 167 patients): 4% (3 out of 75 patients) in group1 and 4.34 % (4 out of 92 patients) in group2. The cause of death was severe low cardiac output syndrome within the first postoperative 24 hours. Preoperative clinical patient characteristics including risk factors are listed in table 1.

The incidence of diabetes, hypertension, smokers, chronic obstructive pulmonary disease (COPD), cerebrovascular accident (CVA), peripheral vascular disease and congestive heart failure was comparable in the two groups. There was no significant difference between the two groups.

Intra-operative patient characteristics are shown in table 2. On-pump beating-heart CABG was associated with a shorter duration of the operation and CPB time; the difference in CPB time is related to prolonged reperfusion period after the release of the aortic cross clamp in group2, (96.6 ± 43.8 in group1versus119 ±59.8 in group2). Total blood loss was less in group 1, but with no statistical difference. Twelve patients (13.04%) in group2 required insertion of intra-aortic balloon pump intra-operatively or postoperatively, as opposed to 2 patients (2.77%) in group1. Intra-aortic balloon pump was used when there was hemodynamic instability as high pulmonary artery pressure, hypotension or ischemic changes in ECG monitoring.

The number of bypass grafts and the rate for complete revascularization were lower in group1 (3.1± 0.7)versus (3.2 ± 0.3) in group2 with no significant difference between the two groups.

Characteristic	On-Pump Beating-Heart CABG (n = 75)	Conventional CABG (n = 92)	*p* Value
Age (years)	65.0 ± 9.6	63.5 ± 8.2	NS
Male sex	55 (73.3%)	68 (73.9%)	NS
Mean EF%	25±4.1	24.8±4.0	NS
Diabetes mellitus	57 (76.0%)	69 (75.0%)	NS
Hypertension	67 (89.3%)	82 (89.13%)	NS
Smoking history	37(49.3%)	48 (52.17%)	NS
Cerebrovascular disease	5 (6.6%)	7 (7.6%)	NS
Peripheral vascular disease	9 (12%)	11(11.95%)	NS
Chronic obstructive pulmonary disease	2 (2.77%)	2 (2.17%)	NS
Congestive heart failure	10 (13.33%)	12 (13.04%)	NS

Table 1: Preoperative Clinical Characteristics
EF: ejection fraction, NS: non significant.

Characteristic	On-Pump Beating-Heart CABG (n = 75)	Conventional CABG (n = 92)	*p* Value
Operation time (min)	249.6 ± 69.9	306.3 ± 89.2	HS <0.0001
Cardiopulmonary bypass time (min)	96.6 ± 43.8	119.1 ± 59.8	HS <0.0001
Intra-aortic balloon pump required	2 (2.77%)	12 (13.04%)	S 0.023
Number of bypass grafts	3.1 ± 0.7	3.2 ± 0.3	NS

Table 2: intraoperative variables of patients in both groups.
HS: high significant, S: significant, NS: non significant

Characteristic	On-Pump Beating-Heart CABG (n = 75)	Conventional CABG (n = 92)	*p* Value
Reopening for bleeding	9 (12%)	11(11.95%)	NS
Stroke	3 (4%)	8 (8.69%)	NS
Renal failure	2 (2.6%)	2 (2.17%)	NS
Atrial fibrillation	6 (8%)	21 (10.86%)	S
Inotropes (hours) (mean± SD)	38± 10.5	49± 11.08	HS
Ventilation time (hours) (mean± SD)	7.6±11.7	10.2±12.3	HS
Total blood loss in 24 hours (mL)	877.1 ± 453.8	970.5 ± 530.3	NS
ICU stay (days) (mean± SD)	2.9± 1.65	3.7± 1.78	HS
Hospital stay (days) (mean± SD)	6.8± 1.43	8.6± 2.13	HS
In-hospital mortality	3 (4%)	4 (4.34%)	NS

Table 3: Early Post-Operative Outcomes
CABG = coronary artery bypass graft surgery; ICU = intensive care unit, HS: high significant, S: significant, NS: non significant

The incidence of early postoperative complications in both groups is shown in Table 3. The incidences of re-exploration for bleeding, reopening for hemodynamic instability, stroke, renal failure and infection were not significantly different in both groups. The incidence of postoperative atrial fibrillation was significantly less in group1 as compared to group2 (6 patients (8%) versus 21 patients (10.86%) patients respectively). All patients required inotropic support in the form of adrenaline (epinephrine) with or without noradrenaline (norepinephrine). The need for inotropes in hours was longer in group2 (38± 10.5 in group1versus 49± 11.08 in group2) .The ventilation time in hours was longer in group2 (10± 12.3) versus (7.6±11.7) in group1. The duration of intensive care unit stay in days was 2.9 ±1.65 in group1 while it was 3.7± 1.78 in group2. Hospital stay in days was shorter in group1 (6.8± 1.43) versus (8.6 ±2.13) in group2.

Discussion:

Patients with severe left ventricular dysfunction are known to have superior long term survival with coronary artery bypass grafting. Patients with LV dysfunction have very poor reserve and even slight damage to myocardium may have significant consequences . Most of these patients have a combination of risk factors and mortality that may reach 10% or higher (6). With improvement in anesthesia, myocardial protection, cardiopulmonary bypass and postoperative support, operative mortality in this group decreased significantly to 2.4- 11 %(7,8).

The in-hospital mortality reported in patients with LV dysfunction during the late 1980 was as high as 20%. This has decreased significantly: the majority of series of low EF patients undergoing CABG in the 1990s reported early mortalities between 5% and 15% , whereas the majority of series describing results in patients operated on after 2000 were reporting mortalities of less than 5%. In the Canadian registry database, 431 patients with EF less than 0.30 were operated on between 1996 and 2001 with an overall mortality of 4.6 %. (3,9).

As low left ventricular ejection fraction is one of the factors associated with increased morbidity and mortality after CABG, the point of consideration is which approach is best for such patients and how to select the patient who is most likely to benefit from surgical revascularization. Despite the new myocardial protection techniques, there are some hearts which do not tolerate aortic cross clamping. Even continuous warm blood cardioplegia which keeps the heart in an aerobic environment does not completely prevent postoperative stunning possibly because of the myocardial edema intrinsic to the diastolic state of the arrested heart. (10,11)

One of the ways to avoid the damaging effects of CPB is to perform CABG on beating heart and some studies have shown good results of CABG on beating heart in patients with poor LV. With the availability of good stabilizers and with due attention to technical details of adequate exposure and maintaining the hemodynamics, all the target vessels on the heart can be comfortably grafted on beating heart. (12,13)

In the present study the in-hospital mortality was lower in the on-pump beating-heart CABG group than in the conventional CABG group. It was 4% and 4.34% respectively. Mizutani and coworkers(14) reported in their study, 2.6% mortality in on pump beating group while it was 11% in the conventional one. They suggested that, this consideration may be related to the elimination of cardioplegic arrest, which is the main difference between the two techniques. Consistent with our finding Izumi and colleagues (15) have reported that on pump beating CABG may be an accepted option for acute myocardial infarction. George and coworkers (16) reported a very low mortality of 1.8% in 111 patients with severe LV dysfunction undergoing CABG with the conventional technique.

Elimination of the CPB may in fact reduce the physiologic derangement caused by the systemic inflammatory response and the direct complication that stems from the use of CPB. Despite the most modern cardioplegic techniques, acute postsurgical ventricular dysfunction is common. Cardioplegic arrest may therefore have a direct adverse effect on the heart that gives rise to an increase in morbidity and mortality, especially for high-risk patients (17).

On-pump beating-heart CABG can eliminate one of these components, and is reported to be an acceptable trade-off between conventional CABG and off-pump CABG. Consequently, the present comparison between this technique and conventional CABG should clarify the effect of cardioplegic arrest on the surgical outcome. The main features of this technique are the use of CPB, the avoidance of cardioplegic arrest and use of the stabilizers devices for off pump CABG. Early surgical outcome after matching was better in the on-pump beating-heart CABG group (18).

The IABP was used in fourteen patients (8.37%) in our study. It should be used whenever one feels it is necessary as timing is the key for preoperative or postoperative use. The idea is to allow the myocardium to recover from the low output state. The IABP augments myocardial performance without increasing workload on the heart and myocardial oxygen requirements. Craver(19) reported the use of IABP electively to enable and facilitate a selected group of high risk patients to undergo off pump coronary bypass with good results and avoid the dangerous hemodynamic instability that may occur. Elefteriades and Edwards (20) used the IABP freely for perioperative support especially in patients with extremely impaired left ventricular function and left main disease.

As expected, no significant benefit was detected for on-pump beating-heart CABG in relation to morbidity, including the incidence of re-exploration for bleeding, stroke and renal failure, which are all believed to be related to the use of CPB itself. The rate for atrial fibrillation was significantly lower in the on-pump beating-heart CABG group. It is not clear why atrial fibrillation was so frequent in the conventional group. The shorter operation time and the shorter CPB time in the on-pump beating-heart CABG group may be related to the relative prolonged reperfusion period after the release of the aortic cross clamp in the conventional CABG group.

In the present study the ventilation time in hours was 7.6 ±11.7 in on pump beating group versus 10.2 ± 12.3 in the conventional group. Bakir and Essam El-Din(12) mentioned in their study that the mean intubation time was 7.6 ± 11.6 hours in group of high risk patients operated by on pump beating procedure. Filsoufi and associates (10) reported no difference in morbidity in on-pump conventional CABG versus OPCAB in patients with low EF. It was however, important to emphasize that patients undergoing on pump surgery in their study were older with significantly higher predicted mortality.

Improvement in ejection fraction is not a universal finding after revascularization as it depends on the presence and extent of stunned and hibernating myocardium and the ability to completely revascularize the hibernating tissue. Elefteriades and Edwards (20) suggested that there are two modes of benefit from CABG in such patients, first recruitment of hibernating muscle and second, protection of the heart from future infarction by the constructed bypass grafts. In their opinion, there is no ejection fraction that is too low and no ventricle that is too big to undergo CABG surgery.

Limitations of this study: This is a retrospective observational study, which may involve too many confounding factors to show any clear advantage of on-pump beating heart CABG. Clinical outcomes focused on postoperative morbidity and mortality with no information on late complications, quality of life, postoperative EF. The small number of patients that were enrolled for matching is a further limitation.

Concluoion :

Excellent results after CABG can be expected in patients with EF of 0.30 or less, with low operative mortality and acceptable postoperative morbidity provided that the target vessels were graftable. On pump beating CABG was found to be safe and excellent approach in such high risk patients who may not tolerate cardioplegic arrest and at the same time also do not tolerate to be operated on totally without the cardiopulmonary bypass. Avoidance of cold CPB and cardiac arrest does not protect against the increased bleeding, stroke, and renal failure that have repeatedly been shown to be greater in conventional technique than in on-pump beating CABG.

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Impact of Prior Percutaneous Coronary Intervention on Short-term Outcome of Subsequent Coronary Artery Bypass Surgery.

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Background: **A significant number of patients with prior percutaneous coronary intervention (PCI) are being referred for coronary artery bypass grafting (CABG) surgery with limited debated outcome data. The aim of this study was to evaluate the impact of prior PCI on the short-term outcome of subsequent CABG.**

Methods: **In this prospective study, 62 patients who had prior PCI and underwent CABG (Group I) were compared with 62 matched control patients without prior PCI (Group II) who underwent CABG during the same period. Short term-outcome was compared between both groups in regard to in-hospital Major Adverse Cardiac Events (MACEs) and in-hospital mortality and early follow up results.**

Results: **the length of stay in intensive care unit and postoperative hospital stay were significantly longer in Group I than Group II (P<0.05). There were significant differences between the two groups in terms of the incidence of postoperative major bleeding and reoperation for bleeding as they occurred more in Group I patients (P<0.05). There were a significant difference in the postoperative in-hospital MACEs rate as they occurred more in Group I patients (Group I: 13% vs Group II: 3%, P<0.05). Group I patients experienced a significantly higher rate of in-hospital mortality than Group II patients (Group I: 8% vs Group II: 1.6%, P<0.05). Follow-up results showed no significant differences between both groups (P=NS). The logistic-regression analysis indicating prior PCI to be significantly associated with in-hospital MACEs (odds ratio [OR], 3.81; 95% confidence interval [CI], [1.45-5.18]; P<0.01) and in-hospital mortality ([OR], 2.72; 95% CI, [1.37-3.24]; P<0.05) .**

Conclusion: **Prior PCI had impact on short-term outcome of subsequent CABG with increased incidence of in-hospital MACEs and in-hospital mortality. Prior PCI emerged as an independent predictor of increased risk of in-hospital MACEs and in-hospital mortality after CABG.**

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Since the advent of percutaneous coronary intervention (PCI) for treatment of coronary artery disease, there has been a dramatic widespread use of PCI [1]. Large-scale clinical studies indicate that 20%-40% of patients after PCI will eventually develop restenosis with complex lesions and 8% to 20 % will have coronary artery bypass surgery (CABG) within 5 years [2, 3]. Therefore, an increasing number of CABG will be performed in patients who have had prior PCI. However, subsequent CABG surgery with prior PCI, might not achieve the same excellent results, as thoroughly demonstrated in the literature [4-6].

Prognostic factors following CABG have been well studied, however, there are little data available regarding the efficacy and risk of CABG after previous successful PCI [4, 7, 8]. It is supposed that this cohort of patients with prior PCI is at higher risk for CABG, nevertheless, consideration of the hypothesis that prior PCI could reduce the safety and efficacy of future CABG has been largely neglected [9]. Wherefore, it is important to investigate what impact prior PCI may have on outcome of patients who require subsequent surgical revascularization in view of the increasingly widespread use of coronary PCI, the frequent need for surgical reintervention in these patients, and the clinical impression that surgical outcomes may also be compromised in this patient group [10].

The aim of our study was to evaluate the impact of prior PCI on the short-term outcome of subsequent CABG by comparing in-hospital and early follow-up results of these patients after CABG with patients treated by CABG as the primary intervention.

Methods

In this prospective study, all patients with history of prior successful PCI who underwent first-time elective isolated CABG surgery and followed up between March 2005 to August 2008 (42 months), in Zagazig University Hospital, were included. During this period, a total of 62 patients had prior successful PCI and subsequently underwent first-time elective isolated CABG were identified and served as the study group (Group I). Those patients were compared with 62 control patients without history of prior PCI, who underwent CABG as their primary revascularization procedure during the same period and who were matched for demographic data, preoperative risk factors and revascularization technique (Group II).

Inclusion criteria for this study included: 1] First-time elective isolated CABG surgery; 2] Prior successful PCI at least one month before the operation; 3] Good preoperative left ventricular function (ejection fraction ≥ 50%); Patients were excluded from this study if they: 1] Had a history of emergent PCI; 2] Had left main stenosis; and 3] Those who needs endarterectomy.

PCI was defined as percutaneous transluminal coronary balloon angioplasty with or without stent implantation. A successful PCI was defined as dilatation of a targeted coronary stenosis (or stenoses) such that the residual luminal narrowing was less than 20%, and not associated with complications.

Perioperative Management

Aspirin was discontinued one week before surgery and restarted within 6 hours after CABG. Clopidogrel was discontinued 5 days before surgery and restarting within 48 hours after CABG in accordance with the current American College of Cardiology/American Heart Association guidelines [11].

Anesthesia and monitoring

All patients received the same standard general anesthetic technique. After harvesting of conduits, Heparin was injected in a dose of 2 mg/kg in patients who underwent operation without cardiopulmonary bypass (CPB) and 3 mg/kg in patients with CPB. Activated clotting time was measured initially and then every 30 minutes; it was maintained for more than 300 seconds in patients who underwent surgery off pump and more than 400 seconds in those who had their surgery on pump. Protamine sulfate was used in 1:1 ratio to reverse the heparin effect after the procedure.

Surgical Technique

All patients underwent operation through a median sternotomy. The left internal mammary artery (LIMA) was harvested by standard technique using hemoclips. The great saphenous vein was obtained by standard technique and stored in heparinized blood. Revascularization was performed using LIMA for left anterior descending artery and saphenous vein grafts for the remaining coronary territories.

On-pump technique (ONCAB) was performed using standard CPB technique with ascending aortic and 2-stage venous cannulation, normothermia to 34°C (drift down without active cooling), intermittent antegrade

warm blood cardioplegia and with a single aortic cross-clamp. During CPB, flow of ≥ 2.2 L/min/m2 and mean perfusion pressure between 50-70 mmHg were maintained. Haematocrit level was kept at ≥22%. Distal anastomoses were performed first using continuous 7-0 prolene. Aortic cross-clamp was released after deairing. Proximal anastomosis with 6-0 prolene was done using a side-bite clamp.

Off-pump technique (OPCAB) was performed based on the surgeon's preferences. A warming blanket was used to maintain the patient's temperature around 35°C. Octopus stabilizer was used to facilitate the distal anastomoses. Intracoronary shunts and silicone rubber vessel loops were usually used during the construction of the distal anastomoses. Proximal anatomoses were created using a side-bite clamp with 6-0 prolene.

Outcome measures for this study included time of ventilation, need of inotopic support, blood loss within 48 hours after surgery (by chest tube output), length of stay in intensive care unit (ICU) and hospital, major postoperative complications [Major adverse cardiac events (MACEs), Major bleeding, Reoperation for bleeding, Respiratory failure, Renal failure, Arrhythmia, Need of intra-aortic pump support (IABP), Cerebrovascular accident (CVA), Deep sternal wound infection], and in-hospital mortality.

Major adverse cardiac events (MACEs) were defined by any of the following outcomes during the postoperative hospitalization period: (1) Myocardial infarction (MI), (2) low cardiac output syndrome (LCOS), (3) Cardiac death (CD), and (4) Sudden cardiac death (SCD). In-hospital mortality was defined as death after the procedure before patient discharge regardless of the duration of hospitalization. Death was considered cardiac in origin if it was caused by MI, significant cardiac arrhythmias, or refractory LCOS. Sudden unexpected death occurring without another explanation was defined as SCD.

Myocardial infarction (MI) documented by the appearance of one of the following diagnostic criteria: (1) Cardiac troponin I level ≥10.5 ng/mL after CABG (2) Creatine-kinase MB level 3 times above the upper normal level, (3) New persistent ST-segment or T-wave changes, or (4) Development of new Q waves. Low cardiac output syndrome (LCOS) was defined as cardiac index <2.0 L/min/m2 or a systolic arterial pressure<90 mm Hg, despite high-dose inotropic support was defined as requiring ventilatory support for greater than 72 hours or the need for reintubation. Renal failure was defined as creatinine > 2.5 mg/dL for more than 7 postoperative days or the requirement for renal dialysis. Cerebrovascular accident (CVA) was defined as a new permanent neurologic event occurring postoperatively. Major bleeding was defined as blood loss > 200 mL/h during the fist 6 hours.

Follow-up

Our follow-up concerned the first 3 months postoperatively. Each patient was scheduled for a follow-up clinical examination and surface electrocardiogram for detection of clinical ischemia recurrence every month postoperatively. A new event was registered as a new myocardial infarction, the return of angina pectoris, congestive heart failure (CHF), or arrhythmia. Also, cardiac related readmission and mortality were registered.

Statistical Analysis

Data are expressed as a mean value ± standard deviation (means ± SD) and as percentages (%).We applied propensity score analysis with greedy matching on the basis of preoperative variables in a 1:1 manner to create set of matched pairs between cases (Group I: patients with prior PCI) and controls (Group II: patients without prior PCI). Variables were compared between the groups using Student's t test and Mann-Whitney U test. Chi-square test ($\chi 2$) and Fischer exact test were used for comparison of data. Short term-outcome was compared between both groups especially in regard of postoperative in-hospital MACEs and in-hospital mortality, and early follow up data. Univariate and multivariate logistic regression analyses were performed to identify preoperative independent predictors for in-hospital MACEs and in-hospital mortality. Statistical significance was defined as a p value of less than 0.05 ($P<0.05$). Statistical analyses were performed with SPSS for Windows, version 11.5 statistical package (SPSS, Inc, Chicago, Ill, USA).

Results :

In this study, a total of 62 cases with prior PCI (Group I) were successfully matched with 62 corresponding controls without prior PCI (Group II). All patients' baseline characteristics before CABG in the two groups matched on propensity score are outlined in Table 1. There were no significant differences between both groups in regard to demographic data, the incidence of major medical co-morbidities and preoperative risk factors (P=NS).

	Group I (Prior PCI) (n = 62)	Group II (No priorPCI) (n = 62)	*P* Value
Age (y)	49±6.8	52±7.3	NS
Female sex	14(23%)	15(24%)	NS
BMI (kg/m^2)	28±6	27±5	NS
Family history of coronary disease	28(45%)	26(42%)	NS
Smoker	38(61%)	37(60%)	NS
Obesity	5(8%)	4(6%)	NS
Hypertension	39(63%)	38(61%)	NS
Diabetes mellitus	18(29%)	17(27%)	NS
Hypercholesterolemia	34(55%)	32(52%)	NS
NYHA FC III or IV	7(11%)	6(10%)	NS
Unstable angina	3(5%)	3(5%)	NS
History of MI	20(32%)	19(31%)	NS
Arrhythmia	6(10%)	5(8%)	NS
LVEF	56±14	55±15	NS
Renal insufficiency	2(3.8%)	2(3.8%)	NS
COPD	5(8%)	4(6%)	NS
PVD	8(13%)	6 (10%)	NS
History of CVA or TIA	3(5%)	2(3%)	NS
Mean number of diseased vessels	2.3±1.2	2.5±1.3	NS

Table 1. Patients' preoperative variables.
PCI, Percutaneous coronary intervention; BMI, Body mass index; NYHA FC, New York Heart Association functional class; MI, Myocardial infarction; LVEF, Left ventricular ejection fraction; COPD; Chronic obstructive pulmonary disease, PVD, Peripheral vascular disease; CVA, Cerebral vascular accident; TIA, Transient ischemic attack. NS= Non-significant.

Of those 62 patients with prior PCI (Group I), 42 patients underwent single vessel PCI, 15 underwent two vessels PCI, and 5 patients underwent triple vessel PCI. Balloon angioplasty only was performed in 3 patients and balloon angioplasty with intra-coronary stent placement was performed in 59 patients (39 patients with single stent, 17 with two stents, and 3 patients with three stents). The mean interval between the PCI procedure and CABG was 16.8 ± 4.2 months. Indication for CABG in patients with prior PCI (Group I) were as follows: symptomatic restenosis only at the site of the PCI in 11 patients, disease progression in other coronary arteries along with restenosis at the PCI site in 30 and development of new stenosis in coronary circulation other than the PCI vessel in 21 patients.

Intraoperatively, OPCAB was used in 31% of patients in Group I and in 32% of patients in Group II, with no statistical difference between both groups (P=NS). The aortic cross-clamp time, the number of grafts, the duration of extracorporeal circulation, and the duration of surgery were not statistically different between the two groups (P=NS). No differences were noted between the two groups with regard to rates of LIMA use (P=NS) (Table 2).

	Group I (Prior PCI) (n = 62)	Group II (No prior PCI) (n = 62)	*P* Value
Off-pump CABG	19(31%)	20(32%)	NS
Aortic cross-clamp time (min)	79±33	88±34	NS
CPB time(min)	114±37	122±39	NS
Total surgery time (min)	156.2±45.4	167.3±51.2	NS
No. of grafts	2.3±1.2	2.5±1.3	NS
LIMA (%)	59(95%)	60(97%)	NS

Table 2: Patients' operative Data
Percutaneous coronary intervention; CABG, Coronary artery bypass surgery; CPB; Cardiopulmonary bypass, No., Number; LIMA, Left internal mammary artery. NS= Non-significant.

Post-operative outcome data for patients in the two study groups are shown in Table 3. The mean mechanical ventilation time, the incidence of need to inotropic support, and the total blood loss did not differ between both groups (P=NS). However, the length of ICU stay and postoperative hospital stay were significantly longer in Group I patients than Group II patients (P<0.05) (Table 3).

There were a significant difference in the postoperative in-hospital MACEs rate between both groups as they occurred more often in Group I patients (Group I: 13% vs Group II: 3%, P<0.05). However, there were no significant differences between the two study groups in terms of the incidence of post-operative MI, LCOS, CD, and SCD (P=NS). There were significant differences between the two study groups in terms of the incidence of major bleeding and reoperation for bleeding as they occurred more often in Group I patients (P<0.05). Meanwhile, there were no significant differences between the two groups as regard to the incidence of other remaining major postoperative complications (P=NS) (Table 3). Group

I patients experienced a significantly higher rate of in-hospital mortality than Group II patients (Group I: 8% vs Group II: 1.6%, P<0.05) (Table 3).

	Group I (Prior PCI) (n = 62)	Group II (No prior PCI) (n = 62)	*P* Value
I] Postoperative data:			
Mechanical ventilation time (hs)	7.4±1.2	7.1±1.1	NS
Inotropic support (%)	22(35%)	20(32%)	NS
Total blood loss (ml)	587±93	498±77	NS
Length of ICU stay (days)	2.5±0.5	1.7±0.3	<0.05
Length of hospital stay (days)	11.3±1.9	8.6±1.6	<0.05
II] Major postoperative complications:			
1] MACEs (%)	8(13%)	2(3%)	<0.05
MI (%)	3(5%)	1(1.6%)	NS
LCOS (%)	6(10%)	2(3%)	NS
CD (%)	3(5%)	1(1.6%)	NS
SCD (%)	0(0)	0(0)	NA
2] Other major complications			
Major bleeding (%)	8(13%)	2(3%)	<0.05
Reoperation for bleeding (%)	6(10%)	1(1.6%)	<0.05
Respiratory failure (%)	3(5%)	2(3%)	NS
Renal failure (%)	2(3%)	1(1.6%)	NS
Supraventricular arrhythmia (%)	8(13%)	7(11%)	NS
Ventricular arrhythmia (%)	2(3%)	1(1.6%)	NS
IABP (%)	2(3%)	1(1.6%)	NS
CVA (%)	1(1.6%)	1(1.6%)	NS
Deep sternal wound infection (%)	1(1.6%)	1(1.6%)	NS
III] In-hospital mortality (%)	5(8%)	1(1.6%)	<0.05

Table 3: Patients' postoperative outcome.
PCI, Percutaneous coronary intervention; ICU, Intensive care unit; MACEs, Major adverse cardiac events; MI, Myocardial infarction; LCOS, Low cardiac output; CD, Cardiac death; SCD, Sudden cardiac death; NA, Not applicable; IABP, intra aortic balloon pump; CVA, Cerebral vascular accident. NS= Non-significant.

Our follow-up was complete for all patients except for two patients in Group I (3.6%), with no statistical difference between both groups (P=NS). Follow-up results showed no significant differences between both groups in regard to the rate of angina, CHF, arrhythmia, or MI during follow-up period (P=NS). Also, the rate of readmission and mortality were statistically non significant between both groups during follow-up period (P=NS). These data were shown in Table 4.

	Group I (Prior PCI) (n = 55)	Group II (No prior PCI) (n = 61)	*P* Value
angina not requiring hospitalization	3(5%)	2(3%)	NS
Total readmission rate :	4(7%)	2(3%)	NS
Unstable angina	2(4%)	1(1.6%)	NS
CHF	1(1.8%)	0(0%)	NS
Arrhythmia (%)	1(1.8%)	1(1.6%)	NS
MI (%)	0(0)	0(0)	NA
Cardiac related mortality	0(0)	0(0)	NA

Table 4: Follow-up Data
PCI, Percutaneous coronary intervention; CHF, Congestive heart failure; MI, Myocardial infarction; NA, Not applicable. NS= Non-significant.

The logistic-regression analysis showed that several univariate factors, included history of prior PCI, were predictive for in-hospital MACEs and in-hospital mortality. Multivariate logistic-regression analysis rather confirmed the results and indicating prior PCI to be significantly associated with in-hospital MACEs ([OR], 3.81; 95% confidence interval [CI], [1.45-5.18]; P<0.01) and in-hospital mortality ([OR], 2.72; 95% CI, [1.37-3.24]; P<0.05). Thus, the logistic-regression analysis was identified history of prior PCI as an independent preoperative predictor for in-hospital MACEs and in-hospital mortality (Table 5).

Discussion

The number of PCI is increasing with changing cardiology practice patterns and the introduction of drug-eluting stents. Therefore, with the dramatic increase in rates of PCI and due to the fact that 20% to 40% of these patients require "poststent" coronary revascularization with nearly 20% are referred to CABG surgery after stenting, it is not surprising that the number of patients presenting for CABG with a prior PCI has increased as well [1-4].

	Variable	Univariate analysis		Mutivariate analysis	
		OR (95% CI)	*P* value	OR (95% CI)	*P* value
I] In-hospital MACEs	Age (y)	1.02[0.98-1.04]	0.22	1.01[0.92-1.08]	0.38
	Female sex	1.08[0.79-1.52]	0.63	1.3[0.8-2.7]	0.28
	Obesity	1.13[0.82-1.47]	0.52	------	----
	NYHA FC III or IV	1.58[1.13-2.27]	<0.05*	2.01[0.96-4.42]	0.09
	Smoker	2.23[1.47-3.21]	<0.05*	3.79[1.44-4.95]	<0.01*
	Hypertension	1.47[0.92-2.36]	0.12	------	----
	Diabetes mellitus	1.23[0.89-1.63]	0.24	------	----
	Hypercholesterolemia	1.37[0.92-2.04]	0.14	------	----
	Renal insufficiency	1.64[1.12-2.46]	<0.05*	------	----
	COPD	1.66[1.17-2.32]	<0.05*	------	----
	PVD	1.82[1.33-2.59]	<0.05*	1.2[0.87-2.05]	0.19
	Previous MI	1.64[1.23-2.24]	<0.05*	1.8[1.03-3.12]	<0.05*
	Prior PCI	2.22[1.48-5.67]	<0.01*	3.81[1.45-5.18]	<0.01*
II] In-hospital mortality	Age (y)	1.05[1.01-1.08]	<0.05*	1.09[1.01-1.1]	<0.05*
	Female sex	0.96[0.56-1.59]	0.85	1.8[0.91-4.3]	0.13
	Obesity	1.01[0.63-1.57]	0.97	------	----
	NYHA FC III or IV	1.63[0.95-2.79]	0.08	------	----
	Smoker	1.45[0.91-2.29]	0.13	------	----
	Hypertension	1.76[0.81-3.82]	0.09	------	----
	Diabetes mellitus	1.42[0.89-2.25]	0.13	------	----
	Hypercholesterolemia	0.99[0.57-1.71]	0.93	------	----
	Renal insufficiency	1.59[0.86-2.91]	0.11	------	----
	COPD	2.83[1.77-4.54]	<0.01*	------	----
	PVD	2.27[1.37-3.71]	<0.05*	------	----
	Previous MI	1.51[0.97-2.36]	0.11	1.3[0.83-2.3]	0.16
	Prior PCI	2.85[1.35-3.93]	<0.05*	2.72[1.37-3.24]	<0.05*

Table 5. Univariate and multivariate logistic regression analysis of variables associated with in-hospital MACEs and in-hospital mortality.
MACEs, Major adverse cardiac events; NYHA FC, New York Heart Association functional class; COPD; Chronic obstructive pulmonary disease; PVD, Peripheral vascular disease; MI, Myocardial infarction; PCI, Percutaneous coronary intervention.
****= Statistically significant.***

Little is known in the literature regarding the significance of PCI on outcome of CABG and only a few studies are available with contradictory [4, 7, 8]. Some authors suggest that initial PCI may complicate the operation and may increase postoperative morbidity and mortality [1, 4-6, 8, 12]; meanwhile, others describe no difference in postoperative morbidity and mortality [7, 9, 13, 14]. Wherefore, the relationship between increased perioperative risk during CABG and prior PCI is still debatable and has not been well studied so far [1]. Accordingly, it is important to investigate what impact of prior PCI may have on subsequent CABG in view of the increasingly widespread use of PCI [4, 10].

In our study, we evaluate the impact of prior PCI on the short-term outcome of subsequent CABG by comparing patients with prior PCI with matched corresponding controls without prior PCI. Intraoperatively in our study, the aortic cross-clamp time, the duration of CPB and the duration of surgery were not significantly different between the two groups. Thielmann et al. [1, 5] and Pliam et al. [9] reported the same intraoperative results; Nevertheless, Van Den Brule et al. [14] reported that the duration of CPB was obviously shorter in patients with prior PCI, but without clear explanation.

In our study , there were significant differences between the two study groups in terms of the incidence of postoperative major bleeding and reoperation for bleeding as they occurred more in patients with prior PCI ($P<0.05$). Thielmann et al. [1] showed that the incidence of major bleeding was significantly more in patients with prior PCI. Moreover, in another study of Thielmann et al. [5], they showed that the incidence of re-exploration for bleeding was significantly more in patients with prior PCI. The explanation of excess post-operative bleeding in patients with prior PCI may be the preoperative use of anti-platelet medication [11, 15-18]. Contrary, Barakate et al. [7] showed that no significant difference in the incidence of major bleeding or re-exploration for bleeding between patients with prior PCI and patient without prior PCI.

Postoperative in-hospital MACEs occurred significantly more in patients with prior PCI than patients without prior PCI in our study (Group I: 13% vs Group II: 3%, $P<0.05$). Also, patients with prior PCI experienced a significantly higher rate of in-hospital mortality than patients who did not have prior PCI (Group I: 8% vs Group II: 1.6%, $P<0.05$). This results were in agreement with other previous studies [1, 4-6, 8, 12]. Hassan et al. [8] compared outcome after CABG in 919 patients with and 5113 without prior PCI, and reported that patients with prior PCI had greater in-hospital mortality. In two groups of 919 propensity-matched patients in the same study, the in-hospital mortality was 3.6% in the prior vs. 1.7% in the non-prior PCI group which was statistically significant. Thielmann et al. [1] investigated outcome in 2626 consecutive patients undergoing CABG without prior PCI in comparison with 360 after a single and 289 patients with multiple prior PCI, they reported that multiple prior PCI were associated with increased in-hospital mortality and the risk of MACEs. In another study of Thielmann et al. [5], they compared the surgical outcome of 621 non-PCI patients with 128 PCI patients and all patients presented with diabetes mellitus and triple-vessel disease; they showed that PCI patients had a greater risk of in-hospital mortality and MACEs. Moreover, Gürbüz et al. [4] reviewed 611 consecutive patients after CABG, 190 patients with prior PCI and 421without PCI. They reported that patients with prior PCI were more likely to develop MACEs following CABG. In addition, Chocron et al. [6] in IMAGINE (Ischemia Management with Accupril post bypass Graft via Inhibition of the coNverting Enzyme) study of 2489 patients, 430 had prior PCI and 2059 without prior PCI, have reported that prior PCI leads to increase in-hospital MACEs and mortality after CABG than non-PCI group.

However, contrary to our findings, others described no difference in postoperative morbidity and mortality [7, 9, 13, 14]. Kalaycioglu et al. [13] compared 40 patients who had prior PCI with a case-matched control group of 40 patients with no prior PCI after CABG and they reported that rates of in-hospital morbidity and mortality were similar between the two groups. In another study, Barakate et al. [7] compared 361 patients after initially successful PCI with 11909 patients without prior PCI after CABG during the same period; they found that rates of in-hospital morbidity and mortality were similar between the two groups. Also, in a study of Van Den Brule et al. [14], they compared 113 patients with prior PCI after CABG and 1141 patients who underwent CABG as the primary intervention during the same period, and they reported that there is no indication that a prior PCI results in a higher postoperative mortality or morbidity after CABG. Also, Pliam et al. [9] compared the outcome of 1317 consecutive patients without prior PCI with 137 patients who had 1 to 3 stents and 289 with more than 3 stents after CABG. They showed that incidence of MACEs and hospital mortality were statistically insignificant between their groups.

