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THORACIC

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 " 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.

In addition, each author must indicate whether or not he has had full "freedom of investigation" which is defined as freedom from outside interests in controlling the design of the study, acquisition, analysis, and interpretation of data and having freedom to fully disclose all results.

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Each author must certify that none of the material in this manuscript has been published previously in either print or electronic form, and that none of this material is currently under consideration for publication elsewhere. This includes symposia and preliminary publications of any kind except an abstract of 400 words or fewer.

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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 Receipt: The "received for publication" date is the date when the editorial office receives the manuscript, the cover letter, and the Copyright Transfer and Author Declaration Statement, signed by all authors. The revised manuscript on disk and all camera-ready figures.

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

Acceptance of a Manuscript for Review

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

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.

Early and Intermediate Results of Combined Coronary Artery Bypass Grafting and Valve Replacement

Cardiovascular

Hatem A. Moneim Elsorogy, M.D.,

Wael A.Aziz A.Hamid1 M.D.,

Shaaban Abdul_Aziz Abul_Ela, M.D.,

Sameh M. Amer, M.D

Background: **Myocardial revascularization associated with valve replacement represents a surgical challenge. The conduct and the strategy of the operation differ greatly than when performing surgery for isolated CABG. The presence of atherosclerotic heart disease may severely worsen the prognosis after valve replacement. So combined lesions should be treated simultaneously. Good preservation of the myocardium during such operations represents the corner stone for the success of these operations. Earlier studies of simultaneous valve replacement and CABG showed a higher risk for the combined procedure.**

Objectives: **The purpose of this prospective study was to evaluate the outcome of coronary artery bypass grafting alone versus coronary artery bypass grafting with valve replacement surgery in terms of the early and intermediate results of the surgical interference. More importantly was to establish a protocol to optimize the results of this combined surgery through modifications in the surgical technique, myocardial preservation and the sequence of operation.**

Patients and methods: **This study was done in Cardiothoracic Surgery Department, Mansoura Faculty of Medicine, Cardiac Surgery Unit, Nasser Institute for Research and Treatment and Sheikh Zayed Specialized Hospital, Cairo, from October 2011 to April 2014; patients were divided into two groups. Randomly 50 patients with coronary artery disease who were subjected to myocardial revascularization only (group 1). On other hand randomly 50 patients with coronary artery disease with valve abnormalities who were subjected to myocardial revascularization and replacement of the diseased valve (group 2).**

Results: **There was statistically significant difference regarding cross clamp (XC) time, cardiopulmonary bypass (CPB) time and ICU stay. Regarding postoperative complications there was a statistically significant increase in the incidence of low cardiac output. Comparison of postoperative EF, NYHA class and mortality in both groups showed that there was no statistically significant difference.**

Conclusions: **Combined valve replacement and CABG is a common surgical procedure with good early and intermediate results regarding morbidity and mortality compared with patients underwent isolated CABG. Improvement in surgical techniques will shorten the XC time and CPB time which will have a positive impact on the results of combined operations.**

Key words: **CABG, Combined valve replacement.**

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Continuous aging of the population of coronary artery bypass grafting (CABG) candidates increases the proportion with associated valve disease requiring operative correction, and vice versa.[1] The interaction between the pathophysiologies of valvular heart disease and coronary artery disease is complex as valvular heart disease affects ventricular function. Coronary artery disease affects the ventricular morphology and physiology and leads to decrease in contractile strength and regional myocardial infarction may lead to distortion of ventricular shape with resulting effects on ventricular function and valve performance. In patients with valvular heart disease, coronary obstructions may

be symptomatic or asymptomatic, but the decision to intervene surgically is made regardless of the presence of symptoms.[2] Combined coronary artery and valve operations usually have a higher risk for early and late mortality than operations for valvular heart disease alone, more recent experience has shown improved results in terms of early mortality.[3]

Patients and methods

We conducted this study to compare the early and intermediate postoperative course of two randomized groups of patients who underwent myocardial revascularization alone or with valve replacement. This study was done, between October 2011 and April 2014 in Cardiothoracic Surgery Department, Mansoura Faculty of Medicine, Cardiac Surgery Unit, Nasser Institute for Research and Sheikh Zayed Specialized Hospital, Cairo. The study approved by Ethical Committee of Mansoura Faculty of Medicine. All patients provided informed consent for inclusion in the study. Included in this study all patients with IHD alone or associated with valve abnormalities who were subjected to elective myocardial revascularization alone or with valve replacement. Excluding patients with valve reconstruction, recent infarction in the last month, Redo CABG, Redo valve surgery, associated aortic artery aneurysm or LV aneurysm and Liver impairment.

The 100 patients were classified into 2 groups; each included 50 patients; the first group included randomly 50 patients with coronary artery disease who were subjected to myocardial revascularization only (group 1); while the second group included randomly 50 patients with coronary artery disease with valve abnormalities who were subjected to myocardial revascularization and replacement of the diseased valve (group 2).

Patients were evaluated with the aid of daily follow up. Pre-operative and 6 months post-operative Echo and NYHA class evaluations were done. All patients were subjected to cardiac catheterization within 6 month. Coronary artery disease was defined as 50% or greater narrowing of diameter in a coronary artery.

Preoperative data

These data included the routine demographic data, risk factors, present history (chest pain, dyspnea and its grade according to New York Heart Association (NYHA) class, data from past, family and present history. Echocardiography was done for each patient. The different dimensions of the cardiac chambers were measured as well as the LV ejection fraction [Good ($\geq$ 50%),Fair (31-49%) and Poor ($\leq$ 30%)], regional wall motion abnormalities, evaluation of the valves were documented (rheumatic, degenerative, ischemic, congenital, others). All patients were subjected to cardiac catheterization within 6 month.

Surgical technique

The routine CABG technique was applied to all patients. All cases were operated upon on-pump. Cardioplegia infused into the ascending aorta at 4°C with a pressure of 200 mmHg. Induced cardiac standstill was usually achieved within one minute. In cases of extensive occlusion of the native coronary arteries, retrograde cardioplegia was used to augment the antegrade dose; also supplemental doses of cardioplegia at low pressure (100 mmHg) were infused through the vein grafts after the distal anastomoses. Graft harvesting was done first then aorto-caval cannulation was then performed and an aortic root cannula was inserted for cardioplegia administration, venting and de-airing. The distal anastomosis of the internal mammary artery graft and all other conduits were made before valve replacement. In aortic valve replacement with CABG, Left ventricular vent was inserted. When all the distal anastomoses were complete, the ventricles may be wrapped in a cooling pad, after which the aortic root was opened, the diseased valve was removed and aortic valve replacement was carried out using the prosthesis of choice. In mitral valve replacement with CABG, Bicaval cannulation for superior and inferior vena cava was done, then left atriotomy or trans-septal approach was done, the diseased valve was removed and mitral valve replacement with or without preservation was carried out using the prosthesis of choice. In double valve replacement with CABG, the aorta was opened and the aortic valve was resected. Replacement of the mitral valve was done first then aortic valve replacement. The atrium was closed with a vent across the mitral valve. The replacement valve could be either mechanical or biological tissue valve. The proximal anastomoses were performed while the aortic XC still in place. So single clamp technique was prolonging the ischemic time but avoided application of a second clamp to the aorta with disruption of atheromatous debris or injury to the aortic suture line. After completion of all anastomoses and establishing a stable intrinsic or paced cardiac rhythm, metabolic optimization, appropriate pharmacologic support, and the initiation of effective mechanical ventilation the patient was weaned from CPB.

Postoperative data

All patients were admitted to cardiac intensive care unit (ICU) intubated and mechanically ventilated till extubated, transferred to the ward and then discharged from the hospital. Operative data (XC time, CPB time, the type of prosthetic valve and the No of grafts) were collected. Postoperative data were collected in the form of: the duration of ICU stay, duration of hospital stay, duration of mechanical ventilation, pulmonary complications, neurological complications, blood loss, infections and low cardiac output (LCOP) state in the form of use of intra-aortic balloon pump (IAB) required for weaning patient from CPB or intravenous inotropic support required for more than 24 hours postoperatively, or added in ICU after optimizing preload, and afterload as well as correcting all electrolyte and blood gas abnormalities. Early mortality

(hospital mortality): was death within 30 days of operation regardless of the patient's geographic location.

Patients were evaluated 6 months after surgery by: NYHA class, echocardiography, follow up of complications if any and mortality.

Statistical Analysis

The completed questionnaire were revised and data were coded, processed and analyzed through SPSS (Statistical Package for Social Sciences) (Standard version release 16.0). Descriptive statistics in the form of frequencies and percent were used for qualitative data. Quantitative Continuous data were summarized by (mean median –standard deviation). One sample K-S test was used to test normal distribution of data. Independent t test to compare between 2 means. Chi Square was used for testing significance of discrete and categorical variables. $P \leq 0.05$ was considered as the level of statistical significance. Mc Nemar test was used to compare dichotomous variables before and after operation .Paired t test was used to compare 2 means before and after operation.

Results

Preoperative Assessment

Demographic data of both groups showed that 33 male and 17 female patients were included in group 1 with a mean age of 57.5 ± 6.8 years while 36 male and 14 female patients were included in group 2 with a mean age of 58.04 ± 6.3 years. Comparative preoperative clinical data on the patients regarding demographic data, risk factors, ejection fraction, NYHA score, and hemoglobin are shown in **Table (1)**. The demographic and clinical data of the two studied groups were similar with no statistically significant difference.

Demographic data of group 2 (combined valve replacement + CABG) showed in **table (2)**. which revealed that patients underwent MVR, AVR or DVR + CABG were similar with no statistical significance except the age in DVR + CABG less than MVR or AVR +CABG and the preoperative NYHA score between ischemic patients with mitral valve disease only and ischemic patients with aortic valve disease only.

Variable			Group 1 N=50	Group 2 N=50	P value
Age (years) (mean±SD)			57.5 ± 6.8	58.04 ± 6.3	0.7
Gender (%No)	**Male**		33(66)	36(72)	0.6
	Female		17(34)	14(28)	
DM (No%)			18(36)	12(24)	0.2
Hypertension (No%)			29(58)	31(62)	0.6
Smoking (No%)			12(24)	6(12)	0.1
EF % (mean±SD)			60.7 ± 8.9	59.7 ± 10.6	0.6
NYHA (No%)		**≤ 2**	15(30)	19(38)	0.3
		≥ 3	35(70)	31(62)	
Hemoglobin (g/dl)			13.7 ± 1.04	13.25 ±1.72	0.08

Data were expressed as mean ± standard deviation (SD) and number (%)

Table (1): Pre-operative demographic and clinical data of studied 2 groups

Variable			MVR No=22	AVR No=23	DVR No=5	P value
Age (years) (mean±SD)			58.2 ± 5.2[a]	59.4 ± 4.9[b]	51 ± 10.5[ab]	**0.02***
Gender (No%)	**Male**		15(68.2)	17(73.9)	4(80)	0.8
	Female		7(31.8)	6(26.1)	1(20)	
DM (No%)			5(22.7)	5(21.7)	2(40)	0.6
Hypertension(No%)			14(63.6)	15(65.2)	2(40)	0.5
Smoking (No%)			3(13.6)	3(13)	0(0)	0.6
EF % (mean±SD)			56.95 ± 10.7	62.39 ± 9.96	9.96 ± 10	0.08
NYHA (No%)		**≤ 2**	4(18.2)	13(56.5)	2(40)	**0.03***
		≥ 3	18(81.8)	10(43.5)	3(60)	

Data were expressed as mean ± standard deviation (SD) and number (%)

Table (2): Pre-operative demographic and clinical data of group 2

Intra-operative and Post-operative Assessment:

There were no statistically significant differences between groups regarding most intraoperative and postoperative data as shown in **Table (3)**. But there was statistically significant difference regarding the mean XC time, the mean CPB time, the median ICU stay and postoperative LCOP.

