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Guidelines For Authors

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

Editorial Office

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

General Instructions

Every submission must include:

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

Required disclosures;

A. **Conditions for Publication Form** which includes disclosures regarding freedom of investigation and conflicts of interest, signed by ***all*** authors. In single Author publication an additional Senior Consultant Signature is required.

B. **Written permission from the *publisher*** (copyright holder) is required to reproduce any previously published table(s), illustration(s) or photograph(s) in *both print and electronic media*.

C. **Written permission** from unmasked patients appearing in photographs is also required.

Revised_Manuscripts:

Revised manuscripts must be submitted in three parts as Microsoft word-processing files : (1) cover letter with responses to reviewers' comments (2) revised, marked manuscript showing additions and deletions; (3) revised, unmarked manuscript.

General Information

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

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.

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

Case reports and **"how to 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 words for each illustration and 300 words for each table.

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

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

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

Manuscript Preparation

Title Page (first page)

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, including correspondence, must have a title.

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

Authors. List all authors by first name, all initials, family name and highest academic degree using "MD, PhD" for holders of both degrees (if more then 7 Authors justifie).

Institution and Affiliations. List the name and full address of all institutions where the work was done. List departmental affiliations of each author affiliated with that institution after each institutional address.

Meeting Presentation. If the paper has been or is to be presented at the annual meeting of The Society, provide the name, location and dates of the meeting.

Keywords. Provide up to 5 keywords selected from the appended list to describe the manuscript. Do not use any keywords that are not on the list..

Word Count. Provide the electronic total word count of the entire manuscript including title page, abstract,text,figure legends and entire reference list.

Corresponding Author. Provide the name, exact postal address with *postal code, telephone number, fax number and e-mail address* of the author to whom communications, proofs and requests for reprints should be sent.

Abstract Page (Second page)

- Original articles

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

*- **New Technology***

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

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

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

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

Text *(thirdpagecontinueuptoacknowledgments)*

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**. Credit suppliers of drugs, equipment and other brand-name material mentioned in the article within parentheses in text, giving company name, city and country.

Acknowledgments

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

References

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

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

Chapter in Book

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

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.

Tables;

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.

Figure Legends

Figure Legends should be numbered (Arabic) and typed *double-spaced* in order of appearance beginning on a separate sheet. Identify (in alphabetical order) all abbreviations appearing in the illustrations at the end of each legend. Give the type of stain and magnification power for all photomicrographs. **Cite the source** of previously published material in the legend and indicate permission has been obtained. Proof of permission must be surface mailed or faxed to the editor.

Illustrations

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

Images or figures are submitted online as one or more separate files that may contain one or more images. Within each file containing images, use the figure number (eg, Figure 1A) as the image filename. The system accepts image files formatted in TIFF and EPS. Powerpoint (.ppt) files are also accepted, but for line drawings only and you must use a separate Powerpoint image file for each Powerpoint figure.

Most illustrations will be reproduced at a width of one column (8.25 cm; 3 1/4 inches). **Black, white and widely crosshatched bars** are preferable; do not use stippling, gray fill or thin lines.

Instructions:

Identify print proofs of figures on the back with figure number and name of the first author; when necessary, indicate the top with an up arrow

Please include hardware and software information, in addition to the file names, with figures submitted electronically or on disk

For figures submitted in electronic format, all images should be at least 5 inches wide. Graphics software such as Photoshop and Illustrator, should be used to create art.

Color images need to be CMYK, at least 300 dpi.

Gray scale images should be at least 300 dpi .

Line art (black and white or color) and combinations of gray scale and line art should be at least 1200 DPI .

Cover letter:

Include with the manuscript a cover letter that provides 1) the category of manuscript (e.g., original research, Brief Communication, Letter to the Editor); 2) statement that the material has not been previously published or submitted elsewhere for publication; 3) information about any personal conflicts of interest of any of the authors; and 4) names of sources of outside support for research, including funding, equipment, and drugs .You may also submit the name of one reviewer of your choice. You should include that individual's mailing address, telephone number, fax number, and e-mail address.

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Before publication of an accepted manuscript, each author is required to certify by signing the Conditions for Publication Form that he or she has participated sufficiently in the work and approved the final version of the manuscript to be published.

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The J. Egypt. Soc. Cardiothorac. Surg. requires authors to disclose any conflict of interests. Authors who have a financial relationship with one or more companies whose products are featured in an article will ***disclose the existence of this relationship in a box at the bottom of the first page of the published article.***

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All manuscripts with statistical analysis are required to undergo biostatistical review .The most appropriate way is to involve a biostatistician consultant or coauthor from the investigators' home institution . Manuscripts may undergo further biostatistical review by the Journal after submission. Additional information on statistical methods can be found in "Uniform Requirements for Manuscripts Submitted to Biomedical Journals"(www.acponline.org/journals/resource/unifreqr.htm).

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Date of acceptance : letter is provided from the editor.

Checklist:

A] Cover letter

- *Letter to the Editor*
- *Manuscript category designation .*
- *Single-journal submission affirmation .*
- *Conflict of interest statement (if appropriate).*
- *Sources of outside funding.*
- *Signed Statistical Collaboration .*

B] Complete manuscript

- *Title page .*
- *Title of article*
- *Full name(s), academic degrees, and affiliation(s) of authors.*
- *Corresponding author .*
- *Telephones, fax, and e-mail address*
- *Abstract (250 words; double-spaced) .*
- *Ultramini-abstract (50 words; double-spaced) .*
- *Text (double-spaced).*
- *References (double-spaced; separate pages).*
- *Tables (double-spaced; separate pages).*
- *Figures (separate files; on hardcopy; properly identified),*
- *Figure legends (double-spaced; separate pages) .*
- *Word count.*

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Electronic Publishing

Tips for preparing Word documents

1 Learn how to use the Word features under the Tools/ Autocorrect submenu. Some people turn off all autocorrection features because they are disconcerted by Word's default behaviour of adjusting capitalisation and reformatting type on the fly, but these features save a lot of time once you tune them in to match your expectations. In particular, if you have a long word like 'hypergammaglobulinaemia' that you need to type repeatedly, turn on `Replace text as you type' and add it to the replacement list.

2 Keep formatting to a minimum. Editors, much prefer manuscripts in a simple one-column layout. Only use fonts that everybody has on their computers: for example, Times New Roman for your main text font and Arial as your font for headings. Turn off type justification, automatic hyphenation, and automatic paragraph numbering. On the other hand, the use of bold, italic, superscript, and subscript text as appropriate is good.

3 Use styles and style tagging rather than formatting the article paragraph by paragraph. This makes it much easier to format an article as you write and easier again if you are asked to change the formatting later. For your level I headings, therefore, define a Heading l style, with the combination of font, spacing, and alignment that you want to use, and then apply this to each heading as you create it. To change all your level I headings later, simply redefine the style and all will be changed without having to select and manipulate each heading.

4 Format text as one continuous flow. Use a page break (Ctrl + Enter) to start a new page (e.g. after your title page) not a stream of hard returns. Put only one hard return between each paragraph,. Do not break the article up with Word's section breaks.

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

6 Image files should be sent as separate files. The same goes for Excel spreadsheets or charts. If you are embedding images in the file, it is probably best to do it at the end, after the text and references.

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

What about PDF?

Send your Manuscript in a Word file. Don't send it as

PDF or any other word processor format.

PDF files are not editable in the same way as word processor files. Some publishers will ask for, or even create, a pdf file of your manuscript for use during the peer review process, but a Word file will also be required for editing and production.

Tips for preparing images

Do not make electronic images too small . No effective way exists to increase the resolution of an image beyond its original size, and if an image is reduced in size and saved, picture data is permanently lost. Image files therefore have to be created and saved at high resolution. For a colour image that is to be printed as 4 X 4 in., the required size is (4 X 300) X (4 X 300) = 1200 X 1200 = 1440 000 dots. In many image formats (e.g. tagged image file format, or tiff), each dot will take eight bits (one byte) to store, so the image file will be 1.44 megabytes

Compression techniques can reduce the size of the image file. Zip compression is safe, because it uses an algorithm that packs the data tighter without throwing any of it away; In Compression during which files are saved in jpeg format, select the option for large file size (maximum picture quality).

Guidelines for Reviewers

Purpose of Peer Review

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

Acceptance of a Manuscript for Review

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

Category of the Manuscript

The broad categories of papers for which peer review is undertaken are (1) original scientific articles; (2) new technology papers; (3) case reports, how to do it articles and images; and (4) review articles. The editor and/or associate editors review correspondence, invited commentaries, editorials, surgical heritage submissions and ethical and statistical papers.

General Requirements for Publication

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

Original Scientific Article

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

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

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

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

New Technology

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

Topics which the reviewer should consider include:

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

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

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

Case Reports, How to Do It, Images

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

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

Review Article

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

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

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

Footnote.

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

Secundum Atrial Septal Defect Closure by Video-Assisted Minimal Invasive Technique in Adult Patients: An Early Results Study

Cardiovascular

Marwan H. Elkassas, MD [a],

Prof. Olivier Jegaden [b]

Introduction & aim: The operation for atrial septal defect (ASD) is a low risk procedure; the cosmetic issue and postoperative early recovery are important especially for young adults and females. Minimal invasive video-assisted minithoracotomy resolved these problems, and it was not associated with increased operative or postoperative morbidity. However its technical difficulty makes it a problem for some surgeons, here by we present our early results, **aiming** to prove it is safe and easy, to encourage other surgeon to adopt this technique and use it more frequently.

Methods: Nine patients with secundum septal atrial defect all were closed with video-assisted minimal invasive technique between Jun 2012 and August 2013 in Sheikh Zayed Hospital in Cairo. We compared the results with another ten patients operated for the same lesion by conventional sternotomy in our center.

Results: We operated nine patients with secundum atrial defect all were closed with minimal invasive technique, five were females (55.5%), and mean age was 26 ys. Mean bypass time was 56.73 min, cross clamp time was 24.18 min; mean skin incision was 6.8 cm. All patients were extubated within the first few hours after surgery, average postoperative bleeding amount was 203.48 ml. Mean stay at the intensive care unit was 17.28 Hs. Patients were discharged after a mean of 5.6 days with statistically significant difference. Only one patient had postoperative pleural effusion, no residual shunts or neurological defects were denoted.

In conclusion: minimal invasive ASD closure in adult patients is a challenging technique, but it is safe and with good overall postoperative results.

Author's contribution: M.H.K results collection, preparing the paper writing, operated the last four patients. O.J. helped in results collection, operated the first five cases, transmitted and teaching the technique.

Median sternotomy is the standard surgical technique applied for the treatment of congenital ASD lesions. However, full or even partial sternotomy have sternotomy-related complications and incision at the middle of the chest given a visible scar that is permanent reminder of actually low-risk procedure especially for young females [1-4].

Different approaches, such as ministernotomy [5, 6], antrolateral thoracotomy [7-10], and posterolateral [11] thoracotomy have gained popularity, but all still have certain complications and morbidity, as antrolateral right-sided thoracotomy in young female patients impaired breast development, and for both the posterolateral and the anterolateral approaches transection of large muscle groups is required. Moreover more incidences of postoperative pain and analgesic usage with wide area of paraesethia were reported [12-15].

Minimally invasive interventions have been preferred in recent years for correction of congenital ASD closure in children and young adults [16-22], particularly females[23]. Minimal invasive cardiac surgery techniques proved to be superior in reducing postoperative complications, overall hospital stay and patients recovery with equal incidence of safety and accuracy [17-27].

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Although the new minimally invasive approaches are appealing to patients for the small scars, and also for the health care administrations in reducing the hospital stay and overall cost [28], the surgeon must be cautious and look beyond the market attraction to assure that the new procedures are equivalent to conventional approaches in efficacy and safety.

Despite we have relatively limited numbers of patients, we intended to present our preliminary encouraging results of this new surgical technique in our country, to encourage other surgeons to adopt this technique, and to pave the way for others who are specialized in congenital heart surgery to use this technique in there daily activities.

Patients and Methods

Since we started our minimal invasive program Jun 2012 till August 2013 in Sheikh Zayed hospital in Cairo, we operated nine patients with secundum atrial defect all were closed with minimal invasive technique (group 1), five were females (55.5%), and mean age was 26 ys. All data were retrospectively collected, during the previous two years from October 2011 to March 2013 we found that we operated 12 patients with secundum ASD by conventional median sternotomy, we collected the data of those patients but excluded two patients, one with AF and age was 52 y, the other was with pulmonary pressure of 62 mmHg, so we had 10 patients (group 2) that we compared their results of ASD closure by median sternotomy technique with the minimal invasive patients.

Statistical comparisons for all data were made with the use of a $\chi 2$ analysis to calculate significance with respect to discrete variables. Operative and postoperative times were compared by means of a two-tailed t test. Data are shown as mean ± standard error of the mean.

Anesthesia

The necessary peripheral arterial and venous accesses are installed for patient hemodynamic monitoring. The patient is anesthetized in a supine position with the right side of the chest elevated 15 to 20 degrees, intravenous anesthesia with fentanyl, propofol, and pancuronium was administered, patient intubated with a single lumen endotracheal tube.

A standard 3-lumen (7.0 or 8.5 Fr) central venous line is used for drug administration and CVP monitoring. External defibrillator pads were placed on the patient's back and the lateral left chest.

Transesophageal echocardiography (TEE) probe is inserted for the venous cannulation guidance and effective Dearing. The patient is draped exposing the left lateral border of the sternum, the anterior and right lateral chest wall and both groin zones, with the right arm away and slightly down the plane of the operating table. The skin is prepared with iodine solution and an aseptic strip is applied to the exposed areas.

Surgical technique

Before we explain the surgical technique, we should mention that we tried to fixe most of our steps, and it was; but there were some differences from case to case during the operation some of them were planed others was not, as we still in our learning curve with limited experience.

The incision is placed on the right side of the chest in the inframammary fold over the fifth rib, and the thorax entered through the bed of the fourth rib after sub pectoral dissection, after good hemostasis a soft tissue retractor was used for tissue protection and better visualization, then a minithoracotomy retractor was introduced to stabilize the field, if every thing is ok the groin incision was carried on.

The 12 mm plastic trocar port was introduced and then the 10 mm (0-degree or 30-degree view) thoracoscopic camera was inserted through the port in the fourth intercostal space posterior to the thoracotomy incision. Co2 insufflations was used once we introduced the trocar through a side way connection by a flow of about 2 to 2.5 L/min, until we closed the right atrium and removed the cross clamp.

Femoral artery cannulation was the site of choice for all patients, exposure of the femoral artery and vein was accomplished through a transverse 4-cm groin crease incision. After systemic heparinization, a thin-walled arterial cannula with rigid occluder (Medtronic-Biomedicus, Eden Prairie, MN) was advanced into the femoral artery over a wire that introduced through a needle at the 5/0 prolene purse-string site. As regard the inferior vena cava cannulation it was cannulated through the femoral vein by multi staged venous cannula 22 or 23/25 Fr according to the vein size using the sildenger technique over a wire (RAP cannula, Estech, San Ramon, USA) Pic. (1), the cannula was introduced retrograde until the orifice of the IVC and not in the atrium where an umbilical tape was used for snaring later on.

For the superior vena cava cannulation it was different from case to case according to the situation and material availability, so in four cases a 20 or 22 Fr metal-tipped right angle venous cannula (DLP, Grand Rapids, MI) was used for direct cannulation of the superior vena cava after two purse-string sutures using 3/0 prolene, and in two cases 20 Fr non-metal right angle single stage venous cannula was used also for direct cannulation of the superior vena cava, and a 20 Fr femoral arterial cannula was used for superior vena cava cannulation in another three cases after two purse string sutures, all the superior vena cava cannulation was done through the thoracotomy incision, placement of venous cannula through the small incision is facilitated by controlling the cannula near its point of insertion with a curved clamp.

We should mention that the most difficult step in this technique was the superior vena cava cannulation and snaring as in four cases we could not do it through the fourth intercostal

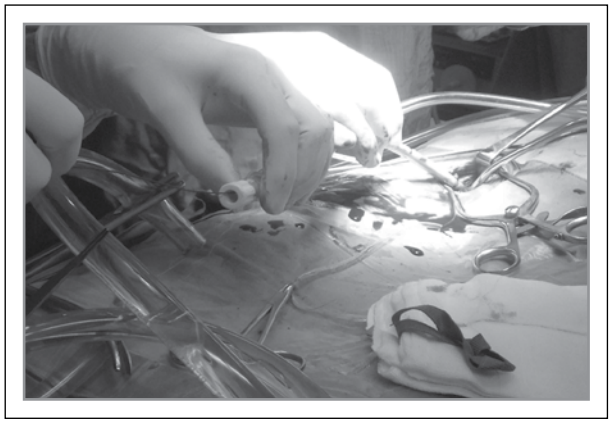

Fig 1. Femoral vessels cannulation using sildenger technique.

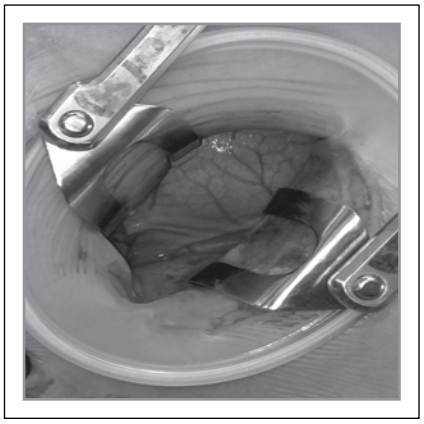

Fig 2. Minimal invasive incision in the fourth intercostal space showing in close up mode the pericardium before harvesting, and the phrenic nerve passing over it.

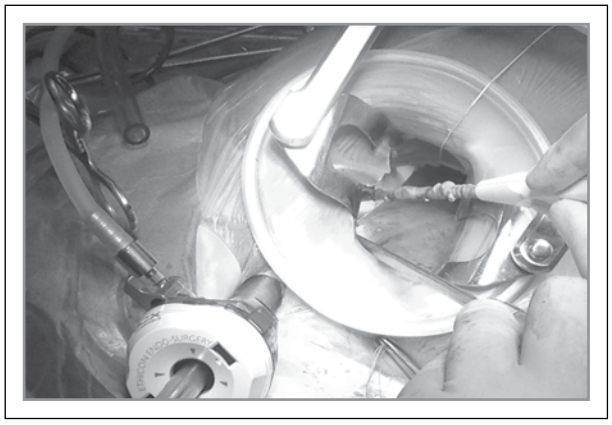

Fig 3. Minimal invasive incision after soft tissue application, using the long diathermy blade for pericardial patch harvesting for ASD closure, and after applying the thoracic port and the camera in the same space posterior to the incision with the side pore connection for the Co2 insufflation.

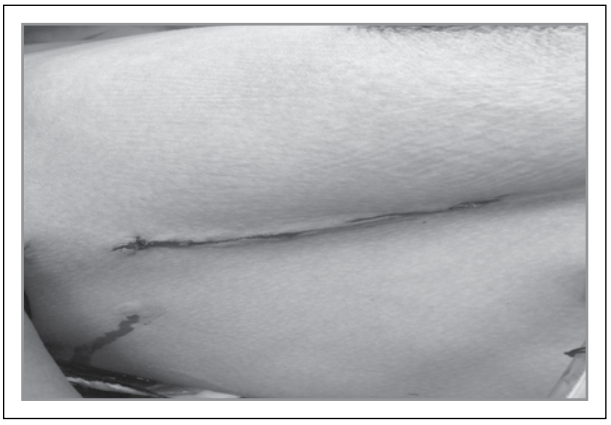

Fig 4. Minimal invasive skin incision post ASD closure (submammary incision)

space but we actually opened the third intercostal space through the same skin incision of coarse, we used a small minimal invasive retractor (Estech, Estech instruments, USA) in the third space for cannulation and snaring of the superior vena cava, then we introduced the cannula through the third space and connected it by Y-connection to the femoral vein cannula for venous drainage. The up coming steps and the ASD closure were done through the fourth space.

Then we begin the bypass machine, conventional cardiopulmonary bypass system with roller pumps and membrane oxygenator was used, a traction suture to the diaphragm was done if needed, where it fixed trans cutaneously at the chest wall, then a pericardial incision was done two cm parallel and superior to the phrenic nerve, and a well enough pericardial patch was harvested Pics (2&3), three traction sutures were done routinely and fixed below the incision on the chest wall through the third, fourth and fifth intercostal space consecutively.

Inspection of the aorta was done, and 2-0 purse string prolene suture was applied at the aortic root slightly at the lateral side and as low as it possible using special long endoscopic instruments. An antegrade cardioplegia cannula (MIAR, Medtronic, USA) placed in the proximal ascending aorta to deliver the cardioplegia and served as an aortic root vent later on in six cases, but in the last three cases a retrograde cardioplegia cannula was used through the opening of the coronary sinus (Retrograde cardiplegia cannula, Medtronic, USA) after caval snarig and after the application of the aortic clamp, care was taken not to introduce the cannula in the sinus beyond its orifice and without inflation of its balloon; not as the usual cannulation, as any injury to the body of the sinus is almost impossible to repair through the minimal invasive incision.

We used a transthoracic special aortic cross clamp (Chitwood, Transthoracic aortic clamp) where it passed through the chest wall in the third intercostal space at the anterior axillary line, anterior to the superior vena cava through the transverse sinus just caudal to the right pulmonary artery. Systemic cardiopulmonary temperature perfusion was maintained not less than 34° C throughout the arrest period

Closure of the ASD is carried out through the right atriotomy, using a pericardial patch and a running single layer 3/0 prolene suture.

Most of the operation, including cross clamp placement, suture placement, and knot tying, was directed by thoracoscopic secondary vision. But ASD inspection, atriotomy closure often was done by direct primary vision.

Aortic root vent was used for Dearing, and in the last three cases Dearing was done through the patch after filling the heart and using a valsalva technique in addition. After atrium closure cross clamp removal, and resuming of the heart beats, two pace maker wires were applied, with two small size intercostal tubes drainage, direct muscle closure was done without any intercostal sutures traction. After protamine administration, removal of the femoral cannulae was done, and we conducted a direct surgical vessel repair technique using 5-0 prolene suture for the both femoral vessels.

Results

Since we started our minimal invasive program Jun 2012 till August 2013, we operated nine patients with secundum atrial defect all were closed with minimal invasive technique, five were females (55.5%), and mean age was 26 ys. Mean bypass time was 56.73 min, cross clamp time was 24.18 min; mean skin incision was 6.8 cm Pic. (4). All patients were extubated within the first few hours after surgery, average postoperative bleeding amount was 203.48 ml. Mean stay at the intensive care unit was 17.28 Hs. All patients were discharged after a mean of 5.6 days. In two patients, a pneumothorax after drainage removal was noticed but resolved after conservative treatment. One patient presented with a right pleural effusion after two weeks, which resolved with medical treatment. At follow-up, no shunt could be detected on atrial level. No phrenic nerve damage or neurologic sequelae were found.

Preoperative data	Minimal Invasive Group (N=9)	Conventional Sternotomy Group (N=10)	P -value
age	26.17±5.35	28.4±5.3	0.95
sex(female)	55.5%	60%	0.98
Hg	11.±2.6	11.9±0.8	0.97
Hct	32.4±0.9	32.6±0.7	0.98
S. Cr	0.9± 0.4	0.8 ± 0.1	0.85
INR	1.1±0.4	1.2±0.2	0.9
platelet count	256.3±21.4	288.4±42.5	0.91
AST	17.3±3.5	23.2±2.7	0.8
ALT	19.2±4.2	16.5±4.6	0.8
NYHA Class	2.5±0.4	2.7±0.3	0.9
EF	53.82±2.7	53.4±2.2	0.98
PAP	24.6±6.7	26.2±5.8	0.81
LA	4.9±0.36	5.3±0.78	0.9
EDD	5.43± 2.1	5.3±2.5	0.89
ESD	3.73±0.36	3.4±0.29	0.9
B.S.A.	1.67±0.4	1.72±0.36	0.7

Table (1) Demographic and preoperative data of the two groups

Variables	Minimal Invasive	Conventional Sternotomy	P value
Total Drainage (ml)	203.48 ±67.8	430.91 ± 61.39	p <0.05
Fresh Frozen Plasma (units)	2.45 ± 0.52	2.3 ± 0.58	p < 0.62
Packed Blood (units)	1.3 ± 0.46	1.7 ± 0.65	p < 0.73
Post Operative Hg %	11.56± 1.3	10.04 ± 0.8	p < 0.68
Time of Ventilation (hrs)	3.3 ± 1.2	7.5 ± 2.3	p<0.001
ICU Stay (hrs)	17.28 ± 4.87	25.45 ± 10.8	p < 0.05
Total Hospital Stay (days)	5.6 ±1.7	8.8 ± 2.4	p < 0.01
Average Skin Incision Length (cm)	6.8 ± 2.3	23.6 ± 1.2	p < 0.001
Cross Clamp Time (min)	24.18 ± 13.7	18.2 ± 6.8	p < 0.05
Total bypass Time (min)	56.73 ± 6.8	37.2 ± 7.9	p < 0.05
Incidence of Neurological complication	0	0	NS
Incidence of Pl effusion	1	1	NS

Table (4) operative and postoperative Data

Discussion

Median sternotomy has been the gold standard technique in the repair of congenital cardiac defects [1, 2, 4]. However, the use of minimally invasive operations in the treatment of children and non-complicated young adults has been growing, and this technique has become the preferred method for the pediatric population and young adults [17-23].

In terms of cosmetic results, right video-assisted minithoracotomy is superior to median sternotomy and right anterolateral thoracotomy [17-23]. In the repair of small cardiac congenital defects like ASD, drawbacks of median sternotomy include the length of the incision in the middle of the chest, postoperative pain, and possible complications of the sternotomy (mediastinitis, osteomyelitis, etc.). The major advantage of minimally invasive cardiac surgery is avoiding sternotomy. Experience with minimally invasive thoracic and cardiac surgery has shown that the surgical method has more reliable outcomes, minimizes surgical complications, provides rapid and functional healing, shortens the hospitalization time, and accordingly reduces the cost [21-28].

Most surgeons have preferred anterolateral thoracotomy in the closure of ASD [7-10]. The advantage of this approach is the field of vision. Its disadvantage is the dissection of large muscle zones and soft tissues, and accordingly, it may cause the deformation of muscles, decrease skin sensation around the nipple, poor development of the breast and pectoral muscles and cosmetic problems [3, 11-14].

The submammary incision usually is associated with the development of hematoma, seroma, and nipple/breast anesthesia in as many as 10% to 15% of women who are operated on through this incision in the conventional antrolateral thoracotomy [12-15] technique with an average skin incision length of 14 cm, but those problems greatly reduced by the minimal invasive technique with an average incision length of 5 cm, more over the technique have the least intercostal muscle dissection, it did not needed any suture around the ribs by any mean (just muscle approximation) for closure, and so avoided the intercostal bundle compression with very low postoperative early pain and completely prevent the long term subsequent chronic pain that could happened to some of the patients [26, 27].

Because of the fact that these cardiac defects were done with minithoracotomy from a restricted space, surgery may last longer in the minithoracotomy. Different study have demonstrated that the duration of surgery in minimal invasive ASD closure by minithoracotomy was longer, but their hospitalization time is shorter [2, 16-20].

Mishra et al. [24] reported that, minimal invasive technique provides maximum security and gives less post operative drainage, a lower transfusion volume, and stated that it shortens the intensive care unit stay and offers early recovery as well; this result is supported by a lot of other studies [16-22, 24-27].

In our study despite it is of limited numbers of patients and it is a preliminary one but the difference between the two groups as regard the post operative drainage amount is quite obvious and it is statistically significant, despite the post

operative difference between the two groups in the hemoglobin concentration or the hematocrite value is not obvious.

Several published articles have concluded that minimal invasive operations are associated with shorter lengths of hospital and intensive care unit stays [16-27], but with longer cardiopulmonary bypass and cross-clamp times [16-19, 22-28] . In our study we proofed that minimal invasive surgery is accompanied with lower ventilation time and this is translated to shorter ICU stay as well, and shorter hospital stay (5.6 ±1.7 days in the minimal invasive group vs. 8.8 ± 2.4 days in the sternotomy group), and both were statistically significant with definitely longer bypass and cross clamp time.

We do have significant longer bypass and cross clamp time, this is expected in this technique, and if we revised the data of the other studies some had more or less the same time between the groups, others have longer time in the bypass or cross clamp time with statistically significant difference [2, 17-22], more over we just began our learning curve and we are sure that we will ameliorate our result in favor of shorter bypass and clamp time step by step.

As regard the average skin incision length it was 6.8 cm which is comparable to other studies results which was around 4-6 cm [16-20], as well it is cosmetically more accepted, and we are sure that we will have shorter incision length later on.

One of the serious complications in conventional median sternotomy is an infection of the sternum. A particularly deep sternum infection produces Mediastinitis, which causes a high rate of morbidity and mortality. On the other hand, in a minimally invasive intervention, the incidence of postoperative infection is quite low and scar site pain is minimized [2, 26, 27]. No incisional or pleural infections were found in the patients undergoing minithoracotomy in our study.

Furthermore, the mini thoracotomy patients did not face any restrictions in their daily activities (such as the position of lying in a bed or lifting a weight), many authors have revealed that this technique has functional and cosmetic advantages.

To conclude: ASD repair with minimal invasive technique, apart from the limited working zone for the surgeon as compared to sternotomy, has a number of advantages lower early and late complications, less need for analgesics, and better cosmetic results. Additionally, when thinking about lower blood loss, early recovery and avoiding sternum infections and hypertrophic changes of the skin, we are supporting that minimal invasive technique in correction of simple congenital adult cardiac lesion is a reliable alternative to sternotomy.

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MANAGEMENT OF RARE POSTTRAUMATIC CARDIAC INJURIES IN A PERIPHERAL HOSPITAL

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Background: **The decision to screen for blunt cardiac injures (BCI) is clinician dependent because there are no standard criteria. Attempts have been made to identify specific injuries that might be highly associated with BCI, such as sternal fracture, but no such association has been demonstrated. On the other hand traumatic cardiac penetration is not frequent but highly lethal, with case fatality rates of 70-80%.**

Patient and methods: **From January 2010 to September 2012, 19 patients diagnosed and managed as post-traumatic cardiac injuries in thoracic surgery unit King Saud Hospital, and Prince sultan Cardiac Center,Al-Qaseem area , Saudi Arabia.**

Results: **There were 18 males and one female. All our patients were young (the mean age was 23 years). All blunt cardiac injury patients (10), had severe chest trauma associated with sternal fracture in two cases, flail chest in 4 cases , and multiple rib fractures in 4 cases. Eight patients (8 from 10)(80%) with blunt cardiac injury were managed conservatively. We have nine penetrating cardiac injuries : 6 injuries (66.66%) were stab wounds, 2 injuries(22.22%) were penetrating nail of nailgun into the heart, and one injury was gunshot wound (11.11%).**

In Conclusion : **Cardiac injuries either blunt or penetrating are often lethal and have a poor prognosis; therefore doctors need to have a high level of suspicion with such injuries, which need to be treated aggressively with resuscitation, early diagnosis and early surgical repair.**

KEY WORDS: **Blunt cardiac trauma - penetrating injury-diagnostic protocol.**

Many patients with cardiovascular compromise from BCI are already admitted to the critical care setting based on their associated injuries, but much debate surrounds those patients who are hemodynamically stable on initial evaluation and do not otherwise require a higher level of care(1). It thus becomes crucial to determine what tests and diagnostic studies are required to safely rule out BCI, to allow for safe discharge home or admission to a nonmonitored setting(2). The decision to screen for BCI is clinician dependent because there are no standard criteria. Attempts have been made to identify specific injuries that might be highly associated with BCI, such as sternal fracture, but no such association has been demonstrated(3). On the other hand traumatic cardiac penetration is not frequent but highly lethal, with case fatality rates of 70-80%. The degree of anatomic injury and occurrence of cardiac standstill, both related to the mechanism of injury, determine survival probability. Patients who reach the hospital before cardiac arrest occurs usually survive(4). Those patients surviving penetrating injury to the heart without coronary or valvular injury can be expected to regain normal cardiac function on long-term follow up.

Ventricular injuries are more common than atrial injuries, and the right side is involved more often than the left side. In 1997, Brown and Grover noted the following distribution of penetrating cardiac injuries(5):

- Right ventricle - 43%
- Left ventricle - 34%
- Right atrium - 16%
- Left atrium - 7%

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The Beck's triad (ie, high venous pressure, low arterial pressure, muffled heart sounds) is documented in only 10-30% of patients who have proven tamponade(6).

In this study, we discuss the clinical features, diagnosis, treatment and prognosis of these cases in our peripheral hospital.

PATIENT AND METHODS

From January 2010 to September 2012, 19 patients diagnosed and managed as post-traumatic cardiac injuries in thoracic surgery unit King Saud Hospital, and Prince sultan Cardiac Center,Al-Qaseem area , Saudi Arabia. Among them 10 patients had blunt cardiac injuries ,8 of those blunt cardiac injuries were managed conservatively and two patients was managed surgically. The remained 9 patients in this study had penetrating injuries, eight patients with penetrating cardiac injuries were subjected to surgery and one was managed conservatively after penetrating gunshot.

Data collected included : Patient age and sex , mechanism of injury, initial clinical presentation and hemodynamic findings, preoperative investigations (chest radiographs, electrocardiogra m,echocardiography either transthoracic or transesophageal,CT scan "fig. 1",cardiac enzymes)according to the patient condition and the need. Surgical modalities for management and repair, ICU stay, hospital stay, and cardiac outcome also recorded .

The decision to screen our patients with blunt trauma as blunt cardiac injury was clinician dependent and based on some criteria:1-Unexplained hypotension ,2- Previously undocumented murmur, 3-New abnormality in the admission ECG(arrhythmia, ST changes,ischemia,heart block , and unexplained ST changes).Close observation of those patients with continuous ECG monitoring and daily serum troponin I level . Differentiation between blunt cardiac injuries and acute myocardial infarction was needed for one case and this was achieved by cardiac catheterization.

Interventions included : thoracotomy,or sternotomy, for resuscitation and definitive repair of cardiac injury. Bleeding was rapidly controlled using finger occlusion, and direct sutures. Cardiopulmonary bypass was necessary in 2 patients : one with blunt trauma resulted in rupture papillary muscle with acute mitral regurge and the other was with penetrating nail into the left atrium which restrict the leaflet movement and causes mitral regurge also . Foreign bodies in the cardiac chambers was removed.

RESULTS

From January 2010 till September 2012 , nineteen cardiac trauma patients arrived alive at emergency department of King Saud Hospital in Al-Qaseem area,Saudi Arabia.

There were 18 males and one female. All our patients were young (the mean age was 23 years). Clinical evaluation was done in the resuscitation room and showed:

All blunt cardiac injury patients (10), had severe chest trauma associated with sternal fracture in two cases, flail chest in 4 cases, and multiple rib fractures in 4 cases.Eight patients (8 from 10)(80%) with blunt cardiac injury were managed conservatively, one of them(10%) died due to low cardiac output failue inspite of high dose of inotropic support ,electrocardiography (ECG) changes was noticed in all patients with blunt cardiac injuries in the form of arrhythmia in 8 patients and ST changes in two patients .Sustained elevation of serum troponin I more than 1.5 μg/L for more than 36 hours was noticed in 2 patients with blunt trauma. The other two patients with blunt cardiac injury were managed surgically (one of them had rupture anterior papillary muscle with acute mitral valve regurge- and the other had rupture pericardium with apical herniation of the heart).

We have nine penetrating cardiac injuries: 6 injuries (66.66%) were stab wounds, 2 injuries (22.22%) were penetrating nail of nailgun into the heart, and one injury was gunshot wound (11.11%), table No. (1). Of the nine wounds, no patients had multiple chamber injuries. Distribution of anatomical injury site showed in table No. (2). We have no mortality among our patients with penetrating cardiac injuries. Tamponade was present in 5 patients (55.55%), and did not affecting survival.

Variable	No.	%
Penetrating stab	6/19	31.6
Penetrating gunnail	2/19	10.5
Penetrating gunshot	1/19	5.3
Blunt traumatic rupture papillary muscle	1/19	5.3
Blunt traumatic pericardial ruptre	1/19	5.3

Table (1) Type of injury

Variable	No.	%
Rt. Ventricle injury	3/10	30
Lt. ventricle injury	1/10	10
Rt. Atrial injury	1/10	10
Lt. atrial injury	1/10	10
Pericardial injury (one penetration and one rupture)	2/10	20
Pulmonary trunk injury	1/10	10
Rupture anterior papillary muscle	1/10	10

Table (2) Operative findings (anatomical injury site)

One case (11.11%) with penetrating wound due to gunshot was managed conservatively with intercostal tube drainage ,as the lesion was affecting the pericardium only with mild haemopericardium and haemothorax. Emergency depatment thoracotomy was performed in 7 of the 9 patients with penetrating injuries (77.77%), and Cardiopulmonary bypass was needed for one case (11.11%) with nail in the left atrium that cause acute mitral regurge.Direct repair of the injured chamber was made for all patients approached through thoracotomy using 3/0 prolene with interrupted stitches that were reinforced with teflon.Six patients were operated on through left thoracotomy (66.7%), 1 through right thoracotomy, and 2 were operated on by means of sternotomy, one of them had blunt trauma and rupture anterior papillary muscle (table 3).

Variable	No.	%
Left thoracotomy	7/10	70
Right thoracotomy	1 /10	10
Median sternotomy	2 /10	20

Table (3) Surgical approach

In concern of operative findings, the right ventricle was injured in 3 cases, the left ventricle in one case, left atrium in one case , and right atrium in one case(table 2).

There was a tear in the pericardium without myocardial lesion in 2 cases, pulmonary trunk was injured in one case , and small injury in the superior vena cava was detected in the case with right atrial injury. Postoperative complications was uncommon for all our cases with no mortality . The average stay in intensive care unit was 3 days for our patients with penetrating injuries and was 6 days for those with blunt cardiac injury, with average hospital stay of 12 and 15 days for our patients with penetrating and blunt cardiac injury respectively.

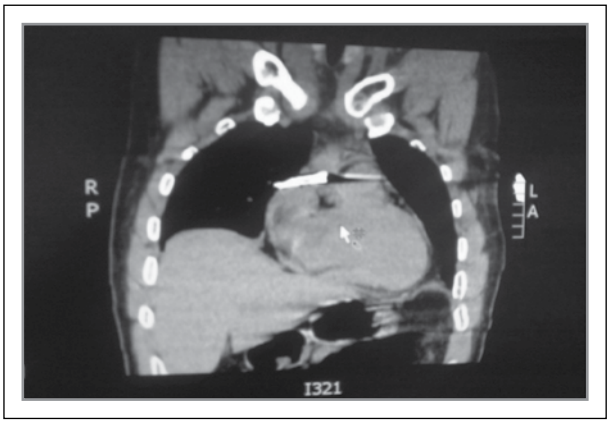

Fig 1. CT scan of the chest with IV contrast of a patient with gunnail in the right atrium

DISCUSSION

The clinical spectrum of cardiac injuries after blunt chest trauma varing from myocardial contusion to valvular rupture. (7)

Little attention has been paid to non penetrating heart lesions which are not fatal. It thus becomes crucial to determine what tests and diagnostic studies are required to safely rule out blunt cardiac injury, to allow for safe discharge home or admission to a nonmonitored setting.(2)Attempts have been made to identify specific injuries that might be highly associated with blunt cardiac injury, such as sternal fracture, but no such association has been demonstrated(7). In general, the literature supports that patients with any significant blunt trauma to the anterior chest should be screened.The frequency with which a diagnosis of traumatic heart injuries is made depends on the freuency and diligence with which they are sought.(8)(9)(10)

Penetrating cardiothoracic injury includes both stab and gunshot wounds. Stabbing wounds generally occur more frequently than gunshot wounds.(11)

The most common site of stabbing cardiac injury is the right ventricle , but the highest mortality rate is found for left ventricular injury because this reflects pump failure and this is followed by RV and superior vena cava injuries

In this study all chest trauma patients with a diagnosis of blunt or penetrating cardiac injury at a period of 32 months were managed in our hospital , except two patients needed cardiopulmonary bypass were shifted to the nearest cardiac center . Our study showed a variety of penetrating injuries , some of these injuries was very rare but was not fatal.

The diagnosis of blunt cardiac injury in our study was more difficult than those with penetrating injury and this was the condition for some other series which stated that the diagnosis of blunt cardiac injury remains challenging (1)(12), but severely injured patients who present with hemodynamic instability must be suspected of having structural damage to the heart, great vessels , or both and should have an echocardiographic examination as soon as possible.(13)

In Baccari S et al., study in 2012, the confirmation of the diagnosis of penetrating cardiac injury may be difficult especially in patients with unstable hemodynamic status.(4) In other series pericardial tamponade with Beck's triade(distended neck veins,muffled heart sounds,and hypotension), is the unique manifestation of cardiac injury.(9)(14)

High suspicious and awareness of our emergency department doctors led to early recognition and proper diagnosis of traumatic cardiac injury patients with good outcome.

In agreement with others , our results have shown that victims of traumatic cardiac injuries are predominantly young males,mean age in our study was 23 years with 18 males and

one female.(14)

The choice of incision may be influenced by the surgeon's experience. In spite of the fact that the emergency department thoracotomy is a very useful tool ,mainly as a life saving procedure to treat traumatic cardiac injuties ,it allows only limited cardiac exposure .(15) Median sternotomy affords optimal mediastinal exposure, it can be performed rapidly and is convenient if a cardiopulmonary bypass in needed to treat multiple chamber wounds , and to repair intracardiac lesions.(16)

Antero-lateral thoracotomy either left or right according to the lesion was the incision of choice in our study , this approach releive tamponade ,if present and allows digital control and repair of the wound. Median sternotomy with cardiopulmonary bypass was needed for two patients in this study , one with traumatic rupture anterior papillary muscle , and the other with a nail penetrating the left atrium.

Our postoperative complications were uncommon and were respiratory in nature , and this was the case in other studies. (7)

In Conclusion : Cardiac injuries either blunt or penetrating are often lethal and have a poor prognosis; therefore doctors need to have a high level of suspicion with such injuries, which need to be treated aggressively with resuscitation, early diagnosis and early surgical repair. Better results can be achieved only with rapid transportation of these patients to hospital, combined with early and aggressive management. Traumatic cardiac injuries will remain a diagnostic challenge to physicians who provide emergency care.

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Femoral Arterial Cannulation For Cardiopulmonary Bypass Using 8-Mm Dacron Graft

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Background: **Prolonged cardiopulmonary bypass requiring femoral arterial cannulation may lead to ipsilateral leg ischemia, compartment syndrome, and direct cannulation of the femoral artery using the standard femoral cannula may lead to arterial injuries especially in diseased vessles. Cannulation of the femoral artery through a graft may eliminate such complications.**

Methods: **Between March 2006 and December 2011, the technique of indirect arterial cannulation of the femoral artery for cardiopulmonary bypass by a Dacron 8-mm tube graft was used in 357 patients(273 males and 83 females) ranging from age 22 years to 84 years (mean 56 years), who were subjected to aortic surgeries at Cairo university hospitals. And complications related to cannulation were noted.**

Results: **Hospital mortality was 54 patients (15%), none of them were related to the method of cannulation. Malperfusion on initiation of cardiopulmonary bypass was noted in 8 (2.3%) patients. 12 patients (4%) developed superficial femoral wound infection with delayed healing, 2 patients (0.6%) had deep femoral wound infection with abscess formation, 32 patients (10.5%) had post-operative lymphorrhea due to injury of the lymphatic vessels which lasted for 10-35 days and disappeared, One patient developed pseudo-aneurysm in the femoral artery and was treated surgically by excision of the affected segment in the femoral artery with inter-position tube graft placement.**

Conclusion: **This easily applied technique allows femoral cannulation during cardiopulmonary bypass and eliminates the complication of distal femoral ischemia in operations requiring prolonged cardiopulmonary bypass.**

Femoral arterial cannulation has been used for cardiopulmonary bypass since the 1950s[1]. The avoidance of direct manipulations of the ascending aorta and the good access to the vessel were the main advantages[2].

Cardiopulmonary bypass for aortic reconstruction often requires femoral arterial cannulation. Standard femoral cannulation results in occlusion of the femoral artery around the cannula, thus eliminating antegrade flow into the distal femoral artery and possibly resulting in lower extremity ischemia[3-5].

Other vascular complications that may occur due to direct cannulation of the femoral artery include arterial injury, dissection of the common femoral artery[6-8], and retrograde arterial dissection which is the most serious complication as it can be fatal when it leads to rupture of the aorta or malperfusion of the major branch arteries[9]. This complication is more likely in diseased arteries and in patients over 40 years old.

Perfusion of the femoral artery via a graft sewn end-to-side onto the artery provides bidirectional flow, and thus eliminates distal ischemia[10], also this technique avoid intimal injury and retrograde dissection, and causes no reduction in the available femoral artery lumen.

Objective: This study is a trial to assess the value and effectiveness of a simple and reproducible surgical procedure for femoral arterial cannulation in ascending aortic surgeries using Dacron arterial graft sewn end to side onto the femoral artery and connected directly to the arterial line of the cardiopulmonary bypass to be used instead of the standard femoral arterial cannula.

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Codex : o3/03/1306

Patients and methods

From March 2006 to December 2011, we used the technique of indirect arterial cannulation of the femoral artery for cardiopulmonary bypass in 357 patients who were subjected to aortic surgeries at Cairo university hospitals.

Patients with type A aortic dissection and ascending aortic aneurysms were operated through median sternotomy, cold cardiopulmonary bypass was carried out through femoral arterial inflow and either common atrial or bicaval venous drainage, intermittent antergrade cold blood cardioplegia was used in all patients.

Patients with type B aortic dissection and descending thoracic aortic aneurysms were operated through posterolateral thoracotomy, left heart bypass was carried out through femoral artery and left inferior pulmonary vein.

Hypothermic circulatory arrest with cerebral protection using retro-grade cerebral perfusion was used in cases of type A aortic dissection for constructing the distal ascending aortic anastomosis and in cases required arch reconstruction.

Surgical technique

During opening the sternum (or the left thoracotomy in descending thoracic aortic surgeries), the assistant exposes the femoral vessels. A transverse skin incision is made directly over the femoral vessels inferior to the inguinal ligament. The femoral sheath is opened. Proximal and distal controls are obtained on the common femoral artery using umbilical tapes.

After systemic heparinization , the artery is clamped proximally and distally using two vascular clamps, a longitudinal arteriotomy is made and a segment of 8-mm collagen-impregnated, knitted Dacron graft is sutured in an end-to-side fashion with a 5-0 polypropylene suture. Then the femoral arterial occlusion is released, and a clamp is placed on the graft. After flushing the Dacron graft and ensuring that hemostasis had been achieved, we used a 1/4-inch to 3/8-inch (6.35-mm to 9.53-mm) standard perfusion connector to connect the free end of the 8-mm graft to the arterial line of the cardiopulmonary bypass (CPB) circuit, and we secured the graft with size 0 silk sutures. During the operation, blood will flow without obstruction both proximally (and hence to the remainder of the body) and distally in the femoral artery. After cardiopulmonary bypass is terminated, the graft is amputated about 1 cm from the anastomosis to the femoral artery and oversewn with 5-0 polypropylene suture or stapled with a vascular stapler.

The cannulation site, specific operative repair, and complications related to cannulation were noted, as was the overall clinical outcome. Specific attention was paid to intra-operative and immediate post-operative vascular complications in the cannulated lower limb related to the process of femoral cannulation.

Most survivors were followed up for a period of 6 to 18 months (mean 12 months) for local complications in the cannulation site as well as the development of any vascular complications in the cannulated lower extremity.

Results

Three hundred-fifty seven patients were enrolled in this study (273 males and 83 females) ranging from age 22 years to 84 years (mean 56 years).

162 patients(45.4%) had acute type A aortic dissection, 116 patients (32.5%) had ascending aortic aneurysm (with or without arch aneurysm), 38 patients(10.6%) with chronic type B aortic dissection, 25 patients(7%) with chronic type A aortic dissection, 9 patients (2.5%) with descending thoracic aneurysm, and 7 patients(2%) with complicated acute type B aortic dissection (Table 1).

AORTIC PATHOLOGY	N=357	%
Acute type A aortic dissection	162	45.4%
Chronic type A aortic dissection	25	7%
Ascending aortic aneurysm	116	32.5%
Acute type B aortic dissection	7	2%
Chronic type B aortic dissection	38	10.6%
Descending thoracic aneurysm	9	2.5%

Table 1: Aortic pathology

Supra-coronary replacement of the ascending aorta was done in 158 patients (with or without hemi-arch or total arch replacement, repair or replacement of one or more of the aortic sinuses), replacement of the aortic root and ascending aorta by a valved conduit (Pentall procedure) was done in 82 patients, replacement of the aortic root and ascending aorta with preservation of the aortic valve (Tayron David technique and remodeling of aortic sinuses) in 63 patients. The 54 patients with descending thoracic aortic pathology had replacement of variable length of the descending thoracic aorta by a Dacron tube graft conduit (Table 2).

Cardiopulmonary bypass time ranged from 1.5 to 9.5 hours (mean 3.9 hours). Total circulatory arrest with retro-grade cerebral perfusion was done in 223 patients to construct the distal anastomosis either due to the presence of dissection or due to distal ascending or arch pathology, circulatory arrest time ranged from 8 to 45 minutes (mean 19 min.).

Procedure	N= 357	%
Supracoronary conduit	158	44.5%
Pentall procedure	82	23%
Valve-sparing root replacement	63	17.5%
Replacement of descending A.	54	15%

Table 2: Operative procedures

Cannulation of the right femoral artery was done in 253 patients(71%) while the left femoral artery was chosen for cannulation in 104 patients(29%), the decision whether to cannulated Rt. or Lt. femoral artery is made according to the pre-operative information if there is ilio-femoral disease affecting one side or if there is extension of the dissection flap in one side, if both sides showed no abnormality or no enough pre-operative assessment of the ilio-femoral vessels we cannulated the side in which the femoral pulsation is felt better, if the pulsations are equal in both sides we prefer to open the Rt. side in case we may need to cannulate the femoral vein as the Rt. femoral vein is much easier in cannulation than the Lt. femoral vein and to proceed with femoro-femoral bypass especially in high risk patients and redo cases.

Malperfusion on initiation of cardiopulmonary bypass was noted in 8 (2.3%) patients in whom we changed the site of cannulation either to the ascending aorta, the axillary artery, the contra-lateral femoral artery, or the constructed graft after performing the distal anastomosis, while in the remaining 349 patients we continued using the femoral arterial line till the end of the procedure.

Intra-operative and hospital mortality in this study was 54 patients (15%) , causes of intra-operative mortality included intractable bleeding, myocardial failure either due to prolonged ischemia or due to undiagnosed pre-existing coronary artery disease, or dissection involving the main coronary arteries. Causes of hospital mortality included postoperative bleeding, low cardiac output, renal failure, hepatic failure, respiratory failure and ARDS.

No mortality occurred related to the technique of arterial femoral cannulation, and none of these patients developed lower limb ischemia in the cannulated limb, the distal pulsations was checked at the end of the operation and daily during the whole hospital stay.

Twelve patients of the survivors (4%) developed superficial femoral wound infection with delayed healing, 9 of them occurred during the first 2 years in this study where we used to make vertical skin incision for exposure of the femoral vessels, but later on with the adoption of the technique of the transverse groin incision with the skin crease just below the inguinal ligament, the rate of infection and delayed healing are markedly reduced. All patients with superficial wound infection were treated conservatively with repeated dressings until healing occurred.

Two patients (0.6%) had deep femoral wound infection with abscess formation which required surgical evacuation; both patients were females, insulin dependent diabetics and overweight. Complete healing with secondary intention occurred within 35-40 days after surgical drainage.

Thirty two patients (10.5%) had post-operative lymphorrhea due to injury of the lymphatic vessels which lasted for 10-35 days and disappeared in all cases.

Follow-up of the hospital survivors for 6-18 months after discharge by clinical evaluation and arterial duplex in some cases revealed no ischemic events affecting the cannulated lower extremity in any of them.

One patient developed pseudo-aneurysm in the femoral artery at the site of the amputated Dacron graft; it was about 5 cm in diameter and presented 3 months after the patient was discharged from the hospital. This patient was treated surgically by excision of the affected segment in the femoral artery with inter-position tube graft placement.

Discussion

Acute femoral occlusion may cause leg ischemia and lead to muscle necrosis and a compartment syndrome. This occurs most commonly with atherosclerotic disease and superimposed clot formation, but it can occur with normal vessels if the cannula is occlusive and collateral circulation is poor. It has also been reported with femoral cannulation for cardiopulmonary bypass[11].

During femoral arterial cannulation, direct axial blood flow to the lower leg is totally interrupted from the cannula and often a distal vascular clamp is applied to the distal common femoral artery. Blood flow to the leg continues by collaterals from the internal iliac arteries and lumbar arteries to the profunda femoris collaterals and then to the lower leg through the descending branch of the lateral femoral circumflex artery or back to the superficial femoral artery.

Perfusion of the femoral artery via a graft sewn end-to-side onto the artery provides bidirectional flow, and thus eliminates distal ischemia. This was suggested (but not employed) by Gates and colleagues[3] in their description of 2 patients with thigh ischemia after cardiac operations performed with femoral arterial perfusion. Cannulation by the technique described above apportions arterial perfusion by the relative resistance of the perfused vascular beds. Thus, excessive blood flow into the

perfused leg (or inadequate flow into the remainder of the body) should be prevented by autoregulation.

Similar technique was described by Vander Salm[10] at University of Massachusetts Medical Center where he used a segment of a 10-mm standard polytetrafluoroethylene (PTFE) graft sewn in an end-to-side fashion to a longitudinal femoral arteriotomy, then inserting a standard femoral cannula through the constructed graft, and he described 19 cases done with this technique. Salm attributed the adoption of this method after he faced a case required an ipsilateral above-knee amputation after femoral arterial cannulation during a long, emergency operation.

Salm advocated the use of polytetrafluoroethylene (PTFE) graft as it is more resistant to infection as there is a stump about 1 cm. will be left, but in our experience we used the Dacron graft in all our patients with only 2 cases of deep femoral wound infection (0.6%). The use of Dacron graft has another advantage that it is more haemostatic with less liability of bleeding from the stitch holes especially after systemic heparinization and exposure to the pump arterial blood flow.

Also, in our technique we connected the free end of the constructed Dacron graft directly to the arterial line of the cardiopulmonary bypass circuit through a 1/4-inch to 3/8-inch (6.35-mm to 9.53-mm) standard perfusion connector, we found that satisfactory with no need to insert a femoral cannula through the graft, we did that in all our patients with no technical or hemodynamic compromise.

Hendrickson and Glower[12] described another method for perfusion of the leg during cardiopulmonary bypass via femoral cannulation by perfusing the distal femoral artery by another pediatric femoral cannula inserted distal to the original one, and both cannulae are then attached to the Y-connector in the arterial perfusion line, by that way blood from the arterial line will simultaneously through the main cannula to perfuse the body and through the pediatric distal cannula to perfuse the leg. But we think this technique is complicated as it entails cannulation of the femoral artery at two sites with increased risk of arterial injuries.

Although cannulation with this technique first requires sewing a graft onto the femoral artery, and thus takes longer time to initiate cardiopulmonary bypass, that time is retrieved at the end of the case by the elimination of the need to suture an arteriotomy, and instead, simply running suture or stapling across the graft.

Conclusion

This easily applied technique allows femoral cannulation during cardiopulmonary bypass and eliminates the complication of distal femoral ischemia in operations requiring prolonged cardiopulmonary bypass.

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Caudal Neostigmine Improves Postoperative Analgesia in Children Undergoing Open Heart Surgery

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Background: **The use of regional anesthesia techniques in infants and children has become increasingly accepted as standard of care during the final decades of the 20th century. As single shot technique with relatively short duration of post operative analgesia so the most frequently used method to further prolong postoperative analgesia following caudal is to add different adjunct drugs to the local anesthetic solution.**

Study Objective: **The aim of the present randomized study was to determine the effect of adding neostigmine to bupivacaine compared with bupivacaine alone in caudal block, on postoperative analgesia and the incidence of side effects in children undergoing open heart surgery for congenital heart disease.**

Study Type: Interventional

Study Design: Allocation: Randomized

Endpoint Classification: Efficacy Study

Intervention Model: Parallel Assignment

Masking: Double Blinded (Subject, Caregiver, Investigator)

Primary Purpose: Treatment

Setting: Assiut University Hospital, Egypt.