The reasons behind that patient with a prior PCI had higher postoperative in-hospital MACEs and in-hospital mortality after CABG is not clearly understood but several hypotheses may play a role [8, 10]. First, instent restenosis is associated with a higher risk of early venous graft failure as restenosis after PCI may be a risk factor for intimal hyperplasia and increased inflammation at the graft anastomotic site after bypass grafting [19- 21]. Second, the presence of stents could result in grafts being performed more distally with a smaller luminal diameter and suboptimal runoff [8, 10]. Third, the application of PCI may have prevented the formation of protective collateral vessels [8]. Fourth, coronary side-branch obstruction or

occlusion due to multiple contiguous and overlapping stents ("stent jail") may lead to a compromised collateral blood flow, affecting coronary runoff and the patency rate of the bypass grafts [1]. Finally, the pathophysiological response to the presence of an intravascular foreign body may adversely affect surgical outcomes as stenting can cause prolonged endothelial dysfunction and local inflammatory response with an accumulation of platelets and neutrophils causing microvascular thrombotic obstruction and/or distal microembolization [10, 17, 22–24]. Conversely, it has been argued that worse surgical outcomes after PCI are artefacts of the more aggressive atherosclerotic disease processes in patients who require reintervention, and not a consequence of PCI [10, 19].

In this study, there were significantly longer length of ICU stay and postoperative hospital stay in patients with prior PCI ($P<0.05$). This may be explained by increased postoperative morbidity which was noted in patients with prior PCI than patients without prior PCI in our study. Thielmann et al. [5] reported that patients with prior PCI had significant prolongation in length of ICU stay; meanwhile, Barakate et al [7] and Pliam et al. [9] showed that patients with prior PCI had significant prolongation in length of hospital stay. In contrast, Van Den Brule et al. [14] showed that no significant difference in length of hospital stay between patients with and without prior PCI.

Follow-up in this study did not show significant differences between both groups in regard to rate of readmission, angina, CHF, arrhythmia, MI or mortality (P=NS). This was in agreement with Van Den Brule et al. [14]. They reported that follow-up results did not show differences in cardiac related mortality and recurrent non-fatal ischemic events [14]. Also, Chocron et al. [6] showed that incidence of unstable angina and CHF requiring hospitalization did not show significant differences between patients with or without prior PCI. Contrary, Gürbüz et al. [4] showed that symptoms recurrence in the form of new angina and CHF were more significant in patients with prior PCI during follow-up. Meanwhile, Pliam et al. [9] reported that the rate of readmission within 30 days postoperatively was significantly more in patients with prior PCI.

To evaluate independent preoperative predictors of in-hospital MACEs and mortality, a logistic-regression analysis model was constructed in this study. Multivariate stepwise regression analysis confirmed the results indicating prior PCI to be significantly associated with in-hospital MACEs ([OR], 3.81; 95% confidence interval [CI], [1.45-5.18]; $P<0.01$) and in-hospital mortality ([OR], 2.72; 95% CI, [1.37-3.24]; $P<0.05$). Accordingly, in our study, prior PCI was found as independent risk factors for in-hospital MACEs and in-hospital mortality. However, none of the sophisticated risk stratification systems include prior coronary stenting as a variable [25, 26]. Nevertheless, Hassan et al. [8] by using multivariate analyses identified prior PCI as an independent predictor of hospital mortality. Also, Thielmann et al. [1, 5] by using risk-adjusted multivariate logistic regression analysis they reported that multiple prior PCI were associated with increased in-hospital mortality and the risk of MACEs. In a subsequent propensity-matched group based on 13 pre-operative risk factors, logistic regression analysis again confirmed multiple prior PCI to be associated with increased in-hospital mortality and MACEs. In addition, Gürbüz et al. [4] showed that PCI group had a significantly higher risk of in-hospital MACEs and mortality after CABG surgery than non-PCI group. Also, Chocron et al. [6] showed that PCI group, even after adjustment of the baseline characteristics, had a significantly higher risk of experiencing in-hospital MACEs and mortality after CABG than non-PCI group. Contrary, Van Den Brule et al. [14] by using multivariate analysis in their study did not identify PCI as a risk factor for early and late adverse outcome.

In conclusion, this study demonstrates that prior PCI had impact on short-term outcome of subsequent CABG. Patients with prior PCI undergoing isolated first-time elective CABG have increased morbidity and a significant higher incidence of postoperative in-hospital MACEs and in-hospital mortality compared to patients without prior PCI. Also, there was strong associated between prior PCI and increased risk of in-hospital MACEs and in-hospital mortality after CABG. Therefore, prior PCI emerged as an independent predictor of increased risk of in-hospital MACEs and in-hospital mortality after CABG.

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Monopolar versus bipolar radiofrequency isolation of left atrium during mitral valve surgery

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Background: **Maze procedure was the first curative treatment for atrial fibrillation (AF). However, due to its complexity several modifications were postulated to simplify the technique. The aim of this study is to evaluate the efficacy of concomitant radiofrequency isolation of left atrium during mitral valve surgery with monopolar and bipolar radiofrequency ablation, and effect of both techniques on restoration of sinus rhythm and release of cardiac biomarkers.**

Methods: **We studied 80 consecutive patients undergoing surgery for their mitral valve disease and concomitant radiofrequency (RF) ablation of left atrium, between December 2005 and July 2008. The patients were classified into two groups according to the technique of RF ablation. Group A: ablation was done by monopolar technique and group B: ablation was performed with bipolar technique. Assessment of cardiac biomarkers was done during the first 24 hours postoperative. Follow up of cardiac rhythm was done for all patients for 6 months postoperative. By the end of follow up period, we divide our patients according to their cardiac rhythm into, sinus converter and persistent AF ; comparing both groups searching for independent preoperative factors for success of RF ablation.**

Results: **Operative mortality rate was 1.25%. No significant differences between the two patient groups as regard preoperative variables. Group (A) showed significant prolonged ablation time, cross clamp time and cardiopulmonary bypass time than group (B). Postoperative conversion to sinus rhythm was significantly higher in group (B) than group (A) (67.5% versus 55% at the end of surgery, 77.5% versus 65% at hospital discharge, 84.2% versus 61.5% after 6 months). Relapse from sinus rhythm to AF was reported in 5% of patients within group (A) after stopping amidarone. Peak release of cardiac biomarker was significantly more**

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in group (A) than group (B). Correlation study between postoperative sinus rhythm and preoperative variables, revealed positive correlation with the duration of preoperative AF and the size of left atrium (odds ratio, 0.961 and 0.982; confidence interval 95% and 97%, P = 0.018 and P= 0.002 respectively). A cutoff value of 53 months preoperative AF and 58.25 mm left atrium were discriminate between sinus converter and non-converter. Conclusions: Bipolar RF ablation of left atrium carries higher rate of sinus conversion and lesser degree of myocardial injury than monopolar ablation. Double ablation lines with bipolar RF resulted in high rate of initial conversion and stable sinus rhythm. Preoperative longer history of AF > 53 months and larger left atrial size > 58.25mm, predicted postoperative persistent AF.

Atrial fibrillation is one of the most prevalent arrhythmias, and is observed in up to 79% of surgical patients with mitral valve disease [1]. Cox introduced the maze operation, a "cut and suture" technique, in 1987. The procedure interrupts all possible macro re-entrant circuits responsible for AF by multiple surgical suture lines placed after surgery [2,3]. However, despite excellent results with the Maze III procedure, it has not yet been widely adopted due to the complex nature of the procedure and its invasiveness [4].

Atrial activation during chronic AF in patients with isolated mitral valve disease demonstrated that the initiation of AF originates from re-entrant circuits or ectopic foci located inside the PVs or in the posterior left atrial wall around the pulmonary veins [1,5], this initiate the era of pulmonary veins or left atrial isolation.

Introduction of cryoablation and radiofrequency ablation (RFA) has reduced the complexity, morbidity and mortality due to a surgical maze procedure [4,6].

A variable degree of myocardial injury is expected among patients undergoing cardiac surgery [7]. Concomitant AF ablation using radiofrequency during open heart surgery could possibly influence postoperative release of cardiac necrosis biomarkers; indeed a significant release of cardiac necrosis biomarkers in patients undergoing transcutaneous radiofrequency ablation has been shown [8].

The aim of this study is to evaluate the efficacy of concomitant radiofrequency isolation of left atrium during mitral valve surgery with monopolar and bipolar radiofrequency ablation, and effect of both techniques on release of cardiac biomarkers (cardiac troponin I and creatinine kinase-MB).

Methods:

During a period of three years from December 2005 to July 2008, 80 patients submitted for surgery for their rheumatic mitral valve disease, with or without functional tricuspid valve regurgitation, with concomitant RF ablation of left atrium. All the patients had chronic atrial fibrillation with history of irregular heart beat and anticoagulation for more than 6 months which was confirmed by 12- leads ECG. The patients were classified into two groups according to the technique of radiofrequency ablation.

Group A: included 40 patients submitted to monopolar radiofrequency ablation, operated in Suez Canal University hospital and National Heart Institute in Egypt in the period from December 2005 to July 2007.

Group B: included 40 patients submitted for bipolar radiofrequency ablation of left atrium operated in Saad Specialist Hospital in Saudi Arabia in the period from August 2007 to July 2008.

Excluded from our study, patients with associated cardiac lesions, redo surgery, organic tricuspid valve disease, and patients with paroxysmal atrial fibrillation.

All patients were submitted for trans-esophageal echocardiography in the day before surgery searching for left atrial thrombus. Oral anticoagulant was stopped three days before surgery and replaced with continuous infusion of heparin maintaining the activated partial thromboplastin time between 1.5 and 2 times that of the

control time. Heparin stopped 6 hours before surgery.

Anesthesia technique: All patients were premedicated with 0.1 mg/Kg Morphine sulphate intramuscular one hour before coming to the operating room. Anesthesia was induced by intravenous fentanyl 15 µg/Kg, propofol 1 mg/kg, and Cisatracurium 0.15mg/kg. After tracheal intubation all patients were ventilated to achieve normocapnea using a volume controlled ventilator. Anesthesia was maintained inhalationaly by 2 % of sevoflurane with incremental dose of fentanyl before sternotomy and during rewarming.

All the patients were submitted for assessment of cTnI and CK-MB levels, 24 hours preoperative, at the end of surgery, 6 hours and 24 hours postoperative. AxSYM System, Microparticle Enzyme Immunoassay (MEIA) was used for quantitative measurement of cardiac Troponin CTnI, and DIMENSION RxL Chemistry analyzer is used to measure serum CK-MB. The reference range was: 0-7 ng/mL for CK-MB and 0–1.5 ng/mL for cTnI.

Surgical technique:

All our patients were approached through median sternotomy incision, after opening the pericardium and systemic heparinization, aortic and both vena cava were cannulated. Normothermic cardiopulmonary bypass was established. If there is possibility of left atrial thrombus, dissection of pulmonary veins and bipolar radiofrequency were delayed after cross clamping of the aorta. Otherwise, bipolar radiofrequency ablation was done on the beating heart.

Myocardial protection was achieved with warm potassium enriched blood , infused antegradely in the aortic root . Potassium chloride 30 milliequivelant was infused over three minutes initially and maintenance dose of 10 milliequivelant potassium chloride infused over three minutes every 20 minutes. The left atrium was entered through the inter-atrial groove. Left atrium was cleaned from any thrombus and left atrial appendage was closed with purse string suture. Then mitral valve procedure was completed either by repair or replacement of the valve.

A standard set of ablation lines were applied for all patients in the two groups:

1. Ablation line around the right and left pulmonary venous cuff (superior and inferior pulmonary vein), and around the base of left atrial appendage.
2. First connecting ablation line between the two ablation lines of pulmonary venous cuffs, through posterior atrial wall.
3. Second connecting ablation line between the left ablation line and the appendage.
4. Third ablation line between the left ablation line and the mitral annulus.

Monopolar ablation (Group A): From the endocardial surface all ablation lines were done after aortic clamping and cardioplegic arrest. The monopolar probe was used to made ablation lines with tip of the electrode is moved back and forth on the atrial tissue till it becomes white, which considered a confirmation that the lesion is transmural. Cold antegrade cardioplegia was infused during doing both connecting lines with appendage and mitral annulus to minimize thermal injury of the adjacent coronary vessels.

The ablation machine utilized was Stockert Ep-shuttle radiofrequency generator (distributed by: Biosense Webster Johnson and Johnson) or (Radionics or Medtronic atakhr generator), which available in our centers and used primarily in catheter laboratory, but we utilize this machine for interaoperative ablation of left atrium

Bipolar ablation (Group B): The right pulmonary venous cuff was encircled with tap, and then the bipolar blade jaws were positioned on epicardial surface of the atrial tissues medial to the pulmonary venous cuff and closed over the atrial tissues. Transmural ablation was done then the clamp released and reapplied on the atrial tissue medial to the first line and second ablation done. In the same manner two ablation lines for the left pulmonary venous cuff was done after dividing the ligament of Marshall. Then epicardial ablation of the left atrial appendage was done, with the ablating piece must be kept away from the A-V groove to avoid injury to a major coronary artery.

The first connecting line was done by applying the ablating clamp with one blade facing the epicardial surface in the oblique sinus (parallel to the A-V groove) and the other facing the endocardial surface and directed to the lower left pulmonary vein. The second and third connecting lines were done with monopolar probe endocardially, after aortic clamping and cardioplegic arrest.

The ablation machine used was (Medtronic Inc., Minneapolis, MN, USA)), the device connected to bipolar

5 cm blade or monopolar pen, with saline irrigation of both jaws or the tip of the pin. The device automatically stops delivery of the charge once transmural ablation completed.

Operative and postoperative rhythm management: After completing the cardiac procedure and heart regain its own rhythm, patients with persistent AF received internal cardioversion shock of 50 joules ; tried twice.

All patients except those with heart block, received amiodarone started in the operating room and completed in the intensive care unit. Loading dose of 300 mg amiodarone intravenous infusion over 30 minutes then 1mg/minute infusion for 6 hours, followed by infusion of 0.5 mg/minute for 18 hours. After finishing the amidarone infusion, oral amiodarone was started 200 mg twice daily and continued for one month postoperatively, then 200 mg once daily for another two months.

Patients with persistent AF after loading with amidarone and patients, who converted their rhythm to AF in the postoperative period received external cardioversion shock of 360 joules ; tried twice.

Postoperative management: Patients were maintained sedated, mechanically ventilated, and transferred to the intensive care unit (ICU) till they met the clinical criteria of tracheal extubation.

All the patients after cessation of postoperative bleeding were anticoagulated with continuous heparin drip until effective anticoagulation is reached with oral medications. Warfarin was continued for three months postoperative in all patients irrespective to their operative details, aiming to maintain international normalization ratio between 2.0 and 2.5. After this period anticoagulant was stopped, in patients maintaining their sinus rhythm and without prosthetic valves.

After hospital discharge, all survivors were followed up in the outpatient clinic on weekly base during the first month, then every month for 6 months. Each time, the patients were submitted for estimation of INR and 12-lead surface ECG. Patients who completed the follow up period were submitted for comparison between sinus converter and persistent AF, to detect the preoperative variables, which significantly affected rate of sinus conversion.

Statistical analysis:

Statistical analyses were carried out with the use of SPSS software version 12 (SPSS Inc, Chicago, IL). The data were collected as mean ± standard deviation; student t-test was utilized for comparing quantitative values, chi-square test and fisher exact test for qualitative values. P-value considered significant if <0.05, highly significant if <0.01, and non significant if >0.05. Sensitivity was defined as the proportion of patients with persistent postoperative AF, with preoperative value greater than the cutoff value. Specificity was defined as the proportion of patients who converted to sinus rhythm with preoperative value less than the cutoff value.

Results:

The overall thirty days mortality was 1.25%, one patient died within group B, from bleeding peptic ulcer in the 14th postoperative day. Both patient groups were comparable as regard patient's age, sex, NYHA class, preoperative medications and duration of preoperative atrial fibrillation (Table-1). Preoperative echocardiographic assessment of the two patient groups revealed non significant differences between the two patient groups as regard cardiac dimensions and function, and mitral valve pathology. Table (2)

Variables	Group A 40	Group B 40	P- value
Age	37.3±18.6	41.6±16.7	>0.05
Male/Female	17:23	16:24	>0.05
AF months	39.2 ± 24.6	41.9 ± 23.1	<0.05
Embolization	8.8%	11.1%	>0.05
NYHA class	3.0±0.9	3.1±0.6	>0.05
II	11 (27.5%)	10 (25%)	>0.05
III	22 (55%)	24 (60%)	>0.05
IV	7 (17.5%)	6 (15%)	>0.05
Hypertension	16 (23.5%)	15 (22.2%)	>0.05
DM	11 (25%)	13 (33.3%)	>0.05
Digitalis	28 (70%)	29 (72.5%)	>0.05
B blocker	19 (47.5%)	17 (42.5%)	>0.05
ACEI	8 (20%)	9 (22.5%)	>0.05

Table 1: Preoperative demographic variables in the two patients groups:
AF= Atrial fibrillation; NYHA= New York heart association grading; DM= Diabetes mellitus; B Blocker= Beta blocker;ACEI= Angiotensin converting enzyme inhibitors

Variables	Group A	Group B	P- value
LA dimension (mm)	52.7±13.2	53.8±11.2	>0.05
RA dimension (mm)	39.3±12.1	40.2±9.9	>0.05
PAP (mmHg)	48.7±18.6	51.2±21.4	>0.05
LVEDD (mm)	72.6±7.2	74.2±6.3	>0.05
LVESD (mm)	36.1±3.4	38.3±2.7	>0.05
EF (%)	49.5±10.7	48.3±9.6	>0.05
TR III/VI (Patients)	23 (57.5%)	21 (52.5%)	>0.05
Mitral stenosis (Patients)			
Mitral regurgitation	9 (22.5%)	8 (20%)	>0.05
(Patients)	23 (57.5%)	24 (60%)	>0.05
Combined	8 (20%)	8 (20%)	>0.05
(Patients)			

Table 2: Preoperative echocardiography:
LA= left atrium; RA= Right atrium; PAP= Pulmonary artery pressure; LVEDD=Left ventricular end diastolic diameter; LVESD= Left ventricular end systolic diameter; EF= Ejection fraction; TR= Tricuspid regurgitation.

Analysis of operative data revealed non significant differences between the two patient groups as regard type of mitral valve procedure and the need for tricuspid valve repair [De-Vega]. Ablation time was significantly prolonged in group A than group B (42.8±6.7 versus 23.9±8.4 minutes respectively, P<0.05). Bypass time and cross clamp time were significantly longer in group A than group B (108.6±21.5 and 76.7±16.4 minutes in group A versus 79.6±17.1 and 48.2±14.9 in group B respectively, P<0.05). Also, the total operative time was significantly longer in group A than group B (205.4±22.6 minutes versus 169.7±30.1 minutes, P <0.05). Table (3)

Variables	Group A	Group B	P value
Clamping time (min)	76.7±16.4*	48.2±14.9	<0.05*
Bypass time (min)	108.6±21.5*	79.6±17.1	<0.05*
Ablation time (min)	42.8±6.7*	23.9±8.4	<0.05*
Total operative time (min)	205.4±22.6*	169.7±30.1	<0.05*
Prosthetic MV (Patients)	29 (72.5%)	28 (70%)	>0.05
Bioprosthetic MV (Patients)	5 (12.5%)	4 (10%)	>0.05
MV repair (Patients)	6 (15%)	8 (20%)	>0.05
TV De-Vega (Patients %)	57.5%	52.5%	>0.05

Table 3: Operative details:

Postoperative complications were comparable between the two patient groups with no significant differences reported as regard, bleeding, re-exploration, pleural and pericardial effusion. However, 20% of patients within group (A) versus 5% in group (B) required prolonged intropic support more than 12 hours and 17.5% of patients within group (A) versus 5% in group (B) required prolonged ventilation more than 24 hours.

Assessment of cardiac necrosis biomarkers revealed significant increase of both troponin I and CK-MB in both patient groups in comparison with preoperative level. However, the peak level is significantly high in group A than group B, of both troponine I (14.3 ng/ml versus 9.1 ng/ml, P<0.05) and CK-MB (59.3 ng/ml versus 45.8 ng/ml, P<0.05).Table (4)

Variables	Group A	Group B	P value
Postoperative drainage	790±353	845±618	>0.05
Exploration for Bleeding	2 (5%)	1 (2.5%)	>0.05
Prolonged ventilation >24 hours	7 (17.5%)	2 (5%)	<0.05
Prolonged intropic support	8 (20%)	2 (5%)	<0.05
Delayed cardiac tamponad	1 (2.5%)	1 (2.5%)	>0.05
Wound infection	1 (2.5%)	2 (5%)	>0.05
Pleural effusion	1 (2.5%)	2 (5%)	>0.05
Troponin I ng/ml	14.3	9.1	< 0.05
CK-MB ng/ml	59.3	45.8	< 0.05

Table 4: Postoperative complications:

Complete heart block was reported in one patient 2.5% within group A and one patient 2.5% within group B, both patients required initiation of temporary pacemaker. However, both of them converted to sinus rhythm spontaneously within 24 hours postoperative.

Atrial flutter was reported in three patients, one of them in group A and after loading with amidarone converted to sinus rhythm, and the other two in group B, one of them converted to sinus rhythm with amidarone, while the other patient rhythm became slow atrial flutter (5:1) and require initiation of temporary pace maker after 24 hours and insertion of permanent pace maker before hospital discharge.

At the end of surgery, sinus rhythm was reported in 22 patients (55%) within group A versus 27 patients (67.5%) of patients within group B (P<0.05). After loading with amidarone, sinus rhythm was reported in 25 patients

(62.5%) in group A versus 29 patients 72.5% in group B, (P >0.05). With external cardioversion sinus rhythm was reported in 27 patients (67.5%) in group A and 31 patients (77.5%) in group B, (P>0.05).

Before hospital discharge 2 patients (5%) within group A ; their rhythm reconverted to AF, one of them regained sinus rhythm after cardioversion. At hospital discharge sinus rhythm was reported in 26 patients (65%) in group A and 31 patients (77.5%) in group B, P<0.05.

After hospital discharge one patient was lost from follow up in group (A), leaving 39 patients for follow up and statistical analysis. In group (B), one patient with permanent pace maker was lost from follow up and one patient died from bleeding peptic ulcer, leaving 38 patients for follow up and statistical analysis.

Three months postoperative sinus rhythm was reported in 66.7% (26 patients) of patients within group A and in 84.2% (32 patients) of patients within group B, P<0.05. Six months postoperative two patients within group A their rhythm reconverted to AF with sinus rhythm reported in 61.5% (24 patients). However, in group B sinus rhythm was reported in 84.2%,(32 patients) P<0.05. Table (5)

Seventy seven patients completed the follow up period and were classified into; sinus rhythm converter 56 patients (72.7%) and those with persistent AF 21 patients (27.3%). Echocardiographic Assessment 6 months postoperatively, revealed no significant differences as regard the LV dimensions and functions between sinus converter and persistent AF. However, significant differences between sinus converter and AF patients, as regarded pulmonary artery pressure (36.2±13.6 in sinus rhythm versus 44.8±15.2 in AF, P<0.05), left atrial diameter (42.3±7.1 mm versus 59.6±14.2 mm in AF, P<0.05), and right atrial diameters (34.4±9.2 mm in sinus rhythm versus and 43.7±11.4mm in AF, P<0.01) were detected. Effective atrial contraction was reported in 55 patients (94.8%) with sinus rhythm while not reported in all patients with AF. Table (6)

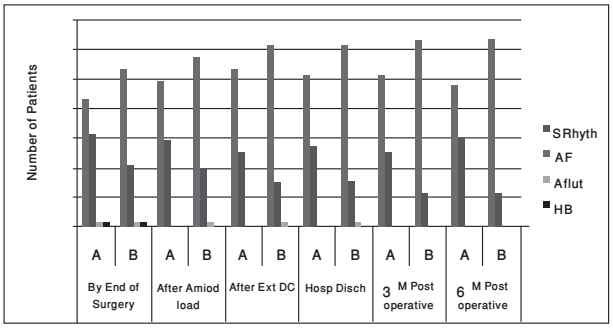
Time	Patient group	Patient number	Sinus rhythm		Atrial fibrillation		Atrial flutter		Heart block	
			Number	%	Number	%	Number	%	Number	%
By the end of surgery	A	40	22	55	16	40	1	2.5	1	2.5
	B	40	27	67.5	11	27.5	1	2.5	1	2.5
	P-value		<0.05	S	<0.05	S	>0.05	NS	>0.05	NS
After amidarone loading	A	40	25	62.5	15	37.5	0	0	-	-
	B	40	29	72.5	10	25	1	2.5	-	-
	P-value	>0.05	>0.05	NS	<0.05	S	>0.05	NS	-	-
After external cardioversion	A	40	27	67.5	13	32.5	0	0	-	-
	B	40	31	77.5	8	2o	1	2.5	-	-
	P-value	>0.05	<0.05	S	<0.05	S				
At hospital discharge	A	40	26	65	14	35	0	0	-	-
	B	40	31	77.5	8	20	1	2.5	-	-
	P-value	>0.05	<0.05	S	<0.05	S				
3 months postoperative	A	39	26	66.7	13	33.3	-	-	-	-
	B	38	32	84.2	6	15.8	-	-	-	-
	P-value	>0.05	<0.05	S	<0.05	S				
6 months postoperative	A	39	24	61.5	15	38.5	-	-	-	-
	B	38	32	84.2	6	15.8	-	-	-	-
	P-value	>0.05	<0.05	S	<0.05	S				

Table (5): Postoperative cardiac rhythm.

Variables	Sinus converter	Persistent AF	P value
LA diameter (mm)	42.3±7.1	59.6±14.2	<0.01
RA diameter (mm)	34.4±9.2	43.7±11.4	<0.01
LVED (mm)	62.9±7.2	61.7±5.3	>0.05
LVES (mm)	29.4±6.9	30.4±6.7	>0.05
LVEF (%)	52.3±6.5	50.2±4.1	>0.05
PAP (mmHg)	36.2±13.6	44.8±15.2	<0.05
Left atrial kick	94.1%	0%	<0.01

Table 6: Postoperative echocardiographic data.
LA= left atrium; RA= Right atrium; PAP= Pulmonary artery pressure; LVEDD=Left ventricular end diastolic diameter; LVESD= Left ventricular end systolic diameter; EF= Ejection fraction; TR= Tricuspid regurgitation.

Correlation study between all preoperative variables, and postoperative sinus rhythm by multiple stepwise logistic regression analysis, revealed that, left atrial diameter and duration of preoperative AF were independent determinant of sinus conversion by the RF maze procedure (odds ratio, 0.961 and 0.982; confidence interval 95.5% and 97%, P = 0.018 and P= 0.002 respectively).



Postoperative Cardiac Rhythm

Linear discriminate analysis was performed to discriminate the preoperative value in predicting the restoration of sinus rhythm by the RF maze procedure. The sensitivity and specificity of the cutoff value of 53 months preoperative AF were 29.1% and 96.2%, respectively. The sensitivity and specificity of the cutoff value of 58.25 mm left atrium were 28.6% and 94.6%, respectively.

The sinus conversion rate was significantly lower in patients with a preoperative AF more than 53 months (70.8%) than in patients with AF less than 53 months (96.2%), P<0.05. Also, sinus conversion was significantly lower in patients with preoperative left atrial diameter of more than 58.25 mm (71.4%) than in patients with a preoperative left atrial diameter of less than 58.25 mm (94.6%), P < 0.01.

Discussion:

In patients with longstanding atrial fibrillation, surgical correction of the underlying cardiac abnormality alone will not abolish the arrhythmia [9]. The Cox's Maze III has proven to be an effective treatment for atrial fibrillation but because of its complexity, cardiac surgeons are reluctant to expose their patients to the potential risks of this procedure [4,6].

The experimental study of Morillo et al, [10] demonstrated that isolation of posterior wall of the left atrium successfully restored a sinus rhythm in most dogs with induced AF. The same finding documented during electrophysiological study [5,10]. Therefore, surgeons started to minimize incision and suture of original Maze, and restricted isolation for left atrium or pulmonary veins only [6,11]. The other important evolutions in surgery for AF is the replacement of cut and sew technique of Maze by sutureless devices such as cryoablation or radiofrequent ablation [6,12] .

Radiofrequency energy had long history of use in ablation of the atrium to mimic Maze line either during catheterization [11] or interaoperative during cardiac surgery [4,11]. It has the advantages of producing minimal tissue damage, and produce transmural lesion without addition of suture line during surgery. The development of bipolar epicardial radiofrequency assures the completeness of transmural line in the myocardium and prevents conduction of heat to the extra cardiac tissues [4,13].

In our study we compare the efficacy of monopolar and bipolar radiofrequency energy for isolation of left atrium during mitral valve surgery in patients with chronic atrial fibrillation (AF). Also, comparing the postoperative sinus rhythm converter with persistent AF to evaluate the benefits from the technique and correlate the preoperative variables in the patients aiming to detect the independent risk factors for failure of the radiofrequency ablation of left atrium.

We utilize Sevoflurane during anesthesia of our patients, which was documented in previous studies to be the least anesthetic medications affecting the conductive tissues and myocardial fibers [14].

The efficacy of RF ablation is related to its role in creating linear scars within the atrial wall by means of thermally-induced coagulative necrosis (15). It is a common belief that after RF ablation there is always a release of cardiac biomarkers as a result of the small localized myocardial necrosis. Our finding show that release of cardiac biomarkers increased after surgical RF ablation with both monopolar and bipolar techniques, but the level is significantly higher with monopolar than bipolar technique. This may be caused by more thermal dispersion occuring with monopolar technique than the localized thermal injury caused by bipolar technique.

Zangrillo et al (16) , reported insignificant rise in cardiac biomarkers between mitral valve surgery with and without monopolar RF ablation, and they explained their finding by the incomplete penetration of the lesion through the myocardium, which from our opinion rendered the ablation incomplete and they also did not mention the rate of sinus conversion in their patients. However, Hanno et al(17), reported significant elevation of cardiac biomarker with cryoablation than bipolar RF ablation in sinus converter during mitral valve surgery and explained their finding by localized myocardial injury caused by bipolar RF.

The overall mortality rate in our patients was 1.25%, the cause of death was due to bleeding peptic ulcer. Heart block was reported in 2.5% of our patients and it was temporary in all patients and spontaneously resolved in postoperatively. Conceding with our results, Saueda et al, 1997[12] and Geidel et al, 2003[13] reported that heart block in their patients were temporary and all patients resolved spontaneously in the postoperative period and regained sinus rhythm. However, Chen et al, 2004[18], reported incidence of 2.5% of Sick sinus syndrome and permanent pacemaker were implanted for those patients. But Electrophysiological studies of those patients showed extensive absence of atrial electric potential with high stimulation threshold of both atria, suggesting irreversible myocardial damage that was present before the RF maze procedure.

Sueda et al, 1997[12], reported incidence of atrial flutter in 5.6% of their patients even with their technique of cryoablation of inferior vena cava tricuspid line; So it is not clear whether addition of ablation line to IVC/TV line of value to eliminate the possibility of atrial flutter[19].

Postoperatively, we encountered 3 patients (3.75%) with atrial flutter. In two patients, the atrial flutter disappeared after the administration of amiodarone, whereas the other patient had a sustained, slow atrial flutter (5:1 conduction rate) that subsequently required the insertion of a ventricular pacemaker because of bradycardia. Therefore, the atrial flutter was rare after left atrial isolation alone and easy to manage using medication or pacemaker implantation.

Comparison between the two patient groups revealed significant more sinus converter within group B than group A, at all time postoperatively. Moreover, postoperative sinus rhythm within group (B) patients was stable and without relapse to AF. However, failure to maintain sinus rhythm and relapse back to AF was reported in 10% within group A.

In our study we reported stepwise increase in the number of patients converted to sinus rhythm in the two patient groups during the first 3 postoperative months. This observation was reported in most of the published literature with variation in the rate of conversion from AF to sinus rhythm with time [4,6,18]. This can be explained by the fact that completeness of electrical isolation was effective after formation of fibrous tissue at the ablation time, which takes variable period of time.

The existed finding in our study was the high rate of initial sinus rhythm in group (B) with bipolar ablation, at the end of surgery 67.5%, which is higher than most of published literatures, which range between 35% and 60% [4,6,13,18,20]. This high rate of sinus conversion at the end of surgery may be due to our technique of double ablation lines at each site of ablation, however all studies utilize one single ablation line. We believe that single ablation line especially in dilated large atrium may be insufficient due to folding of atrial tissue in between the jaws of the blade.

Controversy existed about the need for antiarrhythmic medications after ablation. We agree with others [15,21], that amiodarone is effective in conversion from AF to sinus rhythm. Moreover, amiodarone help stabilization of myocardium to maintain sinus rhythm in postoperative period and prevent recurrence of AF. In our study most of the relapse from sinus rhythm back to AF was reported 3 months after stopping amidarone.

In our study we reported sinus conversion with postoperative electrical cardioversion 5% in each group,

which is lower than the 25% conversion rate with postoperative cardioversion reported by Deneke et al. [20]. This difference may be due to preliminary use of amidarone in our patients which is not used in the other study. However, this observation indicates that some patients with persistent AF in the early postoperative period need a trigger to convert their rhythm to sinus rhythm.

Regaining of atrial contraction was detected in 94.1% of patients with sinus rhythm, and associated with clinical and echocardiographic benefits with near normalization of all dimension of cardiac chambers in patients with sinus rhythm, while most patients with AF still had left and right atrial enlargement and residual moderate pulmonary hypertension. Moreover, the requirement for medication was higher in AF group.

Most of the published literatures reported restoration of atrial function after isolation of the left atrium whatever the technique used for isolation, better restoration of atrial contraction was reported with energy ablation of left atrium than cut and sew technique, (66% to 77%) [3,12] versus (85% to 98%) with radiofrequency and cryoablation[6,11,13,21].

In comparison between sinus converter and those with persistent AF, it was evident that patients with postoperative sinus rhythm had significant, shorter duration of AF, lower NYHA class, smaller left and right atrial diameters in the preoperative period, than those with postoperative persistent AF.

However, correlation study of all preoperative values revealed that the longer duration of AF and increased left atrial size were correlated significantly with persistent postoperative atrial fibrillation (odds ratio, 0.961 and 0.982; 95% and 97% confidence interval, P = 0.018 and P= 0.002). Left atrial diameter of 58.25 mm and duration of preoperative AF of 53 months, were founded to be the cut off points between sinus rhythm converter and non-converter after left atrial ablation.

Conclusion: Bipolar RF ablation of left atrium carries better rate of sinus conversion and lesser degree of myocardial injury than monopolar ablation. Double ablation lines with bipolar RF resulted in high rate of initial conversion and stable sinus rhythm. Preoperative longer history of AF > 53 months and larger left atrial size > 58.25mm, predicted postoperative persistent AF.

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Simultaneous Coronary Artery bypass and Carotid Endarterectomy in Patients with Combined Disease

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Background: **Surgical management of patients with combined occlusive disease of the coronary and carotid arteries is controversial. In this study, we present our early results of simultaneous surgery on both arterial systems in patients with significant disease in both territories.**

Methods: **A retrospective review of 17 patients with significant coronary artery disease and more than 70% carotid artery stenosis whether symptomatic or asymptomatic were included in this study where a simultaneous approach was applied.**

Results: **There were 12 males and 5 females with a mean age of 72.5 years. The average number of coronary bypass grafts was 2.9. There were no cerebrovascular events in the form of stroke or transient ischemic attack. There was only one hospital mortality due to perioperative myocardial infarction in a patient with diffuse coronary artery disease.**

Conclusion: **A combined approach for coronary bypass surgery and carotid endarterectomy can be performed safely. It should probably be the procedure of choice rather the staged procedure as it saves time and cuts down on the cost. Benefits of the combined approach include decreased exposure to anesthesia, reduction of perioperative myocardial infarction, diminished hospital stay.**

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Patients with concomitant cerebrovascular and coronary artery disease (CAD) represent a subset of advanced atherosclerosis who may have other areas of the arterial system involved (1). In addition to a higher risk of perioperative stroke, these patients also have an increased incidence of left main disease and usually have impaired left ventricular ejection fraction. Advances in percutaneous techniques and better medical care has changed the face of

coronary surgery with a significant number of patients in their 8th decade of life which resulted in an increase in the number of patients with combined CAD and carotid artery disease (3). It is known that 2% - 22% of patients with CAD have significant internal carotid artery stenosis (4,5) and nearly 50% of patients with carotid occlusion have significant CAD (6). The management of such patients with severe disease in both arterial systems continues to be controversial. The strategy includes either performing a staged procedure: carotid endarterectomy (CEA) followed by coronary artery bypass grafting (CABG), reversed staged approach: CABG followed by CEA or the combined approach: CEA and CABG during the same anesthetic.