Regarding intra-operative and post-operative analysis of the data of group 2; there were no statistically significant differences between patients underwent MVR, AVR or DVR + CABG as regard number of grafts, the ventilation time, the ICU stay, the hospital stay, the postoperative hemoglobin, blood loss, the number of uncomplicated patients, postoperative complications such as after re-exploration for bleeding or tamponading, LCOP and wound infection **Table (4)**.

There was statistically significant difference regarding the mean XC time in patients underwent DVR with CABG longer than the mean XC time in patients underwent MVR or AVR with CABG, the mean CPB time in patients underwent DVR with CABG which was longer than the mean CPB time in patients underwent AVR or MVR with CABG and the mean post-operative EF in patients underwent AVR + CABG was more than the mean EF of patients underwent MVR + CABG.

The mitral regurgitation was the predominant pathology with statistical significance in patients underwent MVR + CABG. The aortic stenosis was the predominant pathology in patients underwent AVR + CABG and this was of statistical significance **Table (5)**.

Mortality in group 1 was 3 (6%) patients: no intra-operative mortality was recorded but early mortality within 30 days of operation was 2 (4%) and one patient (2%) died within 6 month but mortality in group 2 was 7 (14) patients (4 (8%) early mortality and 3 (6%) intermediate mortality), 2 patients of DVR + CABG died before discharge. No statistical significance regarding mortality between the two studied groups **Table (6)**.

Demographic data, risk factor, pre-operative EF, pre-operative NYHA, XC time and number of grafts had no statistical significance in mortality in group 2 **Table(7)**.

Variable		Group 1 (N=50)	Group 2 (N=50)	P value
XC time (minutes) (mean±SD)		56.3 ± 17.3	96.7 ± 37.9	**<0.001***
CPB time (minutes) (mean±SD)		94.9 ± 26.8	132.2 ± 48.5	**<0.001***
Number of grafts Median		3	2	0.06
Ventilation time (hours) Median		9	10.5	0.07
ICU stay (days) Median		2	3	**0.001***
Hospital stay (days) Median		7	8	0.1
Hemoglobin (g/dl)		11.19 ± 1.23	10.7 ± 1.35	0.08
Post-operative drainage (ml)		672.0 ± 310.1	571.0 ± 292.4	0.09
		Post-operative complications		
Pleural effusion (No%)		2(4.0)	0(0.0)	0.5
Re-intubation (No%)		2(4.0)	0(0.0)	0.6
Wound infection (No%)		5(10.0)	2(4.0)	0.6
LCOP (No%)		5(10.0)	16(32.0)	**0.006***
Reopened (No%)		2(4.0)	4(8.0)	0.4
No complications (No%)		35(70)	29(58)	0.9
		6 months post-operative follow up		
EF% (mean±SD)		60.2 ± 7.7	57.4 ± 9.6	0.6
NYHA (No%)	**≤ 2**	44(93.62)	39(90.7)	0.7
	≥ 3	3(6.38)	4(9.3)	

Data were expressed as median by Mann-Whitney Test, mean ± standard deviation (SD) and number (%)

Table (3): Intra-operative data and post-operative outcome of the two studied groups

Variable		MVR (No=22)	AVR (No=23)	DVR (No=5)	P value
XC time (minutes) (mean±SD)		98.7 ± 42.9[b]	84.13 ± 23.8[c]	146.2 ± 29.19[bc]	**0.002***
CPB time (minutes) (mean±SD)		135.7± 56.07[b]	119.13 ± 39[a]	177 ± 22.8[b]	**0.04***
Number of grafts Median		2	1	2	0.17
Ventilation time (hours) Median		9.5	11	21	0.5
ICU stay (days) Median		3	2	3	0.4
Hospital stay (days)Median		9	8	6	0.1
Post-operative complications					
Wound infecion (No%)		0(0.0)	2(8.7)		0.4
LCOP (No%)		7(31.8)	6(26.1)		1.00
Reopened (No%)		2(9.1)	2(8.7)		1.00
No complications(No%)		14(63.64)	13(56.52)		1.00
6 months post-operative follow up					
EF% (mean±SD)		55.6 ± 10.7	63.6 ± 9.2		**0.04***
NYHA (No%)	**≤ 2**	15(78.95)	20(95.24)	3(100)	0.05
	≥ 3	4(21.05)	1(4.76)	0(0)	

-Data were expressed as median by Mann-Whitney Test, mean ± standard deviation (SD) and number (%)

-2 early mortality before discharge of patients underwent DVR + CABG, so statistical comparison of 3 survived patients of DVR + CABG was of low significance.

Table (4): Intra-operative data and post-operative outcome of group 2

Variable		MVR (No =22)		AVR (No =23)	
Valve stenosis	**Severe**	8(36.36)	8(36.36)	19(82.61)	15(65.22)
	Moderate		0(0.0)		4(17.39)
Valve regurge	**Severe**	14(63.64)	14(63.64)	4(17.39)	3(13.04)
	Moderate		0(0.0)		1(4.35)
P value		**0.001***		**0.001***	

Data were expressed as number (%)

Table (5): Degree of the valve pathology in group 2

Variable	Group 1 (N=50)	Group 2 (N=50)	P value
Mortality	3(6)	7(14)	0.3
In-hospital mortality (before discharge)	(0)0.0	2(4.0)	0.1
Early mortality	2(4)	4(8)	0.6
Intermediate mortality	1(2)	3(6)	0.3

Data were expressed as number (%)

Table (6): Mortality in both groups

Variable		Survived No = 43	Early No = 4	Intermediate No = 3	P value
Type of valve replacement (No%)	**MVR** (No=22)	19(86.36)	1(4.55)	2(9.09)	
	AVR (No=23)	21(91.3)	1(4.35)	1(4.35)	0.7
	DVR (No=5)	3(60)	2(40)	0(0)	
Age (Mean ±SD)		58.2 ± 6.6	58 ± 3.6	56 ± 5	0.8
Sex (No%)	**Male** (No=36)	31(86.1)	3(75)	2(66.7)	0.4
	Female(No=14)	12(85.7)	1(25)	1(33.3)	0.1
DM (No%)		12(27.9)	0(0)	0(0)	0.27
HTN (No%)		27(62.8)	1(25)	3(100)	0.12
Smoking (No%)		5(11.6)	0(0)	1(33.3)	0.4
EF (No%)	**<50**	9(20.9)	1(25)	1(33.3)	0.8
≥50	34(79.1)	3(75)	2(66.7)	0.7	
Pre-NYHA (No%)	**≤ 2**	16(37.2)	1(25)	2(66.7)	0.5
≥ 3	27(62.8)	3(75)	1(33.3)		
NO of grafts (No%)	**≤ 2**	31(72.1)	2(50)	2(66.7)	0.6
≥ 3	12(27.9)	2(50)	1(33.3)		
XC time Mean ±SD (minutes)		93.8 ± 37	125.2 ± 48.9	100.6 ± 21.00	0.2

Data were expressed as mean ± standard deviation (SD) and number (%)

Table (7): Early and intermediate mortality of group 2

Discussion

Myocardial revascularization associated with valve replacement represents a surgical challenge. The conduct and the strategy of the operation differ greatly than when performing surgery for isolated CABG. The presence of atherosclerotic heart disease may severely worsen the prognosis after valve replacement. So combined lesions should be treated simultaneously. Good preservation of the myocardium during such operations represents the corner stone for the success of these operations. Earlier studies of simultaneous valve replacement and CABG showed a higher risk for the combined procedure.[4]

The mean age of our patients underwent combined valve and CABG was 58.04 ± 6.3 years as **Yamak and his colleagues**[3] who reported the mean age of 57.9 ± 5, But **Flameng and his associates**[5] and **Payro-Hernandez and co-workers**[4] had the mean age above 60 years. The younger mean age in our series might be attributed to higher incidence of risk factors especially smoking, dyslipidemia and stressful lifestyle, which are common in developing countries including Egypt.

66% of our patients underwent isolated CABG were males similar to the results of **Calafiore et** al[6].72% of patients underwent combined CABG and valve replacement were males as **Flameng and colleagues**[5] and **Ibrahim and colleagues**[7] reported that more men than women (2:1) underwent combined valve and CABG procedures. The difference of male to female ratio in the combined procedures was similar to that seen for isolated CABG. This difference might reflect a difference in the incidence of disease and/or a lower rate of referral of women for the procedures because of a perceived high risk and poor outcome.

The mean ejection fraction of our patients underwent combined CABG and valve replacement, was 59.7± 10.6 similar to the results of **Yamak and associates**[3].

In our study, patients underwent combined CABG and valve replacement had NYHA score II, III and IV of 44.19%, 53.5% and 2.33% respectively. While **Karimi et al**[8] reported that NYHA score II, III and IV found in 46.2%, 32.7%, and 11.7% of patients undergoing concurrent CABG with MVR operation, respectively. While **Akins and colleagues**[9], were reported NYHA score II, III and IV as 12%, 54%, and 29%, respectively.

Our patients underwent MVR + CABG with NYHA > 3 were 81.8% similar to the results of **Ashraf and his coworkers**[10] while patients underwent AVR + CABG with NYHA > 3 were 43.5% as the results of **Kobayashi and his colleagues**[11]. There was statistical significance regarding the preoperative NYHA score between patients underwent MVR + CABG and patients

underwent AVR + CABG. This may be due to that all patients with severe mitral regurgitation (14 patients) were complaining from dyspnea (NYHA > 3).

Regarding the mean XC time and CPB time of our patients underwent isolated CABG were 56.3 ± 17.3 and 94.9 ± 26.8 respectively as the results of **Szabo and colleagues**[12] which were 47.1 ± 17.3 and 86.7 ± 28.4 respectively. The mean XC time and CPB time of our patients underwent combined CABG and valve replacement were respectively 96.7 ± 37.9 and 132.2 ± 48.5 as the results of **Flameng and his colleagues**[5]. In our series, there was high statistical significance concerning of XC time and of CPB time between combined operation and isolated CABG.

In our series, there was statistical significance concerning of the mean XC time in patients underwent DVR with CABG (146.2 ± 29.19) longer than the mean XC time in patients underwent MVR (98.7 ± 42.9) or AVR (84.13 ± 23.8) with CABG. These results were almost near the results of **Flameng and his colleagues**[5]. Also, there was statistical significance concerning the mean CPB time in patients underwent AVR (119.13 ± 39) with CABG which was shorter than the mean CPB time in patients underwent MVR (135.7 ± 56.07) or DVR (177 ± 22.8) with CABG.

LIMA was used as a conduit in all patients with lesion in left anterior descending artery in 44 (88%) patients underwent combined operation while LAD in 6 patients was not affected so LIMA was not used. Also **Thulin and Sjögren**[13], **Akins and his colleagues**[9], **Ahmed and his associates**[14], **Pereira and colleagues**[15], **Kobayashi and his coworkers**[11], **Hassanein and his colleagues**[16] and **Gunay and colleagues**[1] found that the rate of left internal mammary artery (LIMA) use was previously reported as 30–80%.