Patients and Methods: **Forty children (ASA II-III) undergoing elective corrective cardiac surgery for acyanotic and cyanotic congenital heart disease were randomly allocated into two equal groups, group A (bupivacaine group) received caudal block with bupivacaine (0.125%) alone in a dose of 1.25 ml/ kg and group B (neostigmine group) received caudal block with bupivacaine (0.125%) in the same dose as in group A plus neostigmine in a dose of 2μg/kg. in addition to sevoflurane anesthesia with midazolam premedication and fentanyl supplementation intraoperatively caudal block was performed afterendotracheal intubation. Monitoring included ECG, invasive blood pressure, end tidal CO_2, pulse oximetry, central venous pressure, temperature and urine output.A blind observer in the ICU using modified pediatric objective pain scale assessed the postoperative analgesic efficacy; its duration and side effects as well as rescue analgesic doses of IV paracetamol.**

Results: **Hemodynamic changes were not significantly different between the two groups. Patients in neostigmine group received less intravenous paracetamol in the early postoperative (2 patients versus 11 patients in bupivacaine groupby fishers' exact test P< 0.05) andhad significantly lower pain scores than did in bupivacaine group (Mann-Whitney U-test) over the study period of 24 hours. Mean duration of pain free period were significantly longer in neostigmine group 12.55 hours versus6.1 hours in bupivacaine group (p<0.05).**

Limitations: single shot technique with relatively short duration of post operative analgesia and risk of using heparin after caudal block

Conclusion: **This study demonstrated that adding caudal neostigmine to bupivacaine prolongspostoperative analgesia and reduces the need for**

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supplementary analgesia in children undergoing open heart surgery.

KEY WORDS: **Analgesia, caudal, neostigmine, bupivacaine; Open heart surgery, children**

Congenital cardiovascular disease is defined as an abnormality in cardio-circulatory structure or function that is present at birth; even if it is discovered much later.Pain after cardiac surgery may be intense; it may originate from many sources, including the incision, intra operative tissue retraction and dissection, vascular cannulation sites, chest tubes, and others.[1] Achieving optimal pain relief after cardiac surgery is often difficult. Inadequate analgesia during the postoperative period may increase morbidity by causing adverse hemodynamic, metabolic, immunologic and hemostatic alterations. [2]Adding regional to general anesthesia for children undergoing cardiac surgery is receiving an increasing attention from clinicians. Several studies have demonstrated benefits of regional anesthesia in adult and pediatric patients undergoing major surgery. [3, 4] Many drugs including epinephrine [5], morphine [6], clonidine, ketamine [5, 6], midazolam [7] and tramadol [8] have been co-administered with caudal bupivacaine to maximize and extend the duration of analgesia. Neostigmine is an acetylcholinesterase inhibitor, which, if applied to the neuraxis, will increase the synaptic concentration of acetylcholine and so may induce analgesia. Despite neostigmine with the preservatives methylparaben and propylparaben, it is safe to administer. An advantage to its use neuraxially (centrally), is the potential to counteract LA induced hypotension by an inhibitory effect on the sympathetic nerve activity and tends to increase the respiratory rate. [9, 10]The intrathecal administration of the cholinesterase inhibitor neostigmine was reported to produce analgesia in experimental animals [9]and in acute postoperative pain in humans. [11]The effect of caudal neostigmine on postoperative analgesia and side effects has been examined in pediatric patients. A dose response study using 0-50μg/kg, found that a minimum of 20μg/kg of neostigmine was necessary to produce postoperative analgesia, while doses greater than 30μg/kg caused nausea and vomiting. There were no other side effects, including motor block, hypotension or bradycardia, noted even at the highest doses. [10]

Methods

After obtaining local research ethical committee approval and written parents' consent, forty children undergoing open heart surgery for correction of different congenital heart defects were randomly allocated into two equal groups. Children having any contraindication for regional techniques such as: infection near the site of the needle insertion, coagulopathy, anti-coagulation therapy, pilonidal cyst, congenital anomalies of the lower spine because of the unclear or impalpable anatomy or allergy to the local anesthetic drugs used were excluded from the study.

All children received standardized premedication with midazolam and atropine, anesthesia was induced with sevoflurane plus fentanyl 5 µg / kg and cisatracurium 0.1 mg/ kg and maintained with sevoflurane, fentanyl 1µg / kg/ hr. and cisatracurium 0. 05 mg/kg every 20 minutes.ECG, invasive blood pressure, heart rate, temperature, oxygen saturation and exhaled CO_2 (capnography) were continuously monitored during the procedure.

After induction of anesthesia and before skin incision, patients received caudal epidural block, where they were randomized by block randomization into two groups (20 each):

Group A: caudal bupivacaine 1.25 ml/ kg of bupivacaine 0.125 %.

Group B: caudal bupivacaine 1.25 ml/ kg of bupivacaine 0.125 %. in addition to neostigmine 2µg/kg.

Heparin 400IU/kg was administered before start CPB and this usually after 60 minutes from caudal epidural anesthesia. CPB circuit was primed with mannitol, sodium bicarbonate, heparin and packed red cells to obtain a hematocrit 26%. Once activated clotting time (ACT) reached ≥450 seconds, CPB was initiated. The aorta was clamped and cold blood cardioplegia (30-50 ml/kg, custidol solution over 4-6 minutes) was administered into the aortic root and the patient cooled to 30-32°C. The cardioplegia solution was repeated every 60 minutes if needed. The alpha-stat method of acid-basemanagement was used. A mean arterial pressure (MAP) was maintained between 30-60 mm Hg during CPB. At the end of the intracardiac procedure, re-warming was started, aortic cross clamp removed, and if spontaneous normal sinus rhythm was not present, pacing or defibrillation was performed depending on heart rate and rhythm. Ventilation was started, haemodynamics and arterial blood gases were stabilized and patients were weaned from CPB at 37 °C. Protamine was administered to reverse heparin in a dose of 1mg protamine for every 100 IU heparin. The patients were then shifted to ICU where resident doctors were blinded to the anesthetic technique used.

The criteria for extubation were as the standards for postoperative cardiac patients in the form adequate level of consciousness, hemodynamicstability, absence of arrhythmias adequate, airway reflexes, normothermia, acceptable mediastinal drainage blood loss and acceptable blood gas analysis. A blind observer in the ICU using modified pediatric objective pain scale [12] assessed the postoperative analgesic efficacy every one hour in the first 4 hours then every 2 hours till 24 hours postoperatively, where each criterion scores 0-2 to give a total score 0-10 and a total score of less than 5 mean adequate analgesia. Intravenous paracetamol (15mg/kg/ dose every 4-6 hours) was used as rescue analgesic after the onset of pain (pain score is more than 4) and if pain persisted after paracetamol, morphine (0.1 mg/kg) was administered subcutaneously

Data to be monitored:

1. Demographic data, intraoperative and postoperative variables
2. The mean duration of analgesia was taken as the time when an analgesia was required as evidenced by a pain score > 4 and included either time starting from caudal block or from extubation
3. The number of patients received intravenous paracetamol analgesia in the 1st post operative 2 hours.
4. Total amount of paracetamol or morphine doses as rescue analgesic needed after the onset of pain.
5. Side effects as regarding motor block, vomiting, paraesthesia, and urine retention.

Statistical analysis

Data presented by mean and SD and comparing between groups were performed by independent samples t test. The number of patients needed postoperative analgesia compared by fishers' exact test. Pain scores between both groups were compared using Mann-Whitney U-test in all tests p< 0.05 is considered significant

Results

Patient's general characteristics were summarized in table (2), There were no statistical differences between the two groups regarding preoperative patient's characteristics. Also, there were no significant differences in ischemic time, duration of cardiopulmonary bypass, duration of mechanical ventilation and ICU stay between both groups (Table 3).

As regarding ***modified pediatric objective pain scale*** we found that there were significant changes at extubation, 4 hours, 14 hour, 16 hour, 18 hour and at 20 hour between both groups by using Mann-Whitney U-tests.

The mean duration of analgesia was taken as the time when an analgesia was required as evidenced by a pain score > 4. The mean (SD) duration of analgesia for group A patients was 6.1 ± 9.13hours, and showed significant changes (P=0.022) with that of group B which was 12.55± 7.88 hours(table 4).

The number of patients received intravenous paracetamol analgesia in the early post operative period was more in group A (11 patients) than in group B (2 patients) P< 0.006 by fishers' exact test (figure 1).

The number of analgesic doses (I.V. paracetamol in the first 24 hours postoperatively) in group A the mean ± SD was 2.55±1.57 doses, while in group B it was 1.25±1.12 with significant changes between both groups p <0.006 (table 4). No patients needed morphine (0.1 mg/kg) subcutaneously as rescue analgesic after the onset of pain.

Criteria	Finding	Points
Crying	None	0
	Consolable	1
	Not Consolable	2
Movement	None	0
	Restless	1
	Thrashing	2
Agitation	Asleep	0
	Calm	0
	Mild	1
	Hysterical	2
Posture	Normal	0
	Flexed	1
	Holds Injury Site	2
Verbal	Asleep	0
	No Complaint	0
	Complains But Cannot Localize	1
	Complains And Can Localize	2

Table (1): Modified Pediatric Objective Pain Scale . [12]

Variables	Group (1)	Group (2)
Age (months)	61.15 (42.40)	47.90(27. 94)
Gender (Male/female)	11/9	9/11
Weight (kg)	16.25*(7. 06)	12.95 (4. 16)
Type of cardiac lesion		
• Atrial Septal Defect (ASD)	5	10
• Ventricular Septal Defect (VSD)	8	3
• Tetrology Of Fallot's (TOF)	3	6
• Others	4	1

**P<0. 05 (by independent samples t test)*

Table 2 ***Mean (SD) of patients characteristics in group (1) [Caudal bupivacaine] and group (2) [Caudal bupivacaine and neostigmine]***

Regarding motor block, vomiting, paraesthesia and urine retention, the study showed no significant differences between the two groups.

Variables	Group (1)	Group (2)
Ischemic time (minutes)	67.55 (30.52)	61.1 (28.55)
Duration of CPB(minutes)	120.95(43.98)	113.45(49.21)
Duration of mechanical ventilation (minutes)	78.00 (43.11)	82.05 (48.76)
ICU Stay (days)	3.15 (0.99)	2.70 (1.42)

**P<0. 05 (by independent samples t test)*

Table 3 ***Mean (SD) of intraoperative and postoperative variables in group (1) [Caudal bupivacaine] and group (2) [Caudal bupivacaine and neostigmine]***

Variables	Group (1)	Group (2)
Paracetamol doses (15 mg/kg/ dose)	2.55* (1.57)	1.25 (1.12)
Time to first analgesic rescue medication starting from extubation (hours)	6.10 (7.88)	12.55* (9.13)
Time to first analgesic rescue medication starting from caudal block (hours)	12.1 (7.24)	18.66* (8.84)

**P<0. 05 (by independent samples t test)*

Table 4 ***Mean (SD) of paracetamol as a rescue analgesic, duration of post operative analgesia in group (1) [Caudal bupivacaine] and group (2) [Caudal bupivacaine and neostigmine]***

Discussion

Single-shot caudal anesthesia with local anesthetic (bupivacaine) is the most commonly used regional technique for intraoperative and postoperative pain relief in children. The popularity of this technique is due to its simplicity and frequent success. [5, 6]

This study demonstrated that adding caudal neostigmine2μg/ kg in addition to 1.25 ml/ kg of 0.125% bupivacaine concentration markedly prolonged the postoperative analgesia and reduced the need for intravenous paracetamol as rescue analgesia in children undergoing open heart surgery.

The analgesic effects of caudal neostigmine appeared in this study can be attributed to either to the direct action at the spinal cord level after transdural diffusion to cerebrospinal fluid (CSF) or a peripheral antinociceptive at the surgical site after systemic absorption. [13] The effectiveness of small dose of caudal neostigmine 2μg/kg suggests a spinal rather than a peripheral mechanism of action. Also, neostigmine is a hydrophilic molecule similar to morphine.

The dose of neostigmine used in our study was based on the study of Lauretti et al. [10] as it offers effective analgesia and the incidence of adverse effects is minimized.

The mechanism of neuraxial action is not clear, but autoradiographic studies reveal the existence of muscarinic receptors, both M1 and M2, in laminae II and III of the spinal cord. [14, 15]

Neostigmine preparations used in the present study contains methyl-and propylparabens as preservatives. Animal and human studies confirmed that using neostigmine containing methyl-and propylparabens as preservatives is not associated with any behavioral, chemical or histopathological evidence of neurotoxicity. [16, 17]

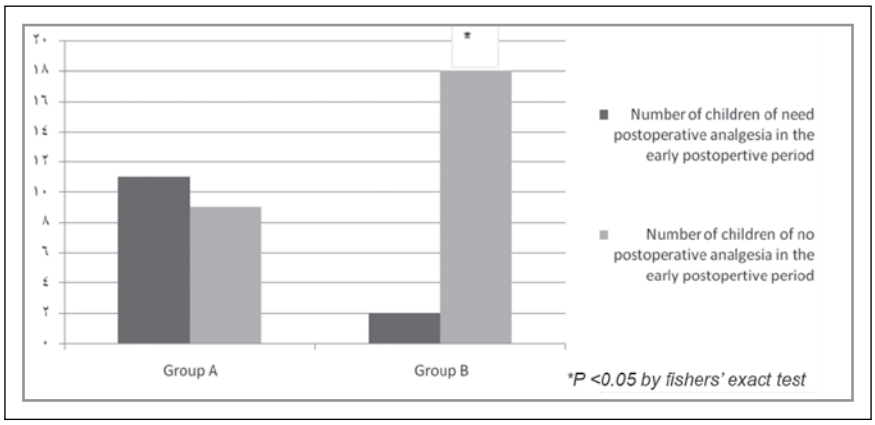

Fig 1. **Fig 1** ***Number of patients required early post operative analgesia in both bupivacaine (group A) and neostigmine (groupB) groups***

However, caudal neostigmine appears to have a reasonably benign side effect profile. Dose-dependent nausea and vomiting are the only reported adverse effects. [18] We did not observe any serious adverse effects, possibly because of the limited number of subjects and the small dose of neostigmine used.

Similarly, administration of caudal neostigmine in combination with bupivacaine was associated with extended duration of postoperative analgesia and reduced postoperative analgesia requirements in children undergoing hypospadiessurgery. [19]

Rosen et al. performed a prospective, randomized, controlled study to determine the effect of caudal morphine analgesia administered after the surgical procedure in children compared with a group of patients receiving general anesthesia for cardiac surgery. Caudal morphine patients had lower pain scores and less need for postoperative intravenous opiates in the first 24 hours. [20]

Peterson et al. retrospectively described different regional techniques (epidural, spinal, or caudal) in 220 children undergoing cardiac surgery. They found that regional anesthesia was safe and effective in management pediatric patients undergoing cardiac surgery. [4]

Conclusion

It appears from this study that adding caudal neostigmine to bupivacaine prolongs postoperative analgesia and reduces the need for supplementary analgesia in children undergoing open heart surgery.

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INCIDENCE AND MANAGEMENT OF DEEP STERNAL WOUND INFECTION

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Introduction: **Deep sternal wound infection (DSWI), although rare complication after cardiac surgery is a serious complication and can be a major cause of morbidity and mortality. Early recognition and treatment can save the life of the patient. We performed this study to identify associated risk factors and method of treatment we use in Cardiothoracic Surgery Department, Alexabdria University.**

Patients and Methods: **A retrospective review was used on patients operated upon between June 2011 to June 2013, 1759 patients were operated, 1709 patients survived, 16 patients developed DSWI (0.93%) and needed surgical interference. Chart review was performed and all patients with DSWI followed up.**

Results: **DSWI developed in 16 patients (0.93%), Risk factors associated with DSWI in our study were and confirmed by univariate and multivariate analysis were prolonged mechanical ventilation, combined coronary artery bypass surgery and valve replacement, patients with excessive bleeding and needed excessive blood transfusion and /or rexploration and increased body mass index (BMI). Patients with DSWI were treated either by sternal debridement with primary closure (n = 9) or debridement with omental flap reconstruction (n = 7). The one year freedom from adverse events (readmission, reoperation, or death was 87%) for both groups of patients.**

Conclusions: **Diabetes, chronic obstructive pulmonary disease, prolonged mechanical ventilation, combined coronary and valve surgery, and increased body mass index, and major blood loss associated with re-exploration increase the risk of DSWI, the use of bilateral skeletonized mammary artery did not increase the risk in our patients. The use of the omental flap is a rapid simple and effective procedure in controlling the infection and obliterating the space.**

KEY WORDS: **DSWI, mediastinitis, omental flap, debridment**

Although the incidence of deep sternal wound infection (DSWI) which is defined as suppuration involving the anterior mediastinal space in patients with midline sternotomy after cardiopulmonary bypass (CPB) is relatively low ranging from 1-5%,[1,2,3] its associated mortality rate is high ranging from 15% to 50%.[4,5] Death may be caused by generalized sepsis, endocarditis, fatal hemorrhage and secondary multiple organ dysfunction as well as superadded infections.[4,6,7] In addition prolonged hospital stay and increased cost due to associated high morbidity, and need for repeatd surgical procedures.[6,7]

Risk factors for development of DSWI were identified and include obesity, Diabetic patients, old age, chronic obstructive pulmonary disease, reoperations, operation time, the use of bilateral internal thoracic artery conduits, low cardiac output, ventilation time and reexploration for bleeding.[2,4]

Prevention of wound infections is one of the most important aspects in management of patients after cardiac surgery. Early diagnosis and treatment of mediastinitis prevents the spread of infection to any artificial prosthetic material used with its devastating results.[2]

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Operative treatment include debridment with early or delayed closure, continuous irrigation, closed drainage and partial or complete sternectomy with flap reconstruction.[8]

Sternal wound complications are as follows:[2]

1-Mediastinal dehiscence: median sternotomy wound breakdown in the absence of clinical or microbiologic evidence of infection.

2-Mediastinal wound infection: clinical or microbiological evidence of infected presternal tissue and sternal osteomyelitis, with or without mediastinal sepsis and with or without unstable sternum.

a.Superficial wound infection (subcutaneous tissue)

b.Deep wound infection (mediastinitis); wound infection associated with sternal osteomyelitis with or without infected retrosternal space which is further divided into four subtypes based on the time of first presentation, the presence or absence of risk factors, and whether previous attempts at treating the condition have failed.

Aim of the Study

Describe the experience of Cardiothoracic Surgery Department, Faculty of medicine, Alexandria University in the management of poststernotomy mediastinitis.

Patients and Methods

From June 2011 to June 2013, 1759 patients were operated upon through a midline sternotomy in Cardiothoracic surgery department, Faculty of Medicine, Alexandria University. Deep sternal wound infection was diagnosed 1- if an organism is isolated in culture; 2- evidence of mediastinitis, is seen during operation (necrotic tissue and pus); or 3- one of the following, chest pain, unstable sternum or temperature more than 38oC with purulent discharge. 16 patients needed operative therapy for DSWI were followed up (0.9%), all the 16 patients developed infection during the first months after surgery.

Mediastinitis was defined as deep wound infection associated with sternal osteomyelitis with or without infected retrosternal space that required surgical debridement.[2]

Perioperative management of patients undergoing CPB

Preoperative preparation

1-Antibiotic prophylaxis All patients received intravenous ceftazidime or cefepime preoperatively

2-Preoperative shower and hair removal

Intraoperative preparation

1-In all patients the operative field was painted povidone-iodine solution the skin was incised with a scalpel and electrocautery was used to open the presternal layers.

2-Sternotomy was done taken care to be in the midline, we use the saw in the majority of patients except a few patients where the sternum was opened using the Lebsche knife (used in 20 patients)

3-Diathermy and bone wax are frequently used to aid hemostasis

4-The internal thoracic artery is harvested skeletonized in cases of coronary artery bypass surgery.

5-Sump drains were placed in the mediastinum, and chest tubes were inserted into the pleural spaces if opened.

6-The sternum was closed with stainless steel wires, the presternal space was obliterated with two layers of absorbable suture and the skin was closed with a subcuticular absorbable suture.

Postoperative factors

1-All patients continue the prophylactic antibiotic for 96 hours.

2-If the patient was re-opened for bleeding or any other reason the antibiotic was changed and vancomycin is added

3-Patients were extubated when hemodynamically stable as soon as possible.

4-All drains were removed when there is no drainage for 3 hours usually 48 hours after surgery

Diagnosis

1-Fever and leukocytosis in the absence of local symptoms or signs

2-Wound discharge

3-Wound pain, tenderness and sternal instability

4-Blood cultures

5-Chest x-rays are routinely done daily

6-Chest computed tomography

Treatment of mediastinitis

1-Prolonged antibiotic therapy based on culture and sensitivity in all patients

2-Wound debridment, primary sternal closure enforced using Robicsek method,[9] and closed mediastinal catheter irrigation using diluted antibiotic and/or diluted 0.5% iodine solution (9 patients)

3-Wound debridment and delayed closure with omental flap (7 patients) (Fig. 1,2,3)

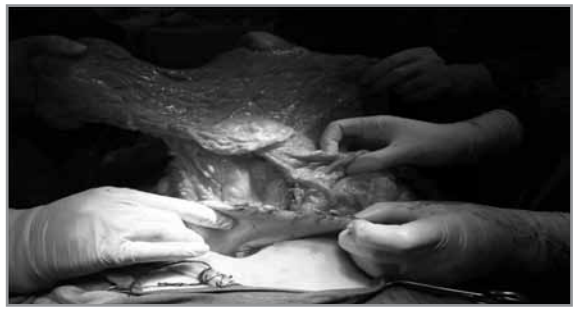

Fig. 1 Omental flap orientation

Fig. 2 Omental flap in place

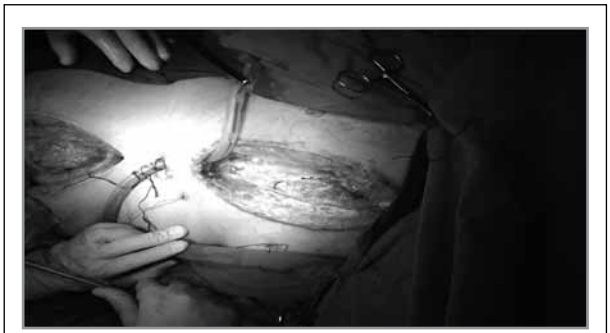

Fig. 3 Wound closure after omental flap harvesting.

Follow up

All patients were followed up after discharge during their visit routine chest x-ray and checking the wound was done to make sure the sternum is stable and the wound is clean, also routine echo was performed on all patients.

Statistical methods

Univariate analysis was done using the X2 test for categorical variables and two-tailed student's t test for continuous variables. All variables suggested by the univariate analysis ($p < 0.05$) or those judged to be clinically important were entered into a stepwise multiple logistic regression analysis model.

Results

During the study period, 16 patients developed DSWI that recquired surgical interference. Patients with mild wound infection that improved with antibiotics alone were not included. Coronary artery bypass grafting (CABG) was performed in 732 patients (41.6%), Combined CABG and valve repair and or replacement in 12 patients (0.68%), valvular procedures in 597 cases (33.9%), Congenital heart surgery including adult congenital in 418 cases (23.7%). DSWI occurred in 16 patients out from 1709 patients who survived the surgery. Table 1.

The most commonly isolated organism was grame positive cocci, Staphylococcus aureus, which was responsible for 10 infections, coagulase negative staph in 1 patient, pseudomonas in one patient and multiple organism in 3 patients and one patient had no growth (Table 2) but he has clinical signs and operative findings consistent with DSWI (purulent discharge, fever, and sternal instability). All the patients received broad spectrum antibiotics before the culture was taken and adjusted according to the culture results.

In the univariate analysis of risk factors (Table 3), age, sex, type of surgical procedure, diabetes mellitus, COPD, CHF, timing for surgery, reoperation, reexploration, body mass index (BMI), ((from 25-30% over weight, > 30% severe obesity), CPB time, cross-clamp time and total operation time, harvesting of LIMA alone or bilateral mammaries in

Operation	No of patients	Survivors	Infected patients	%
CABG	732	712	8	1.1
Valve surgery	597	590	5	0.847
Combo	12	9	2	22.22
CHD	418	398	1	0.25

CABG: Coronary artery bypass grafting; Combo: combined CABG and valve surgery; CHD: Congenital heart disease.

Table 1. DSWI by type of operation

Microorganism	Patients N (%)
MSSA	7 (43.75)
MRSA	3 (18.75)
CNS `	1 (6.25)
Pseudomonas	1 (6.25)
Multiple organism	3 (18.75%)
Unidentified	1 (6.25)

MSSA: Methicillin sensitive Staphylococcus aureus; MRSA: methicillin resistant Staphylococcus aureus; CNS: Coagulase negative staphylococci.

Table 2. Microbiology of the 16 cases of mediastinitis

CABG cases, the presence of postoperative low cardiac output, mechanical ventilation time, and ICU stay, also the amount of bleeding and blood transfused. A significant association was was found between DSWI and diabetic patients, BMI > 30%, COPD, prolonged ventilation, blood loss and need for more transfusions, re-exploration and prolonged ventilator support, also combined procedure like CABG + valve also has an increased risk. On the other hand congenital heart surgery has a lower incidence of DSWI and the only case with DSWI was young adult with complete AV canal defect.

Based on the extent of mediastinitis, 9 patients had sternal debridment and primary wound closure, while 7 patients with more severe DSWI needed an omental flap.

The mean time from diagnosis of DSWI to operation was 5 days in patients with debridment (range 1-32 days) and in patients who received omental flap was 7 days (range 2-29 days).

Variable	Inicidence in Non infected (%) (n=1709)	Incidence in DSWI (%) (n=16)	p value
Male	67%	72%	
Age (y)			
<60	58.5	56.25	0.534
>60	41.48	43.75	
Diabetes	23.4	37.5	0.001
COPD	8.7	18.75	0.004
CHF	19.19	18.75	0.582
Reoperation	7.02	6.25	0.892
Procedure			
CABG	41.19	50	0.325
Valve	34.23	31.25	
Combo	0.40	12.5	0.001
CHD	23.22	6.25	0.004
Emergency	10.18	12.5	0.88
Reexploration	4.9	18.75	0.001
BMI > 30%	5.7	12.5	0.05
Antibiotic			
Cefepime	47.98	43.75	0.488
Ceftazidime	52.08	56.25	
CPB time (mean±SD)	99 ± 41	107.3 ± 45	0.049
Crossclamp time	84.1 ± 28	92 ± 30	0.140
Operation time	246.4 ± 31	284 ± 21	0.07
LIMA	40	43.75	0.820
LIMA + RIMA	2.8	6.25	0.07
Postop low COP	8.6	18.75	0.001
Blood loss (ml)	577.8 ± 23	867 ± 99.6	0.005
Ventilation time (hr)	25 ± 22	46 ± 38	0.05
ICU time (d)	2.5 ± 0.9	4.2 ± 8.1	0.269

COPD: Chronic obstructive pulmonary disease; CHF: congestive heart failure; CABG: coronary artery bypass graft, Combo: combined CABG and valve surgery; CHD: congenital heart disease, CPB: Cardiopulmonary bypass; LIMA: left internal mammary artery; RIMA: right internal mammary artery; COP: cardiac output; ICU: intensive care unit.

Table 3. Predisposing factors for DSWI

Follow-up was obtained in all patients at 6 months and one year after the operative procedure for DSWI, one patient with debridment and primary closure came back with purulent discharge and unstable sternum and was readmitted for redebridment and omental flap was done to control the infection. This patient died 2 weaks after the flap operation from severe pneumonia and adult respiratory distress syndrome. In the seven patients who received omental flap one patient had persistent sepsis postoperatively and died from multiorgran failure.

Discussion

DSWI is a dreadful complication with a high mortality rate, by searching the literature the incidence ranged from 0.4-5%,[1-6] in our study from 1709 survivors 16 cases developed DSWI (0.93%). Mortality rate in different series ranged between 5% and 50%.[9,10] In our study 1759 cases done in 2 consecutive years, Death rates reported in large series were around 20%.[2,4,5] Other studies described lower mortality rates.[3,11,12] It should be noted that some studies included patients with sterile sternal dehiscence.[3,11] In our study we have 2 mortalities (12.5%), it must be noted, that quite often the infection developed usually in patients with a problematic postoperative course, associated lung infections and multisystem failure.

Culture and sensitivity showed gram positive cocci staphylococcus aureus the commonest organism and was responsible for 11 DSWI, one patient developed scalded skin in addition to DSWI, in some studies,[2,8,13] pseudomonas was the commonest pathogen, while other studies were similar to our results.[4,5,14,15]

We performed this retrospective study to identify risk factors for DSWI, mortality associated with it, and our treatment strategy which started with broad spectrum antibiotics adjusted to culture and sensitivity in all patients, followed by sternal debridment and primary closure which was done in 9 cases (56.25%), and omental flap in more severe cases (43.75%).

Age and sex did not show any increased risk, in contrast to a study by Breyer and Mills[16] which found female sex and increased age increased the risk of DSWI.

Comparing valve surgery and CABG, there was no increased risk associated with the procedure, but when CABG is associated with valve surgery the risk increased to reach a statistical difference ($p = 0.001$), from twelve patients operated for combined CABG + valve , 9 patient survived, two of them developed DSWI, one of them was a male and sternal debridment and primary closure was performed successfully, the second was a female with prolonged mechanical ventilation (11 days) complicated by unstable sternum and infection, debridment and primary closure was performed, which failed and continuous purulent discharge necessitated the use of omental flap to obliterate the space, this patient died later from pneumonia and ARDS. On the contrary patients with congenital heart disease have a lower incidence of DSWI, only one patient with adult congenital heart disease and operated upon for complete A-V canal repair developed DSWI. In some reports the type of surgery did not demonstrate a significant association,[3,5,16] while some other studies,[2,9,14,17] agreed with our results.

Harvesting of bilateral mammaries did not increase the risk of DSWI, although some studies,[2,4,7,16] found it to be a major risk factor for development of DSWI, to the extent that one study[4] recommended that bilateral harvesting of the internal thoracic artery may be contraindicated in diabetic patients. The reason behind this finding maybe that we harvest the internal thoracic artery skeletonized and this reduces the risk of infection.

We used ceftazidime and cefepime as prophylaxis and there was no difference between both. Prolonged mechanical ventilation was identified as a risk factor by many studies,[3,5,17] specially if associated with tracheostomy, Breyer and associates,[16] found mechanical ventilation longer than 24 hours to be the most ominous factor associated with wound infection. In our study there was association between prolonged ventilation and infection, prolonged ICU stay showed an increased risk but did not reach statistical significance. Most patients requiring longer ICU, often have low cardiac output, bleeding, resternotomy, respiratory insufficiency, prolonged mechanical ventilation and tracheostomy.[5,18]

Operation time has been considered significant by some,[4,11,19] in our study it has no impact on wound infection. On the other hand blood loss and the need for blood transfusion and frequently for rexploration increases the risk of mediastinitis and this agrees with our findings. Mediastinal hematoma formed by excessive bleeding becomes a perfect environment in which bacteria can grow and becomes a source of mediastinal infection.[19]

Patients with DSWI were treated by sternal debridement with primary closure or omental flap reconstruction depending on the clinical status of the patient, and therefore outcomes for the two groups cannot be directly compared. From the nine patients with debridement and primary closure one patient presented a week later with purulent discharge and required omental flap to die 2 weeks later from pneumonia and ARDS. Another patient who received omental flap has ongoing sepsis complicated by multiorgan failure and died 4 weeks later from multiorgan failure. The overall mortality from DSWI was 2 patients (12.5%) and this agrees with other studies which stated mortality between 5-50%.[4,10,11,12]

The choice of the plastic procedure will depend largely on the experience and the personal preference of the surgical team, in our institution we prefer the omental flap because we don't have to wait long time to arrange with the plastic surgeon for muscle flap repair, in addition omental lipid extract has been shown to have a powerful angiogenic effect.[20]

In conclusion, optimal standards for asepsis in the operating room and ICU must be adhered to, recognition and avoidance of predisposing factors, strict surveillance and more intensive treatment. Some guidelines to follow include: improving the quality of the surgical and intensive care facilities, limiting blood transfusions, careful hemostasis. Long-term follow-up reveals that a good result can be achieved in 87% of patients treated with debridement or omental flap reconstruction.

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Modified Blalock Taussig Shunt (MBTS) in Single Ventricle Physiology. Predictors For Early Outcome

Tarek Nosseir MD,

Introduction; **Since 1940s countless patients have benefitted from BTS procedure. This operation was adapted to treat patients with a variety of congenital cyanotic heart diseases including Tetralogy of Fallot and various forms of single ventricle as tricuspid atresia.**

Methodology: **in this study, eighty six neonates and infants received Modified Blalock shunt. Hospital mortality was higher in single ventricle physiology (18% vs. 12%). The aim of the study was to identify predictors for a poor outcome in early post operative period in those patients of single ventricle physiology.**

Conclusion; **Predictors of early mortality were found to be age, weight, shunt size, heterotaxy syndrome, restrictive atrial septal defect ASD, pre operative prostaglandins treatment and additional procedures.**

KEY WORDS; **Blalock Taussig shunt – single ventricle**

On November 29, 1944, Dr Alfred Blalock performed the first successful palliation of a blue baby with pulmonary stenosis. Frequency of single ventricle (SV) physiology are (7.7%) of all congenital heart diseases. About 70% of patients with SV have pulmonary stenosis (PS) as a component of the cardiac malformation .the majority of them requires surgical intervention at early age because of high mortality within first months of life[1,2]. Modified Blalock Taussig Shunt (MBT) remains most common surgical palliative procedure for univentricular physiology. Recent data demonstrate that a significantly higher proportion of BTS recipients carry a diagnosis of single ventricle and the operative mortality continues to improve and patients survive to have subsequent cavo-pulmonary connections [3, 4].

Methods

Our study included 86 patients who where palliated by Modified B T shunt alone between June 2009 and June 2013 in Abo El Reesh Pediatric hospital. They were divided into 2 groups. Group A (44 patients) had single ventricle physiology and group B (42 patients) had other morphologies which seems amenable for biventricular repair mainly Fallots tetralogy and transposition of great arteries. Excluded from this study all patients with pulmonary atresia who underwent a simultaneous right ventricular outflow tract augmentation , babies with hypoplastic heart syndrome ,patients with bilateral BT shunts and any other patients endergoing associated intracardiac procedures . The age , weight , pre and post operative values of oxygen saturation , the presence of heterotaxy syndrome , the preoperative prostaglandin E1 infusion and the size of the used shunts were studied . The influence of these factors on mortality was evaluated. Since 1990s , sternotomy approach has been the preferred approach for many surgeons ,so we adopted this approach in all our cases[5,6].

Operative technique for Median sternotomy approach

The patient is carefully positioned with the neck extended by a shoulder roll. A median sternotomy extending a few millimeters above the sternal notch is used . The thymus is excised, leaving behind a small cervical remnant. The pericardium is opened

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and suspended on the right side with traction structures. The innominate artery and right subclavian artery are dissected free of adventitial tissue. The right PA is dissected out between the superior vena cava and aorta. A PTFE graft of suitable diameter is selected, and the proximal end is beveled. Heparin is routinely administered. A C clamp is applied to the distal innominate and proximal subclavian arteries. An arteriotomy is made on the inferior aspect and an anastomosis created between the PTFE graft and the distal innominate/ proximal subclavian arterial junction with a continuous monofilament suture (polypropylene or PTFE). A second clamp is then applied distally across the graft, permitting removal of the C-clamp from the innominate or subclavian arteries. The graft is then passed underneath the innominate vein and cut to final length. A Cclamp is applied to the right PA ensuring that flow into the left PA from the ductus or main PA is not compromised. The PA is opened longitudinally and the distal anastomosis between the PTFE graft and the PA completed. The clamp is released to allow back bleeding from the PA. Hemostasis is achieved and antegrade flow is permitted by releasing the clamp on the graft. An open shunt should result in a drop in systolic blood pressure and an increase in arterial oxygen saturation. A patent ductus arteriosus (PDA), if present, may be ligated. Heparin was not reversed. A single chest tube is placed. The sternum is closed in standard fashion.

Statistical methods

The results are expressed as mean (standard deviation), medium (range), distribution frequency or percentage, as appropriate. The chi-square test was used to analyze the effects of age, weight, prostaglandin treatment, presence of adequate ASD and size of the shunt on the outcome of surgery. A p value< 0 .05 was considered statistically significant.

Results

The Two groups were comparable in number of patients, age, body weight, additional source of pulmonary flow and post operative oxygen saturation. (Table I)

In group B patients, 5 postoperative deaths yielded an overall early mortality rate of (12%). All deaths but two occurred in neonates. One infant had early heart failure, probably related to excessive pulmonary blood flow. The other causes of death were: low cardiac output (3 patients) and sepsis (1 patient).

Group A patients had a median age 57 days (25 days-5month) and a median weight 4.1 kg (2.6-7 kg). The shunt ranged in size from 3.5 mm to 5 mm. The median duration of mechanical ventilation was 126 hours, median duration of inotropic support was 5 days and ICU stay was 7 days. Complications exclusive of mortality included wound infection 9% (4 of 44). These infections were all superficial. One patient 2% had phrenic nerve injury. There were 4 cases of pulmonary over circulation and two of them required resternotomy for ligation of a PDA. All patients with heterotaxy syndrome and all patients receiving PGE1 before operations had longer duration of mechanical ventilation, ICU stay and inotropic support (p=0.001).

	Group A n =44	Group B n =42	p Value
Age (median)	57 days	64 days	NS
Neonates n (%)	12(27.3%)	11(26.2%)	NS
Weight (median)	4.1	4.2	NS
Preoperative intubation n (%)	4(9%)	3(7%)	NS
Additional pulmonary flow (n)	35	42	NS
Intubation time (h)	126	37	<0.0001
ICU stay (d)	7	4	<0.0001
O_2 saturation at discharge (% ± SD)	87 ± 4.4	86.0 ± 4.9	NS

Table 1. Patient characteristics and examined variables compared in both groups.

Age(d)	Weight (kg)	Diagnosis	Preoperative Intervention	ASD	Shunt size (mm)	Cause of Death
20	2.8	Pulmonary atresia + intact ventricular septum	None	Restrictive	3.5	Pulmonar-y over circulation
23	3.2	Tricuspid atresia +VSD+ Pulmonary stenosis	PGE	None restrictive	3.5	Acute heart failure
27	3.1	Tricuspid atresia +VSD+ Pulmonary stenosis	None	Restrictive	3.5	Chest infection
19	2.7	Heterotaxy syndrome	None	Restrictive	3.5	Acute cardiac failure
24	3.0	Pulmonary atresia + intact ventricular septum	PGE	Restrictive	3.5	Low cardiac output
18	2.4	Heterotaxy syndrome	PGE	None restrictive	3.5	Chest infection
25	3.5	Mitral atresia+pulmonary stenosis	None	restrictive	3.5	Pulmonar-y over circulation
19	2.7	Heterotaxy syndrome	None	None restrictive	3.5	Acute heart failure

ASAD = atrial septal defect, PGE= prostaglandin E, VSD = ventricular septal defect

Table 2. In –hospital death in group A

In group A, it was found that all patients who died were less than 4 weeks old or less than 4 kg body weight. Five patients also had restrictive ASDs. (Table II)

Many risk factors were analyzed for early mortality (Table 3). Restrictive ASD, heterotaxy syndrome, pre operative PGE1 infusion and additional procedures. These procedures were: PDA ligation (2 patients), balloon atrial septostomy (2 patients) and re-exploration for bleeding(4 patients). There were no blocked shunts.(Table III)

Variable	No. of patients	Deaths	X^2	p Value
Shunt size				
3.5	35	8	1.48	0.19
> 3.5	9	0		
Age and weight				
<4 weeks or 4 kg	32	8	2.21	0.09
>4 weeks or 4 kg	12	0		
Physiology				
Heterotaxy syndrome	8	3	4.84	0.03
Others	36	5		
ASD in univentricular complex				
Restrictive	9	5	4.45	0.035
Nonrestrictive	35	3		
Preoperative PGE1 infusion	15	3	1.95	0.16
No additional procedures	36	4		
Additional procedures	8	4	15.3	<0.0001

Table 3. Risk factors for early mortality in single ventricle group

Discussion

Primary correction is the preferred approach in the neonates and young infants. With only one functional ventricle or reduced pulmonary flow, an initial palliative arterial systemic to pulmonary shunt is mandatory. Use of PTFE graft offers major advantages; greater pulmonary artery growth with less distortion of pulmonary arteries, lower shunt failure rate, preservation of subclavian artery and fewer technical problems including ease of insertion and take down[7].

Some investigators have studied the negative impact of younger age and lower body weight in the early outcome of palliation with MBTS [8-10]. In our study all of the patients who died were under 3 weeks old or less than 4 kg except for two patients. Due to ductus dependent circulation PGE1 infusion was required in 15 patients and was associated with higher mortality.

Nowadays; as increasing number of patients with TOF goes for primary repair, single ventricle patients have become a more prominent group of patients requiring shunting [2]. In most series including ours, patients with TOF tend to do better [11] that is why we decided to analyze the risk factors for early mortality in single ventricle physiology. Evaluation of shunt size for good post operative heodynamics remains difficult .With larger shunts we found similar systemic oxygen delivery reflected by similar values of oxygen saturations. Post operative hemodynamic status in patients with larger shunts were better, shown by higher mean arterial pressure and lower doses of inotropes .Mortality was lower in the large shunt group, but due to limited number of patients the differences did not reach significance levels.

According to our study use of smaller shunt size may result in less pulmonary blood flow so we recommend use of 4 mm graft whenever it is possible.This finding is not consistent with previous studies in patients with tricuspid atresia ,neonates and even canine models of univentricular hearts[7,12,13,14]. This may confirm a hypothesis stating that a larger shunt allows more blood to the pulmonary vascular bed and therefore help to reduce the total after load for the single ventricle.

In single ventricle physiology, an adequate ASD is essential to maintain cardiac output. Those patients with restricted ASD have decreased systemic flow. Probably, a shunt procedure adds to the volume load on the heart and increases the left atrial pressure, leading to decrease flow through the ASD , which is already limited leading to systemic hypo perfusion. [15] In the presented series 5 mortality cases had a restrictive ASD($p<0.05$); the correlation seems to be direct. Postoperative septostomy was performed in two patients and did not help . In such situation it may be better to offer a septostomy before performing a shunt.

Heterotaxy is a term derived from Greek words meaning other than normal arrangement. Because nearly all patients with Heterotaxy syndrome have pulmonary stenosis or atresia with a large ventricular septal defect or single ventricle, cyanosis is almost universal and they maybe in need for early MBTS. A higher mortality in this group could be related to associated abnormal venous return and in some cases of asplenia with pulmonary atresia there may be other systemic collaterals leading to pulmonary over circulation[12,16].

Limitations of our study include small number of patients, wide variety of anatomic subtypes and that is why the available data do not allow us to extract more specific measures to reduce mortality in this group of patients.

Conclusions

In this limited experience study, modified Blalock Taussig shunt is accompanied with higher mortality rate in single ventricle physiology in comparison with other diagnoses. The shunt size , age, weight, restrictive ASD and any additional procedures were the major determinants of outcome of Modified Blalock shunt in single ventricle physiology. Heterotaxy syndrome and pre operative ductus dependant circulation with necessity of PGE1 administration were the other factors of complicated early post operative period.

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Mitral Valve Repair versus Replacement For Rheumatic Mitral Regurgitation: Short Term Results

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Background and aim of the study **MV repair and replacement are two independent surgical techniques for treating MR. The surgical community has become more interested of the advantages of MV repair compared to replacement. Despite these merits, the results of such techniques among studies that compared the two surgical modalities have not been totally consistent [(6)]. This study aims to compare the early (2 years) postoperative influences of MV repair and MV replacement on cardiac function and postoperative functional status.**

Patients and methods **196 patients with mitral regurgitation (rheumatic) were included in the study, divided into two groups according to the surgery performed. Group I consisted of 76 patients who underwent the MV repair. Group II consisted of 120 patients for whom MV replacement with chordal preservation was done.**

Results **both groups were comparable as regard postoperative Echocardiographic LV measurements without significant difference among both groups at the follow up periods. At week of the follow up of LV dimensions, EF and FS of both groups showed a non significant reduction, compared to the preoperative values. Nonetheless, LV dimensions showed a significant reduction, and LVEF and FS showed a significant increase among both groups at six months, one and tow years follow up, compared to preoperative values. Also Symptoms and NYHA functional class were greatly improved by surgery with no significant difference between the 2 groups**

Conclusion: **Our study concluded that surgery for rheumatic Mitral valve regurgitation (Repair and Replacement) result in significant improvement of left ventricular dimentions and function, and functional class and health status, without significant difference among both groups at tow years follow up. The results also suggest that MV repair should be strongly considered for rheumatic MR whenever possible and longer periods of follow up is needed to document these findings.**

KEY WORDS: **Mitral regurgitation, repair, replacement**

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Rheumatic mitral valve disease presents a surgical and a medical challenge to surgeons in the developing and developed world. Comprehensive reproducible repair techniques of the anatomic units in individual patients are required to restore the normal mitral valve anatomy and function[(1)]. There is controversy regarding the role of reparative techniques for rheumatic-mitral valve disease [(2)].

Mitral regurgitation (MR) is a disease in which restoration of life expectancy can be achieved. An encouraging outcome emphasizes the importance of early detection, assessment, and prompt consideration for treatment of these patients [(3)].

In Egypt and most of the developing countries which make up more than 2/3 of the world population, chronic rheumatic heart disease is still the leading cause for valve replacement. Because of the low educational level and medical awareness, Together

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with limited medical services, most patients come late for surgical intervention with already advanced valve disease[4].

Mitral regurgitation (MR) is the commonest form of valvular heart disease in the community [1]. MR (acute or chronic) affects around 5 in 10,000 people [2]. Although the numbers are not as much as those related to coronary artery diseases, this is still a substantial social burden [3,4].

It is a disease in which restoration of life expectancy after correction could be achieved. The encouraging surgical outcomes emphasizes the importance of early detection, assessment, and immediate consideration for treatment of these patients [5].

MV repair and replacement are two different surgical techniques for treating MR. There is more and more awareness of the known advantages of MV repair compared to replacement. Despite these merits, the results of such outcomes among studies that compared these two surgical modalities have not been totally consistent [6].

This study aims to compare the early (2 years) postoperative influences of MV repair and MV replacement on cardiac function and postoperative functional status.

This study aims to compare the early (2 years) postoperative influences of MV repair and MV replacement on cardiac function and postoperative functional statusin patients with rheumatic mitral regurgitation.

Patients and methods

This study was conducted at Cardiothoracic Surgery and Cardiology departments in Qena and Sohag University hospitals, from January 2008 to December 2011. 196 patients with rheumatic mitral regurgitation were included in the study, were divided into two groups according to the surgery performed. Group I consisted of 76 patients who underwent the MV repair. Group II consisted of 120 patients for whom MV replacement with chordal preservation was done.

Preoperative demographic and clinical characteristics Data for patients in both groups are shown on table (1).

The SPSS software (IBM-SPSS Inc, Chicago, IL, USA, version 20) was used for statistical analysis.

Variable	Group I (n=76)	Group II (n=120)	Test of significance
Age (years) (mean±SD)	37.77±10.39	42.67±15.09	t test = 1.465, P value = 0.148 (NS)
Male gender (No%)	33(43.3%)	72(60%)	Chi square = 1.669, P value = 0.196 (NS)
NYHA class:			
II	7(10%)	16 (13.33%)	Chi square = 0.315, P value = 0.854 (NS)
III	25 (33.3%)	44 (36.67%)	
IV	44 (56.6%)	60 (50%)	
Preoperative rhythm:			
Sinus	59 (76.67%)	84 (70%)	Chi square = 0.268, P value = 0.605 (NS)
AF	17(23.33%)	36 (30%)	
Preoperative palpitation	33 (43.3%)	56 (46.7%)	Chi square = 0.067, P value 0.795 (NS)
Left sided HF	58 (76.7%)	84 (70%)	Chi square = 0.341, P value = 0.559 (NS)
PHT	66 (86.7%)	104 (86.7%)	Chi square = 0, P value = 1 (NS)

Table 1. Baseline patient characteristics

Results

For both patient populations, patients in the MV replacement group were older than those in the MV repair group (42.6 Vs 37.7 years). Women were more likely than men to have MV repair (56.7% Vs 40%).

The preoperative, one week, 6 months, 12months, and 2 years postoperative echocardiographic data are shown in table (2).

In group I, LVEDD showed a non significant reduction from the preoperative value (6.45±0.51cm) to (6.38±0.49 cm) one week postoperatively (P = 0.099), while it is significantly decreased at 6 months, 12 months, and tow years postoperatively to (5.83±0.44 cm, P <0.001), (5.73±0.32cm, P=0.001), and (5.65 cm, P=0.001) respectively.

In group II, LVEDD showed a non significant reduction from the preoperative value (6.42±0.48cm) to (6.35±0.46 cm) one week postoperatively (P = 0.06), while it is significantly decreased at 6 months, 12 months, and 2 years postoperatively to (5.81±0.45 cm, P <0.001), (5.69±0.23cm, P=0.001), and (5.63 P=001) respectively.

In group I, EF showed a mean value of (55.13±5.78%) preoperatively. It showed a non significant reduction (53.87±5.76%) one week postoperatively (P = 0.08). where it showed a significant improvement at 6 months (58.57±4.5%, P = 0.012), and (60.17±4.44% P=0.011), (61.9 P=0.01) at 12 months and 2 years postoperatively.

In group II, EF showed a mean value of 56.63±4.26% preoperatively. It showed a non significant reduction (55.50±5.53%) one week postoperatively (P = 0.23), where it showed a significant improvement (59.13±5.24%, P = 0.014), (61.2±3.17% P=0.004) and (60.8 P=0.01) at 6 months, 12 months and 2 years postoperatively.

There was significant improvement in the NYHA functional class from baseline at each of the follow-up time for both treatment groups. The percentages of patients in class III/IV were lower (but not significant) for the MV repair (8.3% Vs 9%).

During follow-up, readmissions for cardiac events were relatively low, The most common reasons for readmission was cardiac arrhythmia, heart failure, bleeding tendency, and thrombosis over prosthetic valve, and reoperation (table 3). Over all Mortality was low, with 11(5.6%) patients (repair: 4; re-placement: 7, *P* _ .43) dying during follow-up

	Pre operative	One week post op.	P value	6 months post op.	P value	One year post op.	Tow Years Post Op.	P value
Group I								
LVEDD (cm)	6.45	6.38	**NS**	5.83	**S**	5.7	5.65	**S**
EF%	55.13	53.87	**NS**	58.57	**S**	60.17	61.9	**S**
Group II								
LVEDD (cm)	6.42	6.35	**NS**	5.81	**S**	5.69	5.63	**S**
EF%	56.63	55.5	**NS**	59.13	**S**	61.2	60.8	**S**

**S (Specific) NS (Non specific) specific (P value>0.05)*

Table 2. Echo findings pre and at the follow up periods

Cadiac Event	Group I	Group II	P value
Arrhythmias	5 (6.5%)	9 (7.5%)	0.40
Heart failure	9 (11.8%)	8 (6.6%)	0.23
High INR &bleeding tendency	----------	11 (9%)	<0.001
Endocarditis	----------	5 (4%)	0.03
Thrombosis over the valve	----------	9 (7.5%)	<0.001
Re-operation	7 (9%)	8 (6.6%)	0.25

P value <0.05 (significant) <0.001 (highly significant) >0.05 (non significant)

Table 3. Causes of readmission for Cardiac events

Discussion

The primary aim of surgical intervention for MR is to improve the overall functional capacity and health status of patients [6].

MV repair and replacement are two independent surgical techniques for treating MR. Repair is associated with a lower rate of reoperation, thromboembolism (TE), and endocarditis than replacement. Despite these perceived benefits, the results of such outcomes among studies that simultaneously compared the two treatment modalities have not been totally consistent [7].

In the present study we found that, both groups were comparable as regard postoperative Echocardiographic LV measurements without significant difference among both groups at the follow up periods. At week of the follow up of LV dimensions, EF and FS of both groups showed a non significant reduction, compared to the preoperative values. Nonetheless, LV dimensions showed a significant reduction, and LVEF and FS showed a significant increase among both groups at six months, one and tow years follow up, compared to preoperative values.

Previous studies demonestrated similar results, where Suri RM and his associates[8] in their study at 2008, demonestrated a significant reduction in LVEF and LVEDD at first week follow up when compared with the preoperative values. The magnitude of the early decline in EF was similar in patients who had MV repair and replacement.

Likewise, Gaasch WH & Meyer TE (2008)[9], found that MV repair or replacement with chordal preservation was not associated with a significant fall in the EF. By preserving the continuity between the mitral apparatus and the LV wall, systolic function is preserved despite closure of the low-impedance left atrial leak. Thus, the LV response to corrective surgery depends largely on the functional state of the ventricle before surgery and the surgical procedure that is performed.

Similar results were found in the study done by Shafii AE and co-workers, (2012)[10], where they found that the postoperative LVEF initially declined significantly from its preoperative value after restoring MV competency. Thereafter, it increased during the first postoperative year.

The current study demonstrates that patients undergoing MV repair or replacement experienced significant recovery 2 years after intervention. Symptoms and NYHA functional class were greatly improved by surgery with no significant difference between the 2 groups. And this is similar to what was found in other studies as, Zhao L et al[6] , Le Tourneau and colleagues[11], and Myken and colleages[12].

The probability of post surgery readmission because of cardiac events was relatively low, but not similar between the 2 treatment groups, while arrhythmias and heart failure were the most commom cause in the repair group, bleeding and thronbosis on the prosthetic valve were the commonest cause of readmission in the replacement group.

Seven (9%) patients reoperated again during the follow up period for sever MV regurgitation scondery to failure of the repair and valve replacement was done for them , this is explained by the fact that most of our patients are rheumatic patients who comes lately in the disease with markedly deformed valve, and also because of the progressing nature of the disease. So, the optimal timing of MV surgery may therefore be earlier in the course of the disease when repair is possible, before marked deformity of the valve and irriversible left ventricular injury occurs. And this is what was concluded by David TE et al, 2003[13], and Zhao L et al, 2007[6].

In the replacement group, eight (6.6%) patients were reoperated again (redo), most of them (7) due to malfunctioning prosthetic valve secondery to thrombosis. This is mostly because most of our patients are poor, not well educated with lack of awarness about the close regular follow up, like most of the other developing countries.

The over all mortality in our study is low (11 patients, 5.6%), with 4 cases in the repair group and 7 in the replacement group (P=0.43).

Conclusion

Our study concluded that surgery for rheumatic Mitral valve regurgitation (Repair and Replacement) result in significant improvement of left ventricular dimentions and function, and functional class and health status, without significant difference among both groups at tow years follow up. The results also suggest that MV repair should be strongly considered for MR whenever possible, and longer period of follow up is needed to document these findings.

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Outcome of Coronary Artery Bypass Grafting On Beating Heart With The Use of High Thoracic Epidural Anaesthsia and Analgesia

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Background: Off pump coronary artery bypass grafting (OPCAB)surgery is a technically demanding strategy for myocardial revascularization .Thoracic epidural anesthesia by reducing the sympathetic stress, may ameliorate the hemodynamic changes occurring during OPCAB surgery by reduction of the incidence of perioperative arrhythmias ,limitation of the oxygen consumption and maintaining haemodynamic stability: Giving better clinical outcome.

Objectives: The aim of this prospectively randomized study was to evaluate the impact of high thoracic epidural anesthesia (HTEA)on the outcome of OPCAB. Including true reduction of arrhythmias, and intra- operative superiority and stability of haemodynamics.

Methods: The study was carried out prospectively randomized in (Saudi German Hospital-Almadinah Almonoura -Kingdom of Saudia Arabia).

The number of one hundred cases prepared to be submitted to OPCAB.Group of 50 patients were all received general anesthesia plus high thoracic epidural anesthesia (GAE), the other group also of (50)patients received general anesthesia alone (GA).The Mean Arterial Pressure(MAP),Heart rate (HR)and Central venous pressure(CVP)were measured before sternotomy and subsequently after each distal anastmosis. High thoracic epidural anesthesia catheter to be inserted in the space between (T2-T4) on the morning of the surgery, with revision of the collected data.

Results: The incidence of perioperative atrial fibrillation (AF) was significantly low in GEA group (4%),while in GA group was (32%).Intraoperative induced bradycardia significantly achieved in(88%) of GEA group while in group GA only in(6%).After induction of anesthesia there was reduction of the mean systolic pressure in GEA group from 125±5 to92±4 mmhg and the heart rate from74±8 to62±5 beats per minute,while in group GA no significant haemodynamic changes observed. The heart rate decreased after sternotomy in both groups but it was less in GEA .The central venous pressur (cvp ucespeciallywhen constructing the distal anastmosis in the lateral and inferior cardiac walls which also associated with haemodynamic variability in both groups.

Conclusion: In our study the clinical outcome of CABG on beating heart(OPCAB) obviously affected with the use of high thoracic epidural(HTEA)in combination with general anesthesia(GAE) as the incidence of perioperative arrhythmias reduced with epidural anesthesia in addition to keeping superior haemodynamic stability and perfect postoperative analgesia. The end result showed obvious reduction of perioperative hemodynamic problems.

KEY WORDS: OPCAB-perioperative-arrhythmias-atrial fibrillation- epidural-thoracic haemodynamics. General anesthesia.