The aim of this retrospective study was to review the early results of the combined approach for both arterial systems as regards stroke, myocardial infarction and hospital mortality.

Methods:

In the period between January 2001 and December 2006 a total of 783 patients under went CABG at the King Fahad Cardiac Center (KFCC). Out of this group17 patients had the combined CABG and carotid endarterectomy procedure. Patients were evaluated by taking a thorough history and physical examination with a detailed neurological assessment. The diagnosis of CAD was confirmed by coronary angiography. Cardiac risk assessment was done using the EuroScore system.

The indication for a combined approach was the need for myocardial revascularization in the presence of symptomatic or asymptomatic carotid stenosis with 70% diameter reduction or more with or without contralateral disease.

Preoperative screening:

It is the policy at KFCC that all patients for CABG have a preoperative carotid artery duplex scanning as part of the assessment.. This is done using both B-mode & color flow characters of the duplex, the study is done in order to identify plaques (location, characters & and anatomical extension.

Area reduction, peak systolic velocity and end diastolic velocity are used to determine percentage of carotid artery stenosis. CT scan for the brain was electively done to all patients with significant carotid stenosis. Patients were classified as having critical, severe, or elective carotid artery disease according to the following criteria (7):

a)critical carotid disease: symptomatic carotid stenosis 70-99% or asymptomatic carotid stenosis 70-99% with occluded contralateral artery.

b) Severe carotid stenosis: bilateral asymptomatic carotid stenosis 70-99%.

c) Elective carotid disease: unilateral asymptomatic carotid stenosis 70-99%.

All patients with 70% or more carotid artery stenosis und erwent the combined procedure.

Anesthetic management:

All patients received premedication in the form of lorazepam 2mg orally at the night of the operation and intramuscular morphine sulphate 0.1mg/kg one hour prior to transfer to the operating room (O.R.). All patients were transferred to the OR receiving oxygen via face mask at a flow rate of 5ml/min. Before induction of anesthesia, a large-bore peripheral venous line was inserted and 5-lead ECG, pulse oximetry, invasive arterial blood pressure monitoring via radial artery line together with bispectral index(BIS) monitor electrodes were connected. Pulmonary artery catheter was inserted.

Anesthesia was induced by Sufentanil 1.5 microgram/kg and intubation of the trachea was facilitated by rocuronium 0.9mg/kg. Direct laryngoscopy was not performed unless achieving a BIS reading in the range of 40-60. The lungs were ventilated with a tidal volume of 8ml/kg and FiO2 OF 50% in air mixture while ventilatory rate adjusted to maintain PaCO2 of 32-36 mmHg. Anesthesia was maintained by continuous infusion of Sufentanil 0.2 microgram/kg/h, midazolam 30 microgram/kg/h, and rocuronium 0.5mg/kg/h supplemented with Sevoflurane as required. Induction doses as well as anesthetic maintenance supplementation doses were guided by the BIS reading within a range of 40-60.

Conduct of the operation:

The surgery involves two separate teams of cardiac and vascular surgeons to perform the combined CABG and CEA procedures with the CEA performed before the CABG. The time spent for the carotid work was utilized in harvesting the saphenous vein.

CEA was performed through a longitudinal incision along the anterior of sternocleidomastoid muscle. The common carotid, internal and external carotid arteries are exposed. The patient is heparinized using a dose that varies between 5000 and 7000 IU usually given before clamping the carotid arteries. A shunt was always used during CEA and a PTFE or bovine pericardial patch was placed at the arteriotomy site. This was followed by coronary revascularization through median sternotomy and conventional CABG. Cold antegrade blood cardioplegia is usually used. In one patient, however, because of the calcified aorta the procedure was carried out on-pump beating procedure without applying a cross-clamp to the aorta and the proximal anastomoses were done using the enclose system (Novare surgical systems INC, Cupertino, CA) without a side-biting clamp. Moderate hypothermia was used (28-30 centigrade). The neck incision is loosely packed and only closed after the completion of the CABG and reversal of heparin. All neck wounds are drained to minimize collections.

Postoperative patterns

The patients are always sent to the cardiac intensive care unit as they are considered primarily open heart cases. The management is standardized for post operative care at KFCC. They are usually transferred to a high dependency unit the following day, some however are transferred directly to the floors. In analyzing their outcome we looked for any evidence of a perioperative M.I. Special care was taken to assess for any perioperative stroke or any TIA. Ventilation time, ICU stay, hospital stay and mortality were also recorded .Neck incisions were evaluated for hematoma or excessive drainage as was the chest drainage.

Results:

Of the 783 patients underwent CABG. 17 patients (2.17 %) had simultaneous CEA and CABG. There were 12 males and 5 females with a mean age of 72.5 years (range 60-85) Table1. 9 patients had a previous history of myocardial infarction, 5 patients had unstable angina at the time of their presentation. Left main CAD was present in 5 patients and one patient had severe mitral regurgitation. Table 2 shows the preoperative cardiac status of the patients. There were 9 patients with unilateral and 8 patients with bilateral carotid artery disease. TIA was present in 2 patients and 3 patients had previous stroke while 12 patients were asymptomatic neurologically. 5 patients were classified as having critical carotid disease, 3 patients as severe disease while 9 were classified as elective carotid disease Table 3.

Variable	Number (%)
Age (mean)	72.5 ± 8.64
Sex M (12)	70.58%
F (5)	29.4%
Arterial hypertension	11 (64.7%)
Dyslipidemia	4 (23.5%)
Smoking	1(5.8%)
Diabetes mellitus	14 (82.3%)
Renal insufficiency	3 (17.6%)
Chronic obstructive pulmonary disease	1 (5.8%)

Table (1): preoperative patients' profiles

Variable	Number (%)
Clinical findings	
-previous M.I.	9 (52.9%)
-unstable angina	5 (29.4%)
-chronic stable angina	12 (70.5%)
Coronary angiography	
-left main disease	5 (29.4%)
-3-vessel disease	12 (70.5%)
-2-vessel disease	5 (29.4%)
Echocardiography (E.F%)	
>50%	4 (23.5%)
30-50%	8 (47%)
<30%	5 (29.4%)
Associated findings:Severe M.R.	1 (5.8%)
Euroscore (mean ± S.D.)	
Additive	8 ± 2.89
Logistic	15.4% ± 8.4

Table 2: Preoperative cardiac status assessment

Variable	Number (%)
Neurological symptoms	
Asymptomatic	12 (70.5%)
Stroke	3 (17.6%)
TIA	2 (11.7%)
Extent of carotid disease	
-unilateral	9 (53%)
-bilateral	8 (47%)
Carotid score	
-elective	9 (53%)
-severe	3 (17.6%)
-critical	5 (29.4%)
Duplex assessment	
-70-89% stenosis	9 (53%)
- ≥ 90% stenosis	8 (47%)
- ulcer	5 (29.4%)
-contralateral occlusion	3 (17.6%)

Table (3) : Neurological and carotid duplex assessment

The mean number of grafts was 2.9/patient (range 1-4), mean CPB time was 88.6 minutes and cross-clamp time was 61.2minutes. Intra-aortic balloon pump was required in 4 patients, in two of them it was inserted through the ascending aorta due to presence of peripheral vascular disease (Table 4). One patient had mitral valve repair in addition to the CABG procedure (Table 5). Conventional CPB in all patients except for one who had an on-pump heart beating procedure.

Variable	Number (%) or mean ± S.D.
Number of grafts	2.9
Ischemic time (min)	61.2 ± 17.6
CPB time (min)	86.8 ± 38.3
LIMA use	10/17 (58.8%)
IABP use	4 (23.5%)
Operative priority	
-elective	10 (58.8%)
-urgent	7 (41.1%)

Table (4): Operative details

Surgical procedure	Number (%)
CEA+CABG x 1	1 (5.8%)
CEA+CABG x 2	4 (23.5%)
CEA+CABG x3	8 (47%)
CEA+CABG x 4	3 (17.6%)
CEA+CABG x 3+ mitral valve repair	1 (5.8%)

Table (5): Surgical procedures

Average ventilation time was 16.27 hours while ICU stay and hospital stay were 43 hours and 10.6 days respectively. Three patients were re-explored for excessive mediastinal drainage. Postoperative stroke was not observed in any patient. There was however, one mortality due to perioperative M.I. as this patient had 3-vessel disease but only the left anterior descending was grafted as the rest of the vessels had diffuse disease and could not be safely grafted. (Table 6)

Variable	Number (%) or Mean ± S.D.
Intubation time (hours)	16.27 ± 5.3
ICU stay (hours)	45.7 ± 12.7
Hospital stay (days)	10.6 ± 3.8
Re-exploration for bleeding (N/%)	3 (17.6%)
Stroke	0
Postoperative arrhythmia (N/%)	3 (17.6%)
Mortality (N/%)	1 (5.8%)

Table (6): Postoperative patterns:

Discussion:

The reported incidence of carotid artery disease in patients undergoing CABG has varied from 2 to 22% with an average of 8%(4,5).This wide variation is related to the population studied, the methods used for screening of carotid disease, frequency of screening, and the definition of significant carotid stenosis(5). In this study significant carotid and coronary artery disease occurred in **2.17**% of patients who were primarily admitted for CABG.

In patients with no carotid artery disease, CABG is associated with a stroke rate of 1.9%(8).Causes of stroke in cardiac patients are multifactorial and include embolization from the heart and great vessels, global brain ischemia due to hypoperfusion, air embolism and intracranial bleeding, in addition to plaques from the carotid bifurcation(9). Controversy still exists about the best management regimen for patients presenting with significant disease in both arterial systems. There is an agreement that symptomatic patients with significant carotid stenosis should undergo CEA whether as a staged or a combined approach, but there is no consensus whether asymptomatic lesions should undergo prophylactic CEA too(10). The rationale behind a combined approach in asymptomatic patients with high grade carotid stenosis is that 18% have impaired cerebrovascular reactivity which may be a potential risk for postoperative stroke (11).

The first combined approach was reported in 1972 by Bernhard and associates (12). While earlier studies by Hertzer(13) reported an increased stroke rate after the combined approach, many other large series(14,15) have not reported the higher stroke and mortality found in earlier studies, our results is in agreement with them. In a study by Bonardelli(16) on 64 patients including both symptomatic and asymptomatic groups there was no neurological complications.

Asymptomatic carotid stenosis is not a proven risk factor for ipsilateral stroke in patients having CABG. However, a retrospective study by Ricotta and associates (17) and another by Das and associates (18) showed an association between carotid stenosis more than 50% and perioperative stroke. According to Schwartz(1), there are patients with carotid artery disease who may be at a higher risk for the development of neurologic events this subset includes: patients with 80-99% unilateral carotid artery stenosis, patients with bilateral stenosis more than 50% and patients with unilateral total occlusion combined with at least 50% stenosis on the contralateral side. At the same time, the presence of symptomatic carotid artery stenosis may increase the risk of postoperative stroke in patients undergoing CABG (Gerraty and associates (19). A systematic review published in 2003(14) evaluated patients with predominantly asymptomatic carotid disease who had undergone the combined procedure ,it was observed that stroke risk associated with unilateral and bilateral 50-99%carotid stenosis was 3 and 5% respectively and that associated with total occlusion ranged from 7-11%. At the same time, in those who had a perioperative stroke with CABG, significant carotid disease was absent in 50% and territorial infarctions documented by CT scan could not be attributed to carotid disease alone in 60%. These data suggest that at least one half of perioperative strokes are not preventable by CEA. However, patients with severe stenosis may represent an exception, this was shown in a study by Hines and associates (20) were there were no neurologic events in patients with 80-99% stenosis undergoing staged or combined procedure compared to 20% incidence of permanent neurologic defect in those undergoing CABG alone. One of the problems comparing patients with carotid artery disease undergoing CABG with or without CEA is selection bias where patients undergoing a combined procedure may have more high-risk features. There is no doubt that the combined approach benefits outweigh those of the staged procedures (21).

Whether staged or combined procedure is performed is influenced by a number of factors including the experience of the operating team, co-morbid medical conditions, urgency of CABG and extent of carotid artery disease(22).

Mishra and associates (23) compared off-pump to on-pump procedures and achieved comparable results in both, however, they preferred OPCAB as it avoids deleterious effects of organ hypoperfusion and dysfunction associated with prolonged CPB time. They reported a perioperative stroke rate of 0.3% and mortality of 1.4%.

Conclusion

The increasing age of the CABG population has made the issue of combined disease a frequent problem facing cardiac and vascular surgeons. We recommend screening of CABG patients especially those over 65 years for carotid disease. Based on our experience and those of others, the combined approach is probably the approach of choice in case of significant carotid and coronary artery disease. Careful patients' selection and monitoring of outcomes will go along way to ensure better results.

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On Pump Beating Heart Coronary Bypass surgery: The Right Choice in Left Main Coronary Artery Disease

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Background: **Significant left main coronary artery stenosis is a clear indication for coronary artery bypass grafting surgery . Many surgical techniques were used in these patients including conventional cardioplegic arrest and beating heart techniques . The aim of this study is to evaluate safety, feasibility, and early outcome of on pump beating heart coronary artery bypass surgery with significant left main coronary artery stenosis.**

Methods: **Between January 2006 and September 2008 , 51 patients with significant left main stenosis >50% were operated by on-pump beating heart technique, 34 patients were stable while 17 patients were clinically unstable. Preoperative , operative and early postoperative data were collected in retrospective and prospective manner and analyzed to assess the early outcome of this technique in this group of critical patients.**

Results: **The hospital mortality was 3.9 % . The mean number of grafts was 3.1 ± 0.6 graft /patient . The mean CPB time was 72 ± 29 minutes . Intraaortic balloon pump was used in 33 patients preoperatively and inserted intraoperatively in 4 patients . There were no conversions to cardioplegic arrest and aortic cross clamping in any of our patients. The mean Intensive Care Unit stay was 3.1 ± 3.5 days and the mean global hospital stay was 12 ± 5.2 days .Postoperative complications included myocardial infarction (3.9%), new atrial fibrillation (23.5%), hemodialysis (3.9%) and one patient (1.9%) had cerebral stroke .**

Conclusion: **On-pump beating heart coronary artery bypass surgery is a safe, effective and technically feasible modality for high risk and unstable patients with significant left main coronary artery disease who poorly tolerate both cardioplegic arrest of the conventional technique and extensive manipulations during off pump**

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technique. It gives chance for excellent visualization and full revascularization without fear of hemodynamic instability. Early outcome is encouraging for this technique in this special subset of critical patients.

The benefit of surgery over medical treatment for patients with significant left main coronary artery (LMC) stenosis is little argued. All of the trials define significant LMC stenosis as being greater than 50% diameter stenosis as judged by contrast angiography. The median survival for surgically treated patients is 13.3 years versus 6.6 years in medically treated patients [1].Current clinical practice offers at least 3 types of procedure from which the surgeon can choose: I) Coronary artery bypass grafting (CABG) with cardiopulmonary bypass (CPB) on an arrested heart, II) CABG with CPB with an empty beating heart (on pump beating heart technique) and III) Off-pump CABG [2]. The conventional technique which is used routinely worldwide to perform standard coronary artery bypass grafting (CABG), is still linked to several side-effects mostly due to the use of aortic cross-clamping, cardioplegic heart arrest and cardiopulmonary bypass (CPB), especially in emergency cases [3].The presence of critical LMC stenosis has been considered a relative contraindication for the off-pump coronary artery bypass technique due to concerns over the well demonstrated hemodynamic changes during displacement of the heart, even though it is now being used more commonly and the results are encouraging even in high risk and elderly patients [4].The on-pump beating heart coronary surgery represents a merge of standard on-pump surgery and off pump CABG technique. The absence of cardioplegic arrest coupled with the hemodynamic stability guaranteed during extensive heart manipulation, are the biggest benefits coming from this technique, especially in cases of unstable high risk patients [3].

The aim of this study is to evaluate safety, feasibility, and early outcome of on pump beating heart coronary bypass surgery patients with significant left main coronary artery stenosis.

Methods:

From January 2006 to September 2008, 51 patients who had significant LMC artery disease (stenosis >50%) were operated by on-pump beating heart technique of CABG at King Fahad Cardiac Center, King Saud University, Riyadh. This group included : 34 patients presented clinically with chronic stable angina, 12 patients presented with unstable angina, 4 patients presented with acute MI and one patient presented with cardiogenic shock. Redo patients and combined procedure were excluded from this study. Unstable patients underwent surgery as an emergency operation mostly due to hemodynamic instability inspite of maximum therapy with inotropic support and IABP support, persistent chest pain not relieved by maximum therapy and often associated with ECG changes and/or progressive elevation of cardiac enzymes. These patients wereoperated within the first 24 hours of the angiogram and all of them had preoperative IABP. Stable patients were not discharged from hospital; they were kept under careful monitoring and medical therapy while they were prepared for urgent surgery as soon as possible (usually 2- 5 days after coronary angiography).

Preoperative evaluation included history, laboratory investigations, chest x-ray, ECG, echocardiography examination and carotid duplex examination. The coronary angiography for each patient was reviewed as routine by cardiac surgery/interventional cardiology team and the surgical myocardial revascularization was agreed to be the treatment of choice for all patients.

operative technique:

All patients received standard cardiac anaesthesia. Preoperative elective IABP was inserted in 9 of the stable/ patients due to critical LMC stenosis ≥ 90% , in 7 other patients due to very critical stenosis > 90% in other vessels with EF% less than 30%. Another 4 patients in the stable group had IABP insertion intraoperatively as they had hemodynamic instability and ECG changes with induction of anaesthesia. In our practice , in such critical patients femoral arterial line is always inserted at the start of the procedure so that insertion of IABP will be rapid and easy when indicated. Swan-Ganz catheters were inserted in all patients as a routine in our center . Full and continuous monitoring of hemodynamics , ECG, ST segment trend analysis and ventilatory variables were carried out during the whole procedure.

All patients had a median sternotomy followed by harvesting of left internal mammary artery (LIMA) as a pedicle and long saphenous vein (s), but in 4 patients (7.8%) LIMA was not harvested due to severe hemodynamic

instability. After full heparinization (ACT>400seconds) , patients were cannulated in the standard way with aortic and two stages single venous cannulation, a membrane oxygenator was used in all operations. On ////beating heart and maintained normothermia, full CPB started. Depending on the target vessels and selected sites for distal anastomosis , exposure was carried out using a variety of techniques. Myocardial stabilization was achieved using Octopus stabilizer(Medtronic Inc., Minneapolis, Minn.), elevation and rotation of the heart was obtained by Starfish exposure system (Medtronic Inc.). A humidified oxygen blower (Medtronic Inc.) was used to clear the anastomosis site from blood for better visualization. Intra-coronary shunts (Medtronic Inc.) were used when needed . Other maneuvers such as the Trendelenburg position and tilting the table were performed as required. Inotropes were used when necessary during surgery .With the aid of all previous tools no coronary arteries were left ungrafted because of technical difficulty in exposure. As patients had the advantage of CPB support, the surgeon had the chance to plan freely the sequence of vessel grafting according to individual patient condition. All patients , except four , had LIMA anastomosed to LAD, and venous grafts to other coronary arteries.The target vessel was occluded only proximally using a 4-0 polytetrafluoroethylene suture passed twice beneath the artery or rubber band, the average time of coronary occlusion ranging between 9 to 15 minutes. All distal anastomoses were performed with running sutures of 7-0 or 8-0 Prolene (Ethicon, Somerville, NJ).The proximal ends of venous grafts were anastomosed to ascending aorta using an aortic side-clamp. Flow in the grafts was checked at the end of the procedure using Transient –time flowmeter device (Medistim BF ,Medistim,Oslo, Norway).

Results were assessed primarily on clinical outcome which included hospital mortality, myocardial infarction, requirement of inotropic support, ventilation time, blood loss, ICU stay and hospitalization period. Complications were recorded .

Statistical method

The data were acquired from our computerized database registry system which is reporting system that registers all data of every patient undergoing a cardiac operation at King Fahad Cardiac Center in King Saud University, Riyadh. Data were analyzed using a statistical software package (Graph Pad In Stat® version 3.00 for Windows, Graph Pad Software Inc., San Diego, California, USA) and presented as mean ± SD, percentage or numbers as needed.

Results:

Preoperative data (Table 1)

The mean age was 58 ± 11 years and 40 patients were males (78.4%). The atherosclerosis risk factors distribution was as following : 32 patients (62.7%) smokers , 42 patients (82.3%) suffering from systemic hypertension ,35 patients (68.6%) were diabetic and 37 patients (72.5%)were dyslipidemic. There was a history of Cerebral stroke in 2 patients (3.9%) renal dysfunction in 6 patients (11.7%) previous old myocardial infarction (more than 3 months) in 18 patients (35.2%). Five patients (9.8%) presented with acute MI . NYHA Class was 2.4±0.9, Canadian cardiovascular society class (CCS) was 2.6±0.8. The mean EuroScore was 9 (range 5-22). The mean left ventricle ejection fraction EF% was 41 ± 8%. The coronary angiogram (Table 2) showed LMC stenosis> 50% in all patients [stenosis 50%–70% in 7 patients (13.7%), stenosis 50%- 70% in 33 patients (64.7%) and very critical stenosis > 90% in 11 patients (21.5%)], LMC stenosis was associated with double vessel disease in 13 patients (25.4%) and severe triple vessel disease in 28 patients (54.9%).

Mean age (years)	58 ± 11
Sex Male	n=40 78.4%
Female	n=11 21.5%
smokers	n=32 62.7%
Hypertension	n=42 82.3%
Diabetes	=35 68.6%
Dyslipidemia	n=37 72.5%
MI Old	n=18 35.2%
Recent	n=5 9.8%
NYHA class	2.4 ± 0.9
CCS class	2.6 ± 0.8
Renal dysfunction	n=6 11.7%
Old cerebral stroke	n=2 3. 9%
EuroSCORE	9 (range 5-22)
Ejection fraction	% 41±8%

Table (1): Preoperative patients characteristics
MI= myocardial infarction, NYHA = New York Heart Association,
CCS = Canadian Cardiovascular Society , data were expressed as numbers, mean ± standard deviation and percentages

Percentage of LMC stenosis	Stable patients (n= 34)	Unstable patients (n=17)	Total
More than 90%	9	2	11 (21.5%)
70-90%	21	12	33 (64.7%)
50-70 %	4	3	7 (13.7%)

Table (2) : Results of coronary angiography
LMC= left main coronary artery

Operative data:

The mean number of grafts was 3.1 ± 0.6 grafts /patient : The LIMA was used for LAD in 47 patients (92.1%), one or more diagonal branches in 30 patients (58.8%), ramus artery in 7 patients (13.7%), one or more marginal branches from the circumflex coronary artery in 44 patients (86.2%) and a branch from the right coronary artery in 28 patients (5.94%). The mean CPB time was 72 ± 29 minutes. There were no conversions to cardioplegic arrest and aortic cross clamping in any of our patients.

Postoperative data:

Ventilation time was 10.4± 6.7 hours. Mean Postoperative inotropic support duration was 19.6±14.9 hours . No patient required IABP insertion in the postoperative period (Table 3). Postoperative chest tubes drainage was 863 ± 903 mL, and average blood products transfusion was 4.7±3.2 units/patient . Reoperation for mediastinal bleeding was done in 5 patients (9.8%) (Table 4). Two patients (3.9%) developed a postoperative acute myocardial infarction diagnosed on basis of ECG examination and elevated cardiac enzymes, both of them had critical LMC stenosis> 70% in addition to very bad quality coronary arteries New postoperative atrial fibrillation occurred in 12 patients (23.5%). A transient postoperative renal dysfunction (creatinine<200 mol/L) was diagnosed in 4 patients (7.8%) during recovery in the ICU . Another 2 patients (3.9%) developed postoperative renal failure and required hemodialysis therapy. Neurological complications occurred in 3 patients (5.8%), one patient (1.9%) had cerebral stroke and two patients had transient confusional state postoperatively but both of them improved before discharge from hospital. The mean Intensive Care Unit stay was 3.1 ± 3.5 days and the mean global hospital stay was 12 ± 5.2 days .

Mortality :There was only one cardiac-related death . This was the patient who presented with cardiogenic shock . He was transferred to our hospital from another hospital where he was arrested and resuscitated then transferred with mechanical ventilation and massive doses of inotropes . During cardiac catheterization he had a second cardiac arrest and resuscitated again . Temporary pacemaker was inserted due to complete heart block and coronary angiography showed LMC stenosis>90% associated with severe triple vessel stenosis . He was transferred directly from the catheterization laboratory to the theater where he had on pump beating CABG and 4 venous grafts were done He died at the fourth postoperative day due to severe pump failure. Another mortality occurred in this series due to cerebral stroke . CT brain examination showed immediate postoperative massive left sided cerebral infarction . This patient , 69 years old had a previous history of right sided infarction 9 years ago and the preoperative carotid duplex showed bilateral calcified plaques with 50% and 70% stenosis in right and left common carotid arteries respectively . He had calcified aorta and coronary arteries . He died 14 days after operation.

Time of insertion	Stable patients (n=34)	Unstable patients (n=17)	Total
Preoperative	16	17	33
Intraoperative	4	0	4
Postoperative	0	0	0
Total	20	17	37

Table (3) : Intraaortic balloon pump

complications	Number	Percentage
Mortality	2	3.9 %
Myocardial infarction	2	3.9 %
New AF//	12	23.5%
Renal failure	2	3.9 %
Cerebral stroke	1	1.9 %
Postoperative confusion	2	3.9 %
Reopening for bleeding	5	9.8 %

Table (4) : postoperative mortality and complications
AF= atrial fibrillation.

Discussion:

Left main coronary artery stenosis has been identified as an independent predictor of postoperative morbidity and mortality after CABG , it is considered a definite indication of CABG regardless of symptomatology. The presence of critical LMC stenosis presents a special situation in beating heart surgery . It has been considered a relative contraindication for the off-pump coronary artery bypass technique due to concerns over the well demonstrated hemodynamic changes during manipulation and displacement of the heart which may not be tolerated by the patient [5]. Acute occlusion of LMC artery is a rare but serious condition, which carries a very high mortality rate due to the resultant massive acute myocardial infarction . Most of these patients with this clinical setting may suffer from sudden death or profound cardiogenic shock due to severe pump failure or malignant arrhythmia. Quigley and associates reported that 94% of patients with acute occlusion or severe critical stenosis of the LMC artery who had car combination of anterolateral acute myocardial infarction, severe stenosis of the LMC artery, and cardiogenic shock into left main shock syndrome because of its high mortality [6]. According to the classification of coronary arterial preponderance, 48% of cases have a dominant right coronary artery (Type I), 34% have a balance between the right and left coronary artery (Type II), and 18% have a dominant left coronary artery (Type III). Most of the patients with acute occlusion of the LMCA who did not suffer from sudden death and reached hospital would have either a dominant RCA or an extensive collateral circulation from the right coronary artery to the left coronary artery, or both [7].

Despite the major advances in myocardial protection that have occurred over the last decades, postoperative adverse events related to cardioplegic arrest have not been completely eliminated. Even continuous warm blood cardioplegia which was expected to keep the heart in an aerobic environment, does not completely prevent some degree of postoperative ventricular dysfunction and myocardial stunning , conversely keeping the heart beating is associated with less myocardial edema and better ventricular function [8].

The detrimental effects of aortic cross-clamping are probably inconsequential in the majority of patients with good ventricular function but may precipitate hemodynamic failure in patients with already marginal left ventricular function with increased morbidity and mortality. Theoretically, the ideal solution to this problem is myocardial revascularization without extracorporeal circulation and cardioplegic arrest by off pump technique. However, this approach has its own concerns and limitations especially in unstable patients and in LMC stenosis patients [9]. Légaré and associates suggested that conventional CABG technique, with cardioplegic arrest and cardiopulmonary bypass, may not be the ideal solution in high-risk and unstable patients, meanwhile avoidance of cardiopulmonary bypass does not confer significant clinical advantages, moreover they had defined cardioplegic arrest and aortic cross clamping as independent surgical risk factors for high risk patients suffering from acute coronary syndrome and severe cardiac dysfunction [10]. On-pump beating heart CABG can eliminate one of these components which is the cardioplegic arrest, and is reported to be an acceptable trade-off between conventional CABG and off-pump CABG [11]. There is objective evidence that the empty beating heart is well protected from ischemia more than the arrested heart as reported by Krejca and associates who found troponin T levels to be higher in arrested heart technique CABG more than in on pump beating CABG [12] .

Furthermore, Szmagala and coworkers in their study measured post-bypass troponin I levels and took pre-bypass and postbypass right atrial tissue biopsies and processed them to evaluate expression levels of messenger RNA (mRNA) coding for cardioprotective protein (HSP 70). They found that the troponin levels in the arrested-ONCAB group were twice as high as in the beating- ONCAB group and that the cardioprotective HSP 70 mRNA levels were increased in the beating-ONCAB group but not in the arrested-ONCAB group [13]. Beating-ONCAB also provides the surgeon with excellent visualization of the displaced heart combined with hemodynamic stability afforded by CPB. This procedure does not use aortic cross-clamping and thus requires less aortic manipulation than arrested heart technique [2].

Since the inception of the coronary bypass operation, surgeons have believed, and they continue to believe, that completeness of the initial revascularization procedure is a prime prerequisite for success Thus in the absence of an absolute compelling technical limitation complete revascularization must be the goal of all surgeons regardless the different techniques they use in CABG surgery [14]. Early markers of incomplete revascularization were identified in a Turkish study published by Tasdemir and associates including higher rates of operative mortality, perioperative myocardial infarction, and low output syndrome [15]. None of these early markers of incomplete

revascularization were present in our present study of on pump beating technique. The long-term markers of incomplete revascularization are recurrent angina, a need for re-intervention, and a decrease in late survival rate [16]. Incomplete revascularization is reported to be more prevalent in off pump CABG operations ,the common recorded reasons were technical difficulty in exposure, when the arteries were too small, severely diseased, or both . Significant collateral formation and the presence of prior infarcted tissue were the next most frequently recorded reasons [17]. Many studies found that fewer grafts were placed in the off pump CABG group. Some critics may argue that off pump CABG patients are undergoing incomplete revascularization [18, 19]. In Japanese nationwide survey , the number of bypass grafts in on pump beating CABG was clearly greater than that of off pump CABG (3.02 versus 2.55) [20]. In the present study The mean number of grafts was 3.1 ± 0.6 graft /patient ,all target graftable vessels were done . All previous reports and our experience showed that on pump beating heart technique gives the surgeons full chance to achieve complete revascularization even in critical unstable patients of LM disease .

Long term graft patency is another major concern for all cardiac surgeons . Although some reports have documented excellent early patency with off pump technique as in the study of Cartier [21] , other conflicting reports as that by Arom and associates showed higher rates of reoperation for graft occlusion in off-pump CABG patients as well as more frequent subsequent re-admissions for angina and re-intervention [4]. Locker and associates reported that late death, recurrent angina, and re-intervention were higher for off pump CABG in comparison to on pump beating CABG in emergency CABG after acute MI .These late results seem to reflect reduced anastomotic accuracy and incomplete revascularization in off pump patients. It is clear that on pump beating heart can give the surgeon the optimal surgical conditions to achieve perfect technique in anastomosis which is the basic determinant of long term graft patency [22].

evascularization :

Inspite of encouraging results of off pump technique, the annual report of the Society of Thoracic Surgeons (STS) notes that only 22% of isolated CABG procedures are off pump CABG procedures. It is likely that many surgeons are uncomfortable with this technique. Hemodynamic instability can be a problem during cardiac displacement, especially in the unstable patient, and visualization of the target vessel can be difficult [4]. Hemodynamic variations during beating heart surgery may be due to mobilization and stabilization of the heart, or myocardial ischemia resulting from coronary artery occlusion during construction of anastomoses. Suction type and compression type stabilizers produce hemodynamic effects through different mechanisms. Heart dislocation (90° anterior displacement) and compression of the right ventricle to a greater extent than the left ventricle are responsible for hemodynamic alterations when using suction type stabilizers. Compression of the left ventricular outflow tract and abnormal diastolic expansion secondary to direct deformation of the left ventricular geometry are proposed mechanisms for hemodynamic derangements with compression type stabilizer. Coronary occlusion during the anastomosis can have additional effects on left ventricular function, depending on the status of collateral flow [23]. All these changes can be tolerated in stable, low risk patients without CPB support but in high risk patients such as LM disease and hemodynamically unstable patients this may lead to serious complications. Effectiveness of on pump beating CABG in hemodynamically unstable patients due to acute coronary syndrome became uncontroversial and reported to be more effective than conventional CABG without reduced quality of revascularization which may be associated with off pump CABG [3] This widely accepted concept resulted in increasing percentage of high risk patients operated successfully by on pump beating technique as reported by Mizutani and coworkers [9].They found that, the most notable characteristic of the population who underwent on-pump beating-heart CABG at their institute was their severity of disease. At least half of the cases underwent surgery with urgent or emergent status. The LV ejection fraction of these patients was significantly low [9].

Utilizing the on pump beating heart technique instead of off pump technique in high risk patients would help to prevent dangerous side effects and possible complications related to accidental or emergency conversion of the technique during conduction of the operation including significantly higher morbities and mortality [24]. The cardiac surgeon should determine quickly without hesitation the necessity of conversion according to the angiograghic results, hemodynamic profile , possibility of expansion and improvement of visual field to achieve optimal surgical field ,severe coronary calcification, small diameter arteries and intramuscular arteries which sometimes required too much dissection and difficult to be stabilized securely during construction of anastomoses (20). Patel and coworkers

reported that the rate of emergency conversion from off pump to on pump technique was 2.9% in all patients but this rate jumped to 38% in cases of LMC stenosis>50% . Timing of conversion was linked in its highest proportion to trail for exposure or grafting of circumflex artery branches followed by grafting or exposure of LAD and diagonal arteries in 34% of patients. The reason for conversion in the majority of patients (76%) was hypotension/ischemia, ventricular fibrillation (8%) and hemorrhage in (8%) of the patients (24) . These reports support our management strategy to operate on these patients presenting with LMC stenosis and unstable hemodynamics by on pump beating heart technique .

Significant LMC disease is one risk factor closely associated with operative mortality. Old report by Kennedy and coworkers [25] showed that elective surgical mortality for patients with LMC disease was 4.2%, while emergency surgical mortality was 40%, while a recent report by Hata and associates [26] showed 8.7% operative mortality for emergrncy CABG due to LMC disease using the arrested heart technique and the logistic regression analysis showed that preoperative cardiogenic shock was the only predictor for operative mortality. Meharwal [5] //and Beauford [27] compared LMC patients operated by off pump versus conventional technique .They reported less hospital mortality, perioperative myocardial infarction,atrial fibrillation , blood transfusion requirement , intubation time , intensive care unit stay and hospital stay in the off pump group [5,27]. Izumi and coworkers reported significantly lower mortality ,CKMB levels and incidence of renal failure as well as tendency for less inotropic support and shorter duration of ventilation in high risk patients done using on pump beating technique compared to conventional CABG technique [28]. Gulcan and associates [29] strongly suggested that normothermic CPB with a beating heart is safe and may be the surgery of choice in cardiogenic shock ,redo CABG , acute infarction,bad ventricular function and unstable patients. These results are comparable to our results in the present study . In a recent study conducted at our center , on pump CABG technique was reported as a safe and convenient method for CABG in different categories of patients with excellent outcome even in high risk group patients [30].

In the present study IABP was used preoperatively in 33 patients (64.7%) and in 4 patients intraoperatively (7.8%) . However no more patients were in need for IABP support in the postoperative period after successful on pump beating CABG denoting favorable outcome of this technique. Christenson and coworkers showed that preoperative use of IABP in high-risk patients including those with significant LMCS was associated with a lower incidence of low cardiac output, and a shorter intubation time and length of stay in both the ICU and hospital (31). The intensive use of heparin, aspirin, clopidogrel before surgery, can explain a mean postoperative bleeding of 863 ± 903 mL and blood products transfusion rate of 4.7±3.2 units/patient . However these results are comparable to many other reports [5,7,9] .

Conclusion:

On-pump beating heart coronary artery bypass surgery is safe, effective and technically feasible modality for high risk and unstable patients with significant left main coronary artery disease who poorly tolerate both cardioplegic arrest of the conventional technique and extensive manipulations during off pump technique. It gives chance for excellent visualization and full revascularization without fear of hemodynamic instability. Early outcome is encouraging for this technique in this special subset of critical patients.