In our study, patients underwent MVR, AVR, DVR + CABG were 44%, 46%, 10% respectively. **Flameng and his colleagues**[5] reported nearly the same results.

Regurgitation is the predominant pathology of our patients underwent MVR + CABG with statistically significant difference as the results of **Disesa et al**[17] and **Acker and co-workers**[18], but stenosis is the predominant pathology of our patients underwent AVR + CABG with statistically significant difference as the results of **Jones and colleagues**[19] and **Gunay and his associates**[1].

The median ventilation time of our patients with isolated CABG were 9 hours while 14.4 hours in results of **Szabo and colleagues**[12] and the median ICU stay in was 2 days nearly the same results as **Calafiore and coworkers**[6]. The median ventilation time of our patients with combined valve and CABG were 10.5 hours as the results of **Yamak and colleagues**[3] and the median ICU stay 3 days as the results of **Payro-Hernandez et al**[4].

There was statistically significant difference in our series regarding the ICU stay which was prolonged more in combined operation rather than isolated CABG.

There was no statistically significant difference regarding the incidence of complications; 70% of patients underwent CABG only were uncomplicated while 58% of patients underwent the combined operation were uncomplicated. In our study, the reported complications such as reintubation and pleural effusion requiring aspiration or re-insertion of intercostal tube were only in patients underwent isolated CABG with higher rate of wound infection with no statistically significant difference between the 2 groups. This may be attributed to longer ICU stay in patients underwent the combined operation so longer better care.

10% of our patients underwent CABG only had low cardiac output nearly similar to the results of **Szabo and his colleagues**[12], so there was statistical significance of LCOP in our patients underwent combined operation (32%) as the results of **Herlitz and coworkers**[20]. This statistical significance may be due to the longer XC time and CPB time of patients underwent the combined operation.

No a statistically significant difference regarding the postoperative blood loss, mediastinitis and hospital stay in our study but **DellAmore and his colleagues**[21] and **Payro-Hernandez and associates**[4] reported that the associated postoperative complications with patients underwent combined operation were postoperative bleeding, mediastinitis, prolonged ICU and hospital stay.

In our study, there was no statistical significance in postoperative EF between the two groups, or between preoperative and postoperative in each group. But regarding the mean post-operative EF (63.6%) in patients underwent AVR + CABG was statistically significant more than the mean EF (55.6%) of patients underwent MVR + CABG; this may be due to the overestimation of preoperative EF in patients complaining from mitral regurgitation. These results were similar to the results of **Smith and colleagues**[22] and **Karimi and associates**[8].

In our study, no statistical significance of postoperative NYHA in the two groups or between patients underwent MVR, AVR or DVR combined with CABG as all patients had a significant clinical improvement regarding the NYHA score. **Flameng and his coworkers**[5] and **Payro-Hernandez and colleagues**[4] reported almost the same results.

Prolonged XC time, CPB time the procedures of aortotomy in aortic valve replacement, atriotomy incision in mitral valve replacement and both in double valve replacement which might increase the risk of postoperative complications.

In our series, the early mortality rate of isolated CABG was as low as 4%, nearly the same results as **Hawkes and his colleagues**[23].

The early mortality of patients underwent the combined operation was 8% as **Herlitz and his associates**[20] who reported 7.8% early mortality while **Flameng and his colleagues**[5] reported a mortality rate of 10% out of 420 patients. Our early mortality rate after MVR + CABG was 4.55% of patients as the results of **Acker and his co-workers**[18]. The early mortality rate after AVR + CABG was 4.35%. Results were less than the published data for early mortality rates by **Lund and his colleagues**[24], **Flameng and colleagues**[5], **Yamak and his colleagues**[3] and **Doenst and his colleagues**[25] which was overall (10.2%), MVR + CABG (8.8%), and AVR (8.7%).

In our series, the demographic data, age, gender, pre-operative NYHA, pre-operative EF, number of conduits, and XC time were not significantly related to early or intermediate mortality.

Conclusion

Combined CABG and valve replacement is an accepted procedure with good postoperative results nearly similar to the results of isolated CABG. The prolonged XC time and CPB time had no bad impact on the postoperative results as long as skillful surgical team with good myocardial preservation.

Recommendations

1. Combined valve replacement and CABG has no additional morbidity or mortality than isolated CABG so if significant valve disease or coronary artery disease left untreated may reduce the survival of these patients.
2. In ischemic patients with aortic stenosis and a borderline gradient across the aortic valve associated with low EF; the surgeon must explore the aortic valve as low gradient on the aortic valve due to low EF will be corrected after total revascularization. And those patients possess specific surgical dilemma due to severe hypertrophy of the left ventricle so a special attempts towards prevention of myocardial injury by giving cardioplegia in grafts, avoiding hypotension (pre-operative, intra-operative and post-operative) and avoiding LV distension.
3. In ischemic patients with severely diseased ascending aorta that are planned to be revascularized with vein grafts and the aortic valve will be replaced by xenograft; it is highly recommended to do proximal anastomoses on totally occluding XC.
4. Ischemic patient with severe mitral regurgitation and low EF should be subjected to viability tests before deciding surgery.
5. Regardless of the type of prosthesis, an effort should be made to retain continuity between the papillary muscles and the mitral annulus.
6. In cases of extensive coronary artery disease, we advise use of retrograde cardioplegia to augment the antegrade cardioplegia and also supplemental doses of cardioplegia at low pressure (100 mmHg) were infused through the vein grafts after the distal anastomoses.

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Effect of Preoperative Degree of Coronary Artery Stenosis on Flow in Venous Conduits (Transit Time Flowmetry Model)

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Background: Effective revascularization means good patent grafts. Functional patency (flow assessment) is most important and more expressive than anatomical patency. Surgeons should evaluate grafts quantitively by new means of flow assessment either intra- or postoperatively.

Methods: 50 consecutive patients underwent on-pump isolated coronary artery bypass graft (CABG) with at least one vein conduit from March 2010 to October 2011 were included.Preoperative coronary angiography was quantitatively assessed for the minimal proximal luminal diameter of the bypassed coronary artery with venous conduit. Intra-operative venous grafts (n=76) flow measurements with the transit time flowmeter (TTFM: VQ2001; Medi-Stim,Norway) were done before sternal closure. Thecorrelation between the flow measurements and the minimal proximal luminal diameter was analyzed.

Results: A negative correlation between proximal minimal luminal diameter of the native coronaries and mean flow in venous grafts ($P < 0.001$) was found. There was a positive correlation ($P < 0.001$)between proximal minimal luminal diameter and the pulsatillity index (PI). 1.08mm was found to be the cut off point for the minimal proximal luminal diameterabove it the mean flow in venous conduits will be inadequate. During CABG, the coronary artery which has proximal minimal luminal diameter ≥1.08mm shouldn't be bypassed with venous conduit because functional patency will be compromised by competitive flow.

The immediate goal of any revascularization procedure is to increase myocardial blood flow. However, in most cases it is not known exactly how much the coronary blood flow is increased by a revascularizing procedure.[1] Transit-time blood flowmetry is easy and convenient for intra-operative use and provides accurate graft flow measurements with few sources of technical error.[2] The flow in bypass grafts is affected by competitive flow which defines the flow from a partially stenosed native artery that competes with the flow from a graft to perfuse the myocardium.[3] Some researchers suggest that, when the stenosis is not critical (under 70%) in the coronary artery, reduction in the patency of the saphenous vein grafts is observed. On the other hand, in some reports it was suggested that the competitive flow only affects the arterial grafts and does not affect the patency in the saphenous vein grafts. Actually, this is still a matter of debate.[4]

The aim of this study is to evaluate the effect of preoperative degree of coronary stenosis (competitive flow) on flow in venous conduits.

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PATIENTS AND METHODS

This was a prospective study in which from March 2010 to October 2011, transit time flowmetry was undertaken in 50 consecutive patients during on-pump isolated coronary artery bypass grafting via median sternotomy with at least one saphenous vein graft performed. Patients undergone redo (CABG), or Patients who needed preoperative or intraoperative implantation of intraaortic balloon counter pulsation were excluded.

Preoperative coronary angiography was assessed visually for significant stenosis and the coronary arteries that bypassed with venous conduit were quantitatively assessed for the minimal proximal luminal diameter by digital computerized program calibrated to the diameter of the catheter used in diagnostic angiography for every view (6 Fr=2 mm).

Intraoperative flow measurements for all venous grafts were performed just before sternal closure using a transit time flowmeter (VQ2001; Medi-Stim ASA, Oslo, Norway) on the proximal portion of the graft body while mean blood pressure was maintained between 70 and 80 mm Hg, and a properly fitted probe was used with acceptable contact between the probe and the graft. The device displays a flow curve and calculates the mean flow (ml/min), pulsatile index (PI) and diastolic filling percentage (DF%).

RESULTS

In 50 patients who underwent CABG with at least one vein graft which were examined intraoperativly by TTFM, there were 76 single venous grafts and 8 sequential venous grafts with either two or three distal anastomosis in the study group. Demographics and risk factors distribution of the patient population are shown in Table 1.

Variable	Studied Group(n=50)
Age	60.34 ± 6.7
Gender	
Male/Female	45/5 (90/10%)
Hypertension	37(74%)
Diabetes Mellitus	28(56%)
Dyslipidaemia	35(70%)
Smoking	26(52%)

Table 1. Demographic data of all patients

Correlation between proximal minimal luminal diameter and TTFM data in single venous grafts, it was found that there was a negative correlation between proximal minimal luminal diameter and mean flow (r= - 0.769) with high statistical significance (P <0.001) and there was a positive correlation (r= 0.479) between proximal minimal luminal diameter and pulsatility index with high statistical significance (P<0.001). It was also found that there was no correlation with statistical significance between proximal minimal luminal diameter and diastolic flow percentage (P>0.05) (Table 2).

	Proximal minimal luminaldiameter	
	Correlation coefficient (r)	P value
Mean flow	- 0.769	<0.001
PI	0.479	<0.001
DF%	- 0.170	>0.05

Table 2. Flow Characteristics of single venous conduit in relation to proximal minimal luminal diameter

	Proximal minimal luminal diameter	
	Correlation coefficient (r)	P value
Mean flow	- 0.922	<0.001
PI	0.337	>0.05
DF%	- 0.657	>0.05

Table 3. Flow Characteristics of sequential venous conduit in relation to proximal minimal luminal diameter

When correlation between mean proximal minimal luminal diameter and TTFM data in sequential venous grafts done, it was found that there was a negative correlation between mean proximal minimal luminal diameter and mean flow (r= - 0.922) with high statistical significance (P <0.001). But there was no correlation with statistical significance (p>0.05) between mean proximal minimal luminal diameter and both the PI and DF% (Table 3).

The results of comparison between single venous grafts (N=76) and sequential venous grafts (N=8) showed that, there was no difference with statistical significance (P>0.05) in vein diameter, proximal minimal luminal diameter, pulsatility index and diastolic flow percentage between the two groups. Mean flow was found to be more in sequential (52.1±16.9) than that in single grafts (44.1±28.1) but also didn't reach a statistical significance (P>0.05) (Table 4).

By drawing the ROC curve between Sensitivity and Specificity in order to obtain a cutoff point for proximal minimal luminal diameter above it the mean flow in venous grafts will be below 15ml/min which was considered to be insufficient, it was found that the cutoff point was 1.08mm with 100% Sensitivity, 77% Specificity, 30% Positive predictive value, 100% Negative predictive value and 79% Accuracy. The area under the curve was (0.923) with (P<0.001) (Figure 1 and Table 5).