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Off pump coronary artery bypass grafting (OPCAB) via median sternotomy using conventional Anaesthetic technique, usually associated with sympathetic activation by surgical stress (1,2). The activation of the sympathetic response usually leads to development of arrhythmias mostly atrial fibrillation and ventricular extrasystole, also it increases the myocardial oxygen consumption and hemodynamic

variability during the run of surgery (3). OPCAB surgery is a techniqually demanding procedure and requires hemodynamic stabilization with maintenance of slow regular heart beats during conduct of surgery (4-5). High thoracic epidural anaesthesia (HTEA) due its sympatholytic effect, has multiple clinical advantages when combined with general anaesthsia(GA) for(OPCAB) surgery ,as it leads to reduction of perioperative incidence of arrhythmias like atrial fibrillation ,and ventricular extra systoles, reduction of myocardial oxygen consumption without inducing ischemia,allows superior hemodynamic stability during the conduct of surgery specially during fashioning of distal anastmosis(6-7). HTEA provides the option of potent analgesia, so faster recovery achieved,early weaning from post operative mechanical ventilation ,earlier extubation and intense postoperative analgesia usually achieved(8-9). With the use of HTEA the need for vasoconstrictors became frequent because of its vasodilator effect while with GA the need frequently for vasodilators (10, 11).

MATERIAL AND METHODS

*This prospective ran*domized study was carried out in Saudi German hospital (SGH) in Almadinah Almonourah,kingdom saudia Arabia.in the period between November2011to November2012 .Total number of 100 adult eligible patients around 50 to60 years with symptomatic coronary artery disease were prospectively submitted to (OPCAB)and were randomized to receive either general anesthesia alone **(GA)** or general anesthesia combined with high thoracic epidural anesthesia (**GAE**) .Patients with history of preoperative atrial arrhythmias ,those will be submitted to emergency CABG,patients with bleeding diathesis and patients in need for massive intraoperative inotropic support excluded from the study .

The objective of this study was determination if the clinical outcome of coronary artery bypass grafting on beating heart (OPCAB) improved with the use of (HTEA) in combination with general anesthesia (GAE) in comparison with the use of general anaesthsia alone(GA), represented by reduction of the incidence of perioperative arrhythmias and giving superior central haemodynamic stability during the (OPCAB) mainly during the heart positioning with grafting of the inferior and lateral coronary vessels.

Anesthetic techniques

In operating room, invasive monitoring catheters were inserted under local anesthesia. Electrocardiogram, pulse oxymetry, capnography, esophageal temperature moninitoring and nerve stimulator (train of fear) were also monitored. Activated coagulation time (ACT) was done preoperatively, 10 minutes after heparin administration, every one hour and 10 minutes after heparin reversal.

In the GAE group, a multiport epidural catheter (19 gague: B. Braun Melsungem AG, Melsungem, Germany) was inserted from (T2-T5) interspaces on the night of surgery, using midline approach and loss of resistance technique with saline solution in each patient.

Intrathecal placement was ruled out using 2 ml of 2% lidocaine without epinephrine. Adequacy and level of the block were evaluated by confirming loss of pain prick and temperature discrimination to ice. In both groups anesthesia was induced with medazolam (0.06mg/kg), fentanyl (2-4ug/kg), propofol (1-2mg/kg) and (0.96 mg/kg) rocuronium was administrated to facilitate tracheal intubation.

Anesthesia was maintained with continuous perfusion of propofol (4-8mg/kg/hour), fentany (3.5-4.5ug/kg/hour) and rocuronium (0.1mg/kg) every 30 minuts according to train of four (TOF). Positive pressure ventilation with oxygen in air and isoflurane (MAC end tidal concentration). Tidal volum adjusted according to the end tidal C02 (PETCO2) to keep the end tidal co2 concentration between 30-45 mml/l.

The patients in the group GAE received a bolus dose of Bupivacain 0.25 (0.1ml/kg)to induce the sensory block and to maintain anesthesia continuous epidural infusion of Bupivicain 0.125% in addition to Fentanyl 5 ug/ml (0.1ml/kg/hour) to provid intaoperative analgesia .All patients received Lactated ringer"s solution in the rate of 8-10ml/kg/hour. The HTEA catheter used for 3 days postoperative for postoperative pain management. Depending on pain perception the patients recived additional doses of analgesic and sedative agents as used in our department.

Surgical technique

The chest was opened through complete median sternotomy using (Giester adult sternal retractor) with its internal mammary harvesting piece used in all cases for exposure and harvesting of left internal mammary artery. At the same time the saphenous vein harvested according to the number of grafts and the length needed. On finishing of the left internal mammary harvesting intravenous heparin given in the standard dose of 150IU/kg. After pericardial holding the target vessels defined the two blade octopus (Meditronic Inc) used for vessel exposure and fixation during the distal anastomoses which done as the slandered beating heart bypass grafting technique using proximal control of the target vessel with silastic blunt suture and oxygen blower to clear the anastmotic site .After finishing the other distal anastmoses with the saphenous vein grafts the proximal aortic anastmoses were performed. after revision of all anastomotic suture lines heparin reversal started with protamin infusion with the standared dose according to the activated coagulation time together with final haemostasis, fixation of mediastinal and chest tubes for proper drainage then closure of the sternotomy wound in layers.

Statistical analysis

Data were collected, tabulated, coded, then analyzed, using version11.0 SPSS Inc Chicago IL. Data were expressed as mean± standard deviation. Categorical data were expressed as a percentage ,means were compared with the use of t-test .P-value less than 0.05 considered significant.

Results

No significant differences between both groups concerning the demographic data including age, gender, weight, length, and preoperative clinical characteristics including,sinus rhythm, left ventricular ejection fraction, preoperative antiarrhythmic medications and Euroscoring as most of the cases in both groups are of moderate risk (Table 1, 2)., (figure:1).

Concerning the operative data there were no significant differences of, the operation time, number of distal anastmosis, blood loss, ventricular fibrillation and perioperative myocardial infarction between both groups .no complications related to HTEA such as puncture site infection or any neurological deficit. In the group of GAE the incidence of AF was significantly lower 4%of cases (p<0.01) while in the group of GA alone the AF incidence was higher32%of cases. Patients with AF lasting more than 10minutes or those who developed hemodynamic unstability managed medically with B-blockers (metaprolo l100mg/d}, amidrone (150mg over the 1st 1o minuets followed b by360mg infusion over 6 hours, then maintenance 540mg over the remaining 18 hours) or electrical shock in unstable cases with failure of the pharmacological control. Intraoperative sinus bradycardia in 88%of cases of the group GAE versus6%of cases in group of GA. Only there was one case of VF in every group controlled by direct electric shock. The incidence of ventricular extra systole in the group GAE is lower than the group of GA (P<0.01). Concerning the postoperative mechanical ventilation time, the group of GAE showed significantly shorter mechanical ventilation time than in GA (p<0.01) Table (3),figure(3).

Concerning the frequent use of vasoconstrictors with the group GAE, it was used with vasodilatation that happened due to the sympatholytic effect of HTEA in GAE group with (p <0.01), whereas the use of vasodilators is more frequent in the group of general anesthesia GA Table (4).

Concerning the changes of haemodynamics from baseline through various positions of the heart during OPCAB for fashioning of distal anastmosis mean arterial blood pressureMAP decreased from the baseline when the heart positioned to perform the first distal anastmosis to the LAD, the reduction of the MAP was higher in GA group than GAE which was consistent all over the anastmosis however the difference was not significant (p=0.24).Table (5) figure(3). The resting heart rate increased between the sternotomy and the first anastmosis in both groups in the group of GAE the rise of heart rate was less through the procedure, while the HR was higher in GA group (p=0.01) Table (6),figure(4).

The right heart filling pressure as reflected by the CVP showed a general increase from the baseline with heart positioning in both groups, but the difference in CVP between both groups varied with the time table (6).

Parameters	GEA	GA	P value	Significance
Age (year)	60.6±4.8	60.8±3.9	0.9	N.S
Gender (M/F)	43/7	45/5	0.53	N.S
Weight (kg)	81±82	82±6.4	0.64	N.S
Height (cm)	168.6±8.2	173.3±6.4	0.56	N.S
BSA (m^2)	1.71±O.2	1.83±0.4	0.36	N.S

GE: group of general with thoracic epidural anesthesia. GA: group of general anesthesia

BSA: body surface area. M:male F:femal cm: centimeter m^2:squar meter, kg: kilogram.

Table (1) Demographic data of both groups

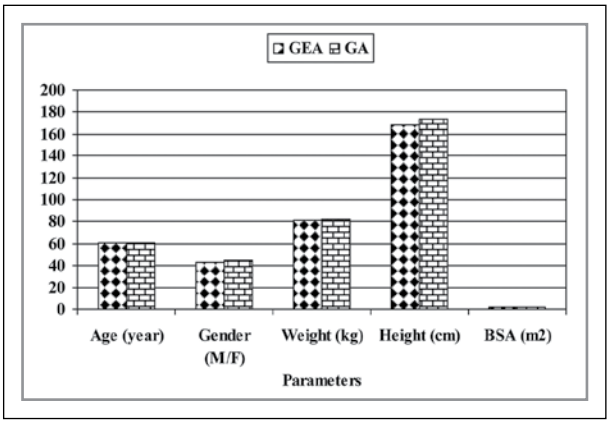

Fig 1. Demographic data of both groups.

Parameters	GEA(n=50)	GA=(n=50)	p-value	Significance
Hypertension	20pts (40%)	20pts (40%)	1.0	NS
Diabetes	10pts (20%)	9pts (18%)	0.9	NS
Renal insufficiency	4pts (8%)	5pts (10%)	1.0	Ns
Peripheral arterial disease	5pts (10%)	3pts (6%)	0.71	NS
Cerbrovascular disease	4pts (8%)	5pts (10%)	1.0	NS
Euroscore	3.1 ±0.83	3.0±0.84	0.6	NS
Sinus rhythm	50pts (100%)	50pts (100%)	1.0	NS
Beta blockers	22pts (44l%)	26pts (52%)	0.4	NS
LVEF>55%	36pts (72%)	38pts (76%)	0.64	NS
LVEF from 35-55%	14pts (28%)	12pts (24%)	o.64	NS
Previous MI	12pts (24%)	14pts (28%)	0.62	NS
Left main coronary disease	13pts (26%)	14 pts (28%)	0.82	NS

LVEF: left ventricular Ejection ,NS: not significant, M I:myocardial infarction, pts: patients

Table 2. Preoperative clinical data

	GEA	GA	P value	Significance
Operative time(hours)	2.3±0.5	2.4±0.5	0.029	NS
Number of grafts	2.48±0.68	2.96±0.7	0.37	NS
Blood loss(ML)	338±84.2	342.2±101	0.83	NS
Ventilation time(hours)	4.1+/-3.11	6.9±3.8	<0.01	Significant
Atrial fibrillation	2pts (4%)	16(32%)	<0.01	Significant
Ventricular extra systoles	1pts (2%)	10(20%)	<0.01	Significant
Sinus bradycardia	44pts (88%)	3(6%)	<0.001	Significant
Sinus tachycardia	2pts (4%)	16(32%)	<0.01	Significant
Ventricular fibrillation	1patient (2%)	1(2%)	1.o	NS

Pts:patients

Table 3. Perioperative data

Time of need to vasoconistrictors	Group (GAE)	Group (GA)	P value
Intraoperative befor of during anastmosis completion	60%	2%	<0.001
Intraoperative after anastmosis completion	48%	6%	<0.001
Postoperative	38%	8%	<0.001

Table 4. The use of vasoconstrictors in both groups.

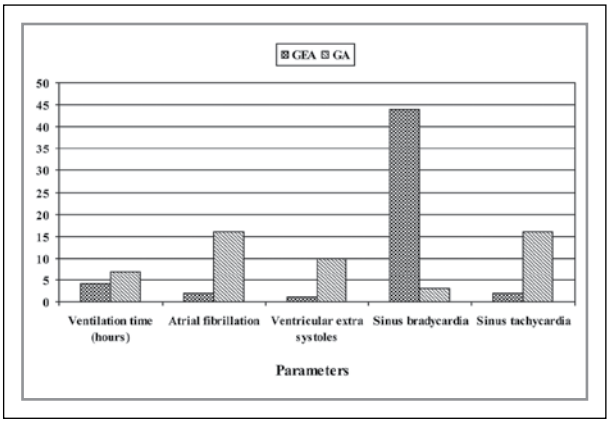

Fig 2. Perioperative significant difference data.

MAP	GAE		GA		P value
Mmhg	Mean	SD	Mean	SD	
LAD	72.9	1.04	74.5	1.3	NS
Lt .Cx	73	1.15	74.2	1.44	NS
PDA	76.0	0.85	75.4	1.02	NS
Post operative	75.0	0.55	75.8	1.01	NS

LAD: left anterior descending coronary artery, Lt Cx: Left circumflex coronary artery ,PDA: posterior descending coronary artery.

Table 5. Effect of positional changes of the heart for performing the distal anastmosis on the mean arterial pressure

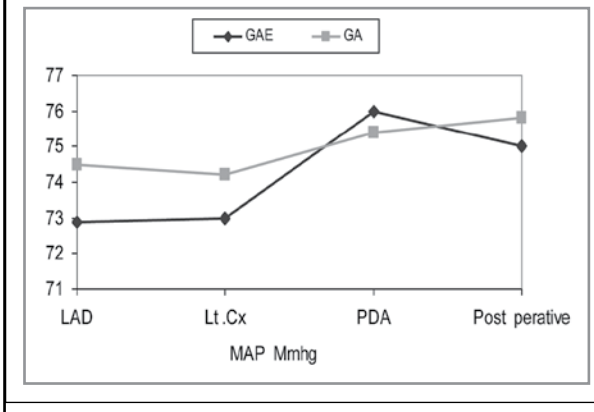

Fig 3. Effect of positional changes of the heart for performing the distal anastmosis on the mean arterial pressure.

Table 6. The effect of positional changes of the heart during performing distal anastmosis in OPCAB on the heart rate

Heart rat	GEA		GA		P value
Beat/minute	Mean	SD	Mean	SD	
LAD	62	1.06	67	1.3	0.002
Lt Cx	63	1.07	69	1.4	
PDA	64	1.2	68	1.05	
Post operative	66.5	1.2	75	1.07	

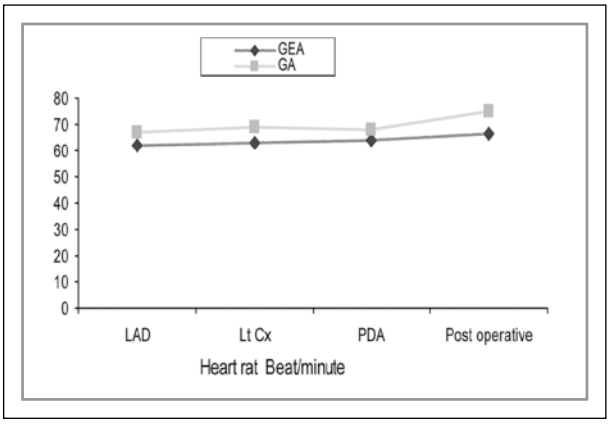

Fig. 4. The effect of positional changes of the heart during performing distal anastmosis in OPCAB on the heart rate

CVP	GEA		GA		P Value
Mmhg	Mean	SD	Mean	SD	
LAD	11.7	0.39	12	0.44	NS
Lt CX	14.0	0.55	11.8	0.40	NS
PDA	13.5	0.66	13.5	0.59	NS
Postoperative	9.0	0.3	9.2	0.25	NS

Table 7. The effect of changes of heart positions during performing distal anastmosis of OPCAB on central venous pressure

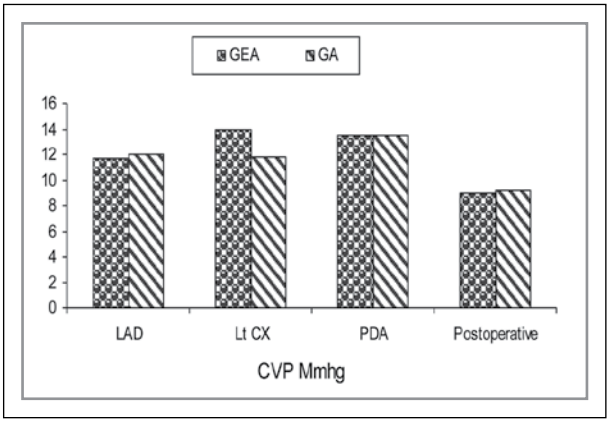

Fig. 5. The effect of changes of heart positions during performing distal anastmosis in OPCAB on central venous pressure

DISCUSSION

This prospective study aimed to prove whether the outcome of OPCAB should be improved if HTEA used in addition to general anesthesia with its known cardiovascular effect to reduce the perioperative incidence of arrhythmias especially atrial fibrillation and keeping intraoperative haemodynamic stability mainly during changing the heart position on performing the distal anastmosis especially of the lateral and inferior walls.Atrial fibrillation remains one of the most frequent complications in patient undergoing CABG and it obviously affects the morbidity during the perioperative period (12).

The autonomic nervous system imbalance leads to changes in the sinus node function and electrical atrial conduction, so the use of HTEA slows the cardiac sympathetic drive leading to reduction of the incidence of atrial fibrillation AF (13).

In the current prospective randomized study we have two groups one of them submitted to combined anesthesia using HTEA in addition to GA (GAE) and the other was GA only, in the group of GAE there was a very low incidence of atrial fibrillation AF only 4% of cases and ventricular extrasystole in 2% of cases in comparison of (GA) group that showed AF in 32% and ventricular extrasystoles in 20% of cases.

One of the most prominent effects of HTEA due to its inhibitory effect on the cardiac sympathetic activity, which lead to induced bradycardia and hypotension (14).

In our study it was obvious in the group of GAE that there was induced bradycardia in88% of cases, while in the group of GA in 6%only.

Haemodynamic variabilities during OPCAB are of usual occurrence during performing the distal anastmosis to the lateral and inferior walls presented as increase in heart rate, dropping of strok volume, cardiac output,and MAP (15, 16, 17).

A better stabilization of the intraoperative haemodynamics during OPCAB surgery

Could be achieved with HTEA and demand mor collaboration between surgical and anaethetic teams to maintain consistant haemodynamics by combination of (trendelenberg position, intravenous fluid fillingand prepheral vasoconstrictor) to allow better right heart filling and facilitate safe construction of distal anastmosis (18).

In our study the mean arterial pressure MAP showed marked drop with increase of the heart rate when the heart position to be changed for construction of the distal anastmosis to the vessels of the lateral and inferior heart walls ,so these patients controlled by change the body to trendelenberg position and pushing of intravenous fluids to maintain accepted haemodynamics in GA group ,while in GAE group addition of vasoconstrictor was mandatory in60%of cases during completion of the distal anastmosis, and 48%of cases after completion of the anastmosis. With HTEA in OPCAB patients a proper intense analgesia could be achieved during the early postoperative days giving the chance for faster recovery, early extubation and satisfactory pain tolerance (19, 20).

In our study the patient of the group GAE showed faster recovery, earlier significant postoperative weaning from mechanical ventilation and extubation with obvious tolerance of the pain with continuous use of HTEA over the first two days in the ICU.

CONCLUSION

A better clinical and surgical outcome could be achieved in OPCAB cases with application of HTEA in addition to GA as anaesthetic technique resulting in very low incidence of arrhythmias especially AF and ventricular extrasystoles, supporting the haemodynamics all over the conduct of surgery and with changing the heart position during construction of the distal anastmosis, with erlier extubation and intense postoperative analgesia.

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Management of Malignant Pericardial Effusion: A comparative study of Subxiphoid versus Mini-thoracotomy Approach

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Objectives: **To evaluate the therapeutic yield of pericardiotomy for management of malignant pericardial effusion (MPE) comparing the subxiphoid versus mini-thoracotomy approaches.**

Patients & Methods: **The study included 45 patients; 31 males and 14 females with mean age of 49.4±11.3 years. Thirteen patients were asymptomatic, 24 patients had varying degrees of tamponade and 8 patients had severe tamponade. Echocardiography detected massive PE in 17, severe PE in 21 and moderate PE in 7 patients. CT imaging detected pericardial mass in 6 patients and pleural effusion in 15 patients. Thirteen patients had emergency pericardiocentesis. Then, 23 patients had subxiphoid pericardiotomy and bleomycin pericardiodesis, while 22 patients had pericardio-pleural drainage through left mini-thoracotomy. Operative and postoperative (PO) data were analyzed.**

Results: **Mean operative time and total hospital stay were significantly longer with thoracotomy compared to subxiphoid approach. There was significantly higher consumption of PO analgesia with thoracotomy compared to subxiphoid pericardiotomy. Frequency of PO pain, infection and recurrence was significantly higher, while the frequency of PO bleeding was non-significantly higher with thoracotomy compared to subxiphoid approach. No procedure-related mortality was reported. All mortalities were attributed to either underlying primary malignancy or associated other co-morbidities. The 30-days, 6-month and one-year mortality rates were 17.8%, 55.6% and 86.7%, respectively. Six patients (13.3%) survived beyond the 1st PO year.**

Conclusion: **Management of MPE must be individually designed; subxiphoid pericardiotomy is appropriate approach for those unfit for general anesthesia and could be conducted for patients had preliminary pericardiocentesis as a continuation procedure. Pericardiodesis and pericardio-peritoneal drainage significantly reduced recurrent MPE after subxiphoid pericardiotomy. Mini-thoracotomy could be preserved for patients had left pleural effusion and fit for general anesthesia. No procedure-related mortality was reported and postoperative morbidities were minimal.**

KEYWORDS: **Malignant pericardial effusion, Pericardiocentesis, Subxiphoid pericardiotomy, Mini-thoracotomy approach**

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The pericardium is a serous membrane composed of two layers; parietal and visceral, containing a small amount of fluid. The pericardium can be directly affected by infectious, inflammatory, physical, or traumatic agents, and secondarily by metabolic disorders and systemic diseases. The reaction of the pericardium to this type of aggression can involve, among other things, accumulated fluid in the pericardial space; pericardial effusion (PE), and on occasion, cardiac tamponade [1,2].

Malignancy is a common cause of pericardial effusion, and malignant pericardial effusion (MPE) is a serious manifestation in advanced malignancies. Malignancy-related pericardial effusion is associated with significantly decreased patient survival. The management of MEP denotes a complex condition, one that is frequently encountered. Autopsy studies have revealed malignancy associated pericardium involvement with

an incidence between 10 and 20%. Slight MPE is frequently asymptomatic and usually is detected incidentally. Symptomatic cases, however, often manifest with cardiac tamponade, which can rapidly lead to cardiovascular collapse and death unless promptly treated [3, 4, 5, 6].

Treatment of MPE must address two concerns: relief of acute symptoms and the hemodynamic effects of cardiac tamponade, and prevention of fluid re-accumulation within the pericardium. However, the best treatment of MPE remains controversial. In the presence of malignancy, optimal treatment of MPE should balance treatment efficacy with life expectancy. Although timely management may decrease short-term risk of death from the effusion, many of these patients have major co-morbidity associated with widespread metastatic disease, limiting both quality of life and survival even with optimal management of MPE. In some cases pericardial effusion might be unrelated with the underlying malignancy and long-term survival can be expected [7, 8].

Management policies are variant; percutaneous pericardiocentesis despite being effective for rapid relieve of hemodynamic variables it carries inherent risks of possibility of cardiac injury and high recurrence rate with re-accumulation and requirement for repeated evacuation. Percutaneous pericardiocentesis under fluoroscopic or CT guidance greatly reduced the risk of injury but still recurrence is a problem [9,10,11]. Surgical interference for fashioning continuous drainage of pericardium to the pleural [12] or peritoneal [13] cavities improved outcome and minimized the risk of recurrence.

The current prospective study aimed to evaluate the therapeutic yield of pericardiotomy for management of malignant pericardial effusion comparing the subxiphoid versus the mini-thoracotomy approaches.

Patients and Methods

The current prospective study was conducted at Cardiothoracic Surgery, Benha University Hospital and Nasser Institute, Cairo since June 2010 till January 2013 to allow a minimum follow-up period of 6 months for the last enrolled case. After approval of the study protocol by the Local Ethical Committee and obtaining a written fully informed patients' consent 45 patients with malignant pericardial effusion were enrolled in the study.

All patients underwent clinical examination and revision of their files for determination of the primary lesion and management course. Then, if patients' condition permitted, all patients underwent echocardiographic examination and CT imaging. Patients with cardiac tamponade or massive PE were prepared for immediate pericardiocentesis to relieve hemodynamic instability and then were prepared for pericardiotomy using either subxiphoid approach or mini-thoracotomy approach.

Management

Pericardial Catheterization

The procedure was defined as urgent if the patient was hemodynamically unstable; the patient had respiratory compromise; or the effusion was massive. All pericardiocentesis were performed through a subxiphoid approach under fluoroscopic guidance. Briefly, after administration of 1% lidocaine to the skin and the deeper tissues of the left xiphocostal area, a 16-18 gauge polytetrafluoroethylene-sheathed needle was advanced from the left of the subxiphoid area aiming toward the left shoulder. Once the pericardial space was entered, the steel core was withdrawn leaving only the sheath in the pericardial space, then a guide wire was introduced into the pericardial space through the needle. The needle was removed and a catheter was inserted into the pericardial sac over the guide wire. Pericardial fluid was then removed. The catheter was left in place to monitor pericardial fluid drainage. The catheter was secured to the skin with 4-0 silk sutures, covered with a sterile dressing. The patients were followed with the use of Doppler echocardiography to ensure that the pericardial space has been adequately drained. Once achieving hemodynamic stability, patients were prepared for pericardial window fashioning.

Pericardial Window Fashioning

Surgical Approach

1. Left Minithoracotomy:

All patients were operated under general anesthesia with endotracheal intubation. The pericardium was exposed via a left minithoracotomy through 4-5 cm submammary incision in the 4th intercostal space using a pediatric chest wall retractor. After identification of the phrenic nerve, an anterolateral pericardial window of 4x4 or 5x5 cm was opened over the left ventricle, or if the tamponade was due to posterior fluid collection, a posterior pericardial window below the phrenic nerve was created. A chest drain (Nu. 28 F) was placed by a separate incision.

2. Subxiphoid approach:

Subxiphoid approach was carried out under local anesthesia under observation of an anesthesiologist for provision of fluent oxygen supply and intravenous sedation according to requirement. A vertical midline incision 8-10 cm in length was made over the lower sternum, xiphoid process, and upper abdomen. The xiphoid process was freed from its fascia1 and muscular attachments and then excised to allow better visualization of the pericardium. The junction of the pericardium and the diaphragm was located by inspection and palpation. The pericardium just cephalad to this junction was grasped with Allis clamps and gently pulled downward.

Surgical technique & follow-up

An incision was made in the pericardium between two clamps, and suction was inserted into the pericardial space to aspirate the fluid. Then the incision was extended to excise a 2x3 cm rectangular window of pericardium. After all fluid was evacuated, the pericardium was explored with the examining finger, and any tumor nodules lying within reach of the pericardiotomy were biopsied. In cases underwent subxiphoid approach, a suction catheter was passed gently around the heart into all recesses of the pericardial sac to make sure all collections of fluid were removed. The pericardial sac was drained with one 24F plastic catheter placed just caudal and posterior to the apex of the heart. The catheter was brought out through the created pericardial window and then through stab wounds in the abdominal wall on either side of the midline incision. In some cases, an incision was made in the diaphragm corresponding to the pericardial defect to create a pericardio-peritoneal window. Patients had this particular technique must have peritoneal cavity free of ascites. Drainage catheters were connected to water-seal drainage systems to which suction was applied. Chest tube was inserted for drainage of ipsilateral pleural space.

The excised window of pericardium was sent for gross and microscopic examination and samples of the pericardial fluid were sent for cytological and bacteriological examination. In cases underwent subxiphoid approach, the pericardial drainage tube was removed when the drainage decreased to ≤50 ml/day. Bleomycin 15 mg were dissolved in 20 ml of normal saline and were instilled through the drainage catheter into the pericardial space so as to act as both chemotherapy and induces sclerosis to initiate adhesions between parietal and visceral pericardial layers. After bleomycin instillation the pericardial drainage tube was removed. The chest drainage tube was removed after the daily drainage was less than 100 ml. Once chest drainage tube and pericardial drainage tubes were removed, patient was arranged for discharge.

Operative time, duration of pericardial and chest drainage, duration of ICU and hospital stay and postoperative complications; pain, infection, bleeding and recurrence were determined. Recurrence was defined as re-accumulation of pericardial fluid to the extent that additional treatment was required.

Statistical analysis

Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon; ranked test for unrelated data (Z-test) and Chi-square test (X^2 test). Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

Results

The study included 45 patients with mean age of 49.4±11.3; range: 27-68 years. There were 31 males and 14 females. Thirteen patients (28.9%) presented asymptomatic; 24 patients (53.3%) had varying degrees of tamponade as evidenced by dyspnea, elevated jugular or central venous pressure, and pulsus paradoxus and in 8 patients (17.8%) the tamponade was severe enough to produce hypotension and oliguria. Primary solid tumor was reported in 42 patients (93.3%) with lung adenocarcinoma was the most frequent primary detected in 23 patients (51.3%), invasive breast carcinoma in 6 patients (13.3%) and esophageal and gastric carcinoma in 6 patients (13.3%), hepatobiliary carcinoma in 3 patients (6.7%) and other solid tumors in 4 patients (8.8%). Hematological primary was detected in 3 patients (6.7%), (Table 1).

Mean ejection fraction as determined by initial echocardiography was 52.5±5.6; range: 38-65; 34 patients (75.6%) had mean ejection fraction of 54.3±2.3, 9 patients (20%) had mean ejection fraction of 43.4±4.3 and only 2 patients (4.4%) had mean ejection fraction of 63±2.8. Echocardiography detected massive PE in 17 patients (37.8%) and chamber collapse in 5 of these patients. Severe PE was detected in 21 patients (46.7%) and 7 patients (15.5%) had moderate PE. CT imaging detected pericardial mass in 6 patients (13.3%) and PE accompanied by pleural effusion in 15 patients (33.3%), (Table 2).

Thirteen patients required emergency drainage of pericardial fluid for a frequency of emergency pericardiocentesis of 28.9%. In these cases, diagnosis relied on clinical findings and positive echocardiography. Twenty-three patients underwent subxiphoid pericardiotomy and pericardiodesis, while 22 patients underwent pericardio-pleural drainage through left mini-thoracotomy approach. There was non-significant (p>0.05) difference between patients categorized according to surgical approach as regards enrollment data, (Table 3).

During pericardiotomy, cases underwent preliminary pericardiocentesis drained a small intraoperative amount of PE fluid. Mean volume of fluid drained during surgery was 652±405; range: 100-1450 ml. The appearance of the effusion was grossly bloody in 26 patients (57.8%) and yellowish in 19 patients (42.2%). Cytological findings of 17 (37.8%) patients were consistent with malignancy, pathological findings of 14 (31.1%) patients were consistent with malignancy and in 11 (24.4%) patients, both cytological and pathological findings were consistent with malignancy, (Table 4).

Mean operative time in patients had mini-thoracotomy was 43.4±6; range: 35-60 minutes and was significantly (Z=4.118, p<0.001) longer than in patients had subxiphoid approach; 23.2±5.6; range: 15-30 minutes, (Fig. 1). Mean duration of pericardial drainage in patients had subxiphoid approach was 4.1±1.3; range: 2-6 days, while mean duration of chest-tube drainage in patients had mini-thoracotomy was 7.3±1.6; range:

Data			Finding	
	Strata	<30	4 (8.8%)	28.3±1 (27-29)
		>30-40	7 (15.6%)	39±2.7 (32-39)
		>40-50	12 (26.7%)	45.7±1.7 (43-49)
		>50-60	14 (31.1%)	55.5±2.3 (51-59)
		>60	8 (17.8%)	64.4±2.7 (61-68)
	Total		45 (100%)	49.4±11.3 (27-68)
Gender	Males		31 (68.9%)	
	Females		14 (31.1%)	
Symptoms & Signs	Asymptomatic		13 (28.9%)	
	Dyspnoea		35 (77.8%)	
	Hypotension		9 (20%)	
	Distended neck veins		8 (17.8%)	
	Edema		10 (22.2%)	
	Weight loss		14 (31.1%)	
	Pulsus paradoxus		17 (37.8%)	
	Oliguria		6 (13.3%)	
Primary cancer	Solid tumor	Lung adenocarcinoma	23 (51.3%)	
		Invasive breast carcinoma	6 (13.3%)	
		Gastric adenocarcinoma	3 (6.7%)	
		Esophageal squameous cell carcinoma	3 (6.7%)	
		Hepatocellular carcinoma	2 (4.4)	
		cholangiocarcinoma	1 (2.2%)	
		Others	4 (8.8%)	
	Hematological malignancies	Lymphoma	2 (4.4%)	
		Others	1 (2.2%)	

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

Table 1. Patients' enrollment data

Data					Findings
Echocardiographic findings	Amount of effusion	Massive			17 (37.8%)
		Severe			21 (46.7%)
		Moderate			7 (15.5%)
	Ejection fraction	Strata	>60	2 (4.4%)	63±2.8 (61-65)
			50-60	34 (75.6%)	54.3±2.3 (51-59)
			<50	9 (20%)	43.4±4.3 (38-49)
		Total			52.5±5.6 (38-65)
CT findings	Pericardial mass				6 (13.3%)
	Pleural effusion				15 (33.3%)

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

Table 2. Patients' Echocardiography and CT data

Data			Mini-thoracotomy (n=22)	Subxiphoid (n=23)
Gender; M:F			16:6	15:8
Primary tumor	Solid		21 (95.5%)	21 (91.3%)
	Hematological		1 (4.5%)	2 (8.7%)
Echocardiography	Ejection fraction		53.3±2.9 (45-58)	51.7±7.4 (38-65)
	Amount of effusion	Massive	8 (36.4%)	9 (39.1%)
		Severe	11 (50%)	10 (43.5%)
		Moderate	3 (13.6%)	4 (17.4%)
CT findings	Not done		5 (22.7%)	8 (34.8%)
	Pericardial mass		2 (9.1%)	4 (17.4%)
	Pleural effusion		6 (27.3%)	9 (39.1%)
	No additional data		9 (40.9%)	2 (8.7%)
Preliminary Catheter drainage	Yes		5 (22.7%)	8 (34.8%)
	No		17 (77.3%)	15 (65.2%)

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

Table 3. Enrollment data of studied patients categorized according to applied approach for pericardial window

Data			Mini-thoracotomy (n=22)	Subxiphoid (n=23)
Preliminary Catheter drainage	Number		5 (22.7%)	8 (34.8%)
	Amount of fluid		161±35.2 (110-225)	159±39.4 (100-200)
No preliminary Catheter drainage	Number		17 (77.3%)	15 (65.2%)
	Amount of effusion		851.6±279.3 (540-1350)	826.5±337.5 (345-1450)
Total	Amount of effusion		701.2±381.6 (110-1350)	584.7±442.5 (100-1450)
Cyto-pathological data	Cytology	Positive	10 (45.5%)	7 (30.4%)
		Negative	12 (54.5%)	16 (69.6%)
	Pathology	Positive	6 (27.3%)	8 (34.8%)
		Negative	16 (72.7%)	15 (65.2%)
	Both	Positive	6 (27.3%)	5 (21.7%)
		Negative	12 (54.5%)	8 (34.8%)

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

Table 4. Enrollment data of studied patients categorized according to applied approach for pericardial window

5-10 days. Mean duration of hospital stay of patients had mini-thoracotomy was 12.8±1.4; range: 11-17 days was significantly (Z=2.310, p=0.021) longer than in those had subxiphoid approach; 11.3±1.8; range: 9-15 days, (Table 5, Fig. 2).

Eighteen patients (40%) required no postoperative analgesia, 22 patients (48.9%) had mild postoperative pain relieved on intramuscular injection of non-steroidal anti-inflammatory drugs and only 5 patients (11.1%) required opioid analgesia. There was significantly higher (X^2=14.824, p<0.001) consumption of postoperative analgesia by patients had thoracotomy compared to those had subxiphoid pericardiotomy. As regards postoperative complications, wound infection and bleeding were reported in 6 and 3 patients, respectively, but fortunately were controllable. The frequency of postoperative infection was significantly higher (X^2=6.524, p<0.05), while the frequency of postoperative bleeding was non-significantly higher (X^2=1.267, p>0.05) in patients had thoracotomy compared to those had subxiphoid approach. Four patients developed recurrent PE for a frequency of recurrence

of 8.9%. The frequency of recurrent PE was significantly higher (X2=3.761, p<0.05) in patients had thoracotomy compared to those had subxiphoid procedure (Table 6).

No procedure-related mortality was reported. All mortalities were attributed to either underlying primary malignancy or associated other co-morbidities. Eight patients died during 1st month after surgery with a 30-days mortality rate of 17.8%. Seventeen patients died during 6 month after surgery for a cumulative 6-month mortality rate of 55.6%. Fourteen patients died the following 6 months for cumulative one-year mortality rate of 86.7% and only 6 patients (13.3%) survived beyond the 1st postoperative year.

Data	Mini-thoracotomy (n=22)	Subxiphoid (n=23)	Statistical analysis
Operative time (min)	43.4±6 (35-60)	23.2±5.6 (15-30)	Z=4.115, p<0.001
Duration of hospital stay (days)	12.8±1.4 (11-17)	11.3±1.8 (9-15)	Z=2.310, p=0.021

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

Table 5. Operative and postoperative data of studied patients categorized according to applied approach for pericardial drainage

		Mini-thoracotomy (n=22)	Subxiphoid (n=23)	Statistical analysis
Postoperative analgesia	No pain	3 (13%)	15 (65.2%)	X^2=14.824, p<0.001
	Mild pain relieved on NSAIDs	15 (68.2%)	7 (30.4%)	
	Pain required opioids	4 (17.4%)	1 (4.4%)	
Postoperative bleeding	No	20 (90.9%)	22 (95.6%)	X^2=1.267, p>0.05
	Controllable	2 (9.1%)	1 (4.4%)	
Postoperative infection	No	18 (81.8%)	21 (91.3%)	X^2=6.524, p<0.05
	Controllable	4 (18.2%)	2 (8.7%)	
Postoperative recurrence	No	19 (86.4%)	22 (95.6%)	X^2=3.761, p<0.05
	Yes	3 (13.6%)	1 (4.4%)	

Data are presented as numbers; percentages are in parenthesis; NSAIDs: Non-steroidal anti-inflammatory drugs

Table 6. The frequency of postoperative pain and complications reported in studied patients categorized according to surgical approach

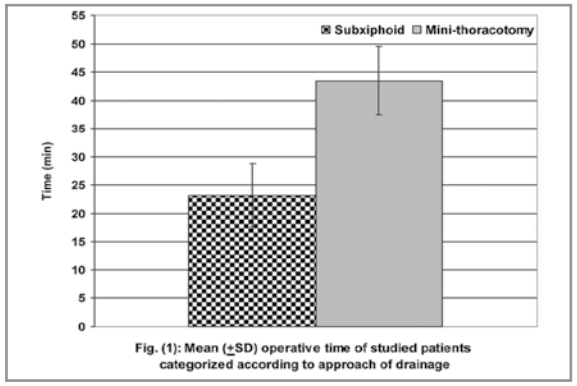

Fig. (1): Mean (±SD) operative time of studied patients categorized according to approach of drainage

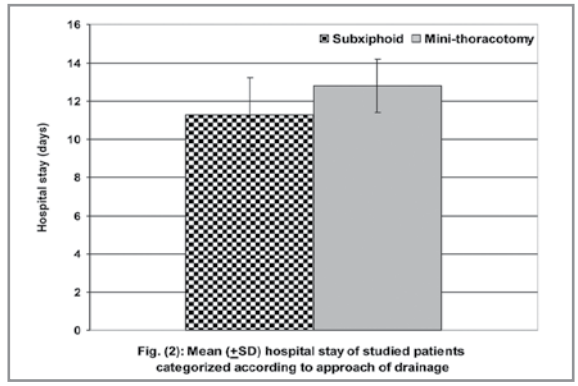

Fig. (2): Mean (±SD) hospital stay of studied patients categorized according to approach of drainage

Discussion

The current study relied on urgent management of MPE using immediate pericardiocentesis for relieve of tamponade and then surgical management using either subxiphoid approach or mini-thoracotomy approach for performing pericardiotomy. Thirteen patients presented with or impending tamponade and were drained successfully using catheter drainage without procedure-related morbidities and all showed relief of presenting manifestations. Four of these patients were unfit for general anesthesia and were managed using subxiphoid approach which is collectively conducted under local infiltration anesthesia, while the remaining cases were randomly allocated to either of study groups. Thus, subxiphoid approach provided the advantage of drainage and proceed in the same setting and being performed under local infiltration anesthesia is another advantage for this patient population which is already compromised.

Data concerning catheter drainage as a first therapeutic option go in hand with that previously reported by **Jaussaud et al.** [14] who reported that percutaneous pericardial drainage is effective to treat postoperative pericardial effusion and when the effusion is more than 10 mm and accessible, it can be the initial strategy and surgical drainage can serve as an alternate strategy in case of failure and complications of this procedure.

Mean duration of operative procedure was significantly shorter with minimal postoperative complications and so significantly shorter total hospital stay with subxiphoid approach in comparison to thoracotomy approach. For both approaches, no procedure related mortalities were reported and the frequency of postoperative complications was minimal and acceptable. These data illustrate the therapeutic benefits of either approach for pericardial drainage and their safety and compatibility for assigned options.

In line with the obtained results; concerning effectiveness of subxiphoid pericardiotomy; **Miao et al.** [15] found the subxiphoid pericardial window drainage procedure is the first choice for a safe, effective, minimal invasive and easy to do procedure for the patients with a large pericardial effusions or cardiac tamponade. **Allen et al.** [16] reported that benign and malignant pericardial tamponade can be safely and effectively managed with subxiphoid pericardiostomy and percutaneous catheter drainage should be reserved for patients with hemodynamic instability. **Campione et al.,** [17] documented that pericardiocentesis is to be preferred in acute pericardial effusion with cardiac tamponade to avoid general anesthesia; subxiphoid drainage is suitable for all neoplastic patients.

Becit et al. [18] reported that pericardial effusions of various causes can be safely, effectively, and quickly managed with subxiphoid pericardiostomy in both adults and children. **Gross et al.** [19] tried initial pericardiocentesis in about 60% of their series of patients presenting by MPE and continued with definitive surgical treatment that was performed in 43 patients, as follows: subxiphoid pericardial window (n = 21); thoracotomy and pleuropericardial window (n = 10); pericardiodesis (n = 8); and videothoracoscopic pleuropericardial window (n = 4) and found pericardial window and pericardiodesis seem to be safe and efficacious in treating effusion of the pericardium. **Rylski et al.** [20] found endoscopic approach for treating late cardiac tamponade provides the advantages of minimally invasive surgery through subxiphoid pericardiotomy combined with an optimal surgical perspective.

Despite the reported significantly longer operative time and hospital stay, mini-thoracotomy was found appropriate especially for patients had left-sided pleural effusion. In line with these data, **Celik et al.** [21] reported that pericardial window creation via minithoracotomy was proven to be a safe and effective approach in surgical treatment of pericardial tamponade in cancer patients.

In support of the efficacy of the applied approaches, multiple studies tried these approaches in cases of PE for variant etiologies and supported the data of the current study; **Kurimoto et al.** [22] found blind subxiphoid pericardiotomy was safe and could be performed quickly in an emergency situation, while percutaneous catheter drainage for hemopericardium could not avoid critical complications because of clotting in pericardium. **Goz et al.** [23] found that in hemophilia A patients, either pericardiocentesis or subxiphoid pericardial drainage or pericardial window creation via thoracotomy may be applied, depending on the primary pathology, but in pediatric cases, pericardial window creation via mini-thoracotomy can be an alternative treatment of choice considering complications such as recurring bleeding and effusion during pericardiocentesis.

Subxiphoid approach provided better postoperative course manifested as significantly lower frequency of postoperative pain and requirement for postoperative analgesia with significantly lower frequency of postoperative bleeding and recurrence. In line with these data **McDonald et al.** [24] found that subxiphoid and percutaneous pericardial drainage of symptomatic pericardial effusions can be performed safely; however, open subxiphoid pericardial drainage with pericardial biopsy appears to decrease recurrence but does not improve diagnostic accuracy of malignancy over cytology alone. The reported low recurrence rate after subxiphoid approach (4.4%) could be attributed to the use of sclerotherapy and proper selection for cases to undergo pericardio-peritoneal drainage.

No procedure-related mortality was reported; all mortalities were attributed to either underlying primary malignancy or associated other co-morbidities. The 30-days, the 6-month and the one-year cumulative mortality rates were 17.8%, 55.6% and 86.7%, respectively and only 6 patients (13.3%) survived beyond the 1st postoperative year. These figures coincided with that reported in literature; **Dosios et al.,** [25] reported an **o**verall 30-day mortality of 16.3% in patients had MPE and had subxiphoid drainage. **Saltzman et al.** [26] reported 30-day mortality rate of 19.8% with open surgical drainage of MPE

It could be concluded that management of MPE must be individually designed; subxiphoid pericardiotomy is the appropriate approach for those unfit for general anesthesia and could be conducted for patients had preliminary pericardiocentesis

as a continuation procedure. Pericardiodesis and pericardio-peritoneal drainage significantly reduced recurrent MPE after subxiphoid pericardiotomy. Mini-thoracotomy could be pre-served for patients had left pleural effusion and fit for general anesthesia. No procedure-related mortality was reported and postoperative morbidities were minimal.

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Preoperative Predictors of Post-Coronary Artery Bypass Graft Atrial Fibrillation

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Background: **Atrial fibrillation is a very common cardiac arrhythmia. It occurs in up to 60% of patients after CABG surgery. Moreover, post-operative AF is associated with an increased incidence of post-operative hypotension, ventricular arrhythmia and even stroke. Additionally AF following CABG prolongs hospital stay. Many attempts were done to identify the true predictors of occurrence of postoperative atrial fibrillation. These predictors include increased age, chronic obstructive pulmonary disease, high resting systolic blood pressure, high resting pulse rate, preoperative angina, recent myocardial infarction less than 6 months and preoperative use of anti-arrhythmic medications. Some studies showed that P-wave dispersion increased postoperatively to a larger extent in those who subsequently developed AF compared with those without AF.**

Study objectives: **We aimed at globally detect the burden of the problem of post-CABG atrial fibrillation in our patients' series. Moreover, we tried to detect the simple pre-operative variables that could predict post-operative atrial fibrillation.**

Patients and methods: The study involves 50 patients who were in sinus rhythm and had open heart surgery for coronary artery bypass grafting. All patients were subjected to careful history taking, full clinical examination, ECG and Echocardiographic assessment. They were followed up for 3 months and had post-operative ECG to detect any rhythm changes.

Results: **There were 66% males with mean age 54.9±7.9. 36% were hypertensives, 24% were diabetics and 22% had history of previous AF. The incidence of post-operative AF was 32%. Those patients who developed AF were mostly hypertensives, diabetics and with impaired left ventricular systolic function. High basal heart rate, increased P wave dispersion and increased left atrial dimensions were good pre-operative predictor for AF occurrence.**

Conclusions: **Post-CABG AF occurs in about one third of patients. Hypertension, diabetes, heart failure and previous AF are common risk factors. Beta-blocker can decrease the incidence of post-CABG AF.**

KEY WORDS: **Post-CABG, atrial fibrillation, P wave dispersion.**

Atrial fibrillation is a supraventricular tachyarrhythmia characterized by uncoordinated atrial activation with consequent deterioration of atrial mechanical function [(1)]. Atrial fibrillation is a very common cardiac arrhythmia. It is considered to be the most frequent rhythm disturbance to be diagnosed in the hospitals or within the private clinics.

Atrial fibrillation (AF) occurs frequently after most types of cardiac surgery. Its incidence varies greatly according to the type of surgery and the method of follow up. It occurs in up to 60% of patients who undergo valve replacement with CABG. Moreover, transient episodes of silent atrial fibrillation could have occurred when these patients were not wearing their rhythm recorders. In addition, transient episodes may not have been accompanied by symptoms, and thus the incidence of post-operative atrial fibrillation may be much higher [(2)].

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The precise mechanism of postoperative AF is incompletely understood, and is still being investigated. In the predominantly elderly group of patients who undergo coronary bypass surgery, age-related structural changes such as atrial dilatation, hypertrophy and fibrosis occur to varying degrees of severity in the atrium. This already heterogeneous myocardium is subjected to operative trauma and subsequent postoperative inflammation and edema. So it becomes a tissue mosaic of differing refractory periods and conduction velocities that is susceptible to aberrant electrical activity, conduction blocks and re-entry hence the name the 'anisotropic' atrium [3].

Atrial fibrillation, per se, has implications both on the patient himself and on the economic health resources including impaired quality of life, thromboembolic diseases with risk of transient ischemic attack and stroke, worsening heart failure and increased mortality [4]. Moreover, post-operative AF is associated with an increased incidence of post-operative hypotension, ventricular arrhythmia and even stroke. Additionally AF following CABG prolongs hospital stay [5].

Therefore, many attempts were done to identify the true predictors of occurrence of postoperative atrial fibrillation. There are many predictors of postoperative atrial fibrillation including increased age, chronic obstructive pulmonary disease, high resting systolic blood pressure, high resting pulse rate, preoperative angina, recent myocardial infarction less than 6 months, type of surgery, and preoperative use of anti-arrhythmic medications [6-7].

Some studies showed that the postoperative P-wave duration decreased to a larger extent, and the P-wave dispersion increased postoperatively to a larger extent in those who subsequently developed AF compared with those without AF. So an increase in postoperative P-wave dispersion can be considered to be independent predictors of postoperative AF [8].

In our study we aimed at globally detect the burden of the problem of post-CABG atrial fibrillation in our patients' series. Moreover, we tried to detect the simple pre-operative variables that could predict post-operative atrial fibrillation.

Study objectives

The aim of this study was to identify the parameters obtained prior to cardiac surgery, which may help to predict occurrence of post-operative AF in a consecutive series of patients.

Patients and Methods

The present study is a cross sectional observational study. It involves 50 patients who had open heart surgery for coronary artery bypass grafting in Assiut University Hospitals during the period between January 1st, 2009 and December 31st, 2012. The study protocol has been approved by the ethical committee of the Faculty of Medicine, Assuit University. A written consent has been taken from every participant As a pre-requisite to be involved in the study; all patients were essentially in sinus rhythm. Any patient who had other than normal sinus rhythm in the baseline ECG was excluded from the study. All patients were subjected to:

(1) Careful history taking: focusing on:

* Age, sex, and special habits of the patients mainly smoking.
* History of relevant cardiac and medical conditions such as previous heart failure, previous atrial fibrillation, hypertension, diabetes mellitus and chronic obstructive pulmonary disease.
* Therapeutic history: We reported only drugs that were regularly used for at least 6 months in the preoperative period. This includes use of beta-blockers, calcium channel blockers, digitalis, amiodarone, non steroidal anti-inflammatory drugs, and angiotensin converting enzyme inhibitors.

(2) Clinical examination mainly for heart rate assessment.

(3) Electrocardiogram (ECG):_

* Preoperative ECG: It was done the day before the operation to confirm sinus rhythm, count heart rate, and measure P wave dispersion. P wave dispersion is a measurement of the heterogeneity of atrial depolarization. P wave dispersion is derived by subtracting the minimum P wave duration from the maximum in any of the 12 ECG leads [9].
* Postoperative ECG: It involves:

A) Early postoperative ECG: it was done in the early postoperative period (within four days postoperatively). During the hospital stay any attack of palpitation was thoroughly analyzed and immediate ECG was done to confirm the underlying rhythm.

B) Follow up ECG: It was done 3 months later to detect occurrence of AF. Any abnormal heart rhythm in postoperative ECG is documented and reported. After discharge, the patient was told to report any attack of palpitation and to seek medical help to have 12 leads ECG.

(4) Echocardiography: All patients had detailed echocardiographic assessment prior to surgery. We used PHILIPS IE-33 device. We collected the parameters that seemed to have relevance to the development of AF such as left atrial anteroposterior diameter (LA) and left ventricular ejection fraction (EF).

(5) Surgical technique: The standard approach was median sternotomy. LIMAs and saphenous vein were then harvested. Total cardiopulmonary bypass has been used in all patients. The aimed coronary artery was then dissected from its epicardial sheath. After the myocardium has become flaccid, a small arteriotomy was made.

Then the distal vein was tailored to the proper angle and a continuous suture initiated the anastomosis. The same technique was used in the anastomosis of LIMA to LAD. All distal anastomoses were performed first under an aortic cross-clamp, while the proximal anastomoses were done after removal of the aortic cross-clamp. Finally, air was evacuated from the grafts, the left ventricular vent was removed, and the patient was weaned from cardiopulmonary bypass.

(6) Statistical analysis: Data are expressed as mean ± SD (for continuous data) or frequency and percentage (for non-continuous data) when appropriate. Continuous variables were compared by Student t test for unpaired data, as appropriate. Non-continuous variables were compared by use of the chi-square statistic test. A P value equal or less than 0.05 was considered statistically significant. Data were analyzed using the SPSS statistical software version 16, for Windows (SPSS, Chicago, IL, USA).

Results

Fifty consecutive patients who had coronary artery bypass graft surgery in Assuit University Hospitals during the period between 1st January 2009 and 31st December 2012 were included in the present study; they were essentially in sinus rhythm.

(1) Clinical history: There were 33 males (66%) with the mean age is 54.9±7.9 years, the minimum age was 38 and the maximum was 70 years old. Out of the fifty patients, 20 patients (40%) were smokers. The table (1) shows the clinical and therapeutic history of the study patients.

Variable	Number	Percentage
Hypertension	18	36
Diabetes mellitus	12	24
COPD	4	8
Previous heart failure	12	24
Previous atrial fibrillation	11	22
Angiotensin converting enyme-inhibitors	15	30
Non-steroidal anti-inflammatory drugs	7	14
Digitalis	9	18
Beta-blockers	24	48
Ca-channel blockers	4	8

Table 1. Clinical and therapeutic history.

(2) Clinical examination: ***The mean heart rate was 74.4±10.1 beats/min.***

(3) Electrocardiography:

* Pre-operative ECG: All patients were essentially in sinus rhythm. The mean heart rate was 74.4±10.1 beats/min. The mean P wave dispersion was 65.8±17.2 msec.

* Post-operative ECG: Atrial fibrillation was developed in 16 patients (32%). 10 patients developed AF early in the post-operative period and before hospital discharge. While 6 patients reported palpitations during the three-months follow up period and they had documented AF in ECG. It was paroxysmal in 12 of them and persistent in the other four patients that necessitated cardioversion.

(4) Echocardiography: The mean LA diameter was 4.1±0.6 mm. The mean ejection fraction was 59.3±11 %.

(5) Predictors of post-operative atrial fibrillation: We drew univariate and multivariate analysis for the various factors that could be associated with occurrence of AF after CABG. We divided the study population into two groups according to the development of post-operative AF.

Group (A): Patients who develop AF (16 patients) and

Group (B): Patients who remained in sinus rhythm (34 patients).

The following table (2) summarizes the results.

Variables	Group A	Group B	P value
Age (mean ± SD in years)	55 ± 5.9	54.9 ± 8.9	0.9
Sex (male %)	62.5	67.6	0.5
Smoking (%)	31.3	44.1	0.3
Hypertension (%)	56.3	26.5	0.04
Diabetes mellitus (%)	50	11.8	0.006
COPD (%)	6.3	8.8	0.6
Previous heart failure (%)	56.3	8.8	0.001
Previous atrial fibrillation (%)	37.5	14.7	0.08
Beta-blockers (%)	25	58.8	0.03
Digoxine (%)	37.5	8.8	0.02
Amiodarone (%)	31.2	20.6	0.3
NSAIDs (%)	25	20.6	0.7
ACE-I (%)	12.5	8.8	0.5
Ca-channel blockers (%)	12.5	8.8	0.5
Heart rate (mean ± SD in beats/min)	83.4 ± 7.4	70.2 ± 8.4	0.001
P wave dispersion (mean ± SD in msec)	83.4±8.9	57.5±13.6	0.001
LA diameter (mean ± SD in mm)	4.7±0.5	3.7±0.4	0.001
EF (mean ± SD in %)	52.6±11.2	62.4±9.6	0.002

Table (2): Predictors of post-operative AF.

* **Demographic criteria**: There was no statistically significant relationship between occurrence of post-operative AF and age (P value > 0.05), sex (P value > 0.05) nor history of smoking (P value > 0.05).

* **History of relevant disease**: There was statistically significant relationship between occurrence of post-operative AF and history of hypertension (P value < 0.05), diabetes mellitus (P value < 0.05) and heart failure (P value < 0.05). There is only a trend that history of previous AF is a predictor of post-operative AF; however, this didn't reach a statistically significant level (P value 0.08). On the other hand, history of chronic obstructive airway disease had no relation to the occurrence of post-operative AF (P value > 0.05).

* **Medical history**: Beta-blockers were shown to be protective against post-operative AF (P value < 0.05), figure (1). This relationship couldn't be demonstrated for any of amiodarone (P value > 0.05), calcium channel blockers (P value > 0.05), non-steroidal anti-inflammatory drugs (P value > 0.05) or angiotensin converting enzyme inhibitors (P value > 0.05). Paradoxically, our results showed that digoxine use was associated with occurrence of post-operative AF (P value < 0.05).