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A comparative study between Complete Versus Partial preservation of annulo-papillary Continuity during Isolated Mitral Valve Replacement: Benefits and Effects on Early Postoperative Left Ventricular Contractile Function

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Background: **It was hypothesized that keeping the integrity of both anterior and posterior leaflets to the chordopapillary subvalvular apparatus is the cornerstone as to preserving postoperative left ventricular contractile functions. Our study comparatively-evaluates the benefits and first postoperative year follow-up results of preserving complete continuity between mitral valve apparatus (annulus-chordae-papillary muscle) to the left ventricle; versus retaining these attachments to the posterior leaflet only on postoperative left ventricular contractile functions after mitral valve replacement.**

Methods: **This prospective comparative study was conducted in the period from 2003 to 2008 in the Departments of Cardiothoracic Surgery and Intensive Care at Faculty of Medicine Cairo University after obtaining the approval of the local ethical committees of these centers. The study group contained 40 patients who had mitral valve pathology (without heavy annular or subvalvular calcification) dictating submission to open heart surgery for mitral valve replacement using a metallic prosthesis. The study specimen was chosen from a larger patient population according to our inclusion criteria. Two groups were formed matching in numbers and preoperative risk factors. Group I contained 20 patients, in whom mitral valve replacement (MVR) was done with complete preservation of annulopapillary chordal attachment (CAPCA) of both leaflets to the non-septal left ventricular free wall respecting their anatomical distribution in the mitral annulus. Group II consisted of another 20 patients in whom partial preservation (PAPCA) was done by retaining the posterior leaflet only. Perioperative patient selection and follow-up study was carried out during outpatient visits by clinical examination combined by transthoracic echocardiography.**

Results: **The total operative time was longer in group I patients with a mean of 150 ± 9.3 minutes (range 124-182 minutes); versus 112 ± 9.2 minutes (range 99 -151 minutes) for group II patients ($p < 0.05$). The aortic clamping time was**

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longer in group I patients with a mean of 90 ± 2.8 minutes (range 73-120 minutes); versus 70 ± 1.9 minutes (range 65-112 minutes) for group II patients (p < 0.05). We had only one mortality in each group (P = 1.0) . Postoperative morbidity was recorded in 4 patients (10 %): three (7.5 %) from group II in the form of prolonged low-cardiac output manifestations treated by prolonged inotropic support by IV infusion. In group I, only a single patient (2.5 %) developed transient Ventricular fibrillations controlled by electric cardivercion antiarrhythmic drugs (p<0.05). Postoperative follow-up echocardiography in group I showed marked improvement in the LV diameters/ function with a mean Left Ventricular End-Systolic Diameter of 36 ± 0.3 mms; mean End-Diastolic Diameter of 48 ± 0.5 mms and mean LVEF % of 55 ± 3 %. In group II, these mean values were 54 ± 0.3 mms; 54 ± 0.7 mms; and 52 ± 0.7 % (respectively). The majority of group I patients showed marked postoperative improvement by expressing more effort tolerance, better quality of life (QOL) and NYHA class step-up.

Conclusion: **We found that preserving complete continuity between mitral valve apparatus (annulus-chordae-papillary muscle) to the left ventricular wall offered more benefit in patients having mitral valve disease of rheumatic origin. Compared to postoperative preserving of the posterior leaflet attachment only, complete retention of the geometry of the subvalvular apparatus was accompanied with more obvious postoperative preservation of the postoperative left ventricular contractile functions after mitral valve replacement.**

RHD: Rheumatic Heart Disease. MVR: Mitral Valve Replacement LVOTO: left ventricular outflow tract obstruction APCA: annulopapillary chordal attachment No: Number NS: Non significant statistical result if > 0.05

Introduction:

In 1961, the first reported mitral valve replacement (MVR) procedure with implantation of the Starr-Edwards prosthetic valve was published. The surgical procedure involved complete excision of mitral leaflets, chordae tendineae and the tips of the papillary muscles. Although standard mitral valve replacement included excision of both valve leaflets and their attached chordae tendineae, however, other issues of concern remained unsettelled [(1)]. These issues included: the fear of possible interference between the mobile parts of implanted mitral prostheses and the subvalvular apparatus; the technical difficulties experienced in the procedures aiming to spare the chordae; as well as the possible reduction of the mitral orifice, induced most cardiac surgeons to use the more traditional approach to mitral valve replacement with severance of part or most of its chordo-papillary attachment [(1), (2)].

In its early days, MVR was complicated by an increased incidence of low cardiac output (LCO) syndrome and associated mortality [(2)]. Since that time, several strategies were proposed with the claim to decrease incidence of postoperative LCO syndrome. They included: improving intraoperative myocardial protection strategies; wider application of mitral valve repair techniques; refining the use of selection criteria for the type of inserted mitral prosthesis; in addition to sub-valvular apparatus preservation (SAP) whenever repair is not possible [(1),(2)].

The physiologic importance of retaining the geometric integrity of the mitral subvalvular apparatus has been recognized in the early reports of mitral valve surgery by Lillehei et al. who, in the 1960s demonstrated a reduction in operative mortality from 37% with conventional techniques to 14% with chordal-sparing techniques [(2-4)]. Several publications followed that raised objections regarding the additional operative procedure and ischaemic time, combined with the potential for a retained valvular apparatus to interfere with the high-profile ball-valve prosthesis. Concerns were also expressed regarding a tendency towards insertion of a

smaller prosthesis if leaflet tissue was preserved and its long-term consequences [5-9].

Moreover, a renewed interest in MVR chordal-sparing techniques was brought into light in 1979, by Miller et al. [10], who reported longer operative survival with SAP due to a decreased risk of intra or postoperative left ventricular rupture. Similar reports like that by David et al. [11-14]; and Hetzer et al. [15],[16], conformed by demonstrating improved outcomes and left ventricular function with chordal preservation.

Despite multiple statements of improved long-term survival following MVR with complete (total) chordal preservation [17],[18], this effect has, not been translated into a standard universal clinical practice. Until now, there are still many surgeons who retain only the posterior leaflet and excise all or part of the anterior leaflet with the belief that this will effectively prevent both prosthetic valvular dysfunction and left ventricular outflow tract obstruction (LVOTO) [10-17]. The majority of the still-investigating surgeons fear the possibility of prosthetic valve entrapment by the retained subvalvular apparatus, creation of left ventricular outflow tract obstruction (LVOTO), and the concern of implanting a smaller- sized prosthesis while advocating chordal-sparing during MVR [19-22].

Methods :

Our study comparatively-evaluates the benefits and first postoperative year follow-up results of preserving complete continuity between mitral valve apparatus (annulus-chordae-papillary muscle) to the left ventricle; versus retaining these attachments to the posterior leaflet only on postoperative left ventricular contractile functions after mitral valve replacement.

This prospective comparative randomized study was conducted in the period from 2003 and 2008 by members from the Departments of Intensive Care and Cardiothoracic Surgery of Cairo University after obtaining the approval of the local ethical committees of these centers.

Forty patients were who had Valvular complications of Rheumatic Heart Disease dictating mitral valve replacement (for a prosthetic valve) were chosen according to out.

Inclusion criteria:

RHD patients having advanced mitral valve disease (combined stenosis and regurge) dictating mitral valve replacement due to the presence of: previous closed mitral valvotomy or mitral valve repair; heavy central leaflet calcification considered it unsuitable for valve repair due to extensive scarring, shortening with severe subvalvular fusion.

NB: Subvalvular tissue was considered worthy of preservation if slightly-calcified mitral leaflets with annular extension could be debrided successfully or segmentally-excised.

We Excluded Patiants with :

Evidence of isolated (repairable) mitral regurgitation; advanced mitral valve pathology with heavy subvalvular or annular calcification; presence of another cardiac valve pathology; coronary artery disease; and active rheumatic fever.

Patient groups:

Two patient groups were formed having an equal total number and matchable preoperative patient data (age, sex, preoperative pathology, surgical risk factors) as well as cardiac and non-cardiac co-morbidity factors (Tables 1 & 2). Perioperative patient data were obtained during outpatient work-out using clinical examination combined with transthoracic echocardiography.

Group I (20 patients):

Group I patients consisted of 20 patients, who had mitral valve replacement (MVR) combined with complete preservation of annulopapillary chordal attachment (APCA) of both leaflets to the non-septal left ventricular free wall respecting their anatomical distribution in the mitral annulus.

Group II (20 patients):

Group II consisted of another 20 patients in whom APCA was retained for the posterior leaflet only.

Variable	Group I (CAPCA)	Group II (PAPCA)	P Value
- **Number of patients**	20 (50 %)	20 (50 %)	1.0*	NS
- Age:				
- Mean (years ± SD)	38 ± 1.5	34 ± 2.4	0.22*	NS
- Range (years ± SD)	20-44	18-42	1.0*	NS
- Sex:				
- Men (no & %)	10 (50 %)	10 (50 %)	0.5*	NS
- Women (no & %)	10 (50 %)	10 (50 %)	1.0*	NS
- Obesity (mean in kg/m2)	5 (25 %)	4 (20 %)	0.55*	NS
- Treated Diabetes Mellitus	2 (10 %)	4 (20 %)	0.32*	NS
- COPD	2 (10 %)	2 (10 %)	1.0*	NS

Table (1): Preoperative Non-cardiac patient data
Mean age are expressed as mean ± SD. SD: Standard Deviation; P: significant if < 0.05; *: P is non-significant (NS) if > 0.05. CAPCA: Complete preservation of Annulo-Papillary-Chordal-Attachment PAPCA: Partial preservation of Annulo-Papillary-Chordal-Attachment

Variable	Group I (CAPCA) (number & %)	Group II (PAPCA) (number & %)	P Value	
*** Atrial Fibrillation**	**11 (55%)**	**9 (45%)**	**0.62**	**NS**
*** Clinical Evaluation by NYHA Class :**				
- II-III (number & %)	13 (65 %)	11 (55 %)	0.42	NS
*** Echocardiographic Data:**				
- LA diameter (mean mms ± SD)	55 ± 4.6	57.2 ± 2.3	0.36	NS
- LVEDD (mean mms ± SD)	60 ± 4.3	59 ± 5.1	0.78	NS
- LVESD (mean mms ± SD)	47 ± 6.5	49 ± 4.5	0.58	NS
- LVEF% (mean value % ± SD)	42 ± 2.4	40 ± 1.4	0.62	NS
- Valve area (mean cms2 ± SD)	1.4 ± 0.3	1.5 ± 0.3	0.8	NS
- PASP (mmHg)				
- mean	55 ± 1.3	57 ± 0.3	0.46	NS
- range	44-59	46-60	0.54	NS

Table 2: Preoperative Cardiac patient data
CAPCA: Complete preservation of Annulo-Papillary-Chordal-Attachment PAPCA: Partial preservation of Annulo-Papillary-Chordal-Attachment No: Number LA: Left Atrium LVEDD: Left Ventricular End-Diastolic Diameter LVESD: Left Ventricular End-systolic Diameter LVEF%: Left ventricular ejection fraction % Echocardiographic Values are expressed in mean (mms) ± SD. P is non-significant (NS) if > 0.05. PASP: Pulmonary artery systolic pressure.

Surgical Procedures:

Median sternotomy was the approach used to obtain cardiac exposure in all patients. We used moderate body hypothermia of 28–29°C by systemic cooling. Antegrade cold blood-enriched crystalloid cardioplegia was infused with local application of ice-slush to achieve intraoperative myocardial protection. Cardiopulmonary bypass was established by routine ascending aortic and bicaval cannulation. The inter-atrial groove of Waterson was initially dissected before the mitral valve was viewed through a left atriotomy incision fashioned behind the groove. In patients of the two groups, mitral valve replacement was done inserting a mechanical prostheses (St Jude Medical, Inc, St Paul, MN) according to the size of each patient's individual annulus.The valve was seated in place using everting mattress suture on pledgets on the atrial side in all patients. Free leaflet mobility was reassured prior to closing the left atrium in all patients.

Techniques of complete Annulo-Papillary-Chordal-Attachment (CAPCA) (group I patients):

Intraoperative valve analysis was initially done in a systematic manner to obtain a clear and detailed impression of the valve structures especially of the specific site of insertion of each group of chordae tendinae. Preserving the Annulo-Papillary-Chordal-Attachment (CAPCA) or in other words the subvalvular apparatus was done in the first groups patients. The anterior mitral leaflet was incised from its annulus and then fashioned into small islands with each of them having an obvious anchor to the subvalvular apparatus eg: paramedical chordae tendinae, or paracommissural chordae tendinae. The major bulk part of the diseased anterior and posterior leaflets tissue was hence excised, leaving about half centimeter rim of leaflet free edge attached to the annulus for suture placement. The anterior and posterior mitral commissures were opened and the papillary muscles were longitudinally split down near their bases. Any fibrous or small calcific nodules were carefully-removed by scalpel excision. The separated anterior and posterior leaflet "tissue islands" were geometrically-reattached to its "assumed" original site "respective" to the annulus by passing it with the valve stitches (Figure 1). For valve seating, we used 2–0 Ethibond everting sutures (Ethicon, Cincinatti, OH) over polytetrafluoroethylene pledgets. If the valvular annulus could not accommodate a mitral prosthesis of an adequate size prosthesis, or when the posterior leaflet was excessively redundant or its chordae tendinae elongated, reefing or imbrication of the leaflet tissue was then done by double passing of the stitch within its tissues. Standardly, we tied the posterior valve sutures first.

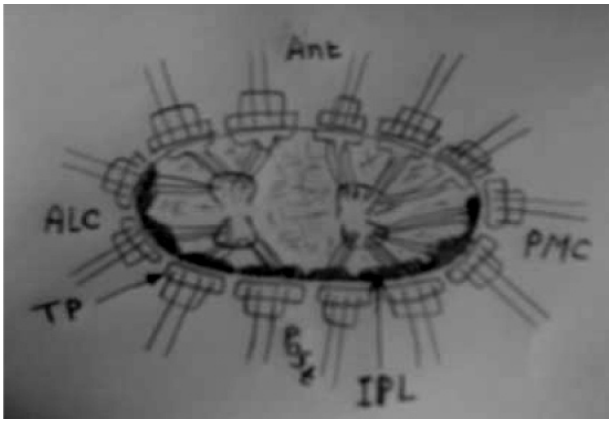

Figure (1): Cutting the anterior leaflet cuspal tissue into small well-supported islands before connecting them through 2-0 ethibond everting stitches over Teflon pledgets through their respective position in the mitral fibrous annulus. ALC: Antero-lateral Commissure PLC: Postero-Medial Commissure TP: Teflon Pledget IPL: Imbricated posterior leaflet

Technique of Partial Annulo-Papillary-Chordal-Attachment (PACA) (group II patients):

The anterior mitral leaflet with its attached chordae tendinae was excised removing also a small part of the apex of its corresponding papillary muscle(s), while retaining the bulk of the posterior leaflet with its Annulo-papillary-chordal attachments.

Patient data were prospectively-collected in both groups on regular intervals for the first postoperative year using follow-up evaluation done by clinical examination and transthoracic (TTE) echocardiography. Echocardiograms ie: Two-dimensional, M-mode, and colour-flow Doppler were obtained from the parasternal long and short axes as well as from the apical two and four-chamber views. The collected echocardiographic data were processed according to the American Society of Echocardiography. The onset of the Q wave in the ECG defines the onset of end-diastole; the peak downward motion of the interventricular septum is indicative of end-systole. The following echocardiographic data were investigated: Left Atrium diameter; Left Ventricular End-Diastolic Diameter Left Ventricular End-systolic Diameter and Left ventricular ejection fraction %.

Statistics and Data Analysis:

Continuous variables are presented as mean ± standard deviation. Categorical data are described using frequencies and percentages. All analyses were performed using SAS statistical software (SAS v8.2; SAS, Inc., Cary, NC) Values are expressed in mean (mms) ± SD. #: Statistically-significant ($p < 0.05$) compared to preoperative value ##: High Statistical-significance ($p < 0.03$) compared to preoperative value .

Results:

Intraoperative Data:

The total operative time was longer in group I patients with a mean of 150 ± 9.3 minutes (range 124-182 minutes); versus 112 ± 9.2 minutes (range 99 -151 minutes) for group II patients ($p < 0.05$). The aortic clamping time was longer in group I patients with a mean of 90 ± 2.8 minutes (range 73-120 minutes); versus 70 ± 1.9 minutes (range 65-112 minutes) for group II patients ($p < 0.05$) Table (3).

Operative outcome (mortality and morbidity):

We had one unexplainad mortality in each group. Postoperative morbidity was recorded in 4 patients (10 %): three (7.5 %) from group II in the form of prolonged low-cardiac output symptoms treated by prolonged inotropic support by IV infusion. In group I, only a single patient (2.5 %) developed transient ventrrcular fibrillations and was controlled by electric cardioversion and antiarrhythmic drugs ($p < 0.05$) Table (4).

Postoperative follow-up echocardiography in group I showed mean Left Ventricular End-Systolic Diameter of 36 ± 0.3 mms; mean End-Diastolic Diameter of 48 ± 0.5 mms and mean LVEF % of 55 ± 3 % with statistical significance compared to group II who had mean results of 54 ± 0.3 mms; 52 ± 0.1 mms; and 52 ± 0.7 % respectively). According to patients' own clinical evaluation, group I patients stated improvement in their quality of life expressing more effort tolerance & NYHA class step-up Table (5).

Value	Group I (CAPCA)	Group II (PAPCA)	P Value
- Total Operative time (minutes)			
- Mean	150 ± 9.3	112 ± 9.2	<0.05 S
- Range	124-182	99-151	-
- Aortic Cross Clamp Time (minutes)			
- Mean	90 ± 2.8	70 ± 1.9	<0.05 S
- Range	73-120	65-112	-

Table 3: Intraoperative data
Data are expressed as mean ± SD. SD: Standard Deviation P: significant if < 0.05 CAPCA: Complete preservation of Annulo-Papillary-Chordal-Attachment PAPCA: Partial preservation of Annulo-Papillary-Chordal-Attachment

Outcome	Group I (CAPCA) (number & %)	Group II (PAPCA) (number & %)	P Value
*** Mortality**	1 (5%)	1 (5%)	1.0 NS
*** Morbidity 4 (10 %)**	1 (2.5 %)	3 (7.5 %)	< 0.05 S
- Low CO + prolonged inotropic support	-	3 (7.5 %)	-
- Transient episode of VF	1 (2.5%)	-	-

Table 4: Postoperative mortality and morbidity
CO: Cardiac Output VF: Ventricular Fibrillation CAPCA: Complete preservation of Annulo-Papillary-Chordal-Attachment PAPCA: Partial preservation of Annulo-Papillary-Chordal-Attachment. P: Significant (S) if <0.05.

Outcome	Group I (CAPCA) (number & %)	Group II (PAPCA) (number & %)	P Value
*** NYHA Class: (number & %)**			
- I (no symptoms)	17 (85 %)	11 (55 %)	< 0.04 S
- I-II (mild symptoms)	3 (15 %)	9 (45 %)	< 0.05 S
*** Echocardiographic Data (1 year postoperative mean values):**			
- LVESD (mean mms ± SD)	36 ± 0.3 # #	54 ± 0.3 #	< 0.03 S
- LVEDD (mean mms ± SD)	48 ± 0.5 # #	52 ± 0.1 #	< 0.05 S
- LVEF% (mean value % ± SD)	55 ± 3 # #	52 ± 0.7 #	< 0.03 S
- LA diameter (mean mms ± SD)	41 ± 3 # #	45 ± 4 #	< 0.03 S
- PASP			
- Mean (mmHg±SD)	44 ± 0.5 # #	46 ± 1.7 #	< 0.02 S
- Range	(39-48)	(30-40)	-

Table 5: Postoperative Clinical and Echocardiographic Data
CAPCA: Complete preservation of Annulo-Papillary-Chordal-Attachment PAPCA: Partial preservation of Annulo-Papillary-Chordal-Attachment No: Number LA: Left Atrium LVEDD: Left Ventricular End-Diastolic Diameter LVESD: Left Ventricular End-systolic Diameter LVEF%: Left ventricular ejection fraction %

Discussion:

A normally-functioning mitral valve apparatus confirms the presence of a healthy and well-coordinated valve components: the annulus, leaflets, chordae tendinae, the papillary muscles in addition to the fibrous annulus which acts as a fulcrum that decreases the valve's orifice (by approximately10-20%) during late diastole and systole [12-14].

A thorough understanding of the detailed normal anatomical construction and function of the different parts of the mitral apparatus as well as evaluation of the different mechanisms inducing mitral valve pathology is the cornerstone of a successful mitral valve replacement surgery [11-13]. Many studies reported that mitral valve dysfunction may occur due to small changes in the spatial relations of the different anatomic components of the mitral valve. They added that even small changes in annular shape and or the papillary muscles direction can be able to induce distortion of leaflet coaptation process [14-16]. Multiple anatomical studies demonstrated that, due to a double blood supply from LAD and circumflex branch of LCA, the anterior papillary muscles are more resistant to infarction. In contrast, the posterior papillary muscles, which receives its blood supply from only a single branch from either the circumflex or the RCA, is more prone to ischemia and infarction [17-20].

In 1956 Rushmer et al. demonstrated that the papillary muscles play an important role in left ventricular contraction [23],[24]. Referring to Rushmer's results in 1964 Lillehei et al showed that preservation of the chordae of the posterior mitral leaflet resulted in a reduction of mortality from 37 to 14% [4]. In patients with MVR. In animal experiments Lillehei et al. had only investigated the technical aspect of this implantation technique, they did not examine the influence of chordal preservation on cardiac performance.

It was Rastelli et al., who performed animal experiments with respect to cardiac function and were not able to find any differences between transection or preservation of the posterior mitral leaflet in their studies [8]. Lillehei's technique was reintroduced in 1981 by David and co-workers [13] and in 1983 by Hetzer et al. (15). They reported on beneficial effects of chordal preservation in a larger series of patients regarding the clinical status of the patients with respect to the need for catecholamines and other clinical parameters. Since then several studies, particularly those by David et al. [11-14]; and Hennein et al. [25]; have shown that preservation of the chordae improves left ventricular performance in the early postoperative course. In 1988 Miki et al. [26], published a new surgical technique that allowed preservation not only of the posterior, but also of the anterior, mitral leaflet as well Straub et al [27],[28] first published a larger

series of patients in whom different techniques were used for preservation of the anterior mitral leaflet . Following these studies, a trend to practice mitral subvalvular apparatus retention during valve replacement became widely-adopted aiming to sustain good postoperative left ventricular performance as opposed to that associated with standard mitral valve replacement [29].

In this study, there was no significant differences in postoperative mortaliyt in both goups , however we found that preservation of the annulo - chordo - papillary continuity of the mitral subvalvular structures r esulted in a significant decrease of left ventricular diameters as well as of left atrial and pulmonary artery systolic pressure. These postoperative echocardiographic changes were evident during our first postoperative year follow-up. Complete chordal preservation led to an obvious reduction of the end-diastolic left ventricular length in the long axis views. The same finding was also shown by Gams et al. [29],[30], who demonstrated, in canine animal experiments, that resection of the chordae resulted in a decrease of approximately 30% of the left ventricular shortening in the long axis, reflecting an impaired left ventricular contraction compared to chordal preservation.

On the other hand, some surgeons [17],[18], raised a point of argument against the procedure of "complete" preservation of all the mitral chordae especially that of the anterior mitral leaflet. They claimed that in this situation, the surgeon may find himself obliged to implant an undersized valve prosthesis. This was not the case in any of our patients as according to our results, most of the total preservation group patients (I) received size 27 prostheses, followed by size 25 with (good leaflet mobility). The body weights and body surface areas ranged from 75-94 kg and 1.8-2.0 m2, and thus these sizes were acceptable in terms of echocardiographic absence of postoperative transvalvular pressure gradient. Similar results were obtained by other surgeons [11-15],[25]. In addition to that, several studies by different investigators in different surgical centers reported that hemodynamic evaluations of the St. Jude cardiac valve prosthesis (commonest type implanted in our series) have shown that there is no significant difference of pressure gradients between the 27 mm and the 29 mm prosthesis at rest and on exercise [32-37]. This statements conforms well with our findings by adding further solidification to the statement that "chordal preservation in MVR does not necessarily dictate the implantation of smaller valve prostheses".

The other crucial point of concern against preservation of the anterior mitral leaflet in MVR was that it might cause obstructions of the left ventricular outflow tract. The remaining redundant chordae tendinea, the postoperative reduction of left ventricular size (cavity) that occurs after surgery; in addition to the systolic anterior motion of the native anterior mitral leaflet after prosthetic mitral valve insertion, can all lead to LVOT obstruction [22],[24]. In our study patients, this mishap was not observed as we were very meticulous in positioning each "island" of tissue with its corresponding chordal attachment to its exact location in the sewing ring. Strong anchorage with distribution of the knotting force over an adequate area was achieved by using tefoln pledgets. In only two group I patients, an additional teflonized-stitch was passed from inside-out the valve to plicate furtherly a redundant posterior leaflet chordae and bring it under its respective site in the valve's sewing ring.

Furthermore, other surgeons reported that [20-24] the step of longitudinal splitting of both papillary muscles quite near its roots (but well away from the LV free wall) is an equally-important surgical step as it is claimed to maximize the surgical gain by decreasing the tension posed on each chord with the corresponding annular site of attachment, as well as distribute the chordae away from the LVOT direction, added to allowing the insertion of a prosthetic valve of an adequate size.

The clear improvement in the patients' quality of life (stepped-up NYHA clinical class), and the internationally-acceptable lower rate of morbidity complications (being all non-fatal and completely controllable with no mortality) are confirming the patient benefit in addition to the favorable mean echo results over the first postoperative year.

Conclusion:

We found that preserving complete continuity between mitral valve apparatus (annulus-chordae-papillary muscle) to the left ventricular wall offered more benefit in patients having mitral valve disease of rheumatic origin. Compared to postoperative preserving of the posterior leaflet attachment only, complete retention of the geometry of the subvalvular apparatus was accompanied with more obvious postoperative preservation of the postoperative left ventricular contractile functions after mitral valve replacement.

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Comparative study between upper mini-sternotomy and full sternotomy in aortic valve replacement

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Introduction: **Minimal invasive approach for aortic valve surgery is an attractive surgical option to minimize patients discomfort and results in less postoperative complications and reduce the total cost of surgery. This study is aiming to Evaluate the technique of aortic valve replacement through upper mini-sternotomy incision and comparing it with standard full sternotomy incision.**

Methods: **This is a prospective clinical study that evaluated 180 patients submitted for first time aortic valve replacement and classified into two groups according to the surgical approach. Group (A) approached through standard full sternotomy incision and included 105 patients. Group (B) included 75 patients approached through upper ministernotomy incision (inverted L). All patients submitted to the same preoperative, anesthetic and operatives protocols with calculation of the total operative time, 1st operative time (time from skin incision to start of cardiopulmonary bypass), cardiopulmonary bypass time, aortic cross clamp time, and the 2nd operative time (time from the end of cardiopulmonary bypass to skin closure). Forced expiratory volume in one second (FEV1) was evaluated for all patients preoperatively, at time of hospital discharge and three months postoperatively.**

Results: **The overall hospital mortality was 1.7%. The two patient groups were comparable as regard the preoperative variables that may affect the outcome including age, sex distribution, associated co-morbid disease, valve pathology, and left ventricular functions. The 1st operative time was significantly longer in ministernotomy group (40±24 minutes versus 20±14 minutes, P-value <0.05), and the 2nd operative time was significantly longer in full sternotomy group (45±22 minutes versus 30±19 minutes, P-value<0.05). The patients within group (B) reported significantly less pain than group (A) during their hospital stay (1.6±1.3 in group B, versus 4.6±2.1 in group A, P<0.05) and also, required less pain medication as regard the dose (17.8% of group B required opiate medication versus 88.9% in group A, P<0.01) and the**

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duration (2.1±1.8 days in group B, versus 6.4±2.3 days in group A, P<0.01). Group (B) patients had significant short hospital stay than group (A) patients (3.5±1.35 days versus 6.9±1.07 days, P-value<0.05). Both patient groups exhibit significant decrease in FEV1 at time of hospital discharge, with significantly more decrease in full sternotomy patients than in ministernotomy patients (2.1±0.8 versus 2.6±0.3, P<0.05). However, three months postoperative FEV1 returned to the preoperative values in the two patient groups.

Conclusion: **Aortic valve replacement, through upper mini-sternotomy has the advantages of decreased postoperative pain, decreased need for analgesic, and less impairment of pulmonary function and also shorter hospital stay than with standard full sternotomy incision.**

Traditionally, valvular heart surgery has generally been performed via a full sternotomy incision with cardiopulmonary bypass. However, with the era of minimally invasive surgery which aimed to hasten postoperative recovery by reducing incisional pain, improving respiratory function, and producing an overall reduction in trauma; the development of minimal invasive approach for aortic valve surgery became an alternative attractive surgical options [1,2].

Several approaches were utilized in aortic valve surgery, including the right anterior thoracotomy [3], right parasternal incision [4], transternal incision [2,4], and multiple variations of the ministernotomy[1,2,5,6]. Cannulation approaches have included femoral/femoral, atrial/femoral, atrial/axillary, atrial/aortic (central), and aortic/innominate vein.

Minimally invasive aortic valve replacement via the upper hemi-sternotomy (inverted L) approach was originally developed by Cosgrove and Sabik at the Cleveland Clinic[1] and soon after by others[2,5,6]. The upper ministernotomy incision provides access from the mid ascending aorta to the mid-ventricular cavity which gives sufficient room for standard aortic cannulation and aortic valve replacement without added difficulty to the procedure[1].

The aim of this study is to evaluate the technique of aortic valve replacement through upper inverted L mini-sternotomy incision and comparing it with standard full sternotomy incision.

Methods :

This is prospective clinical study conducted in the departments of Cardio-Thoracic surgery in Suez Canal University hospital and National Heart Institute in the period from January 2005 to December 2007. The study included 180 patients submitted for aortic valve surgery. Included in the study all patients submitted for first time aortic valve replacement. Excluded from the study, all patients with, redo aortic valve surgery, endocarditis, dilated aortic root and possibility of root replacement, and patients with concomitant coronary artery bypass or other valve surgery.

The patients were classified into two groups according to the surgical approach. The first group (A) approached through standard median sternotomy incision, and included 105 patients. The second group (B) approached through upper inverted L- shaped mini-sternotomy, and included 75 patients. Selection of the surgical approach was done after full discussion of the two alternatives with the patients and getting written consent.

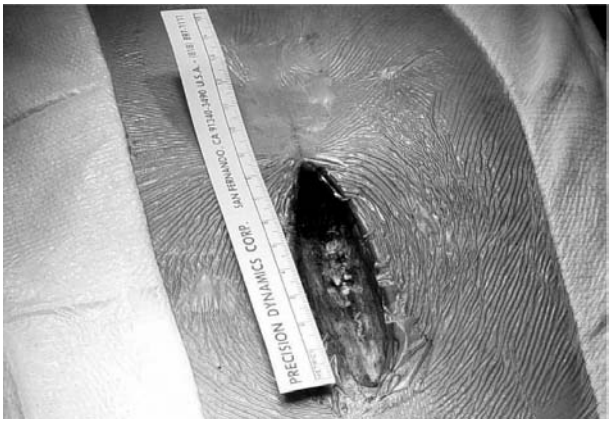
Standard preoperative evaluation for open heart surgery were done for all patients as per our protocols, included full clinical assessment , full laboratory assessment, ECG, chest X-ray posteroanterior and lateral films, and echocardiographic assessment. Preoperative assessment of forced expiratory volume in one second (FEV1) as predictor of pulmonary function was done for all patients and the test was repeated at hospital discharge and three months postoperatively.

Surgical technique :

In group (A): Skin incision was started 2 cm inferior to the sternal notch and extended down to the 1 to 2 cm below the tip of xyphoid process. Full sternal split was done by standard saw.

In group (B): Skin incision started 2 cm inferior to the sternal notch extended down to the level of fourth

intercostal space, followed by a partial midline sternotomy extending to the fourth intercostal space; with the standard saw. The sternotomy was then completed by a transverse sternotomy limited to the right hemisternum opposite the right fourth intercostal space using a narrow blade oscillating saw (inverted L), taking care not to injure mediastinal or pericardial structures. (Picture 1, show skin incision of upper ministernotomy incision-inverted L)

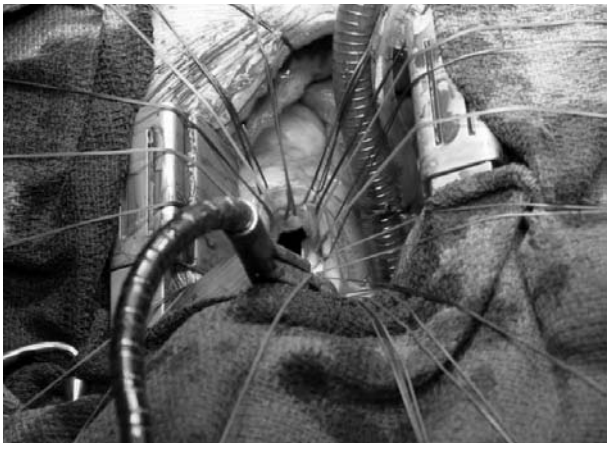


Picture (1): Mini-sternotomy incision before sternal split (the incision started two cm. below the sternal notch to the level of 4th intercostal space).

The pericardium was opened and fixed to the skin for suspension on both sides of the wound. The ascending aorta was cannulated, as was the right atrium via the atrial appendage (picture 2, show cannulation through upper ministernotomy incision). A left ventricular vent was inserted through the right superior pulmonary vein. Normothermic cardiopulmonary bypass started and myocardial protection was achieved by antegrade warm blood potassium cardioplegia delivered by perfusionist.

Picture (2): Cannulation of aorta and right atrium through ministernotomy .

Transverse or oblique aortotomy was utilized according to surgeon preference. The aortic valve excised and replaced by prosthetic valve (picture 3 and 4 show operative view through upper ministernotomy incision with inserted prosthetic valve). During closure of aortotomy two channel cardioplegic cannula is inserted in the aorta, one channel is utilized for hot shot infusion and the other one used as root vent during de-airing.



Picture (3): Mini-sternotomy with valve sutures in the aortic annulus (utilization of malleable aortic clamping).

Picture (4): Mini-sternotomy with prosthetic valve inserted in place (utilization of standard aortic clamping).

The heart nearly always recovered spontaneously in sinus rhythm. If the heart needed cardioversion; the internal defibrillator pads where used in group (A). However in group (B), either pediatric internal defibrillator pads were used or the external defibrillator pads placed prior to commencement of the operation were used. While the heart was decompressed on bypass, pacing wires and two mediastinal drains were placed.

After carful hemostasis, the remnant of thymus gland and the pericardium were closed over the ascending aorta. The sternum was closed in standard fashion using sternal wires. However, in group (B) addition of one oblique wire placed between the lower intact segment of the sternum and the angular segment of the incision was used.

Operative data collected as included; total operative time, 1st operative time (time from skin incision to establishment of cardiopulmonary bypass), cardiopulmonary bypass time, aortic clamping time, 2nd operative time (time from end of cardiopulmonary bypass to skin closure), operative blood loss, volume of transfused blood, and length of skin incision.

All the patients were followed in the ICU and the ward with daily assessment for degree of pain by means of a numerical rating scale ranging from 0 (no pain), to 10 (intolerable pain). A standard protocol for postoperative analgesia included; Paracetamol one gram every 6 hours in the first three postoperative days, also given as per patient's request and opiates in the form of tramal or pethidine were given at any time as per patients request.

Postoperative follow up was done during hospital stay and after discharge in the outpatient clinic on weekly base in the first month and monthly afterwards to adjust anticoagulation. Pulmonary function test and echocardiographic assessment were done at the end of third postoperative month.

Statistical analysis:

Statistical analyses were carried out with the use of SPSS software version 16. The data was collected as mean + standard deviation; student t-test was utilized for comparing quantitative values, chi- square test and fisher exact test for qualitative values, P-value considered significant if <0.05, highly significant if <0.01, and non significant if >0.05.