	Single (N=76) Mean±SD	Sequential (N=8) Mean±SD	Mann-Whitney test	P-value
Vein diameter(mm)	3.5±0.6	3.5±0.7	1.3	>0.05
Proximal minimal luminal diameter(mm)	0.8±0.5	0.7±0.3	0.2	>0.05
Mean flow(ml/min)	44.1±28.1	52.1±16.9	1.4	>0.05
PI	2.5±1.2	2.5±0.5	0.9	>0.05
DF%	61.7±9.5	63.5±4.8	0.2	>0.05

Table 4. Comparison of Flow Characteristics of single venous conduit and sequential venous conduit

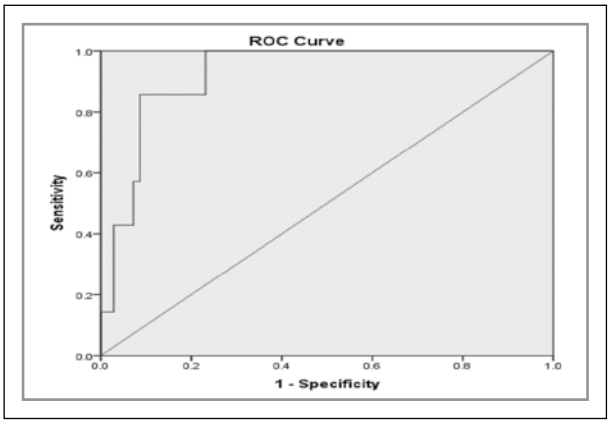

Fig. 1. Roc Curve for proximal minimal luminal diameter

In our study , there were 9 patients (18%) developed episode of AF which resolved with cordarone I.V, also 4 patients (8%) developed leg wound erythema with serous discharge that resolved before hospital discharge. There was no postoperative MI or mortality (Table 6).

Characteristic	Value
Area under the curve	0.923
p-value	<0.001
95% confidence interval	
Upper bound	0.994
Lower bound	0.853
Cut off point	1.08
Sensitivity	100%
Specificity	77%
Positive predictive value	30%
Negative predictive value	100%
Accuracy	79%

Table 5. Parmeters of Roc curve for proximal minimal luminal diameter

Post-operative complications	Studied group (n = 50)
Atrial fibrillation	41 (82%)
Wound complications	4 (8%)
Post-operative MI	0
Mortality	0

Table 6. Post-operative complications

DISCUSSION

The main aim of coronary artery bypass grafting (CABG) is to increase blood flow to ischemic myocardium. Although this procedure is successfully performed in more than several hundred thousand patients a year, graft flow measurements are rarely performed in most centers. It is assumed that grafts are patent at the end of the operation, especially if the patient has no hemodynamic demise and, if cardiopulmonary bypass (CPB) was used, separation from CPB was successful.[5]

Different factors influence arterial and vein graft patency and that they act at different times, arteriosclerosis decreasing late vein graft patency and competitive flow decreasing early arterial graft patency, this influence surgeons' decisions about what conduit is most likely to be best (remain patent) for an individual coronary artery with a specific stenosis. Surgeons ask a question when choosing between arterial and saphenous vein conduits: is there a degree of coronary artery stenosis below which a saphenous vein graft will more likely remain patent and therefore be more effective than an arterial graft?[6]

Some researchers suggest that, when the stenosis is not critical (under 70%) in the coronary artery, reduction in the patency of the saphenous vein grafts is observed. On the other hand, in some reports it was suggested that the competitive flow only affects the arterial grafts and does not affect the patency in the saphenous vein grafts. Actually, this is still a matter of debate.[4]

Some recent reportshave demonstrated that the minimal luminal diameter correlates far better with arterial graft functionality than the percent stenosis. They believe that this measure is a more relevant predictor of the degree of competitive flow, which is known to be a critical determinant in long-term arterial graft functionality.[7] We used the minimal proximal luminal diameter to be our tool for measuring the degree of coronary artery stenosis instead of maximal proximal percent of stenosis and correlating that to flow parameters in venous graft.

Previous studies used the patency of grafts as the parameter for evaluating CABG results in perfusing myocardium, and their results were patent or not denoting the anatomical view only; but in our study, when we studied it functionally to accurate estimate if the flow parameters is still adequate in those pat-

ent grafts or not, we found that we may have patent grafts with marked competitive flow meaning slow flow in the new graft with less blood to offer for the deprived myocardium, meaning anatomically patent but functionally impaired.

Concerning our results in relation of flow parameters and minimal luminal diameter, we got results that respect general rule of physics of flow in which the blood flow in the native coronary artery through the stenosed segment will compete with the flow in the new graft, giving a statistical significant correlation in which with each increase in proximal minimal luminal diameter, a proportionate increase in competitive flow will occurs resulting in decrease flow in new venous graft.

Grafts with flow less than 15ml/min are highly susceptible to early failure as supposed byTokuda et al., they analyzed a total of 261 grafts that were evaluated by intraoperative transit time flow measurement and underwent early postoperative coronary angiography within 3 months of surgery. According to the receiver operating characteristic curve analysis for the grafts to left coronary arteries, a mean flow of 15 mL/min or less and a pulsatility index of 5.1 or higher were found to be the optimal cutoff criteria to predict early graft failure. Similarly, for the grafts to right coronary arteries, the cutoff values were 20 mL/min and 4.7 respectively.[8]In our study, by drawing ROC curve for sensitivity and specificity to get a cut off point for proximal luminal diameter above it the mean flow in venous conduit will be below 15ml/min, we got 1.08mm with 100% sensitivity, 77% specificity and 79% accuracy.

In our study when we compaiered the flowmetry results for venous grafts on the left system (N=42) to that on the right system (N=34), we found that DF% is lower with a statistical significance (P-value <0.001) on the right coronary grafts (57.6±8.7) than that on the left coronary grafts (65.0±8.9).Our results coincides with Kim et al., they studied flow parameters in 67 grafts to left system and 36 grafts to the right system and found that the grafts anastomosed to the right coronary territories showed significantly less diastolic dominant pattern with a P-value <0.001.[9]

In our study there were increased flow in sequential vein grafts (52.1±16.9) in relation to single vein grafts (44.1±28.1) but did not reach a statistical significance.Also there were no changes of statistical significance regarding (PI) between the two groups.

Kim et al., studied the intraoperative flow characteristics with the transit time flow meter of 309 patients who underwent either sequential (group A, n = 84 grafts) or individual (group B, n = 244 grafts) saphenous vein coronary bypass grafting. They reported that Group A showed a higher mean flow compared with group B at 49.4 ± 27.4 mL/min versus 37.1 ± 20.1 mL/min, respectively with (P = .001). The mean flow increased linearly as the number of anastomosis increased per graft (P < .001).[10]

Nordgaard et al., studied flow in 558 single vein graft, 316 sequential vein grafts with two distal anastomosis and 46 sequential vein grafts with three distal anastomosis they found that flows measured in single vein grafts were significantly lower than in double ($p < 0.001$) and triple sequential vein grafts ($p < 0.001$). Flows were lower in double versus triple sequential vein grafts ($p = 0.017$). Moreover, PI values of single versus double versus triple SVG group were not significantly different ($p= 0.244$).[11]

CONCLUSION

As the proximal minimal luminal diameter of native coronaries increase, the flow in venous graft decrease. The more the proximal minimal luminal diameter increases, the more the pulsatility index in venous grafts increases. Therefore, the competitive flow affects flow in venous grafts. The cut off point for proximal luminal diameter was found to be 1.08 mm; above it, the mean flow in venous conduits will be inadequate.The DF% is lower in grafts for the right coronary system than that in grafts for the left coronary system.

The flow in sequential vein grafts increases when the mean proximal minimal luminal diameter of the bypassed arteries decreases.

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Urgent Coronary Artery Bypass Grafting: Early Postoperative Results

Basem Ali Hafez

Background: Indication for immediate revascularization during acute myocardial infarction (MI) is debated. Drug-resistant crescendo angina, as well as hemodynamic compromise, however, often requires acute operation. In this study the differential risks of urgent coronary artery bypass grafting with and without MI were stratified.

Methods: Eighty patients underwent isolated coronary artery bypass grafting (CABG) were investigated, they were divided into two groups: Group A included 40 patients underwent urgent CABG for acute coronary syndrome. And group B included 40 patients underwent elective CABG. The two groups were compared regarding preoperative, operative, and postoperative data.

Results: Preoperative risk factors namely dyslipidemia and hypertension were significantly higher in the urgent group. Critical left main coronary artery disease was significantly more in the urgent group. Heart failure score, angina score, and STS (society of thoracic surgeons) score were also significantly higher in the urgent group. Elective group showed a significantly higher ejection fraction. Postoperatively, the amount of tube drainage, blood and blood products transfused were significantly more in the urgent group, while Patients in the elective group had a significantly shorter ventilation time, intensive care unit, and total hospital stay. Postoperative complications namely myocardial infarction and superficial wound infection were significantly higher in the urgent group. Postoperative mortality was significantly higher in the urgent group.

Conclusion: Liberal use of left internal thoracic artery grafts was not detrimental in urgent patients. Urgent coronary artery bypass grafting may be addressed as a high risk group as they have a significantly worse early postoperative outcomes and a significantly higher incidence of developing myocardial infarction. Also, postoperative mortality is significantly higher in the urgent group of patients.

The benefit of an acute restoration of uncompromised blood flow in the coronary arteries is clear [1]. However, the rising numbers of instantaneous interventions for acute myocardial infarction (MI) have resulted in an increasing demand for immediate surgical procedures in patients who do not technically qualify for a catheter intervention or in patients in whom this measure fails [2].

Urgent surgical intervention in the presence of drug-resistant crescendo angina or even hemodynamic compromise has been extensively debated. However, recent data show that immediate revascularization of such a cohort can indeed be beneficial [3], although the surgeon has to cope with an unclear myocardial state as well as often unknown comorbidities. Furthermore, potent platelet aggregation inhibitor application or even fibrinolytic therapy directly before surgical intervention may cause additional problems [4].

CABG offers a survival benefit when compared to medical treatment in patients with unstable angina and LV dysfunction, particularly in those with triple vessel disease. Also early CABG for acute myocardial infarction may be appropriate in patients with residual ongoing ischemia despite other types of therapy [5].

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The aim of this study is to evaluate the outcomes of urgent CABG and to compare them with elective surgery.

PATIENTS AND METHODS

This study included 80 patients underwent isolated CABG done in Sharque ElMadena hospital from Jan. 2009 to Jul. 2014. Operation was considered emergency if the medical factors relating to the patient's cardiac disease dictated that surgery should be performed within hours to prevent morbidity or death. Operation was considered urgent if the medical factors required the patient to stay in the hospital for an operation before discharge, and elective, if clinical situation allowed discharge from the hospital with readmission at a later date [6].

Patients were divided into two groups. Group A included 40 patients. Two underwent emergent CABG and thirty eight underwent urgent CABG for ACS, combining the emergent and urgent patients was done because the number of emergent patients was small and therefore a meaningful analysis was not possible. Group B included 40 patients underwent elective CABG.

A standard operative technique utilizing extracorporeal circulation and moderate systemic hypothermia with myocardial protection by antegrade cold intermittent blood cardioplegia was used in all patients. Patients with previous cardiac operations, cardiogenic shock, and post resuscitations were excluded from the study.