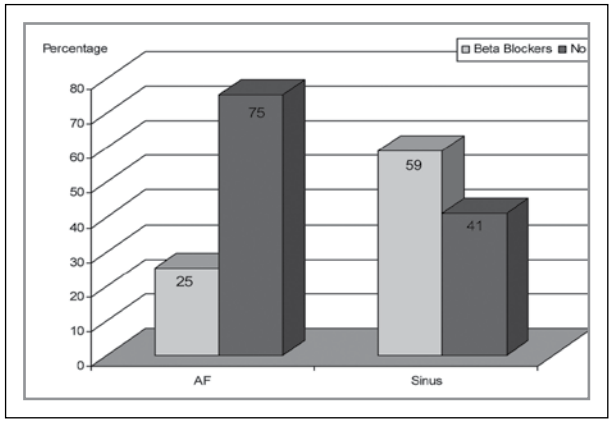

Fig 1. Relation between pre-operative beta-blocker use and development of post-operative AF.

* **Heart rate**: Using Student t test, there was a strong relationship between high heart rate and development of post-operative AF (P value < 0.05), figure (2).

* **Electrocardiography**: Increased P wave dispersion is a strong predictor for post-operative AF, (P value < 0.05).

* **Echocardiography**: We found that the presence of dilated left atrium was strongly associated with the development of post-operative AF, (P value < 0.05). Moreover, the impaired left ventricular systolic function was one of the echocardiographic parameters that predict the development of post-operative AF, (P value < 0.05).

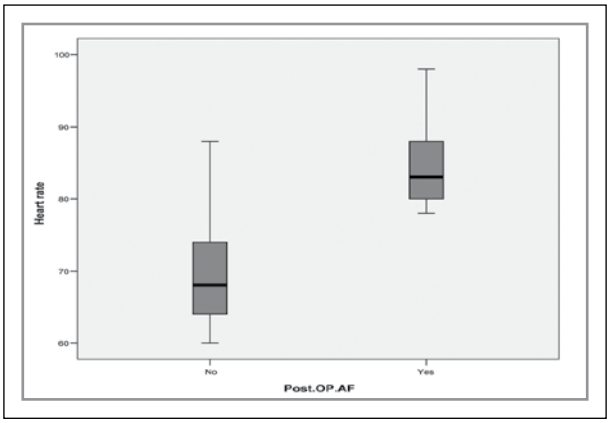

Fig 2. Relation between heart rate and development of atrial fibrillation.

Discussion

No doubt that atrial fibrillation constitutes a major health problem with a great burden on the health resources especially in the developing countries. In the United Kingdom, the cost of atrial fibrillation management was about 655 million Euros in the year 2000 making about 0.97% of the total national health services. Moreover, these are almost certainly conservative estimates since additional costs, such as those related to stroke rehabilitation, digoxin toxicity and warfarin or aspirin related haemorrhage, have not been considered [10]. Hence every effort should be done to prevent its occurrence. The actual incidence of post-CABG AF is variable. It has been reported in up to 15% to 40% of patients in the early postoperative period [11]. In our study we reported post-CABG AF in 32% of our study population.

On contrast to what have been stated by many studies, our results didn't detect a consistent relationship between age and occurrence of post-CABG AF. Framingham study stated that AF is a disease with increasing prevalence among elderly patients [12]. Moreover, Babaev et al. reported an association between older age and prolonged P-wave duration in signal-averaged ECG and hence AF production [13]. In the current study, the mean age of our population was around 55 years, while in other studies, it was higher. Zangrillo et al reported a mean age about 64 years [14]. In a study published by Dogan et al., they reported a mean age around 60 years [15]. On the other hand, in a recent study conducted on 670 patients who underwent CABG surgery, the mean age of the participants was 55 years. They found that there was no significant difference on univariate analysis between patients who developed post CABG AF and those who remained in sinus rhythm [16]. In a recent study published in 2012, they found no age difference between those who developed AF and those who remained in sinus rhythm after CABG surgery. Again they reported a mean age about 57 years old [17].

It is well known that atrial fibrillation is more common in men than women overall and in every age group. In Framingham data, after adjustment for age and other risk factors, atrial fibrillation was found to develop in men at 1.5 times the rate in women [12]. However, our results didn't demonstrate any gender difference regarding the occurrence of post-CABG AF. This has been also shown in many studies [14-16].

Smoking is a strong predisposing factor for AF development among general population. Many studies reported that smoking is a pre-operative predictor for post-CABG AF [16]. Almassi et al. in a large scale study enrolling more than 3000 patients undergoing open heart surgery also confirmed that fact [18]. On contrast, our results didn't support this fact in patient undergoing CABG surgery. Also Hashemi Jazi et al., who also enrolled about 50 patients post CABG, found the same results in their study [17]. This may be due to the relatively small number of the patient population both in our study and in that of Hashemi Jazi et al.

In the current study, we tried to identify the relation between post-CABG AF and other common co-morbidities such as diabetes, hypertension, chronic obstructive airway disease, previous history of heart failure and previous history of AF. This has been also discussed in many previous studies.

In the Framingham Heart Study, hypertension and diabetes were the sole cardiovascular risk factors to be predictive of AF after controlling for age and other predisposing conditions[12]. Arterial hypertension, found in 65–70% of AF patients but only in 25–50% of the population, is the most common co-Morbidity found in AF registries in Germany and Europe [19-20]. Our results confirmed the relationship between hypertension and post-CABG AF. This was also confirmed by Cetin et al., who conducted their study on 272 post CABG patients [21]. Moreover, Almassi et al. reported that hypertension in the perioperative period was a significant predictor for post CABG AF [18]. On the other hand some studies didn't demonstrate that relationship [8, 14-15, 22-23].

Diabetes mellitus is a disease that may alter both the electrical and biochemical atrial milieu, hence predisposes the atria to develop AF [24]. So, diabetes was found to be strong predictor of post-CABG AF [16-17]. This goes with our current results. However, other studies didn't demonstrate this relationship [8, 14-15, 22-23].

'AF begets AF' is a standard role in arrhythmology [1]. We detected that previous history of AF is a predictor of post-CABG AF. This has been reported in many studies as well [8, 23, 25].

In our study, heart failure either manifested clinically or derived from reduced left ventricular ejection fraction in echocardiography was shown to be predictor for post-CABG AF. Other studies showed controversial results regarding the ejection fraction. Some studies didn't report a relationship between post-CABG AF and prior EF [14, 15, 22]. While Dogan et al. and Hashemi Jazi et al. stated that low ejection fraction is predictor for post-CABG AF both in univariate and multivariate analysis [15, 17].

The relation between chronic obstructive airway disease and post CABG AF is a matter of debate in previous literatures. Some authors reported that history of COPD is a predictor of post-CABG AF [14, 22-23]. On contrast, others didn't state that relationship in their work [16, 18]. Our current results didn't show any relationship between chronic obstructive airway disease and post-CABG AF.

History of prior drug intake was so important since many drugs were thought to be protective against post-CABG AF. Our study confirmed the potentially protective effect of pre-operative beta-blocker use. This has been shown previously in many studies [23, 25]. On the other hand, none of the other studied drugs show that effect. Paradoxically, digoxine was shown to be related to occurrence of post-CABG AF. This can be attributed to three factors; firstly: on the level of myocardial tissue, digoxine per se is arrhythmogenic so it may play a role in sensitizing the atrial myocardium to arrhythmia and AF production. Secondly: those patients who use digoxine may do so for the presence of AF one day before so they are still more vulnerable for AF recurrence. Lastly, those patients who are on digoxine therapy are mostly who had heart failure and impaired myocardial function, hence they more susceptible for AF. This was reported more than ten years ago by Almassi et al. They stated that the use of digoxine within 2 weeks before cardiac operation is a significant contributing factor to the development of post-operative AF [18].

Electrocardiographically, we have found that higher heart rate is one of the risk factors for developing post-operative AF. This seems to be quite logic as increased heart rate is associated with high basal sympathetic tone which may predispose to AF. This was also reported in previous studies [18]. The atrial changes associated with CABG may result in intraatrial conduction abnormalities detectable in P-wave characteristics on surface ECG [8]. These changes in P-wave characteristics may be due to fluid overload and atrial stretch [26]. However, mechanisms leading to the postoperative increase in P-wave dispersion remain unclear [8].

P-wave duration and P-wave dispersion on standard ECG are noninvasive markers of intraatrial conduction disturbances, which are believed to be the main electrophysiological cause of AF [27]. Our study reported that increased P wave dispersion is a main independent predictor for the development of post-operative AF. This has been reported in other studies [8, 15, 17, 23].

Study limitations

The relatively small number of the study population may affect the validity of the results. However, we have overcome this aspect by using the suitable statistical tests. Other P wave

indices, such as minimum and maximum P wave durations, should be included to globally assess the role of P wave indices in prediction of post-CABG AF.

Conclusions

Post-CABG AF is new emerging concern among post-CABG patients occurring in about one third. There are some pre-operative predictors that help to identify those patients who are more likely to have post-CABG AF. These include being hypertension, diabetes, history of heart failure and history of previous AF. Moreover, simple pre-operative bedside tests that help to predict post-CABG AF are increased basal heart rate, increased P wave dispersion, increased left atrial dimensions and impaired left ventricular systolic function**.** Finally beta-blocker therapy was found to be protective against post-CABG AF.

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Should Vacuum Assisted Closure Therapy Change Our Practice for The Management of Deep Sternal Wound Infections in Diabetic Patients After Open Heart Surgery?

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Background: **Post-sternotomy mediastinitis is a rare disastrous complication. We assessed the incidence, predisposing factors, and outcome of 2 treatment options for, mediastinitis after cardiac surgery in diabetic patients in 2 centers in Saudi Arabia.**

Methods: **We reviewed the files of 1286 patients who underwent open-heart surgery in almost 3 years period in 2 tertiary centers in Saudi Arabia using the available data in the hospital discharge registry, operating room logbook, the hospital's cardiac surgery department registry and outpatient clinics files. Nine hundred eighty three patients (76.4%)had Diabetes Mellitus, out of them twenty patients (2.3 %) were treated for superficial sternal wound infection, and forty nine patients (5%, our study cohort) had deep sternal wound infection (DSWI) , based on criteria of the Center for Disease Control and Prevention in USA. Those 49 patients were classified into two groups based on the treatment modalities: vacuum assisted closure (VAC group, group A; 25 patients) and conventional treatment (CON group, group B; 24 patients). Data were collected, reviewed and analyzed.**

Results: **Forty nine diabetic patients developed DSWI (49/983 cases, 5 %) and were classified into two groups according to the option of treatment: VAC group included 25 cases (group A 25/49, 51%) and Conventional group included 24 cases (group B 24/49, 49%). The overall rate of DSWI was more in men than women; (71.4 % vs. 28.6%, p < 0.001). Our analysis showed significant differences between group A and group B regarding the need for more than one antibiotic, persistent sternal dehiscence, recurrence of DSWI, length of stay after diagnosis of DSWI and mortality. In addition, multivariate analysis revealed that; BMI >30 kg/m2 and emergency surgeries are independent predictors for DSWI.**

***Conclusions*: VAC is an acceptable therapeutic option in cases of mediastinitis in diabetics. The portable VAC is an easy technique to use in a clinical domiciliary setting, with a low acceptable complication rate. It improves quality of life and reduces time and cost of hospitalization. Obesity and emergency surgery are independent predictors of mediastinitis.**

***KEYWORDS*: Mediastinitis; Vacuum Assisted Closure; diabetic deep sternal wound infection; outcome.**

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Infection following cardiac surgery may involve superficial wound, sternum and mediastinum. The reported incidence of deep sternal wound infection (DSWI) varies from under 1% to about 5% of all sternotomy procedures. [1] Although, it is an infrequent, yet devastating complication after open-heart surgery. Diabetes mellitus has been established as an independent risk factor for post-operative surgical wound infection with infection rates two to five times more prevalent than in the non-diabetic population. [2-3] Post-sternotomy mediastinitis in diabetics following open heart surgery may increase operative mortality two to three folds.[4] This complication often results in increased cost of care, prolonged hospitalization, and increased morbidity and mortality. [5] The related mortality despite of improved antibiotic therapy and asepsis environment in peri-operative care is still high, ranging from 5% to 47 %. [6-7] Many studies have reported several risk factors for

development of deep sternal wound infection (DSWI) such as obesity, chronic obstructive pulmonary disease, elderly age, DM, peripheral vascular disease, reoperation, use of internal thoracic artery (ITA) conduits, operation time, low cardiac output, ventilation time, and re-exploration for bleeding. [6-7-8-9-10] Until recently, established treatment options included aggressive surgical debridement, sternal wound drainage, antibiotics, closed continuous irrigation, open packing, delayed closure of the sternal defect with flap reconstruction. However, a novel technique using vacuum-assisted closure (VAC) has gained popularity and been increasingly used for the treatment of sternal infections instead of Conventional Therapy. [9-10-11-12-13-14-15-16]

The purpose of this study was to analyze and compare the outcomes of the two treatment protocols for diabetic DSWI; Vacuum Assisted Therapy and Conventional Therapy.

Patients and Methods

Forty nine cases of diabetic DSWI were diagnosed in a cohort of 983 consecutive patients who underwent open heart surgery procedures through a midline sternotomy performed at our centers, from December 2009 to August 2012, in King Fahd Medical City and Southern region military hospital; Saudi Arabia. Data were prospectively and retrospectively collected and surveyed for those diabetic patients with a diagnosis of sternal wound infection. Deep sternal wound infection was defined according to the guidelines of the Center for Disease Control and Prevention. [10-11-12-13-14-15] Its diagnosis required one of the following criteria: 1- an organism is isolated from culture of mediastinal tissue or fluid; 2- evidence of mediastinitis is seen during operation; or 3- presence of either, chest pain, sternal instability, or fever (>38°C), and either purulent discharge from the mediastinum or an organism isolated from blood culture or culture of drainage of the mediastinal area. Diabetic patients who developed deep sternal wound infection (49/983 patients, 4.98%) were the subject of follow-up and evaluation. The patients were randomly allocated to either vacuum assisted closure (VAC group, group A; 25 patients) or conventional treatment (CON group, group B; 24 patients). When the diagnosis was made, all patients were re-admitted to our center under the attending cardiac surgeon. Patients were started on broad spectrum antibiotics after securing sample for culture and sensitivity and each patient is monitored frequently by a trained practitioner. Later, appropriate antibiotic was started based on culture results. VAC therapy was routinely used, unless there was a contraindication as; active bleeding, exposed grafts or anastomotic site, and exposed heart. Before starting VAC; adequate debridement for the formation of granulation tissue is essential. The patient risk factors must be thoroughly considered and controlled before use such as: DM, nutritional status and bad personal hygiene. Complete healing of a wound would normally be anticipated if the sternum and stainless steel wires were completely covered, cessation of the drainage, the wound edges were reduced to 2 cm in width and healthy granulation was present to within 5 mm of the surface. Conventional group; 24 patients (group B, 49%) underwent sternal debridement and primary closure, closed irrigation (irrigation with povidone-iodine solution, saline and H2O2) or wound drainage, open packing, and delayed closure were performed moreover, sternectomy with muscle flap reconstruction by the plastic surgeons. In the VAC group, a vacuum-assisted therapy system, consisting of polyurethane foam and a special, computer-controlled pump unit (Fig.1), was used. The polyurethane VAC sponge was fitted into the wound. The wound was covered with an adhesive, semipermeable drape that was connected to the therapy unit (Fig.2). The therapy unit delivers a negative pressure in a continuous modus. As recommended in the clinical guidelines of the distributor (KCI Medical, Hannover, Germany and KCI International, San Antonio, TX, USA), pressure of −125 to −150 mm Hg was applied. This was reduced down to −75 mm Hg, if the patient developed pain. The VAC dressing was renewed every 48 – 72 hours, until the wound was free from microbiological cultures. Data obtained from medical records included demographic information (age, sex and weight), prior operative procedures, interval to mediastinitis, wound VAC intervention, mediastinal intervention, in hospital stay, duration of antibiotics, frequency of antibiotics, frequency of dressing, interval to wound closure, type of anti-diabetic medications(oral hypoglycemic, insulin), morbidity and mortality. Regular blood chemistry, C reactive protein, white cell counts, hemoglobin and pan-cultures were performed, at diagnosis of mediastinitis, then every 5 days till we get a negative culture. Standard descriptive statistics are given. Comparison of groups was performed by Student's t-test, Mann–Whitney test or Chi-square test where appropriate. For time-related variables Kaplan–Meier estimates and log-rank test were computed. We used a mixed effect model with the square root transformed (producing a near Gaussian distribution) to test the difference between groups and course in time by means of a likelihood ratio test.

RESULTS

Forty nine diabetic patients (5%) with DSWI were included in this study. Twenty five patients (51%) were treated with VAC therapy and Twenty four (49%) were treated with conventional therapy. There were no significant statistical difference between both groups in age, gender, Body Mass Index(BMI), type or urgency of surgery, ejection fraction, redo, bypass or ischemic times, diabetic control, hypertension, COPD, renal insufficiency, interval to diagnosis(Table 1). Blood and clinical variables of group A and group B at the time of admission such as basal hemoglobin level, leucocytic count, serum creatinine, CRP, Temperature or sternal dehiscence were shown in (Table 2). Eight Patients from group A were discharged home with VAC connected and were examined bi-weekly at outpatient clinic.

Baseline Characteristics	Group A (n=25)	Group B(n=24)	p Value
Age, years (Mean ± SD)	61.3 ± 9.2	62.5 ±10.8	0.16
Male Sex, n (%)	18(72%)	17(70.8%)	NS
Female Sex, n (%)	7(28%)	7(29.1%)	NS
BMI>30, n (%)	22(88%)	21(87%)	NS
Type of Surgery			
CABG, n (%)	19(76%)	19(79.1%)	NS
Non CABG, n (%)	3(12%)	3(12.5%)	NS
Combined surgery, n (%)	3(12%)	2(8.3%)	NS
LVEF < 30%, n (%)	12(48%)	11(45.8%)	NS
Previous cardiac operation, n (%)	3(12%)	3(12.5%)	NS
Urgency operation, n (%)	8(32%)	8(33.3%)	NS
Total bypass time (min), (Mean ± SD)	149.2 ± 23.1	152.4 ± 17.3	NS
Aortic cross clamp (min), (Mean ± SD)	72.9 ± 21.7	78.1 ± 11.6	NS
Diabetic control			
Oral hypoglycemic, n (%)	20(80%)	18(75%)	NS
Insulin, n (%)	5(20%)	6(25%)	NS
Hypertension, n (%)	23(92%)	22(91.6%)	NS
COPD, n (%)	4(16%)	4(16.6%)	NS
Smoking, n (%)	21(84%)	19(79%)	NS
Renal insufficiency, n (%)	7(28%)	6(25%)	NS
Renal dialysis, n (%)	5(20%)	4(16.6%)	NS
Interval to DSWI(days), (Mean ± SD)	15.6 ± 10.4	16.1 ± 11.3	0.129

BMI = body mass index; CABG = coronary artery bypass graft; COPD = chronic obstructive pulmonary disease; LVEF = left ventricular ejection fraction; SD = standard deviation; VAC = vacuum-assisted closure.

Table 1: Baseline Characteristics of VAC Group (Group A) and Conventional Therapy Group (Group B).

Blood Variables	Group A (n=25)	Group B(n=24)	p Value
Leukocyte counts >10000, n (%)	23(92%)	21(87%)	NS
Hemoglobin (g/dL) <10Gm, n (%)	12(48%)	11(45.8%)	NS
Creatinine (>1.6mg/dL), n (%)	7(28%)	6(25%)	NS
High CRP (more than 6 mg/dL), n (%)	22(88%)	21(87%)	NS
Temperature >38, n (%)	9(36%)	8(33.3%)	NS
Sternal dehiscence, n (%)	2(8%)	2(8.3%)	NS

CRP=C -reactive protein

Table 2. Blood and Clinical Variables of VAC Group (Group A) and Conventional Therapy Group (Group B) at the time of admission.

Fig 1. The VAC system was used. It pulls the wound edges together and stabilizes the sternum.

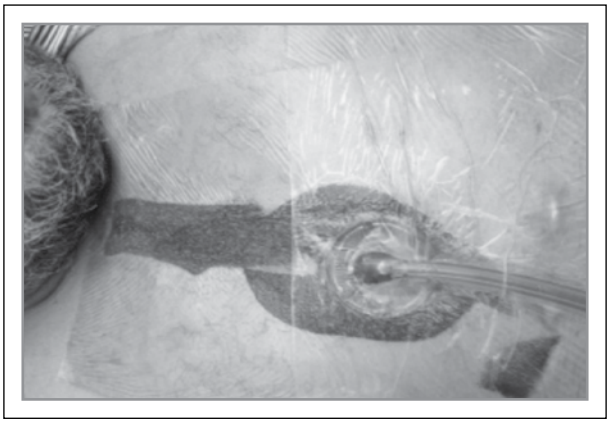

Fig 2. The VAC system was applied into the wound. The vacuum tubing and the sponge are covered with transparent adhesive dressing.

Pathogens of Mediastinitis

The causative pathogens are shown in Table (3). The commonest organism was staph. Aureus followed by Klebsiella, Pseudomonas, Stenotrphomonas maltophilia, MRSA and Staphylococcus epidermis. More than 1 organism was accused in 7 cases out of 49 cases (14.2%), with rate of incidence 3 patients (12%) and 4 patients (16%) for group A and B respectively with no significant difference (Table 3).

Type of Organism	Group A (n=25)	Group B (n=24)	p Value
Staphylococcus aureus, n (%)	13(52%)	12(50%)	NS
Klebsiella pneumonia, n (%)	3(12%)	2(8.3%)	NS
Pseudomonas aeroginosa, n (%)	2(8%)	2(8.3%)	NS
Stenotrphomonas maltophilia, n (%)	2(8%)	2(8.3%)	NS
MRSA, n (%)	1(4%)	1(4.1%)	NS
Staphylococcus epidermis, n (%)	1(4%)	1(4.1%)	NS
Multi organisms, n (%)	3(12%)	4(16%)	NS

MRSA= methicillin resistant staph aureus

Table 3. Culture Results for Patients in Group A and Group B.

Post-readmission variables for the Patients

As shown in table 4, there is no significant difference between both groups regards time interval to culture negative status, interval to normal CRP, creatinine level, leucocytic counts, persistent fever for more than 1 week and need of blood transfusion. However, there are significant differences regarding the need for more than one antibiotic, persistent sternal dehiscence, recurrence of DSWI, length of stay after diagnosis of DSWI and mortality between group A and group B.

Variables	Group A (n=25)	Group B(n=24)	p Value
More than one antibiotic, n (%)	4(16%)	8(33.3%)	p 0.005
Interval to culture negative(days), (Mean ± SD)	7.4±3.6	7.8±5.2	NS
Interval to normal CRP (days), (Mean ± SD)	7.5±3.6	8.2±4.7	NS
Leucocytic counts (x10^9/L), (Mean ± SD)	4.46 ± 5.61	5.88 ± 5.14	NS
Need of blood transfusion, n (%)	3(12%)	4(12.5%)	NS
Sternal dehiscence, n (%)	0(0.0%)	2(8.3%)	p 0.005
Persistent fever for more than 1 week, n (%)	0(0.0%)	0(0.0%)	NS
Creatinine (mg/dL) (Mean ± SD)	1.4 ± 0.5	1.8 ± 0.55	NS
Length of stay after DSWI(days), (Mean ± SD)	25.7 ± 14.6	37.4 ± 17.8	P 0.002
Recurrence of DSWI, n (%)	0(0.0%)	2(8.3%)	p 0.005
Death	2(8%)	4(16.6%)	p 0.005

DSWI = deep sternal wound infection.

Table 4. Post re-admission variables for Patients in Group A and Group B.

Discussion

According to the presence or absence of risk factors, the duration of the incubation period and previous failed therapies, Oakley and Wright 1999 classified Post-sternotomy mediastinitis into five subtypes as ; Type I is mediastinitis within 2 weeks after operation in the absence of risk factors. Type II is mediastinitis presenting at 2 to 6 weeks after operation in the absence of risk factors. Type III A is mediastinitis type I in the presence of one or more risk factors. Type III B is mediastinitis type II in the presence of one or more risk factors. Type IV A is mediastinitis type I, II, or III after one failed therapeutic trial. Type IV B is mediastinitis type I, II, or III after more than one failed therapeutic trial. Type V is mediastinitis presenting for the first time more than 6 weeks after operation. [13-17-18-19]

We did not use Oakley and Wright's classification due to some lacking data and also our main aim was to compare between 2 different options of treatment for mediastinitis in a high risk diabetic cohort. Also the types of mediastinitis according to its severity were classified based on the level of tissue infiltration as; SSWI: when involve only the skin or subcuticular tissue, and DSWI: when involve deeper tissues such as a pectoral fascia, sternal bone as well as mediastinal space. [20]

In our study, the incidence of DSWI after cardiac surgery was high (5%) which could be explained by that our study cohort is high risk patients; the population became older and sicker, and the proportion of females increased.

Risk factors for mediastinitis have been previously reported and they include urgent surgeries, redo surgeries, COPD, renal failure, obesity, left internal mammary artery graft (LIMA), bilateral internal mammary artery graft (BIMA), DM, hypertension etc. [21-22-23]

We found also in the present study, the main predictive factors for occurrence of mediastinitis were obesity and urgent surgery. These results came in difference with that from Eklund et al; 2006 which showed an incidence of mediastinitis 1% which may be due to the different demographic data of both cohorts and our higher proportions of both obesity and urgent surgeries. [12]

It is noted from the present study that, VAC shortened significantly the hospital stay and mortality, we used VAC therapy in a domiciliary setting, increasing mobilization, physical and emotional wellbeing of patients and eight patients (8/25) could leave the hospital with the VAC system in situ, visiting the outpatient clinic biweekly and the change of dressings was performed by specially trained nurse practitioners. As a result this increases patient comfort and may lead to cost reduction, also may improve the patient's satisfaction, quality of life and decreased the costs. This is similar to other studies one of this by Mokhtar J. et.al 2008. [21]

We found a higher mortality rate (12.2%) in our study as a whole group of mediastinitis but it is lower than our mortality before 2008 and it is lower in VAC than Conventional group(8% Vs 16.6%). It is higher than the earlier reported results that revealed and confirmed the benefits of VAC therapy compared to open packing. [13-19-21-22] we also noted from our study that, the causes in death was sepsis and DIC in 2 cases, cerebral haemorrhage in one case, prosthetic valve endocardditis in one case, heart failure in 1 case and liver cell failure in 1 case.

In contrary to our results as regards mortality rate, Sjogren et al.2005 reported lower mortality rates in their VAC group (3%) compared to our results (8%) and a possible explanation for this observed difference could be the incidence of renal failure where the incidence of pre-operative renal impairment was higher in our cohort (28%) and they found this to be a strong predictor for mortality. [13]

Karra et al. reported many risk factors for 1-year mortality in patients with mediastinitis however these risk factors were not specific for patients treated with VAC but obesity and renal failure have been shown to be strong predictors for mortality in our VAC-treated patients. [13-21-22-23-24]

According to the relation between mortality and type of pathogens, it was found in our study that, there was no difference in mortality was observed between sternal infections caused by different pathogens. The main causative pathogen in post-sternotomy mediastinitis in our series is S. aureus, which may have a more aggressive nature and demonstrate more classical signs of infection. These bacteria have been increasingly associated with colonization of the nasal passages of the patient, the incidence of nasal colonization with S. aureus in the normal population is reported to range from 10% to 15% and such colonization increases the risk of post-sternotomy mediastinitis and this result came in similarity to that obtained by Sjögren J 2005. [13]

About long term survival, we didn't discuss our long term follow up in such cases but some studies as that from Sjögren J et.al. 2005 concluded that patients with vacuum-assisted closure treated mediastinitis may have long term survival which is quite similar to patients without mediastinitis after coronary artery bypass grafting. [13] But we feel that this is very optimistic conclusion.

As regards in hospital stay, our results are accordance with previous studies which showed a shorter in-hospital stay and better survival among patients who used VAC therapy than in patients used conventional therapy.

Although VAC is an effective method to treat post-sternotomy mediastinitis, possible drawbacks of VAC have recently been delineated as right ventricle wall rupture due to the high negative pressure. [22] Regards the complications of VAC among our patients we reported some complications of VAC such as erythema, blustering of the edges in 3 cases,

controlled arrhythmias in 2 cases and chest pain in 2 cases, also we didn't have noticed any case of ventricular rupture with VAC therapy although Sjögren J et.al., 2005 reported a case of right ventricle rupture despite protection of the vital structures by polyvinyl alcohol dressings. [13]

To achieve a successful outcome following post-sternotomy mediastinitis it is very important to early refer the patient to a surgical center with a structured approach and a well-known experience in wound-healing management, while delayed diagnosis and therapy will most likely lead a deteriorating patient resulting in increased morbidity and mortality. Time between the primary surgery and diagnosis in our series was 15.6 ± 10.4 and 16.1 ± 11.3 days in group A and B, while in the series of Cowan et.al. 2005, it was 21±6.8 days. [25]

Although, many variables such as; interval to negative culture, leucocytic counts, and C-reactive protein levels showed no significant difference between group A and B. The need for more than one antibiotic, recurrence of deep sternal wound infection and persistent sternal dehiscence were all significantly higher in group B compared to group A (p value 0.004, 0.005 and 0.005 respectively). The determinants of Successful therapy were meant for us; negative bacterial culture, absence of fever, falling C-reactive protein levels and clinically healthy granulating wound. Sternal wounds were then allowed to close by secondary intention or closed surgically depending on their size.

Among some of the previous studies, they advocated the use of debridement and the use of the vacuum-assisted closure system (VAC pump) for few weeks following by the use of sternal clips or sternal osteo-synthesis with horizontal titanium plates that can be inserted in the para-sternal space with consecutive proper stabilization of the sternum . Sternal preservation whenever possible should be our goal, but if there is delayed diagnosis or in old sick patients with poor vascularised multi-fractured sternum should be treated with sternal excision and a musculo-cutaneous flap. Prolong antibiotic treatment up to 6 weeks is usually advocated. [26-27-28-29] we used pectoral muscle flap in 2 cases only in group B but never in the VAC group.

Conclusion

VAC is an acceptable therapeutic option in cases of mediastinitis in diabetics. The portable VAC is an easy technique to use in a clinical domiciliary setting, with a low acceptable complication rate. It improves quality of life and reduces time and cost of hospitalization. Obesity and emergency surgery are independent predictors of DSWI. **Limitations:**

A part of this study was done retrospectively, that has all the inherent defects of retrospective studies. It also included a relatively small number that may weaken the statistical power of conclusions.

Disclosures: none.

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Intra-Operative Transesophageal Echocardiography In Rheumatic Mitral Valve Surgery: Diagnostic Accuracy and Predictability of Repair.

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Background: **Operating for rheumatic mitral valve disease is still a common part of our surgical practice. Whenever feasible, mitral repair is preferable for this pathology. As minimally invasive approaches are gaining popularity, a detailed echocardiographic assessment of the valve, whether for repair or replacement is mandatory. For this purpose, we continue to rely heavily on intraoperative transesophageal echocardiography or TEE. Whereas the correlation between TEE findings and surgery has been validated for other pathologies, there is a lack of similar information in rheumatic mitral valve disease, as well as a lack of specific echocardiographic criteria to predict valve reparability.**

Aim of work: **This study was conducted for three goals: the first is to test the correlation between the intraoperative TEE findings and the surgical observations in patients with rheumatic mitral valve disease. The second aim is to establish a new scoring system and well-defined echocardiographic parameters to predict the feasibility of repair in these patients. The third aim is to investigate whether TEE measurements can help to determine in advance the annuloplasty ring size.**

Material and methods: **The study included 35 consecutive patients with rheumatic heart disease, undergoing elective mitral valve operations by the same surgeon and anesthetist at Nasser Institute, in the period between April 2011 and January 2012. Using intraoperative TEE, a new scoring system for thickness, calcification and subvalvular affection was designed and applied for individual mitral valve segments. A total valve score out of 66 points was calculated. In addition, several other dimensions were measured, including anteroposterior and transverse annular diameters, height of A2 and P2 scallops, the length of one primary chorda to A2 and P2, and the inter-papillary muscle distance. The valve was also examined for commissural fusion or calcification and for segmental prolapse. All of the observations were repeated during surgery for comparison.**

Results: **Twenty-two patients or 63% underwent mitral valve repair and 13 patients or 37% underwent replacement. Concerning all dimensions and scores, there was agreement in variable degrees between TEE and surgical findings. However, TEE was not accurate in measuring the anteroposterior annular diameter. Moreover, it was not sensitive in detecting commissural fusion or calcification, and showed a predilection to falsely diagnose A2 prolapse. The following cutoff values obtained by TEE were identified as absolute prerequisites for reparability: a total valve score < 20.5, an A1 score < 3.5 and an A3 score < 2.5. The following criteria were associated with feasibility of repair: predominant regurgitation, A2 prolapse, freedom from commissural fusion or calcification and freedom from annular calcification. Stepwise multiple linear regression of TEE measurements yielded a specific equation to predict the ring size.**

Conclusion: **TEE is a valid method for evaluating rheumatic mitral valve pathology. In most parameters, it correlates well with surgical findings. It can accurately predict valve reparability as well as the annuloplasty ring size.**

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Rheumatic heart disease continues to be the prevailing pathology in our mitral valve (MV) surgical practice. Mitral valve repair, whenever feasible, has numerous advantages over replacement, even if it is associated with higher reoperation rates.[1] A comprehensive preoperative assessment of mitral valve morphology is essential in patients undergoing MV repair. Sound operative planning begins with a clear understanding of the underlying pathologic condition of the MV as diagnosed by echocardiography. Advances in minimally invasive mitral valve repair techniques and percutaneous interventions increase the demand for more accurate and reliable echocardiographic assessment of the mitral valve.

Existing scores for assessing mitral valve pliability like the Wilkins' score were primarily devised for the setting of balloon valvotomy. [2] Such scores have several limitations, including the following: they are flawed by the limited ability of transthoracic echocardiography to differentiate localized fibrosis from calcification, they either don't include or they underrate the weight of commissural involvement, they don't account for uneven distribution of pathologic abnormalities, they lack detailed segmental evaluation of each scallop and component of the mitral apparatus and, finally, they frequently underestimate subvalvular disease.[3]

Three-dimensional echo has gained increasing popularity in mitral valve assessment. However, due to financial constraints, we continue to rely entirely on conventional two-dimensional intraoperative transesophageal echocardiography (TEE) in our institution. Whereas several studies have addressed the accuracy of TEE compared to the operative observations in cases of degenerative, ischemic and functional mitral valve pathologies, there is a paucity of data regarding its reliability in rheumatic heart disease.[4]

This study has a triple aim. The first is to test the correlation between the intraoperative TEE findings and the surgical observations in patients with rheumatic mitral valve disease. The second aim is to establish a new scoring system and specific echocardiographic criteria to predict the feasibility of repair in these patients. The third aim is to find out whether TEE measurements can help to determine in advance the annuloplasty ring size.

Material and methods

Patient population

This study included 35 consecutive patients with rheumatic heart disease, undergoing elective mitral valve operations by the same surgeon and anesthetist at Nasser Institute, in the period between April 2011 and January 2012. Following approval from an institutional ethics and research committee, an informed written consent was obtained from every patient or from his or her next of kin. There were 11 males (31%) and 24 females (69%). Their age ranged between 14 and 63 years with a mean of 37.2 ± 14.2 years. All patients were in functional class III or IV. Atrial fibrillation was present in 13 of them (37%). The predominant pathology was mitral stenosis in 11 cases (31%) and mitral regurgitation in 24 cases (69%).

Anesthetic protocol and TEE assessment

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

Echocardiographic end-diastolic measurements were performed at the onset of the R wave, and early-systolic measurements were performed just after mitral valve closure. Calcification was defined as a bright echocardiographic density with acoustic shadowing. The aortic root was used as a point of reference, and calcification was said to be present if there was a brighter echocardiographic density in the leaflets than was seen in the adjacent aortic root. [5] The mitral annulus was defined as the junction between the mitral leaflets and the left atrium. The nomenclature of individual leaflet scallops (A1, A2, A3, P1, P2 and P3) was done according to the Carpentier classification. [6] Based on a modification of the Wilkins score [2], thickness and calcification scores were developed and applied to individual scallops. The thickness score was given to each scallop as follows: grade 0 = normal thickness, grade 1 = near normal thickness, grade 2 = mid part normal with considerable thickening of the margins, grade 3 = thickening extending throughout the entire scallop, grade 4 = considerable thickening of all scallop tissue. A calcification score was similarly assigned to each scallop as follows: grade 0 = no calcification, grade 1 = a single area of increased echo brightness, grade 2 = scattered areas of brightness confined to scallop margins, grade 3 = brightness extending into the mid portion of the scallop, grade 4 = extensive brightness throughout most of the scallop tissue. The two scores were then added for individual scallops, yielding an additive score out of 8 for each scallop. A modification of the Wilkins score [2] and the one proposed by Anwar et al. [7] was used to assess the subvalvular apparatus, whereby the chordae tendinea were inspected in the mid-esophageal and the transgastric views at 90º and divided lengthwise into three segments: the proximal or cuspal one-third, the middle one-third and the distal or papillary muscle one-third. Thickening, calcification and fusion for each

segment were noted. A grade of 0 (absent) or 1 (present) for each parameter in each segment was given. This was repeated separately for the anterior and posterior leaflet chordae to give a total score out of 9 for each of the anterior and posterior leaflet chordae. The two thus obtained subvalvular scores were then added to the six individual scallop scores to calculate a total valve score out of 66 for each patient.

In addition to valve scoring, several parameters of the mitral apparatus were also measured. In the mid-esophageal commissural view at 60-70º, the transverse diameter of the mitral annulus was measured in both end-diastole and early systole. In the mid-esophageal view at 120-160º, the following parameters were measured: the anteroposterior diameter of the annulus both in end-diastole and early systole, the maximum height of A2 and P2 scallops during the cardiac cycle and the length of one primary chorda for each of the A2 and P2 scallops. The inter-papillary distance, defined as the distance between the heads of both papillary muscles in the transgastric view at 90º, was measured at end-diastole and early systole. In case of atrial fibrillation, an average of 3 measurements was taken for each parameter. Prolapse of individual scallops was investigated and was defined as systolic displacement >2mm relative to the plane of the annulus. The valve was also examined for fusion or calcification of the anterior and posterior commissures in the transgastric short-axis view.

Surgical procedures

All patients were operated upon by the same surgeon, who was aware of the global echocardiographic assessment of the valve but was blinded to the centimetric measurements and to the calculated scores. The operations were performed through a full median sternotomy, aorto-bicaval cannulation, mild hypothermic (32 C) cardiopulmonary bypass, and intermittent antegrade cold blood-crystalloid cardioplegia. Access to the mitral valve was obtained by a standard left atriotomy incision. The surgeon performed routine functional analysis of the valve and then repeated the scoring process for individual scallops and for the anterior and posterior subvalvular apparatus as was done by TEE. All measurements of the mitral valve previously done by echocardiography were repeated using a silk thread and a metallic ruler. A record was also made of any prolapse, commissural fusion or calcification. The decision was made to repair or to replace the valve according to the surgeon's judgment. Repair techniques included standard maneuvers of commissurotomy, papillotomy, leaflet thinning or peeling, excision of localized areas of calcification, posterior leaflet augmentation, chordal transfer and artificial chordae. A complete rigid annuloplasty ring was always implanted at the end. Ring sizing was done by fully unfurling the anterior leaflet by means of vertical downward traction on the primary chordae by two nerve hooks or a right-angled clamp. Using commercially available annuloplasty ring sizers, the correct ring sizer was chosen to fit the surface area of the maximally deployed anterior leaflet. In case it was decided to oversize or undersize the ring, the true ring size was documented in every case.

Statistical analysis

For descriptive analysis, continuous variables are expressed as mean ± standard deviation and categorical variables as frequency and percentage, unless stated otherwise. For agreement analysis between TEE and surgical findings, calculation of the intra-class correlation coefficients was used for continuous variables and kappa coefficients were used for dichotomous data. Both coefficients range from 0 to 1 and, the nearer to 1, the more the agreement. Agreement values were considered moderate from 0.40 to 0.59, substantial from 0.60 to 0.79 and outstanding starting from 0.80. In comparing the repair group to the replacement group, the Mann-Whitney test was employed for continuous variables and either the Pearson Chi-square test or Fischer's exact test, as indicated, were used for categorical data. Receiver operating characteristic curves (ROC curves) were constructed to investigate cut-off values for reparability as determined by TEE measurements. Stepwise linear regression analysis was used to predict the size of the annuloplasty ring in the repair patients, based on the echocardiographic measurements of the mitral annular diameters and the height of the A2 segment. A Bland-Altman plot was constructed to assess the accuracy of the obtained equation relative to the surgically determined true ring size. P values less than 0.05 were considered significant. All statistical analyses were performed using SPSS for Windows, version 16 (SPSS, Chicago, IL) and MedCalc Software, version 12.7.7 (MedCalc, Ostend, Belgium).

Results

Surgical procedures

Twenty-two patients or 63% underwent mitral valve repair and 13 patients or 37% underwent replacement. Concomitant procedures included aortic valve replacement in 6 patients (17%) and tricuspid valve annuloplasty in 17 patients (48.5%). The true ring size in repair patients ranged from 30 to 38 with a median of 34 and a mean of 34±2.6. Post-bypass TEE evaluation showed successful immediate results in all repairs, with no patient suffering from more than mild mitral regurge (MR), or from any residual gradient. The MR grade after conclusion of bypass ranged between 0 and 1 with a mean of 0.3±0.2. The mean diastolic pressure gradient ranged from 2.4 to 7.8 mmHg, with a mean of 5.3±1.8 mmHg. The coaptation lengths between the anterior and posterior leaflets ranged between 7 and 12.1 mm with a mean of 8.4±0.9 mm.

Correlation between TEE and surgical findings

Results of the agreement analysis between the measurements taken by TEE and those taken surgically are listed in table I. Briefly, there was lack of agreement in determining the anteroposterior annular diameter. Moderate agreement was noticed in the following parameters: A2 height, A2 chordal

length, A3, P2 and P3 calcification scores. There was substantial agreement in measuring P2 height, the transverse annular diameter, the inter-papillary muscle distance, P2 chordal length, A2, A3 and P2 thickness scores, A2 and P1 calcification scores, A2, A3, P2 and P3 additive scores, as well as anterior and posterior subvalvular scores. There was outstanding agreement in A1, P1 and P3 thickness scores, A1 and P1 additive scores and, finally, in the total valve score. Agreement analysis for categorical variables is summarized in table II. TEE was not sensitive in detecting commissural fusion (17 cases or 48.5%, versus 31 or 88.5% by surgical inspection, K=0.18, p=0.07) or commissural calcification (6 cases or 17.1%, versus 12 or 34.2% by surgical inspection, K=0.36, p=0.01). It was also fallacious by over diagnosing A2 prolapse (8 cases or 22.2%, versus 3 or 8.5% by surgical inspection, K=0.35, p=0.03). TEE however showed substantial agreement with surgical findings in detecting A1 prolapse and annular calcification, and outstanding agreement in the assessment of prolapse in all other valve segments (A3, P1, P2 and P3).

Valve parameter	Intraclass correlation	95% Confidence Interval	
		Lower Bound	Lower Bound
A2 height	0.497	-0.057	0.761
P2 height	0.749	0.466	0.882
Transverse annular diameter	0.600	0.160	0.810
AP annular diameter	0.305	-0.460	0.669
Papillary distance	0.779	0.523	0.898
A2 chordal length	0.478	-0.165	0.766
P2 chordal length	0.651	0.246	0.839
Segmental thickness scores			
A1	0.855	0.696	0.931
A2	0.767	0.511	0.889
A3	0.720	0.412	0.867
P1	0.848	0.680	0.928
P2	0.739	0.451	0.876
P3	0.824	0.630	0.916
Segmental calcification scores			
A1	0.898	0.785	0.951
A2	0.713	0.398	0.864
A3	0.494	-0.064	0.759
P1	0.664	0.295	0.840
P2	0.409	-0.243	0.719
P3	0.527	0.006	0.775
Segmental additive scores			
A1	0.920	0.832	0.962
A2	0.671	0.308	0.843
A3	0.716	0.404	0.865
P1	0.802	0.584	0.906
P2	0.578	0.114	0.799
P3	0.737	0.447	0.875
Anterior subvalvular score	0.699	0.367	0.857
Posterior subvalvular score	0.652	0.269	0.834
Total subvalvular score	0.728	0.428	0.870
Total valve score	0.916	0.824	0.960

Table I: *Agreement analysis of the measurements taken by TEE and surgery. Correlation values were considered moderate from 0.40 to 0.59, substantial from 0.60 to 0.79 and outstanding starting from 0.80.*

Finding	TEE	Surgery	Kappa coefficient	P value
A1 prolapse	1(2.8%)	2(5.7%)	0.651	0.000
A2 prolapse	8(22.8%)	3(8.5%)	0.359	0.033
A3 prolapse	0	1(2.8%)	0.967	0.000
P1 prolapse	0	1(2.8%)	0.967	0.000
P2 prolapse	1(2.8%)	0	0.967	0.000
P3 prolapse	2(5.7%)	0	0.933	0.000
Commissural fusion	17(48.5%)	31(88.5%)	0.186	0.079
Commissural calcification	6(17.1%)	12(34.2%)	0.364	0.01
Annular calcification	5(14.2%)	4(11.4%)	0.712	0.000

Table II: *Agreement analysis for categorical variables identified by TEE and surgery. Kappa values were considered moderate from 0.40 to 0.59, substantial from 0.60 to 0.79 and outstanding starting from 0.80.*

TEE criteria of repair feasibility:

The comparison between the TEE measurements in the repaired and replaced valves is reported in table III. Regarding anatomic measurements, there were no differences in mean A2 height, P2 height, diastolic and end-systolic transverse and anteroposterior annular dimensions. However, the following dimensions were all significantly longer in the repair group: the mean systolic inter-papillary muscle distance (2.2±0.7 cm, versus 1.7±0.5 cm, p=0.01), the mean diastolic inter-papillary muscle distance (2.8±0.9 cm, versus 2.2±0.6 cm, p=0.009), the mean A2 chordal length (1.9±0.4 cm, versus 1.5**±0.3** cm, p=0.01) and the mean P2 chordal length (1.3±0.2 cm, versus 1.1±0.3 cm, p=0.02). Mean thickness scores for the 6 scallops were all significantly lower in the repair patients, as well as the calcification scores of all scallops, except those for A1 and P3 who were comparable in both groups. Repair patients had similarly significantly lower mean additive scores for all scallops, as well as lower anterior and posterior subvalvular scores and, consequently, significantly lower mean total valve scores. ROC curve results of significance for the TEE measurements are summarized in table IV. The following cutoff values were identified as absolute prerequisites for reparability with very good sensitivity: a total valve score < 20.5 (sensitivity = 92% and specificity = 100%), an A1 additive score < 3.5 (sensitivity = 84% and specificity = 100%) and an A3 additive score < 2.5 (sensitivity = 62% and specificity = 100%). The following criteria were identified as relative predictors of reparability with reasonable sensitivity and specificity: an additive P1 score < 2.5 (sensitivity = 77% and specificity = 95%), an end-diastolic inter-papillary muscle distance > 2.25 cm (sensitivity = 77% and specificity = 84%), an A2 chordal length > 1.65 cm (sensitivity = 72% and specificity = 70%) and a P2 chordal length > 1.25 cm (sensitivity = 63% and specificity = 70%). Bivariate analysis of categorical TEE parameters of the repair and replacement groups is summarized in table V. TEE identified very few cases of segmental prolapse in the repaired valves, with the exception of A2, and none at all in the replaced valves. The following criteria were associated with feasibility of repair: predominant regurgitation (19 cases or 86.3% in the repair group, versus 5 cases or 38.4% in the replacement group, p=0.007), A2 prolapse (8 cases or 36.3%, versus none, p=0.03), freedom from commissural fusion (18 cases or 81.8%, versus none, p=0.000) and freedom from commissural calcification (22 patients or 100%, versus 7 patients or 53.8%, p=0.001). Replaced valves showed a trend for a higher incidence of annular calcification, which almost reached statistical significance (4 replaced valves or 30.7%, versus 1 repaired valve or 4.5%, p=0.05).

Valve parameter by TEE	Repair (n=22)	Replacement (n=13)	P value.
A2 height	2.5±0.3 cm	2.5±0.4 cm	0.96
P2 height	1.1±0.3 cm	1.3±0.3 cm	0.389
Systolic transverse annular diameter	3.6±0.6 cm	3.3±0.5 cm	0.28
Diastolic transverse annular diameter	3.6±0.5 cm	3.3±0.6 cm	0.13
Systolic AP annular diameter	3.3±0.4 cm	3.5±0.6 cm	0.67
Diastolic AP annular diameter	3.8±0.6 cm	3.5±0.5 cm	0.35
Systolic papillary distance	2.2±0.6 cm	1.7±0.4 cm	0.012
Diastolic papillary distance	2.8±0.8 cm	2.1±0.6 cm	0.009
A2 chordal length	1.8±0.4 cm	1.5±0.3 cm	0.016
P2 chordal length	1.3±0.2 cm	1.1±0.2 cm	0.026
Segmental thickness scores			
A1	1.2±0.7	2.7±0.7	0.000
A2	1.6±0.5	2.5±0.6	0.002
A3	1.4±0.8	2.3±0.4	0.003
P1	1.2±0.8	2.9±0.7	0.000
P2	1.3±0.5	2.2±0.6	0.001
P3	1.2±0.6	2.0±0.8	0.004
Segmental calcification scores			
A1	0.04±0.2	1.9±1.0	0.2
A2	0.2±0.4	1.1±1.0	0.01
A3	0±0	1.0±1.2	0.009
P1	0.1±0.6	2.0±1.4	0.000
P2	0.2±0.6	1.0±1.3	0.04
P3	0.2±0.4	0.7±0.8	0.6
Segmental additive scores			
A1	1.2±0.8	4.7±1.6	0.000
A2	1.8±0.7	3.5±1.5	0.004
A3	1.3±0.8	3.4±1.4	0.000
P1	1.4±1.2	4.9±2.0	0.000
P2	1.5±0.8	3.2±1.8	0.001
P3	1.2±0.8	2.7±1.5	0.002
Anterior subvalvular score	1.3±0.9	3.8±1.8	0.000
Posterior subvalvular score	0.9±0.8	3.5±2.3	0.000
Total subvalvular score	2.2±1.6	7.3±3.6	0.000
Total valve score	10.7±5.3	30±9.8	0.000

Table III: *Mann-Whitney test comparison of TEE findings in repair & replacement groups. AP=anteroposterior.*

Parameter	Cutoff	Sensitivity	Specificity
Total valve score	<20.5	0.92	1.0
A1 additive score	< 3.5	0.84	1.0
A3 additive score	< 2.5	0.61	1.0
P1 additive score	< 2.5	0.77	0.95
Diastolic papillary distance	≥ 2.25 cm	0.77	0.84
A2 chordal length	≥ 1.65 cm	0.72	0.7
P2 chordal length	≥ 1.25 cm	0.63	0.7

Table IV. *ROC curve results for thresholds of repairability.*

Parameter	Repair (n=22)	Replacement (n=13)	P value
Predominant MR	19 (86.3%)	5 (38.4%)	0.007
Segmental prolapse			
A1	1 (4.5%)	0 (0%)	0.7
A2	8 (36.3%)	0 (0%)	0.03
A3	0 (0%)	0 (0%)	N.A
P1	0 (0%)	0 (0%)	N.A
P2	1 (4.5%)	0 (0%)	0.7
P3	2 (9%)	0 (0%)	0.3
Commissural fusion	4 (18.1%)	13 (100%)	0.000
Commissural calcification	0 (0%)	6 (46.1%)	0.001
Annular calcification	1 (4.5%)	4 (30.7%)	0.05

Table V: *Bivariate analysis of categorical TEE findings in the repair and replacement groups. MR=mitral regurgitation, N.A=not applicable.*

TEE prediction of ring size

By simple linear regression, the TEE measurements of the mitral annular transverse diameter at early systole was the only important predictor of the size of the ring, yielding the following equation represented in figure 1 (Equation A): predicted annuloplasty ring size = 25.24 + (2.306 X annular transverse diameter at early systole) (r = 0.536, r^2 = 0.236, p = 0.032, 95% confidence interval = 0.223-4.390). Stepwise multiple linear regression yielded the following equation to predict the ring size (Equation B): predicted ring size = 31.487 + (3.646 X transverse annular diameter at early systole) – (3.005 X transverse annular diameter at end-diastole) (r = 0.72, r^2 = 0.445, p = 0.009). Overall, Equation B (derived from TEE measurement of the annular transverse diameter at early systole and end-diastole) achieved better prediction of the ring size compared to Equation A (derived from TEE measurement of the annular transverse diameter at early systole alone). Therefore, a Bland-Altman plot was constructed to assess the agreement between the predicted ring size using Equation B and the true ring size as determined by surgical measurement (figure 2). The mean difference between the predicted and the true ring sizes was 0. The limits of agreement were -3.3 to 3.3 numerical values, which included 95% of the differences between both measurements and had a 95% confidence interval of -0.9-0.9. In 18 patients (81.8%), the differences between the predicted and true ring sizes were ≤ 2.0 numerical values, corresponding to one ring size.

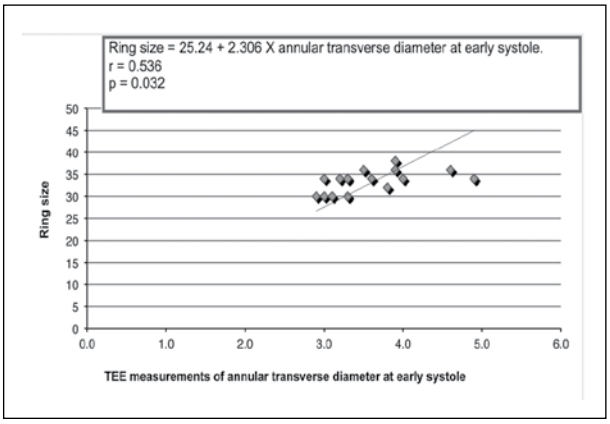

Fig 1. Linear regression between the TEE measurements of the annular transverse diameter and the true ring size.

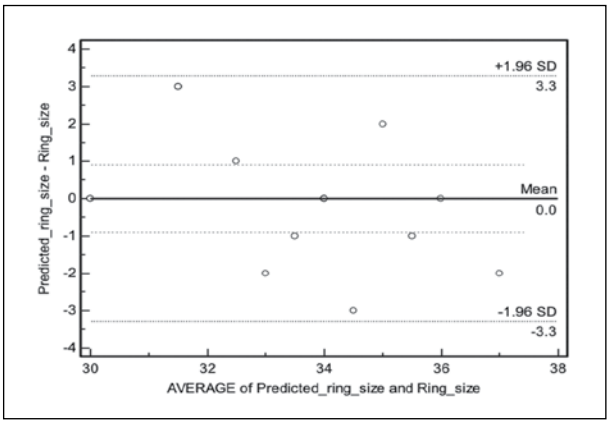

Fig 2. Bland-Altman plot depicting predicted versus true ring size.

Discussion

Intraoperative transesophageal echocardiographic assessment is a fundamental part of any mitral valve operation. In functional mitral valve disease, such as in ischemic or dilated cardiomyopathy, the induction of general anesthesia has been known to underestimate the degree of mitral regurgitation (MR) by several mechanisms. First, there is a decreased preload resulting from many factors: the hypovolemia associated with long hours of fasting, the venodilator effect of intravenous anesthetics, and the compression of the superior and inferior vena cava and pulmonary veins by positive pressure ventilation resulting in decreased ventricular filling. There is also a decreased afterload due to systemic vasodilatation and the reduction in the peripheral vascular resistance. Alterations in ventricular geometry lead to shifts in the interventricular septum and changes in the spatial relationships of different components of the mitral valve apparatus: the papillary muscles, the chordae and the leaflets. [8,9] However, it was demonstrated that in degenerative and rheumatic pathologies, where the valve is structurally abnormal, general anesthesia had no effect on mitral valve assessment. [10] We add that this is more pertinent in a study like ours which tackles morphometric assessment of the mitral valve, rather than valve function.

The TEE scoring system that we propose correlated well with operative scoring. It provided an accurate global and segmental analysis and proved to be a powerful predictor of valve reparability. It lacked however estimation of segmental mobility, a factor that could be added in future studies. Because it is relatively time consuming, time will tell if we will be able to include it in our routine practice. The inaccuracy of TEE in measuring A2 height and the anteroposterior annular diameter as suggested by our data is in agreement with a previously published studies by Biaggi and coworkers. [11] It can be explained by the inherent shortcoming of TEE by which it is strongly dependent on the cut section at which the valve is visualized. On the other hand, TEE proved to correlate well with surgery in measuring the height of P2, a finding that is also similar to results reported by Biaggi et al. in the same study. [11] Awareness of P2 height is important because a decreased height is associated with posterior leaflet tethering, which necessitates pericardial patch augmentation.