Results:

The overall hospital mortality was 1.7% (three patients), out of them two patients in group (A) 1.9%, and one in group (B) 1.3%. Cause of death in the three patients was postoperative low cardiac output syndrome, leaving 103 patients in group (A) and 74 patients in group (B) for follow up and statistical analysis.

No significant differences reported between the two patient groups, as regard, patients age (38.8±18.3 versus 41.6±17.9 years, P>0.05), sex distribution (male sex 68.6% versus 61.3%, P>0.05), preoperative NYHA class (2.3±1.4 versus 2.1±1.7, P>0.05), and associated co-morbidity (Table 1). Also, Preoperative echocardiographic assessment revealed no significant differences between the two patient groups as regarded valve pathology and LV dimensions and function (Table 2).

Variables	Group A		Group B		P-value
	Number	**%**	**Number**	**%**	
Age > 60	29	27.6	16	21.3	>0.05
Male sex	72	68.6	46	61.3	>0.05
NYHA III/IV	24	22.9	18	24	>0.05
Hypertension	48	45.7	29	38.7	>0.05
DM	23	21.9	14	18.7	>0.05
Smoking	61	58.1	39	52	>0.05
COPD	19	18.1	11	14.6	>0.05
B blocker	32	30.8	21	28	>0.05
ACI	39	37.1	28	37.3	>0.05
Bronchodilator	19	18.1	16	21.3	>0.05
Corticosteroid	9	8.8	5	6.7	>0.05
RI	6	5.7	4	5.3	>0.05

Table (1): Preoperative patient's characteristics
NYHA= New York heart association, DM= diabetes mellitus, COPD= chronic obstructive airway disease, B blocker= beta blocker, ACI= Angiotensin converting enzyme inhibitor, RI= Renal impairment.

Variables	Group A	Group B	P-value
LVEDD	68.9±10.1	70.2±8.3	>0.05
LVESD	39.9±12.3	40.1±11.1	>0.05
EF	42.8±16.4	43.1±14.2	>0.05
AS	52.4%	46.7%	>0.05
AR	22.9%	26.7%	>0.05
AS+AR	27.8%	26.7%	>0.05
PAP	35±14	39±8	>0.05

Table (2): Preoperative echocardiographic parameters.
LVEDD= left ventricular end diastolic dimension, LVESD= left ventricular end systolic dimension, EF= ejection fraction, AS= aortic stenosis, AR= aortic regurgitation, PAP= pulmonary artery pressure.

Comparative study between the two patient groups as regard operative time revealed non-significant differences as regard total operative time, cardiopulmonary bypass time, and aortic clamping time. However, the 1st operative time was significantly shorter in group (A) than group (B), (20±14 minutes versus 40±24 minutes, P-value <0.05) and the 2nd operative time was significantly longer in group (A) than group (B), (45±22 minutes versus 30±19 minutes, p value <0.05). No significant differences between both groups as regard the type of valve used, operative blood loss, the requirement for blood transfusion, and the need for inotropic support (Table 3).

Variables	Group A	Group B	P-value
Total OR time	130±41	118± 25	>0.05
1st OR time	20±14	40±24*	<0.05
2nd OR time	45± 22*	30± 19	<0.05
Bypass time	58± 20	52± 26	>0.05
Coss clamp time	30±28	33± 23	>005
Blood loss (ml)	420± 234	388± 182	>0.05
Blood transfusion (ml)	300±40	200±600	>0.05
Inotropic support	17.8%	15.6%	>0.05
St Jude valve	41 (39%)	34 (45.3%)	>0.05
Carbomedics valve	55 (52.4%)	36 (48%)	>0.05
Bioprosthetic valve	9 (8.6%)	5 (6.7%)	>0.05

Table (3): Operative details.
OR= operating room, 1st OR time = time from skin incision to establishment of cardiopulmonary bypass, 2nd OR time = time from end of cardiopulmonary bypass to skin closure, ml= milliliter, and *= significant.

Postoperatively, the total hospital stay was significantly longer in group A than group B (6.9±1.07 days versus 3.5±1.35 days, P<0.05). However, the two patient groups were comparable as regard, the ICU stay (18.4±13.7 hours versus 16.6±8.3 hours, P>0.05), ventilation time (6.5±8.1 hours versus 5.9±5.7 hours, P>0.05), blood loss in the postoperative period and requirement for transfusion. Also, three months postoperatively echocardiographic assessment revealed significant improvement of cardiac function and dimensions in both patient groups with non significant differences between the two patient groups (Table 4).

Variables	Group A	Group B	P-value
Ventilation time	6.5± 8.1	5.9±5.7	>0.05
Inotropic duration (hours)	10.1±4.2	8.9±5.1	>0.05
Blood loss (ml)	268±123	198±161	>0.05
Blood transfusion (ml)	600±300	400±500	>0.05
ICU stay (hours)	18.4±13.7	16.6±8.3	>0.05
Hospital stay(day)	6.9±1.07*	3.5±1.35	<0.05
LVEDD	67.1±12.3	67.9±10.2	>0.05
LVESD	38.7±11.1	39.4±12.5	>0.05
EF	44.4±12.3	46.3±13.9	>0.05

Table (4): Postoperative assessment.
ICU= intensive care unit, LVEDD= left ventricular end diastolic dimension, LVESD= left ventricular end systolic dimension, EF= ejection fraction, ml= milliliter, and *= significant.

Comparison of the degree of pain score between the two patient groups revealed that patients within group (A) exhibited significant more degree of pain than those within group (B), during hospital stay (4.6±2.1 versus 1.6±1.3, P<0.05). Daily comparison of the degree of pain, revealed significant more pain in patients within group (A) than those within group (B) during the first three postoperative days. However, this difference became non significant from the fourth postoperative day till hospital discharge. As per our protocol all patients received non steroidal analgesia after extubation, however patients within group (A) required this medications for significantly prolonged duration than patients within group (B) (12.6±9.4 days versus 9.4±3.1 days, P<0.05). Moreover, patients within group (A) showed highly significant requirement for addition of opiate than those within group (B) (88.9% versus 17.8%, P<0.01), also the duration of requirement for opiate was highly significantly prolonged in group (A) than group (B) (6.4±2.3 days versus 2.1±1.8 days, P<0.01) (Table 5).

Variables	Group A	Group B	P-value
Total hospital pain score	4.6±2.1*	1.6±1.3	<0.05
1st day pain score	5.8±1.3*	2.3±1.7	<0.05
2nd day pain score	4.9±1.1*	2.1±1.5	<0.05
3rd day pain score	3.6±2.1*	1.5±1.1	<0.05
From 4th day to hospital discharge pain score	2.1±1.3	1.5±0.8	>0.05
NSAI	100%	100%	>0.05
Duration of NSAI (days)	12.6±9.4*	9.4±3.1	<0.05
Opiate	88.9%**	17.8%	<0.01
Duration of opiate (days)	6.4±2.3**	2.1±1.8	<0.01

Table (5): Pain score and requirement for analgesia. NSAI= non steroidal anti-inflammatory drugs, * = significant, and ** = highly significant.

Preoperative pulmonary function tests were comparable between the two patient groups, forced expiratory volume in one second (FEV1) was 2.9±0.7 in group A versus 3.1±0.5 in group B (P-value>0.05). Early post-operative evaluation of pulmonary function tests at time of hospital discharge revealed significant decrease in FEV1 in both patient groups, with significant decrease in group (A) than in group (B), FEV1 was 2.1±0.8 in group A versus 2.6±0.3 in group B (P-value<0.05). However, three months postoperative evaluation of pulmonary functions in both patient groups revealed significant improvement than the early postoperative one with non significant differences between the two patient groups (3.01±0.3 versus 2.9±0.9) or from the preoperative values (Table 6).

Discussion:

An increased interested in the minimal invasive techniques in surgery, was developed in a hope to decrease patient discomfort, operative morbidity, length of hospital stay, and total cost. Also improved cosmetic healing, and facilitated rapid return to normal life. However, this should not be on the expense of short or long term outcome of the surgical procedure or increases the difficulty of surgical technique [3,4].

In cardiac surgery minimal invasive coronary artery bypass surgery progressed to eliminate the need for cardiopulmonary bypass. However, in valve surgery it is not possible to exclude cardiopulmonary bypass machine and only minimal invasive valve surgery focus on minimize the incision or utilizing another approach with less postoperative pain and better cosmetic appearance.

Several approaches were utilized in aortic valve surgery, right parasternal, lower ministernotomy, upper ministernotomy, and anterior right thoracotomy. The upper ministernotomy incision provides access from the mid ascending aorta to the mid-ventricular cavity which gives sufficient room for standard aortic cannulation and aortic valve replacement without added difficulty to the operative technique[1].

In this comparative study we evaluate the overall benefits from the upper ministernotomy approach for aortic valve replacement over the standard full sternotomy approach.

Some authors[1,7] reported longer operative time with minimal invasive aortic valve replacement; others[5,6]

Variables [FEV1]	Group A		Group B		P value
	Actual	% of predicted	Actual	% of predicted	
Preoperative	2.9±0.7	98±16	3.1±0.5	98±15	>0.05
Hospital discharge	2.1±0.8*	79±16*	2.6±0.3*	88±11*	<0.05
Three months postoperative	3.01±0.3	96±17	2.9±0.9	97±17	>0.05
P value	<0.05	<0.05	<0.05	<0.05	

Table (6): Pulmonary function test. [FEV1;Forced Expiratory Volume 1st second]

reported this difference only in the initial learning period of ministernotomy technique with no significant differences afterword. In our study we reported no significant differences between total operative times for aortic valve replacement with ministernotomy or full sternotomy aortic valve replacement. Actually the first part of surgery from the skin incision to the establishment of cardiopulmonary bypass take significant more time in ministernotomy technique than full sternotomy. However, the time required for hemostasis and sternotomy wound closure was significantly short in ministernotomy patients than with full sternotomy.

In the two patient groups we reported no significant difference in operative or postoperative bleeding or the requirement for blood transfusion. Some authors [7,8,9] agree with our results and reported no significant difference between the two techniques as regarded blood loss or the requirement for blood transfusion. However, others[1,2,6], reported less bleeding and less blood transfusion required with minimal invasive aortic surgery than standard technique. This controversy between the published literatures may greatly relate to the different patients population, and the different protocols for preoperative preparation and postoperative hemoglobin level on which transfusion was required.

In cardiac surgery, the overall pain levels are relatively low because of a better stability of the bony thorax[10,11], resulting in lower pain levels, also most of pain usually related to ribs rather than the sternotomy due to effect of stress applied on the ribs with sternal retractors[11]. However, we reported significant reduction in level of pain with ministernotomy than full sternotomy and the same observation reported by Bonacchi[10] and Zlotnick[11]. The decrease pain with minimal sternal split may related to use of small retractor in ministernotomy which decrease the retraction and stress placed on the ribs with retractor than with classic full sternotomy, also retraction was limited by the length of skin incision. Moreover, we reported significant reduction in the requirement for analgesic medications with ministernotomy than full sternotomy as regard type and duration of pain killer medications.

Duration of ICU and hospital stay is gaining most of importance as they directly related to the total operative cost. Several reports[2,4,8] revealed significant short hospital and ICU stay with ministernotomy than full sternotomy. However in our study no significant differences between the two patient groups as regard ICU stay but significant difference existed as regard the hospital stay. The same observation was reported by several authors'[6,8,10,13]. Others reported no significance differences between the two surgical techniques as regard both ICU and hospital stay [7,9]. The differences between publications about ICU stay seem to be due to the improvement in surgical technique and myocardial protection, also the tendency for fast track in cardiac surgery which allows early extubation and discharge from ICU. However, the degree of pain play important role in patient recovery and the need for rehabilitation and physiotherapy, which may prolong hospital stay.

Few studies evaluate the effect of length of sternotomy on pulmonary function test. In our study sternotomy incision resulted in significant decrease of pulmonary functions in the two patient groups in the early postoperative period. However, full sternotomy patients exhibited significant more impairment of their pulmonary functions than patients within ministernotomy group in the early postoperative period.

Decrease in pulmonary functions in the postoperative period is multi-factorial, partially related to anesthesia which leads to improper function of diaphragmatic and chest wall musculature, and partially related to the operative technique with Increase postoperative pain, limitation of chest wall expansion and decreased lung compliance due to accumulated bronchial secretion, microatelectasis, increased lung water, or reduced surfactant activity[7,15], all these factors accentuate impairment of postoperative pulmonary function in patients with full sternotomy than those with ministernotomy in early postoperative period.

Aris et al[7], reported no significant differences in pulmonary functions between ministernotomy and standard full sternotomy. However, they evaluate pulmonary function 6 weeks after surgery, which is the same finding in our study that in both patient groups pulmonary functions return to preoperative level within three months postoperative with no significant differences between the two patient groups.

Ali et al[15] in their study of the consequence of postoperative variations in respiratory mechanics, reported deterioration of pulmonary function test in any surgery included chest opening and the degree of deterioration was related to the extent of damage to the chest wall and the lung. The resultant deterioration of pulmonary function was totally reversible within one

month postoperative if there is no lung resection or permanent muscle damage.

Conclusions:

Aortic valve replacement, through upper mini-sternotomy has the advantages of early postoperative less pain, less need for analgesics, and less impai rment of pulmonary function; all these factors lead to shorter hospital stay than with aortic velue replacement through standard full sternotomy.

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The outcome of cirrhotic patients after valvular heart surgery using continuous ultra-filtration

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Background: **The use of continuous ultrafiltration may be effective in preventing the hepatic decompensation in cirrhotic patients after valvular heart surgery with cardiopulmonary bypass (CPB). We aimed to evaluate the effects of continuous ultrafiltration on liver functions and outcome in cirrhotic patients undergoing valvular heart surgery.**

Methods: **60 cirrhotic patients with valvular heart diseases were divided into two groups. In the conventional ultrafiltration (CUF) group (n=30), CPB was used with conventional ultrafiltration. In the continuous ultrafiltration group (n=30), in addition to the same CUF procedure, modified ultrafiltration was used after CPB. Perioperative liver function tests, haematocrit, platelet count, the postoperative ventilation time, ICU and hospital length of stay, complications and mortality were recorded.**

Results: **After CPB, patients receiving continuous ultrafiltration had a shorter time to extubation, postoperative ventilation time and ICU and hospital length of stay ($P < 0.01$), lower bleeding ($P < 0.01$), greater rise in haematocrit [11.3% ± 2.39% vs. 4.7% ± 1.22%, $p = 0.001$] and platelet count [7.0 ± 3.0 vs. 0.8 ± 0.21 104/µmL, $p = 0.001$], higher albumin levels ($P< 0.001$), and lower plasma levels of bilirubin, aminotransferase, alkaline phosphatase and γ glutamyl transpeptidase ($P < 0.02$). There was no significant difference between the two groups in the dosage of nitroglycerine or epinephrine, morbidity or mortality.**

Conclusion: **continuous ultra-filtration may reduce postoperative bleeding and blood transfusions, improve liver function and shorten the hospital stay in cirrhotic patients after valvular heart surgery.**

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Egypt has possibly the highest HCV prevalence worldwide; 10%–20% of the general population is infected and HCV is the leading cause of chronic liver disease and hepatocellular carcinoma in the country. [1] Because of recent advances in open-heart surgery, there are broadened indications to approach an increasing number of patients with moderate to severe liver dysfunction subjected to open-heart surgery.

Patients with mild or moderate cirrhosis have high mortality and morbidity rates after elective cardiac surgery using cardiopulmonary bypass (CPB) with increasing the length of stay in intensive care unit (ICU) and overall hospitalization time. [2-4] Coronary artery bypass grafting without CPB may be an alternative therapeutic strategy for patients with advanced cirrhosis, however, this may be technically difficult in patients undergoing valve surgery.[2]

Systemic inflammatory response and capillary leak syndrome, caused by extracorporeal circulation, have negative effects on the function of vital organs during the postoperative period. Continuous ultrafiltration (CUF+MUF) is a technique that using both conventional (CUF) and modified (MUF) ultrafiltration during and after the cessation of the bypass, respectively, to remove plasma water and low molecular weight solutes.[5] CUF+MUF attenuates the inflammatory response by decreasing the levels of inflammatory mediators [interleukin-6 and 8, thromboxane B2, and endothelin-1], increases levels of haemoglobin, haematocrit and platelets, improves postoperative haemodynamics, and decreases the need for blood transfusion, the duration of mechanical ventilatory support, and the length of ICU stay.[5-7]

We postulated that the use of CUF+MUF may improve outcome, decrease the need for blood transfusion, and shorten the duration of mechanical ventilator support, and the length of ICU stay in patients with hepatic cirrhosis after valve surgery. The aim of the present study was to investigate the effects of CUF+MUF on the need for blood transfusion, the liver function tests, the duration of postoperative ventilatory support, and the length of ICU stay in patients a with hepatic cirrhosis undergoing valve surgery.

Methods:

This randomized double-blinded study was carried out from January 2004 to December 2007 in cardiothoracic surgery department, Mansoura university hospitals. Sixty ultrasound and computer tomography confirmed-cirrhotic patients (Child-Pugh Grade A-C); aged 18-55 years were scheduled to undergo elective valve surgery. The main causes of hepatic cirrhosis were hepatitis C in 47 (78.3%), hepatitis B in 10 (16.7%), and undetermined conditions in 3 (5%).

Patients with history of symptoms or documentation of ischemic heart disease, left ventricular ejection fraction less than 45%, cirrhotic cardiomyopathy, thyrotoxicosis, hepatocellular carcinoma, neurological, and renal diseases, pregnancy, or those on regular use of vasoactive drugs or any drugs affecting liver function, those requiring preoperative ventilator support, re-do or emergency surgery, were excluded from the study.

The patients monitoring included five leads electrocardiography, pulse oximetry, end-tidal carbon dioxide concentrations, radial artery and flow-directed balloon-tipped pulmonary artery catheter. Anaesthesia was induced with fentanyl, propofol, and cisatracurium 0.2.

The CPB lines, oxygenator, and venous reservoir were primed with 1500 ml lactated Ringer's solution, 20% albumin, 20% mannitol 0.5 g kg-1, 50 mEq L-1 of NaHCO3, and packed RBCs sufficient to keep haematocrit value from 22 to 25%. CPB was established with the ascending aorta cannula and the bicaval venous cannulae. Before the initiation of CPB, heparin sodium was administered at an initial dose of 300 IU kg-1. Additional heparin was administered if the celite-activated clotting time became less than 480 s. During CPB, the non-pulsatile pump flow rate was 2.4 L min–1 m–2, perfusion pressure was 50-80 mmHg, arterial carbon dioxide tension was 35-40 mmHg, unadjusted for temperature (α-stat), arterial oxygen tension was 150-250 mmHg, and moderate systemic hypothermia was maintained. Myocardial viability was preserved with topical hypothermia and cold blood antegrade cardioplegia administered intermittently into the aortic root. The surgical procedures included conventional mitral, aortic, double valve replacement; using mechanical prosthesis, or Devega repair of the tricuspid valve.

Subjects were allocated randomly to two groups by drawing sequentially numbered sealed opaque envelopes containing a computer-generated randomization code. In the conventional ultrafiltration (CUF) group (n=30), CPB with conventional ultrafiltration was used. Recirculation line from arterial filter was used as the inflow to the ultrafilter and its outlet was drained into the venous reservoir. CUF volume of 20-30 mL/ kg-1 was removed during CPB and it was stopped if the venous reservoir level fell low. In the continuous ultrafiltration (CUF+MUF) group (n=30), conventional ultrafiltration was performed during CPB and arterio-venous modified ultrafiltration (MUF) was performed after termination of CPB as described by Naik and co' workers. [8] MUF volume of 20-30 mL kg-1 was removed after CPB. The target volume for ultrafiltration removal was the priming

solution plus any additional fluid during CPB minus the CUF fluid minus urine output during bypass

Before separation from CPB, all patients were re-warmed and a minimal dose of epinephrine infusion was used to maintain a cardiac index of more than 2.0L min–1 m–2 and systolic blood pressure of greater than 80 mmHg after CPB. Intravenous nitroglycerin was administered as needed after CPB. Heparin was neutralized after discontinuation of CPB in the CUF group or after MUF in the CUF+MUF group, with protamine sulfate. After surgery, the patients were warmed actively with a forced-air warmer until awake.

Haematocrit values and platelet count were recorded before, 15 and 30 min after the initiation of CPB, and 1, 6, 12, 24 hours after the end of surgery. The CPB and aortic cross clamp times, inotropic support required during weaning, the time to extubation and the duration of the postoperative ventilatory support, ICU and hospital length of stay were recorded. Serum concentrations of aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin (T.Bil), albumin (Alb), alkaline phosphatase (ALP), and Gamma Glutamyl Transpeptidase (GGTP) were measured before, 12 hours and 1, 3, and 7 days after surgery.

Peri-operative bleeding requiring transfusion (surgical site or gastrointestinal), coagulopathy, pulmonary (ventilatory dependence or pneumonia), renal (acute tubular necrosis or hepatorenal syndrome), new onset or worsening of ascites or encephalopathy, wound (dehiscence or infection), infection (bacteraemia or fungaemia) and mortality were registered within 30 days of surgery, because a shorter period may have missed complications and deaths directly related to events that occurred after cardiac surgery.

Statistics:

A prior power analysis indicated that 30 patients in each group would be a sufficiently large sample size to be adequate to detect a 20% reduction in aminotransferase values to 83%, with a type-I error of 0.05 and a power of approximately 87%. Data were tested for normality using Kolmogorov-Smirnov test. Un-paired student t-test and Mann-Whitney U test were used to compare the parametric and the non-parametric values of the studied groups, respectively. Serial changes in liver function variables, at different times within groups were analysed with repeated measure analysis of variance. Data were expressed as mean (SD), number (%) or (median [range]). A value of $P<0.05$ was considered to represent statistical significance.

Results:

All 60 patients completed the study: 30 patients in the conventional ultrafiltration (CUF) group and 30 in the continuous ultrafiltration (CUF+MUF) group. Patient characteristics including age, sex, weight, height, Child-Pugh grade, type of surgery, and cardiopulmonary bypass (CPB) and aortic clamping times did not significantly differ between the groups (Table 1).

	CUF (n=30)	CUF + MUF (n=30)
Age (years)	27.3 (7.8)	28.4 (8.3)
Sex (M / F)	21 / 30 (70%)	18 / 30 (60%)
Weight	67.5 (11.6)	73.4 (9.2)
Height	166.5 (3.7)	167.2 (4.3)
Child-Pugh		
Grade A	14 (46.7%)	11 (36.7%)
Grade B	13 (43.3%)	15 (50%)
Grade C	3 (10%)	4 (13.3%)
Types of surgery		
Aortic valve replacement	9 (30%)	12 (40%)
Mitral valve replacement	14 (46.7%)	10 (33.4%)
Double valve replacement	5 (16.6%)	4 (13.3%)
Triple valve Surgery	2 (6.7%)	4 (13.3%)
CPB time (min)	102.4 (20.5)	110.1 (27.3)
Aortic clamping time (min)	57.5 (25.1)	60.2 (28.8)

Table 1: Patients data.
Data are presented as mean (SD) and number (%)

After CPB, patients receiving CUF+MUF had a shorter time to extubation, postoperative ventilation time and ICU and hospital length of stay, lower bleeding, and fewer numbers of packed red blood cells (PRBCs) transfusion ($P < 0.03$). There was no significant difference between the two groups in the dosage of nitroglycerine or epinephrine or in the mean volume of ultra filtrate removed during CUF (Table 2).

	CUF (n=30)	CUF + MUF (n=30)	P value
Nitroglycerine dose (µg kg-1 min-1)	1.7 (0.67)	1.9 (2.1)	0.770
Epinephrine dose (ng kg-1 min-1)	97 (40.01)	102 (27.3)	0.814
Volume of conventional ultra filtrate (mL)	1687.5 (278.4)	1908.4 (202.4)	0.671
Volume of modified ultra filtrate (mL)		1541.4 (239.23)	
Time to extubation (hrs)	10.3 (5.61)	6.3 (2.61) *	0.006
Ventilation time (hrs)	8.6 (6.21)	5.5 (2.41) *	0.007
Perioperative bleeding (mL)	1064 (337.13)	808 (137.42) *	0.02
PRBCs transfusion (n)	4.4 (1.32)	2.8 (0.82) *	0.004
ICU length of stay (days)	7.6 (3.91)	4.1 (1.61) *	0.02
Hospital length of stay (days)	18.7 (10.6)	10.4 (2.11) *	0.03
Mortality	2 (6.7%)	1 (3.3%)	0.481

Table 2: Clinical data:
Data are mean (SD) and number (%). * P< 0.05 significant compared with CUF group.

Baseline haematocrit value, platelet count, serum concentrations of AST, ALT, total bilirubin, albumin, ALP, and GGTP were similar in the two groups (Table 3). The haematocrit value and platelet count were significantly higher in CUF+MUF group than in the CUF group at 1, 6, 12, and 24 h after surgery (P< 0.02). A significant increase in the serum concentrations of AST, ALT, total bilirubin, ALP, and GGTP and a significant decrease in the level of serum albumin were noted in the CUF group than in the CUF+MUF group at 12 h, days 1, 3, and 7 after surgery (P< 0.02).

There were no differences between groups in the frequency of perioperative bleeding (either from surgical site or haematemesis), coagulopathy, pulmonary complications, renal complications, new onset or

	Haematocrit (%)		Platelets (10^4/µmL)	
	CUF (n=30)	CUF + MUF (n=30)	CUF (n=30)	CUF + MUF (n=30)
Baseline	32.8 (4.42)	31.6 (6.21)	16.9 (3.18)	18.9 (4.52)
After initiation of CPB				
15 min	22.8 (1.43)	23.2 (1.63)	13.1 (3.31)	14.7 (2.70)
30 min	23.6 (1.41)	23.1 (1.53)	11.5 (2.88)	12.5 (2.21)
Postoperative				
1 h	28.3 (2.63)	34.4 (3.92) *	12.3 (2.67)	19.5 (5.21) *
6 h	30.3 (3.84)	37.9 (4.52) *	14.1 (2.81)	20.7 (3.82) *
12 h	31.6 (5.13)	39.4 (4.54) *	15.1 (2.83)	22.4 (3.64) *
24 h	31.2 (5.73)	41.2 (4.74) *	16.7 (2.81)	21.5 (3.59) *

Table 3: Hematology data:
Data are mean (SD). * P< 0.05 significant compared with CUF group.

Group		Postoperative				
		Baseline	12 h	Day 1	Day 3	Day 7
AST (IU/L)	CUF	47.2 (22.63)	101.1 (27.83)	137.7 (51.42)	124.9 (26.54)	88.9 (27.94)
	CUF + MUF	39.9 (19.17)	50.5 (25.64) *	84.1 (29.14) *	90.7 (14.74) *	53.6 (18.92) *
ALT (IU/L)	CUF	46.7 (22.43)	112.4 (31.23)	152.1 (31.44)	134.8 (31.23)	98.9 (37.81)
	CUF + MUF	38.5 (18.93)	55.7 (21.54) *	82.1 (14.91) *	96.6 (13.64) *	59.2 (16.50) *
T. Bil (mg/L)	CUF	2.34 (1.41)	3.7 (1.90)	4.4 (1.84)	4.9 (2.04)	4.4 (1.94)
	CUF + MUF	2.61 (1.27)	2.5 (1.34) *	2.7 (1.33) *	2.3 (1.24) *	2.2 (1.22) *
Alb (g/dL)	CUF	3.3 (0.81)	2.5 (0.60)	2.6 (0.64)	2.7 (0.63)	2.8 (0.74)
	CUF + MUF	3.4 (0.61)	3.5 (0.54) *	3.9 (0.43) *	4.1 (0.44) *	4.1 (0.51) *
ALP (IU/L)	CUF	154.9 (101.61)	211.1 (114.62)	255.8 (120.63)	283.2 (122.60)	222.5 (128.90)
	CUF + MUF	161.3 (79.30)	176.4 (74.42) *	186.4 (74.42) *	166.1 (60.53) *	127.7 (54.80) *
GGTP (IU/L)	CUF	112.9 (67.13)	196.0 (80.34)	224.0 (85.41)	208.4 (80.24)	189.1 (78.61)
	CUF + MUF	115.8 (65.94)	136.0 (61.80) *	176.6 (56.40) *	139.8 (49.21) *	121.7 (42.84) *

Table 4: Liver function tests:
Data are mean (SD). * P< 0.05 significant compared with CUF group

worsening of ascites, encephalopathy, infection or wound complications (Table 5). Two patients (6.7%) in the CUF group and` one patient (3.3%) in the CUF+MUF group died postoperatively with hepato-renal syndrome (Table 2)

Cardiac interventions using CPB in patients with advanced liver cirrhosis pose considerable challenges and are associated with high mortality and morbidity rates than those in the general cardiac surgical population. Several contributing factors peculiar to adverse outcome after the use of cardiopulmonary bypass in cirrhotic patients, such as non-pulsatile flow, haemodilution, haemolysis, activation of the inflammatory cascade, anticoagulation, hypothermia and reduced end-organ perfusion.[9-10] This study has demonstrated that valve surgery in cirrhotic patients with continuous ultrafiltration after CPB is correlated with a higher haematocrit value, platelet count and albumin level and lower total bilirubin and liver enzymes levels in the serum compared to the conventional ultrafiltration.

	CUF (n=30)	CUF + MUF (n=30)	P value
Coagulopathy	4 (13.3%)	2 (6.7%)	0.770
Pulmonary Complications	1 (3.3%)	0 (0%)	0.814
Renal Complications	1 (3.3%)	0 (0%)	0.556
New onset or worsening of ascites	5 (16.7%)	3 (10%)	0.477
Encephalopathy	3 (10%)	1 (3.3%)	0.442
Wound dehiscence or infection	1 (3.3%)	2 (6.7%)	0.544

Table 5: Perioperative complications:
Data are number (%). * P< 0.05 significant compared with CUF group.

Similar to others,[6] we recorded reduced ventilation time, ICU, and hospital stay with the use of CUF+MUF, which may be related to the attenuated lung oedema and inflammatory pulmonary injury.[7] Others found that MUF was associated with a lower prevalence of early morbidity and comparable ICU (39.9±49.2 vs. 46.3±72.8 hours, P=0.218) and hospital length of stay (7.6±3.5 vs. 7.9±4.4 days, P=0.372) compared to the non use of ultrafiltration.[11] However, Aggarwal and co-workers did not report any significant difference in ventilation time and ICU stay with the use of CUF+MUF in 15 children undergoing cardiac surgery under CPB compared to MUF.[12] This conflict may be referred to the relatively large number of studied cirrhotic subjects in our study.

For patients with hepatic dysfunction, problems with haemostasis can be expected because of thrombocytopenia, platelet dysfunction, decreased hepatic production of coagulation factors, fibrinolysis, and portal hypertension. (13) We reported reduced postoperative bleeding and transfusion requirements with CUF+MUF after CPB. Similarly, MUF was associated with lower transfusion requirements (1.66±2.6 vs. 2.25±3.8 U/patient, P=0.039). (11, 14-16) Others reported reduced postoperative bleeding (522.2 ± 233.4 mL vs. 740 ± 198.4 mL, $p < 0.003$)(17) and chest tube drainage in the first 48 hours after CPB (100 ± 18 vs. 85 ± 20 mL, $P<0.05$)(12) with the use of CUF+MUF. This may be explained with the associated increase in platelets count in our study. The later may be explained with similar reported increased fibrinogen, prothrombin, and factor VII with the use of MUF with no changes in factor IX and factor X.(14) In the current study, the increases in haematocrit and platelet levels secondary to the concentration effects of CUF+MUF(7) is similar to the reported greater rise in haematocrit (5.7% ± 2.4% vs. 1.2% ± 1.9%, $p < 0.001$), and platelet levels (27.800 ± 29.200 vs. 9.000 ± 30.970, $p < 0.001$) after CPB with CUF+MUF compared with no ultrafiltration in the study of Kiziltepe and colleagues.(17)

We reported higher albumin and lower bilirubin and liver enzymes plasma levels with the use of CUF+MUF. Similarly, others reported increased serum albumin, and lower increases in the serum concentrations of interleukin-6, thromboxane B2, and endothelin-1 after CUF+MUF than after CPB without ultrafiltration.[7]

We reported two deaths in CUF group and 1 death in CUF+MUF group with advanced cirrhsosis (Child-Pugh class C). Child-Pugh class is related to morbidity and mortality after open-heart surgery in patients with hepatic cirrhosis. CPB surgery is associated with higher morbidity and mortality in patients with advanced cirrhosis. [18]

Conclusion: We concluded that continuous ultrafiltration may reduce postoperative bleeding and blood transfusions, improve liver function and shorten the hospital stay in cirrhotic patients after valvular heart surgery.

Further studies are needed to define the efficacy of CUF+MUF in the attenuation of the inflammatory mediators after CPB compared with MUF technique in cirrhotic patients.

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Valve Surgery in Severe Pulmonary Arterial Hypertension

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Background: **Severe pulmonary arterial hypertension (PAH) is a common problem in our patients with Rheumatic Heart Disease (RHD) in Yemen due to the limited medical services and late patient preseutation .**

Methods: **In retrospective study we studied our early results in 567 patients with severe PAH who underwent valve replacement because of RHD between January 2007 and December 2007.**

The main age was 31 years. There was mitral involvement in 100% with different lesions, 51.3% pure mitral stenosis, 32.6% mixed lesions and 16.1% only mitral regurgitation. Aortic valve was involved in 46.5% patients with 14.8% stenosis, 32.4% regurgitation and 52.8% mixed lesions. Tricuspid valve was involved in 19.7% patients with 31.6% secondary tricuspid regurgitation and 68.4% combined lesions organic and secondary.

According to PAP we divided our patient to tow groups. Group I 70.4%, PAP ranged from 31 mmHg to 64 mmHg with main 47.8% mmHg.

Group II 29.6%, PAP range from 65 mmHg to 140 mmHg with main 88.4 mmHg.

Results: **Operative mortality was in group I (4.5%) and (13.7%) in group II, ventilator period range from 6 hours to 26 hours with main 8 hours in group I and 24 hours to 113 hours with main 51.4 hours in group II and ICU period ranged from 2 to 5 days with main 2.8 days in group I an 3 to 16 days with main 7.3 days.**

Pulmonary arterial pressure on discharge dropped by 33.7% in all cases.

Conclusion: **We concluded that even valve replacement could be safe in patient with severe PAH but is carrying high mortality and morbidity in compared with patient with low PAH.**

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Yemen is one of developing country, where RHD still the leading cause for valve replacements. Because of limited medical services most patients come late for surgical interventions with already severe PAH and impaired heart function.

There is a big debate between surgeons about the benefit of surgical intervention. Because most surgeons deny operation to this group because of high mortality which range from 15% to 31% [1]. While others thought that PAH in RHD reversible and it will regress after surgery.

So we conduct this retrospective study to evaluate early results in this group with severe PAH in compare with patients with low PAH who underwent valve replacement.

Methods:

We reviewed in this retrospective study our surgical results between January 2007 and December 2007, for patients who underwent valve replacement. There were 567 patients underwent valve replacements. 42% MVR, 11.5% MVR + TVR, 38.2% DVR and 8.3% DVR + TVR.

We divided the patients into tow groups, group I, 399 (70.4%) patients with mean pulmonary pressure < 65 mmHg and group II, 168 (29.6%) patients with severe PHT defined as mean pulmonary arterial pressure > 64 mmHg by Echocardiography study. The characteristics of patients in both groups are presented in Table 1.

Variable	Group I	Group II	p Value
Mean age (years)	31.5	30.7	NS
Sex (male)	47%	48.1%	NS
NYHA class III - IV	63.6%	65.1%	NS
Mean PAP mmHg	47.8	88.4	<0.05

Table 1: Characteristics of patients in both groups.
Preoperative assessments were carried out clinically and by transthoracic 2D echocardiography study.
Operation done through median sterntomy on CPB with modearate hypothermia (28C-32C).

All patients underwent valve replacement with St.Jude medical bileaflet mechanical prosthesis. De Vega tricuspid annuloplasty were performed in 37% and De Vega pulse commissurtomy in 63% patients with severe tricuspid involvement.

The mean CPB time, aortic cross clamping time and surgical procedures performed are shown in table 2.