We used the definitions of society of thoracic surgeons (STS) for elective and urgent CABG [7]. Left ventricular (LV) dysfunction was categorized on the basis of ejection fraction (EF) and considered severe, moderate, mild, or normal if EF was <30%, 30–44%, 45–54%, ≥55%, respectively [8]. Operative mortality was defined as death occurring within 30 days of operation. All postoperative complications were recorded and the two groups were compared regarding preoperative, operative, and postoperative data.

RESULTS

Demographic data:

Age and sex did not differ significantly among the two groups although in the urgent patients' female sex tended to be slightly higher. A typical proportion of diabetes and chronic obstructive pulmonary disease was present in both groups. Dyslipidemia and hypertension were significantly higher in the urgent group (Table 1).

The preoperative data

The indications of urgency in group A included 13 (32.5%) patients with critical left main disease, 2 (5%) patients had acute no reflow during catheterization with persistent chest pain and they underwent emergent coronary artery bypass grafting, 4 (10%) patients with failed coronary angioplasty, and 21 (52.5%) patients with persistent chest pain.

Variable	Urgent n= 40	Elective n= 40	p-value
Age (years)	58.92±42.6	60.95±8.35	0.088
Female sex	(12)30%	(10)25%	0.39
Hypertension	31(77.5%)	21(52.5%)	0.02
Dyslipidemia	21(52.5%)	9(22.5%)	0.004
Diabetes mellitus	26(65%)	22(55%)	0.26
Smoking	24(60%)	21(52.5%)	0.1
COPD	6(15%)	4(10%)	0.26
Renal impairment	3(7.5%)	5(12.5%)	0.37

COPD=chronic obstructive pulmonary disease.

Table 1. Demographic Data and Characteristics of Study Groups

Table 2 showed that left main disease was significantly more in the urgent group; also the urgent group had a statistically significant higher incidence of ST-segment myocardial infarction, heart failure score, angina score, and STS score. The elective group showed a significantly higher incidence of unstable angina and non ST-segment myocardial infarction. The overall left ventricular function was almost normal in the elective group of patients with a mean ejection fraction (56.14±7.9%), while in the urgent group there was a mild left ventricular dysfunction with a mean ejection fraction of (46.73±15.28%), and the difference between both groups was statistically significant. Patients on inotropic support and vasodilators were significantly more in the urgent group. Wall motion score index (WMSI) was significantly higher in the urgent group.

Operative data

The majority of all patients received left internal mammary artery (LIMA) graft to the left anterior descending artery, only two patients underwent emergent CABG did not use LIMA graft, and there was no significant difference between the two groups. Bypass time, clamp time and the total operative time were significantly longer in the urgent group but the number of grafts used did not show any significant difference between both groups (table 3).

Postoperative data

Postoperative characteristics are demonstrated in table 4 showed a significantly higher incidence of inotropic support and intra-aortic balloon pump needed in the urgent group. The

use of vasodilators tended to be more in the urgent group but without statistically significant difference. The amount of tube drainage and the need for blood and blood products transfusion was significantly higher in the urgent group. Patients in the elective group had a significantly shorter ventilation time, intensive care unit, and total hospital stay.

Variable		Urgent n= 40	Elective n= 40	p-value
Left main disease		17(42.5%)	3(7.5%)	<0.001
No, of stenotic arteries	One	1(2.5%)	2(5%)	0.25
	Two	6(15%)	4(10%)	
	three	33(82.5%)	34(85%)	
Unstable Angina		7(17.5 %)	14(35%)	0.001
Non ST-segment MI		12(30%)	24(60%)	0.001
ST-segment MI		22(55%)	4(10%)	<0.001
Heart failure class: III/IV		17(42.5%)	5(12.5%)	0.002
Angina class: III/IV		24(60%)	6(15%)	<0.001
STS score	Mortality	8.95±6.35	1.36±0.69	<0.001
	Mortality & morbidity	39.42±18.78	12.95±8.76	
Inotropic support		6 (15%)	0(0%)	0.005
Vasodilator		32(80%)	0(0%)	<0.001
Ejection fraction %		46.73±15.28	56.14 ± 7.9	<.001
WMSI		1.31±0.19	1.14±0.21	0.012

MI=myocardial infarction; STS=society of thoracic surgeons; WMSI=wall motion score index.

Table 2. Preoperative clinical, angiographic, and echocardiographic data

Table 5 revealed a significantly higher incidence of Postoperative myocardial infarction among the urgent group. Mild superficial wound infection and ooze was significantly more in the urgent than the elective group, however deep wound infection did not show any statistically significant difference between both groups. Again, re-exploration for bleeding did not show statistically significant difference between both groups despite that blood loss, blood and blood products transfusion was significantly more in the urgent group. The overall mortality in the study groups were five patients, all were among the urgent group of CABG, three of them died because of unresponsive low cardiac output, one from septicemia and septic shock and the last patient died from multiple organ failure. Mortality rate was found to be significantly higher in the urgent group

Variable	Urgent n= 40	Elective n= 40	p-value
Numbers of grafts	3.09± 0.84	3.28±1.13	0.39
LIMA	38(95%)	40(100%)	0.29
Bypass time (minutes)	145.23± 45.03	108.64± 45.21	0.003
Clamp time (minutes)	76.28± 35.18	60.24± 15	0.015
Operative time (minutes)	334.79± 97.89	270.45± 69.92	0.049

LIMA= left internal mammary artery

Table 3. Operative data

Variable	Urgent n= 40	Elective n= 40	p-value
Inotropic support	34(85%)	14(35%)	<0.001
Vasodilator	36(90%)	31(77.5%)	0.06
IABP	6(15%)	1(2.5%)	0.025
Tube drainage (ml)	1590.6± 742.3	1007.2±123.2	0.006
Blood units	4.19±3.35	2.64±1.82	0.017
Plasma units	8.21±2.17	4.83±5.41	< 0.001
Ventilation time (hours)	18.68±21.1	9.42±7.78	0.001
ICU stay (hours)	103.96± 69.5	49.89±78.9	< 0.001
Hospital stay (days)	12.43±6.7	8.54±3.73	0.004

IABP=intra-aortic balloon pump; ICU=intensive care unit.

Table 4. Postoperative characteristics

Variable	Urgent n= 40	Elective n= 40	p-value
Myocardial infarction	6(15%)	1(2.5%)	0.023
Arrhythmias	6(15%)	5(12.5%)	0.48
Exploration for bleeding	3(7.5%)	1(2.5%)	0.29
Chest infection	2(5%)	1(2.5%)	0.5
CVA	3(7.5%)	1(2.5%)	0.29
Renal impairment	4(10%)	4(10%)	1.0
Renal dialysis	1(2.5%)	0(0%)	0.45
Mild wound infection	12(30%)	3(7.5%)	0.049
Deep wound infection	3(7.5%)	1(2.5%)	0.29
Sternal rewiring	2(5%)	1(2.5%)	0.5
Mortality	5(12.5%)	0(0%)	0.04

CVA=cerebrovascular accidents.

Table 5. Postoperative complications

DISCUSSION

For many years studies using the huge numbers of coronary artery bypass grafting could demonstrate distinct differences in the outcome of patients stratified into typical risk groups with regard to the urgency of surgical intervention. It was demonstrated that urgent, emergent, or elective revascularization significantly affects EM and morbidity, as well as late mortality [9].

In our study, the preoperative characteristics of both groups did not show any significant statistical difference apart from dyslipidemia and hypertension that were significantly higher in the urgent group. These results were also recorded by Weiss et al. [7]. Unlikely, Parikh et al. [10] reported a lower age in patients with urgent CABG and a lower incidence of diabetes, hypertension and dyslipidemia. The contrary was reported by Dumbor et al. [11] as they recorded that patients underwent early CABG were older with higher prevalence rates for co-morbidities such as diabetes, impairment of renal function and chronic obstructive pulmonary disease.

The number of diseased coronary arteries did not show statistically significant difference between both groups, but the incidence of left main disease was significantly higher in the urgent group. The same results were reported by Kim et al. [12] and Deyell et al. [13], while Luqman et al. [6] found no significant difference of left main disease between urgent and elective patients.

Patients in the urgent group had a higher prevalence rates for cardiac morbidity such as lower left ventricular ejection fraction and higher wall motion score index (WMSI). The same results were recorded by Kim et al. [12] and Dumbor et al. [11] as well as the study published by Dokhan et al. [14].

According to our general policy, 95% of patients in the urgent group received LIMA graft to the left anterior descending artery. Although it has been suggested by other authors that in the acute situation arterial grafts may be avoided because of spastic reactions [15] we did not encounter hemodynamic problems caused by a compromised initial blood flow to the left anterior descending artery in the urgent patients. Because of the absence of problems and considering the superior long-term patency rate of LIMA grafts, we believe that they should indeed be used in all patients. The same conclusion was reported by Johannes et al. [16].

Bypass, clamp and total operative times were significantly longer in the urgent group despite that the number of grafts did not show a significant difference between both groups. Technical operative difficulties encountered during urgent CABG usually due to edema, and fragility of myocardial tissue may partly explain this finding. The same results were recorded by Kim et al. [12]. In the study of Dokhan et al. [14], bypass time and clamp time were significantly longer in the urgent group but there was no significant difference in the total operative time. Dumbor et al. [11] recorded a significant longer bypass time in the urgent group but similar ischaemic times for all groups. Luqman et al. [6] did not record any significant difference between both groups regarding the bypass time or clamp time.

The overall findings in this study were that patients exposed to urgent CABG had greater postoperative bleeding volumes and greater transfusion requirements. These findings were expected because of potent platelet aggregation inhibitor application or even fibrinolytic therapy directly before surgical intervention. The same findings were recorded by Dumbor et al. [11], and Michael et al. [17].

Postoperative myocardial infarction was significantly higher in the urgent group (15%) than the elective group (2.5%). These results were similar to that reported by Dokhan et al. [14] but higher than that reported by Kim et al. [12].

Luqman et al. [6], found that in the urgent group mortality rate was 13.3%, which shows a higher mortality trend in urgently operated patients but did not reach statistical significance. The same was documented by Dokhan et al. [14]. Our findings were different from these studies as the mortality was significantly higher in urgently operated patients but it still was in acceptable range (12.5%). Ishikawa et al. [18] reported a 4-fold increase in operative mortality in the urgent or emergency operation group compared to the elective cases. In a large retrospective study [10] examined the influence of CABG timing after non-ST elevation MI on operative outcomes in 2647 patients they classified the timing of CABG as early (≤48 h, n = 825, 31.2%) or late (>48 h, n = 1822, 68.8%) and found no significant survival differences.

CONCLUSION

Liberal use of left internal thoracic artery grafts was not detrimental in urgent patients. Urgent coronary artery bypass grafting may be addressed as a high risk group as urgent surgery does increase the operative risk and has a worse early postoperative outcomes but it should not be a contradiction per se to offer surgery in such patients.