Our mitral valve repair rate in the present series was 63%, which is comparable to the repair rates reported in the literature for rheumatic mitral valve disease: 58.6% by Kumar et al. [12], 59% by El Oumeiri et al. [13], and 69 % by Yakub and coworkers [14]. As we have identified commissural involvement by fusion or calcification as a predictor of irreparability in our hands, it would be possible to increase our repair rate by adopting more aggressive approaches for commissural reconstruction. Commissural replacement by a posterior tricuspid leaflet autograft has been proposed by Hvass and colleagues [15] and used liberally by others. [16] We feel it is a technically challenging procedure and has the disadvantage of transforming single valve pathology into a two-valve problem, since the long-term effects on the tricuspid valve have not yet been fully elucidated. On the other hand, Chotivatanapong et al. introduced the principle of commissural excision and reconstruction with double-breasted pericardial patches, supported by artificial chordae, which is similarly difficult and time consuming. [17]

Annular calcification also came out in this study as a factor strongly precluding feasibility of repair. Whereas in degenerative mitral valve disease, calcification occurs peripherally at the annulus, occasionally involving a limited portion of the leaflets, the secondary chordae or the tips of one papillary muscle, the calcium can almost always be removed as a bar and the valve repaired. [18,19] By contrast, calcification in rheumatic heart disease starts centrally at the commissure and by the time it has reached the annulus, the leaflet tissue has become involved beyond repair.

Gupta and associates identified a minimal height of the A2 segment of 26 mm by TEE as a prerequisite for valve repair in rheumatic affections. [20] We did not observe any difference in terms of A2 height between repaired and replaced valves in our cases. We did however delineate several specific criteria of repair feasibility related to the anterior leaflet, the first being prolapse of the A2 segment. In our hands, TEE was fallacious in detecting this abnormality with a tendency to over diagnose it, probably due to the frequent association with posterior leaflet retraction which gives the impression on echocardiography of a "pseudo prolapse", meaning that the anterior leaflet appears to have excessive motion only in comparison to the posterior one, but still without overriding the plane of the annulus. No matter how erroneous, this finding seems to indicate a certain pliability of the anterior leaflet. The other relevant predictors which were an A2 chordal length of 1.65 cm or more, an A1 score lower than 3.5 and an A3 score lower than 2.5, all seem to go in the same direction.

Insertion of an adequately sized annuloplasty ring is mandatory for a successful mitral repair, as a ring that is too small would result in an unacceptable gradient, and one that is too large would decrease the coaptation reserve or result in residual regurgitation. The capacity to determine the ring size in advance would have several advantages. In facilities with logistical problems, where keeping a fully stocked inventory containing all ring sizes at all times is difficult, this can help in not canceling operations if the expected size is available. The echocardiographer can guide surgeons who are at the early stages of their learning curve in performing repair procedures in their choice of ring. Finally, in the forthcoming era of minimal access surgery, knowing the appropriate ring size beforehand can save time and effort. As for percutaneous techniques, relying on echocardiography will probably be the only possible method of ring sizing. It is imperative to emphasize that the formula we were able to reach is valid only for the sizing method used in this series. Many sizing strategies are used by different

surgical teams based on either the anteroposterior dimension of the sizer to estimate the maximal height of the anterior leaflet [21] or the height of the bare area of the leaflet [22], or based on the distance between the notches in the sizer to gauge the intercommissural distance [23] or the intertrigonal distance [24]. We choose instead to use the surface area of the whole anterior leaflet as reference, as recommended by Carpentier for rheumatic valves [25]. We estimate it to be a reproducible sizing method, since all the cases in this study were weaned from cardiopulmonary bypass without significant gradients and with adequate coaptation surfaces.

Three-dimensional transoesophageal echocardiography is an emerging modality for mitral valve assessment that proved to be superior to conventional two-dimensional transoesophageal echocardiography in localizing segmental prolapse, in the setting of degenerative mitral valve disease. [26,27] It also demonstrated superiority in measuring the height of different scallops. [11] No information is yet available about its possible benefits in rheumatic pathologies. It is still unavailable in our operating rooms and, for the foreseeable future, we will continue to rely on two-dimensional transoesophageal echocardiography.

Conclusion

We conclude that two-dimensional transoesophageal echocardiography is a valid method for evaluating rheumatic mitral valve pathology. In most parameters, it correlates well with surgical findings and can be used to devise a scoring system for global and segmental valve analysis. It can accurately predict valve reparability as well as the annuloplasty ring size.

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Evaluation of Non-Severe Mitral Valve Regurgitation After Aortic Valve Replacement For Severe Aortic Valve Stenosis or Severe Aortic Valve Regurgitation

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Background: Mitral valve regurgitation (MR) is common in patients with aortic valve stenesis (AS) or insufficiency (AI). In patient with AS up to two – thirds will have varying degrees of M.R.

Objective: To evaluate the degree of the non-severe mitral valve regurgitation after open heart surgery for aortic valve replacement for aortic stenosis or aortic regurgitation**.**
Methods: This study included 30 patients suffer from sever aortic valve stenosis with mild mitral regurgitation or mild to moderate mitral regurgitation or moderate mitral regurgitation or suffer from sever aortic valve regurgitation with mild mitral regurgitation or mild to moderate mitral regurgitation or moderate mitral regurgitation. All those patients whom participated in this study have been consented as well as the approval of ethics committee of Zagazig university hospital has been taken. All these patients will undergo aortic valve replacement only. All these patients will be subjected to full clinical history and examination, laboratory investigations, chest X-ray, resting twelve leads electrocardiogram and transthoracic echocardiography. In this study , assessment of the degree of mitral regure was based on semiquantitative method using Doppler echocardiography. Mechanical ventilation, low cardiac output, renal failure, cerebrovascular stroke and respiratory failure were recorded.

Result(s): In our study, the age of the patients was ranging from 18-72 years. Their gender were 22 male and 8 females. There were 8 +ve for smoking and 22 –ve for smoking. It was found that mean of ejection fraction six months post-operatively was (60 ± 7.7) compared to (57.6 ± 11.6) pre-operatively with p value 0. This indicate that is statistically significant . On follow up of the mean value of end diastolic dimention (EDD) 6 months post-operatively is (45 ± 8.9) compared to (60.1 ± 10.3) pre-operatively & the mean value End systolic dimensions (ESD) 6 months post-operatively is (32 ± 6.4) compared to (37.7 ± 8.5) pre-operatively. This decrease in EDD , ESD & the mean value of LA size 6 months post-operatively (30.8 ± 5.8) compared to (40.7±7) pre-operatively & these are statistically significant . Peak and mean pressure gradient on mitral valve showed statistically significant reduction six months after aortic valve replacement of as the mean value of peak pressure gradient decrase from (9.3 ± 4.4) mmHg pre-operatively to (4.2 ±1.7) mmHg post operatively and that of mean pressure gradient on mitral valve decrease from (4.1 ± 1.3) mmHg pre-operatively to (2.2 ± 0.7) mmHg post – operatively . Regarding to mitral valve area it was found that there was statistically significant reduction in the mitral valve area post-operatively as the mean value of mitral valve area pre-operatively was (5.5±0.5)cm compared to (4.3 ± 1.1)cm post-operatively. In our study there is positive direct correlation between MR improvement and ejection fraction (EF) & there is negative indirect correlation between MR improvement and EDD, ESD, LA size, mean PG, max PG on MV & MV area but with no statistical significance. MR improvement is detected in 6 patients (100%) with functional MR & in 20 patients (90.9 %) with Rheumatic MR and also in 2 patients (100%) with Degenerative MR. & in all patients with sever AS (14 patients) (100 %) & in 14 patients with sever AR (87.5 %) and These are statistically insignificant & improvement of MR is detected in 28 patients (93.3%), while no improvement in MR is detected in 2 patients (6.7 %).

Conclusion(s): Mitral valve regurgitation was significantly improved in the majority of patients operated for aortic valve replacement.

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KEY WORDS: Mitral valve regurgitation, aortic valve replacement, stenosis, regurgitation.

Mitral valve regurgitation (MR) is common in patients with aortic valve stenesis (AS) or insufficiency (AI). In patient with AS up to two – thirds will have varying degrees of MR[1].

Mitral regurgitation (MR) in patients undergoing aortic valve replacement (AVR) for aortic stenosis (AS) is a common finding, and reported incidence varies from 61% to 90%. Although most reported MR is functional (ie, in the absence of a structural abnormality), significant MR (grade 2/4) has been reported in almost 13% of such cases. The presence of concomitant coronary artery disease, fluid overload, and structural changes in the left ventricle (LV) also are believed to contribute to concomitant mitral valve dysfunction in patients with critical AS. Additionally, chronic left ventricular outflow tract obstruction as seen in AS can cause permanent geometric changes in left ventricular shape and structure, which eventually result in reduced mitral leaflet coaptation and significant MR. It is obvious that the pathophysiology of this condition is more complicated than MR because of the structural abnormalities of leaflets[2].

When there's intrinsic mitral valve disease , this may result from calcification of the mitral leaflets or annulus , particularly in the elderly , but also from rheumatic involvement or from myxomatous degeneration . MR associated with AS should not be over looked , as it can worsen functional status and independently affect prognosis. More over a surgeon's decision to operate on both valves should only be made after careful clinical and echocardiographic assessment because double valve surgery increase the perioperative risk and MR can improve spontaneously after isolated aortic valve replacement (A.V.R)[3].

There is some evidence that MR improvement may be seen following aortic valve replacement alone avoiding the increased risk of double valve surgery[4].

Furthermore, there has been no data on clinically relevant parameters that predict which patients will show improvement in MR following AVR[5].

Aortic valve stenosis progresses predictably over time, but systolic dysfunction appears to be an inconsistent marker of the hemodynamic consequences of severe aortic stenosis. Progressive hypertrophy, as an adaptive response to pressure overload, seems to prevent ventricular dilatation and mitral regurgitation development. On the other hand, progressive Mitral Regurgitation (MR) may act as a marker of impaired left ventricular performance in aortic stenosis and may also be a maladaptation to increasing aortic stenosis[6].

Surgery is often required for aortic stenosis or insufficiency. However, double valve intervention (replacement, repair, or the 2 in combination) is associated with an elevation in hospital mortality rates (5% to 12.5%) and postoperative morbidity rates[7].

Moreover, several studies have suggested that the severity of concomitant MR improves after aortic valve replacement[8].

Functional mitral regurgitation appears to have a better prognosis than structural regurgitation after AVR[9].

MR in patients with aortic stenosis is often functional in nature although organic mitral disease may coexist. Increased afterload and LV remodeling have been implicated to explain the functional MR in patients with aortic stenosis[10].

Ventricular hypertrophy, ventricular dilatation, or annular dilatation commonly occur in patients with severe aortic stenosis or insufficiency and may result in Functional Mitral Regurgitation (FMR), without recognizable intrinsic disease of the mitral valve leaflets[11].

When MR is moderate to severe, heart failure symptoms may increase. A concomitant mitral valve repair or replacement could then be performed resulting in a higher operative risk[12].

Nevertheless, in a few studies, the authors suggest that coexisting MR could improve after aortic surgery whereas others do not agree[8].

The aim of the work is to evaluate the degree of the non-severe mitral valve regurgitation after open heart surgery for aortic valve replacement for aortic stenosis or aortic regurgitation.

PATIENTS AND METHODS

This study will include 30 patients suffer from sever aortic valve stenosis with mild mitral regurgitation or mild to moderate mitral regurgitation or moderate mitral regurgitation or suffer from sever aortic valve regurgitation with mild mitral regurgitation or mild to moderate mitral regurgitation or moderate mitral regurgitation .

All those patients whom participated in this study have been consented as well as the approval of ethics committee of Zagazig university hospital has been taken.

Inclusion criteria

All patient included in the study had mild or mild to moderate or moderate degree of mitral regurge either function or organic that did not necessitate mitral vavle surgery but necessitate A.V.R for sever AS or sever AR.

Exclusion criteria

Patient necessitate A.V.R for sever AS or sever AR but with the following *Exclusion criteria:*

- Patient with severe mitral regurgitation were excluded from the study as those patients are already candidates for mitral valve surgery.
- Ischemic MR when valvular anatomy was normal and MR was caused by failure in coaptation of mitral leaflets because of their restricted motion associated with apical systolic tethering of posterior papillary muscle (Carpentier type IIIb) and there was evidence of coronary artery disease.
- Patients with infective endocardites as a cause of MR.

Methods:

All these patients will undergo aortic valve replacement only. All these patients will be subjected to:

(A) Preoperative

- Full clinical history and examination.
- Laboratory investigations including full blood count, liver and kidney functions tests, serum electrolytes, serology and coagulation profile.
- Chest X-ray.
- Resting twelve leads electrocardiogram.
- Transthoracic echocardiography.

(B) Operative data

- In this study , assessment of the degree of mitral regure was based on semiquantitative method using Doppler echocardiography.
- Parameters of severity of mitral regurge were regurgitant jet width area ratio of regurgitant jet width into left atrial area. Preoperative echocardiography was essential in detecting mechanism of mitral regurge and to clarify its cause either functional or organic aetiology .
- All patients in the study were followed up after 6 months from operation by complete transthoracic echocardiography to detect degree of mitral regurge after aortic valve replacement and also to detect geometric echocardiographic changes after aortic valve replacement. A change in MR was considerered significant when there was at least a degree different between preoperative and postoperative echocardiographic parameters of severity of mitral regurge including regurgitant jet width into left atrial area .

(C) Postoperative care:

Mechanical ventilation, low cardiac output, renal failure, cerebrovascular stroke and respiratory failure were recorded.

All patients included in this study were contacted by us and outpatient clinic staff every one month asking them many questions as regard the following: thromboembolic events, NYHA functional class, Cardiac related morbidity, Cardiac related hospitalization, Bleeding complications due to Anticoagulant therapy.

Statistical analysis

The collected data were presented, summarized, tabulated and analyzed by using computerized software statistical package (EPI-info Version 6.04 and SPSS version 19). Fisher exact test was used to compare proportions. Mc Nemar X2 test was used for paired qualitative data. Paired t test was used to compare means pre and post operative Echocardiography of the studied patients. Pearson correlation coefficient (r) was done for the relation between quantitative variables. $P < 0.05$ was considered to be statistically significant. Survival analysis and log rank test were done.

RESULTS

In our study, the age of the patients was ranging from 18-72 years (mean 39.9 ± 18.4 year). Their gender were 22 male(73.3%) and 8 females (26.7%). There were 8 +ve for smoking(26.7%) and 22 –ve for smoking(73.3%) (table 1).

Variable	Frequency (NO=30)	%
	-Mean ± SD (39.9±18.4) -Range (18-72)	
Age groups:		
< 30years	10	33.3
30-	10	33.3
45-	4	13.4
≥60 ys	6	20.0
Sex:		
Male	22	73.3
Female	8	26.7
Smoking:		
-ve	22	73.3
+ve	8	26.7

NO: *Number,* **SD:** *Standard deviation*, **-ve:** *Negative*, **+ve:** *Positive*,**%:** *percentage*.

Table (1): ***Distribution of some demographic criteria of the studied patients***

It was found that mean of ejection fraction six months post-operatively was (60 ± 7.7) compared to (57.6 ± 11.6) pre-operatively with p value 0 ® This indicate that is statistically significant .

On follow up of the mean value of LV end diastolic dimension (LVEDD) 6 months post-operatively is (45 ± 8.9) compared to (60.1 ± 10.3) pre-operatively & the mean value LV end systolic dimensions (LVESD) 6 months post-operatively is (32 ± 6.4) compared to (37.7 ± 8.5) pre-operatively ® this decrease in LVEDD , LVESD is statistically significant . The mean value of LA size 6 months post-operatively (30.8 ± 5.8) compared to (40.7±7) pre-operatively ® this decrease in L.A size 13 statistically significant .

Peak and mean pressure gradient on mitral valve showed statistically significant reduction six months after aortic valve replacement of as the mean value of peak pressure gradient decrase from (9.3 ± 4.4) mmHg pre-operatively to (4.2 ±1.7) mmHg post operatively and that of mean pressure gradient on mitral valve decrease from (4.1 ± 1.3) mmHg pre-operatively to (2.2 ± 0.7) mmHg post – operatively .

The mean value of I.V.S thickness after the operation was (10.5 ± 1.9) mm compared to (11.13 ± 2.3) mm pre-operatively. The mean value of PLVW Thickness after the operation was (10.2 ± 1.3) mm compared to (10.9 ± 2.1) mm pre-operatively. This decrease in both I.V.S & PLVW Thickness were not statistically significant .

Regarding to mitral valve area it was found that there was statistically significant reduction in the mitral valve area post-operatively as the mean value of mitral valve area pre-operatively was (5.5±0.5) compared to (4.3 ± 1.1) post-operatively (table 2) .

In our study improvement of MR was detected in 28 patients (93.3%), while no improvement in MR is detected in 2 patients (6.7 %) (table 3).

MR improvement was detected in 10 patients (100%) with NYHA class II and in 18 patients (90 %) with NYHA class III . It was found that MR improvement occur in 11 patients with angina (91.7%) & in 17 patients (94.4%) without angina .Also MR improvement detected in 7 patients (87.5 %) with congestive heart failure(CHF) & in 21 patients (95.5 %) without CHF .

MR improvement occur in 4 patients (100%) was complaining from AF , also occur in 24 patients (92.3 %) wasn't complaining from AF. Thus the relation ships between MR improvement and NYHA class , angina , CHF , AF were statistically insignificant (table 4).

In our study MR improvement was detected in 6 patients (100%) with functional MR & in 20 patients (90.9 %) with Rheumatic MR and also MR improvement was detected in 2 patients (100%) with Degenerative MR. But it was found that relation between M.R improvement & pathology of MR weren't statistically significant (P Value 0.634) (table 5).

In our study MR improvement was detected in all patients with sever AS (14 patients) (100 %) while MR improvement was detected in 14 patients with sever AR (87.5 %). This relationship was statistically insignificant (P value 0.485) (table 6).

Table (7) shows that there is negative indirect correlation between MR improvement and EDD, ESD, & LA size but with no statistical significance and it shows positive direct correlation between MR improvement and ejection fraction (EF) with no statistical significance also (p value 0.811).

Table (8) shows that there is negative inverse correlation between MR improvement and mean PG, max PG on MV & MV area but with no statistical significance relation.

Table (9) shows that there is negative (inverse) correlation between MR improvement and IVS, & PWT but with no statistical significance relation.

Variable	Mean ± SD preoperative	Mean ± SD post operative	Paired t test	P value
EF	57.6 ±11.6	60 ± 7.7	1.012	0.000
LVEDD	60.1±10.3	45 ± 8.9	14.5	0.000
LVESD	37.7 ±8.5	32 ± 6.4	4.3	0.000
LA measurement size	40.7 ± 7.0	30.8 ± 5.8	9.1	0.000
Mean PG on MV	4.1 ± 1.3	2.2 ± 0.7	8.2	0.000
Max PG on MV	9.3± 4.4	4.2 ± 1.7	5.7	0.000
IVS thickness	11.13 ± 2.3	10.5 ± 1.9	0.98	0.336
PLVWT	10.9 ± 2.1	10.2 ± 1.3	1.4	0.171
Mitral valve area	5.5±0.5	4.3± 1.1	4.48	0.000

EF: *Ejection fraction,* **LVEDD:** *Left ventricular end diastolic dimensions,* **LVESD:** *Left ventricular end systolic dimensions,* **LA:** *Left atrium,* **PG:** *Pressure gradient,* **MV:** *Mitral valve,* **IVS:** *Inter ventricular septum,* **PLVWT:** *Posterior left ventricular wall thickness,* **SD:** *Standard deviation*.

Table (2): ***Mean values of the pre operative & postoperative Echocardiography data of the studied patients***

MR improvement	Frequency (NO=30)	%
yes	28	93.3
No	2	6.7
Total	30	100

NO: *Number*, **%:** *percentage*.

Table (3): ***Frequency of MR improvement after aortic valve replacement***

Variable	MR improvement				Total	Test of significance	P value
	Yes		No				
	No	%	No	%			
NYHA class:							
II	10	100	0	0.0	10	Fisher exact	0.540
III	90.0		2	10.0	20		
Angina:							
No	17	94.4	5.6		18	Fisher exact	0.648
Yes	11	91.7	1	8.3	12		
MI:							
No	28	93.3	2	6.7	30	Not applicable	
CHF:							
No	21	95.5	1	4.5	22	Fisher exact	0.468
Yes	7	87.5	1	12.5	8		
AF:							
No	24	92.3	2	7.7	26	Fisher exact	1.000
Yes	4	100	0	0.0	4		

NYHA*: New York heart association,* **MI:** *Myocardial infarction,* **CHF:** *Congestive heart failure,* **AF:** *Atrial fibrillation*, **%:** *percentage*.

Table (4): ***Relation between M.R improvement & pre-operative clinical data***

Pathology of MR	MR improvement				Total	Test of significance	P value
	Yes		No				
	No	%	No	%			
Functional	6	100	0	0.0	6		
Rheumatic	20	90.9	2	9.09	22	Fisher exact	0.634
Degenerative	2	100	0	0.0	2		

MR*: Mitral regurgitation,* **NO:** *Number*, **%:** *percentage*.

Table(5): ***Relation between M.R improvement & Pathology of MR***

Pathology of Aortic valve .	MR improvement				Total	Test of significance	P value
	Yes		No				
	No	%	No	%			
Severe AR	14	87.5	2	12.5	16		
Severe AS	14	100	0	0.0	14	Fisher exact	0.485

MR*: Mitral regurgitation,* **AR:** *Aortic regurgitation,* **AS:** *Aortic stenosis,* **NO:** *Number*, **%:** *percentage*.

Table (6): ***Relation between M.R improvement & Pathology of aortic valve***

Operative data	Pearson correlation (r)	P value
EF	0.046	0.811
LVEDD	-0.274	0.143
LVESD	-0.074	0.696
LA size	-0.254	0.181

EF: *Ejection fraction,* **LVEDD:** *Left ventricular end diastolic dimentions,* **LVESD:** *Left ventricular end systolic dimentions*, **LA:** *Left atrium*.

Table (7): ***Relation between M.R improvement and EF, EDD, ESD of L.V and LA size***

Operative data	Pearson correlation (r)	P value
Mean PG on MV	-0.199	0.292
Max PG on MV	-0.122	0.520
MV area	-0.127	0.503

PG: *Pressure gradient,* **MV:** *Mitral valve*.

Table (8): ***Relation between M.R improvement and mean & peak A.V pressure gradients & MV area***

Operative data	Pearson correlation (r)	P value
IVS	-0.075	0.692
PLVWT	-0.159	0.402

IVS: *Inter ventricular septum,* **PLVWT:** *Posterior left ventricular wall thickness*.

Table (9): ***Relation between M.R improvement and I.V.S & PWT thickness (PLVW)***

DISCUSSION

Mitral valve regurgitation (MR) is common in patients with valve stenesis (AS) or insufficiency (AI). In patient with AS up to two – thirds will have varying degrees of M.R[1].

All patient is our study were followed up after 6 monthes by complete trans-thoracic echocardiography with espical emphasis on degree of MR because changes in MR severity in the immediate postoperative period may not reflect those in a more stable setting after a period of 6 months postoperatevly .

The duration of follow up was different among varies studies as following in the study of **Waisbren et al.**[13], it was in the interaoperative period & in studies done by **Unger et al.**[14] & it was in the early postoperative period in **Tassan-Mangina et al.**[12] & also the follow up occur after 2 months postoperatively as in study done by **Moazami et al.**[5]. Follow up occur after 6 months as in our study and in study done by **Christenson et al.**[1] and After one year as in study done by **Vanden Eynden et al.**[9] & follow up of MR after 1.5 years in **Ruel et al.**[11].

Characters in our study the demographic data of our patients according to age was (18-72 years) with mean of (39.9±18.4) but in the study of **Mostafa**[4], the mean age was (60± 7) & in the study done by **Vanden Eynden et al.**[9] was (66±11) and in study done by **Ruel et al.**[11] was (64.6 ± 11.6) & in study done by **Absil et al.**[10] was (74± 66) & the age in the study done by **Goland et al.**[15] was (72±6.5) years .

According to sex in our study there was 22 male (73.3 %) & 8 female (26.7 %) & this is similar to study of **Mostafa**[4] 18 male & 12 female & to **Goland et al.**[15] 17 male & 13 female also Similar to The study of **Tassan Mangina et al.**[12], 18 male & 12 female .

According to smoking in our study there was 8 patient (27%) +ve for smoking that was similar to the study of **vanden Eynden et al.**[9] that there was 17 patient (21%) +ve for smoking .

According to angina in our study there were 12 patients (40%) were complaining from angina & that is similar to a study done by **Waisbren et al.**[13] as here 41% of patients were complaining from angina also patient that were complaining from congestive heart failure (C.H.F) in our study were 8 patients (26.7%) & This was similar to the study of **Waisbren et al.**[13] that 27% of patients had C.H.F & according to A.F in our study 4 patients (13.3%) were complaining from A.F but in the study of **Mostafa**[4] (43.3%) of patient had A.F & (25%) of patient sin the study of **Waisbren et al.**[13] had A.F & (28.7%) of patients in the study done by **Ruel et al.**[11] had A.F .

As regard preoperative echocardiographic data EF (ejection fration) in our study was (57.6 ± 11.6%) & this is similar to the study done by **Waisbren et al.**[13] (60±14%) also to the study done by **Goland et al.**[15] (59 ± 12 %) & about LVEDD in our study was (60.1+10.3 mm) and this is similar to the study done by Vanden **Eynden et al.**[9] (54 ± 8 mm) & to the study done by **Goland et al.**[15] (54 ± 9 mm) & about LVESD in our study was (37.7 ± 8.5 mm) & this is similar to the study of **Goland et al.**[15] (35 ± 10 mm) & to the study done by **Tassan-Mangina et al.**[12] (35 ± 9 mm) .

According to L.A size (Left atrium size) in our study was (40.7±7 mm) & this was similar to the study of **Mostafa**[4] (44.2 ± 5.6 mm) & to the study done by **Waisbren et al.**[13] (43 ± 6.4 mm) & also to the study of **Vanden Eynden et al.**[9] (45 ± 6 mm) and about I.V.S (interventericular septum) thickness in our study was (11.13 ± 2.3 mm) & This is similar to the study done by **Mostafa**[4] (13.1 ± 0.94 mm) & to the study done by **Vanden**

Eynden et al.[9] (12.4 ± 2.4) & also similar to the study done by **Tassan-Mangina et al.**[12] (13.1 ± 2.6 mm) .

According to PLVWT (posterior left ventricular wall thickness) in our study was (10.9 ± 2.1 mm) & this is similar to the study done by **Mostafa**[4] (13.3 ± 0.86 mm) to **Waisbren et al.**[13] (13 ± 2 mm) .

According to operative data in our study all patients (patients 30) had mechanical aortic valve prothesis & this is similar in number to the study of **Vanden Eynden et al.**[9] as 29 patients had mechanical valve prothesis.

As regard MR improvement after aortic valve replacement (A.V.R) it was occurred in our study in 28 patients of 30 patients (93.3%) this is similar to the study of **Ruel et al.**[11] as MR improvement was occurred here in (89.4%) of patients and the study of **Absil et al.**[10] as MR improvement was occurred in (87.1%) of patients & also similar to the study of **Goland et al.**[15], as all patients with preoperative moderate MR had been improved postoperatively after A.V.R but MR improvement was occurred in (64.4%) of patients in the study done by **Mostafa**[4] & in (64.4%) of patients in the study done by **Waisbren et al.**[13] & in (36%) of patients in the study done by **Vanden Eynden et al.**[9] in (45%) of patients in the study of **Moazami et al.**[5].

In our study M.R improvement was occurred mostly in cases with preoperative MR pathology was F.M.R but less in cases with organic or structural MR pathology preoperatively as (100 %) of patients with F.M.R was showed MR improvement after A.V.R while (90.9 %) of patients with rheumatic MR was showed MR improvement after A.V.R but this was statistically insignificant due to small sample size . This also accepted in other studies as in the study of **Vanden Eynden et al.**[9] that showed MR improvement in cases with F.M.R and ischaemic MR where as rheumatic or myxomatous MR will most likely remain stable or even deteriorate after isolated A.V.R & also in the study done by **Goland et al.**[15] that suggested that patients with sever AS & Coexisting MR without structural mitral valve diease can be improved markedly following A.V.R & This is also accepted in the study of **Tassan-Mangina et al.**[15] that concluded that The presence of mitral annular calcification predict the long term persistence of MR postoperatively.

In our study improvement in MR degree was occurred in all patients with preoperative Aortic valve pathology was sever AS and in 87.5% of patients with pathology was sever AR mostly due to rheumatic pathology of the mitral valve preoperatively in patients whose MR not improved but patients whose MR was improved mostly due to the decrease in the max & mean pressure gradient on aortic & mitral valve postoperatively & change in LT ventericular geometery & haemodynamics but this was statistically in significant due to small number of patients studied & this is similar to the study of **Ruel et al.**[11] That studied that F.M.R improvement was occurred in (89.3%) in patients with sever AR & in (89.4%) in patients with sever AS preoperative .

In our study follow up echocardiography after 6 months of A.V.R showed statistical significant increase in EF and statistical significant reduction in EDD , ESD , LA size, mean & max pressure gradient on mitral valve & mitral valve area and it was detected that there was – ve indirect correlation between MR improvement in our study and LVEDD (45 ±8.9 mm) , LVESD (32 ± 6.4), LA size (30.8±5.8 mm), mean & max pressuregradient on mitral valve , mitral valve area (4.3 ± 1.1 cm), I.V.S (10.5 ± 1.9mm) and PLVWT (10.2 ± 1.3 mm) and it was detected that there was + ve direct correlation between MR improvement & ejection fraction (EF) (60 ± 7.7%) and this MR improvement in relation to postoperative Echo data mostly due to decrease in LV mass & change in LV geometry and also due to improvement in LV function this results were similar to number of other studies as in the study of **Mostafa**[4] that stated that two of the predictors of persistence of moderate MR after A.V.R were decrease in E F & increase in LA size preoperative (4.42 ± 0.56 cm) but postoperative was (4.38 ± 0.64cm) & also similar to the study of **Waisbren et al.**[13] That stated that one of the independent predictors that affect MR improvement was the LA size & in the study of **Vanden Eynden et al.**[9] that stated that MR improvement was occurred with postoperative Echo data show decrease in LA size {(pre (45 ± 6 mm), post (44.9 ± 8.3 mm)} , decrease in LVEDD {pre(54 ± 8 mm), post (51.2 ± 8.3mm)}, decrease in I.V.S {(pre (12.4 ± 2.4 mm), post (12.1 ± 2.7 mm)} & also this was similar to the study of **Ruel et al.**[11] that concluded that MR improvement was less in patients with LA size more than 5 cm & LVEDD more than 45 mm and also similar to the study of **Tassan-Mangina et al.**[15] that showed one of the predictors of MR regression was the decrease in LV mass and also stated that postoperative MR severity was related to LV diastolic dysfunction that may regress later & whose predominate effect as an increase in LA dilatation and also in the study of **Goland et al.**[15] that concluded that patients with AS and coexisting MR but without structural mitral valve disease or coronary artery disease (CAD) and with normal LV function showed marked improvement in MR degree following A.V.R.

In our study we analyze different demographic data, preoperative clinical data, preoperative chronic diseases, operative data and postoperative complications in relation to MR improvement.

As regard to demographic data we observed that improvement in MR was occurred mostly at age group of 30 & 45 years mostly due to absence of Cardiomyopathic changes and decrease in L.V mass , L.A size, M.V area and improvement of LV function postoperatively in these age groups but this was statistically insignificant due to small number of the studied patients in our study this was in contrast to other studies that stated that MR improvement was occurred in older age groups as in the studies of **Absil et al.**[10]**; Ruel et al.**[11]**; Tassan-Mangina et al.**[12]**; Waisbren et al.**[13] **and Goland et al.**[15].

As regard to preoperative clinical data there was marked MR improvement in patients with AF in our study & this in

contrast to the study of **Mostafa**[4] that suggested that AF was one of the predictors of persistence of MR after A.V.R & about congestive heart failure (C.H.F) , there was marked MR improvement in patients without C.H.F & less MR improvement in patients with C.H.F mostly as C.H.F affect LV function & LV remodeling that affect MR improvement postoperatively & this was similar to the study of **Waisbren et al.**[13] that stated that one of the independent predictors that affect MR improvement was C.H.F and about preoperative angina MR improvement was occurred more in patients without angina & less in patients with angina as coronary artery disease (CAD) affect LV function & remodeling and this had acceptance with the study of **Christenson et al.**[1] that suggested that if AS and MR were associated with symptomatie CAD → myocardial revascularization is importive along with A.V.R without mitral valve replacement except if there was papillary muscle rupture.

But there were statistically insignificant results as regard preoperative clinical data in ours study due to small sample size.

As regard to the relationship between MR improvement and operative data in our study it was found that there was +ve direct correlation between MR improvement & the size of aortic valve prothesis & this is mostly due to avoidance of patient prosthesis mismatch that may affect LV remodeling that affect MR improvement postoperatively but this result had no statistical significance due to small number of studied patients in our study & this result was found to be similar to the study of **Mostafa**[4] that concluded that patients with F.M.R should be subjected to carefully selection of prosthesis to aortic valve to avoid patients prosthesis mismatch that may affect MR improvement after A.V.R but the study of **Vanden Eynden et al.**[9] stated that post operative EOAi had no effect on MR regression after A.V.R.

CONCLUSION

- Mitral valve regurgitation was significantly improved in the majority of patients operated for aortic valve replacement .
- Functional mitral regurgitation was predictor of postoperative mitral regurge improvement while rheumatic etiology was predictor of persistent mitral regurge postoperatively .
- Younger age of patients, history of absence of angina and absence of congestive heart failure were found to be predictors of postoperative improvement of mitral regurge .
- Mitral regurge improvement was associated with increased postoperative ejection fraction, lower postoperative left ventricular mass, decreased postoperative LVEDD and LVESD, reduced postoperative left atrial size , lower postoperative mean and peak pressure gradient on mitral valve and also with reduced postoperative mitral valve area.
- Conservative approach to mitral valve rather than mitral valve repair or replacement may be recommended after recognition of predictors of mitral regurge improvement .

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Effects of Pleural Drainage Techniques on Postoperative Respiratory Functions Following On-Pump Coronary Artery Bypass Graft Surgery

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***OBJECTIVE*: To evaluate postoperative respiratory functions as represented by respiratory muscle strength, blood oxygenation, and postoperative pulmonary morbidities in patients undergoing on-pump coronary artery bypass using left internal Mammary artery grafts based on comparing pleural drain insertion site : at the subxiphoid region , the lateral region ,versus pleural sparing techniques to conclude which technique is with less respiratory dysfunction .**

***METHODS:* Prospective study in Ain shams university hospitals where sixty patients; according to certain criteria; were sampled from all the patients who underwent on-Pump CABG in year 2012, they were randomized into three groups in accordance with the technique of pleural drainage. Group I (n= 20) left pleura was left intact during harvesting of the LIMA; Group II (n = 20) left pleural chest tube was exteriorized at the subxiphoid region, and Group III (n=20) –left pleural drain pleural drain was exteriorized in the intercostal space .All patients underwent assessment of respiratory muscle strength (inspiratory and expiratory) on the pre, 1, 3 and 5 postoperative days (POD). Arterial blood gas analysis was collected on the pre and at regular intervals postoperatively till 48 hrs. Postoperative respiratory morbidities were also recorded till hospital discharge .Pain assessment by the pain scoring scales were also noted till hospital discharge.**

***RESULTS:* A significant decrease in respiratory muscle strength (inspiratory and expiratory) was seen in all groups until POD5 (P <0.05). When compared, the difference between groups remained significant with greater decrease in the III (P <0.05). The blood arterial oxygenation fell in all groups (P <0.05), but the oxygenation was lower in group III (P <0.05). Referred chest pain was higher at the 1st, 3rd and 5th POD in group III. No significant differences were noted in other pulmonary morbidities .No significant differences in hospital stay and in hospitalization time was noticed.**

***CONCLUSION:* Patients with intact pleura and those who subxiphoid pleural drainage showed less decrease in respiratory muscle strength, better preservation of blood oxygenation when compared to patients with intercostal drain on early ON-Pump CABG postoperative period evaluation.**

***Descriptors:* Myocardial revascularization, Coronary artery bypass, pulmonary gas exchange, Respiratory function tests, Respiratory mechanics.**

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Impairment of gas exchange after coronary artery bypass graft (CABG) surgery utilizing the left internal mammary artery (LIMA) can complicate the early postoperative period.[1, 2]. In our department as in others, the LIMA is used as the primary conduit in about 98% of CABG procedures. Although there are many alternatives, the left internal mammary artery (LIMA) is widely used as the conduit of choice because when compared with the saphenous vein, the LIMA has superior graft patency and better long-term survival.

However, several studies showed that harvesting of the LIMA leads to changes in pulmonary mechanical characteristics with a greater decrease in pulmonary function because of the pain associated with the opening of the pleural space. Iatrogenic injuries to the pleura and the harvesting of the left internal mammary artery (LIMA) necessitate the placement of chest tubes to prevent hemothorax or pneumothorax after surgery.

Tube placement can be performed through a subxiphoid or intercostal approach.

Irritation of the pleura and intercostal nerves by friction from the chest tubes can cause postoperative pain and pulmonary morbidities. [1-4] consequently, additional analgesic agents, chest physiotherapy for pulmonary sequelae, medical or surgical treatment of pleural fluid collection, and longer periods of hospitalization may be required. [1] .Specifically, pain associated with chest tubes can diminish pulmonary functions because of hypoventilation and atelectasis, particularly in high-risk CABG patients who have pulmonary disease. [2,3] Among reports of the impact of different routes for tube insertion, [4,5] it is was shown that the subxiphoid route leads to significantly less impairment of pulmonary function and less subjective pain than does intercostal insertion .

Our study aims at comparing the lung function parameters in patients with the left chest drain placed from the midline (subxiphoid) to patients with standard intercostal drain placement to patients with left pleural space left intact during the LIMA harvesting.

Materials and Methods

Patient selection

This prospective randomized controlled study was conducted at Ain Shams University Hospitals and affiliated hospitals. Written informed consent was obtained from all patients. All the patients who underwent CABG at Ain Shams University Hospitals during the year 2012 were examined and added to the pool of the patients. 375 patients underwent CABG during the period from Jan 2012 till Dec 2012. 120 patients were excluded from the study .From the remaining 255 patients , **Sixty patients** who underwent elective CABG using LIMA were randomly sampled , and randomized into three groups (numbered, opaque and sealed envelopes), in accordance with the drain position: **Group (I**) or intact pleura during LIMA harvesting**; Group (II)** or patients with midline sub-xiphoid tube insertion , and **Group (III)** or patients with intercostal tube insertion in left pleura with the drain exteriorized at the intersection of sixth intercostal space in the mid-axillary line .Any patient with bilateral opening of pleural cavities were also excluded and replaced by another patient .No patients died , failed or refused to perform the respiratory muscle strength test. (fig 1). All patients were followed up and none were lost due to the short evaluation period.

Inclusion criteria were: patients with obstructive atherosclerotic coronary artery disease and referred to elective ON-PUMP CABG , left ventricular ejection fraction greater than 50%, age between 35 and 75, hemodynamic stability during measurement of respiratory muscle strength and spirometry.

The exclusion criteria were patients with previous pulmonary disease assessed by spirometry in preoperative. We also excluded patients from the study population if they had left ventricular ejection fractions of less than 0.50, renal insufficiency (preoperative creatinine level, >1.5 mg/dL), histories of alcohol or drug abuse, or neurologic dysfunction. In addition, we excluded patients who were taking non-steroidal anti-inflammatory drugs (NSAIDs) on a chronic basis or tranquilizers before surgery, because these medications might have affected the evaluation of postoperative analgesia.

Anaesthesia Technique

All patients were given 0.1 mg/kg of diazepam intra-muscularly 30 min before surgery. General anaesthesia was induced with use of midazolam (0.1 mg/kg), fentanyl (5 μg/kg), vecuronium (0.1 mg/kg). Anaesthesia was maintained with use of fentanyl, midazolam, sevoflurane, and a 50% mixture of air and oxygen. Additional bolus doses of fentanyl (100–200 μg) were given during the operations if needed. Additional fentanyl was given in the post-operative period as required.

Surgical Technique

All patients underwent median sternotomy and harvesting of the left IMA. The IMA was harvested with a pedicle in standard fashion, with use of cauterization and a chest retractor on one side of the sternum. In two thirds of the patients (Group II and Group III) wide opening of the left pleura was used for better exposure of the LIMA. In the other third, Group (I) care was made to push the pleura away from the pedicle of the mammary without opening the pleural space.

Standard on-pump CABG was performed with membrane oxygenation and moderate hypothermia. Myocardial preservation was achieved through the intermittent administration of cold blood cardioplegic solution. In each patient, 2 soft, 38F and 40F chest tubes were used after surgery to drain blood and air from the chest cavity (Fig. 1).

In the Group I patients, both chest tubes were inserted through the subxiphoid area and were exclusively mediastinal.

In the Group II patients, a tube was placed in the left hemithorax, and the tip of this tube was placed in the left costophrenic sinus above the diaphragm which was exteriorized at the subxiphoid region. Another straight tube was placed in the anterior mediastinum.

In Group III, a straight tube was inserted in the left hemithorax through the 6th intercostal space along the mid-axillary line, and the tip of this tube was directed toward the apex of the left lung. Another tube was inserted subxiphoid and mediastinally placed.

All tubes were connected to an underwater drainage system. Chest radiographs confirmed the placement and

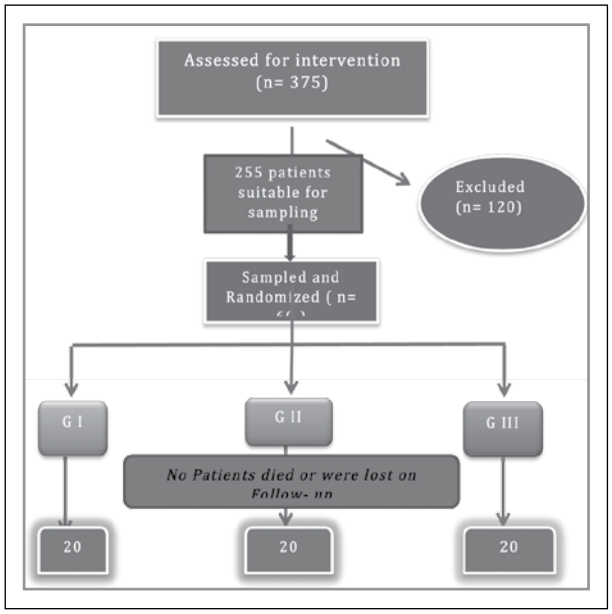

Fig 1. CONSORT flowchart illustrating the design of the study

position of the tubes. Before drain removal, all patients were put into an upright position early on the first postoperative day, to enable the evacuation of residual fluid in the pericardial or pleural cavity. The chest tubes were removed 48 hours after postoperative extubation provided no continued drainage. The sternotomy was closed with 6-8 separate stainless steel wires, and the skin and subcutaneous tissues closed in layers. (Fig 2).

Postoperative management

All patients were transferred to the intensive care unit (ICU) with endotracheal intubation, inspired oxygen fraction to keep arterial oxygen saturation above 90%, estimated tidal volume of 8 ml/kg, positive end expiratory pressure (PEEP) of 5 cmH2O and were extubated according to ICU ventilatory weaning protocol. All patients received the same analgesic protocol administered during the postoperative period. The drains (mediastinal and/or pleural) were routinely removed on POD2 and all patients were submitted to a standard physical therapy program until hospital discharge (breathing exercises and early ambulation). Chest pain sensation was assessed on 1, 3 and 5 PODs, and quantified by a modified standard score (0 = no pain to 10 = unbearable pain) [7]. This evaluation was performed at rest before the measurement of respiratory muscle strength. The time of mechanical ventilation and hospital stay after surgery were also recorded.

Postoperative Analgesia Protocol and pain scoring

A visual analogue scale (VAS) and verbal rating scale (VRS) were used for pain severity evaluation. The **VAS score** (range, 0–10) ranged from "no pain" to "worst pain imaginable" or "pain as bad as it could be." **The VRS score** (range, 0–5) was used to evaluate the severity of pain after deep inspiration, as follows: 0 = no pain at rest and while moving in bed; 1 = pain when coughing but without pain during deep breathing; 2 = mild to moderate pain during deep breathing but without pain while at rest; 3 = mild pain while at rest; 4 = moderate pain while at rest; and 5 = severe pain while at rest.

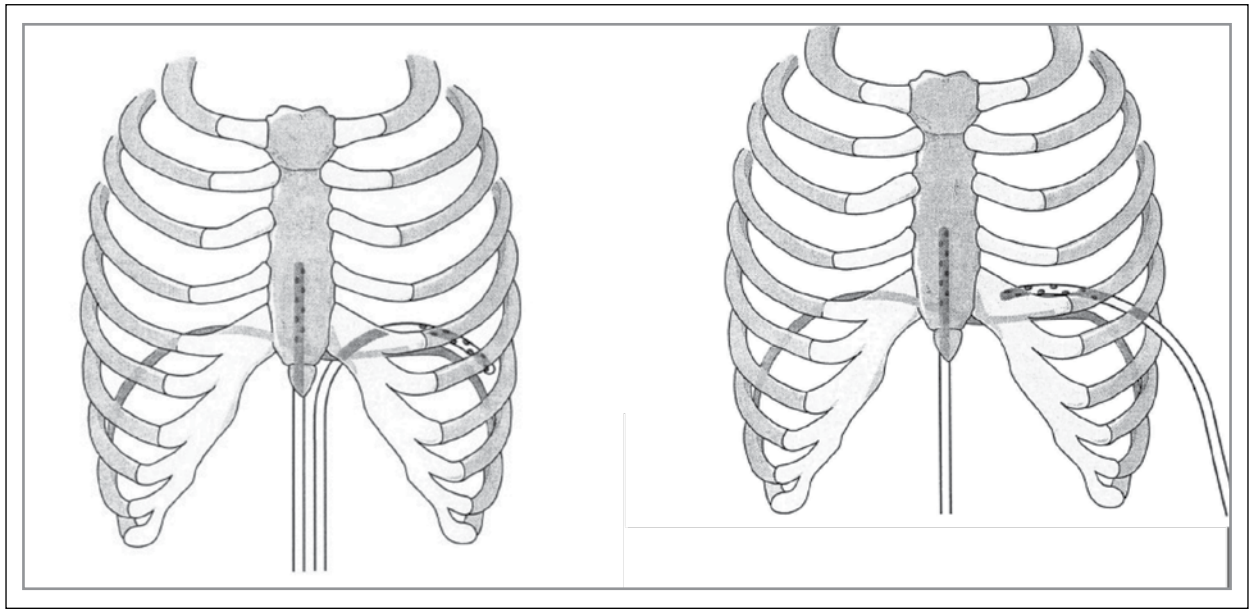

Fig 2. a: Subxiphoid tube placement a central mediastinal drain and another mediastino-pleural drain inserted.
b: Mediastinal drain insertion and a separate intercostal tube inserted in the 6th intercostal space in the mid-axillary line.

Postoperatively, NSAIDs were administered as analgesic agents. All patients were routinely given 1 mg/kg of diclofenac sodium every 12 hours during the first 48 hours after postoperative extubation. Paracetamol 1000 mg tds. orally were co-administered routinely to all patients as well.

If a patient's VAS pain score was from 5 through 8 or the VRS pain score was 3 or 4, 1 mg/kg of tramadol was delivered intravenously or orally. If pain persisted, the VAS score was above 8, or the VRS score was above 4, the pain team is called and will evaluate further pain on individual basis.

Primary Measurements

Our primary measurements included respiratory muscle strength evaluation, blood oxygenation as indicated by arterial blood gas measurement.

1. Respiratory muscle strength evaluation

Evaluation of respiratory muscle strength consisted of measurement of maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) by a manovacuometer. The recordings were performed at preoperative, 1, 3 and 5 postoperative day (POD) and the results were expressed as percentage of the preoperative period. The measurements were performed in the Fowler position (45 degrees).The MIP was measured from residual volume, the patient was requested to perform a forced expiration and then take a maximal inspiratory effort against an occluded airway (Mueller manoeuvre). The MEP was measured from total pulmonary capacity; the patient was instructed to perform a forced inspiration followed by a maximal expiratory effort against an occluded airway (Valsalva manoeuvre). The MIP and MEP were obtained using a pressure transducer connected to a system with two unidirectional valves. This measurement was always performed by the same professional. The spirometry was performed preoperatively to evaluate and discard patients with chronic obstructive or restrictive pulmonary diseases, according to American Thoracic Society [6].

2. Arterial blood gas measurements

Arterial blood gas measurements (partial pressure of arterial oxygen [PaO2] and partial pressure of carbon dioxide [PaCO2]) were determined at preoperative and 1st POD with patient breathing room air, always before the measurement of respiratory muscle strength. We also recorded breaths per minute and the results of blood gas analysis. Blood gas samples were collected at least 6 times daily

Secondary Measurements

Secondary measurements included other Postoperative pulmonary morbidities, including atelectasis, pleural effusion, diaphragmatic elevation, and the amount of drainage from the chest tubes. Postoperative chest-tube drainage in both groups was recorded hourly for at least 2 days .In the process of evaluation these morbidities ,Chest radiography was performed on each of the 2 days after surgery and again on postoperative day 4 to detect residual pleural fluid. It is repeated on patient's discharge from the hospital, and finally at the 1-month follow-up examination.

Statistical analysis

Initial sample-size estimation showed that approximately 20 patients were needed in each group .Variables were described as mean ± standard deviation. PaO_2, PaCO2, MIP and MEP were analysed with the values expressed in percentage of preoperative value with the preoperative baseline value, considered as 100%. The paired t Student test was used to compare two intragroup variables. The analysis of variance (ANOVA) for repeated measures was applied. When the groups were compared Student's t unpaired test were used. The analysis of categorical data was performed by chi-square test. Statistical analysis was performed by GraphPad Prism 5.0 Software (GraphPad Software Inc., San Diego, CA). For all statistical tests, the significance level adopted was a P value <0.05.

Results

The three groups did not differ significantly from each other with regard to age, sex, weight, height, body mass index, left ventricular function, and preoperative comorbidities (Table I). Perioperative data were similar with regard to durations of number of grafts, total cardiopulmonary bypass time, aortic cross-clamping time, surgery, duration of mechanical ventilation, and total hospitalization period (Table 2).

A significant decrease in **inspiratory and expiratory muscle strength** as indicated by the MIP and MEP in all groups was found until the POD5 (P <0.001), when compared with preoperative values. In the comparison between groups, the difference remained significant in 1, 3 and 5 PODs, with even greater reduction in group III (Table 3).

There was a significant drop in **PaO2** in the POD1 for all groups in relation to preoperative values (P <0.05).Between groups, the percentage of PaO2 in relation to preoperative was significantly higher in the group I compared to the group II and higher than group III (72.40 ± 11.01% in GIII versus 86.21 ± 7.67% in GII, versus 90.45 +/- 9.5 in GI; P <0.0001). The **PaCO2** values increased in all groups in the POD1 but this increment was not statistically significant, (P = 0.11). When compared, the group III showed higher value although not statistically significant (47.73 ± 8.68 in GIII versus 39.77 ± 4.02 in GI, 41.85 +/- 3.04 in GII). Readings were taken on room air.

There was no statistically significant difference in oxygen Saturations and Respiratory rate between the three groups. Table (4).

	Group I	Group II	Group III	P value
Age (Years)	58.3 +/- 11 .6	57.3 +/- 10.4	57.5+/- 10.9	***NS***
Male Sex	18 (90%)	16 (80%)	18 (90%)	***NS***
Weight (Kg)	80.4 +/- 5.7	76.6 +/- 7.7	81.5 +/-10..8	***NS***
Height (cm)	170.5 +/- 3.2	168.7 +/- 9.7	167 +/- 5.9	***NS***
BMI (Kg/M²)	23.3 +/- 1.0	24.1 +/- 0.9	23.1 +/- 0.3	***NS***
DM (No. / %)	12 (60%)	11 (55%)	13 (65%)	***NS***
HTN (No. /%)	20 (100%)	18 (90%)	20 (100%)	***NS***
Ejection Fraction	0.56 +/- 0.02	0.51 +/- 0.04	0.55 +/- 0.03	***NS***
Pulmonary functions				
FVC (l)	3.7+/- 0.66	3.46 +/- 0.44	3.6 +/- 0.64	***NS***
FEV1(l)	3.02 +/- 0.6	3.12 +/- .34	3.2 +/- 0.52	***NS***
Po2 (mmHg)	79.9 +/- 3.2	80.9 +/- 4.2	79.1 +/- 2.3	***NS***
Pco2(mmHg)	32.1 +/- 3.4	32.9 +/- 4.5	31.4 +/- 3.2	***NS***
So2 %	98.6 +/- 3.4	99.0+/- 1.0	98.3 +/- 2.3	***NS***
MIP (cm H2O)	76.89 +/- 21.15	81.25 +/-26.49	78.56 +/- 24.87	***NS***
% expected	84.76 +/- 18.32	75.72 +/- 19.09	79.86 +/- 15.54	***NS***
MEP (cmH2O)	93.89 +/-24.70	93.00 +/- 30.00	93.4 +/- 23.00	***NS***
% expected	84.76 +/- 18.32	75.72 +/- 19.09	79.86 +/- 15.54	***NS***

BMI : Body Mass Index, DM : Diabetes Mellitus , HTN : Hypertension ,FVC : Forced Vital Capacity ,FEV1 : Forced Expiratory volume first second, PO2: Partial Arterial Oxygen Pressure , PCO2 : Partial Arterial Carbon Dioxide Pressure, SO2 : oxygen Saturation , MIP : Mean Inspiratory Pressure, MEP : Mean Expiratory Pressure .Values presented as Mean +/- Standard deviation

TABLE I. Comparison of Demographic and Preoperative clinical Characteristics between Groups.

	Group I	Group II	Group III	P Value
Number of grafts	2.78 +/- 0.41	2.52 +/- 0.87	2.6 +/- 0.8	NS
CPB Time (Min)	81.89 +/-34.79	82.94 +/- 34.82	78.63 +/-31.27	NS
Aortic Cross Clamp time (min)	51.25 +/- 20.91	53.93 +/- 21.66	50.57 +/- 15.31	NS
Duration of mechanical Ventilation (Hrs.)	14.49 +/- 10.22	14.56 +/- 11.45	14.36 +/- 3.81	NS
Hospital stay (days)	7.4 +/- 2.3	7.8 +/- 2.1	7.1 +/- 1.9	NS
Fentanyl use (micrograms)	1440.6 +/- 277	1487.6 +/- 250.1	1634.5 +/- 288	0.12
Values presented as Mean +/- Standard deviation				

TABLE 2. Comparison of Perioperative Data between Groups.

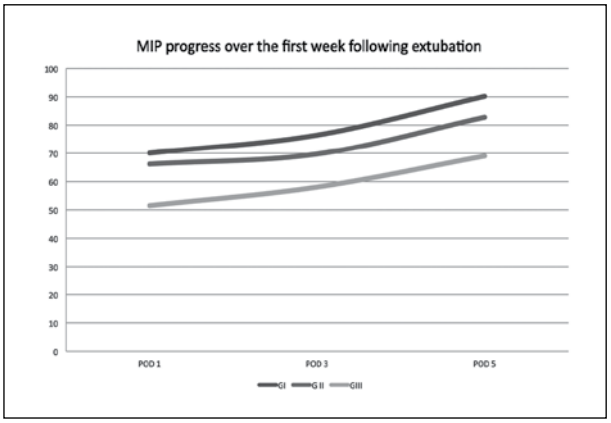

Chart 1. Line chart showing relation of the three groups in relation to the Mean Inspiratory Pressure (MIP).

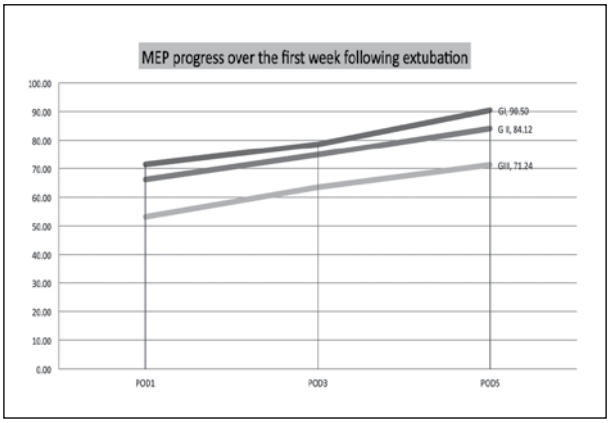

Chart 2. Line chart showing relation of the three groups in relation to the Mean Expiratory Pressure (MEP).

MIP	POD1		POD3		POD5	
	Cm H2O	% of Post/Pre	Cm H2O	% of Post/Pre	Cm H2O	% of Post/Pre
GI	51.65+/-12.01	70.1+/-11.33	60.89+/- 14.01	76.48+/-14.01	71.35+/-12.98	90.2+/-14.87
G II	49.96+/-12.05	66.2+/- 15.88	56.68+/-16.07	69.77+/-10.89	67.29+/-15.62	82.82+/-15.62
GIII	39.58+/-12.92	51.48+/-12.05	44.62+/-10.89	58.04+/-16.07	53.09+/-9.84	69.05+/-15.62
P value		P<0.05		P<0.05		P<0.05
MEP	POD1		POD3		POD5	
	Cm H2O	% of Post/Pre	Cm H2O	% of Post/Pre	Cm H2O	% of Post/Pre
GI	67.86+/-12.01	71.4+/-11.33	72.86+/-13.98	78.54+/-13.87	82.76+/-13.01	90.5+/-14.87
G II	61.49+/-12.07	66.12+/-15.88	69.59+/-12.01	74.83+/-12.75	78.23+/-12.98	84.12+/-10.69
GIII	49.89+/-11.02	53.14+/-12.79	59.57+/-9.08	63.45+/-12.91	66.88+/-10.9	71.24+/-12.26
P value		P<0.05		P<0.05		P<0.05

MIP: Mean Inspiratory Pressure, MEP: Mean Expiratory Pressure. Values presented as Mean +/- Standard deviation

Table 3. Comparison of MIP and MEP between groups.