Variable	Group I	Group II	p Value
Mean CPB min	131.5	172.7	<0.05
Mean X-clamp min	67	68.1	NS
MVR	43.2%	39.3%	NS
MVR + TVR	11.2%	12%	NS
DVR	37.6%	39%	NS
DVR + TVR	8%	9%	NS

Table 2: Intraoperative characteristics of both groups

All patients in group II were given Milrinone infusion before CPB was started and continued in ICU till hemodynamic stabilized. Inotropic agents were given according to the patient>s hemodynamic status table 3. All patients weaned from ventilator according to the same protocol when their hemodynamic status became stable, table 3.

Variable	Group I	Group II	p Value
Adrenaline µg/kg/min	0.03(0.0 – 0.10)	0.6(0.01-2.10).	<0.05
Dopamine µg /kg/min	5(0-10)	15(5-20)	<0.05
Dopbutamine µg /kg/min	6(0-10)	16(6-25)	<0.05
Ventilation time (hours)	8 (6-26)	51.4 (24-113)	<0.05
ICU stay (days)	2.8 (2-5)	7.3(3-26)	<0.05

Table 3: ICU period

All survivor patients were transferred to postoperative ward, echocardiograpic evaluation were done for all before discharge.

The values are given in as mean and range. A paired Student>s t test was used for comparison of tow groups of data. A p value <0.05 was considered significant.

Results

Curdle 30 days mortality is 41 patients (7.2%). 18 patients (4.5%) in group I and 23 patients (13.7%) in group II. The main cause of death in group II was severe

right ventricular failure which did not respond to medical managements. And 10 (43.5%) of them the men PAP was supra- systemic.

132 (78.6%) patients in group II needed prolonged ventilation more than 24 hours, while only 4 10(2.5%) patients in group I needed ventilation more than 24 hours. High Inotrpe supports were needed in (75%) in group II (67% for more than 10 days because of persistence hemodynamic instability). While high support was needed only in (15%) patients in group I for short period. (32.4%) patients in group II developed chest infection because of prolonged period of ventilation. Temporary Sequential pacing was required in 45% patients in group II to improve homodynamic condition.

According to echocardiography measurements before discharge (about one week post op) there was 33.7% reduction in the mean pulmonary arterial pressure (from 88.4 mmHg to 58.6 mmHg) in group II. While in group I it came back to normal in the most.

Follow up for 3 months post op was completed in 73%. There was improvement in functional class in groups, 37% in class I, 48.2% in class II and only 14.8% in class III but no one in class IV. No late mortality. 10% presented with thromboembolic complications.

Echocardiography study was available in 47%, which showed mean pulmonary arterial pressure 32 mmHg in patients in group I and 51.2 mmHg in patients in group II.

Discussion :

Although mild pulmonary hypertension rarely impacts surgical outcome post valve replacement, severe pulmonary hypertension and exacerbation of moderate hypertension can lead to acute right ventricular failure and cardiogenic shock. And there is a correlation exists between pulmonary hypertension and high mortality risk as well as good hemodynamic recovery of the survivors in the late follow-up. Najafi and colleagues found the degree of PAH correlated strongly with perioperative mortality, ranging from 16% in patients with mild PAH to 23% in severe PAH and 61% when PAP was at systemic levels [2]. Recently, several studies have reported improvement in the outcome in patients with severe PAH undergoing valve replacement, with perioperative mortality ranging from 2.3% - 10% [3,4].

We believe the following points to be of relevance to improvement of outcome.

1. Improvements in operative technique

Better myocardial protection, improved CPB techniques and innovative operative techniques, such as the preservation of the subvalvular apparatus as reported by Hetzer et al. in 1983[5] has led to better early results and long-term performance of the left ventricle as a result of less damage being done and ventricular geometry being preserved

2. Improvements in perioperative patient care

The possibility of being able to use different inotropic drugs, such as dopamine, dobutamine, adrenaline and noradrenaline made the treatment of postoperative ventricular dysfunction much more effective.

In our study, overall mortality was 7.2%. 18 patients (4.5%) in group I and 23 patients (13.7%) in group II, which is consistent with recent reports.

As stated by Kirklin and Barratt-Boyes [4], whenever severe pulmonary hypertension is present preoperatively, it is usually the combined result of simple back pressure resulting from elevated left atrial pressure, and increased PVR. Unlike congenital heart disease, these changes do not progress beyond grade III a–b changes described by Harris and Heath. In acquired mitral valve disease, plexiform lesions and arterialisation of elastic lamina fail to develop and the structural changes are reversible. Thus, even severe pulmonary artery hypertension will very likely regress toward normal after MVR [3,7,8] . This reduction often occurs soon after valve replacement, and thus seems related largely to the sudden drop in left atrial pressure and to a reversal of the severe spastic pulmonary vasoconstriction that accompanies left atrial hypertension in some patients [9,10,11] .

In our study the mean PAP fell significantly following surgery in both groups of patients, This prompted us to operate on patients with PAH regardless of the value of the mean PAP on the basis that relief of pressure at the left atrium level might reduce the reactive component of pulmonary vascular disease.

According to the literature, after 5.5 years, the hemodynamic studies showed a transpulmonary gradient reduced by 63.8%, left atrial pressure reduced by 53%, and the pulmonary artery mean pressure reduced by 58% [3].

Despite the lack of long term follow – up in our series. Follow up for 3 months post op in our study showed improvement in functional class both groups, 37% in class I, 48.2% in class II and only 14.8% in class III but no one in class IV. No late mortality. And mean PAP dropped to normal in group I and to 51mmHg in group II.

Conclusion :

On the basis of our results we conclude that despite a high risk of mortality in the presence of severe pulmonary hypertension, as reflected by our early mortality rates, valve replacement still safe and effective. Supra-systemic PAP is major predictor of poor outcome.

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PDA CLOSURE IN PREMATURES VIA AN ANTERIOR MINITHORACOTOMY

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Background: **PDA surgical closure in the prematures by lateral or posterior thoracotomy remains a challenge due to their fragility and short and long term complications related to the lateral decubitus and the trans pleural approach. The goal of this study is to evaluate another approach that should avoid these complications.**

Methods: **158 prematures underwent consecutively PDA closure by an anterior mini thoracotomy (less than 1.5 Cm) in the left 2nd or 3rd intercostal space, while in the supine position. An extra pleural intra pericardial approach was used without insertion of chest tubes. The gestational age ranged from21 to 34 weeks (median 26.6 +1.2 weeks) and there weigh ranged from 430 to 2105 grams (median 1329 +106 grams) with 67 patients (42.4%) below 1000gm. Indomethacine had failed to close the PDA in 124 and was contraindicated in 34. Most patients were operated either in the ICU due to high risk of transfer or in the theatre on the ICU table using noninvasive monitoring.**

Results: **Mean follow-up was 50 months (1,5-72).The duration of postoperative ventilation was related to gestational age (median 6 + 3.2 days in patients below 30 weeks and 3 + 1.8 days in the others with a statistical significance (P=0.013)**

There was no procedure related mortality. Echodoppler showed complete ductal closure in 156. One patient had phrenic palsy and 3 patients were successfully reoperated two for incomplete closure (reclipping) and one for left pulmonary artery compression (clip removal and ligation).

Conclusion: **The left anterior mini thoracotomy with extra pleural approach in the supine position provides a safe technique for ductal closure in prematures.**

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Since Gross performed the first successful closure of PDA in 1938 many authors have published several less invasive methods for PDA closure.[1] Forstmann and others in 1967 introduced PDA closure by preshaped Invalon plug delivered by a femoral artery catheter.[2]

In 1979 Rashkind and Causso developed the polyurethran foam disc umbrella that can be delivered by either transvenous or trans arterial approach. [3]

Foster in 1993 began the thoracoscpic closure of PDA in a premature and shortly after that Majid published PDA ligation through a subaxillary mini thoracotomy. [4] two years later Miles and others published 34 closures of PDA in prematures by the same technique.[5]

All these methods didn't solve completely the problem of PDA closure in prematures. This article describes a technique that we use to close the PDA in prematures and very low birth weight through an anterior mini thoracotomy via an extra pleural approach.

Methods:

Between August 1997 and January 2008, 158 premature infants 89 (56.3%) males and 69 (43.7%) females presented with PDA were operated (the 1st 51 patients operated at La Timone childrens` hospital, Marseille, France and studied retrospectively, the remaining patients were operated in different hospitals in Canada, KSA and Ain Shams university hospitals in Egypt and were studied prospectively) for closure of the PDA in premature neonates and very low birth weights with respiratory or cardiovascular instability caused by the ductal flow. The indications for ductal closure were: inability of weaning from assisted ventilation in 149 cases (94.3%) and severe hemodynamic imbalance related to the left to right shunt in cases (5%). The trial of ductal closure by inhibitors of the cyclooxygenase (indomethacine) was performed in 137 cases (86.7%) and it was repeated in 6 case (3.8%) and was contraindicated in 21 cases (12.7%) either due to impaired renal functions in 4 (5.6%) or due to thrombocytopenia in 5 (7%). The gestational age at the time of operation ranged from 21 to 34 weeks (median 26.6 +1.2 weeks) and there weigh ranged from 430 to 2105 grams (median 1329 +106 grams) with 67 patients (42.4%) below 1000gm. 22 (13.9%) premature neonates were operated upon in the operating theatre and 136 (86.1%) in the ICU and in all cases noninvasive monitoring in form of pulse oxymetry and noninvasive arterial blood pressure detector was very satisfactory for our anesthetists.

The left internal mammary vessels are retracted medially and the left pleuron is pushed laterally by careful blunt dissection and the left thymic lobe is retracted medially. The pericardium is opened and suspended with 2 7/0 proline sutures and the left and right pulmonary arteries are dissected and the PDA is dissected carefully. The systemic blood pressure is measured and The PDA is temporarily closed by a non toothed forceps and the pressure is remeasured to insure the effect of the ductal closure on the diastolic blood pressure. A suitable titanium clip is used to close the PDA except in a single case where the PDA was ligated with a 3/0 silk suture. The pericardium is closed without drainage and the thoracotomy is closed in layers without any chest drain. The skin was closed in most cases with surgical glue if not an absorbable 5/0 suture was used. All patients had early postoperative echo-doppler study and at least one remote follow up.

Results:

The follow-up time ranged from 1 week to 72 months with a mean of 50 months. There was no procedure related mortality but there were11 mortalities (7%) due to other causes related to prematurity within 3 postoperative months postoperatively (systemic infection and organ failure). three of our early patients (1.9%) needed reoperation; two for incomplete closure of the PDA and the third for relief of left pulmonary artery compression by the clip. One patient (1.9%) had phrenic nerve palsy and needed left diaphragmatic copula plication later on. No patients needed thoracic drainage. Postoperative echodoppler study revealed no ductal flow in all cases except one (98.04%). We considered the duration of postoperative mechanical ventilation as a parameter for the success of this technique. The duration of postoperative ventilation was related to gestational age with a median of 6 + 3.2 days in patients below 30 weeks and 3 + 1.8 days in the others with a statistical significance (P=0.013).

Discussion :

We can summarize the major difficulties in the management of PDA in prematures in : 1. The low birth weight with increased technical thoracoscpic difficulty 2. The fragility of prematures and their intolerance to minor physical (e.g.: change in body temperature) or chemical (e.g.: metabolic or respiratory acidosis) trauma. 3. The

increasing number of premature infants presenting with PDA as a direct result of the fast improvement of perinatal care that allows survival of an increasing number of highly premature babies.4. Problems of keeping the premature in a lateral position either due to the usual association of pulmonary problems or the presence of other congenital anomalies that renders the lateral position difficult or impossible and the long term possible complications of the lateral position in prematures like scoliosis breast deformity winged scapula, shoulder weakness, reduced shoulder mobility and chest wall pain syndromes.[6]

The closure of PDA via an anterior mini thoracotomy with an extra pleural approach in the supine position represents an ideal approach for premature and very low birth weights in case of failure or contraindication of medical treatment as it avoids the potential problems of the trans pleural approaches for PDA closure and the problematic lateral position in case of lateral thoracotomy. The indications of this technique are not only related to prematurity due to its minimal invasiveness but also to all cases that contraindicates the lateral position like the presence of abdominal malformations or unilateral lung pathology. The simplicity of this procedure facilitated its application in the ICU to avoid the risk of transport, which is a major risk in the premature neonates. The extra pleural approach avoids the use of pleural drains and minimizes the postoperative morbidity. The supine position avoids the long-term complications of the lateral position in prematures. The postoperative duration of mechanical ventilation was related to the patient age due to the immaturity of the lung in younger prematures.

Conclusion :

The left anterior mini thoracotomy with extra pleural approach is an ideal approach to close the PDA in prematures in case of failure or contraindication of medical treatment maintaining the hemodynamic stability of the premature and avoiding the short and long-term respiratory or musculoskeletal complications of the lateral position in prematures.

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PDA Closure in prematures via an anterior minithoracotomy

This article shows results of PDA closures in prematures via a mini-anterior thoracotomy without opening the pleural cavity . the series of patients are impressive 157 taints. Nevertheless complications of the procedure were important : 3 needed re-operation, 2 for incomplete ductus closure and a third one to relieve a left pulmonary artery compression that has occurred from the procedure. One patient had phrenic nerve palsy necessitating placation of the diaphragm. ALL such complications should not occur in closure of PDA especially in prematures this approach is difficult. Possibility of injuring recurrent laryngeal nerve and phrenic nerves are present.

My Comment is : this procedure illustrates the following proverb : Why to do simple since complicated procedures are available.

If one needs to be less invasive he may adopt the surgical approach of jean Yves NEVEUX published in he French Encyclopedia of surgical techniques in year 2001 about respect of latissimus dorsi muscle during postero-lateral thoracotomy for ligation of PDA in prematures and neonates.

This article should be accepted and published as an example of acrobatic procedures that carry higher surgical risks.

Apart from my personal opinion about the procedure , the paper is excellent demonstrating that the department of cardiac surgery in Marseille in France is an excellent department of paediatric cardiac surgery.

It is important to know how to select the type of surgical procedure and to adapt it to the local circumstances of each team . It is this type of what I call " Hollywood surgical procedures that when published mislead junior surgeons. When they do it they get bad results , It is important to know that in surgery one should not perform any acrobatic surgical procedure unless he is well trained and having a large experience, otherwise ,the young surgeon will compromise his results and expose his patients to higher unnecessary surgical risks.

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DIFFERENT MODALITIES FOR MANAGEMENT OF RETAINED HAEMOTHORAX

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Background: **the recognition and treatment of retained haemothorax (RH) remains a significant problem. Conventionally these condition are managed surgically with open thoracotomy .Video-assisted thoracoscopic surgery (VATS)is an alternative surgical technique in evaluation of this condition .**

Methods: **of the 318 patients admitted during the study period requiring or admitted with tube thoracostomy, there were 21 patients (6.6%) with RH. Intra-pleural installation of streptokinase 250000 IU daily for 5 days was started and then VATS was done for all cases. Failed VATS patients were requiring conversion to thoracotomy. Results: all patients were managed outside our hospital firstly, except one patient initially managed in our unit resulting in (0.31%) of residual haemothorax rate. There were 19 men and 2 women. 19 patients sustained blunt chest trauma and 2 patients sustained penetrating injury with failed attempts to drain with tube thoracostomy, thoracoscopic evacuation was successful in 16 patients (76.2%) and 5 patients requiring conversion to thoracotomy. Conclusion: video-thoracoscopy is safe and effective procedure allowing successful treatment of up to (76.2%) of patients. Best results are obtained when drainage is performed within the first 5 days after trauma**

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Inadequately drained posttraumatic haemothorax with tube thoracostomy can lead to the complications of fibro-thorax/entrapped lung or empyema. Residual posttraumatic hemothoraces occur in 1% to 20% of patients managed with tube thoracostomy,. but this sequela of thoracic injury is not uncommon [1] .

Retained haemothorax (RH) is defined as a condition that is synonymous with clotted blood in the intra-thoracic cavity not drained despite the presence of a closed tube thoracostomy (CTT). The clotted blood is basically due to inadequate drainage [2].

The recognition and treatment of RH remains a significant problem in trauma care. It has been demonstrated that computed tomography (CT) of the chest is superior to plain radiography in the diagnosis of retained hemothorax. In clotted haemothorax, both thoracocentesis and closed tube thoracostomy will not be able to evacuate the pleural cavity especially if it is minimal [3].

The optimal management following diagnosis remains a matter of debate. Intra pleural installation of thrombolytic agents has been usefull in the treatment of haemothorax when thoracostomy tube drainage is unsuccessful. The use of intra-pleural fibrinolytic agents has resulted in resolution of clotted haemothorax with an overall success rate of 91.7% [4].

Conventionally, these conditions are managed surgically with open thoracotomy. Video-assisted thoracoscopic surgery (VATS) has emerged as an alternative surgical technique in the evaluation and treatment of posttraumatic pleural complications. Notably, retained hemothoraces have been successfully evacuated and are currently indicated as one of the most suitable conditions amenable to thoracoscopic surgery [5].

Methods:

Over the 30-month period January 2006 to June 2008 the records of all patients with posttraumatic retained clotted hemothoraces that underwent surgical evacuation were reviewed. A clotted haemothorax was defined as a residual clot estimated to be larger than 500 mL or that occupied at least one third of the involved haemothorax. . Patients with persistent opacities (> 33% involvement of a haemothorax) on chest radiograph and those with persistent opacities. were evaluated with a thoracic spiral computed axial tomography (CAT) scan.

The size of the retained haemothorax will be estimated by CT, using the method previously validated for estimation of pleural effusions by Mergo et al [6]. :

ESTIMATE = V (in cc) = d2 X L (d = greatest depth of haemothorax; from chest wall to lung on any one CT image, in cms, L = cranio-caudal length, in cms) (number of slices X cm thickness of CT cuts) Retained haemothorax will then be categorized, according to this CT estimate

Inclusion Criteria:

Placement of a thoracostomy tube within 24 hours of admission for evacuation of pneumothorax or haemothorax .

Subsequent CT of the chest showing retained haemothorax within 14 days after initial placement of tube thoracostomy .

Exclusion Criteria:

Patients treated with thoracotomy before placement of tube thoracostomy .

Intra pleural installation of streptokinase (SK)250000 iu or urokinase 100000 iu diluted in 100ml of saline solution was given daily and repeated for five days.

In the operating room, all patients underwent general anesthesia with double lumen endo-tracheal intubation. All patients were administered intravenous antibiotic combination of amoxicillin and clavulinic acid peri-operatively. This was continued for a maximum of 24 hours. Thereafter, therapy was directed according to microscopy, culture, and sensitivity results.

Patients were placed in the corresponding full lateral decubitus position to facilitate conversion to a postero-lateral thoracotomy if required. Standard thoracoscopy equipment was used, including a scope with a zero-degree angle with 16x magnification and a xenon light source, and a single high-resolution video monitor. No positive-pressure insufflations was used. A 2-cm incision was placed directly over the site of the loculated collection as determined from the CT scan or lateral chest radiograph. A suction catheter was inserted into the pleural cavity, into the loculated collection, and as much of the pleural fluid removed. Pleural fluid was sent for microbiologic assessment. A 10-mm trocar with the telescope was introduced into the loculated cavity. Another 2-cm incision was placed 8 to 10 cm away from the initial incision, along the

same intercostal space, and the suction catheter was introduced through this incision. Further evacuation of the pleural contents was performed under direct vision with the camera. Ring forceps was used to remove rind from the visceral and parietal pleura. Gentle dissection under direct vision with sponge sticks and ring forceps released the trapped lung.

Once all the pleural fluid and fibrin was evacuated, adequate lung expansion was observed by ventilating the ipsi-lateral lung. Two thoracostomy tubes were placed postoperatively into the port sites; one into the previous loculated cavity and another directed toward the apex.

Open Thoracotomy: With the patient under general anesthesia using single lung ventilation, a limited postero-lateral thoracotomy was made through the 5th intercostals space, sparing the serratus anterior and the rhomboid muscles. The ribs were spread only enough to performed evacuation of the clotted haemothorax and dissection of adhesion, and decortication. The incision was closed in layers using absorbable material, including the pericostal sutures. Two drains were inserted through two separate incisions and placed on suction at 2–5 kPa.

All patients were transferred to a high-care unit where both intercostal drains were placed onto low-pressure suction. A chest radiograph was obtained, blood for arterial blood gas taken, and routine monitoring of vital signs performed. All patients received physiotherapy twice daily. Chest tubes were removed once pleural drainage was less than 50 mL or when the air leak had stopped for 12 hours.

Statistical analysis :

Using SPSS for measurement of mean, standard deviation and using the indicator for measuring the significance and non significance of the data .

Results :

Of the 318 patients admitted during the study period requiring or admitted with tube thorocostomy, there were 21 patients (6.6%) with a retained haemothorax. Of note, is that 20 patients (96%) were referred with a suspected retained thoracic collection from neighboring hospitals. Only one patients initially managed in the unit developed a residual haemothorax resulting in a 0.31% residual haemothorax rate.

There were 19 men and 2 women with a mean age of 29.3 ± 19.2 years old (range 14 to 64 years old). Nineteen patients sustained blunt chest trauma and 2 patients sustained a penetrating injury. Before referral, 10, 8, and 2 patients each had one, two, and three attempts at pleural fluid drainage with tube thoracostomy, respectively. The only patient managed initially in the unit had a single tube drainage procedure only.

All patients had residual opacities on chest radiograph and had a spiral CAT scan of the chest illustrating a loculated, retained pleural collection. With failed attempts to drain with tube thoracostomy. Thoracoscopic evacuation of the pleural fluid was successful in 16 patients (76.2%) and 5 patients (23.8%) required conversion to standard thoracotomy.

Analysis of sixteen patients undergoing successful VATS evacuation

The mean time from injury to thoracoscopy was 16.7 days (range 14 to 46 days). Inadequate lung deflation under general anesthetic with double lumen endo-tracheal intubation occurred in 12 patients (75%) in this group. The mean operative time was 62.6 minutes (range 30–85 minutes), and the mean volume of retained fluid evacuated was 578 mL (range 350–1600 mL).

Full lung expansion was visualized in all patients intra-operatively and confirmed with postoperative chest radiographs. one patients sustained iatrogenic minor lung lacerations during the VATS procedure. These were left alone and did not adversely influence hospital stay or tube thoracostomy removal.

Tube thoracosotmy was removed at a median of 3 days (range 2–7 days). The median postoperative stay was 5 days (range 3–12 days). There were no recurrences of pleural fluid at 2- and 6-week clinical and radiologic follow-up.

Analysis of five patients requiring conversion to thoracotomy

Severe pleural inflammatory reaction resulting in dense adhesions, thus precluding camera insertion and VATS evacuation, was the main reason to convert to thoracotomy. All except 1 patient was febrile with a mean temperature of 38.5°C. The mean time delay from injury to thoracotomy was 16.8 days (range 15–24 days).

The mean volume of fluid recovered at thoracotomy was 738 mL (range 100–3000 mL). Full lung expansion was visualized in all patients intra-operatively and confirmed with postoperative chest radiographs.

One patient developed superficial wound sepsis of the thoracotomy wound. This was managed with suture removal and dressings as an outpatient. Tube thoracosotmy was removed at a median of 3 days (1–7 days) in 4 patients. One patient with an empyema had the tube thoracostomy cut short and a drainage bag applied for persistent purulent drainage. This was removed at 2-week follow-up. There was no recurrence of clinical or radiologic evidence of empyema or pleural fluid at 2- and 6-week follow-up. The median postoperative stay was 5 days (range 3–28 days).

Discussion :

Management of hemothoraces related to trauma follows basic tenets well respected by both trauma and cardiothoracic surgeons. In most instances, a non-operative approach is adequate with a defined group of patients requiring only tube thoracostomy. It is only in a true minority of individuals that operative intervention necessary. For both blunt and penetrating injuries, the presence of retained haemothorax is well treated by early intervention with thoracoscopic techniques, shown to decrease hospital stay and costs. Controversial areas including the use of prophylactic antibiotics, sequence of operative intervention in patients with combined thoraco-abdominal trauma, and the use of emergency department thoracotomy, remain a challenge but recent literature can serve to guide the clinician.[3]

Retained haemothorax reportedly occurs in 1% to 20% of patients with chest trauma. Using a protocol based on vigorous physiotherapy and early withdrawal of tube thoracostomy in 318 patients, retained haemothorax rates of 0.31% in our study, while rate of RH was high by Knottenbelt and associates [7]and Coselli and coworkers,[8] (2.7% and 3.7%) respectively .

The use of VATS in the early evacuation of posttraumatic retained haemothorax has been well documented. Villavicencio and colleagues,[9] , in a review analyzing the role of thoracoscopy in retained haemothorax, identified eight studies with a total 99 patients . Evacuation by VATS was successful in 89 of 99 patients (90%). Mean post-injury day to operation varied among the studies, and ranged from 4.3 to 10.8 days. Technical failures during VATS evacuation occurred as a result of poor visualization from incomplete lung deflation, dense adhesions, or clotted blood. Despite the 10% failure rate, all the studies recommended early VATS evacuation to avoid complications of fibrothorax and empyema. Several of the authors described a window period for the VATS evacuation of less than 3 days [10], 4 to 10 days , [11] , or less than 10 days [12]. After the tenth post-injury day, clotted blood was reportedly difficult to remove, and adhesions prevented lung collapse [13] . Successful evacuation has been reported as late as post-injury day 8 , day 15 and day 35 [14] .

Subsequent to the above analysis, a further two studies addressing thoracoscopy and retained hemothoraces with a total of 49 patients has been reported. Vassiliu and associates, (13), in a series of 24 patients with residual haemothorax, successfully performed thoracoscopic evacuation in 22 of their patients (92%). In our study successful thoracoscopic evacuation in 16 of our patients (76.2%). This may be due to our early experience or late management as 95.2% of our patients referred from surrounding hospitals.

Meyer and colleagues [15], investigated the early evacuation of traumatic retained hemothoraces using thoracoscopy versus second tube thoracostomy. They found that early intervention (< 48 hours) with VATS may be more efficient and economical for managing retained hemothoraces.

The use of intra-pleural fibrinolysis with streptokinase and urikinase as an adjunctive treatment in haemothorax and empyema is well documented with success rates ranging from 62.5% [16] to 92% [17]. More than 52.4% of patients in this series had two or more attempts at tube

drainage and 20 patients (95.2%) were referred from surrounding hospitals. This resultant delay in referral had many patients presenting with semi-clotted blood, adhesions from pleural inflammatory reaction.

To overcome the problems of not achieving complete lung deflation with double-lumen intubation and adequate thoracoscopic visualization, a direct surgical approach to the retained haemothorax was adopted. The position of the loculated collection was determined from CT scans of the chest or lateral chest radiographs.

It is currently our policy to perform a spiral CAT scan of the chest in all patients with significant residual opacities on chest radiographs to delineate the total geometry of loculated collections and to differentiate among consolidation or atelectasis, contusion, intrapulmonary collection, pleural collection, and pleural reaction. Skin incisions for port placement were made directly over the loculated collections. These were then directly entered into, using the camera and suction catheter, and the pleural fluid evacuated. The adherent lung was thus freed from within the cavity that contained the retained fluid. This operative strategy proved successful in 16 patients (76%) undergoing VATS evacuation, thereby avoiding a significant number of thoracotomies.

Navsaria et al [2] had success rate 80% using VATS for 46 patients had retained haemothorax, with failure of 20% converted to open thoracotomy. Dense adhesion present in 2o%. Mean time between injury to VATS is 13.3 days.

Morales Uribe et al (1) had success rate 73.4% using VATS for 102 patients had retained haemothorax, with failure of 15.6% converted to open thoracotomy because inability to attain adequate drainage of clots and collation and lung re-expansion .

Conclusion :

Video-thoracoscopy must be considered the procedure of choice of treatment of retained haemothorax. It is safe and effective procedure allowing successful treatment of up to (76.2%) of patients. Best results are obtained when drainage is performed within the first 5 days after trauma. The decision to proceed to thoracotomy can be rapidly based on the findings of VATS, and does not unduly prolong the procedure nor require a second trip to the operating room. A direct approach to the pleural fluid collection, as described, can be attributed to our successful outcome.

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Predictors of Outcome in Blunt Diaphragmatic Rupture; Analysis of 44 cases

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Background: **Traumatic blunt diaphragmatic rupture (BDR) is reported with increasing frequency and is associated with high morbidity and mortality our objective was to identify (1) predictors of outcome in blunt diaphragmatic rupt ure (BDR), and (2) factors contributing to diagnostic delay.**

Methods: **We reviewed the charts and radiographs of 44 patients with BDR treated in our hospital from 1998 to 2007. Two groups of patients were identified: group A (n=38, 86.4%) with acute BDR, and group B (n=6, 13.6%) with post-traumatic diaphragmatic hernia (TDH).**

Results: **There were 37 males (84.1%) and 7 females (15.9%), aged 15–70 (mean: 42 ± 7.65) years. BDR was left-sided in 30 cases (68.2%), right-sided in 12 (27.3%) and bilateral in two (4.5%). In group A, diagnosis of BDR was made in less than 12 hours in 34 cases (89.5%), and between 12 and 24 hours in 4 cases (10.5%). Preoperative diagnosis was made in only 28 cases (73.7%) and intraoperative diagnosis made in 10 cases (26.3%) Associated injuries were present in 32 patients (89.5%), but severe multiple injuries in 17 cases (40.7%) and included: spleen (n=10, 26.3%), rib fractures (n=8, 21.1%), liver (n=8, 21.1%), lung (n=18, 47.4%), head (n=10, 26.3%), pelvic fractures (n=10, 26.3%), long bone fractures (n=11, 28.9%), bowel (n=5, 13.2%) and kidney (n=3, 7.9%). Six patients had isolated left BDR. BDR repair was accomplished through thoracotomy in 31 cases, laparotomy in 4 and thoraco-laparotomy in 3 cases. The overall mortality rate was 13.2% (5/38). Both patients with bilateral BDR died. The patients who died were older than the survivors (mean age: 57 vs. 37 years, P<0.05), were more in severely multiple injured patients (100% vs. 36.4%, P<0.05) and were in shock (100% vs. 24.2%, P<0.05). In group B with TDH, diagnosis was delayed for 6–24 months after injury. Five patients had non-specific clinical signs and one patient had strangulation of the intestine. One patient had undergone surgery during acute injury but BDR was overlooked. Location of TDH was on the left in 4 cases and on the right in two. Repair of TDH was achieved through**

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thoracotomy in all cases. No mortality or major morbidity was encountered.
Conclusions: **(1) Predictors of BDR mortality are: age, associated severe multiple injuries and hemodynamic status of the patient. (2) Delay in diagnosis does not influence the outcome and is not influenced by the side of BDR location. (3) BDR can easily be missed in the absence of other indications for prompt surgery, where a thorough examination of both hemidiaphragms is mandatory. (4) A high index of suspicion combined with repeated and selective radiologic evaluation is necessary for early diagnosis.**

Blunt diaphragmatic rupture (BDR) is not an uncommon injury and mostly considered as a marker of severe trauma. It occurs in 0.8–5% of hospitalized automobile accident victims and in approximately 5% of blunt trauma patients that undergo exploration [1].

The first collective review of traumatic diaphragmatic rupture was published in 1951. When Carter et al. [2] published the first case series and they stated that Sennertus was the first to describe a traumatic diaphragmatic hernia in 1541 [2]. Ambroise Pare diagnosed the first diaphragmatic rupture during autopsy, in 1579. Bowditch made an antemortem diagnosis of a traumatic diaphragmatic rupture in 1853 [3].

Traumatic blunt diaphragmatic rupture (BDR) occurs in approximately 5% of patients with major blunt thoracoabdominal trauma, most of them on the left side and an early correct diagnosis is made in less than 50% of cases [4,5]. The difficulty of the diagnosis and the high mortality and morbidity rates of the untreated cases make this clinical entity more important. A 30% mortality rate has been found in cases with bowel strangulation associated with diaphragmatic hernia [6].

In conservatively managed patients the rate of initially missed diaphragmatic injuries ranges from 12 to 66%, and they may even be overlooked at laparotomy [1,5,6]. Diagnosis of diaphragmatic injury requires a high index of suspicion. Delayed diagnosis of BDR is associated with increased morbidity and mortality [7].

The aim of this retrospective study is to review the experience of our hospital with the management of BDR in order to identify incidence, associated morbidity and mortality, predictors of outcome, and factors contributing to diagnostic delay.

Methods:

We reviewed the charts and radiographs of 44 patients with BDR treated in our hospitals from 1998 to 2007. All cases with penetrating injuries of the diaphragm were excluded. The variables studied and correlated with outcome were: patient age, hemodynamic status on admission, multiple associated injuries, time to diagnosis, and BDR side.

All the films of the radiologic exams (chest x-rays, computed tomography "CT" scans) were retrospectively reviewed in order to identify signs suspicious for BDR that were overlooked at the initial radiologic interpretation.

Statistical analysis: Statistical data analysis was performed with Student's t-test or Chi-square test, where appropriate. Statistical significance was determined at $P<0.05$.

Results:

Demographic data

There were 37 male (84.1%) and 7 female patients (15.9%), aged 15–70 (mean: 42 ± 7.65) years. The causes of injury were: motor car accident (n=35, 79.5%), fall from a height (n=7, 15.9%) and compression by agricultural tractor (n=2, 4.6%). BDR was left-sided in 30 cases (68.2%), right-sided in 12 (27.3%) and bilateral in two (4.5%) as shown in table (1) and Fig (1 & 2).

Data	No = 44	%
Age group:		
15 – 20	4	9.1%
20 – 30	7	15.9%
30 – 40	11	25%
40 – 50	10	22.7%
50 – 60	8	18.2%
60 – 70	4	9.1%
Sex:		
Male	37	84.1%
Female	7	15.9%

Table (1): Demographic data.

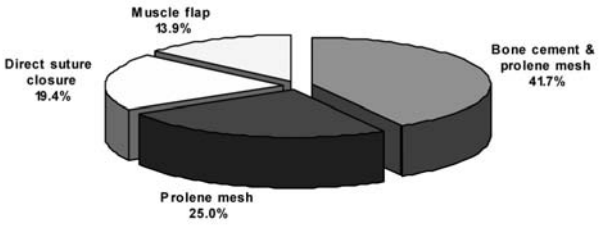

Fig (1): Causes of injury.

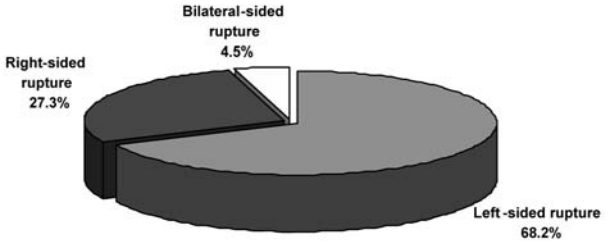

Fig (2): Location of diaphragmatic injuries.

We classified our patients into two distinct groups of patients: (i) patients with acute BDR (group A: 38, 86.4%), and (ii) patients with post-traumatic diaphragmatic hernia (TDH) (group B: 6, 13.6%).

Acute BDRs (Group A):

Location of acute BDRs

In group A, there were 26 left-sided (68.4%), 10 right-sided (26.3%) and two bilateral BDRs (5.3%) as shown in Fig (3).

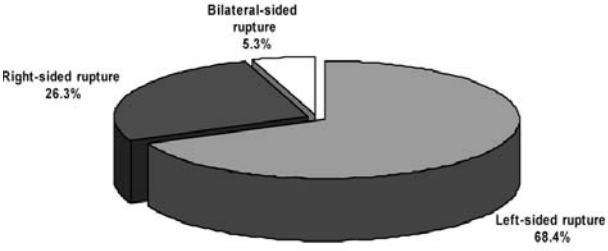

Fig (3): Location of acute BDR.

Diagnosis of acute BDRs

Diagnosis of BDR was made in less than 12 hours in 34 cases (89.5%), and between 12 and 24 hours in 4 cases (10.5%). Preoperative diagnosis was made in only 28 cases (73.7%), and was based, partly on physical examination (absent respiratory sounds, audible enteric sounds in the chest, tympany or dullness on percussion of the chest according to the herniated organ) and mainly, on CXR findings which was done in all patients (hemidiaphragm elevation, gas shadow in the lower chest, blurring of the diaphragm and lower lung fields, collapse of basal lung segments, mediastinal shift, nasogastric tube in the chest).