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EFFECT OF PREOPERATIVE ASPIRIN ON BLOOD LOSS AND BLOOD TRANSFUSION IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS GRAFTING: IMPACT OF DISCONTINUATION PRIOR TO SURGERY, SINGLE CENTER EXPERIENCE

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Objective: **The aim of our study is to evaluate the impact of recent aspirin use before CABG on post-operative bleeding, blood transfusion and re-exploration.**

Methods: **Retrospectively collected data from 67 patients who were operated on in Sultan Qaboos University Hospital from 2008-2009 was included in this study. All patients received low dose aspirin of 81 mg once daily preoperatively. Patients were divided into two groups: in group 1 (34 patients), aspirin was discontinued more than seven days prior to CABG, and in group 2 (33 patients) aspirin was discontinued ≤ seven days before surgery.**

Results: **Platelet transfusion and length of hospital stay were greater in patients where aspirin was stopped ≤ seven days (*p* values 0.03 and 0.002, respectively). There was trend of increase in intraoperative bleeding and PRBC transfusion in the group who had received aspirin within seven days. Postoperative blood loss was higher in aspirin users than in non-users but this difference was not statistically significant. There was no difference between the two groups regarding re-exploration or operative mortality.**

Conclusion: **Patients who take aspirin within seven days before CABG are more likely to have post-operative bleeding and need to receive blood products. They also have longer length of stay in hospital. Our recommendation is to stop aspirin more than seven days before surgery.**

KEY WORDS: Aspirin; bleeding; coronary artery bypass grafting.

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The antiplatelet activity of acetylsalicylic acid (ASA) is due to its ability to irreversibly reduce thromboxane-A2 (TXA2) production. TXA 2 is a potent platelet aggregator and vasoconstrictor. Because the lifespan of platelets is seven days and ASA-induced cyclooxygenase inhibition is irreversible, the effect of aspirin persists until platelets are replaced by the bone marrow; a measurable antiplatelet effect from a single dose of aspirin may persist for up to one week (1).

Nonetheless, preoperative aspirin continued to the day of operation or administrated during the early postoperative period has been shown to result in improved early graft patency and also the late patency of vein grafts (2-4).

Almost all patients who present for coronary bypass surgery are undergoing chronic daily therapy with aspirin at a dose of 81 to 325 mg. This dose of aspirin improves survival in patients with ischemic heart disease (5).

Aspirin has been shown to reduce the risk of major cardiovascular events (myocardial infarction, stroke and cardiovascular death) by 25% in patients with previous MI, by 46% in those with unstable angina, by 33% in those with stable angina, by 41% in

patients with heart failure, and by 53% in those who have had previous coronary angioplasty (5). Because these are the groups of patients on whom cardiac surgeons are operating, many surgeons have these patients continue taking aspirin until the day of surgery, with the rationale that its beneficial effects for secondary prevention of acute coronary events outweigh the effects on postoperative bleeding and transfusion requirement (4).

Controversy continues to surround perioperative aspirin therapy; this controversy springs from the conflicting literature describing the risk/benefit ratio when aspirin is continued until the time of surgery. Aspirin may cause postoperative bleeding, which is associated with the need for both transfusion and re-exploration; these interventions are associated with increased morbidity, mortality, length of stay, and cost to the healthcare system (6).

MATERIAL AND METHODS

This study was a retrospective study looking at the effect of aspirin use within seven days before coronary artery bypass grafting (CABG) on postoperative bleeding and blood product requirements. Sixty-seven patients who underwent primary isolated CABG in our institution, the Cardiothoracic Surgery Division of Sultan Qaboos University Hospital (Oman), from April 2008 to June 2009 were included in our study. All patients received low dose aspirin of 81 mg once daily preoperatively. Patients were assigned into two groups: in group 1 (34 patients) aspirin was discontinued more than seven days prior to CABG, while group 2 (33 patients) stopped taking aspirin within seven days before surgery (days 0-7).

Patients with the following conditions were excluded from our study: 1) patients on oral anticoagulant or clopidogrel; 2) patients with allergy or intolerance to aspirin; 3) patients with history of bleeding diathesis; 4) patients needing repeat cardiac surgery; 5) patients needing other procedures than CABG.

Patient demographic data (age, sex, body mass index) and medical history (history of hypertension, diabetes, renal disease, myocardial infarction, unstable angina, congestive heart failure etc.) were obtained before the operation. Preoperative hematocrit, platelet count and Euroscore were recorded. All operations were performed by a single surgical and anaesthesiology team. Seventeen patients in group 1 and twenty patients in group 2 underwent pump CABG. The number of grafts, cross clamps and total bypass time in patients with CPB were recorded.

In the postoperative period, total chest drainage, need for re-exploration for bleeding, requirements of blood transfusion, either RBCs, platelets or fresh frozen plasma, hematocrit, platelet count, length of hospital stay and mortality were recorded in both groups.

STATISTICAL ANALYSIS

Data are expressed as a mean value ± standard deviation (means ± SD) and as percentages (%). According to the type of data, the following tests were used to test differences for significance; normally distributed continuous variables were compared between the groups using the unpaired Student's t test, and abnormally distributed variables were compared using Mann-Whitney U test. Chi-square test ($\chi 2$) and Fischer exact test were used for comparison of ordinal and nominal data. Statistical significance was defined as a p value of less than 0.05 ($p<0.05$). Statistical analyses were performed with SPSS for Windows, version 11.5 statistical package (SPSS, Inc, Chicago, Ill, USA).

RESULTS

Sixty-seven patients were included in this study and were divided into Group 1 (n=34), in whom aspirin was stopped >7 days before CABG and Group 2 (n=33), in whom aspirin was stopped ≤ 7 days before surgery.

	Group 1 (n=34)	Group 2 (n=33)	*p*-value
Age	57.3 ± 1.3	57.4 ± 1.8	0.96
Male gender	23 (67.6%)	24 (72.7%)	0.87
Body mass index	26.5 ± 2.4	26.6 ± 2.1	0.97
Smoking history	7 (20.6 %)	8 (24.2%)	0.56
Diabetes mellitus	18 (52.9%)	21 (63.6%)	0.23
Dyslipidemia	31 (91.2%)	29 (87.9%)	0.71
Renal failure	7 (20.6%)	3 (9.1%)	0.31
Hypertension	29 (85.3%)	27 (81.8%)	0.75
History of MI	20 (58.8%)	18 (54.5%)	0.41
Unstable angina	7 (20.6%)	9 (27.3%)	0.77
CHF Class III-IV (NYHA)	14 (41.2%)	14 (42.4%)	0.98
LV EF, %	50.6 ± 10.5	46.1± 15.4	0.40
Preoperative Hematocrit, %	38.1 ± 3.7	37.7 ± 5.7	0.90
Preoperative platelet count, 10^9/L	292.8 ± 8.4	273.5 ± 12.4	0.16
Log Euroscore, %	5.4 ± 0.01	4.7± 5.8	0.49

MI –myocardial infarction, CHF – congestive heart failure, LVEF – left ventricle ejection fraction

Table 1. ***Preoperative variables***

Patient demographics and disease characteristics are listed in Table 1. There was no significant difference between the two groups in the preoperative variables. The intraoperative data is illustrated in Table 2. There were no differences between the two groups.

The postoperative variables are displayed in Table 3. Platelet transfusion was significantly greater (p=0.03) in aspirin users (group 2). Length of hospital stay was also significantly greater in aspirin users (p=0.002). There was a trend of increase in intraoperative bleeding and PRBC transfusion in the group who had received aspirin within seven days. Postoperative blood loss was higher in aspirin users than in non-users but this difference was not statistically significant. There was no difference between two groups regarding re-exploration or operative mortality. One patient in group 1 died due to low cardiac output.

	Group 1 (n=34)	Group 2 (n=33)	*p*-value
CABG off pump	17 (50%)	13 (39.4%)	0.46
Number of grafts (median)	3.5 ± 2.0	3.0 ± 1.0	0.69
Cross clamp time (min)	63.4 ± 19.2	57.4 ± 16.3	0.39
Total bypass time (min)	113.4 ± 27.1	106.7± 22.4	0.58

Table 2. ***Operative variables***

	Group 1 (n=34)	Group 2 (n=33)	p-value
Total chest drainage, ml (median)	603 ± 112	800 ± 63	0.09
Transfused RBCs, units	2.1 ± 2.3	2.9 ± 2.7	0.17
Transfused platelets, units	0.58 ± 1.4	1.78 ± 2.6	0.03*
Transfused FFP, units	0.91 ± 1.4	1.3 ± 1.9	0.54
Post-operative hematocrit, %	29.3 ± 4.2	29 ± 5.0	0.74
Post-operative platelet count, 10^9/L	214.9 ± 6.9	204.4 ± 12.7	0.21
Length of hospital stay, days	8.3 ± 3.5	11.6 ± 6.3	0.002*
Re-exploration	1 (3.0%)	2 (6.1%)	0.13
Mortality	1 (3%)	0	0.51

**-significant*

Table 3. ***Postoperative variables***

DISCUSSION

The decision to discontinue aspirin preoperatively in patients undergoing coronary artery bypass grafting (CABG) is controversial. Many studies report that patients receiving aspirin before CABG operations have increased blood loss, increased transfusion requirements and a higher incidence of re-operation for hemorrhage (7-9).

Accumulating evidence shows that perioperative blood transfusion is associated with higher morbidity and mortality and also decreased long-term survival in patients undergoing cardiac surgery (10). Whitson *et al*. (11) reported that blood transfusion after cardiac surgery is associated with a higher rate of postoperative complications. These complications include higher incidence of severe postoperative infections, especially nosocomial pneumonia, deep sternal wound infection,

sepsis and leg wound infection due to the immunosuppressive effect of blood transfusion. In addition to infectious complications, blood transfusion was associated with increased risk of neurological, cardiac, pulmonary and renal complications.

There are some studies that recommend continuing aspirin until the day of surgery. Vuylsteke *et al*. (12) evaluated the effect of aspirin in coronary artery bypass grafting and showed that aspirin therapy did not appear to increase blood loss, reopening for bleeding or blood product usage requirements during the hospital stay.

Kamran *et al*. (13) concluded that contrary to the commonly held beliefs, the use of aspirin until the date of surgery does not increase the risk of postoperative bleeding after CABG. In contrast, their data show reduction in bleeding incidence of those in whom aspirin was not withheld prior to surgery. Therefore, they strongly recommend the continued use of aspirin until the date of surgery.

In our study, aspirin use seven days or fewer before surgery (Isolated CABG) was associated with increased tendencies to have post-operative bleeding, receiving more blood products and longer hospital stay than in those patients who stopped aspirin intake more than seven days before surgery. These findings were similar to the results of other studies. Ferraris et al. (14) evaluated aspirin and postoperative bleeding after CABG; they reported that aspirin use was associated with more postoperative bleeding and transfusion of blood products than in patients who stopped aspirin.

In another study, Alghamdi *et al*. (15) showed that aspirin causes increased blood loss and transfusion of red cells and fresh frozen plasma in the aspirin group.

Ghaffarinejed *et al*. (16) recommended the withdrawal of aspirin seven days prior to CABG, as they found that aspirin use in patients undergoing elective CABG was associated with a marked elevation in postoperative bleeding and the need for red cell and fresh frozen plasma transfusion.

LIMITATIONS OF THE STUDY

Our measure of aspirin use (yes or no within seven days) may be imprecise, leading to inadequate classification of exposure. We did not collect information on the timing of aspirin use within the seven-day period, leading to a possible range of exposure for the aspirin's antiplatelet action. However, we specifically chose the seven-day period as the more conservative position. Aspirin's action on platelets is irreversible, and the lifespan of platelets is seven days.

CONCLUSION

Patients who take aspirin within seven days before CABG have more tendencies to have post-operative bleeding and receive blood products. They also have a longer length of stay in hospital. Our recommendation is to stop aspirin more than seven days before surgery.