	Before Ex-tubation	After Extbution						
		1	3	6	12	18	24	48
So2 %								
GI	98 (0.19)	98 (0.31)	98 (0.25)	97 (0.18)	97 (0.20)	97 (0.19)	96 (0.24)	94 (0.49)
G II	98 (0.15)	98 (0.23)	97 (0.23)	97 (0.17)	97 (0.21)	97 (0.23)	97 (0.30)	94 (0.50)
GIII	98 (0.19)	99 (0.25)	98 (0.23)	97 (0.19)	95 (0.21)	95 (0.19)	95 (0.27)	95 (0.51)
P value				NS				
RR								
GI	17 (0.47)	18 (0.59)	18 (0.64)	18 (0.59)	17 (0.59)	18 (0.53)	17 (0.49)	17 (0.41)
G II	17 (0.42)	18 (0.61)	18 (0.74)	19 (0.62)	17 (0.52)	19 (0.51)	19 (0.51)	19 (0.47)
GIII	18 (0.77)	20 (0.63)	20 (0.68)	22 (0.74)	19 (0.57)	20 (0.61)	22 (0.47)	22 (0.43)
P value				NS			0.06	0.06

SO2: oxygen saturation, RR: Respiratory rate. Values presented as Mean +/- Standard deviation.

Table 4. Comparison of Oxygen Saturation and respiratory rate between groups.

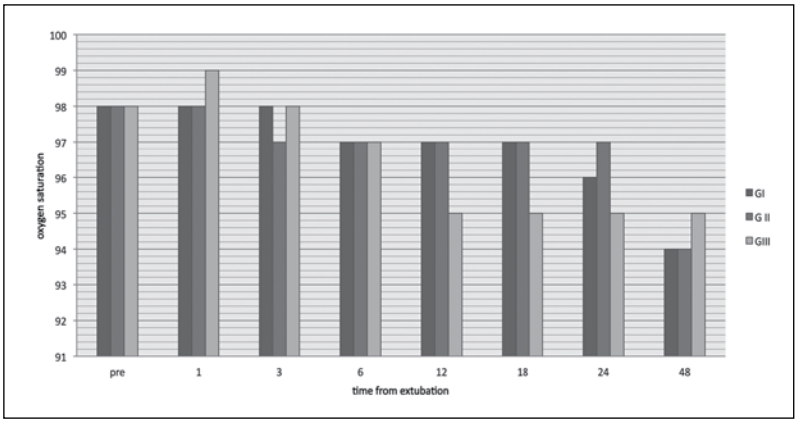

Chart 3. *Column chart showing relation of the three groups in relation to the Oxygen Saturation .*

	Group I	Group II	Group III	
Pleural effusion (No. /%)	0%	15% (3)	5%(1)	0.68
Tube drainage (ml)	300.2 +/- 42.8	550.2 +/- 25.5	565.5 +/- 12.5	P<0.005
Atelectasis (No. /%)	5%(1)	15%(3)	5%(1)	0.75

TABLE (5) Comparison of Postoperative Pulmonary Morbidities between Groups

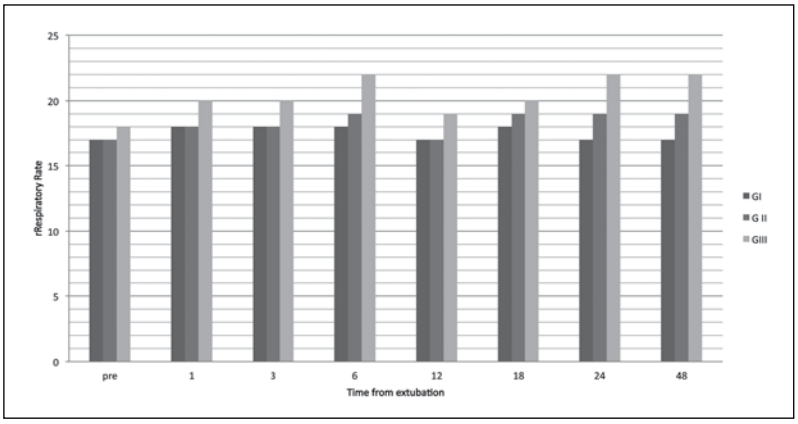

Chart 4. ***Column chart showing relation of the three groups in relation to the Respiratory Rate .***

Chest drainage was higher in Group II and III in comparison with Group I and that was statistically significant with P value <0.05.

Postoperative pulmonary sequelae in the subxiphoid and intercostal approaches included pleural effusion with no cases recorded in the group I (0 vs. 3 vs. 1 patients, respectively; P=0.68) and atelectasis (1 vs. 3 vs. 1 patients, respectively; P=0.75). None of the patients who developed pleural effusion required in-hospital drainage. The chest radiographs of these patients were normal at the 1-month follow-up examination. Table (5).

Discussion

Our study showed that either the intercostal or the subxiphoid route for chest-tube insertion can be used in CABG patients without significant associated pulmonary morbidity. There were no significant differences between the techniques in pulmonary function in the early postoperative period. The patients in Group II had higher percentages of pleural effusion and of atelectasis (both 15% vs. 5%) and a higher probability for a consequent need for pleural drainage. These differences were not statistically significant (both p=0.68, p=0.75), and a larger sample size is needed to reach a definitive conclusion. In addition, no significant difference was observed in the comparative intensity of postoperative pain.

A deterioration of lung volumes and respiratory muscle strength in the CABG postoperative period is evident from clinical experience. There is a 40% to 50% drop in volumes and capacities in relation to preoperative values [7, 8, and 9]. The decline in the postoperative pulmonary dysfunction is due to several factors. General anaesthesia alters the ventilation perfusion and functional residual capacity; and increase pulmonary vascular resistance. The sternotomy changes the chest compliance, induces decline of its mobility, promoting decrease of the pulmonary compliance and alveolar collapse [10]. In addition, pleural fluid retention and lung atelectasis may reduce lung volume. Guizilini et al. [11] in a study comparing median sternotomy versus mini-sternotomy in OPCAB observed that the mini-sternotomy resulted in better preservation and recovery of lung function, probably due to less trauma caused to the ribcage. As a result, patients had less time of orotracheal intubation and hospital stay. Therefore, CPB avoidance and limited incisions may provide a faster recovery and earlier hospital discharge. Evidence shows that changes in pulmonary function in patients undergoing on-pump cardiac surgery are largely responsible for morbidity.

Recently, Silva et al. [12] demonstrated that significant deterioration in lung function occurs following either on- and off-pump CABG. However, a greater decrease was found in patients undergoing on-pump CABG. Pulmonary dysfunction is more pronounced when LIMA is used due to the frequent opening of the pleural cavity, with the consequent need for intercostal pleural drainage. New techniques with pleural drain inserted at the subxiphoid site clearly afforded better preservation of lung volumes and capacities; and reduction of pain compared to the intercostal region [4, 8].

Respiratory muscle strength after CABG is also affected, the reduction of respiratory muscle strength has been reported as a factor that potentiate the reduction of volume and capacity in the postoperative period, possibly raising the risk of pulmonary complications [13].The CPB may increase the degree of diaphragmatic dysfunction potentiating the decrease of inspiratory muscle strength. The IMA use may represent an additional surgical trauma and decrease the blood supply to the intercostal muscles and diaphragm, due to phrenic nerve ischemia and lesion of pericardico-phrenic artery during harvesting, further reducing inspiratory muscle strength.

In this study, it was shown that there is a decrease in respiratory muscle strength (MIP and MEP) until POD5 .Even though; the preoperative values were not restored until discharge. However the intercostal group showed a greater decrease of MIP and MEP compared to the two other groups. These results reinforce that the chest tube in the intercostal region may be a contributing factor for the decline in respiratory muscle strength in the early postoperative period of CABG. The weakness of respiratory muscles is one of the mechanisms that contribute to the restrictive changes in the early postoperative period.

After CABG, regardless of the technique employed, a drop in PaO2 in the first days is seen with gradual recovering [18]. Regardless of the drain position, a decrease of respiratory muscle strength and oxygenation was noticed in the postoperative period. However, the drain insertion in the subxiphoid region was able to afford better preservation of respiratory muscle strength (MIP and MEP). In this study, a significant decrease of PaO2 on POD1 was observed in all groups. The decline was more pronounced in Group III. Similar results were found in previous studies In the Hagl et al. [17] study, the need for supplemental oxygen was lower in patients with subxiphoid insertion and with the pleural intact (group I and II). Therefore, the drain positioned at the intercostal region seems to impact PaO2 deterioration after surgery. Several mechanisms might explain the hypoxemia: alveolar hypoventilation, altered ventilation- perfusion ratio, reduction of diffusion and shunt. The alveolar hypoventilation could in part contributed to the pain in patients with intercostal tube drainage, the values of PaCO2 in group III were significantly higher compared to group I and II .

Earlier reports show that patients with greater pain after CABG present increased risk for pulmonary complications due to the immobility and deep breathing absence. Patients with pleural opening had more pain associated with a greater reduction in lung volumes and capacities during the first week after surgery [11]. Hagl et al. [17] also showed that pain in patients with subxiphoid drain position was lower compared to intercostal tube drainage. Picket al. [19] showed that this pain caused by intercostal drainage is able to add respiratory dysfunction postoperatively. In this present study similar results were found. The referred pain was significantly higher in patients with intercostal pleural drain until POD5 and was associated to a greater decrease in respiratory muscle strength. This greater reduction in respiratory muscle strength with intercostal chest tube may be due to further trauma consequent to the worse chest pain. The additional need for a chest lateral incision for tube placement, the intercostal opening leads to periosteal and intercostal nerve irritation, impairing the intercostal muscles performance. The pleura is very sensitive, and the breathing-dependent friction on drains causes suffering for the patient. The friction between the tube and the parietal pleura during breathing triggers ventilator dependent pain and superficial breathing resulting in major decreases in lung volume, alveolar hypoventilation and subsequent hypoxia, predisposing lung function worsening with increased risk for respiratory complications .[19].

It is often argued that intrapleural fluid drainage is more efficient when an intercostal placement site is used. In this study, all of the chest drains had nearly similar efficiency as measured by the amount of discharge .For adequate drainage, only the position of the sealed draining system is important. The problem of tube occlusion because of clotting is comparable in all groups, but the surgeon should exclude sharp bends at the insertion site, and make sure that the distal part reaches the phrenico-costal sinus. In our study, there was no fluid retention demonstrated by chest x-ray and clinical examination, indicating sufficient drainage regardless of the insertion site. From the surgical point of view, the subxiphoid position is safer than the intercostal approach because of the bleeding that can result from injury of the intercostal artery. we found that group I had significantly less drainage than the other two groups and this might be due to more trauma associated with pleural opening , loss of the mediastinal tamponade with opening of another space that would allow the blood to trickle to it .Although none of the patients required re-exploration .the advantage of less blood loss is obvious .

Conclusion

Patients with the pleura intact and those with subxiphoid tube insertion showed less decrease in respiratory muscle strength, better preservation of blood oxygenation compared to patients with intercostal drain on early postoperative period .Although no significant difference in the time of mechanical ventilation and the total hospital stay, both techniques seems as an attractive option due to the less invasiveness and more patient tolerance .

Study limitations

Our study had several limitations. First, we studied relatively small population that underwent CABG sternotomy and harvesting of the left IMA. Second, lack of spirometry precluded evaluation of postoperative pulmonary function beyond recording the MIP and the MEP. Third, the size of chest

tubes might have affected the efficacy pleural drainage, pain sensation, and associated morbidities as we use the large pore 38 and 40 F sizes. Fourth, the small size of the sample , as larger series are needed to determine the exact effects of the chest drainage mechanism.

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The role of Tranexamic Acid in Patients Undergoing Urgent on Pump Coronary Artery Bypass Surgery under Antiplatelets Therapy Thromboelastography Guided Regimen

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Background: **Aspirin combined with Clopidogrel is the treatment of choice for acute coronary syndromes but they increase the risk of bleeding and transfusion in those undergoing coronary artery bypasses grafting (CABG). The aim of this study is to assess the efficiency of Tranexamic acid (TA) in minimizing bleeding and transfusion requirements in patients undergoing CABG with respect to preoperative Clopidogrel and Aspirin use over a period of 5 days preoperatively.**

Methods: **This study is a prospective, randomized, double-blinded and placebo-controlled trial. A hundred and twenty patients who underwent primary and isolated on- pump CABG with their last dose of Clopidogrel and aspirin less than 5 days preoperatively were randomly assigned to receive systemic Tranexamic acid (10 mg/kg after anesthetic induction and maintenance of 10 mg/kg/h) or topical Tranexamic acid, (2gm Tranexamic acid in 200 ml saline) poured in the pericardium before closure of the sternum or saline in control group. The primary outcome of the study was postoperative 24 h blood loss. Secondary measures included intra-operative and postoperative transfusion of blood or its products. Thromboelastography guided assessment of anti- platelets effect was included.**

Results: **Twenty four hours chest tube drainage was less in both Tranexamic acid groups than that in the placebo group; the differences were statistically significant (P<0.001). Control subjects received significantly more units of Packed RBCs and Platelets as compared to Tranexamic acid-treated patients (P<0.001). Again, when compared to placebo, Tranexamic acid reduced Packed RBCs exposure in TA-systemic (RR, 0.406; 95% CI, 0.253-0.652) and TA-topical groups (RR, 0.500; 95% CI, 0.470-0.916) than in placebo group (P < 0.001). The same for platelets transfusion, Tranexamic acid reduced exposure in TA-systemic group (RR, 0.225; 95% CI, 0.160-0.695) and TA-topical group (RR, 0.258; 95% CI, 0.135-0.683) than in placebo group (P = 0.001).**

Conclusions: **Our findings proved that the use of Tranexamic acid, in patients undergoing CABG surgery and had no chance for adequate preoperative cessation of Aspirin and Clopidogrel, in such situations, they may continue their anti-platelets therapy till the day of surgery with limited increase in postoperative bleeding and transfusion requirement rates.**

***KEY WORDS*:** **Antifibrinolytic; Hemorrhage; Coronary surgery; Thromboelastography**

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Major cardiac events are documented to be reduced in patients with acute coronary syndrome (ACS) by combining aspirin with Clopidogrel (1). Patients with ACS often undergo urgent angiography, followed by percutaneous coronary intervention (PCI). After PCI, long-term Clopidogrel therapy significantly reduces the risk of adverse ischemic events (2). Aspirin and Clopidogrel treatment during the peri-operative period is associated with a substantial increase in re-exploration rate, chest tube drainage, blood loss and blood product usage. As a result,

clinical guidelines currently request cessation of Clopidogrel therapy 5-7 days prior to surgery even in urgent cases, and the withdrawal of aspirin 2-10 days before elective surgery (3,4). However it is reported that stopping Clopidogrel therapy in patients going for urgent coronary surgery may increase the risk of myocardial infarction while awaiting surgery (1). Balancing thrombotic and bleeding risks is critical when deciding to continue or to stop use of anti-platelet agents in patients planned for cardiac surgery.

Plasmin release during cardiopulmonary bypass (CPB) activates fibrinolysis and may induce platelet dysfunction (5,6). Anti-fibrinolytics may therefore improve platelet function and attenuate fibrinolysis after CPB (7). Her emerged the Tranexamic acid, a synthetic antifibrinolytic agent that inhibits activation of plasminogen to plasmin and a potential substitute for Aprotonin, which was suspended in 2008 (8). Meta-analysis has reported a decrease in postoperative bleeding and transfusion by using Tranexamic acid during cardiac surgery (9). However, evidence on the effect of Tranexamic acid in coronary artery bypass surgery (CABG) patients together with Aspirin and Clopidogrel is lacking, and hence the importance of investigating the effect of Tranexamic acid in this research population. Tranexamic acid is a safe medication but some rare complications were reported such as increased risk of thromboembolic events (e.g. early graft closure in

CABG) (10) and the risk of postoperative seizures, both were associated with high-dose regimens (11,12). The pericardium acts as a natural barrier which prevents free diffusion of substances, so recent experimental studies documented that local use of different drugs into the pericardial cavity are highly effective and safe with minimal systemic absorption (13,14). In the scope of these findings, topical use of Tranexamic acid may be an effective and safe medication that reduces blood loss in cardiac surgery (15).

The current 'gold standard' for platelet function evaluation is laboratory based light transmittance aggregometry, which is labor intensive and operator dependent. Therefore, point-of-care platelet function tests, such as thromboelastography (TEG), could be beneficial. Results of platelet function assessment by this method correlate closely with light transmittance aggregometry. In addition to estimating the severity of platelet function inhibition, this method provides valuable information about the whole steps of blood coagulation (16).

The aim of this study was to investigate the effect of Tranexamic acid applied either systemically or topically in the pericardium on blood loss and transfusion requirements in patients underwent on-pump CABG, treated with Clopidogrel and Aspirin preoperatively. Our hypothesis was that Tranexamic acid would reduce bleeding and transfusion requirements in our study population.

PATIENTS AND METHODS

Patient Recruitment:

The study was a prospective, randomized, double-blinded and placebo-controlled trial. It was a multicenter study, conducted at Cairo University hospitals and at Dr.Erfan hospital (a tertiary care center in Saudi Arabia), from March 2011 to April 2013. After approval of the local Ethics and research Committee of each center and obtaining written informed consents, the study was designed to recruit 120 patients scheduled for first-time elective or urgent on pump CABG. All patients were on Aspirin and Clopidogrel regimens within 5 days prior the surgery. The study included patients with unstable angina unsuitable for PCI and scheduled for urgent CABG. Those patients had been given an oral starting dose of 300 mg Clopidogrel followed by a daily intake of 75 mg. Surgery was scheduled for the next available session. Also, it included patients with critical left main disease who continued Clopidogrel until within 5 days of surgery. Other indications for continuous Clopidogrel treatment were prior PCI or acute MI. Patients were excluded if they received nonsteroidal anti-inflammatory drugs, platelet count less than 50,000/mL, allergy to Tranexamic acid, coagulopathies, renal or hepatic impairment. Also, we excluded patients admitted for emergency procedure due to failure of PCI or those who required intra-aortic balloon pump for difficult weaning from CPB. Again, we excluded any patient who did not received any oral antiplatelet agents within 5 days prior surgery or those who have been preoperatively exposed to platelet glycoprotein IIb/IIIa inhibitors.

Study Protocol:

Patients were randomly assigned into one of three equal groups (40 patients each).

1. Systemic Tranexamic acid group (TA-systemic).

2. Topical Tranexamic acid group (TA-topical) .

3. Placebo group.

Random assignment was conducted using sealed envelopes. A nurse, not sharing in the study design, was responsible for the preparation of placebo and treatment solutions (Tranexamic acid - Cyklokapron®, 100 mg/mL, 500mg/5ml, Pharmacia N.V/S.A, Belgium), which were identical in appearance and packing. Thus, neither patients nor staff was aware of treatment assignment. The target dose was calculated according to body weight then diluted to complete 60 mL syringes. In TA-systemic group, patients were given a bolus of 10 mg/kg Tranexamic acid after anesthetic induction followed by maintenance of 10 mg/kg/h for the duration of surgery and at the end they received topical 200 ml saline over the heart. In TA-topical group, we gave saline bolus followed by infusion during the operation

then we put 2gm Tranexamic acid in 200 ml saline then was poured in the pericardium before closure of the sternum. The chest tubes were clamped until complete closure of the chest then we released the clamps. In control group, we gave both saline injection and topical over the heart.

Anesthetic and Surgical techniques

The protocol for the surgeons, anesthesiologists, and intensivists were standardized in both centers of study. Premedication consisted of diazepam 5mg and ranitidine 150 mg orally the night before surgery. In the morning of surgery, morphine 0.1 mg/kg IM was given one hour preoperatively. After arrival to the operating room a five-lead electrocardiography using continuous ST segment analysis, pulse oximetry and invasive blood pressure monitoring were initiated. General anesthesia induction consisted of fentanyl 5-10 μg/kg, Propofol 1 mg/kg and Cisatrachurium 0.15 mg/kg. After the trachea was intubated, a central venous catheter was inserted. Anesthesia was maintained using Isoflurane 0.5% and infusion of Cisatrachurium at a rate of 3μg/kg/min. Heparin sulphate 4 mg/kg was administered to maintain an activated clotting time (ACT) of at least 480 sec.

Operations were performed through a standard median sternotomy. The distal ascending aorta was cannulated, and a two-stage venous cannula was inserted into the right atrium and inferior vena cava. Non-pulsatile CPB will be ensured at a flow of 2.4 L/ min/m2. The systemic perfusion during CPB was normothermic > 36°C. The CPB circuit was primed with Ringer's acetate, 300 mL of mannitol 10%, and and 5000 IU heparine. Myocardial preservation was done by intermittent antegrade blood cardioplegia. After weaning from CPB, protamine sulfate 1 mg for every 100 U of previously administered heparin was given. Additional doses of protamine were given when necessary. All patients started their combined antiplatelet therapy given by mouth as soon as possible. The day after surgery, enoxaparin 40 mg was S.C given once daily.

Thromboelastography -TEG

TEG was performed in the standard manner according to the manufacturer's manual using a computer-controlled thromboelastograph haemostasis system (TEG® 5000 Haemoscope Corporation, Niles, Illinois, USA) in a blood sample withdrawn from arterial lines after discarding 10ml of blood to eliminate the effect of heparin flush. The TEG analysis was done at the temperature 37 °C. It was performed by an investigator not directly involved in patient care. Recorded values from TEG were; R =Reaction time to initial fibrin formation (4-8 min for kaolin- activated); K = Time and Kinetics for fibrin cross-linkage (0-4 min), i.e. the width of the TEG trace 20 mm; α-angle = Speed of clot strengthening (47-74 degrees) MA = Maximal Amplitude – fibrin and platelet interaction /aggregation (54-72 mm); LY30 = Measured fibrinolysis 30 min after MA (0-8%). Values R, K and α-angle indicate the rate of clot formation (Increased with factor deficiency/dilution, heparin, and Decreased in hypercoagulable conditions). MA represents the strength of the blood clot, which is a function of platelet number and fibrinogen concentration (Increased after platelets infusion and decreased with aspirin and Clopidogrel). LY30 describes the stability of the blood clot in time, i.e. describes the amount of fibrinolysis (Fig. 1) (18).

Outcome Measures

The primary endpoint of the study was to estimate postoperative 24-h chest tube blood loss which was recorded at hourly intervals in the intensive care unit. Chest tubes were removed the day after surgery when blood loss goes less than 100 mL in 4 hours. Bleeding during the first 24 h, was expected to be around 600±200 mL after surgery. Secondary measures included transfusion of blood or its products. Packed red blood cells (PRBCs) were transfused for Ht % < 30%, and the threshold for plasma transfusion depends on high levels of prothrombin times and INR (or bleeding > 200 mL/hr for 2 consecutive hours). The platelet transfusion threshold was a

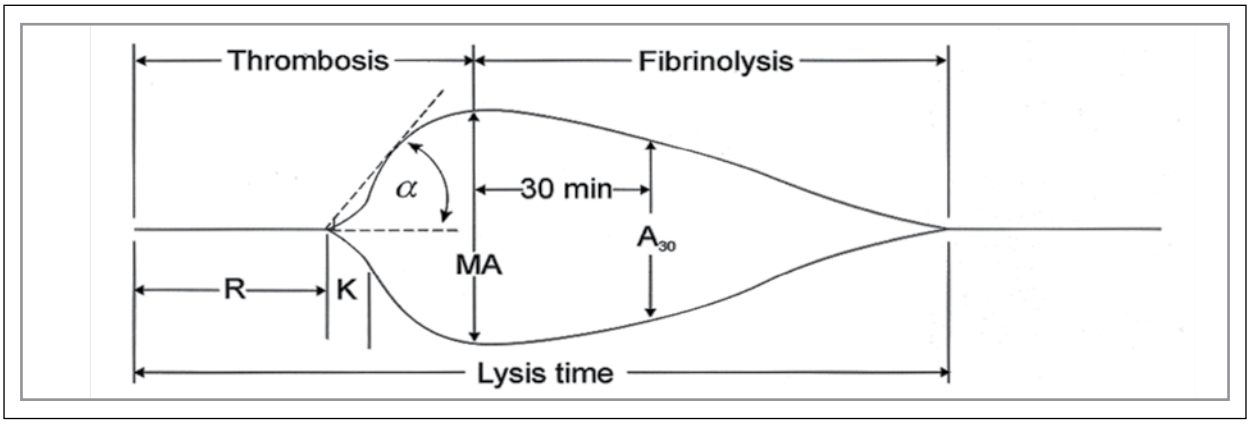

Fig 1. Thromboelastography (18).

platelet count < 50 x 10^9/L and bleeding > 200 mL/hr for 2 consecutive hours, or excessive bleeding without clots after full heparin reversal. Re-exploration was performed if bleeding was > 200 mL/hr for 4 hr consecutively or > 400 mL during the first two hours.

Hematological profile (Ht %, platelet count, international normalized ratio-INR and activated partial thromboplastin - aPTT) and markers of fibrinolysis (fibrinogen and D- dimer) were recorded preoperatively and in the first postoperative day. D-dimer levels were considered negative when present in concentrations < 0.5 mg/mL.

TEG parameters were done using two samples. The first one was taken after the induction of anesthesia before heparin administration and the second one within 15 min after coming off bypass and after heparin neutralization by protamine.

Postoperative complications like myocardial infarction (diagnosed by rise in cardiac enzyme or abnormal ECG), neurological complications (proved by clinical examination and CT-scanning), respiratory failure, pericardial effusion or kidney complications were reported.

The statistical methods

Data were statistically described in terms of mean ± standard deviation (± SD) for Continuous variables and frequencies (number of cases) and percentages for Categorical variables when appropriate. Comparison of numerical variables between the study groups was done using ANOVA test. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. Risk Ratio (RR) and its 95% Confidence Interval (95%CI) were calculated for the need of different blood product between the active groups and placebo. p values less than 0.05 was considered statistically significant. The sample size calculation was based on the basis of a clinically relevant blood loss difference of 200 mL and SD for blood loss of 300 mL, we determined a sample size of 40 patients in each group given 80% power and α =

0.05. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows. The sample size calculation was based on previous studies (19), a total number of 102 participants was found enough to achieve 30% clinical effect (blood loss difference of 200 mL and SD for blood loss of 300 mL), with a beta error of 0.2 and alpha error of less than 0.05 and power of 80%. We recruited 10% more to compensate for drop-outs. Sample size calculation was done by software program PASS (Power Analysis & Sample Size calculation Software by NCSS, LLC, USA) version 12 for Microsoft Windows.

RESULTS

Baseline Characteristics and Perioperative Data

The three groups were well matched as regard to demographic and risk factors data. There were no significant differences between the three groups concerning preoperative clinical variables; previous MI (P = 0.873), previous PCI (P = 0.68), critical Left main disease (P = 0.78) or unstable angina attacks (P = 0.152). All the participants received oral Clopidogrel 75 mg and 150 mg Aspirin daily until less than 5 days preoperatively. The last oral doses of Clopidogrel taken were 46.2 ± 5.7, 43.4 ± 6.2 and 44.13 ± 5.8 hours between three groups respectively (P = 0.07). Almost all of the patients also received Aspirin within 24 hours of surgery with no significant differences between the three groups (Table -1). There were no differences in the incidence of urgent operations and total heparin or protamine doses given between the three groups (Table-2). Postoperative time courses were comparable between groups except for the chest closure time which reflects time for hemostasis after weaning from CPB, it was significantly longer in the placebo group (P =0.04). In addition , the time for extubation was significantly high in placebo group (P = 0.023) (Table-2).

Bleeding and Transfusion Outcomes:

Twenty four hours' chest tube blood loss was less in both Tranexamic acid groups than that in the placebo group; the differences were statistically significant (P<0.001). Control subjects received significantly more units of PRBCs and Platelets as compared with Tranexamic acid-treated patients (P<0.001). Again, when compared with placebo, Tranexamic acid reduced PRBCs requirements in TA-systemic (RR, 0.406; 95% CI,

0.253-0.652) and TA-topical groups (RR, 0.500; 95% CI, 0.470-0.916) than in placebo group (P < 0.001). The same for platelets transfusion, Tranexamic acid reduced exposure in TA-systemic group (RR, 0.225; 95% CI, 0.160-0.695) and TA-topical group (RR, 0.258; 95% CI, 0.135-0.683) than in placebo group (P = 0.001). The volume and the exposure of plasma transfusion were similar between the three groups. When compared topical vs. systemic use of Tranexamic acid, the 24-h postoperative blood loss was higher but without statistical significance (P > 0.05). The incidence and the amount of PRBCs transfusion were also above that in systemic group without any significant difference. Incidence of reoperation was higher but without statistically important difference in placebo group in comparison to Tranexamic acid groups (P =0.08) (Table-3 and 4).

Variables , each group=40	TA- Systemic	TA- Topical	Placebo
Demographics and Risk factors			
Male	31 (77.5%)	32 (80%)	34 (85%)
Age (years) BSA (m2)	54.6 ±10.4	53.6 ± 9.1	54.2 ± 9.7
Ejection fraction (%) HTN	1.92 ± 0.16	1.89 ± 0.10	1.76 ± 0.10
DM COPD	41 ± 2	43 ± 3	39 ± 2
	25 (62.5%)	28 (70%)	26 (65%)
	22 (55%)	23 (57.5%)	19 (47.5%)
	17 (42.5%)	19 (47.5%)	18 (45%)
Clinical data			
Previous myocardial infarction	18 (45%)	16 (40%)	17 (42.5%)
Previous PCI	13 (32.5%)	10 (25%)	10 (25%)
Critical left main disease	24 (60 %)	23 (57 %)	26 (65 %)
Unstable angina	20 (50 %)	16 (40 %)	18 (45 %)
Hours from last dose clopidegril Aspirin<24 hours	46.2 ± 5.7	43.4 ± 6.2	44.13 ± 5.8
preoperative Concomitant antithrombotic therapy	36 (90%)	39 (97.5 %)	37(92.5%)
(Unfractionated heparin or LMWH)	16 (40 %)	16 (40 %)	13 (32.5 %)

BSA, body surface area; HTN, hypertension; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; PCI, percutaneous coronary intervention; LMWH, low molecular weight heparin; #=P< 0.05= significance between three groups.

Table 1. Patients' Characteristics.

Variables , each group=40	TA- Systemic	TA- Topical	Placebo
Urgent operations	36 (90 %)	35 (87.5 %)	37 (92.5 %)
Grafts / patient	2.8 ± 0.5	2.7 ± 0.7	2.5 ± 0.5
Heparin total dose IU†	307,770±2856	30,870±3052	30,512±3142
Protamin total dose (mg)	311 ± 33	312 ± 31	307± 32
Ischemic time (min)	59 ± 11.8	67 ± 12.5	63 ± 27.3
Bypass time (min)	103 ± 25	112 ± 22	109 ± 17
Chest closure time (min)	45 ± 15	47 ± 17	67 ± 11 #
Inotropic support	27 (67.5%)	25 (62.5%)	28 (70 %)
Time to extubation (hr)	3.8 ± 1.3	4.2 ± 1.2	9.1 ± 4.19 #
Chest tube removal (h)	45.6 ± 12.3	47.6 ± 12.3	51.5 ± 16.3
ICU stay (days)	2.2 ± 0.8	2.2 ± 0.8	3.1 ± 1.2

†Not including 5000 IU in the CPB prime. #=P< 0.05= significance between three groups.

Table 2. Perioperative Data.

Variables, each group=40	TA-Systemic	TA- Topical	Placebo
24 h chest tube Blood Loss	524.9 ± 99.19	660.9 ±157.8	1216±185.7 #
Reoperation for bleeding	1 (2.5 %)	0 (0.0 %)	3 (7.5 %)
Transfusion unites/patients			
PRBCs	0.98 ± 1.09	1.35 ± 1.18	3.4 ± 1.8 #
Plasma	0.7 ± 0.88	0.6 ± 0.85	0.9 ± 1.05
Platelets	1.7 ± 1.32	1.45 ± 1.15	4.8 ± 2.13 #
Patients requiring			
PRBCs	13 (32.5%)	16 (40 %)	32 (80 %) #
Plasma	12 (30 %)	10 (25%)	16 (40 %)
Platelets	7 (17.5 %)	8 (20 %)	31 (77.5%) #

#=P< 0.05= significance between three groups.

Table- 3. Bleeding and Transfusion Outcomes.

Transfused roduct in each group		Risk in Active groups	Risk in Placebo	RR	95 % CI for RR	
					Upper	Lower
PRBCs need	TA systemic	0.325	0.800	0.406	0.652	0.253
	TA local	0.400	0.800	0.500	0.916	0.470
Plasma need	TA systemic	0.300	0.400	0.750	0.758	0.284
	TA local	0.250	0.400	0.625	0.799	0.313
Platelets need	TA systemic	0.175	0.775	0.225	0.695	0.160
	TA local	0.200	0.775	0.258	0.683	0.135

CI, confidence interval; RR, relative risk;

Table 4. Relative Risk for Transfusion Outcomes

D-dimer levels which determine fibrinolytic activity were elevated in all groups at the end of operation, but more in the placebo group (P < 0.001)) (Table-5). Other hematological profile data (Hematocrite , Platelet count, INR and aPTT) were comparable between the three groups (p >0.05).

Variables	each group=40	TA- Systemic	TA- Topical	Placebo
Fibrinogen [1.5–4.5 g/ L]	Preoperative	3.9 ± 0.9	4.3 ± 1.7	4.2 ± 0.72
	Postoperative	3.2 ± 0.6	3.6 ± 0.8	3.1 ± 0.7
D-dimer (µg/mL)	Preoperative	0.3 ± 0.1	0.3 ± 0.2	0.4 ± 0.3
	Postoperative	0.9 ± 0.8	0.8 ± 0.7	2.3 ± 1.4 #

#=P < 0.05= significance between three groups.

Table 5. Markers of fibrinolysis.

Variables,	*Each group=40*	*TA-Systemic*	*TA- Topical*	*Placebo*
R=Reaction time	*T1*	*6.9 ±1.8*	*5.3 ±1.8*	*6.5 ±2.0*
(4-8 min)	*T2*	*5.9 ±1.5*	*5.2 ±1.9*	*4.6 ±1.2*
K=Clot formation time	*T1*	*2.1 ±0.7*	*1.9 ±0.5*	*1.8 ±0.7*
(0 - 4 min)	*T2*	*2.1 ±0.6*	*2.1 ±0.5*	*1.7 ±0.4*
Angle	*T1*	*60.2 ±8.3*	*57.2 ±5.3*	*64.1 ±4.2*
(47-74 degrees)	*T2*	*66.1 ±7.3*	*59.1 ±6.2*	*62.1 ±6.1*
MA=Maximum Amplitude	*T1*	*53.6 ±6.8*	*54.5 ±4.8*	*56.2 ±7.1*
(54-72 mm)	*T2*	*74.4 ± 0.3**	*75.3 ± 0.3**	*64.5 ± 0.3 #*
LY30 (0-8%)	*T1*	*2.6 ± 0.3*	*2.5 ± 0.3*	*2.4 ± 0.1*
	T2	*5.3± 0.5**	*4.7 ± 0.2**	*8.6 ± 0.1* #*

* = p < 0.05 relative to preoperative time within the same group; #= P < 0.05= significance between three groups; (T1) start of the operation, (T2) at the end of the operation.

Table 6. Thromboelastographical values at the start of the operation (T1) and at the end (T2)

TEG values are presented in Table 6. We can say that heparin taken preoperatively, in most cases, increased the values of reaction and clotting times (R and K) then both decreased after protamine administration. Again, MA values were low preoperatively due to the effect of anti-plateletes which improved significantly postoperatively in all groups and there was statistically significant difference between the placebo group and the other Tranexamic acid treated groups postoperatively (P = 0.03). Also, we noted that CPB activated fibrinolysis represented by increased LY30 values postoperatively with marked increase was in placebo group. The fibrinolysis activation was statistically significant between the three groups (P < 0.05).

One patient in the control group died on the 15th postoperative day, primarily because of postoperative mediastinitis. There were two cases of postoperative myocardial infarction; one in TA-systemic group and one in placebo group. Two patients (one in the TA-systemic group and one in the TA-topical group) had neurological complications. Renal complications were observed in 2 patients in the placebo group and 1 in each of the other TA groups. All patients recovered after a smooth course and were discharged uneventfully from hospital.

DISCUSSION

The main findings of the present study were that in a specific population of patients who received dual anti-platelet therapy (Clopidogrel and Aspirin daily) with their last ingestion less than 5 days before on-pump CABG, Tranexamic acid reduced both the total volume of postoperative blood loss and the volume and exposure of PRBCs and platelets transfusion. Because Clopidogrel and Salicylates affects platelet function irreversibly, their effect lasts the lifetime of the platelets, around 10 days. In consequence, after cessation of Clopidogrel, platelet aggregation progressively returns to baseline value up to 8 days (19). Reports from the CURE trial (1) and ACUITY trial (20) suggested that preoperative Clopidogrel reduces ischemic complications compared to placebo (RR 0.4) but, at the same time, increases the risk of massive bleeding. In addition, Clopidogrel, together with Aspirin, is superior to Aspirin alone for patients hospitalized with non-ST- elevation ACS (21).

Fox and his colleagues (1) documented that in patients with non-ST-elevation ACS treated with combination of Clopidogrel and Aspirin, overall, the benefits of starting Clopidogrel on admission appeared to outweigh the risks, even in those who proceeded to CABG during the initial hospitalization. The latest American Heart Association guideline for CABG published in November 2011 recommended cessation of Clopidogrel more than 5 days before elective CABG (class I, level of evidence: B) and an acceptance of late cessation of Clopidogrel less than 5 days before urgent CABG (class IIb, level of evidence: C) (22). To the best of our knowledge, this is the first prospective randomized trial which evaluated the effect of Tranexamic acid on bleeding and the need for transfusions in patients receiving Clopidogrel and Aspirin less than 5 days undergoing CABG.

Dunn, and McCormack (23,24) in their reviews of Tranexamic acid use stated that it is a synthetic derivative of the amino acid lysine. The anti fibrinolytic activity is due to reversible binding to plasminogen which prevents its interaction with fibrin. Generally, plasminogen binds to fibrin at a lysine binding site and is converted in the presence of tissue plasminogen activator (tPA) to plasmin. Tranexamic acid blocks the lysine binding site and prevents access of plasminogen to fibrin molecules. This agent also preserves platelet function by reducing the effect of plasmin on platelet glycoprotein 1b receptors. In the present study, we started Tranexamic acid regimen before skin incision because after that, there is a rapid

release of tPA with subsequent fibrinolysis (19). The use of a bolus followed by a maintenance infusion covered the rapid metabolism of TA (half-life, 80 min) and prolonged its efficacy (23).

Tranexamic acid use in cardiac surgery has been deeply analyzed in the recently published meta-analysis by Henry et al. (9). Generally, in the 34 trials with 3,006 patients underwent cardiac surgery, Tranexamic acid reduced PRBCs exposure by an RR of 0.68 and the volume transfused by a mean difference of 0.87 units. In the current study, Tranexamic acid reduced PRBCs exposure in TA-systemic by an RR of 0.41 (95% CI, 0.253-0.652) and in TA-topical groups by an RR of 0.5 (95% CI, 0.47-0.92) than in placebo group ($P < 0.001$). These results were coinciding with that of Jia Shi and his colleagues (25) who evaluated the influence of Clopidogrel and Tranexamic acid on bleeding and transfusion outcomes. Patients were assigned into 3 groups based on preoperative Clopidogrel treatment (ingestion ≤7 days, discontinuation >7 days, and nonexposure). Patients were randomized to receive Tranexamic acid or placebo. The authors found that, Tranexamic acid reduced blood loss, volume and exposure of RBCs transfused. Similar findings were observed in the study of Senay and his colleagues (26) , which documented that prophylactic Tranexamic acid reduced bleeding and the need for transfusion in patients using Clopidogrel without any need for postpone the surgical procedure.

De Bonis group (15) in 2000 initiated topical use of Tranexamic acid. They mentioned that bleeding significantly reduced by 36% during the first 3 hours postoperative when compared to the placebo group. In the present study, we investigated the effect of topical Tranexamic acid in comparison to its systemic use and placebo control. Our results showed that, topical use values were moderately higher than systemic values but still insignificant. On the other arm of comparison with the placebo group, topical use was significantly effective than placebo use. These findings are supported by a more recent work, that was done by Abul-Azm and Abdullah in 2006 (27) who randomized 100 patients to receive 2 g of Tranexamic acid in 100 ml of saline into the pericardium before closure, or saline alone. Bleeding was significantly reduced with topical use group when compared to control patients.

Baric D and his colleagues (28) stated that, bleeding rate values were significantly higher in placebo group compared to the groups treated with topical antifibrinolytic agents. However, our findings contradict the findings of Yasim and his group (29) who did not find a statistically significant reduction in post-operative blood loss after topical application of Aprotinin and Tranexamic acid. There was no significant difference between both groups as regards the use of blood products in the study of De Bonis' (15), while in our study we reported a significant reduction in both PRBCs and platelet transfusion. Meanwhile in the work of Abul Azm (27), he had a significant reduction only in PRBCs use in Tranexamic acid group.

The amount of reduction in postoperative bleeding presented in our work is comparable with the values reported by two recent meta-analyses concerning topical application of antifibrinolytics for on-pump cardiac surgery. They were done by Abrishami (30) and Tomas (31) and their colleagues and they suggested that topical application of Tranexamic acid in cardiac surgery can significantly reduce 24-h postoperative blood loss and saving of 1 unit of PRBCs per patient.

There are two bodies of literature that support the rationale of topical application of antifibrinolytic agents during open-heart surgery. It has been postulated that this way of drug delivery is both "target-directed" and "potentially safe" in minimizing postoperative bleeding. The first one suggested that topical use of antifibrinolytic agents can directly target the source of bleeding, which is the local increase in fibrinolytic activity. The second reason for the topical use of antifibrinolytics is based on the suggestion that the pericardium acts as a natural barrier that reduces the rate of systemic absorption and side effects of medical drugs applied locally into the pericardial cavity. According to this information, and considering the short half life of tranexamic acid, it was postulated that topical application of these medications will not lead to systemic absorption and toxicity (30).

The D-dimer assay detects a plasmin-derived proteolytic fragment of cross linked fibrin released by fibrinolytic activity so it is considered a sensitive quantitative measure of fibrinolysis (24). In the current study, cross linked D-dimer levels, as expected, were increased following CPB in the three groups, but the levels were lower in both Tranexamic acid groups in comparison to control patients, confirming that it inhibited intra-operative fibrinolysis.

The use of TEG in the current study added a great strength and valuable information about fibrinolysis and changes in coagulation as a whole. It involves the effects of all factors affecting coagulation such as number and function of platelets, activities of coagulation and fibrinolytic factors and effects of drugs (32). Thus, in contrast to conventional coagulation tests performed in plasma, TEG as a whole blood coagulation test is superior in evaluating the coagulation status (33). Evidence was sought whether use of TEG could predict and decrease bleeding and blood product requirements in adult patients undergoing cardiac surgery. Ti et al. (34) found moderate correlation between TEG parameters, total blood loss and requirements for FFP or platelets in bleeders. Other studies did not find the TEG to be a useful predictor of blood loss. A number of studies have used TEG to guide transfusion management. Avidan et al. (35) compared TEG to a laboratory-based algorithm and concluded that despite similar blood loss, blood and blood product usage were significantly greater in the laboratory group.

Independent predictors of seizures following cardiac surgery include advanced age, peripheral vascular disease, and high dose of tranexamic acid (100 mg/kg) (12). Although our

study is lacking the risk factors mentioned above, still we have reported two cases of stroke.

There were two cases of postoperative MI (based on rise in cardiac enzyme and change in ECG) but there is no available evidence that prophylactic use of tranexamic acid caused graft occlusion or other thromboembolic complications. Chest closure time may be affected by factors such as hemodynamic stability, quality of the bone, and experience of the surgeons. Most of these factors were similar in all groups, so, we considered chest closure time to be an indicator of hemostasis.

Some limitations were encountered during this research, which are to be considered. We did not study 30 days morbidity and mortality postoperatively, which could reduce the power to detect small differences in long term mortality and morbidity events. Moreover, the study did not directly monitor vein grafts' patency after tranexamic acid.

CONCLUSION

Our findings highlighted the value of using Tranexamic acid, in patients undergoing CABG surgery and treated preoperatively by Aspirin and Clopidogrel, particularly those in need for urgent intervention . In these patients on dual therapy and presenting for urgent procedure, tranexamic acid could serve as an extra tool to decrease post-operative bleeding and the need for transfusion. Future studies should focus on the effect of Tranexamic acid in groups of patients treated with dual anti-plateltes therapy who are at increased risk of postoperative bleeding, such as those undergoing combined procedures and second go cardiac surgery.

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Hemodynamic Response of Ketofol Versus Midazolam For Induction of Anesthesia In Patients With Poor Left Ventricular Function Undergoing Elective Coronary Artery Bypass Graft Surgery

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Objectives: **To evaluate hemodynamic variability during induction of anesthesia using 1:1 admixture of ketamine/propofol (Ketofol) versus midazolam for patients with poor left ventricular function undergoing elective coronary artery bypass graft (CABG) surgery.**

Patients & Methods: **This study was conducted as a collaboration project between Anesthesia and Cardiac surgery Departments in Cairo university Hospitals and Nasser Institute between Jan 2011 and Jan 2013. It included 100 patients with poor left ventricular function assigned for elective CABG. Patients were randomly allocated into 2 equal groups: Midazolam group: included patients received midazolam 0.1mg/kg (1mg/ ml) and Ketofol group: included patients received 0.2 ml/kg Ketofol containing ketamine 5 mg/ml and propofol 5 mg/ml. Systolic arterial blood pressure (SAP) and heart rate (HR) were recorded prior to induction of anesthesia (T_0), 30-sec after induction of anesthesia (T_1), immediately prior to intubation (T_2), immediately and 5-minutes after intubation (T_3 & T_4).**

Results: **Both midazolam (p=0.0003 and 0.0001) and ketofol (p=0.0005 and 0.0001) induced significant reduction of SAP at T_1 and T_2 compared to T_0 with significantly lower SAP with midazolam than ketofol at T_1 (p=0.001) and T_2 (p=0.0003). Endotracheal intubation in midazolam group induced significant elevation of T_3 SAP compared to T_0 (p=0.006) and T_3 in ketofol (p=0.0009) group. At T_4, SAP in midazolam group was decreased signficantly compared to T_0 (p=0.0008) and T_3 (p=0.0009), but was non- significantly higher compared to ketofol group (p=0.224). Tracheal intubation in ketofol group induced significantly (p=0.002) lower T_3 SAP compared to T_0, but was significantly higher compared to T_2 (p=0.006). At T_4, mean SAP was significantly lower compared to T_0 (p=0.0006) and T_3 (p=0.034). Tracheal intubation induced significantly higher HR at T_3 compared to T_0 in midazolam (p=0.018) and ketofol (p=0.028) groups. At T_3, HR was significantly higher with midazolam compared to ketofol (p=0.035). At T_4, HR was still significantly higher with midazolam compared to T_0 (p=0.032) and to ketofol group (p=0.046) with non-significantly higher T_4 HR with ketofol compared to T_0 .**

Conclusion: **Ketamine/propofol admixture (ketofol) in a ratio of 1:1 provided superior control of blood pressure and heart rate during induction of anesthesia and endotracheal intubation of patients with poor left ventricular function assigned for elective CABG surgery and was associated with lower frequency of variability of both parameters in comparison to midazolam.**

KEYWORDS: **Ketofol, Midazolam, Induction of anesthesia, Endotracheal intubation, CABG surgery**

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Left ventricular dysfunction has been reported to be an independent predictor of operative mortality in patients undergoing coronary artery grafting (CABG) and patients with impaired left ventricular function undergoing revascularization on cardiopulmonary bypass (CPB) have increased mortality and morbidity when compared with normal left ventricular function. Left ventricular dysfunction also often leads to low cardiac output and a high postoperative morbidity, with many patients requiring inotropic or mechanical support, and vasopressors for hours to days after surgery [1, 2, 3].

Induction of anesthesia in patients with heart disease is hazardous because the impaired circulatory system is less tolerant to depression. Direct laryngoscopy and passage of endotracheal tube through the larynx is a noxious stimulus, which can provoke untoward response in the cardiovascular systems manifested as significant tachycardia and hypertension especially if tracheal intubation was performed under light anesthesia. Hypertension, tachycardia and arrhythmia caused by endotracheal intubation can be deleterious in patients with poor cardiovascular reserve as it may alter the delicate balance between myocardial oxygen demand and supply and precipitate myocardial ischemia in patients with coronary artery disease [4, 5].

The primary goal during CABG surgery is attenuation of sympathetic responses to noxious stimuli, such as laryngoscopy, intubation, skin incision, sternal splitting, and spreading. Hypotension caused by vasodilation and cardiac depression due to anesthetic drugs should also be avoided. No single anesthetic agent is suitable for all CABG patients, and many drug combinations have been used to achieve hemodynamic stability [6, 7, 8].

The current comparative study aimed to evaluate the hemodynamic variability during induction of anesthesia using admixture of ketamine/propofol (Ketofol) versus midazolam for patients with poor left ventricular function undergoing CABG surgery.

Patients & Methods

The current prospective study was conducted at Departments of Cardiothoracic Surgery and Anesthesia,Cairo university hospitals and Nasser Institute since Jan 2011 till Jan 2013. After approval of the study protocol by the Local Ethical Committee and obtaining fully informed written patients' consent, patients with poor left ventricular function (EF<40%) and assigned for elective CABG surgery were enrolled in the study. Patients with renal or hepatic dysfunction, patient with known hypersensitivity to the studied drugs, or scheduled for emergency operation were not enrolled in the study. Also, patients with preoperative AF, permanent or temporary pacemaker, patients on medication with class I and III antiarrhythmic agents or digoxin, any degree of atrioventricular block were excluded from the study.

Patients were randomly, using sealed envelops, allocated into 2 equal groups: Midazolam group: included patients assigned to receive midazolam 0.1mg/kg (1mg/ml) and Ketofol group: included patients assigned to receive Ketofol admixture in concetration ratio of 1:1; ketamine:propofol for induction of anesthesia. Ketofol admixture was prepared as 100 mg ketamine (50mg/ml) diluted to 10 ml with glucose 5% (10mg/ml) added to propofol 10 ml 1% to get net conc. of 20 ml Ketofol containing ketamine 5 mg/ml and propofol 5 mg/ml to adjust the 1:1 ratio.

Induction of anesthesia included sleeping dose of midazolam in dose of 0.1 mg/kg or ketofol 0.2 ml/kg to provide 1 mg/kg ketamine and 1 mg/kg propofol. Both groups received fentanyl in a dose of 3 μg/kg and pancuronium in a dose of 0.1 mg/kg. All patients were invasively monitored for arterial blood pressure measures; systolic arterial pressure (SAP), diastolic arterial pressure (DAP) and mean arterial pressure (MAP) and heart rate (HR).

Systolic blood pressure and heart rate were determined and recorded prior to induction of anesthesia (T_0), 30-sec after induction of anesthesia (T_1), immediately prior to intubation (T_2), immediately after intubation (T_3) and 5-minutes after intubation (T_4). The primary end point of the current study was the detection of SAP and HR varaibility with induction of anesthesia and on endotracheal intubation. Variability of SAP was expressed as the frequency of SAP change by 20% in relation to baseline SAP. Hypotension defined as SAP<90 mmHg was managed by CaCl 1mg/kg then noradrenaline bolus of 2 μg if required. Hypertension defined as SAP>150 mmHg was managed using additional dose of fentanyl.

The anesthetic procedure was continued as usual using heparin sulphate given in a dose of 4 mg/kg and supplemented as needed to keep the activated clotting time (ACT) >400 seconds before going on cardiopulmonary bypass (CPB). Establishment of CPB was conducted using membrane oxygenator, roller pump and non-pulsatile flow. Warm K^+ Cardioplegia was given by the perfusionest every 20 minutes. When inotropic support was needed; Adrenaline 0.05-0.2 μg/kg/minute was used. The frequency of the use of intra-aortic balloon (IAB) was recorded.

Number of grafted vessels, aortic cross clamping time, CPB time and total operative time were recorded. Postoperative duration of ICU stay and amount of chest tube drainage, and the frequency of PO events were also recorded.

Statistical analysis

Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon; ranked test for unrelated data (Z-test) and Chi-square test (X^2 test). Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

Results

The study included 100 patients; 69 males and 31 females with mean age of 52.2±5.3; range: 42-63 years. Mean BMI of enrolled patients was 28.9±1.9 kg/m^2. Mean ejection fraction was 32.6±3.1; range: 26-39%; 15 patients (15%) had EF <30%, 69 patients (69%) had EF in range of 30-35% and 16 patients (16%) had EF >35%. There was non-significant difference between studied groups as regards patients' enrolment data, (Table 1).

Enrolled patients showed non-significant (P=0.268) difference as regards baseline SAP (T_0). Both induction modalities induced significant reduction of SAP at 30-sec after induction of anesthesia (T_1) and immediately prior to intubation (T_2) in comparison to their respective baseline SAP (p=0.0003 and 0.0001 for midazolam and p=0.0005 and 0.0001 for ketofol group, respectively) with significantly lower SAP measures in midazolam group compared to ketofol group at both T_1 (p=0.001) and T_2 (p=0.0003). Endotracheal intubation of patients of midazolam group induced significant elevation of SAP estimated immediately after intubation (T_3) compared to baseline SAP (p=0.006) and to SAP estimated at T_3 in ketofol (p=0.0009) group. However, at 5-minutes after intubation (T_4), mean total SAP was decreased signficantly compared to SAP estimated at T_3 (p=0.0009) and was significantly lower comapred to baseline SAP (p=0.0008), but was non-significantly higher compared to that of ketofol group (p=0.224). On contrary, ketofol could significantly lessen the vasopressor effect of intubation manifested as significantly (p=0.002) lower mean SAP estimated at T_3 compared to baseline SAP despite being significantly higher compared to mean SAP estimated at T_2 (p=0.006). Thereafter, SAP of ketofol group continued decreasing and at T_4 mean SAP was significantly lower compared to baseline SAP (p=0.0006) and to that measures at T_3 (p=0.034), (Table 2, Fig. 1).

Post-induction hypotensive attack, defined as SAP<90 mmHg, occurred in 15 patients; 10 patients in midazolam group versus 5 in ketofol group. Two patients in midazolam group had hypotensive attack at 30-sec after induction of anesthesia (T_1), while 8 patients developed hypotensive attack immediately prior to intubation (T_2). On the other hand, patients received ketofol had SAP drop immediately prior to intubation (T_2). Endotracheal intubation induced vasopressor reflex manifested as increased SAP estimated immediately after intubation (T_3) in relation to baseline SAP in 36 patients; 22 patients in midazolam group and 14 patients in ketofol group. Only 5 patients in midazolam group had sustained elevated SAP till 5 minutes after intubation and required additional fentanyl doses for control of hypertension, (Table 2, Fig. 2).

Baseline mean HR level showed non-significant (p=0.638) difference between both studied groups. Induction of anesthesia using either modality induced non-significantly higher HR level with ketofol compared to midazolam, both at T_1 (p=0.729) and T_2 (p=0.379) times with non-significantly higher HR in both groups compared to their baseline rate. Endotracheal intubation induced pressor reflex in both groups manifested as significantly higher HR at time of intubation (T_3) compared to baseline HR (p=0.018 & 0.028 with midazolam and ketofol, respectively).