CT scan performed in 27 cases supported the diagnosis in 22 (81.5%), and it was equivocal in 5 cases (18.5%).

In the 6 cases with isolated BDR, the initial CXR was suspicious for BDR. This suspicion became stronger after the second CXR, obtained within the first 24 hours, and diagnosis was confirmed with CT scan or/and upper GI contrast studies.

Intraoperative diagnosis of BDR was made in 10 cases (26.3%). Physical examination was unreliable and, although CXRs (obtained in 9 cases) were not normal, a preoperative diagnosis of BDR was not considered.

Associated injuries in acute BDRs

Associated injuries were present in 32 patients (89.5%), but severe multiple injuries in 17 cases (40.7%) and included: spleen (n=10, 26.3%), rib fractures (n=8, 21.1%), liver (n=8, 21.1%), lung (n=18, 47.4%), head (n=10, 26.3%), pelvic fractures (n=10, 26.3%), long bone fractures (n=11, 28.9%), bowel (n=5, 13.2%) and kidney (n=3, 7.9%). Six patients had isolated left BDR.

Thirteen patients (34.2%) were in hypovolemic shock on arrival.

Surgical management of acute BDRs

BDR repair was accomplished through a low thoracotomy in 7th space in 31 cases (81.6%), laparotomy in 4 (10.5%), and laparo-thoracotomy in 3 (7.9%) as shown in Fig (4). Both interrupted and running techniques with non-absorbable prolene (No 0, 1 & 2) sutures were used.

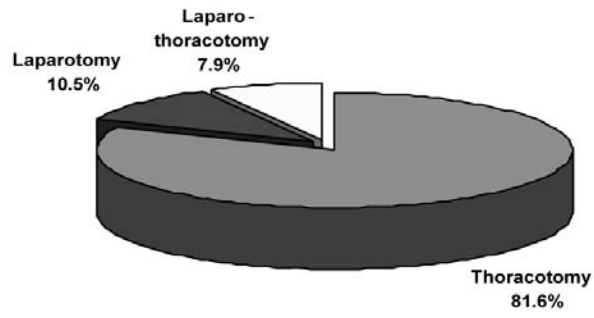

Fig (4): Approach of surgery for acute BDR repair.

Management of associated injuries in 27 patients who survived included: suture of the lung tear (n=12), splenectomy (n=7), long-bone fractures fixation (n=11), pelvic fracture fixation (n=7), craniotomy for sub-/epidural hematoma drainage (n=8), suture of the liver (n=5) with or without tissue debridement, lung lobectomy (n=4), nephrectomy (n=1), partial nephrectomy (n=1), transverse colectomy (n=2), ligation of intercostal arteries (n=2), rib fractures fixation with wire (n=2), suture of sigmoid (n=1), partial excision of jejunum (n=1) and suture-repair of ileum (n=1).

Outcome in acute BDRs

The hospital mortality rate in group A (acute BDRs) was 13.2% (5/38). Three patients died intraoperatively due to non-reversible hypovolemic shock, one of them had bilateral BDR. The other 2 patients died postoperatively due to ARDS, and septic intraabdominal complications requiring multiple surgical interventions, one of them had bilateral BDR.

So, both patients with bilateral BDR died. They had multiple intraabdominal injuries and were in shock on admission. One died intraoperatively due to non-reversible hypovolemic shock, and the other one due to multiple intraabdominal abscesses requiring multiple surgical interventions.

Postoperative complications (morbidity rate) encountered among 11 (33.3%) survivors were: pneumonia (n=8, 24.2%), urinary tract infection (n=6, 18.2%), ARDS (n=4, 12.1%), stress ulcer bleeding (n=4, 12.1%), intraabdominal abscess (n=3, 9.1%), renal failure (n=2, 6.1%), temporary phrenic nerve palsy (n=2, 6.1%) as shown in table (2).

Predictors of outcome in acute BDRs

Of the variables tested as predictors of outcome in group A (acute BDRs), only age, hemodynamic status at admission, and associated multiple injuries were predictive but time to diagnosis and BDR location were non-predictive as shown in table (3).

	No = 44	%	Causes
Mortality:	5/38	13.2	Non-reversible hypovolemic shock Sepsis & ARDS
Intraoperative	3	7.9	
Postoperative	2	5.3	
Morbidity:	11/33	33.3	One patient may had more than one complication
Pneumonia	8	24.2	
Urinary TI	6	18.2	
ARDS	4	12.1	
Stress ulcer bleeding	4	12.1	
Intraabdominal abscess	3	9.1	
Renal failure	2	6.1	
Phrenic nerve palsy	2	6.1	

Table (2): Mortality and morbidity
The hospital stay for the survivors was 7–48 (mean: 15) days. The ICU stay was 1–32 (mean: 6.5) days. The time spent on mechanical ventilation was 0–20 (mean: 5.4) days.

Variable	Survivors (n = 33)	Non-survivors (n = 5)	P
Mean age	37 years	57 years	< 0.05
Hypovolemic shock	8 (24.2%)	5 (100%)	< 0.05
Associated severe multiple injury	12 (36.4%)	5 (100%)	< 0.05
Time to diagnosis:			
< 12 h	29 (87.9%)	5 (100%)	NS
12 – 24 h	3 (9.1%)	1 (20%)	
BDR location:			
Left	24 (72.7%)	2 (40%)	
Right	9 (27.3%)	1 (20%)	NS
Bilateral	0 (0%)	2 (40%)	

Table (3): Predictors of outcome in acute BDRs
P < 0.05 = significant, NS = non-significant

The patients who died: (a) had a mean age of 57 years compared to 37 years of the survivors (P<0.05) (b) all (100%) were in shock on admission (systolic blood pressure <90 mmHg and heart rate >120 bpm and/or clinical signs of shock) compared with only 24.2% of the survivors in shock (P<0.05), and (c) were more severely injured, as had multiple severe injuries (100%) compared with 36.4% of the survivors (P<0.05).

Traumatic diaphragmatic hernias (TDHs) (Group B):

Location of TDHs

In group B (patients with TDH), location of TDH was in the left hemidiaphragm in 4 cases and in the right in two.

Diagnosis of TDHs

Diagnosis was delayed for 6–24 months after injury. In all cases the BDR was missed during the initial hospitalization. One patient with a left TDH had undergone surgery for intraabdominal trauma during the acute phase of injury but BDR was overlooked. Five patients had non-specific and inconstant symptoms as abdominal and/or chest pain, abdominal discomfort, dyspnea and respiratory infections. One patient presented with strangulation of the intestine. Diagnosis was made with CXR in all cases and confirmed by upper GI studies and thoracoabdominal CT scan. In one case, the patient presented with dyspnea at the emergency department, the CXR demonstrated gas shadow (the gastric bubble) in the left middle and lower lung field, which was interpreted by mistake as 'basilar pneumothorax', two thoracic tubes were inserted, one of which drained gastric fluid, the patient was promptly transfered to the operating room and through a left thoracotomy a TDH containing the stomach and omentum was revealed, and was repaired, as well as the hole in the stomach.

Surgical management of TDHs

Direct closure of the diaphragm using interrupted non-absorbable prolene (No 0, 1 & 2) sutures was achieved through a low thoracotomy in 6th or 7th spaces in all cases. No mesh was required in order to cover the diaphragmatic defect. The organ found to be herniated were: stomach (n=4), transverse colon (n=2), liver (n=2), small bowel (n=2) and spleen (n=2). No resection of any part of the gastrointestinal tract was necessary.

Outcome in TDHs

No mortality or major morbidity were encountered.

Discussion:

Traumatic diaphragmatic rupture that results from blunt thoraco-abdominal trauma is common and regarded as a marker of trauma severity [1,4]. It was suggested that 75% of the injuries to the diaphragm are caused by blunt trauma [5,7]. It was reported that in North American series blunt trauma accounts for 10–30% of traumatic diaphragmatic ruptures [8], whereas in Western Europe series blunt trauma accounts for 80–100% of BDR [9]. The true incidence of BDR is unknown because in 7–66% of major trauma victims, the diagnosis is missed. This is particularly true for ruptures of the right hemi diaphragm. The incidence of BDR is reported to be between 0.8 and 7% when associated with blunt trauma [6,7]. In our series, the incidence of BDR after blunt truncal trauma was about 3% from all blunt injured patients. The principle cause of BDR was blunt trauma following motor car accident in 79.5% and this matches with Athanassiadi et al. [11] and Turhan et al. [12]. In their studies, the motor car accident represent 78% and 77% respectively.

In blunt truncal trauma, most ruptures occur on the left posterolateral aspect of the diaphragm. This is a structurally weak area as it originates from the pleuroperitoneal membrane. The right diaphragm is congenitally stronger than the left and is partially protected by the liver, which can dissipate pressure over a large area [5,12]. The injury of the left hemidiaphragm occurred three times more frequently than injury of the right side. Nevertheless, the less common right-sided ruptures had more severe associated injuries and resulted in greater hemodynamic instability [3,9,11]. There is a preponderance of left-sided diaphragmatic ruptures following blunt trauma reported to be between 68.5 and 87% [2,4,10]. This matches with our series in which left-sided BDR occurred in 30 patients (68.2%). The estimated ratio of right-sided versus left-sided (16.2% vs 83.8%) BDR correlates with the literature [3,12,13], but in our study the ratio was 27.3% right versus 68.2% left and 4.5% bilateral.

Traumatic diaphragmatic rupture presents a challenging emergency because of the high injury severities of the associated injured organs and generally requires a high interest of diagnostic suspicion. If BDR cannot be diagnosed and treated in the acute phase of the trauma, the affected structures may strangulate into the thoracic cavity and the mortality rate may increase dramatically [3,13]. Most of the patients suffer from dyspnea and pain

in the upper abdomen. Generally, patients present with symptoms related to the associated injuries. Other factors that should arouse suspicion for BDR and prompt further diagnostic investigation are the following: pericostal injury, fracture of pelvis or lumbar spine, auscultation of bowel sounds in the chest and tympany or dullness on percussion of the chest [13]. Meanwhile, in cases with a small tear and no herniation, specific signs and symptoms may not be present during the acute phase [12]. The most common symptoms of our study were dyspnea and upper abdominal pain with picture of associated injuries and picture of shock in severely injured patients. All patients with late diagnosis complained of dyspnea.

Diagnostic means for BDR including CXR, upper GI studies, ultrasound, CT scan and MRI lack both sensitivity and specificity [14,15,16,17,18,19]. CXR is currently the most valuable simple test, although, it can be diagnostic or suggestive of BDR in only 28–70% of cases [14,15,16]. Sensitivity of the initial CXR interpretation can be increased by heightened awareness of this injury [17,18,19]. All patients in our series had CXRs. Repeated CXR during hospitalization, as well as some days after discharge, is necessary in order to detect a herniation slowly increasing [14,15], as it happened in 3 of our patients. CT is another diagnostic tool for BDR. Previous reports suggest that helical CT has a sensitivity of 71% (78% for left-sided and 50% for right-sided injuries), a specificity of 100% and an accuracy of 88% for left-sided and 70% for right-sided injuries [20,21,22]. The most common findings on CT include a localized defect of the diaphragm, the absent diaphragm sign, and herniation of hollow organs and omentum into the hemithorax [22]. In our study, CT scan performed in 27 cases supported the diagnosis in 22 (81.5%), and it was equivocal in 5 cases (18.5%). In the 6 cases with isolated BDR. The suspicion of follow up CXR was confirmed with CT scan or/and upper GI contrast studies.

The limitations of CT include difficulty in delineating hemidiaphragms from adjacent soft-tissue structures (i.e. atelectatic lung), big slice thickness (8–10 mm), and respiratory motion around the diaphragm [21,22]. Helical CT with axial, saggital and coronal reformations is possibly superior to conventional CT in diagnosing BDR [19,21,22]. In our series, a CT diagnostic value of 76.5% in BDR was obtained. The 'collar sign' around herniated organs was observed in one fourth of our cases. In this study, the most of the cases diagnosed by using these two radiological methods (CXR, CT). In addition, concerning the group of patients with late diagnosed BDR, chest radiography followed by a thorax CT had been carried out to find out the underlying cause of their major complaint dyspnea. Studies have shown that MRI is helpful in equivocal cases of BDR. Interruption of the diaphragmatic signal due to laceration may confirm a BDR [23]. Unfortunately, MRI is not always available in the acute setting and even if it is, many trauma patients require support devices that are not compatible with MRI [23]. In our series MRI was helpful in one case when we used it (a late appearance of a right BDR). MRI should be done in the acute setting when the diagnosis remains uncertain after CT, or for non-acute, clinical, or radiological presentation suggesting BDR [23]. MRI was done for 2 cases of our late cases. Since 1993, when video-assisted thoracoscopic surgery (VATS) was first used to diagnose BDR, it has been proposed as a safe, expeditious, and accurate method of evaluating the diaphragm in trauma patients, comparable to diagnostic value of exploration (specificity, sensitivity and positive predictive value of 100%) [24]. But VATS has two important limitations: it cannot be performed in hemodynamically unstable patients, and it requires general anesthesia. In our hospital, VATS has been employed in our practice only recently and not in the trauma field yet.

There is no doubt in the literature as regard the need for aggressive operative treatment of BDR. This is due to early and late associated morbidity and mortality of this injury [7,9,11]. In our study, we obtained an early diagnosis (less than 12 h) of BDR in 34 patients (89.5%). When diagnosed, surgery must be performed as soon as possible, as any delay might cause a herniation of any abdominal organ. The pressure difference between the two cavities causes a herniation and this may result in strangulation and perforation of the abdominal organs, which will increase the morbidity and mortality rate. The choice of surgical approach can be thoracotomy, laparotomy or both if necessary [25,26,27]. The laparotomy is recommended for early-diagnosed patients who allow exploration of the intra-abdominal organs for any associated injury. Thoracotomy is necessary for isolated BDR and late cases to safely separate the adhesions between the abdominal organs and the thoracic wall [28]. We performed 31 thoracotomy which was the most preferred incision and 4 cases was made by laparotomies by general surgeons. All the patients with late diagnosis were approached with a thoracotomy incision. The thoracoabdominal incision was used for 3 patients, who had colonic perforation to left hemithorax, rupture spleen, severe chest wall defect and lung laceration which gave an opportunity to access both left hemithorax and abdominal cavity at the same session. The colonic perforation was not caused by strangulation. The anatomic location, its close

relationship to adjacent intrathoracic and intra-abdominal organs, and the severity of trauma account for associated injuries in 52–100% of patients with diaphragmatic rupture [13,27,28]. Common associated injuries include pelvic fractures (40–55%), splenic injuries (60%) and renal injuries [29,30,31]. In our series, in 6 patients, the only injury was a BDR. The rest of the patients had associated injuries with thoracic injury in 18 cases (47.4%), splenic injury in 10 cases (26.3%), liver injury in 8 cases (21.1%) and pelvic fracture in 10 cases (26.3%).

Postoperative complications (morbidity rate) encountered among 11 (33.3%) survivors were: pneumonia (n=8, 24.2%), urinary tract infection (n=6, 18.2%), ARDS (n=4, 12.1%), renal failure (n=2, 6.1%), intraabdominal abscess (n=3, 9.1%), stress ulcer bleeding (n=4, 12.1%) and temporary phrenic nerve palsy (n=2, 6.1%). The mortality rates of BDR are reported as 1–28% in the literature and it is generally associated injuries that are accused (11,12). In our series, the hospital mortality rate in group A (acute BDRs) was 13.2% (5/38). Three patients died intraoperatively due to non-reversible hypovolemic shock, one of them had bilateral BDR. The other 2 patients died postoperatively, due to ARDS, and septic intraabdominal complications requiring multiple surgical interventions, one of them had bilateral BDR. In our study, the patients who died: (a) had a mean age of 57 years compared with 37 years of the survivors ($P<0.05$) (b) all (100%) were in shock on admission (systolic blood pressure <90 mmHg and heart rate >120 bpm and/ or clinical signs of shock) compared with only 23% of the survivors in shock ($P<0.05$), and (c) were more severely injured, as had multiple severe injuries (100%) compared with 35% of the survivors ($P<0.05$). Turhan et al. [12] found that the mortality rate is 16.1% (n = 11), ten patients died because of the associated injuries and one patient died of septic complications and they stated that, there was no specific predictor found for mortality, since parameters like associated multiple injuries, blood transfusion, time elapsed between the injury and operation and type of injury revealed no difference. Nine patients (13.1%) had postoperative complications and all recovered and were discharged. Also, Athanassiadi et al. [11] stated that early morbidity and mortality from BDR is due to the associated injuries. Mortality in their series was 16.6%, within a reported broad range of 3.6 to 41% [32,33,34,35,36]. No death was directly attributable to BDR and this is in accordance with the literature (9,12,14,19,20,36,37), and also, they stated that age, severity of injury, and hemodynamic status on admission were proved to be significant predictors of mortality in their series as in our study. Also, age and associated injury as head injury, have been confirmed as strong prognostic factors of mortality by others (35,36,37).

Meticulous inspection of both hemidiaphragms must take place during any exploratory laparotomy for trauma [28,29]. One of our patients presented with a left TDH had undergone surgery in the acute setting for intraabdominal injuries, but the BDR was overlooked. Missed BDR results inevitably in herniation of abdominal contents into the chest due to the intra-abdominal to intrathoracic pressure gradient reaching up to 100 mmHg during Valsalva manoeuvre (normal: 2–10 mmHg) [30,31]. Progressive herniation results in respiratory embarrassment, chronic abdominal complaints, and strangulation of abdominal viscera, contributing to the late morbidity and mortality of the missed injury [32,33]. In our series late diagnosis and repair of a TDH had no influence in morbidity and mortality, and this is in accordance with other observations [33,34,35,36,37].

So, our recommendations are the high index of suspicion is of importance for the diagnosis of diaphragmatic rupture in any patient with thoracoabdominal injury. A high index of suspicion combined with repeated and selective radiologic evaluation is necessary for early diagnosis as early diagnosis is often difficult and can easily be missed in the acute trauma setting despite the technological equipment and available diagnostic modalities. Chest X-rays or CT scans may be indicative. A thorough examination of both hemi diaphragms is recommended for all patients undergoing emergency laparotomy, and of the respective hemidiaphragm for patients undergoing emergency thoracotomy in all cases of blunt truncal trauma as if not promptly diagnosed, it may be associated with a high morbidity and mortality peri-operatively and on the long term. Surgical repair is necessary even for small tears as soon as diagnosed. The transthoracic approach might be used in most cases of acute rupture and in all with latent diaphragmatic rupture.

In conclusion, [1] Predictors of BDR mortality are: age, and hemodynamic status of the patient. [2] Delay in diagnosis did not influence the outcome and was not influenced by the side of BDR location. [3] BDR can easily be missed in the absence of other indications for prompt surgery.

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VATS FOR PRIMARY SPONTANEOUS PNEUMOTHORAX : COMPARATIVE STUDY WITH OPEN THORACOTOMY

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Background: **primary spontaneous pneumothorax remain a significant problem occurring in healthy subject. The risk of recurrence is 54% within the first 4 years. Bullectomy combined with pleurectomy using VATS technique is safe and effective and requires only a short hospital stay. The aim of the study is to evaluate the safety and efficacy of VATS in management of primary spontaneous pneumothorax compared to open thoracotomy.**

Methods: **from jan.2006 to June 2008, all patients required bullectomy and pleurectomy by thoracotomy (limited posterolateral or transaxillary) or VATS due to recurrent primary spontaneous pneumothorax or first attack of primary spontaneous pneumothorax with failure of lung expansion by thoracostomy tube and massive air leak were included in this study.**

Results: **there were 37 patients, 23 male and 14 female with a mean age 27.9+18.3 years. The right lung was affected in 21 patients and 16 were in the left lung. 15 patients (40.5%) underwent trans-axillary thoracotomy, nine patients (24.3%) with limited posterolateral thoracotomy, while VATS was carried out on 13 patients (35.2%). The median operating time was significantly longer in open group than VATS group (75.34+ 22.1 vs. 54.9+ 16.2 min.). The amount of analgesia required(morphine consumption) in the first 5 days was significantly more in thoracotomy group (150.5+52mg. vs. 55+22mg.). Chest drainage was significantly more in open group (1027.4 + 230 ml. vs. 643.8+ 120 ml.).However, chest drain duration and hospital stay had no significant difference.**

Conclusion: **VATS is safe and effective technique for bullectomy and pleurectomy and we can consider that VATS is the technique of choice for surgical treatment of primary spontaneous pneumothorax.**

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Primary pneumothorax remains a significant global problem, occurring in healthy subjects with a reported incidence of 18–28/100 000 per year for men and 1.2–6/100 000 per year for women. (1).

Despite the absence of underlying pulmonary disease in patients with primary pneumothorax, subpleural blebs and bullae are likely to play a role in the pathogenesis since they are found in up to 90% of cases of primary pneumothorax at thoracoscopy or thoracotomy and in up to 80% of cases on CT scanning of the thorax. The aetiology of such bullous changes in otherwise apparently healthy lungs is unclear (2)

Undoubtedly, smoking plays a role; the lifetime risk of developing a pneumothorax in healthy smoking men may be as much as 12% compared with 0.1% in non-smoking men. (3)

Patients with primary pneumothoraces tend to be taller than control patients. (4).The gradient in pleural pressure increases from the lung base to the apex, thus alveoli at the lung apex in tall individuals are subject to significantly greater distending pressure than those at the base of the lung and, theoretically, are more predisposed to the development of sub-pleural blebs. (5)

The risk of recurrence of primary pneumothorax is 54% within the first 4 years, with isolated risk factors including smoking, height in male patients, and age over 60 years. (6)

In both primary and secondary spontaneous pneumothorax the diagnosis is normally established by plain chest radiography. When a pneumothorax is suspected but not confirmed by standard postero-anterior (PA) chest radiographs, lateral radiographs provide added information in up to 14% of cases. The lateral decubitus radiograph is superior to the erect or supine chest radiograph and is felt to be as sensitive as CT scanning in pneumothorax detection (7) . In patients with severe bullous lung disease CT scanning will differentiate emphysematous bullae from pneumothoraces and save the patient an unnecessary and potentially dangerous aspiration. (8)

The of this study is to evaluate the safety and efficacy of VATS in management of primary spontaneous pneumothorax compared to open thoracotomy (transaxillary or limited posterolateral thoracotomy).

Methods :

From 2006 to 2008, twenty-seven patients requiring pleurectomy by open thoracotomy or VATS due to recurrent spontaneous pneumothoraces or first spontaneous pneumothorax with failure of lung expansion by thoracostomy tube with massive air leak were included in this prospective study conducted at King Fahad Specialist Hospital, Buridah,AL Qassim region, KSA . and Zagazig university hospital, Egypt The patients unfit for general anesthesia were excluded.

Each patient received an explanation by the surgeon about the differences between the VATS and open pleurectomy to make a choice for himself or herself.

Preoperative investigations included pulmonary function tests, chest radiograph and a computed tomographic scan of the thorax

Video-assisted thoracoscopic (VATS) bullectomy and pleurectomy: With the patient under general anesthesia, ventilation was commenced with double-lumen intubation. The patient was prepared for thoracotomy. Contra-lateral single lung ventilation was begun before the initial 2-cm incision was made below the tip of scapula in the 6th intercostals space. A 10 mm video-thoracoscope (mainly 0° telescope) was inserted via 10.5 mm thoraco-port, and the thoracic cavity inspected. If a single large bulla was identified, thoracotomy was performed through two further 2-cm incisions anterior and posterior to the borders of the latissmus dorsi in the fourth intercostals space. The bulla was grasped with an endo-grasp or an endo-babcock and excised with the 30 mm endo GIA stapling device.

Apical pleurectomy was then performed by blunt dissection to the level of the fifth rib using a curved artery forceps.

Two intercostal drains were inserted through the anterior and lateral incisions and placed on continuous suction to 2–5 kPa.

Open bullectomy and pleurectomy: With the patient under general anesthesia using single lung ventilation, a limited postero-lateral thoracotomy was made through the 5th intercostals space, sparing the serratus anterior and the rhomboid muscles.

The ribs were spread only enough to allow a parietal pleurectomy to be performed from the level of the fifth rib, together with stapled excision of apical bullae, if present, using the TA 30 or TA 55 stapling devices. The incision was closed in layers using absorbable material, including the pericostal sutures. Two drains were inserted through two separate incisions and placed on suction at 2–5 kPa.

Trans-axillary mini-thoracotomy: The procedure is considered a minimally invasive procedure. The incision in the axillary margin measures 5–6 cm. Apical pleurectomy were performed and the apex carefully inspected for pleural blebs or bullae which were stapled.

Analgesia: A postoperative para-vertebral regional nerve block between T4 and T8 using 10 ml of 0.5% bupivacaine was performed in all patients. After the operation, patients were extubated in the operating room and transferred to the high dependency unit, where they were started on a patient-controlled analgesia (PCA) system using bolus doses (1 mg) of morphine with a lockout time of 5 min and no background infusion. This was continued until oral analgesia was commenced on as and when needed basis.

Postoperative: Intercostal drains were removed when the underlying lung was fully expanded with no residual air leak. Patients were discharged from the hospital when they were fully mobile and when their pain was controlled by oral analgesia.

Follow-up: on follow-up examination as an outpatient at 6–8 weeks after operation, the following details were recorded. The evidence of recurrent pneumothorax (as assessed by chest radiograph), the findings from the subjective assessment of wound pain, the results of the assessment of wound healing, and information regarding complications or recurrent pneumothorax after discharge from outpatient follow-up was obtained from the respective referring physicians.

Statistical analysis : Statistical analysis was performed using Stat Most for Windows . Descriptive data were given as mean + SD. Comparison between means were performed with Student's " t " test . Categorical variables were compared by "x2 " or Fisher's exact, when appropriate. A P-value $\leq$ 0.05 was considered significant.

Results :

In all,37 patients were studied in this prospective review. fifteen patients underwent transaxillary thoracotomy open pleurectomy,nine patients with limited posterolateral thoracotomy ,while VATS pleurectomy was carried out on 13patients.

Recurrent spontaneous pneumothorax was the indication for treatment in 21 patients of the open pleurectomy group (trans-axillary or limited posterolateral thoracotomy) and 10 patients of the VATS pleurectomy group. While, first spontaneous pneumothorax with failure of lung expansion by thoracostomy tube with massive air leak was the indication for treatment in 3 patients of open pleurectomy group and 3 patients of the VATS pleurectomy group.

Of the 37 surgical procedures analyzed, 6(16.2%) were performed in the first episode of pneumothorax, 24 (64.9%) were performed after the first episode of pneumothorax7(18.9%) after the second episode. No significant differences regarding age or sex were found between the groups.

All patients underwent apical pleurectomy. Bullectomy was performed in 24 patients of open and 13 patients of VATS pleurectomy group using a median of two staple cartridges per patient range of 1–4. The median operating time was significantly longer for patients in open pleurectomy group than those in VATS pleurectomy group 75.34 +22.1 vs. 54. 9 + 16.2 min (P=0.005). There was no significant difference in the operative blood loss between the two groups.

The median postoperative analgesic requirement as reflected by morphine consumption in the first five days after operation was significantly more in open pleurectomy vs. in VATS pleurectomy (150.5 + 52 vs 55 + 22 mg, respectively(P=0.02).

The median postoperative intercostals drainage, mainly blood in the first three days, was significantly more in open pleurectomy group i.e. 1027.35 + 230ml in open pleurectomy vs. 643.8 + 120ml in VATS pleurectomy (P=0.04). There was no significant difference in the duration of intercostals drainage for the two groups, as the drains were removed at a median of four days with the range of 2–9 days after operation for both groups.

The median postoperative hospital stay for both groups was six days with the range of 2–11 days which was not statistically significant

During subsequent follow-up, recurrent pneumothorax developed in 3 (5.27%) patients in VATS pleurectomy group and none in open pleurectomy patients.

Discussion :

Spontaneous pneumothorax (SP) is a common disorder with an annual incidence of between four and nine cases per 100,000 population. Tube thoracostomy is the usual initial treatment and has been successful in most patients [9].

The recurrence of pneumothorax constitutes a special problem since the chances of a further recurrence increase with the number of episodes. The effective way to resolve the pneumothorax and prevent recurrences is surgical excision of pathological lesion (blebs or bullae) along with fusion of the pleural surface [8].

Successful pneumothorax management should regard cause and extent of the air leak and must be directed towards elimination of the causative lesion, rapid and full expansion of the lung, minimal risk of recurrence, low or no morbidity and mortality, low cost and short hospital stay [7]..

The internationa l literature reports recurrence rates of pneumothorax ranging from 2.1 to 7.9% while the rate is 0 to 4.5% after pleural abrasion and limited pleurectomy, respectively [10] . An interesting review of multi-institutional data for about 1365 patients refers recurrence rate of 2,7, 4.4 and 7.9% when talc poudrage, parietal pleura coagulation, apical pleurectomy and pleural abrasion were compared [3] .

In our study we had 37 patients, 15 patients (40.5%) underwent trans-axillary thoracotomy, nine patients (24.3%) with limited posterolateral thoracotomy, while VATS was carried out on 13 patients (35.2%).

The recent literature agrees for the most part that VATS is the technique of choice for treating PSP. However there is a lack of consensus regarding the ideal moment for performing the procedure. In our hospital we propose VATS for all patients at the second ipsi-lateral or first contra-lateral episode. Some services, however, propose VATS as early as the first episode, while others delay intervention until the third. This lack of consensus results in heterogeneity of practice from one service to another [11] . In our series, the time of surgery was decided by the delayed referral of patients from some medical and surgical services for which ours is the referral hospital, such that 19.3% of the patients underwent surgery after the third or later episode (the delayed-referral group).

We believe as Qureshi et al , [12] believe , that stapling wedge resection of apical blebs is an appropriate option than bulla ligation. However, we are not in agreement with Hatz and his associates (13),who suggested blind apical stapling in patients with no evidence of bulla because we consider that an isolated apico-lateral pleurectomy is the right choice in this group of patients.

Qureshi and his colleges, [12] and us choose to use a postero-lateral rather than axillery thoracotomy in diffuse bullous disease because of reservation about the access offered and chronic wound pain by the latter approach. Furthermore, in a prospective, randomised comparison, .Qureshi and his colleges, [12] found no reduction in the postoperative respiratory dysfunction when a muscle sparing rather than the standard postero-lateral thoracotomy was used.

We agree that preoperative CT-scan in fine cuts may help the detection of underlying bullous disease and in choosing the appropriate surgical procedure.

Conclusion :

The goal in the surgical management of primary spontaneous pneumothorax is to abolish its recurrence with no mortality and minimal morbidity and functional impairment. We consider that video-assisted thoracoscopy with stapler resection and apical pleurectomy is the first option in the management of spontaneous pneumothorax.

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Thoracic chondrosarcoma. Is it common? A retrospective study of the last fifteen years

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Background: **Chondrosarcoma is the most common primary malignant tumor of the chest wall which needs resection and reconstruction of the chest wall. The aim of this study is to review our cases of condrosarcoma and to evaluate our experience of resection and reconstruction of the chest wall.**

Methods: **This is a retrospective study including 36 patients with thoracic chondrosarcoma for whom chest wall resection and reconstruction were done in the Cardiothoracic Surgery Department, Mansoura University Hospital in the last fifteen years between January 1993 and December 2007. All patients were examined clinically with routine investigations as laboratory investigations and radiological examination. Excision of the mass and 4-5 cm of the surrounding healthy tissue as safety margins was done for all cases. Different types of reconstruction of the chest wall depending upon the site and extent of the excision were done. Follow up postoperatively were done for any complications or recurrence of the tumor.**

Results: **The age of our cases ranged from 20 – 70 years with the majority of the cases between 50 and 60 years (mean age 47.5±4.3 years) with male predominance (63.9%). Clinically the mass presentation was the commonest picture (55.6%) followed by pain and mass presentation (33.3%) and only pain in 11.1%. Anatomically the lesion present in the ribs in 83.3% while it was in the sternum in 13.9 and posteriorly in the thoracic vertebrae in 2.8%. Excision was done in all cases followed by chest wall which included muscle flap in 5 cases (13.9%), prolene mesh in 16 cases (44.4%) and by prolene mesh with bone cement in between in 15 cases (41.7%). Postoperative morbidity occurred in 9 patients (25%) varied from fever and seroma to wound infection and dehiscence. Local recurrence occurred in 3 cases and needed redo operation. Only one mortality (2.8%) occurred in old aged asthmatic man with large mass which needed postoperative ventilation and died after 5 days in the ICU.**

Conclusion: **We conclude that chondrosarcoma is not an uncommon lesion of the chest wall which need early**

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diagnosis and excision with safety margin. The surgeon should not worry about the size of the chest wall defect that remains after full excision of the mass as there are many types of chest wall reconstruction which can be used.

Chondrosarcomas represent approximately 30% of primary malignant bone tumors, the most frequent of which is on anterior thoracic wall [1,2]. Thoracic chondrosarcomas are the most common primary malignant tumor of the chest wall, it comprises between one sixth and one half of those which are malignant [2,3].

Approximately 80% of thoracic chondrosarcoma occurs in the ribs, the remainder in the sternum or vertebrae. They have been shown to arise mostly as initially malignant or as a malignant transformation in preexisting benign cartilaginous tumors [1,3]. They are found anywhere along the course of the ribs most frequently attached to, or near the costal cartilages of the upper five ribs [1,4].

Chondrosarcoma initially displaces and incorporate adjacent ribs. They usually grow inwards, impenging upon the thoracic cavity expanding subpleurally and so simulate pleural or mediastinal tumors [3,5]. Rarely the tumors extend beneath and under the skin in an iceberg fashion and then become palpable [2,6].

Pain and the presence of a mass have been the two most common complaints of patients with chondrosarcoma and many patients experienced both [3,7]. Radiologically, chondrosarcoma frequently appears as a large lobulated mass arising from a rib with scattered flocculent calcification characteristic of its cartilaginous matrix [8,9].

Chondrosarcomas are chemoresistant and radioresistant tumors that require wide local excision with 4 to 5 cm safety margin for local control [9]. So, tumor resection with chest wall reconstruction by muscle flap or prosthetic material will yield satisfactory results in most patients [8,10].

Aim of this study is to review our cases of thoracic chondrosarcoma. Also, to evaluate our results of resection and reconstruction of the chest wall in these cases.

Methods:

This is a retrospective study including 36 patients with thoracic chrondrosarcoma for whom chest wall resection and reconstruction were done in the Cardiothoracic Surgery Department, Mansoura University Hospital in the last fifteen years between January 1993 and December 2007.

Perioperative management for all patients:

Full history taking as regard age, sex, occupation, special habits was taken for all patients. The onset, course, and duration of illness were taken. All patients were asked for past history of trauma, chest irradiation, or chemotherapy for previous malignancy. Clinical examination; including general condition, chest, abdominal and cardiac examination were done. Local examinations of the tumor and any other swellings in the body were done. Laboratory investigations; including routine complete blood picture, liver and kidney functions, blood glucose level and tumor markers were done. In 8 cases, alkaline phosphatase, Bence Jones protein and bone marrow examination were done to exclude bone marrow tumors. Radiological investigations including: Chest X ray PA and lateral views were done in all cases. Oblique view was done in 10 cases. Bone scan and survey and metastatic work up were done in 7 cases. CT chest, abdomen and brain were done in all, 12 and 5 cases respectively. ECG was done for all cases. Biopsy were done for all patients whether preoperative or postoperative or both.

Surgical treatment:

The type of surgical approach to the chest wall resection and its extent with the type of the chest wall reconstruction were first planned.

Excision of the involved rib or ribs with their intercostal muscles, neurovascular bundles and 4 – 5 cm of the surrounding healthy tissue as safety margins was done for all cases of the rib origin.

Excision was carried out in such a manner that the entire rib segments and the intercostal muscles were excised in continuity and at least two normal ribs one above and one below the tumour mass were included and the extent of lateral resection was up to 4 – 5 cm of grossly normal tissue.

The skeletal resection of sternal tumours included 2 to 4 cm of adjacent ribs in addition to the affected portion of the sternum and it was preferable to keep part of the sternum intact if the margin of resection allows it safely. Segments of pleura and the pericardium were included in the resection.