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Mitral Valve Replacement For Functional Severe Mitral Incompetence In Patients With Idiopathic Dilated Cardiomyopathy

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Objectives: to evaluate outcome of mitral valve replacement (MVR) for patients with functional severe mitral regurgitation and congestive heart failure (CHF) due to idiopathic dilated cardiomyopathy (IDCM).

Methods: Between January 2012 and September 2013, eight patients underwent mitral valve replacement with mechanical valves and preservation of whole mitral valve apparatus for severe functional MR due to IDCM. Most Patients had ejection fraction (EF) < 40%. CHF patients of ischemic or valvular etiologies were excluded.

Results: Thirty day survival and 1-year survival rates were 100%. After a mean follow up of 14±3 months New York Heart Association class improved from 3.5±0.5 to 1.8±0.6 (p =0.01), LVEF improved from 37.4±5.6% to 43.2±6.7 (p =0.04), LVEDD improved from 6.7±4.4 cm to 6.3±5.0 cm (p =0.1).

Conclusion: mitral valve replacement with preservation of whole mitral valve apparatus can provide good early results for patients with non-ischemic DCM and severe FMR.

KEY WORDS: IDCM - FMR – WHOLE VALVE PRESERVATION- MVR

IDCM: Idiopathic dilated cardiomyopathy. FMR: Functional mitral regurgitation. MVR: Mitral valve replacement.

Dilated cardiomyopathy (DCM) is often complicated by the appearance of functional mitral regurgitation (FMR). The incidence of FMR complicating dilated cardiomyopathy has been reported in as high as 60% of patients. It is related both to changes in the geometry of the left ventricle and the sub-valvular mitral apparatus, and to dilatation of the mitral annulus leading finally to congestive heart failure. Despite improvements in medical management, approximately 50% of patients with severe CHF die within 3 years of presentation (1). The appearance of FMR has a negative impact on survival of patients with DCM, with a mortality rate of 40% to 70% after 12 months from the diagnosis of FMR (2).

Surgical correction of FMR has been demonstrated to improve symptoms and quality of life and promote reverse LV remodeling in a significant proportion of patients with is- chemic and dilated cardiomyopathy (3-6). It has been demonstrated that mitral repair can be safely performed in DCM patients with severe FMR. However little data is available about the outcome of mitral valve replacement for those subset of patients (4). Mitral annuloplasty using undersized rigid or flexible ring technique, with or without edge-to-edge leaflet suturing is considered the standard to correct mitral regurgitation in those patients (5). However, FMR can reappear in the follow-up of patients treated with ring annuloplasty even with annular over-reduction (6). The objective of this study was to assess the early outcome of mitral valve replacement for severe FMR in patients with DCM.

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METHODS

Study Population

Between January 2012 and September 2013, eight patients underwent mitral valve replacement with mechanical valves and preservation of whole mitral valve apparatus for severe functional mitral regurgitation secondary to idiopathic DCM. FMR was graded preoperatively by echocardiography into 4 grades by measurement of absolute regurgitant jet area, and/or regurgitant jet area relative to left atrial size. The severity of mitral regurgitation (MR) was graded as: mild, 1+ (jet area/left atrial area <10%); moderate, 2+ (jet area/left atrial area 10–20%); moderately severe, 3+ (jet area/left atrial area 20–45%); and severe, 4+ (jet area/left atrial area >45%). Based on regurgitant jet area, severe FMR was defined as grade 4 with regurgitant jet area equal or more than 8 cm.

Inclusion criteria

- *Idiopathic DCM Patients with severe FMR grade 4*

Exclusion criteria

- FMR patients of ischemic or valvular etiologies
- Pulmonary artery pressure (PAP) >70 mmHg
- EF < 25 %
- Left ventricular end diastolic dimension (EDD) > 7.5 mm
- Patients with severe right ventricular failure
- Patients with severe renal or hepatic impairment

End points

Primary end points: 30 day post operative survival.

Secondary end points: 1-year survival, NYHA class improvement, need for re-hospitalization, left ventricle dimensions and EF changes.

Surgical technique

Conventional median sternotomy, standard cardiopulmonary bypass using bi-caval cannulation. Myocardial protection was achieved using antegrade intermittent cold cardioplegia. Mitral valve replacement was performed with preservation of the whole valve with out excision of any valve leaflets or chordae; this was easily performed due to huge annular dilatation. Sutures were passed from the annulus toward middle of leaflet tissue to pass finally to tip of the leaflet plicating the whole leaflet tissue. Mechanical bi-leaflet valves size 29 and 31 were used in all cases.

Follow-up

Patients were seen and followed up in a heart failure out patient clinic with physical examination, electrocardiography and echocardiography. All patients had an echocardiographic exam at hospital discharge and again at 1-year follow-up.

RESULTS

The mean age of the patients was 56 ± 12.5 yrs. The mean ejection fraction (EF) was less than 40 % (table 1). Most of the patients were in sinus rhythm (67.5 %). Table 1 summarizes the preoperative patient characteristics.

All patients (n=8) underwent mitral valve replacement by a mechanical bi-leaflet valve. Two sizes were used, size 29 in 3 patients (37.5%) and size 31 in 5 patients (67.5%). Concomitant segmental tricuspid valve annuloplasty was performed in 3 patients (37.5%). The baseline clinical and echocardiographic characteristics, together with the relevant operative data are summarized in table 1. Most of the patients were in NYHA grade III-IV (62.5%).

Age (mean ± SD)	56 ± 12.5
EF %	37.4 ± 5.6
LVEDD (mm)	67 ± 4.4
LVESD (mm)	51 ± 8.0
PAP (mmHg)	45 ± 11
NYHA	
II-II	3 (37.5%)
III-IV	5 (62.5%)
AF (%)	3 (37.5%)
Mitral valve size 31	5 (62.5%)
Mitral valve size 29	3 (37.5%)
Concomitant tricuspid repair	3 (37.5%)

AF: atrial fibrillation; EDD: left ventricle end diastolic dimension; EF: ejection fraction; ESD: left ventricle end systolic dimension; NYHA: New York heart association; PAP: pulmonary artery pressure;

Table 1. Preoperative and operative patient characteristics

Hospital survival was 100 %. At hospital discharge there was a significant improvement in NYHA functional class compared to preoperative values (p=0.01). Most of the patients were NYHA class II-III (75%).

The Echocardiography study done at discharge showed decreased left ventricular dimensions as compared to the preoperative values, however with no statistical significance (p=0.1). Nevertheless, there was a significant improvement in EF at discharge. It went up from a mean of 37.4%± 5.6 to a mean of 42% ± 7.6 (p=0.04).

Only one patient (12.5%) stayed in NYHA class IV postoperatively and continued as such at the 1-year follow up. This same patient was the only patient who later needed re-hospitalization for symptoms of congestive heart failure. He had chronic AF, a preoperative EF of 30%, a postoperative EF of 28% and preoperative moderate tricuspid regurgitation with PAP of 65 mmHg. The patient was admitted to the hospital at 8 months for decompensated heart failure, received intravenous diuretics and was later discharged at 9 days after losing the excess edema fluid and improvement of his clinical condition.

The NYHA class of the patients at 1-year did not differ much as compared to hospital discharge data. That is true also for the EF. Other than the single patient who needed re-hospitalization for CHF, no other patient needed re-hospitalization or re-operation during the 1-year follow up period. Table 2 reports postoperative data at hospital discharge and at 1-year follow up.

	Hospital Outcome	One year follow-up
Death	0 (0)	0 (0)
NYHA class		
I-II	1 (12.5%)	2 (25.0%)
II-III	6 (75.0%)	5 (62.5%)
III-IV	1 (12.5%)	1 (12.5%)
Re-hospitalization for HF	--	1 (12.5 %)
EF %	42 ± 7.6	43.2 ± 6.7
LVEDD (mm)	62 ± 4.5	63 ± 4.0
LVESD (mm)	48 ± 4.0	50 ± 4.4

EF: ejection fraction; HF: heart failure; LVEDD: left ventricle end diastolic dimension; LVESD: left ventricle end systolic dimension; NYHA: New York heart association

Table 2. Hospital outcome and 1-year follow-up

DISCUSSION

In patients with idiopathic dilated cardiomyopathy left ventricular dysfunction and/or remodeling lead to functional mitral regurgitation (FMR), which is associated with cardiac mortality and congestive heart failure episodes independently of all other baseline patient characteristics [7]. Surgical correction of FMR has been demonstrated to improve symptoms and quality of life and promote reverse LV remodeling in a significant proportion of patients with ischemic and non-ischemic cardiomyopathy. However, recent data confirm that moderate to severe residual MR, whether ischemic or non-ischemic, remains an independent predictor of cardiac death and heart failure [8]

In the current study we chose to surgically correct only grade 4 severe FMR however others state that even moderate FMR should be surgically corrected (6). We excluded patients with severe right ventricular failure and renal or hepatic failure as this spectrum of patient population has the highest risk of mortality. However the new evolving advent of percutaneous interventions like MitraClip has a new hope for those patients (7). Although there is a well-established data retrieved from literature confirming efficiency of mitral repair with rigid rings in patients with severe FMR secondary to DCM, however recurrent regurgitation after repair in that cohort of patients is a critical issue (8). In our study we decided to replace the mitral valve with bi-leaflet mechanical valves of 29 and 31 sizes, to overcome the recurrence of mitral regurgitation. Those valve sizes were selected with tendency for under sizing to relatively plicate hugely dilated mitral annulus.

All 8 patients in the study survived the immediate postoperative period as well as through the 1-year follow up. This is slightly better than the results reported by Bonis et al in 2011[9]. They reported 3 out of 54 (5 %) hospital mortality. Their patients were subjected to surgical mitral repair with ring. In addition, 70% of their study population was subjected to AF ablation and/ or ventricular resynchronization therapy.

Most of our patients were in sinus rhythm (62.5%), which translated to a good postoperative outcome. In fact the one patient who seemed not to benefit clinically from surgery had chronic AF and severe pulmonary hypertension. He also had a severely dilated left ventricle with LVEDD of 7.4 mm. The patient survived the surgery but remained in NYHA class III-IV postoperatively. He was re-hospitalized for congestive heart failure 8 months postoperative. Many authors reported AF and severely dilated left ventricle to be predictors of morbidity and mortality in patients with non-ischemic heart failure [9,10]

Almost all of our patients had clinical improvement and at least one step-down in their NYHA class (7/8 patients). Postoperatively most of the patients were in NYHA class II-III (6/8) while one patient was in class I-II. This clinical improvement coincided with significant improvement in EF, which stepped up from a mean 37 % preoperative to a mean of 42 % postoperative. Through the 1-year follow up the clinical picture and echocardiographic data have not changed significantly.

These results were well close to the work of Theron et al [10]. The group reported in 2013 the early and mid-term outcome of mitral valve replacement versus mitral repair with under-sizing annuloplasty for chronic FMR in 59 patients. The mitral replacement arm had an early mortality of 2%, had an 8-year survival free from cardiovascular death of 72%, as compared to 3.3% and 60 % respectively for the repair group, although the difference in favor of replacement group was not statistically significant [10]. The most important finding in that study was the incidence of recurrence of mitral regurgitation. Fifty percent of the mitral repair group had recurrence of

significant mitral regurgitation, while none of the mitral replacement group patients experienced recurrence of mitral regurgitation. The team concluded that surgical treatment of FMR could be performed with an acceptable operative risk and mid-term survival. Mitral valve replacement is a reasonable approach, which does not expose patients to mitral regurgitation recurrence, particularly frequent after mitral repair with undersizing annuloplasty [10].