However, ketofol significantly lessened the pressor reflex manifested as significantly higher HR at T_3 with midazolam compared to ketofol (p=0.035). Moreover, post-intubation HR at T_4 was still significantly higher in midazolam group compared both to their baseline HR (p=0.032) and to ketofol

			Midazolam	Ketofol	Total
Age (years)			52.8±5.4 (45-62)	51.6±5.1 (42-63)	52.2±5.3 (42-63)
Gender; M:F			35:15	34:16	69:31
Body mass measures	Weight (kg)		83.4±5.4 (71-95)	84.2±4.7 (73-95)	83.8±5 (71-95)
	Height (cm)		170.2±3 (165-180)	170.7±2.9 (166-178)	170.4±3 (165-180)
	BMI (kg/m^2)		28.8±2 (24.1-32.9)	28.9±1.9 (23.4-32.6)	28.9±1.9 (23.4-32.9)
Ejection fraction (%)	Strata	<30	7 (14%)	8 (16%)	15 (15%)
		30-35	34 (68%)	35 (70%)	69 (69%)
		>35	9 (18%)	7 (8%)	16 (16%)
	Value		32.8±3.1 (27-39)	32.3±3 (26-39)	32.6±3.1 (26-39)

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

Table 1. Patients' enrollment data

			T0	T1	T2	T3	T4
Level (mmHg)	Midazolam		128.2±4.9	114.1±6.5	103.1±5.2	133.8±12.1	121.6±6.2
	Statistical significance			P1=0.0003	P1=0.0001 P2=0.0006	P1=0.006 P2=0.0004 P3=0.0001	P1=0.0008 P2=0.0005 P3=0.0007 P4=0.0009
	Ketofol		127.1±4.5	118.3±5.8	110.6±5.9	122.9±7.7	120.2±6.4
	Statistical significance			P1=0.0005	P1=0.0001 P2=0.0009	P1=0.002 P2=0.006 P3=0.0007	P1=0.0006 P2=0.302 P3=0.0009 P4=0.034
			P5=0.268	P5=0.001	P5=0.0003	P5=0.0009	P5=0.224
Variability	Hypotension episodes	Midazolam		2 (4%)	8 (16%)	0	0
		Ketofol		0	5 (10%)	0	0
	Hypertension episodes	Midazolam		0	0	22 (44%)	5 (10%)
		Ketofol		0	0	14 (28%)	0

SAP: systolic arterial blood pressure; T0: baseline time, T1: 30-sec after induction of anesthesia, T2: immediately prio to intubation, T3: immediately after intubation, T4: 5-minutes after intubation, hypotension = ≥20% decrease of SAP in relation to T0; hypertension = any elevation of SAP in relation to T0, P1: significance versus T0; P2: signfiicance versus T1; P3: significance versus T2; P4: signfiicance verus T3; P5: significance verus midazolam group; p>0.05: non-significant difference, p<0.05: significant difference.

Table 2. The mean SAP levels estimated throughout the study period and frequency of changes recorded in the studied groups

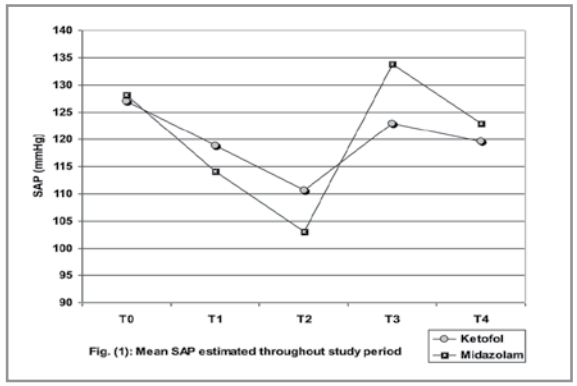

Fig. (1): Mean SAP estimated throughout study period

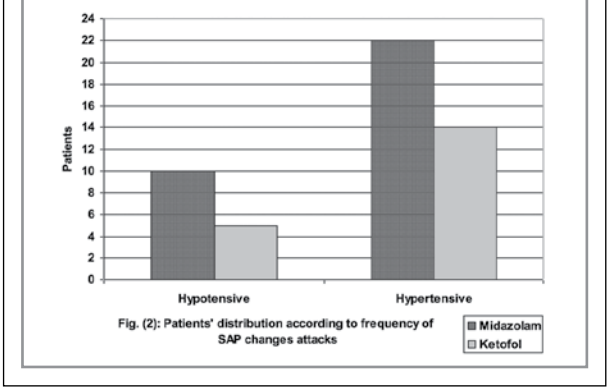

Fig. (2): Patients' distribution according to frequency of SAP changes attacks

group (p=0.046) with non-significantly (p=0.072) higher HR at T4 in ketofol group compared to their baseline rate, (Table 3, Fig. 3).

Mean ischemia time was 59.7±10.2; range: 35-75 minutes, mean CPB time was 75.5±10.7; range: 50-95 minutes and mean total operative time was 181.3±23; range: 130-220 minutes. Mean number of grafter vessels was 4.1±0.8; range: 3-5 vessel. No postoperative fever, new ST changes in postoperative ECG or mortality were reported. Only 3 patients (3%) required re-operation and all passed uneventfully. Mean duration of postoperative mechanical ventilation was 4.8±0.7; range: 3-7 hours and mean duration of ICU stay was 66±6.5; range: 55-95 hours. Mean amount of chest tube drainage was 1169±133.5; range: 900-1450 ml. There was non-significant (p>0.05) difference between studied groups as regards operative and postoperative data, (Table 4).

		T0	T1	T2	T3	T4
Midazolam	Level (beat/min)	77.5±6.1	78.1±6.7	78.3±7.1	82.3±6.6	81.1±5.2
	Statistical significance		P1=0.486	P1=0.291	P1=0.018	P1=0.032
				P2=0.826	P2=0.029	P2=0.076
					P3=0.029	P3=0.076
						P4=0.291
	Level (beat/min)	76.6±5.4	78.3±7.8	79.6±7.4	80.8±5.8	79.7±6.3
			P1=0.173	P1=0.098	P1=0.028	P1=0.072
				P2=0.259	P2=0.188	P2=0.597
					P3=0.236	P3=0.912
						P4=0.068
Ketofol	Statistical significance	P5=0.638	P5=0.729	P5=0.379	P5=0.035	P5=0.046

HR: Heart rate; T0: baseline time, T1: 30-sec after induction of anesthesia, T2: immediately prio to intubation, T3: immediately after intubation, T4: 5-minutes after intubation; P1: significance versus T0; P2: signfiicance versus T1; P3: significance versus T2; P4: signfiicance verus T3; P5: significance verus midazolam group; p>0.05: non-significant difference, p<0.05: significant difference.

Table 3. The mean HR levels estimated throughout the study period and frequency of changes recorded in the studied groups

Data	Midazolam group	Ketofol group	Statistical significance
Ischemic time (min)	58.9±10.2 (35-70)	60.4±10.2 (38-75)	P=0.335
CPB time (min)	75.1±11.2 (50-90)	75.8±10.2 (50-90)	P=0.882
Duration of surgery (min)	180.2±22 (140-215)	182.4±24.1 (130-220)	P=0.897
Number of grafted vessels	4.1±0.9 (3-5)	4±0.8 (3-5)	P=0.531
Resumption of sinus rhythm	17 (34%)	18 (36%)	P=0.871
Frequency of atrial fibrilation	2 (4%)	1 (2%)	P=0.374
Need for defibrillation	3 (6%)	2 (4%)	P=0.612
Need for inotropic support	35 (70%)	31 (62%)	P=0.099
Need for IAB	10 (20%)	8 (16%)	P=0.275
Need for re-operation	2 (4%)	1 (2%)	P=0.0374
Duration of MV (hours)	4.7±0.7 (3-6)	4.9±0.7 (4-7)	P=0.168
ICU stay (hours)	65.3±5.7 (55-80)	66.7±7.4 (57-95)	P=0.077
Amount of chest tube drainage (ml)	1177.4±138.7 (900-1450)	1160.6±128.9 (900-1400)	P=0.355

Data are presented as mean±SD & numbers; ranges & percentages are in parenthesis; CPB: cardiopulmonary bypass; IAB: Intra-aortic balloon; ICU: Intensive care unit; MV: mechanical ventilation

Table 4. Operative and postoperative data of studied patients

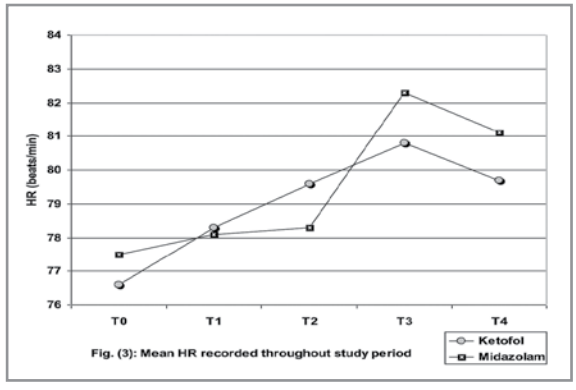

Fig. (3): Mean HR recorded throughout study period

Discussion

The results of the current study showed more hemodynamic stability during induction and intubation using ketofol compared to midazolam manifested as significantly lower post-induction SAP and significantly higher post-intubation SAP with midazolam compared to ketofol. Moreover, the frequency of patients had post-induction hypotension and post-intubation hypertension was higher with midazolam compared to ketofol. As regards HR, ketofol could suppress the pressor reflex to intubation more than midazolam as manifested by the significantly higher HR recorded at T_3 and T_4 with midazolam compared to ketofol.

The superior hemodynamic stability with propofol-ketamine admixture versus midazolam could be attributed to the contradictory effects of both ketamine and propofol on autonomic nervous system, ketamine being sympathomimetic while propofol lessens this effect. In support of this attribution, Oklü et al.[9] compared the effects of propofol and ketamine on systemic circulation in pediatric patients scheduled for elective cardiac catheterization and found propofol administration was associated with significant decreases in MAP; while after ketamine infusion, MAP increased significantly in all patient groups. Akin et al.[10] found a significant decrease in MAP in 36.6% of patients with propofol compared to 10% with ketofol during cardiac catheterization in pediatric patients and concluded that the addition of low-dose ketamine to propofol preserved blood pressure without prolonging recovery or increasing the incidence of adverse events. Timm et al.[11] reported that even low-dose S(+)-ketamine has a stimulatory effect on the cardiovascular system, but this stimulatory effect is nullified in the presence of a continuous propofol infusion at a dosage >3 mg/kg/h, however, such high propofol dose used was not the applied in the current study and this could explain the occurrence of blood pressure changes reported in some patients.

In line with the reported data, Smischney et al.[12] demonstrated a significant decrease of >20% in SAP from baseline with propofol, at 5 and 10 minutes, compared to ketofol with significantly lower diastolic blood pressure and mean arterial pressure and concluded that ketofol improved hemodynamics during induction of general anesthesia. Thereafter, Smischney et al.[13] found propofol was more likely to generate a 20% reduction in SAP from baseline at 5 minutes in 48.8% vs. 12% with ketofol and at 10 minutes in 67.4% vs. 39% as compared with "ketofol with significant difference in favor of ketofol and concluded that ketofol is associated with improved hemodynamic stability during the first 10 minutes after induction and this combination has the potential to be used as an alternative agent for emergency induction during which time stable hemodynamics are desirable. Khutia et al.[14] reported a frequency of hypotension of 14.6% with ketofol compared to 38.6% with propofol/fentanyl and intraoperative MAP was significantly lower with propofol/ fentanyl compared to baseline than with ketofol.

The obtained results using ketamine/propofol admixture in ratio of 1:1 support that previously reported on application of similar mixing ratio in comparison to various modalities for induction of anesthesia. Gayatri et al.[15] found the combination of propofol (25 μg/kg/minute) and two different doses of ketamine (25 and 12.5 μg/kg/ minute, respectively) are safe and efficacious for cardiac catheterization in children and although the time to awaken was more in patients receiving higher dose of ketamine compared to those received lower dose, but it was well within acceptable limits. Singh Bajwa et al.[16] found propofol-fentanyl combination produced a significantly greater fall in pulse rate and in both systolic and diastolic blood pressures as compared to propofol- ketamine during induction of anesthesia. Yalcin et al.[17] and Kayhan et al.[18] found ketofol 1:1 mixture is associated with longer mean seizure time than propofol, and shorter mean recovery times than ketamine, with better hemodynamic stability, without any important side effects in anesthesia for electro-convulsive therapy.

Kim et al.[19] found ketamine 0.5 mg/kg provided adequate intubation condition during propofol induction with low-dose rocuronium in children and despite the mean arterial pressure and heart rate were higher but remained within the normal limit throughout the study period. Erdogan et al.[20] compared the effects of 1:1 ketamine- propofol mixture (ketofol) and propofol on hemodynamic changes during ProSeal laryngeal mask airway (PLMA) insertion in elderly patients and found the number of patients in need of ephedrine and the total dose of ephedrine were significantly lower ketofol group compared with the propofol group and SAP was significantly higher with ketofol than propofol immediately and 5 min after PLMA insertion.

Conclusion

The obtained results and review of literature allowed concluding that ketamine/ propofol admixture (ketofol) in a

ratio of 1:1 provided superior control of blood pressure and heart rate during induction of anesthesia and endotracheal intubation of patients had poor left ventricular function assigned for elective CABG surgery and was associated with lower frequency of variability of both parameters in comparison to midazolam.

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Papillary Muscle Sling as An Adjunctive Procedure For The Repair of Ischemic Mitral Regurgitation

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Background: **Ischemic mitral regurgitation or MR is a condition that gravely affects the survival of patients with coronary artery disease. An undersized ring annuloplasty is the standard procedure for repair. Specific echocardiographic criteria that are associated with severe leaflet tethering and papillary muscle displacement can lead to high recurrence rates. Many techniques have been proposed to supplement the undersized annuloplasty in such cases. One of these techniques is the papillary muscle sling.**

Aim of work: **This study is aimed at evaluating the immediate and mid-term results of the papillary muscle sling technique, added to a restrictive annuloplasty, in the treatment of severe ischemic MR, in the presence of echocardiographic predictors of recurrence.**

Material & methods: **37 consecutive patients, referred for coronary artery bypass grafting and repair of severe ischemic MR, and presenting criteria of high risk for recurrence, were operated upon by the same surgeon and anesthetist at Cairo University Hospitals and Nasser Institute, in the period between January 2009 and June 2013. The patients were divided into 2 groups: group A received an undersized annuloplasty alone, and group B received in addition a papillary muscle sling. They were studied by intraoperative echocardiography and followed up for mean period of 16 months.**

Results: **There were 2 deaths in each group. Immediate relief of MR was achieved in both groups, but group B had evidence of relief from leaflet tethering and papillary muscle displacement. Freedom from MR was better in group B at the end of follow-up, as well as improvement in ventricular function and reverse remodeling. Group B patients had also bigger ring sizes and ended up with lower gradients and larger mitral valve areas.**

Conclusion: **It was concluded that the ring and sling combination is superior to the ring alone policy in the treatment of severe ischemic MR, in the presence of echocardiographic predictors of recurrence.**

KEYWORDS: **Ischemic mitral regurgitation, mitral valve repair, papillary muscle sling, coronary artery bypass grafting.**

Ischemic mitral regurgitation or MR is a condition that gravely affects the survival of patients with coronary artery disease [1]. However, the surgical management of moderate or severe ischemic MR remains a challenge in many cases, due to the complexity of the underlying pathological mechanisms. An undersized ring annuloplasty is the standard procedure for repair [2,3], but disturbances at the annular, leaflet and ventricular levels interact and lead to a high rate of recurrence if the problem is tackled at the annular level alone. The mid-term rates of recurrence after mitral valve repair using an isolated undersized ring annuloplasty, with or without coronary revascularization, are reported to be as high as 30% [4]. Another limitation of this technique is that aggressive undersizing can questionably lead to elevated gradients across the mitral valve [5].

Ciarka and coworkers have identified specific echocardiographic criteria that are associated with recurrent functional MR after ring repair, including the anterior

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and posterior leaflet angles, the tenting height, the tenting area, the interpapillary distance, and the left ventricular (LV) sphericity index [6]. The same group also reported that a preoperative left ventricular end diastolic diameter greater than 6.5 cm predicts an unfavorable outcome with restrictive annuloplasty [7]. All of these parameters are related to increased leaflet tethering, resulting from ventricular dilatation and papillary muscle displacement. As a supplement to ring annuloplasty, numerous investigators have proposed different solutions to what seems to be a ventricular problem, with the goal of increasing leaflet coaptation: posterior leaflet augmentation by a pericardial patch [8,9], anterior leaflet augmentation [10], secondary chordal cutting [11], papillary muscle repositioning either posteriorly as recommended by Kron et al. [12], or anteriorly by the so called "ring and string" technique described by Langer and associates [13], papillary muscle approximation either by suturing as practiced by Rama and colleagues [14] or by a PTFE sling, introduced by Hvass et al. [16,17], LV surgical remodeling [18] and, finally, LV constraining devices like the CorCap system[19] and Coapsys implants [20].

This study was aimed at investigating the results of one of those techniques, namely the papillary muscle sling, as an addition to restrictive annuloplasty, in comparison to restrictive annuloplasty alone, in patients with severe ischemic MR and echocardiographic criteria of severe leaflet tethering.

Patients and methods

In the period between January 2009 and June 2013, 64 patients undergoing mitral valve repair for severe ischemic MR at Cairo University Hospitals and Nasser Institute, with or without coronary revascularization, and managed by the same surgeon and anesthetist, were prospectively studied. A written informed consent was obtained from every patient or his family.

Inclusion criteria

As assessed by intraoperative transoesophageal echocardiography or TEE, 35 patients (54%) met one or more of the following criteria of severe leaflet tethering defined by Ciarka et al. [6] and were included in the study: a left ventricular end diastolic diameter (LVEDD) >6.5 cm, a left ventricular end systolic diameter (LVESD) >5 cm, a posterior leaflet angle or PLA >45 degrees, an anterior leaflet angle or ALA >34 degrees, a tenting depth >11 mm, a tenting area >2.5 cm2, or an end systolic interpapillary distance >2 cm. They were divided into two groups, according to the surgical technique. Group A consisted of the first 16 consecutive patients who received an undersized annuloplasty alone. In the latter 17 patients, in addition to ring annuloplasty, the papillary muscle sling technique was applied. The sling failed in 2 cases due to papillary muscle adherence to the left ventricular free wall. A decision was made to perform an augmentation of the anterior leaflet instead and the two patients were excluded from the study. The technique was completed in 15 patients who thus constitute group B.

Anesthetic protocol and echocardiographic assessment

All patients were managed by a standard anesthetic protocol. After sedation with midazolam 0.02 - 0.07 mg/Kg, local anesthesia was used for the insertion of a wide bore peripheral intravenous cannula and a radial arterial catheter. Induction of anesthesia was accomplished with sodium thiopental 2-3 mg/kg, fentanyl 7-10 μg/kg and pancuronium 0.12 mg/kg. Anesthesia was maintained with isoflurane 0.6 - 1% in 100% oxygen. Continuous monitoring included ECG, pulse oxymetry, invasive arterial and central venous pressure measurements, urinary catheter output, and nasopharyngeal temperature. Intra- operative trans-esophageal echocardiographic (TEE) assessment was carried out before cardiopulmonary bypass by the anesthesiologist with a Hewlett-Packard Sonos 5500 machine (Hewlett-Packard, Palo Alto, California). The following parameters were inspected in the apical 4-chamber view and the long axis view at 120 degrees at mid systole: the plane of the annulus was defined as the line connecting the hinge points of the leaflets, the PLA was defined as the angle between the posterior mitral leaflet and the plane of the annulus, the ALA was the angle measured between the anterior leaflet and the annular plane, the tenting depth was the perpendicular distance between the coaptation point of the leaflets and the plane of the annulus, the tenting area was the surface area of the triangle formed by the 2 leaflets and the annular plane, and the length of coaptation was measured as the line of maximal apposition between the leaflets. The interpapillary distance was measured at end systole in the short axis view at the mid-ventricular level. The assessment of MR was performed after vasopressor stimulation by an intravenous bolus of ephedrine raising the systolic blood pressure to a minimum of 150 mmHg. The residual MR grade, the coaptation length and the mean pressure gradient across the valve by continuous wave Doppler were estimated after separation from cardiopulmonary bypass, as well as a repeated measurement of the tenting depth and inter papillary distance.

Surgical technique

The same surgeon performed all of the operations. The approach was through a standard median sternotomy, aorto bicaval cannulation and mild hypothermic cardiopulmonary bypass at 32 degrees C. Myocardial protection was achieved by intermittent antegrade cold blood cardioplegia. Access to the left atrium was obtained via a left atriotomy incision. Distal anastomoses to branches of the circumflex and right coronary arteries were done first, followed by the mitral valve repair. Anastomosis of the left internal mammary artery to the left anterior descending coronary artery was done at the end. Proximal anastomoses to the ascending aorta were constructed on tangential clamping.

The mitral procedure was started by the application of the annuloplasty sutures, using 2/0 braided polyester to bring the valve up into view. This was followed by the insertion of a complete rigid annuloplasty ring in group A. In group B, a technique similar to the one described by Hvass and coworkers [16] was used. Exposure of the papillary muscles was improved by gentle retraction on the free edge the anterior leaflet by two 3/0 silk suspensions passed around two primary chordae. Visualization of the posterior papillary muscle was enhanced by the placement of a wet laparotomy pad under the diaphragmatic surface of the heart. Using careful blunt probing by a long curved vascular clamp or a Semb's clamp, a passage was negotiated around the most basal trabeculations of the posterior papillary muscle. One end of a 4 mm tube of e-PTFE (expanded polytetrafluoroethylene) was passed first around the posterior papillary muscle and then around the anterior papillary muscle. By means of one 2/0 braided polyester pledgetted suture, the tube was sutured to itself into a loop as tight as possible arround the base of the two muscles. The ecxcess tube length was then trimmed from both limbs. Alternatively, a 4-5 mm wide Dacron band was cut longitudinally out of a 6 or 8 mm vascular tube graft and used for the same purpose. Ring sizing was achieved according to the intertrigonal distance and the height of the anterior leaflet. Downsizing by two sizes was done in group A and by one size only in group B.

Follow-up

Survivors were followed up by the surgeon at the outpatient clinic. Follow-up transthoracic echocardiography was performed by their referring cardiologists 3 months after discharge and then on a biannual basis.

Statistical analysis

Data are expressed as frequency and percentages or as mean values ± standard deviation, unless stated otherwise. Group comparison was done using the paired Student's t-test for continuous variables and the Pearson chi-square test for categoric variables. P values lower than 0.05 were considered significant.

Results

Patient characteristics

The preoperative patient characteristics are listed in table I. There were no differences between the 2 groups in the mean age, sex distribution, functional class, incidence of diabetes mellitus and systemic hypertension. The mean ejection fraction was equally depressed in both groups (33±12% in group A, and 32±5.6% in group B, p=0.2). There was a similar degree of pulmonary hypertension (57±17 mmHg and 56±8 mmHg, p=0.9). The mean MR grade was also similar and the left ventricular dimensions were comparably dilated.The pre bypass TEE evaluation revealed an equal degree of extreme leaflet tethering and papillary muscle displacement in both groups, as summarized in table II. *Operative data:*

	Group A (n=20)	Group B (n=15)	p value
Age	58±8.5 years	46±12.4 years	0.1
Male sex	15(75%)	10(66%)	0.2
Diabetes	8(40%)	5(33%)	0.2
Hypertension	7(35%)	4(26%)	0.1
NYHA class	3.2±0.85	3.6±0.5	0.06
EF	33±12%	32±5.6%	0.2
PASP	57±17 mmHg	56±8 mmHg	0.9
LVEDD	6.9±0.8 cm	7.1±0.7 cm	0.2
LVESD	5.3±0.8 cm	5.5±0.8 cm	0.1
MR grade	3.3±0.5	3.6±0.5	0.3

NYHA= New York Heart Association, EF= ejection fraction, PASP= pulmonary artery systolic pressure, LVEDD= left ventricular end diastolic diameter, LVESD= left ventricular end systolic diameter, MR= mitral regurgitation.

Table I: Preoperative patient characteristics.

	Group A (n=20)	Group B (n=15)	p value
Tenting depth	1.2±0.2 cm	1.5±0.3 cm	0.08
Tenting area	2.8±0.9 cm^2	3±0.7 cm^2	0.2
PLA	56±2°	55±14°	0.9
ALA	43±13°	42±3°	0.8
IP distance	2.7±0.2 cm	2.8±0.5 cm	0.6

PLA= posterior leaflet angle, ALA= anterior leaflet angle, IP= inter-papillary, TEE=transoesophageal echocardiography.

Table II. Tethering criteria by pre-bypass TEE.

The operative details are listed in table III. The mean number of coronary bypass grafts was the same (2.4±0.9, versus 2.2±0.8, p=0.1). Concomitant procedures were significantly more frequent in group B patients who had 5 tricuspid valve repairs (33%) and one aortic valve replacement, compared to

one tricuspid valve repair in group A (p=0.01). The mitral ring sizes ranged from 26 to 32 in both groups, with a median ring size of 27 in group A and 30 in group B. Cross clamp times were significantly longer in the ring and sling patients (130±45 minutes, versus 96±32 minutes, p=0.002). The need for intra-aortic balloon pumping was comparable (7 patients or 35% in group A, versus 4 or 26% in group B, p=0.1).

	Group A (n=20)	Group B (n=15)	p value
Bypass grafts	2.4±0.9	2.2±0.8	0.1
TV repair	1(5%)	5(33%)	*0.01*
AV replacement	0	1(6%)	0.2
Ring size (median)	27	30	0.3
XCL time	96±32 min	130±45 min	0.002
IABP	7(35%)	4(26%)	0.1
Mortality	2(10%)	2(13%)	0.1

TV= tricuspid valve, AV= aortic valve, XCL= cross clamp, IABP= intra-aortic balloon pump.

Table III. Operative data.

There were 2 operative deaths in each group (10% and 13%,respectively). The two patients in the ring alone group died of left sided heart failure, one 10 hours and the other 4 days postoperatively. In the ring and sling group, one patient died of left sided heart failure at 10 days, and one died suddenly of ventricular fibrillation at 1 week.

Post bypass TEE evaluation

Intra-operative TEE measurements after completion the repair are listed in table IV. There was no difference in the mean residual MR grade between the two groups. However, the ring and sling technique achieved significantly longer coaptation lengths than the ring only strategy (8.8±1.4 mm, versus 6.5±2.4 mm, p=0.02), while creating significantly lower mean pressure gradients across the mitral valve (2±0.3 mmHg, versus 6±1.7 mmHg, p=0.0001). Moreover, in group B, there was an evidence of significantly shallower tenting depths (0.46±0 cm, compared to 0.9±0.2 cm in group A, p=0.0004), as well as shorter inter papillary distances (1±0.4 cm, versus 2.4±0.3 cm in group A, p=0.003). Relative to their respective preoperative values, the reduction in both parameters was significant in group B (p=0.006 and p=0.0007). On the other hand, the reduction was significant in group A for the tenting depth (p=0.007), but not for the inter papillary distance (p=0.1). Figures 1 and 2 illustrate an example of the papillary muscle approximation achieved in a ring and sling patient.

	Group A (n=20)	Group B (n=15)	p value
Residual MR	0.5±0.6	0.2±0.4	0.2
Coaptation length	6.5±2.4 mm	8.8±1.4 mm	*0.02*
MPG	6±1.7 mmHg	2±0.3 mmHg	*0.0001*
Tenting depth	0.9±0.2 cm	0.46±0 cm	*0.0004*
IP distance	2.4±0.3 cm	1±0.4 cm	*0.003*

MR= mitral regurgitation, MPG= mean pressure gradient, P= inter-papillary, TEE=transoesophageal echocardiography.

Table IV. Post-bypass TEE assessment of the mitral valve.

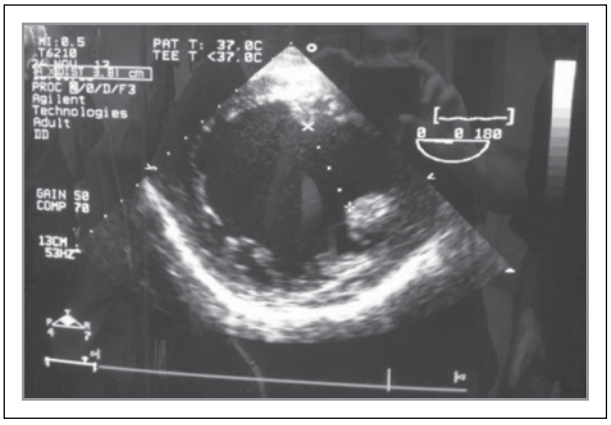

Fig 1. TEE picture in one group B patient in the short axis view at mid ventricular level before cardiopulmonary bypass. The papillary muscles, connected by the dotted line, are markedly displaced. The inter papillary distance is 3.81 cm.

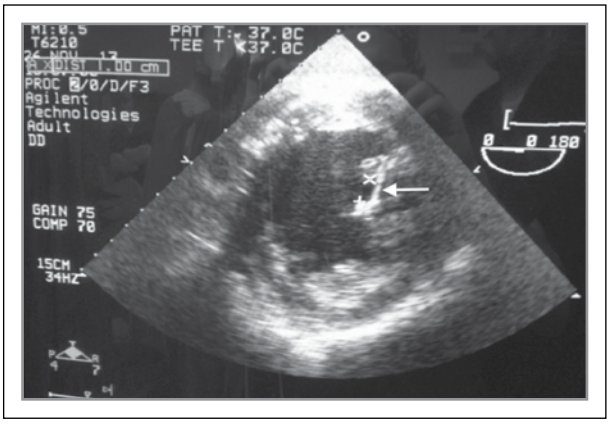

Fig 2. The same view as in figure 1, in the same patient after cardiopulmonary bypass, showing the papillary muscle sling in position, indicated by the arrow. The new inter papillary distance is 1.0 cm.

Follow-up

Follow-up was 100% complete in both groups. The follow-up information is summarized in table V. The follow-up period was similar in both groups (15±3 months in group A, and 16±4 months in group B). There was one mortality due to stroke at 7 months in group A. The mean functional class was similar (1.8±0.4 for group A, 1.6±0.3 for group B, p=0.1). Four patients (22%) in group A developed grade 3 or 4 recurrent MR, while freedom from MR was 100% in group B (p=0.04). The overall mean MR grade was lower in group B (0.2±0.4, versus 1.1±1 in group A, p=0.002). The ejection fraction was also higher in the ring and sling patients (42±4.5%, compared to 36.5±3.2% in the ring only patients, p=0.04), which also constituted a significant improvement relative to the baseline (p=0.003). Group B patients showed evidence of reverse remodeling: their mean LVEDD (6.1±0.2 cm) was significantly lower than that of their counterparts in group A (6.7±0.4 cm) with a p value of 0.002. It was also reduced in comparison to its preoperative value (p=0.01). Their mean LVESD was also lower in comparison to the baseline (p=0.01). On the other hand, all ventricular parameters for group B were basically unchanged relative to the preoperative levels. Regarding mitral valve areas, group B had wider areas than group A (2.0±0.2 cm^2 , versus 1.7±0.1 cm^2, p=0.007). No information was available concerning tenting criteria or inter-papillary muscle distances.

	Group A (n=18)	Group B (n=13)	p value
Follow-up period	15±3 months	16±4 months	0.9
NYHA class	1.8±0.4	1.6±0.3	0.1
MR grade	1.1±1	0.2±0.4	*0.002*
MR > grade 2	4(22%)	0	*0.04*
LVEDD	6.7±0.4 cm	6.1±0.2 cm	*0.002*
LVESD	5.1±0.7 cm	4.8±01 cm	0.2
EF	36.5±3.2%	42±4.5%	*0.04*
MVA	1.7±0.1 cm^2	2.0±0.2 cm^2	*0.007*

NYHA= New York Heart Association, MR= mitral regurgitation, LVEDD= left ventricular end diastolic diameter, LVESD= left ventricular end systolic diameter, EF= ejection fraction, MVA=m itral valve area.

Table V. Follow-up data.

Discussion

The management of ischemic MR is still a debated issue, especially in the presence of echocardiographic criteria of extreme leaflet tethering, predicting high rates of recurrence after restrictive annuloplasty alone. Some investigators believe that in this situation it is advisable to proceed directly for valve replacement rather than repair, arguing that the life expectancy of these patients is shorter than the expected durability of most biological valves [21]. Other groups however reported an increased mortality associated with replacement, even with partial or complete chordal preservation. In one study, operative and long term survival was 10 to 15% lower with valve replacement [22]. Another issue that was put forward is the problematic reintervention in patients whose ventricles successfully remodel, and live long enough to require redo replacement of their bioprostheses, particularly in the presence of patent bypass grafts [23].

Repair options that were designed to nullify the effect of severe papillary muscle displacement and leaflet tethering each have their own limitation and pitfalls. Posterior leaflet augmentation, which is easy to perform in a rheumatic situation where the tissues are thickened, becomes a very delicate maneuver in the setting of ischemia where the leaflets are thin and often friable [9]. It also has an inherent risk of narrowing the valve orifice if the patch is a bit too large, due to the so called "curtain" effect described by Carpentier et al. [24] or "aortic cusp effect" detailed by Dion and associates [25]. Coupled with an undersized ring, this risk is logically compounded. As for secondary chordal cutting to increase leaflet mobility, some data have cautioned that it leads to regional motion abnormalities in the area of left ventricular wall to which the severed chordae were anchored, resulting in left ventricular dysfunction [26]. Anterior or posterior papillary muscle repositioning [12,13] and papillary muscle suture approximation [14] all require passing sutures in the papillary muscles, which pose the risk of tearing. We had a personal experience with one suture that tore through the papillary muscle, just as the heart started beating vigorously coming off bypass, luckily with no catastrophic consequences. Transventricular repair options like surgical ventricular remodeling are quite complex procedures that need a steep learning curve. Finally, restraining devices such as the CorCap [19] or Coapsys [20] implants are costly and commercially unavailable in our market.

Hvass and associates first described the papillary muscle sling technique in 2003 [16], and reported its mid-term follow-up results in 37 patients in 2010 [17]. They had an operative mortality of 5.4%, evidence of significant reverse remodelling at 6 months. Freedom from moderate and severe MR was 94% at 5 years. This study was however observational as the technique was not compared to any other. We were encouraged to adopt the technique because it offers several advantages: it is safe, easily reproducible and economic. Unlike a procedure requiring an incision in the leaflet or in the ventricle, this

technique has the added advantage of being readily reversible, since it would take a few seconds to undo the sling. There is no attendant risk of bleeding nor of papillary muscle rupture. Last, there is a versatility in the employed material, as we have used custom made bands in case of unavailability of PTFE tubes, with so far the same efficacy. We are confident to have achieved a good result, because our higher mortality can be explained by the very sick condition of our patients and the smaller number included in the study. In our hands, the ring and sling combination provided a good functional improvement, sufficient evidence of reverse remodelling, and cure for MR in our patients at 16 months of follow-up. It allowed us to use larger ring sizes, relative to the ring only technique, achieving longer coaptation lengths, and with lower gradients. Even if the follow-up period is limited, we have good reasons to hope that the results will be durable, in view of the large coaptation reserves which, in most cases, fulfilled the 8 mm benchmark of a durable repair[23]. Although the cross clamp times were higher by a mean of 34 minutes in group B, the mortality was not affected, and the use of intraortic balloon assistance was not increase. This time requirement can also be expected to decline with experience, since Hvass and coworkers stated that the average time needed for them to insert the sling dropped from 28 minutes initially to about 5 minutes toward the end of their experience [17].

The only limitation we have encountered with the technique was the inability to pass the sling around the posterior papillary muscle in two cases, due to tethering of the muscle to the left ventricular free wall. Carpentier and colleagues classified the papillary muscle anatomy into 5 types, which was of particular interest in the setting of mitral valve homograft replacement. According to this classification, type V papillary muscles are the ones who are totally adherent to the ventricular wall. [24] The incidence of such complex anatomy was reported to be the lowest among all types, occurring in 9 of 82 (10.9%) explanted human mitral homografts [27]. This percentage is in good agreement with our own findings (2 out of 17 cases or 11.7%), but not with those of Hvass et al. who reported not having encountered a single case [17]. For this anatomical variation preventing the encircling of the posterior papillary muscle, we switched to pericardial patch augmentation of the anterior leaflet as described by Kincaid and coworkers [10] with a successful result.

Conclusion

We conclude that the papillary muscle sling technique, when added to the restrictive annuloplasty procedure is safe and effective, in the treatment of severe ischemic mitral regurgitation that is associated with extreme leaflet tethering and papillary muscle displacement. It results in a satisfactory abolition of regurgitation that is secured by long coaptations and by relief of leaflet tethering. It also triggers a reverse remodeling due to a lasting papillary muscle approximation.

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Surgical Treatment of Pulmonary Tuberculosis: Indications and Outcome

Thoracic

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Background and Aim: Pulmonary Tuberculosis (PTB) is a common medical and social problem worldwide, especially in developing countries. Currently, management of tuberculosis is essentially medical, and surgery has a little role. Today surgery is usually performed only in patients with tuberculosis when the diagnosis is needed, who have complications, or who have active disease resistant to treatment (MDR TB). The aim of this study is to assess the role and outcome of surgical intervention in patients with multidrugs resistance or complicated pulmonary TB.

Patients and Methods: Between 2005 and 2013, 70 patients with pulmonary tuberculosis were included. There were 57 males and 13 females with a mean age of 35 years. Preoperative clinical manifestations included coughing with expectoration in (65) patients, hemoptysis in (8), chest distress in (29), weight loss in (70) and night fever in (19). Indications for surgery were: entrapped lung in 15 (21.4%), MDR-PTB in 5 (7%), destroyed lobe in 17 (24%), massive hemoptysis in 5 (7%), empyema with bronchopleural fistula in 9 (12.8%), persistent cavity in 10 (14%).

Results: The most common procedure were lobectomy 38 (54%), wedge resection 10 (14%), decortication 13 (18.5%), thoracoplasty 1(1.4%), and 8 (11.4%) pneumonectomy. Postoperatively sputum was negative in all patients except one patient who had relapse 6 months later, complications occurred in 17 (24%) patients, there were prolonged air leak in 8 patients, residual space in 2, empyema and bronchopleural fistula in 2 patients, thoracotmy wound infection in 5 patients. There were 5 (7%) mortality cases, 2 of then early postoperative, while 3 late postoperative, respiratory failure is the most common cause of death.

Conclusion: Surgery associated with medical treatment provides a high cure rate for patients with MDR-TB and those with TB complications with acceptable morbidity and mortality

Keywords: *Pulmonary TB , TB empyema . multidrug resistance TB, surgery for pulmonary TB*

Tuberculosis (TB) is perhaps the oldest disease known to mankind. It reaches the 21st century as a public health problem and not yet solved, with significant morbidity and mortality. It is the most common infectious disease in humans, killing nearly 3 million people worldwide each year. The most common sequelae are parenchymal destruction, fungal ball, bronchiectasis, and tracheal stenosis(1).

Pulmonary Tuberculosis (**PTB**) is a common medical and social problem worldwide, especially in developing countries. Accurate diagnosis is very important to start anti-**TB** drugs. Chest radiography is usually the first choice of diagnostic imaging , then computed tomography (**CT**) scan provides more detailed information on the extent and distribution of disease. Definite diagnosis is confirmed by detected Mycobacterium tuberculosis in sputum / pleural effusion culture, or in lung / pleural biopsy (2).

Currently, management of tuberculosis is essentially medical, and surgery has a little role. Today surgery is usually performed only in patients with tuberculosis when the diagnosis is needed, who have complications, or who have active disease resistant to treatment (MDR TB) (3).

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The aim of this study is to assess the role and outcome of surgical intervention in patients with multidrugs resistance or complicated pulmonary TB.

Patients and methods

This study was conducted at the cardiothoracic surgery departments in Minia, South valley, and Sohag universities between 2005 and 2013. Seventy patients with pulmonary TB who underwent surgery were included. The age, sex, concomitant disease, results of acid-fast smear and culture of sputum, drug susceptibility results, duration of anti-TB drugs before surgery, surgical indications, surgical intervention, mortality, and morbidity as a final outcome were retrospectively evaluated. Diagnosis was confirmed on identifying acid fast bacilli (AFB), using Ziehl-Neelsen's staining method on sputum staining or biopsy from lung or pleura revealed TB granulomatous lesion.

The patients rolled for surgery in the study selected as follow:

1- Persistent positive sputum smear after anti - tuberculosis treatment for at least a 3-months period .

2- Disease is confined to one lung or one lobe or well-localized pulmonary cavity that can be recognized by imaging..

3- Repeated massive hemoptysis

4- Exclusion of endobronchial FB by bronchoscopy preoperatively.

5- Adequate postoperative pulmonary reserve.

All patients received anti –TB drugs at least 3 monthS before surgical intervention except in cases of massive recurrent hemoptysis.

Technique

Under general anesthesia preoperative bronchoscopy was performed to exclude endobronchial FB. Then, double-lumen endobronchial intubation was used in all cases. Surgical resection was performed by a posterolateral thoracotomy (figure 1). Preserving blood supply to the bronchus was crucial to the healing of the bronchial stump, by avoiding excess dissection and diathermy. All bronchi were closed manually. vascularzed pedicled intercostal muscle, or pleura flap is most frequently used for bronchial stump reinforcement in order to reduce the incidence of bronchopleural fistula.

At the end of operation, two chest tubes (32 &28) were placed posteriorly and anteriorly. Postoperative course of anti-TB medications were continued for a median (range) of 12 (9–24) months after the surgery especially still +ve TB smear before surgery. Follow up was included clinical manifestations, sputum culture for TB, and chest x- rays.

Results

Seventy Pulmonary TB patients were underwent surgery. There were 57 males and 13 females with a mean age of 35 years. Preoperative clinical manifestations included coughing with expectoration in (65) patients, hemoptysis in (8), chest distress in (29), weight loss in (70) and night fever in (19).

Indications for surgery were: entrapped lung in 15 (21.4%) *(Figure 1),* MDR-PTB in 5 (7%), destroyed lobe in 17 (24%), massive hemoptysis in 5 (7%), empyema with bronchopleural fistula in 9 (12.8%) *(Figure 2),* persistent cavity in 10 (14%), destroyed lung 5 (7%), and diagnostic in 4 (5.7%) cases, *table (1)*. The most common procedure were lobectomy 38 (54%), wedge resection 10 (14%), decortication 13 (18.5%), thoracoplasty 1(1.4%), and 8 (11.4%) pneumonectomy *table (2)*.

Postoperatively sputum was negative in all patients except one patient who had relapse 6 months later, complications occurred in 17 (24%) patients, there were prolonged air leak in 8 patients, residual space in 2, empyema and bronchopleural fistula in 2 patients, thoracotmy wound infection in 5 patients. There were 5 (7%) mortality cases, 2 of then early postoperative, while 3 late postoperative, respiratory failure is the most common cause of death.

Indication	No. of patients	%
Entrapped lung	15	21.4
Destroyed lobe	17	24
Massive hemoptysis	5	7
Empyema with BP fistula	9	12.8
Persistant cavity	10	14
Destroyed lung	5	7
MDR-TB	5	7
Diagnostic	4	5.7

Table 1. Indications of surgery in TB patients

Procedure	NO. of patients	%
Lobectomy	38	54
Wedge resection	10	14
Pneumonectomy	8	11.4
Decortication	13	18.5
Thoracoplasty	1	1.4

Table 2. Surgical procedures performed

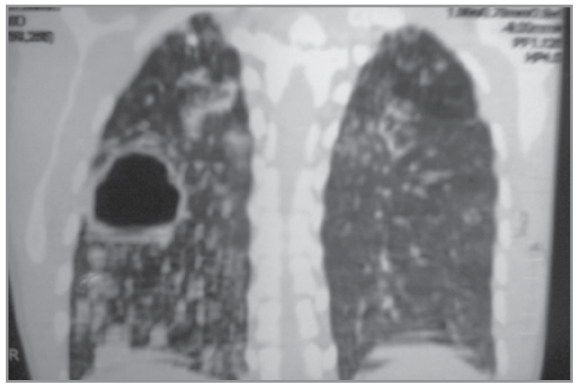

Fig 1. Axial chest CT with contrast showing residaul cavity in right upper lobe

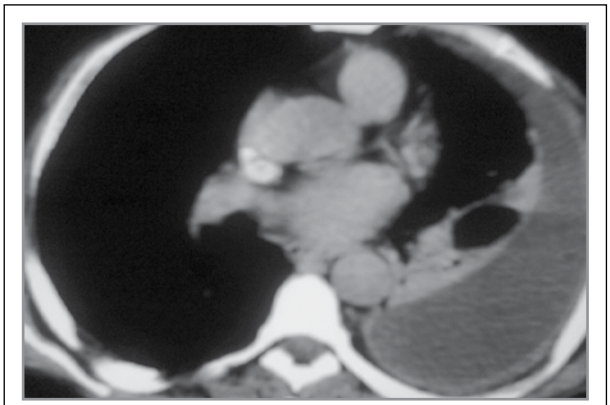

Fig 1. Chest CT with contrast showing TB empyema with entrapped lung

Discussion

The main treatment of TB is medical, and less than 5% of patients with tberculosis require surgery [4]. In our study the main indication for surgery in patients with pulmonary TB are complications of the disease and undiagnosed pulmonary nodule, and recently the emergence of MDR-TB has become a main indication for surgery, which agree with other studies by [5,6] .

Excellent outcomes have been achieved in our study in patients with MDR-TB by adding surgery to medical therapy where the sputum became negative in all (except one) patients post operative. This is in agreement with Boxiong Xie et al. 2013[7] and Pomerantz M et al,1991[8], who reported a very favorable outcome by combination of pulmonary resection and medical therapyto this group of MDT-TB.

Surgery is effective and sometimes indispensable for the treatment of complications of pulmonary tuberculosis with serious and even life-threatening consequences [5]. For patients with bronchopleural fistula and/or empyema, pleural drainage is sufficient in most cases. When conservative methods fail, major surgical procedures must be considered. Surgery is offered to manage the symptoms in patients with a destroyed lung, but surgery should be suggested even for asymptomatic patients with aspergilloma, to avoid the potential risk of massive hemoptysis that threatens life [9].

In our study lobectomy is by far the commonest type of resection and it is the most suitable resection for most lesions, wedge resection in confined mostly to undiagnosed or suspected cases. Decortication and release of the entrapped lung is common in our series. Pneumonectomy was done for severe extensive pulmonary damage.

In agreement with our findings, Souilamas R et al, 2001[10], in his study (Lobectomy is the preferred type of resection for pulmonary tuberculosis). Segmentectomy is not recommended due to the high risk of bronchopleural fistula, however, in certain reports that included patients operated on for undiagnosed nodules, the rate of segmentectomy or wedge resection is high[11,12].

The complication rate of surgery for pulmonary tuberculosis has been reported as up to 30% [5, 6]. Minor complications such as atelectasis, pleural space problems, and wound infection are more frequent in this group of patients. Pneumonia and atelectasis were frequently encountered due to underlying infection. Moreover, wound infection was often seen because these patients were generally in a catabolic state. We were generally able to manage these complications by conservative methods. It has also been reported that bleeding requiring re-operation is frequent [6].

The most important reported complication is bronchopleural fistula which has been found in 3% to 7% of patients [5, 12]. The mortality rate of surgery for pulmonary tuberculosis has been reported as 0–3.3% [5, 6, 13].

In this study, the overall complication rate was 24%, the most common complication is prolonged air leake (11%), follwed by infection, persistent space, and bronchopleural fistula occued in only tow patients.

Conclusion

Surgery associated with medical treatment provides a high cure rate for patients with MDR-TB and those with TB complications with acceptable morbidity and mortality.

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Ministernotomy For Anterior Mediastinal Masses

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BACKGROUND: **Median sternotomy is the traditional approach used to resect anterior mediastinal masses or access the anterior-superior compartment of the mediastinum. A partial upper sternotomy is an alternative , less invasive technique.This partial or (minimal) sternotomy technique may be required for upper mediastinal involvement in diseases of the head and neck.**

MATERIAL AND METHODS: **Between January 2010 and December 2012, 14 patients underwent surgical resection or biopsied for anterior mediastinal masses in our unit of thoracic surgery in King Saud Hospital and cardiothoracic department Zagazig University Hospital. Eight patients had anterior mediastinal masses resected successfully through partial sternotomy (partial sternotomy was added to collar incision for two patients with huge retrosternal goiter.**

RESULTS: **14 patients were included in this study with clinical presentations ranged from dyspnea and cough in 7 patients, dyspnea and dysphagea with neck swelling in 2 patients ,features suggestive myasthenia gravis in 4 patients, and bone ach with pathological fractures in one patient. The patients ranged in age from 22 to 52 years (mean = 34.9 years), there were 6 men and 8 women. All patients were extubated shortly after surgery except one patient with myasthenia gravis who stayed 48 hours on mechanical ventilation. There was no mortality occurred. The duration of wound healing and postoperative rehabilitation was easy and short. The average length of hospital stay was (11.14 ± 2.65) (range 5 to 16 days).**

CONCLUSION: **Mini-sternotomy is gaining significance for exploration and treatment of most of anterior mediastinal lesions. Mini- sternotomy appears to be an excellent alternative for surgical exploration of the mediastinum. This approach is safe and effective in resecting small anterior mediastinal masses with good surgical outcome and less postoperative discomfort.**

KEYWORDS: **Mini-sternotomy, Anterior mediastinal mass.**

The most common neoplasms of the anterior mediastinum are thymomas, lymphomas, and germ cell tumors. Surgical exploration was the routine approach to the diagnosis and management of these tumors. This is no longer true. The appropriate initial treatment of these neoplasms varies from surgical resection to radiation therapy to systemic chemotherapy. Except for the small well-encapsulated anterior mediastinal mass, it is imperative that a definitive tissue diagnosis be obtained before initiating treatment[1].

Median sternotomy is the traditional approach used to resect anterior mediastinal masses or access the anterior-superior compartment of the mediastinum. A partial upper sternotomy is an alternative, less invasive technique. This partial or (minimal) sternotomy technique may be required for upper mediastinal involvement in diseases of the head and neck[2].

Recently, because of the improvements in endoscopic procedures, a limited operation for anterior mediastinal lesions that does not require a median sternotomy was developed, and video-assisted surgical intervention with various approaches have been reported[1,3].

We believe that partial sternotomy is an underappreciated and particularly attractive option for exploration of the mediastinum.

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PATIENT AND METHODS

Between January 2010 and December 2012, 14 patients underwent surgical resection or biopsied for anterior mediastinal masses in our unit of thoracic surgery in King Saud Hospital. Clinical history was obtained from patients record files, our patients were symptomatic with presenting clinical features of dyspnea, cough, bone ach, and features suggestive of myasthenia gravis. Preoperative investigations in the form of (chest radiograph-computed tomography of neck and chest-thyroid gland ultrasound-thyroid function tests-technetium sestamibi scans-calcium and parathyroid hormone level-other laboratory findings according to the need) were done for our patients.

Eight patients had anterior mediastinal masses resected successfully through partial sternotomy (partial sternotomy was added to collar incision for two patients with huge retrosternal goiter), one patient was in need for standard median sternotomy, and another patient had prior fine needle aspiration biopsy failed to yield a diagnosis, this patient had VATS for another biopsy for accurate histopathological diagnosis. The remaining 4 patients were histologically diagnosed as non-hodgkins lymphoma by fine needle aspiration biopsy, and started radiotherapy with or without chemotherapy with no need for any surgical interference.

Operative technique

Partial sternotomy was used for most of our patients.

After induction of general anesthesia, the patient is positioned in the supine position with extended neck using a transverse shoulder roll.

The incision is performed in the midline from the sternal notch to just below the angle of Louis, and the sternum is divided from the sterna notch up to the third intercostals space according to the extent of the lower border of the lesion radiographically. Complete median sternotomy was needed in one patient with preoperative histopathological diagnosis of thymoma.

Care should be taken to avoid injury to the internal mammary artery, and to avoid sternal fracture. Through this incision the lesions was mobilized and resected easily without any complications.

One or two mediastinal drains were left in place.

RESULTS

14 patients were included in this study with clinical presentations ranged from dyspnea and cough in 7 patients, dyspnea and dysphagea with neck swelling in 2 patients, features suggestive myasthenia gravis in 4 patients, and bone ach with pathological fractures in one patient(Table1).

No.	Age	Sex	Presentation	Clinical diagnosis	Pathology	Procedure
1	26	F	Bone ache + path. fracture	Ant. Mediastinal mass	Adenoma	Excision
2	52	F	Dyspnea + dysphagia	Ant. Mediastinal mass	Ectopic thyroid	Excision
3	35	F	Dyspnea + neck swelling	Ant. Mediastinal mass	Retrosternal goiter	Excision
4	45	M	Dyspnea + neck swelling	Ant. Mediastinal mass	Retrosternal goiter	Excision
5	42	M	Symptoms suggestive MG	Myasthenia gravis	Normal thymus	Thymectomy
6	45	M	Symptoms suggestive MG	Myasthenia gravis	Normal thymus	Thymectomy
7	22	F	Symptoms suggestive MG	Myasthenia gravis	Thymic hyperplasia	Thymectomy
8	25	F	Symptoms suggestive MG	Myasthenia gravis	Thymoma G1	Thymectomy
9	38	F	Symptoms suggestive MG	Ant. Mediastinal mass	Benign thymic cyst	Thymectomy
10	25	M	Dyspnea + cough	Ant. Mediastinal mass	Lymphoma	VATS biopsy
11	28	M	Dyspnea + cough	Ant. Mediastinal mass	Lymphoma	CTguided biopsy
12	49	M	Dyspnea + cough	Ant. Mediastinal mass	Lymphoma	CTguided biopsy
13	30	F	Dyspnea + cough	Ant. Mediastinal mass	Lymphoma	CTguided biopsy
14	26	F	Dyspnea + cough	Ant. Mediastinal mass	Lymphoma	CTguided biopsy

Table 1. Patient characters

Of the 14 patients, 9 underwent complete surgical resection for anterior mediastinal mass (5 thymectomies, one ectopic parathyroid adenoma, and three retrosternal goiters), surgical resection for 8 patients was through partial sternotomy and one through standard median sternotomy(Table 2). VAT biopsy was achieved for one patient with non-hodgkins lymphoma after failure of fine needle biopsy for him. Tissue diagnosis was obtained properly for the remaining 4 patients through fine needle aspiration biopsy, and all were non-hodgkins lymphoma. The patients ranged in age from 22 to 52 years (mean = 34.9 years), there were 6 men and 8 women.

Approach	No.	%
Partial sternotomy	6	66.66
Cervical incision + partial sternotomy	2	22.22
Standard sternotomy	1	11.11

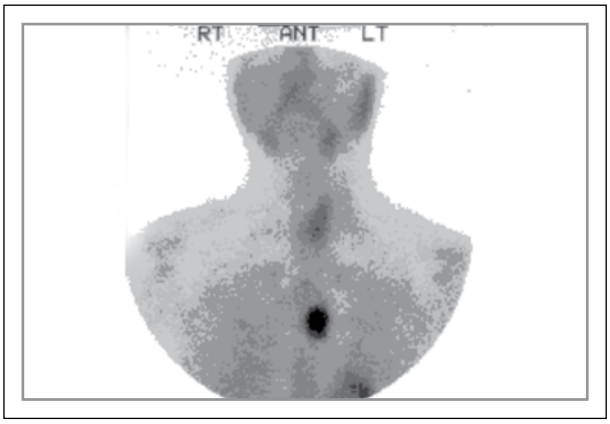

Fig 1. Technetium sestamibi for one pt. with anterior mediastinal parathyroid adenoma

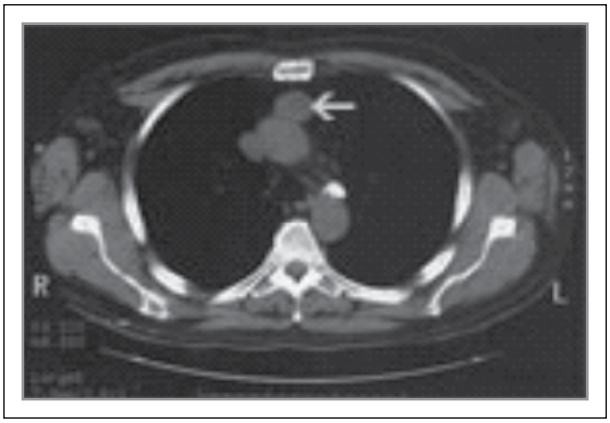

Fig 2. C.T. of the same Pt. with anterior mediastinal adenoma

Table (2): Approach used for resection

All patients were extubated shortly after surgery except one patient with myasthenia gravis who stayed 48 hours on mechanical ventilation and was receiving his myasthenia medications. Mediastinal drains were removed within the first three postoperative days. Postoperative recovery of the patients was smooth except for two patients, one patient 26 years old female, diagnosed as ectopic parathyroid adenoma (Figure 1,2), she was dependent on high calcium doses and still in need for calcium replacement for 2 weeks postoperatively until calcium and parathyroid hormone levels was normalized, the other patient was a 45 year old male, with severe myasthenia required repeated plasmapheresis three times before operation, and after thymectomy his myasthenia medications were tapered gradually and discontinued later on.

There was no mortality occurred. The duration of wound healing and postoperative rehabilitation was easy and short. The average length of hospital stay was (11.14 ± 2.65) (range 5 to 16 days).

DISCUSSION

Primary mediastinal tumors are uncommon representing about 3% of tumors within the chest, as many as 25-40% of these lesions are malignant[3]. Many authors reported a higher incidence of about 72% prevalence of malignancy in their study[4]. **Vaziri *et al.*** showed 60% of malignancy in their study[3]. Majority of tumors are seen in the anterior mediastinum[2,3,4]. The knowledge of the nature of AMMs is very important for making correct diagnosis and therapeutic decisions[2,3,4,5]. Usually mediastinal masses are picked-up by clinical examination and radiological appearance[4,5].

The purpose of our study was to diagnose anterior mediastinal masses properly, and to prove that a less invasive approach of a non-invasive anterior mediastinal mass is possible for complete surgical resection.

Tissue diagnosis of AMMs can be performed by a variety of techniques ranging from FNAC and CNB to surgical procedures allowing biopsy as well as resection[1,6,7].