Posterior chondrosarcoma in the paravertebral region were not readily amenable to wide and complete excision, with parts of vertebral bodies with their laminae and transverse processes. This was done in one patient with cooperation of the neurosurgeon.

Different types of biological and prosthetic materials were used in our study to provide the rigid replacement.

In biological replacement we used muscle flaps; latissimus dorsi muscle flap, pectoralis major muscle flap and rectus abdominus muscle flap.

In prosthetic grafts we used prolene mesh, either alone or with bone cement.

The postoperative care of the reconstructed patient is critical:

For all patients, all vital signs were monitored including blood pressure, pulse, respiratory rate, temperature, blood gases, and urine output. Fluid therapy was adjusted in all patients. Chest x-ray was done for all patients postoperatively.

Postoperative pathological examination was done for all patients. Postoperative follow up was done for possible complications or tumor recurrence.

Results:

During the last fifteen years, our department received 36 patients with thoracic chondrosarcoma. The age of these cases ranged from 20 – 70 years (mean age 47.5±4.3 years) and the majority of cases were between 50 and 60 years as shown in table (1) and figure (1).

Age group	No	%
20 – 30	5	13.9%
30 – 40	7	19.4%
40 – 50	8	22.2%
50 – 60	10	27.8%
60 – 70	6	16.7%
Total	36	100%

Table (1): Age distribution.

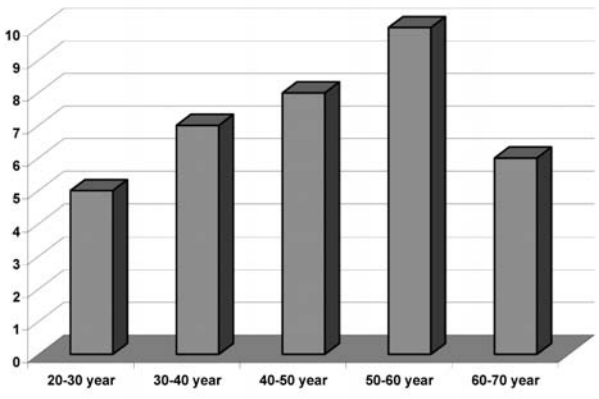

Fig (1): Age distribution.

As regard sex: chondrosaroma was common in males (63.9%) and the females represent 36.1% as shown in figure (2) and (3).

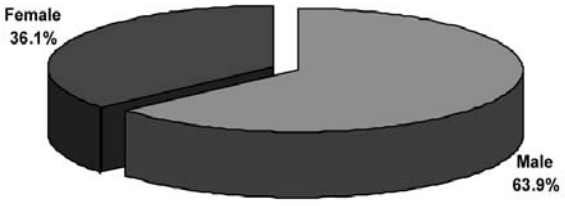

Fig (2): Sex distribution.

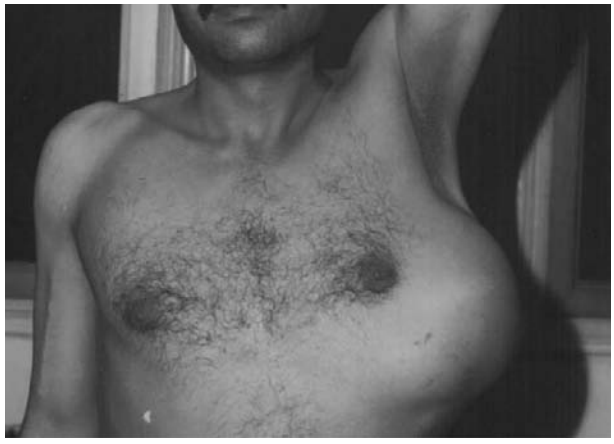

Fig (3): Male patient presented with swelling of the chest wall.

Clinically the mass presentation was the commonest picture (55.6%) followed by pain and mass presentation (33.3%) and only pain in 11.1% as shown in table (2) and figure (4).

	No	%
Mass	20	55.6%
Pain and mass	12	33.3%
Pain	4	11.1%

Table (2): Clinical presentation.

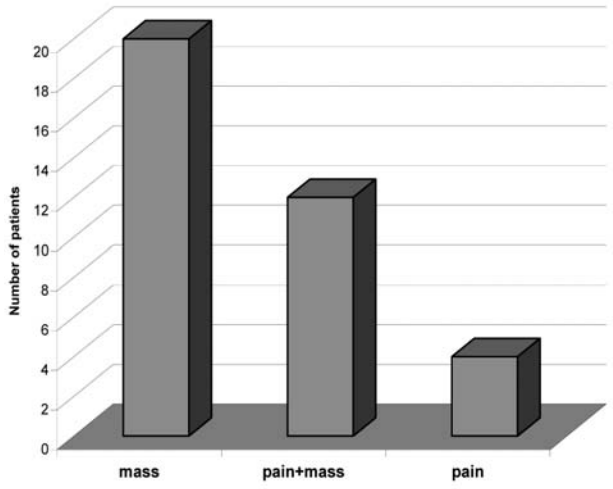

Fig (4): Clinical presentation.
Mass was the commonest symptom in clinical presentation of chondrosaroma (55.6%) as shown in figure (5).

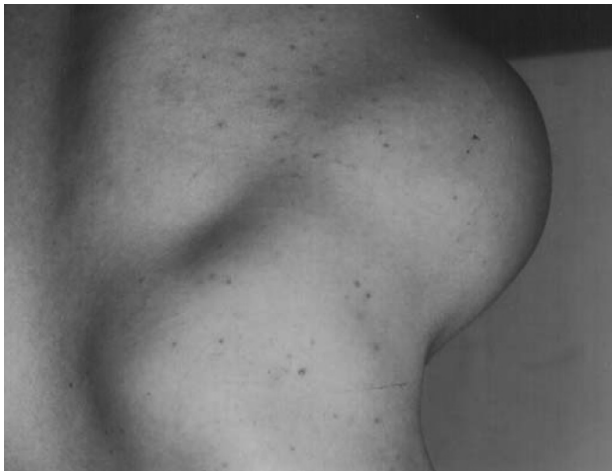

Fig (5): Lateral figure showing the same patient with huge mass presentation.

Anatomically the lesion present in the ribs in 83.3% including all parts of the rib mostly the costochondral junction, while it was in the sternum in 13.9% and posteriorly in the thoracic vertebrae in 2.8% as shown in table (3).

Anatomical site	No	%
Ribs		
Parasternal line	18	50%
Midclavicular line	6	16.7%
Anterior axillary line	3	8.3%
Mid axillary line	2	5.5%
Posterior axillary line	1	2.8%
Sternum	5	13.9%
Thoracic vertebrae	1	2.8%
Total	36	100%

Table (3): Anatomical position of the tumors.

Excision was done in all cases followed by chest wall reconstruction by the following methods: muscle flap in 5 cases (13.9%), prolene mesh in 16 cases (44.4%) and by prolene mesh with bone cement in between in 15 cases (41.7%) as shown in table (4) .

	No	%
Bone cement and prolene mesh	15	41.7%
Prolene mesh	16	44.4%
Muscle flap	5	13.9%
Total	36	100%

Table (4): Methods of reconstruction of the chest wall. Reconstruction by bone cement and prolene mesh were done in the majority of cases (41.7%).

After excision of the tumor in all cases, pathological examination was done for all cases for detection of the type of the tumors as shown in figure (6) and (7).

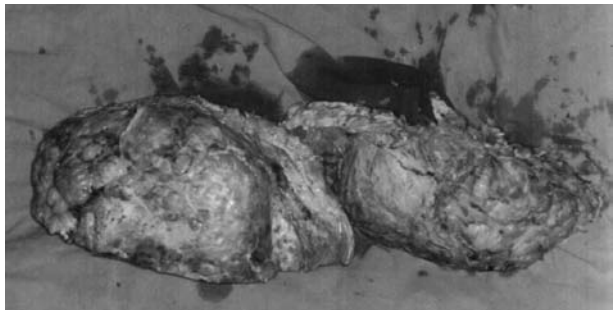

Fig (6): Macroscopic picture of chondrosarcoma of the rib.

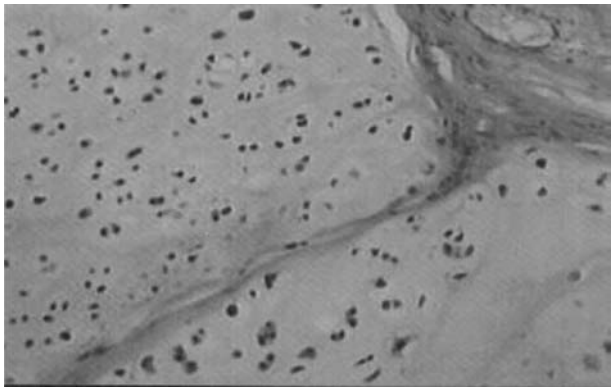

Fig (7): Microscopic picture of chondrosarcoma of the rib.

Postoperatively all patients were monitored for vital signs and follow up was done by clinical observation and radiological examinati on until discharge of the patients as shown in figure (8) and (9).

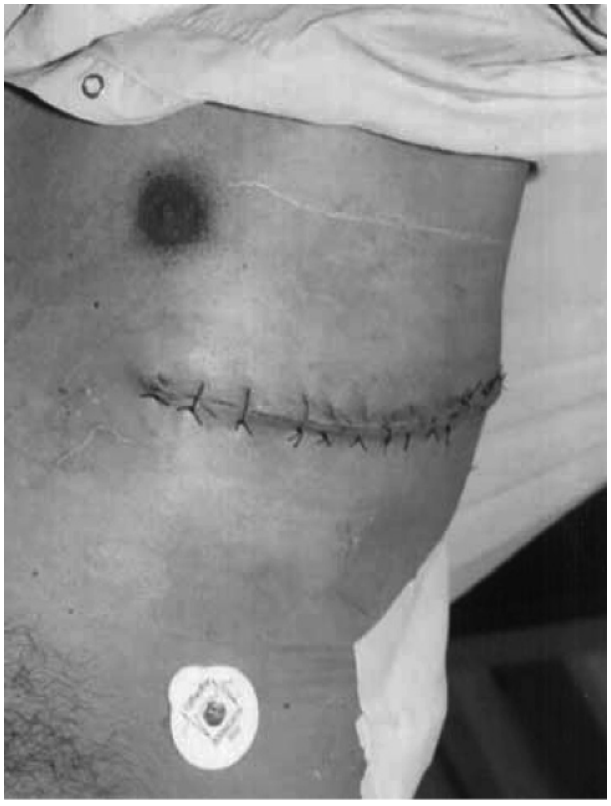

Fig (8): The patient after excision of the tumor and reconstruction of the chest wall by bone cement and prolene mesh.

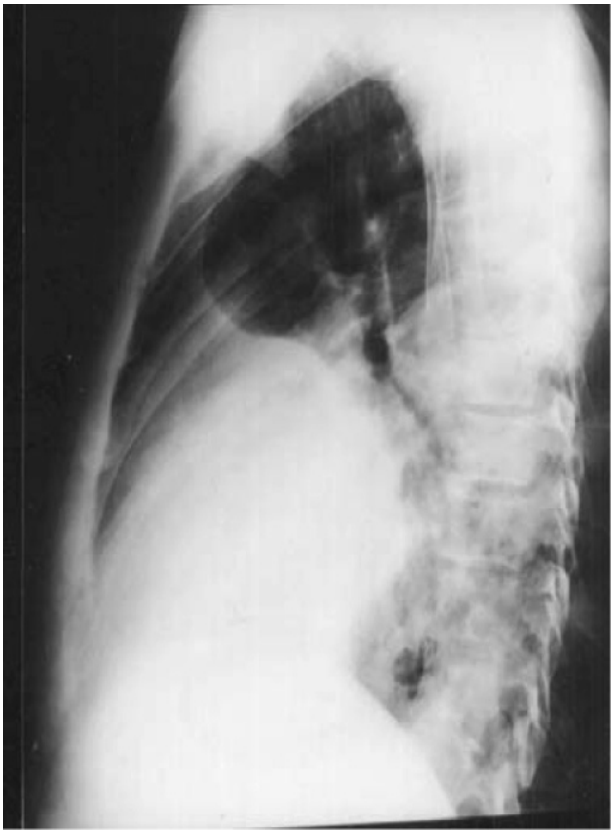

Fig (9): Lateral chest x-ray of the patient showing the reconstruction of the chest wall by bone cement and prolene mesh.

Morbidity occurred in 9 patients (25%), 3 patients suffered from fever, wound infection and dehiscence, 4 patients suffered from fever and seroma, 1 patient suffered from seroma and bleeding, and last patient suffered from fever, infection and bleeding as shown in table (5).

	No	Bone cement and prolene mesh	Prolene mesh alone	Direct	Muscle flap
Fever	8	5	2	0	1
Seroma	5	1	2	1	1
Wound dehiscence	3	1	2	0	0
Wound bleeding	2	0	1	0	1
Wound infection	4	1	2	0	1

Table (5): Postoperative complications in relation to the method of reconstruction.

N.B : One patient may suffer from more than one complication.

Local recurrence occurred in three patients (8.3%) after a period from 3 – 5 years after the initial surgery for its primary lesion and needed redo operation by wide excision and reconstruction of the chest wall by prolene mesh and bone cement.

Mortality occurred in one case (2.8%) in old aged asthmatic man aged 67 years with large defect who needed prosthetic chest wall reconstruction and postoperative ventilatory support and died after 5 days in ICU.

Discussion :

Chest wall tumors represent 5% of all thoracic cancers and 7% of primary bone lesions. Chondrosarcomas represent approximately 30% of primary malignant bone tumors, the most frequent of which is on anterior thoracic wall [2, 11]. The majority of chondrosaromas present as painful and enlarging swellings. Some of them may present as tumors that recur or persist after previous resection [12]. Surgical excision sometimes, is considered the only line for management. Advancement in the surgical techniques used in chest wall reconstruction occurred primarily through the muscle transposition and the better understanding of the functional anatomy and the blood supply of the trunk muscles or by the prosthetic reconstruction. The combined influence of all these factors resulted in a boost to the trend towards aggressive resection of this kind of tumors [8,9,12,13]. Although, malignant chest wall tumors has a tendency to appear in older patients, however chondrosaroma occur in any age group [6,7]. The age of our cases ranged from 20 – 70 years and the majority of the cases between 50 and 60 years (mean age 47.5±4.3 years). In the study of Cavanaugh et al. [14] the age was 30.5 and in the study of Pairolero and Arnold [15] the average age was 54.5 years. Chest wall tumors of the malignant etiology are as twice as frequent in men compared to women [1,7,12], this matched with our study in which the males were 63.9% while the females were 36.1% and this matched also with Burt et al. [16] where their males were 55%.

In Deschamps et al. [17], mass presentation occurred in 30%, pain occurred in 37% and pain and mass in 43%. Pain and the presence of a mass have been reported to be the most common complaints of patients with chest wall tumors and many patients experience both. In study of Sabanathan et al. [18], the pain was present in 27% of his cases and presence of a mass was in 29% and 44% presented by both. In our series 55.6% of cases presented by a mass, 33.3% presented by both mass and pain and 11.1% presented by pain. These differences were due to the fact that our study was on chondrosarcoma alone, but the others two studies were done upon all types of chest wall primary malignant tumors.

Arnold and Pairolero [19] noticed that primary malignant tumors originated in the cartilaginous ends of ribs, near to the sternum. Malignancy must always be considered and its possibility kept in mind when any patient presents with a chest wall tumor. This is particularly-true when painful mass is discovered [19,20]. The anatomical site of the pain or mass, is sometimes giving much help to the diagnosis. The majority of tumors of cartilaginous origin usually occur along the costochondral junction [18,20]. Many authors commonly believe that tumors of the sternum are almost always malignant and should be assumed so until proved otherwise [12,19]. In our study, Anatomically the lesion was present in the ribs in 83.3% while it was in the sternum in 13.9 and posteriorly in the thoracic vertebrae in 2.8%.

The diagnostic evaluation of patients with a chest wall mass which is suspected to be malignant should include, beside careful history and clinical examination, a good quality conventional plain and tomographic chest radiography. Computed tomography scanning, must also be performed to deliniate soft tissue, pleural, mediastinal and pulmonary involvement [21]. In our study, we examined all our patients clinically after careful history taking with routine investigations. Also all cases were examined radiologically by plain chest x-ray and by CT scanning. Many surgeons believe that primary chest wall tumors should be diagnosed by excision rather than incision or needle biopsy [19,21,22], but this opinion differ as what constitute of wide resection. Zuslu et al. [23] reported that the extent of margin resected did not affect the patient survival but may affect the rate of tumor recurrence.

Many surgeons agree with the opinion that a margin grossly free by 2.5 cm from macroscopic tumor growth should be considered as adequate resection, especially in low grade malignant primary chest wall tumor as chondrosarcoma [21,23]. In our study, only 6 cases were diagnosed preoperatively by incision biopsy but all the other were diagnosed by excision biopsy and 9 of them were diagnosed by frozen section to detect the safety margin around the excised mass during the operation.

Primary chest-wall neoplasms tend to infiltrate the external thoracic layers and need large resections to assure free margins. Such surgery poses difficult technical problems due to the necessity of assuring a full coverage of the thoracic defect. Then, before any major resection, careful planning of the reconstruction possibilities by a multidisciplinary team is mandatory [25]. Chest-wall reconstruction is a major procedure with a risk of life-threating complications. Accurate preoperative assessment is therefore critical, as it allows detection and treatment of correctable problems and permits the surgeon to individualize prospective management [17]. The indications of chest wall resection are primary chest wall malignancy, recurrent chest wall malignancy and contiguous lung or breast carcinoma [17,20]. In our study, all cases were primary chest wall chondrosarcoma and accurate preoperative assessment for every case was done with careful planning of the reconstruction possibilities.

Large chest wall defects frequently result from treatment of primary tumors. Chest wall reconstruction should include stabilization of the bony thorax and coverage of any soft tissue defect.

Reconstruction was planned and performed routinely with plastic surgeons. Pectoralis major muscle and myocutaneous flaps are frequently used to reconstruct defects of the upper sternum and chest wall [20,22]. The fact that these muscles have an axial blood supply, permits them to be substantially elevated and rotated with or without their overlying skin [17,25]. Pectoralis major is easy to raise and its size was large enough to cover large chest wall defects especially if internal mammary arteries and thoracodorsal arteries are compromised during surgery where the transverse rectus abdominis myocutaneous flap and latissimus dorsi flap became unreliable. In such cases a contralateral modified breast flap associated with pectoralis major muscle is the better choice [26]. Lanfery et al. [27] used pectoralis major muscle flap in 30.1% of his cases. In our study, we used muscle flap in scases (13.9%) we used pectoralis major muscle flap in 9 cases (40%), of those reconstructed by muscle flap and latissimus dorsi in other 2 cases (40%) and rectus abdominis muscle flap was used in only one patient (20%).

Grafting prosthetic materials for stabilization of the bony thorax were used in 31 cases (86.1%) in our study, we used prolene mesh in 16 cases (44.4%) and by prolene mesh with bone cement in between in 15 cases (41.7%). While in the study of Graeber et al. [21] it was used in 52% of cases. Prosthetic material stabilization may be used together with pedicled muscle flap for good stabilization of bony thorax with good blood supply as in the study of Stanic et al. [28] who described a case of 50-year-old man suffering from a slow-growing, painless giant chondrosarcoma of the anterior chest wall. A wide resection was performed to excise the tumor including attached skin, right breast, ribs, sternum, soft tissues and parietal pleura. Mediastinum was not affected by the tumor. After resecting a 26 x 20 x 22 cm segment, the chest wall defect was reconstructed with a Marlex mesh and extensive latissimus dorsi myocutaneous flap pedicled on the right thoracodorsal vessels. Histopathology diagnosis was chondrosarcoma G 2-3. The mechanics of ventilation was not altered and respiratory function was normal from the immediate postoperative period. Three years after the operation postoperative results showed no local recurrence and excellent respiratory functional results was evident [28].

Three cases in our study showed local recurrence after a period ranged from 3 – 5 years after the initial surgery for their primary lesion in whom wide excision were done with redo operation and reconstruction of the chest wall by prosthetic material and this matched with the study of Okutani et al. [29] who described a 63-year-old female with an anterior chest wall tumor, a recurrent chondrosarcoma in the right 2nd rib 4 years after the initial surgery for its primary lesion. Computed tomography (CT) showed a low density mass, 36 mm in diameter, arising from the 2nd rib. An extended excision of the chest wall including the tumor was performed followed by the reconstruction of the chest wall with double Marlex Mesh. As she had already undergone the reconstruction of the chest wall for its primary lesion, this reconstruction was her 2nd one. Nevertheless, her respiratory condition was well preserved with no significant chest deformity. Wide excision and reconstruction could be performed for the 2nd arising chondrosarcoma of the rib even after the initial lesion was already widely removed and reconstructed [29].

Postoperative morbidity occurred in 9 (25%) of our cases and varied from fever and seroma to wound infection and dehiscence. Only one mortality (2.8%) occurred in old aged asthmatic man with large mass which needed postoperative ventilation and died after 5 days in the ICU.

These rates of morbidity and mortality matched with other studies [7,8,11,13]. Also, Deschamps et al. [17] has

operative mortality rate is 4.1% and stated that chest wall resection and reconstruction with prosthetic material yielded satisfactory results in most patients.

Conclusion:

We conclude that chondrosarcoma is not an uncommon lesion of the chest wall which need early diagnosis and excision with safety margin. Also, there is many types of chest wall reconstruction which were needed to reconstruct the chest wall after excision of the tumor. So, the surgeon must be not in dilemma in cases of wide resection with large chest wall defect as they can use any of these different type of chest wall reconstruction.

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The Way I Do It

Optimal management of sternal wound infections

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The rapid growth of cardiac surgery over the past 40 years has median sternotomy a popular exposure of the heart and great vessels. Infections of this incision are fortunately uncommon , with rates of 1.2 to 6.8% in large series, and deep sternal wound infections consistently less than 3% . Advancements in the treatment of this complication range from the early open packing with granulation to the current treatment of choice –debridement and muscle flap closure-which have reduced its associated mortality from 30 to 50 % to 5.3 to 11.9% 1-4

Epidemiology:

Reductions in infection rates have occurred through the extensive use of perioperative antibiotics and the modification of risk factors when possible . Predisposing medical conditions identified as risk factors for sternal infection in various studies include chronic obstructive pulmonary disease, morbid obesity , diabetes mellitus with poor glucose control , steroid dependency , and preoperative stav in intensive care unit. Intraoprative risk factors indentified include sternotomy for conronary artery bypass , length of cardiopulmonary bypass , and total operative time . Postoperative factors include postoperative bleeding , need for re-exploration , low cardiac output syndrome , prolonged mechanical ventilation , and the presence of a tracheotomy. 1-2

The increasing use of internal mammary artery (IMA)in coronary aftery bypass surgery has led to a higher complication and mortality rate than in those earlier reviews that included saphenous vein grafts (SVG) . although the infection rate after SVG is not significantly different from that folloeing IMA grafts , an established sterna l infection after IMA grafting is a more virulent disease , possibly secondary to devascularization of the sternum .

Concern regarding the importance of the internal mammary artery (IMA)to the blood supply of the sternum was first suggested by Arnold , noting the devascularization of the sternum with IMA harvesting . Later primate studies have confirmed a marked decrease in perfusion of the sternum after IMA harvest , especially in the inferior sternum . Harvesting the mammary as a skeletonized vessel is associated with less reduction in

blood supply than is harvesting a pedicle . The results in clinical studies have been mixed with regard to the risk of sterna infection after unilateral mammary harvest , with mild risk seen in certain studies but not confirmed in others . While unilateral mammary harvest may not increase the risk of occurrence of an infection in some patients , the virulence of the infection appears worse on the side of the IMA harvested . Bilateral IMA harvest has been shown to be a consistent risk factor for infection , especially in the diabetic population , with a six-to eighfold increase in deep sternal infections .

Diagnosis :

The diagnosis of postoperative infection is usually preceded by unexplained fever, erythema, increasing pain in the incision and sternum, wound drainage, and instability of the sternum. Presentation ranges from 3 days to 3 weeks, with the median presentation ranging from 10 to 13 days postoperatively . The early cases are usually indicative of a major break in technique during the surgery . The diagnosis of a wound infection is usually not difficult but determination of depth of infection can be more challenging . Gallium bone scan s have not been useful in diagnosis, and experience with indium-labled WBCs has been minimal. Clinical experience and careful follow-up have been the best determinants of adequacy of wound care and need for surgical intervention.

Microbiology :

Of these infections, 75% involve staphylococcus aureus or S. epidermidis, with Gram-negative bacilli responsible for the majority of the remaining cases. Typical Gram-negative bacilli include Enterobacter, Pseudomonas, or Serratia marcescense. Fungal infections, which are difficult to treat, are fortunately rare. The Gram-positive infections usually represent skin contaminants, where as the Gram-negative infections usually have a concomitant infection, such as pneumonia or a leg wound infection. This suggest a role for hematogenous spread during an immunocompromised period perioperatively. Diabetic patients are particularly at risk for polymicrobial infections, which have a significantly higher mortality and need aggressive treatment both medically and surgically.

Surgical Principles :

Therapeutic measure includes (1) closed catheter irrigation for superficial wound infections; (2) open drainage and packing, with healing by secondary intention; (3) debridement and flap closure, which provide a higher success rate with decreased mortality and length of hospital stay; and (4) sternal resection, which should considered when previous multiple attempts at debridement with or without muscle flaps have failed.

The surgical principles of care of the infected wound remain unchanged, with drainage, debridement of all devitalized tissue, and elimination of dead space within the infected wound as the mainstays of treatment. Small superficial wound infections can be managed open, with healing by secondary intention. Opening the wound also provides an opportunity to evaluate the extent of the infection into deep tissues.

Deep wound infections are no longer treated open, with long periods of dressing changes and allowing the sternum to granulate. This method has a high morbidity, is difficult to manage, and requires long hospitalization. Debridement and closed irrigation improved the care of these patients but they also are no longer used in our institution because of the relativity high percentage of treatment failures (50%). The current treatment of choice for deep sternal infection involves surgical debridement and closure with autologous tissue, as originated by Jrkiewicz and bostwick in 1979. The original concept was used for salvage of treatment failure for debridement and closed irrigation. The wound was and converted to open. Once the wound remained clean with dressing changes and began to granulate, the patient was returned to the operating room for muscle flap closure. This approach salvaged 9 of 12 patients who failed closed irrigation.

Between 1978 and 1988, 246 patients where taken to the operating room for wound infection-out of 16,000 sternomotomies at our institution. Local wound debridement was adequate in 35, and the remaining 211 underwent debridement and muscle flap closure. This resulted in 94% overall success rate; 12 patients required three or more producers for closure. The flap survival rate was 99.2%, with a 10% incidence of abdominal complications in patients with rectus abdominis flaps.

Flap Selection :

The choice of muscle flaps depends on the type of conduit used for the bypass and the dimensions of the sterna defect (Table 19-1).

Bypass Conduit	Flap selection
Vein graft	Pectoralis rotation-advancement
	Unilateral split pectoralis turnover
	Unilateral rectus abdominis
	Combined flaps
Unilateral IMA	Contralateral split pectoralis turnover
	Contralateral rectus abdominis
	Pectoralis rotation-advancement
	Combined flaps
Bilateral IMA	Segmental pectoralis flaps
	Pectoralis rotation-advancement
	Rectus abdominis
	Omentum
	Bipedicled pectoralis-rectus
	Latissimus
	Combined flaps

Table (19-1). Local Flap Selection following Reversed Saphenous Vein and Internal Mammary Artery (IMA) Bypass Grafts

The pectoralis muscle has several advantages that make it the first choice for the majority of patients requiring a flap. It is in close proximity to the wound, has a reliable vascular anatomy, and has the lowest rate of complications of any flap. The blood supply to the pectoralis come primarily from the thoracoacromial vessels from the subclavian artery, with secondary supply from

The perforators of the internal mammary artery. Variable contributions are made from the lateral thoracic vessels (Figure 19-1). The various blood vessels to the muscle provide several options in the use of the pectoralis. The most common has been the use of the entire muscle as a rotation-advancement flap based on thoracoacromial vessels (Figure 19-2). The IMA perforators are shacrificed ,and humeral attachments are divided . The anterior axillary fold is usually abolished but may be partially restored by attachment of the insertion stump to the perctoralis minor . For smaller defects ,the humeral attachments and motor nerves can be left intact for preservation of function .

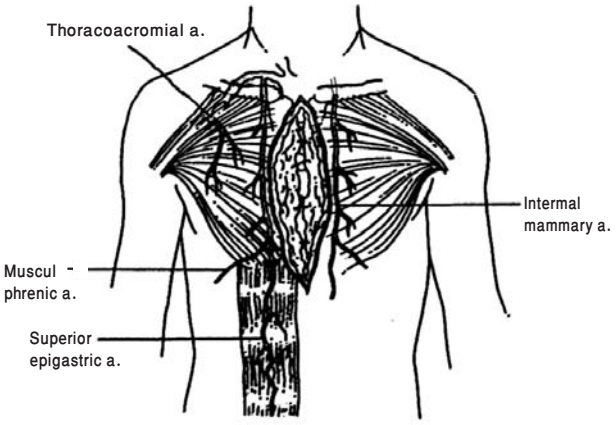

Figure 19-1. Anatomy and blood supply of pectoralis major and rectus abdominis muscles.

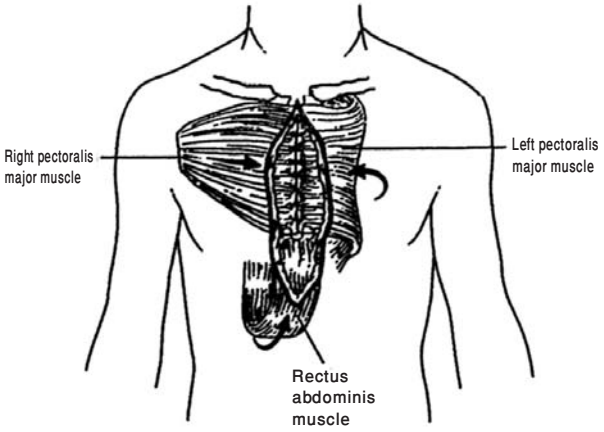

Figure 19-2 . pectoralis turnover and advancement flaps and rectus turnover .

The muscle may also be used in its entirety as a turnover flap . This method is limited to the side of the sternum with undisturbed IMA , as the perforators of this vessel are used and the thoracoacromial trunk and humeral attachments are divided . In large shallow wounds after a total sternectomy , bilateral perctoralis advancement flaps may be used without separation of the humeral attachment or the overlying skin . For patients with bilateral IMA grafts , the segmental pectoralis flap is used . The pectoralis muscle is split, and the superior half is used as a rotation advancement flap based on the thoracoacromial pedicle . The inferior half is mobilized

from lateral to medial direction and is supplied by the intercostals artery perforators (Figure 19-3) .

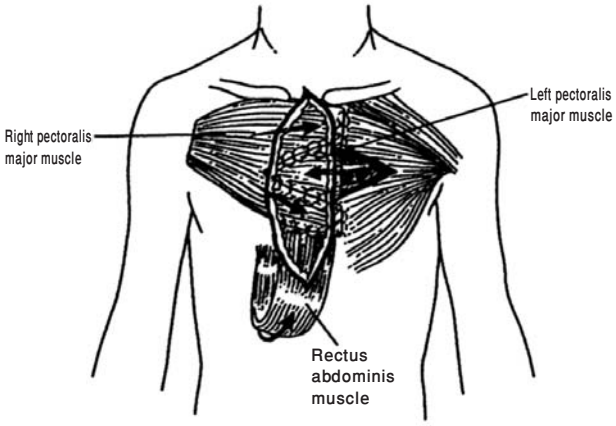

Figure 19-3 . Small portion of left pectoralis transposed on its internal mammary vessels and interdigitated with contralateral pectoralis based on its thoracoacromial vessel . Rectus flap covering inferior defect .

The rectus abdominis is used for coverage of the lower third of the sternum (Figure 19-4) . The dominant blood supply is from the inferior epigastric artery , which is divided when the rectus is raised , leaving the superior epigastric artery as the primary blood supply , and so it must be intact . This flap is associated with a high incidence of seroma formation as well as a 2.4 % incidence of abdominal wall herniation . The rectus abdominis muscle can survive as a turnover flap based on the eighth intercostals artery at the cost margin in patients who are at least 6 months out after havesting of both IMAs .

The omentum is a distant third in sternal wound coverage utilization (see Figure 19-4) . Its superb pliability allows it to fill deep and irregular defects . The vascular arcade from the right or left gastroepiploic allow the lengthening of the omentum . The omentum can reach the nipple level in 70% of patients and the sternal angle in 40% by detaching it from the transverse colon . The blood supply can be based on either the right or left or on both gastroepiploic vessels .

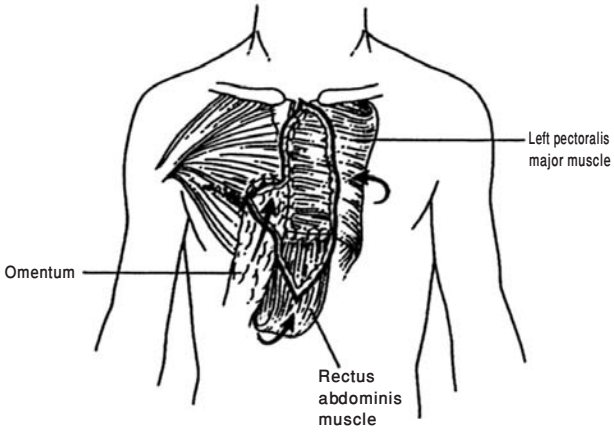

Figure 19-4 . Closure with pectoralis , rectus , and great omentum .

Another alternative , when both IMAs have been harvested , is the "single bipedicled pectoralis-rectus unit"based on both the thoracoacromial vessels superiorly and the deep inferior epigastric vessel inferiorly (Figures 19-5A and B) . This flap is elevated from medial to lateral direction and divided lateral to the thoracoacromial pedicle . The pectoralis-rectus unit is then transposed medially and is often sutured to a similar flap from the other side .

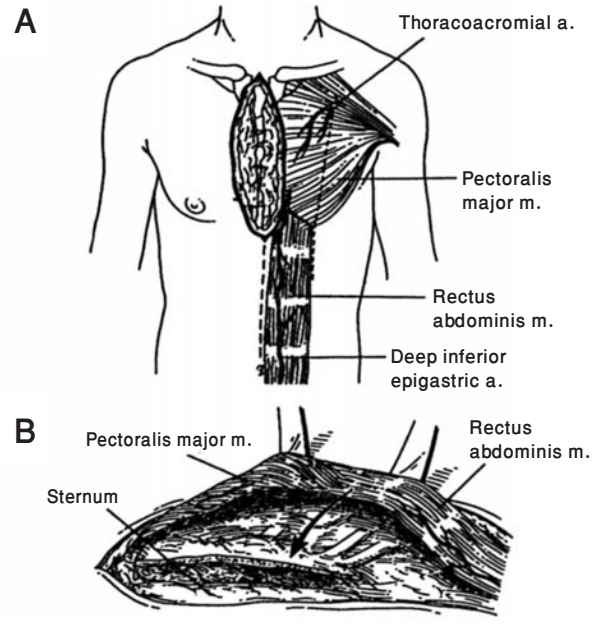

Figure 19-5A,B . Bipedicled pectoralis-rectus flap .

The latissimus dorsi muscle , based on the thoracodorsal vessels that arise from the ipsilateral axillary vessels , can be transposed subpectorally in the rare instance in which these other options are not available .

In our series of sternal resections , partial or complete , infection was the most common indication . The majority of our patients had undergone previous multiple attempts at incision and debridemnt , with or without previous muscle flap closures of the sternum . Sternal resection was performed only after failure of less radical measures for an established infection .

Conclusion :

The mortality of sternal infection and the length of hospitalization have been greatly reduced by advances in the treatment of this complication . The treatment of choice is early debridement and closure of the resulting wound defect with the pectoralis flap as a single-stage procedure . Rare cases require complete resection of the sternum to remove a source of ongoing sepsis .

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