In our study all patients with AMMs were symptomatic with chief complaint of dyspnea, cough, dysphagia, and boneache. Most AMMs in our series were benign. It is to be noted that the incidence of benign versus malignant lesions varies with the lesion under consideration, the location of the mass, and the hospital referral patterns. In our cases, there was a female preponderance. Most AMMs in this series were identified in the middle age. The most common lesions in our series was lymphoma (35.7 %), followed by thymic lesions (35.7%), then thyroid and parathyroid lesions was (28.5%), similar to study by Shpitzer, et al.[8].

Tissue diagnosis was obtained for all our patients by CT guided biopsy and was conclusive, except for one patient, the biopsy was not enough so VAT biopsy was needed for histopathological diagnosis which was Nonhodjkins lymphoma.

In 1998 Shinj et al., began performing the resection of an anterior mediastinal mass diagnosed as a benign lesion preoperatively using minimal skin incision and upper part ministernotomy[7].

Our series demonstrates that a less invasive surgical approach is possible with good outcome regarding postoperative pain, early recovery, and cosmotic problems (psychologic benefit), when preoperative imaging of anterior mediastinal mass does not show a large, extended, or invasive lesion, and this is consistent with the results of **Kido and associates**[6,9,10]. Postoperative discomfort and pain seemed to be reduced in patients with minimal invasive techniques, may be because of the reduced stretch on all thoracic ligaments and diaphragm attachments[9,10].

The average length of hospital stay for our patients was 11.14 ± 2.65 days. Our approach was of a considerable value for the patient, even if we does not demonstrate any benefit rather than the psychologic effect of a reduced skin incision without any risk reported during the procedure.

Conclusion

Mini-sternotomy is gaining significance for exploration and treatment of most of anterior mediastinal lesions. Mini-sternotomy appears to be an excellent alternative for surgical exploration of the mediastinum. This approach is safe and effective in resecting small anterior mediastinal masses with good surgical outcome and less postoperative discomfort.

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Sevoflurane Ameliorates Local Immune Response to One-lung Ventilation during Chest Surgery for Cancer Lung

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Objectives: **To determine the local and systemic immune response (IR) to open chest surgery using one-lung ventilation (OLV) during either propofol intravenous or sevoflurane inhalational anesthesia.**

Patients & Methods: **The study included 56 patients undergoing thoracotomy and resection for lung cancer; patients were divided into two equal groups: Group P received propofol infusion and Group S received sevoflurane inhalation with OLV using 100% oxygen and a tidal volume of 8-10 ml/kg at a rate to maintain the $PaCO_2$ between 35 and 40 mmHg. Bilateral broncho-alveolar lavage (BAL) was performed in all patients in supine position after intubation and at end of surgery. Synchronously, venous blood sample was obtained and then serum was separated. The BAL fluid of both sides and serum samples were ELISA assayed for estimation of interleukin (IL)-1β, IL-6, IL-10 and tumor necrosis factor (TNF)-α levels.**

Results: **Propofol anesthesia allowed significantly lower blood pressure measures and heart rate both during two-lung and one-lung ventilation compared to sevoflurane anesthesia. At the end of surgery, serum and BAL fluid levels of pro- and anti-inflammatory cytokines were significantly higher compared to levels estimated prior to surgery and irrespective of anesthetic modality used. Local IR was more fulminate than the systemic IR manifested as significantly higher BAL levels of cytokines estimated at the end of surgery compared to serum levels. Sevoflurane significantly modulated the local pulmonary IR as manifested by significantly lower BAL levels of TNF-α, IL-1β and IL-6 with significantly higher levels of IL-10 in both lungs at the end of surgery compared to propofol group.**

Conclusion: **Open chest surgery using OLV triggers vigorous inflammatory response in both ventilated and collapsed lungs. This response was manifested at the end of surgery and was more pronounced locally than systemically. Sevoflurane inhalational anesthesia significantly suppressed such local immune response compared to propofol and is advocated for anesthesia for chest surgery.**

KEYWORDS: **One-lung ventilation, Lung resection, Sevoflurane, Propofol, Broncho-alveolar lavage, Cytokines levels**

One-lung ventilation (OLV) has become a standard procedure for many interventions in thoracic surgery with a need for deflation of the lung to facilitate the surgical procedure. Experimental and clinical studies have shown that mechanical ventilation with increased tidal volume and airway pressure can induce a pro-inflammatory reaction in ventilated lung. However, only limited data exist on inflammatory alterations in the temporarily non-ventilated and thus atelectatic lung in patients undergoing thoracic surgery [1,2,3].

One-lung ventilation strategy initiates a series of patho-physiologic events that can be attributed to two major factors, namely hypoxia and re-oxygenation. The cellular damage that follows the oxygen deprivation is exacerbated during the re-oxygenation by the generation of free radicals. OLV in animals has been accepted as an ideal model to produce lung injury associated with organ failure and high mortality levels. The control of the pulmonary inflammation resulting from thoracic surgical manipulations has been a great challenge. Although some pharmacological treatments aiming to suppress the acute lung injury or acute respiratory distress syndrome has been used,

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many specific therapies have not proved beneficial, such as mortality reduction [4, 5, 6].

Sevoflurane is a highly fluorinated methyl-isopropyl ether widely used for induction and maintenance of general anesthesia. In addition to its anesthetic properties, it has also shown to be involved in protective mechanisms in conditions of hypoxia or endotoxemia, mostly studied in neuronal and myocardial tissues. Moreover, sevoflurane pretreatment during endotoxin-induced shock in rats significantly improved systolic blood pressure, acid–base balance and reduced mortality rates and plasma levels of tumor necrosis factor alpha (TNF-□) and interleukin-6 (IL-6), thus showing an attenuation of the inflammatory response [7, 8, 9].

Tissue injury causes the release of pro-inflammatory cytokines such as TNF-□ and IL-1β which are involved in many aspects of inflammation. Resident cells such as macrophages, mast cells and lymphocytes are able to release large amounts of TNF-□ and IL-1ß after stimulation by exogenous inflammatory stimuli and/or endogenous mediators, such as lipopolysaccharide and enterotoxins [10, 11, 12].

The produced TNF-□ triggers the release of a cascade of cytokines, which mediate the release of prostaglandins and sympathomimetic amines. Indeed, TNF-□ stimulates the production of IL-1ß and IL-6, which in turn stimulate the production of cyclooxygenase products and IL-8/neutrophil chemoattractant-1 thereby enhancing the production of sympathomimetic amines [13, 14]. IL-6 is also able to promote T-helper 2 (Th2) phenotypic responses and its actions can be classified as both pro- and anti-inflammatory. The local balance of IL-6 and IL-10 is an important determinant of subsequent immune responses. The Th2 responses predominate in critically ill patients and after surgery [15].

The current prospective comparative study aimed to determine the local and systemic immune response to open chest surgery using one-lung ventilation during either propofol intravenous anesthesia or sevoflurane inhalational anesthesia.

Patients & Methods

The current study was conducted at Departments of Chest Surgery and Anesthesia, Naser Insurance Institute since Jan 2010 till April 2013. After approval of the study protocol by the Local Ethical Committee and obtaining written fully informed patients' consent; 56 patients undergoing thoracotomy and resection for lung cancer were enrolled in the study. Exclusion criteria were patients assigned for pneumonectomy or minimal invasive procedures, patients had immunomodulating disease states other than the pulmonary pathology, patients maintained on immunosuppressant drugs. Patients were divided into two groups according to maintenance anesthesia used: Group P (n=28) received propofol infusion and Group S (n=28) received sevoflurane inhalation.

Anesthetic procedure

Anesthetic procedure was standardized for all patients including the use of double-lumen endobronchial tubes under fiber-optic control to allow single lung ventilation. All patients were taken into the operating room unpremedicated and after standard monitoring with non-invasive blood pressure, electrocardiography and peripheral oxygen saturation (SpO_2); administration of Lactated Ringer's solution was started. Patients were positioned in the lateral decubitus and after identification of the epidural space using the loss of resistance technique, a 20 gauge epidural catheter (Perifix 401, B. Braun, Melsungen AG) was inserted through an 18-gauge Tuohy needle that was placed at the T_{9-10} interspace and advanced 3 to 5 cm into the epidural space. After injection of 3 ml of 2% xylocaine through the epidural catheter as a test dose, the catheter was fixed and the patient was repositioned supine. Continuous epidural infusion of bupivacaine 0.125% was injected at time of induction of anesthesia prior to skin incision to act as preemptive analgesia and was continued as intraoperative and postoperative analgesia.

Anesthesia was induced by a bolus of remifentanil (1 μg/kg) followed by propofol (1-2 mg/kg) and vecuronium was given in dose of 1 mg/kg to facilitate tracheal intubation and was continued throughout duration of surgery. All patients received remifentanil-based maintenance anesthesia by slow remifentanil 0.05 to 0.25 μg/kg/min for remifentanil infusion in addition to propofol infusion 100 μg/kg/min of propofol in Group P or 1-2% sevoflurane in Group S.

After the induction of anesthesia, an arterial catheter was placed in the radial artery, and a central venous line (two lumens 20 cm long) was applied. After clinical confirmation of correct double-lumen tube placement (by inspection and auscultation) with the patient in both the supine and lateral decubitus positions ventilation was controlled by using 100% oxygen and a tidal volume of 8-10 ml/kg at a rate to maintain the $PaCO_2$ between 35 and 40 mmHg. Effective lung isolation was determined by the absence of a leak from the non-ventilated lumen of the endobronchial tube. When the pleura was opened, the isolation was confirmed by direct observation of the collapsed non-ventilated lung and the absence of leak from this lung.

Blood samples were withdrawn simultaneously from the distal central venous lumen and arterial catheters and analyzed within 5 min for measurement of arterial and venous blood gases. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) were measured, always with the patient in the lateral position, in three phases: during two-lung ventilation (TLV), 15 min and 30 minutes after beginning of OLV (OLV_{15} and OLV_{30}). These measurements were made before ligation or division of any pulmonary vessels or bronchi. The duration of surgery, the duration of OLV, the amount of intraoperative blood loss, type of tumor and extent of resection were recorded.

Operative techniques

With the patient lying in the lateral decubitus position, a postero-lateral thoracotomy was made and pleural cavity was entered either through the fourth or the fifth intercostal space. The lobe to be resected was mobilized by preparation of the hilum and the interlobar fissures. Systematic mediastinal lymph node dissection was performed, then the tumor was resected either by a lobectomy, a bi-lobectomy, a sleeve-lobectomy or by an anatomical segmentectomy using staplers for the vascular, bronchial and parenchymal resection. After completing the systematic lymph node dissection, the pleural space was drained using one or two intercostal tubes. After ensuring proper hemostasis, wound closure was done.

Samples collection

Bilateral broncho-alveolar lavage (BAL) was performed in all patients in supine position after intubation and at end of surgery. The BAL fluid was immediately centrifuged at 2500 rpm for 15 minutes and the supernatant stored at -20°C. Synchronously, at time of obtaining BAL sample, a venous blood sample was collected under complete aseptic conditions in clean dry tube and allowed to clot and then serum was separated in clean dry Eppendorff tube to be stored at -80°C till assayed. The BAL of both sides and serum samples were assayed for ELISA estimation of levels of IL-1β [16], IL-6 [17], IL-10 [18] and TNF-α [19].

Statistical analysis

Sample Power was calculated according to Kraemer & Thiemann [20] using the proposed figure showed the sample size for 60% power would require an N of 26/group and 80% power would require an N of 31/group. This hypothesis was documented by Murphy & Myors [21]. Thus the current study sample size was chosen to be 28 patients per group. Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon; ranked test for unrelated data (Z-test) and Chi-square test (X^2 test). Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

Results

The study included 56 patients; 41 males (73.2%) and 15 females (26.8%) with mean age of 59±10.8; range: 30-73 years. Mean duration of disease was 3.9±0.4; range: 3-5 years. Mean body mass index was 31.8±3.2; range: 24.4-37.6 kg/m^2. Thirty-two patients were ASA grade II, 20 patients were ASA grade III and only 4 patients were ASA grade I. There was non-significant (p>0.05) difference between both groups as regards demographic and preoperative data, (Table 1).

Forty-two patients (75%) had lobectomy, 6 patients (10.7%) had sleeve lobectomy and 5 patients (8.9%) had segmentectomy, while only 3 patients (5.4%) required bi-lobectomy. Mean duration of surgery was 197.2±24.7; range: 135-240 minutes;

		Total	Group P	Group S	P value
Age (years)		59±10.8 (30-73)	59.6±10.2 (35-73)	58.4±11.6 (30-70)	P>0.05 (=0.676)
Gender	Male	41 (73.2%)	21 (75%)	20 (71.4%)	P>0.05 (=0.429)
	Female	15 (26.8%)	7 (25%)	8 (28.6%)	
Duration of disease (years)		3.9±0.4 (3-5)	4±0.5 (3-5)	3.8±0.3 (3.5-4.2)	P>0.05 (=0.676)
Body weight (kg)		89.3±6.5 (73-97)	89.2±7.1 (73-97)	89.4±6 (78-95)	P>0.05 (=0.838)
Body height (cm)		167.8±5 (159-182)	168.1±5.5 (159-182)	167.5±4.6 (160-180)	P>0.05 (=0.760)
Body mass index (kg/m^2)		31.8±3.2 (24.4-37.6)	31.7±3.5 (24.4-37.1)	31.9±2.9 (26.7-37.6)	P>0.05 (=0.936)
ASA grade	I	4 (7.1%)	2 (7.1%)	2 (7.1%)	P>0.05 (=2.575)
	II	32 (57.1%)	14 (50%)	18 (64.3%)	
	III	20 (35.8%)	12 (42.9%)	8 (28.6%)	

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

Table 1. Patients' enrolment data

mean duration of OLV was 178.6±25.5; range: 120-225 minutes and mean amount of intraoperative blood loss was 437.2±121.9; range: 250-710 ml. As regards the type of tumor; 34 patients (60.8%) had adenocarcinoma, 11 patients (19.6%) had large cell carcinoma and another 11 patients (19.6%) had squameous cell carcinoma. There was non-significant (p>0.05) difference between both groups as regards operative data and type of tumor, (Table 2).

Baseline hemodynamic data showed non-significant (p>0.05) difference between patients of both study groups. However, propofol anesthesia allowed significantly (p<0.001) lower blood pressure measures and heart rate both during two-lung and one-lung ventilation compared to sevoflurane anesthesia, (Table 3).

		Total	Group P	Group S	P value
Surgical procedures	Lobectomy	42 (75%)	20 (71.5%)	22 (78.6%)	p>0.05 (=0.119)
	Bi-lobectomy	3 (5.4%)	2 (7.1%)	1 (3.6%)	
	Segmentectomy	5 (8.9%)	3 (10.7%)	2 (7.1%)	
	Sleeve lobectomy	6 (10.7%)	3 (10.7%)	3 (10.7%)	
Duration of surgery (minutes)		197.2±24.7 (135-240)	196.2±22.7 (145-225)	198.1±26.9 (135-240)	P>0.05 (=0.129)
Duration of lung ventilation (minutes)		178.6±25.5 (120-225)	178.4±23.8 (125-215)	178.9±27.5 (120-225)	P>0.05 (=0.600)
Amount of intraoperative blood loss (ml)		437.2±121.9 (250-710)	399.6±92.2 (250-540)	474.8±137.2 (300-710)	P>0.05 (=1.843)
Type of tumor	Large cell carcinoma	11 (19.6%)	6 (21.4%)	5 (17.9%)	p>0.05 (1.451)
	Adenocarcinoma	34 (60.8%)	18 (64.3%)	16 (57.1%)	
	Squameous cell cancer	11 (19.6%)	4 (14.3%)	7 (25%)	

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

Table 2. Operative data

		Group P	Group S	Statistical significance
HR (beats/min)	Baseline	81.3±3.7	80.8±3.4	p>0.05
	TLV	73.6±3.4	76±5.9	p<0.05
	OLV_{15}	69.4±3	76.4±5.4	P<0.001
	OLV_{30}	68.3±3.4	76.6±5.9	P<0.001
SBP (mmHg)	Baseline	114.8±6.5	114±5.6	p>0.05
	TLV	92.2±6.9	104.3±6.8	p<0.001
	OLV_{15}	88.5±8.5	100±5.6	P<0.001
	OLV_{30}	83.4±6.9	95.7±5.1	P<0.001
DBP (mmHg)	Baseline	81.3±4.6	81.7±3.8	p>0.05
	TLV	75.9±3.6	77.8±3.2	p<0.001
	OLV_{15}	74.3±2.3	76.1±2.5	P<0.001
	OLV_{30}	72.8±2.4	74.6±2.1	P<0.001
MAP (mmHg)	Baseline	92.4±4.2	92.5±3.6	p>0.05
	TLV	81.3±3.5	86.5±3.1	p<0.001
	OLV_{15}	79±3.4	84±2.3	P<0.001
	OLV_{30}	76.4±2.7	81.6±2.2	P<0.001

Data are presented as mean±SD; TLV: two-lung ventilation; OLV: one-lung ventilation; HR: Heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; MAP: mean arterial pressure

Table 3. Intraoperative hemodynamic data during two-lungs and one-lung ventilation at 15- and 30-minutes compared to baseline data

Baseline serum levels and BAL levels of either the ventilated (BAL-V) or collapsed (BAL-C) lung of estimated cytokines showed non-significant (p>0.05) difference between both groups. Estimated serum TNF-α levels at the end of surgery were significantly (p<0.05) higher compared to that estimated prior to surgery with non-significantly (p>0.05) higher serum levels in patients of group P compared to group S. Mean BAL-C levels of TNF-α estimated at the end of surgery were significantly (p<0.05) higher in both groups compared to levels estimated prior to surgery with non-significantly (p>0.05) higher levels in group P compared to group S. On the other hand, mean BAL-V levels of TNF-α estimated at the end of surgery were significantly (p<0.05) higher in both groups compared to levels estimated prior to surgery with significantly (p<0.05) higher levels in group P compared to group S. Moreover, BAL levels of TNF-α estimated at the end of surgery in collapsed lung were non-significantly (p>0.05) higher, but were significantly (p<0.05) higher in ventilated lung compared to serum levels of the same patients, (Table 4, Fig. 1).

Estimated serum IL-1β levels at the end of surgery were significantly (p<0.05) higher compared to that estimated prior to surgery with non-significantly (p>0.05) higher serum levels in group P compared to group S. Mean BAL-V levels of IL-1β estimated at the end of surgery were significantly (p<0.05) higher in both groups compared to levels estimated prior to surgery with significantly (p<0.05) higher levels in group P compared to group S. On the other hand, mean BAL-C levels of IL-1β estimated at the end of surgery were significantly (p<0.05) higher in group P, but were non-significantly (p>0.05) higher in group S compared to levels estimated prior to surgery with significantly (p<0.05) higher levels in group P compared to group S. In both groups, mean BAL levels of IL-1β were significantly higher in ventilated lung compared to collapsed lung. Moreover, in group P, BAL levels of IL-1β estimated at the end of surgery both in collapsed and ventilated lungs were significantly (p<0.05) higher compared to serum levels of the same patients. On contrary, in group S, BAL levels of IL-1β estimated at the end of surgery were significantly (p<0.05) higher in ventilated lung, but non-significantly higher in collapsed lung compared to serum levels of the same patients (Table 4, Fig. 2).

Estimated serum IL-6 levels at the end of surgery were significantly (p<0.05) higher compared to that estimated prior to surgery with non-significantly (p>0.05) higher serum levels in group P compared to group S. Mean bilateral BAL levels of IL-6 estimated at the end of surgery were significantly (p<0.05) higher in both groups compared to levels estimated prior to surgery. Mean BAL-V level of IL-6 estimated at the end of surgery in group P was significantly (p<0.05) higher compared to group S, while mean BAL-C levels showed non-significant (p>0.05) difference between both groups despite being lower in group S. Moreover, bilateral BAL levels of IL-6 estimated at the end of surgery in both groups were significantly (p<0.05) higher compared to serum levels of the same patients (Table 4, Fig. 3).

Estimated serum IL-10 levels at the end of surgery were significantly (p<0.05) higher compared to that estimated prior to surgery with significantly (p<0.05) higher serum levels in group S compared to group P. Mean bilateral BAL levels of IL-10 estimated at the end of surgery were significantly (p<0.05) higher in both groups compared to levels estimated prior to surgery with significantly (p<0.05) higher levels in group S compared to group P. Mean BAL-V level of IL-10 estimated at the end of surgery in group S was significantly (p<0.05) higher compared to its level in BAL-C, while the difference was non-significant (p>0.05) in group P. Moreover, in group S, mean BAL levels of IL-10 estimated at the end of surgery in both lungs were significantly (p<0.05) higher compared to serum levels of the same patients; while in group P the difference was non-significant despite the higher BAL levels (Table 4, Fig. 4).

			Group P	Group S
TNF-α	Prior to surgery	Serum	2.3±0.66	2.25±0.65
		BAL-V	2.15±0.56	2.13±0.46
		BAL-C	2.1±0.51	2.08±0.53
	After surgery	Serum	3.2±1.13[a]	2.93±0.9[a]
		BAL-V	6.4±1.4[acd]	4.87±1.35[abcd]
		BAL-C	3.4±0.89[a]	3.14±0.97[a]
IL-1β	Prior to surgery	Serum	8.82±5.52	8.39±5.24
		BAL-V	10.86±4.21	11.21±7.5
		BAL-C	11±4.41	12±3.69
	After surgery	Serum	17.64±5.94[a]	13.93±4.79[a]
		BAL-V	59.14±30.52[acd]	17.86±4.26[abcd]
		BAL-C	26.75±14.9[ad]	13.14±3.17[b]
IL-6	Prior to surgery	Serum	16.5±6.3	19.3±8.7
		BAL-V	14.2±8	17.6±8.8
		BAL-C	16.2±8.5	15.5±5.7
	After surgery	Serum	24.9±6.5[a]	22.1±8.4[a]
		BAL-V	62.1±17[acd]	53.6±10.7[abd]
		BAL-C	55.6±14.8[ad]	50±19[ad]
IL-10	Prior to surgery	Serum	21.9±5.6	23±5.3
		BAL-V	23.3±7.8	25.7±6.9
		BAL-C	23.5±6.3	24.9±5.9
	After surgery	Serum	39.5±8.9[a]	49.9±11.3[ab]
		BAL-V	47±14.2[a]	68±12.1[abcd]
		BAL-C	43.2±11.8[a]	63.1±8.1[abd]

Data are presented as mean±SD; BAL-V: Broncho-alveolar lavage of ventilated lung; BAL-C: Broncho-alveolar lavage of collapsed lung; Preop.: Preoperative; PO: postoperative; TNF-α: Tumor necrosis factor-α; IL-6: Interleukin-6; [a]: significance versus preoperative level; [b]: significance versus Group P; [c]: significance versus BAL-C; [d]: significance versus serum level.

Table 4. Mean serum and BAL levels of studied cytokines in both studied groups estimated prior to and after surgery

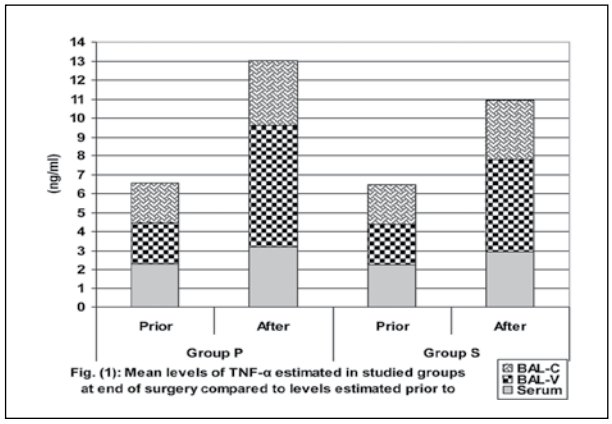

Fig. (1): Mean levels of TNF-α estimated in studied groups at end of surgery compared to levels estimated prior to

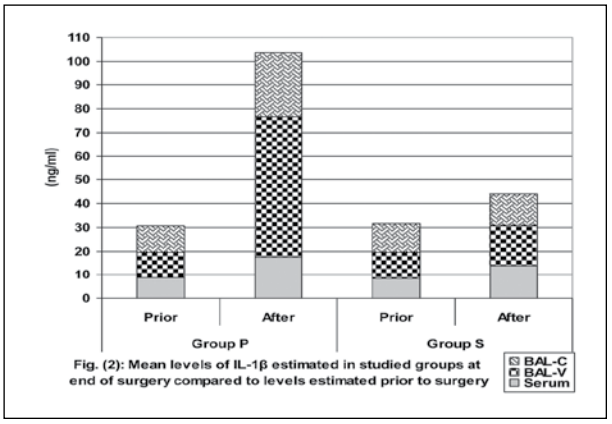

Fig. (2): Mean levels of IL-1β estimated in studied groups at end of surgery compared to levels estimated prior to surgery

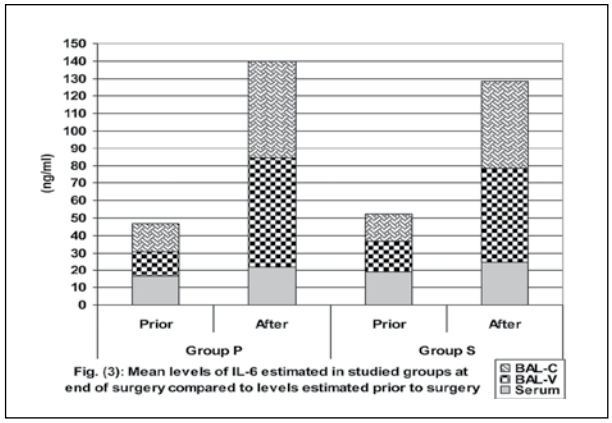

Fig. (3): Mean levels of IL-6 estimated in studied groups at end of surgery compared to levels estimated prior to surgery

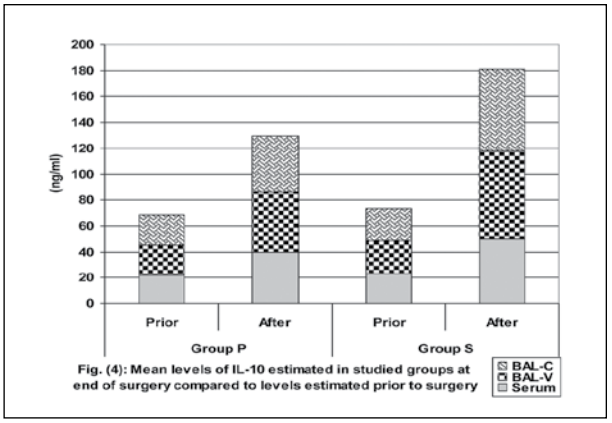

Fig. (4): Mean levels of IL-10 estimated in studied groups at end of surgery compared to levels estimated prior to surgery

Discussion

The current study showed that chest surgery triggers a vigorous systemic inflammatory response (IR) manifested as significantly higher levels of both pro- and anti-inflammatory cytokines estimated at the end of surgery in serum and locally in BAL and irrespective of anesthetic modality used. Moreover, the local IR was more fulminate than the systemic IR manifested as significantly higher BAL levels of cytokines estimated at the end of surgery compared to serum levels.

These findings supported that previously reported in literature concerning the impact of open chest surgery on IR; **Walker & Leaver** [22] documented that conventional open major surgery evokes an injury response involving endocrine, neural, and immunologic mechanisms with the immunologic responses are characterized by release of cytokines, inflammatory mediators, and acute-phase proteins and by adverse disturbances in immune cell function. **Bobocea et al.** [23] reported that prospective thoracoscopic lobectomy trials found better preservation of lymphocyte T-cell function and quicker return of proliferative responses to normal, lower levels of CRP, thromboxane and prostacyclin and concluded that immune function is influenced by the extent of surgical trauma. Also, **Leite et al.** [24] experimentally detected that OLV significantly increased myeloperoxidase activity in the collapsed and continuously ventilated lungs (31% and 52% increase, respectively) and serum IL-6 and CRP levels were markedly higher in OLV group compared with control.

The current study reported significantly higher BAL levels estimated at the end of surgery in ventilated lung compared to collapsed lung. These data indicated a possible role for OLV as a stimulant for IR exaggeration. In support of these findings; **Zingg et al.** [25] reported that both the ventilated and the collapsed lungs during OLV in transthoracic esophagectomy showed an inflammatory response which was more pronounced on the ventilated side and the response was already observed at the end of surgery, indicating a rapid reaction to the surgical and anesthetic trauma. **Breunig et al.** [26] found that both sides of the lung showed a significant increase in IL-6 and IL-1 receptor-A concentrations over time and concluded that the difference in extent of response underlines the complexity of the inflammatory processes during OLV. **Jonker et al.** [27] conducted clinical study for the impact of thoracic injury on local and systemic IR and found that injured patients had significantly higher BAL fluid and serum TNF-α, IL-1β, and IL-6 concentrations with greater increases in the BAL fluid

than in the serum and concluded that injury significantly increases human airway TNF-α, IL-1β, and IL-6 and increases are greater in the airway than in serum, implying a local rather than a systemic stress response to thoracic injury. **Leite et al.** [28] experimentally found that bronchial occlusion for 1 or 3 hours followed by lung re-expansion exhibited pulmonary edema formation and neutrophil recruitment as well as a higher myeloperoxidase activity with increased levels of IL-6, IL-1β, and TNF-α in BAL fluid in comparison with control rats.

Sevoflurane significantly ameliorated the effects ventilation on local pulmonary IR as manifested by significantly lower BAL levels of TNF-α, IL-1β and IL-6 in both lungs at the end of surgery in patients received sevoflurane compared to those received propofol. In support of these data; **De Conno et al.** [29] reported an immuno-modulatory role for the volatile anesthetic sevoflurane in patients undergoing OLV for thoracic surgery with significant reduction of inflammatory mediators and a significantly better clinical outcome during sevoflurane anesthesia with the increase of inflammatory mediators on OLV was significantly less pronounced in the sevoflurane group. **Schilling et al.** [30] reported that alveolar pro-inflammatory cytokines were increased in the ventilated lung after OLV and the mediator release was more enhanced during propofol anesthesia compared with desflurane or sevoflurane administration with significantly higher levels of TNF-α, IL-8 and IL-1β, whereas the systemic proinflammatory response was negligible, and concluded that OLV increases the alveolar concentrations of proinflammatory mediators in the ventilated lung, but both desflurane and sevoflurane suppress the local alveolar, but not the systemic inflammatory responses to OLV and thoracic surgery. **Sugasawa et al.** [31] reported that BAL levels of IL-1β, IL-6, and IL-8 were significantly increased in the dependent lung and the nondependent lung after OLV compared with baseline levels; moreover, IL-6 BAL level in the dependent lung was significantly higher in the propofol group than in the sevoflurane group after OLV and concluded that OLV induced inflammatory responses of the bronchial epithelia in both lungs during lung resection and this inflammatory response was significantly suppressed by sevoflurane compared with propofol and the anti-inflammatory effect of sevoflurane was more pronounced in the dependent lung than in the nondependent lung during OLV. **Schmid et al.** [32] tried to explore the immuno-modulatory action of sevoflurane and found that sevoflurane inhibits granulocyte activation during ex vivo extracorporeal circulation and therefore has the potential to decrease the triggered inflammatory response.

It could be concluded that chest surgery using OLV triggers vigorous inflammatory response in both ventilated and collapsed lungs. This response was manifested at the end of surgery and was more pronounced locally than systemically. Sevoflurane inhalational anesthesia significantly suppressed such local immune response compared to propofol and is advocated for anesthesia for chest surgery

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Povidone-iodine Pleurodesis versus Talc Pleurodesis in Preventing Recurrence of Malignant Pleural Effusion

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Objectives: **To compare the efficacy, safety, and outcome of Talc Powder Pleurodesis (TPP) with Povidone-iodine Pleurodesis (PIP) through a chest drain as a palliative preventive treatment of recurrent malignant pleural effusion.**

Methods: **A total of 39 neoplastic patients with recurrent malignant pleural effusion were enrolled in a prospective randomized trial. Twenty-one patients received Talc pleurodesis (group A), and eighteen patients (group B) underwent pleurodesis by instilling Povidone-iodine through a thoracotomy drain.**

Results: **Our study included 11 males and 28 females, the mean age was (71.0 ± 5.0) years for group A and (70.9 ± 5.1) years for group B (non-significant). Post-procedure analgesic requirements were recorded in both groups. Four patients in each group had fever (>38°C) within 48 hours of the procedure. Both groups achieved good symptomatic relief. There were no in-hospital deaths. The mean post-procedure hospital stay was (4.7 ± 1.2) days for group A and (4.2 ± 1.0) for group B (non-significant). At follow-up recurrence of significant pleural effusion requiring intervention was noted in four and five patients in group A and group B, respectively (non-significant difference).**

Conclusion: **Povidone-iodine pleurodesis can be considered as a good alternative to Talc pleurodesis for recurrent malignant pleural effusion. The drug is available, cost effective, safe and can be administered through a thoracotomy drain and repeated if necessary.**

KEYWORDS: **Pleural airleak/effusion; Pleural space (drainage, management).**

Pleural effusion is the accumulation of fluid in the pleural space caused by many conditions, the commonest of which are; congestive heart failure, pneumonia and malignancy [1]. Malignant pleural effusions continue to be a common problem in patients with metastatic disease, leading to a significant reduction in quality of life with progressive dyspnea, dry cough, chest pain and reduced physical activity [2]. The commonest cause of malignant pleural effusion is bronchogenic carcinoma followed by metastatic breast cancer [3]. The management of recurrent malignant pleural effusions is palliative, and should be aiming at improving the quality of life with minimal complications. The aim of pleurodesis in these patients is to prevent re-accumulation of the effusion and thereby of symptoms, and avoid the high cost and physical and emotional trauma caused by repeated hospitalization for thoracocentesis [4].

Over the past several years, chemical pleurodesis has evolved as the most widely accepted treatment method for these conditions [5]. There are a wide variety of agents available for pleurodesis, such as tetracycline derivatives (doxycycline or minocycline), talc (insufflation or slurry), bleomycin, mitoxantrone, nitrogen mustard, silver nitrate, iodopovidone, dry killed Corynebacterium parvum and OK-432 (obtained from the Su strain of Streptococcus pyogenes) [6]. Like any other drug, the criteria for selection of the agent for pleurodesis include its effectiveness, affordability, availability, ease of administration and safety profile [7].

Many reports showed talc pleurodesis as the surgical pleurodesis of choice for recurrent malignant effusion, with a reported success rate of 90% [8, 9]. In Egypt,

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however, the use of talc powder has been disapproved and it remains unavailable in the Egyptian market [4]. Instead, bleomycin, which is expensive and less effective, is being used.

Povidone–iodine (in a 10% solution), which is primarily used as a topical antiseptic agent, has recently been shown to be an inexpensive, easily available, safe, and mostly effective alternative sclerosing agent in some series [5]. It also can be infused, with excellent tolerance, through intercostal drain under local anesthesia and repeated, if necessary [4].

This study was conducted to compare the efficacy, safety, and outcome of Talc Powder Pleurodesis (TPP) with Povidone-iodine Pleurodesis (PIP) through a chest drain as a palliative preventive treatment of recurrent malignant pleural effusion

Patients and methods

This study was conducted at the cardiothoracic Surgery department in Menofia University Hospitals between January and November 2013. A total of 39 patients with malignant pleural effusion were enrolled in a prospective randomized control trial, after informed consent was obtained from each patient. All patients diagnosed (clinically and histo-pathologically) with recurrent malignant pleural effusion were included in our study. Patients with allergy to iodine and those with incompletely inflated lung on radiograph were excluded from the study.

Therapeutic thoracocentesis was performed in all patients, and the drained pleural fluid amounts were recorded and sent for physical, biochemical, bacteriological and cytological evaluation. Patients were then randomized into two groups; group A (21 patients) with Talc pleurodesis, and group B (18 patients) with Povidone-iodine pleurodesis.

1.1. Technique of pleurodesis

After insertion of wide-pore chest drain (size 28F - 36F) under local anesthesia and allowing for free drainage of pleural fluid over 6 - 12 hours, chest radiograph were done to confirm the drainage of fluid and inflation of the lung.

For patients in group A, a dose of 4 - 5 grams of sterile, asbestos-free talc (Steritalc® F2, manufactured by Novatech, France) in 50 ml of normal saline were instilled through the chest drain. The chest drain was clamped for 6 hours after talc instillation.

For patients in group B, 20 ml of 10% Povidone-iodine (Betadine®, manufactured by Nile Co. for Pharmaceuticals and Chemical Industries, Cairo, Egypt; licensed by Mundi Pharma AG, Basel, Switzerland) mixed with 10 ml of lidocaine 1% and 30 ml of normal saline were instilled through the chest drain, which was clamped for 6 hours as well.

Chest drains were removed when the chest radiograph confirmed satisfactory lung expansion, and the total 24-hour drainage was less than 100 ml, with no air leak. Another chest radiograph was done for all patients few hours post chest drain removal and if satisfactory, patients were discharge on the same day.

Follow-up:

All patients were followed-up in the out-patient clinic, after 2 weeks, 2 months and 6 months. The efficacy of pleurodesis was defined in three levels of response: complete (absence of pleural fluid re-accumulation), partial (residual pleural fluid or re-accumulation, which did not require further drainage or remained asymptomatic), and failed (additional pleural procedures were necessary).

A normal chest radiograph or radiological re-accumulation of pleural fluid without recurrence of dyspnea or the need for drainage was reported as a success.

Statistical analysis

The continuous variables were expressed as mean values ± standard deviation (SD) and compared using the unpaired t-test. The discrete variables were compared using the chi-square test ($\chi 2$) test. p-values of less than 0.05 were considered significant.

Results

A total of 39 patients with malignant pleural effusion were enrolled during the study period and randomized into two groups; twenty-one patients in group A, underwent Talc powder pleurodesis, while eighteen patients in group B underwent Povidone-iodine pleurodesis through the intercostal chest drain.

They were 11 males (28.2%) and 28 females (71.8%). Their ages ranged from 65 - 80 years. There was no statistically significance difference between both groups regarding sex, age, height, weight and BMI (table 1).

	Group A N: 21 patients	Group B N: 18 patients	*p* value
Sex Male * Female *	 7 (33.3%) 14 (66.7%)	 4 (22.2%) 14 (77.8%)	0.442
Age (years) ^	71.0 ± 5.0	70.9 ± 5.1	0.949
Weight (kg.) ^	77.9 ± 5.3	77.1 ± 5.7	0.652
Height (cm.) ^	174.0 ± 5.5	174.7 ± 5.5	0.687
BMI ^	25.3±1.9	24.8±1.8	0.428

**: Number (%)* *^: mean ± SD*

Table 1. Demographic Data:

There was no statistically significance difference between both groups regarding pre-pleurodesis medical history (table 2). Regarding patients complaints; dyspnea was present in 38 patients (97.43%), while cough was present in 15 patients (38.46%) and chest pain occurred in 19 patients (48.71%) with no statistically significance difference between both groups (table 2). Also, there was no statistically significance difference between both groups regarding history of thoracocentesis (number of thoracocentesis per month, amount drained, number of days before recollection and relief of symptoms). The mean total pleural fluid drained ± SD was (2.7 ± 0.5 L) and (2.8 ± 0.4 L) for groups A and B, respectively with no statistically significant difference.

	Group A N: 21 patients	Group B N: 18 patients	p value
Primary tumor			
Lung *	5 (23.9%)	6 (33.3%)	0.480
Breast *	9 (42.9%)	9 (50%)	
Unknown *	7 (33.3%)	3 (16.6%)	
Symptoms			
Dyspnea *	20 (95.3 %)	18 (100%)	0.348
Cough *	8 (38.1 %)	7 (38.8%)	0.959
Chest pain *	10 (52.3%)	9 (50 %)	0.882
Previous thoracocentesis			
Number/month ^	4.7 ± 1.8	4.7 ± 1.5	0.926
Total amount (liters) ^	2.7 ± 0.5	2.8 ± 0.4	0.246
Re-collection after (days) ^	6.1 ± 2.3	6.7 ± 1.5	0.421
Relief of symptoms *	21 (100%)	18 (100%)	1.00
Complete lung inflation *	21 (100%)	16 (87.8%)	0.117

*: Number (%) ^: mean ± SD

Table 2. Pre-pleurodesis medical history:

There was no statistically significance difference between both groups regarding physical and cytological analysis of pleural fluid (type of effusion, character and cytology) (table 3). There was no statistically significance difference between both groups regarding biochemical analysis of pleural fluid (LDH content and total protein) (table 3).

There was no statistically significance difference between both groups regarding post-pleurodesis success rate and response to treatment (table 4). There was no statistically significance difference between both groups regarding post-pleurodesis complications (pain, fever, and allergy to the agent) (table 4). The most common post-pleurodesis complication was pain (encountered in 14 patients and 9 patients in group A and group B respectively). Post-pleurodesis fever was recorded in 4 patients in each group (table 4).

	Group A N: 21 patients	Group B N: 18 patients	p value
Type of effusion			0.493
Exudative *	4 (19.2%)	2 (11.2%)	
Transudative *	17 (80.8%)	16 (87.8%)	
Character			0.447
Hemorrhagic *	14 (66.7%)	10 (55.6%)	
Serosanguinous *	7 (33.3%)	8 (45.4%)	
Cytology			0.458
Positive malignant cells *	20 (95.3%)	16 (87.8%)	
No malignant cells *	1 (4.7 %)	2 (11.2%)	
LDH content (IU/L) ^	220.0 ± 95.5	296.8 ± 75.1	0.209
Total protein (g/L) ^	93.1 ± 55.6	107.0 ± 59.9	0.457

*: Number (%) ^: mean ± SD

IU/L: International Unit per Liter g/L: gram per Liter

Table 3: Physical, cytological & biochemical analysis of pleural fluid:

	Group A N: 21 patients	Group B N: 18 patients	p value
Success rate *	17 (80.9 %)	13 (72.2%)	0.519
Response to treatment			0.201
Complete inflation *	15 (71.4%)	12 (66.7%)	
Partial inflation *	2 (9.6%)	1 (5.5%)	
Failure *	4 (19%)	5 (27.8)	
Complications			
Pain (comparative pain scale)			0.291
No pain *	7 (33.3%)	9 (50%)	
Mild pain (1-3) *	12 (57.1%)	9 (50%)	
Moderate pain (4-6) *	2 (9.5%)	0	
Severe pain (7-10) *	0	0	
Fever *	4 (19.2%)	4 (22.3%)	0.807
Allergy to agent *	2 (9.6%)	0	0.179
Post-procedure hospital stay(days) ^	4.7 ± 1.2	4.2 ± 1.0	0.172
Recurrence of dyspnea *	4 (19%)	5 (27.7%)	0.519

*: Number (%) ^: mean ± SD

Table 4: Post-procedure data

During the long-term follow up there was recurrence of dyspnea in 4 cases with talc powder pleurodesis (19%) and in 5 cases with Povidone-iodine pleurodesis (27.7%) with no statistically significant difference between both groups.

There was no statistically significance difference between both groups regarding the post-pleurodesis hospital stay (table 4).

There was one mortality recorded in group A with the cause of death related to the primary tumor not the pleurodesis. No mortality was recorded in group B.

DISCUSSION

Recurrent and symptomatic pleural effusions are common in patients with malignancy. Up to 25% of patients with lung cancer and 50% of patients with breast cancer will develop a pleural effusion. Overall, mesothelioma, breast and lung cancer, account for the majority of malignant pleural effusions. According to underlying disease, many patients with malignant pleural effusion may live for months or even years. These patients' quality of life is therefore of much importance and the aim of treatment should be beside the management of the primary disease, is to relieve symptoms, and to decrease the discomfort of the patient [10]. The necessity for repeated aspirations to relieve dyspnea is both physically and psychologically traumatic to the patient and a burden to the physician. Therefore, the majority of patients will need a procedure to remove the fluid and prevent recurrence [11]. Treatment options for malignant pleural effusions are determined by several factors: symptoms and performance status of the patient, the primary tumor and its response to systemic therapy, and lung re-expansion following pleural fluid evacuation [12].

Pleurodesis is considered the best palliative therapy for the treatment of recurrent malignant pleural effusions [13]. Several techniques and various agents have been used for this purpose, with variable efficacy and safety [14]. Talc, tetracycline and bleomycin have been widely used for pleurodesis. Many studies have shown the effectiveness and safety of Povidone-iodine as an agent for pleurodesis with achieving very good results [3, 15].

Our study included 39 cases divided into two groups; group A had talc pleurodesis and group B had Povidone-iodine pleurodesis. They were 11 males (28.2%) and 28 females (77.8%) with no statistical significant difference between both groups regarding sex. Our study patients' ages ranged from 65-80 years. Mean ±SD (71.0 ± 5.0 for group A and 70.9 ± 5.1 for group B).

Regarding etiology, our study included 18 cases breast cancer (9 cases with Talc, 9 cases with Povidone-iodine), 11 cases lung cancer (5 cases with Talc. 6 cases with Povidone-iodine) and 10 cases with unknown primary with no statistical significant difference between both groups. Das SK et al. study included 41 patients secondary to bronchogenic carcinoma, 8 secondary to breast carcinoma, 1 non-Hodgkin's lymphoma, and unknown primary malignancy in 2 patients [16].

Regarding patients' complaints: the most common symptom in our study was dyspnea (100%) of cases followed by cough which occurred in 15 cases, and chest pain that occurred in 19 cases. Occurrence of dyspnea can be explained as moderate to massive pleural effusion causing compression on the lung. Also presence of cough and chest pain in some cases can be explained by the massive effusion, pleural irritation and chest infection with no statistical significant difference between both groups.

Routine thoracocentesis was done for symptomatic relief and diagnostic analysis of pleural fluid. Our study revealed that our cases were reported with number of thoracocentesis ranging from 3-8 times per month with total amount of fluid drained by thoracocentesis (2700 ± 500 ml in group A, 2800 ± 400 ml in group B) with re-collection after 2 - 10 days (Group A) and 5 - 10 days (Group B) with no statistically significant difference between both groups.

In our study pleurodesis as a palliative treatment was attempted after complete re-expansion of the lung after drainage of pleural fluid through wide pore intercostal chest drain. During early follow-up, the success rate was recorded in 17 cases (80.9%) in group A and 13 cases (72.2%) in group B (p= 0.519) with no statistical significant difference between both groups.

Regarding the response to treatment in group A there was complete response with no fluid re-accumulation in 15 patients (71.4%), and partial response in two patients (9.6%) with radiologically detected re-accumulation of minimal to mild amount at 2 months post procedure but never developed any clinical dyspnea during the follow-up and failure in 4 cases (19%) with recurrence of dyspnea and radiologically detected re-accumulation of moderate to massive pleural effusion. In group B, there was complete response with no fluid re-accumulation in 12 patients (66.7%), and partial response in one case (5.5%) who developed re-accumulation of fluid but never developed any clinical dyspnea, and failure in 4 cases (19%) with recurrence of dyspnea and radiologically detected re-accumulation of moderate to massive pleural effusion with no statistically significant difference between both groups.

Mohsen et al. studied 44 patient with malignant pleural effusion secondary to breast cancer, divided into 2 groups using VATS talc pleurodesis in one group and bedside povidone-iodine in the other group. His study results match with our study regarding the success rate between both groups [4]. In a meta-analysis conducted by Agrawal et al. the success rate of Povidone-iodine pleurodesis was 90.6% which is almost equal to the efficacy of talc pleurodesis [14].

Regarding response to treatment, Mohsen et al. study reported fluid re-accumulation in 19 patients of group A (87%), and partial response in one patient (4%) and failure response in two patients (9%) while In group B with Povidone-iodine pleurodesis, there was complete response with no fluid re-

accumulation in 17 patients (85%) at the early post-procedure follow-up, and failure response in three patients (15%) with no statistically significant difference between both groups which agrees with our study [4].

Regarding the complications of our procedure, Chest pain and fever were the most common adverse effects in both groups. In our study chest pain was recorded in 14 cases of group A and 9 cases of group B. Fever was the second most common complication with our procedure as 4 cases of group A and 4 cases of group B and anti-pyretic was given with close follow-up and fever subside with no more side effects until removal of the drain and discharge with no statistically significant difference between both group .

Mohsen et al agree with our results regarding post-operative complications as chest pain was the most common complications (4 cases only with talc pleurodesis) followed by fever (4 cases with talc pleurodesis, a single case with Povidone-iodine pleurodesis) but without a significant difference [4].

Concerns that Povidone-iodine might be associated with visual loss were reported by Wagenfeld et al. in three cases during VATS. However, authors used an unusual large amount of 200 - 500 ml of 10% Povidone-iodine [17]. They also noted that the safe amount to be used is 20 ml of 10% iodine, which is the amount that we have used in our study. As an additional safety precaution, we administered this dose in a diluted form (in normal saline).

In our study the hospital stay was ranging from 3 - 6 days in most cases with no statistical significant difference between both groups. Mohsen et al. study match with our results regarding the hospital stay as they were 3 - 7 days for talc pleurodesis and 2 - 6 days for Povidone-iodine pleurodesis with no statistically significant difference between both groups [4].

There was one mortality recorded in group A with the cause of death related to the primary tumor and not the pleurodesis. No mortality detected in group B.

CONCLUSION

Based on the results of our study, Povidone-iodine was shown to be an efficient pleurodesis agent and demonstrated a good safety profile in treating malignant pleural effusions with a good success rate and few minor complications. Therefore, it can be considered as a cost effective alternative sclerosing agent for pleurodesis when talc is not available or contraindicated.

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Pentalogy of Cantrell: Case report

Case Report

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Ectopia cordis is a rare clinical condition that means exteriorization of the heart outside the thoracic cavity. It is classified into partial and complete forms. Pentalogy of Cantrell is a partial form of ectopia cordis and comprises an association of anomalies that includes : deficiency of the anterior diaphragm, defect of anterior diaphragmatic pericardium, defect of the lower sternum, defect in midline supra umbilical abdominal wall and congenital cardiac abnormalities. We present here a two years old female infant with pentalogy of Cantrell presented with symptoms of heart failure in addition to a characteristic pulsating swelling in the upper abdomen.

KEY WORDS: **Cantrell pentalogy, Ectopia cordis, pediatric**

Ectopia cordis is a rare clinical condition that means exteriorization of whole or part of the heart outside the thoracic cavity It is classified into partial and complete forms according to the extent of midline defect, also it is varied between thoracic, abdominal, cervical and combined varients (1). Pentalogy of Cantrell is a partial form of ectopia cordis and comprises an association of anomalies that includes : deficiency of the anterior diaphragm, defect of anterior diaphragmatic pericardium, defect of the lower sternum, defect in midline supra umbilical abdominal wall and congenital cardiac abnormalities (2). So, it is considered as a partial form, thoraco abdominal variant of ectopia cordis but itself is varied between three classes, Class 1: Exact diagnosis, with the 5 present defects**,** Class 2: Probable diagnosis, with 4 defects (including intracardiac and abdominal wall defects)**,** Class 3: Incomplete diagnosis, with combination of the defects (always accompanied by sternal defects) (3). The exteriorized part is usually a ventricular diverticulum and cardiac defects varies between simple lesions like atrial septal defect (ASD) and complex lesions as fallot tetralogy (2) . Diagnosis and management should be tailored for each patient and depend on; age at presentation, severity of cardiac defects and severity of associated extracardiac malformations (2,4).

Case report:

We present here a two years old female infant with class 1 pentalogy of Cantrell presented with symptoms of heart failure in addition to a characteristic pulsating swelling in the upper abdomen coincident with the heart beats. Echocardiography revealed left ventricular (LV) apical diverticulum, abnormal ventricular relationship with LV is more anterior and midline apex, large apical ventricular septal defect (VSD), marked biventricular enlargement, Severe pulmonary hypertension, impaired myocardial functions (LVEF= 35%) and Moderate mitral and tricusbid incompetence. Computed tomography (CT) also was done and revealed the apical diverticulum protruded into the upper abdomen and the lower sternal defect (figure, 1). The surgical strategy consisted of; single stage repair, full hypothermic cardiopulmonary bypass (CPB) and cold blood cardioplegia (CP), resection of LV diverticulum (figure, 2), trans diverticulectomy synthetic patch closure of the apical VSD using interrupted teflon pledgetted 5 0 prolene sutures (figure, 3) , direct closure of the apical ventricular defect between two Teflon stripes (figure, 4) and direct repair of the diaphragmatic, abdominal wall and sternal defects.

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Results

The operative and early post operative data regarding; X clamp time, CPB time, mechanical ventilation time, ICU and Hospital stay are grouped in (table 1). The pre discharge and early follow up (two month) echocardiography was nearly the same with EF is 40 %, Cardiomegally, Mild MR, moderate TR**.** Clinically, the pulsating abdomial Swelling disappeared completely with only Mild symptomatic improvement ,so; the patient is still on maximized medical treatment.

X clamp time	72 minutes
CPB time	100 minutes
Support	dobutamine; 10 mug/kg / minute, milrinone : 0.5 mug/kg/ minute
Mechanical v	24 hours
ICU stay	5 days
Hospital stay	13 dayes

Table (1). The operative and early post operative data

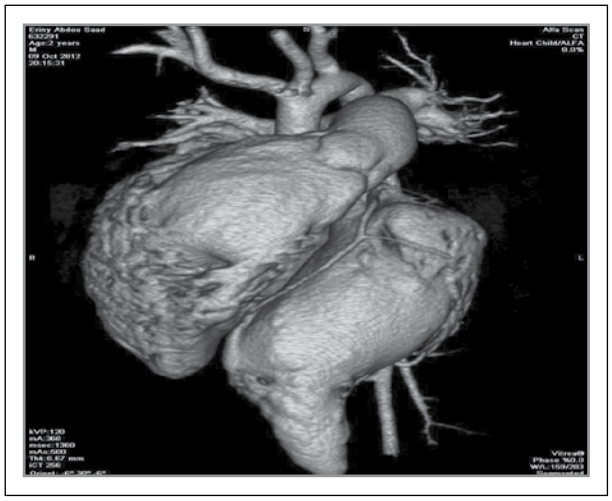

Fig 1. CT Pentalogy of Cantrell

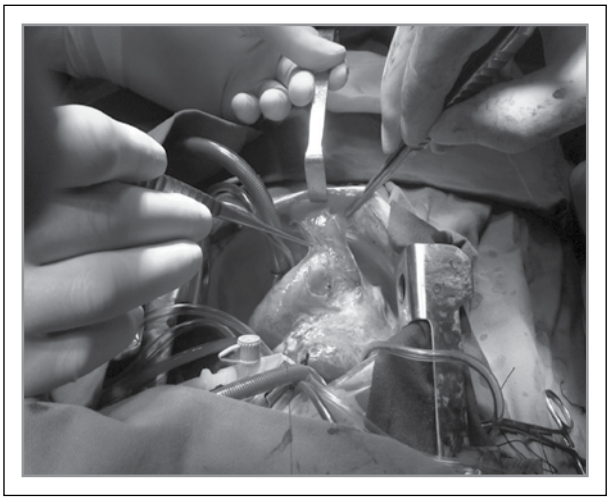

Fig 2. Operative view: apical diverticulum protruding into upper abdomen.

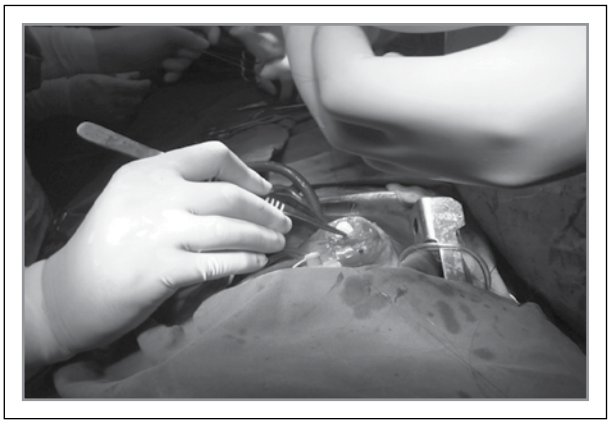

Fig 3. Operative view: VSD closure.

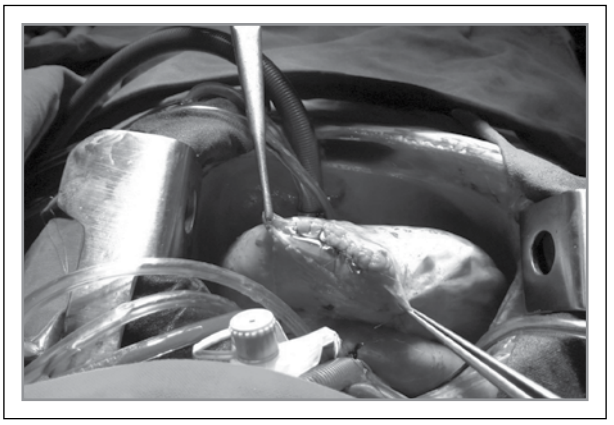

Fig 4. Operative view: closure after diverticulectomy

Case Report

Conclusion

There are several reports about repair of pentalogy of Cantrell and the outcome of repair varies and depends mainly on severity of cardiac defects, size of the exteriorised part and the associated extracardiac anomalies ,so; the surgical strategy should be tailored for each patient but the main issues remain concerning ; single versus staged repair, reduction versus resection of the exteriorized part and direct closure versus augmenting the wall defect

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