In conclusion, it seems that mitral valve replacement with preservation of whole mitral valve apparatus can provide good early results for patients with non-ischemic DCM and severe FMR.

Limitations of The Study

1- This is a pilot study. It is considered exploring uncharted territory. Very little data is available in the literature regarding mitral valve replacement for severe FMR secondary to idiopathic DCM. Accordingly our patient selection was strict, the sample size was small (8 patients) and their preoperative clinical and echocardiographic characteristics were generally better than what is recorded in the literature.

2- The effective regurgitant orifice (ERO) and the regurgitant volume (RVol) were not routinely adopted to quantify the severity of FMR. Therefore, they were not used for analysis and comparison.

3- This is a single arm study, looking at short-term results of a specific procedure. A comparative pivotal study is needed to compare the outcome of mitral valve replacement to repair, with emphasis on mid-term and long-term outcomes

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Relation Between Ejection Fraction and Route of Cardioplegia Administration During CABG Surgery

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Background: **There are different parameters for judgment on the efficiency of myocardial protection during open heart surgery. Most important of these parameters are the biomarkers such as Troponin "I and T",CK-MB and non biomarkers such as the initial reperfusion rhythm, need for defibrillation shocks, chemical or mechanical support, myocardial contractile function "ejection fraction" and the occurrence of post operative arrhythmias and ECG changes.**

Objective: **The objective of the study is to find out whether ejection fraction (E.F) can be used as a reliable parameter for judgment on myocardial protection using two different techniques of cardioplegia administration during CABG surgery.**

Patient and Methods: **100 patients with multivessel coronary artery disease were divided into two equal groups. (Group A = 50) used antegrade cardioplegia administration, while (Group AR = 50) used combined ante / retrograde cardioplegia administration. Both groups were administered cold blood cardioplegia and underwent conventional CABG surgery using cardiopulmonary bypass (CPB) and median sternotomy.**

Echocardiographic study was done for all patients pre-operatively and six days post operatively to determine any change in myocardial function. Pre-operative parameters and demographic characters of both study groups showed no statistical difference. Intra and post operative parameters such as cardiopulmonary bypass time, ischemic time, recovery rhythm, the need for D.C shock, inotropic or mechanical support, arrythmias and ECG changes were all recorded.

Results and conclusion: **Despite that recovery with fibrillation, the need for defibrillation, the need for chemical support and post operative ECG changes were all statistically *lower* in group AR, but that was not reflected in terms of (E.F) as it didn't show any statistical difference between both study groups denoting that it cant be used as a reliable parameter for judgment on efficiency of myocardial preservation.**

KEY WORDS: **Myocardial Protection, Ejection fraction, CABG.**

Improved results of coronary artery surgeries with the traditional use of cardiopulmonary bypass entails adequate intraoperative myocardial protection [1]

Effective intraoperative myocardial protection requires adequate distribution of cardioplegia solution to all myocardial segments in a safe, simple and rapid fashion [2]

Thought antegrade cardioplegia is an advantageous route, yet, it is associated with numbers of actual and theoretical limitations [3,4]

Among these drawbacks is the non homogenous distribution of antegrade cardioplegia in severe critical proximal coronary artery stenosis and in evolving myocardial infarction [5]

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To obviate these limitations, retrograde coronary sinus perfusion has been proposed as an alternative method of providing myocardial protection that offers excellent protection in case of severely diseased coronary artery disease "CAD" and when internal mammary grafts are used [6]

However, recent studies have showed that retrograde cardioplegia does not adequately perfuse the right ventricle due to low flow rate and so delayed cardiac arrest [7]

Therefore, a combination of both methods is expected to provide better cardiac protection than using each route alone that could be interpreted in terms of parameters as ischemic markers and ejection fraction [8]

Research Strategy:

100 patients who were diagnosed to have multivessel coronary artery disease were scheduled for conventional CABG surgery using CPB and median sternotomy were operated upon in Kasr AL Ainy Hospitals – Egypt, from February 2012 to June 2014. The study was designed as a prospective randomized clinical trial to assess and compare the effect of using antegrade versus combined ante/retro grade cardioplegia on ejection fraction as well as clinical, hemodynamic and electro-cardiographic parameters between both methods.

Exclusion Criteria:

The route of cardioplegia delivery was the only variant between both groups. The criteria of exclusion of patients from the study included re-operation, emergency or combined procedures, off pump CABG, age less then 35 years or more than 75 years, patients with severe co- morbidities, patients with pre-operative acute myocardial infarction as evident by new electrocardiographic, echocardiographic and biochemical changes .

Echocardiography Regimen:

All patients had a preoperative colored Echo-Doppler study for their myocardial function and regional wall motion abnormalities followed by post operative assessment at day 6. Poor left ventricular function was defined in this study as an E.F below 35 % and those patients were excluded from the study.

Surgical Maneuver:

Standard anesthesia and monitoring were used in all patients. After median sternotomy the left internal mammary artery was dissected, harvesting of the saphenous vein was performed simultaneously, full heparinization, aortic and venous cannula were inserted. Antegrade cardioplegia and venting were accomplished through another aortic cannula this was done in both study groups. A retrograde coronary sinus cannula was inserted routinely in group AR. Standard cardiopulmonary bypass (CPB) and moderate systemic hypothermia (28–32°C) were instituted for all patients.

In both groups, all proximal and distal anastmosis were performed while the aortic cross clamp is applied (Without aortic de-clamping and placement of a side bitter clamp on the ascending aorta). [9]

Cardioplegia Processing:

The preparation of cardioplegic solution was the same in both groups; it was prepared using cold ringer solution where each 500 cc contained the following additives; Potassium Chloride 30 mEq, Sodium bicarbonate (8.4% solution) 25 mEq, Xylocain (2.5ml of 2% vial) 100 mg. The solution was diluted with blood by evacuating 200cc for each 1000cc of the prepared solution and replacing it with blood. i.e: (800 cc solution and 200 cc blood).

In antegrade method:

The solution was delivered, keeping an average aortic root pressure around 60–90 mm Hg and a flow rate at 175–200 mL/min. One liter of cardioplegic solution was given initially and a booster injection (250–350 cc) was delivered after each distal-end anastomosis. Topical cold saline was applied repeatedly around the heart.

In combined antegrade /retrograde method:

Half of the initial dose will be delivered antegradely with high aortic root pressure; the other half is shifted to the retrograde route keeping the coronary sinus pressure about 40 mmHg. All subsequent doses were given retrogradely. The two routes of administration were never used simultaneously. [10]

Data Collection:

The following parameters have been recorded, total cardiopulmonary bypass time, total cross clamp time, initial reperfusion rhythm, the of use of defibrillator (D.C shock), the use of inotropic support, the occurence of post bypass ventricular arrhythmias, myocardial ischemia or infarction and occurence of post operative morbidity and mortality.

Statistical Work Up:

IBM-SPSS statistical software for MAC © release 22 and Microsoft © Excel 2002 were used for data analysis. All data was presented as mean and standard deviations. Inter-group comparisons were made using unipaired t-test. Intra-group comparisons were made using ANOVA. P value less than 0.05 was considered statistically significant.

Outcome:

The two groups of the study were similar in terms of number, age range, sex distribution, body weight, ejection fraction range, and preoperative morbidity (smoking, hypertension, diabetes, extent of CAD, unstable angina and previous MI) with no statistical differences between these respects. (table 1 , 2)

		Group		P*	Sig
		(A)	(AR)		
		N	N		
Age (yrs)	Mean±SD	60.3±7.85	59.8±9.02	0.8	NS
	Range	35-70	40-75		
Gender	Male	43	44	0.766	NS
	Female	7	6		
Body Weight	Mean±SD	86.7±16.4	88.6±16.3	0.5	NS
	Range	67-100	68-110		
Ejection Fraction (Pre)	Mean±SD	58.54±10.7	58.14±9.40	0.8	NS
	Range	35-70 %	35-70 %		

** Values are presented as numbers (%) or mean ± standard deviation as indicated *P value {S = significant, NS = non significant, HS = highly significant}*

Table 1. Analysis of demographic characters among both study groups

	Total	Group				P*	Sig
		(A)		(AR)			
		N	%	N	%		
Cerebro Vascular Disease	3	2	4%	1	2%	0.558	NS
Unstable Angina	23	13	26%	10	20%	0.476	NS
Diabetic	54	27	54%	27	54%	0.715	NS
Previous Infarction	27	14	28%	13	26%	0.822	NS
Hypertensive	71	36	72%	35	70%	0.826	NS
Smokers	44	20	40%	24	48%	0.420	NS

* Values are presented as numbers (%) or mean ± standard deviation as indicated *P value {S = significant, NS = non significant, HS = highly significant}

Table 2. Analysis of preoperative morbidity among both study groups

	Total	Group				P*	Sig
		(A)		(AR)			
		N	%	N	%		
Elective Surgery	92	47	94%	45	90%	0.461	NS
Urgent Surgery	8	3	6%	5	10%	0.529	NS
Left internal mammary conduit	94	48	96%	46	92%	0.206	NS
Initial recovery with fibrillation (O.R)	32	24	48%	8	16%	0.001	HS
Defibrillation Shocks (O.R)	32	24	48%	8	16%	0.001	HS
Defibrillation Shocks (I.C.U)	2	2	4%	0	0%	0.153	NS
Chemical support (O.R)	37	27	54%	10	20%	0.001	HS
Chemical support (I.C.U)	38	17	34%	21	42%	0.410	NS
Electrocardiography changes	54	35	70%	19	38%	0.001	HS
Dysrrhythmias	14	7	14%	7	14%	1.0	NS
Need for pacing	2	2	4%	0	0%	0.153	NS

* Values are presented as numbers (%) or mean ± standard deviation as indicated *P value {S = significant, NS = non significant, HS = highly significant}

Table 3. Analysis of operative and early post operative data among both study groups

The average post operative EF was 56.36 ± 9.8 with overall no significant difference between EF (pre) and EF (post). Table (6,7) show comparison between the mean preoperative and post operative EF in both groups; there was no significant statistical difference between both groups.

The amount of change in E.F pre and post operatively was recorded for all patients in each group to detect whether there is a relation between route of cardioplegia administration and E.F with standardization of all other variables. Tables (4,5,6) show that there was no significant statistical difference in the amount of change in E.F between both routes of administration. (Fig 1)

Total Population	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
EF-1 (Pre-opearative)	58.34	10.1	35	76
EF-2 (Post-operative)	56.36	9.8	30	77

* Values are presented as numbers (%) or mean ± standard deviation as indicated

Table 4. Analysis of pre and post operative recordings of Ejection Fraction among all study patients

	Group									
	(A)				*(AR)*				*P**	*Sig*
	Mean	*SD*	*Min*	*Max*	*Mean*	*SD*	*Min*	*Max*		
EF-1 (pre)	58.54	10.7	35	73	58.14	9.40	38	76	0.8	NS
EF-2 (Post)	57.38	11.5	30	76	55.34	7.73	37	68	0.6	NS

** Values are presented as numbers (%) or mean ± standard deviation as indicated* **P value {S = significant, NS = non significant, HS = highly significant}*

Table 5. Analysis of Ejection Fraction among both study groups

	No change	*Increased*	*Decreased*	*Total patients*	*P**
Group - A	6	23	21	50	NS
Group - AR	5	30	15	50	NS

** Values are presented in numbers as indicated* **P value {S = significant, NS = non significant, HS = highly significant}*

Table 6. Description of the change in EF pre and post operatively among both study groups

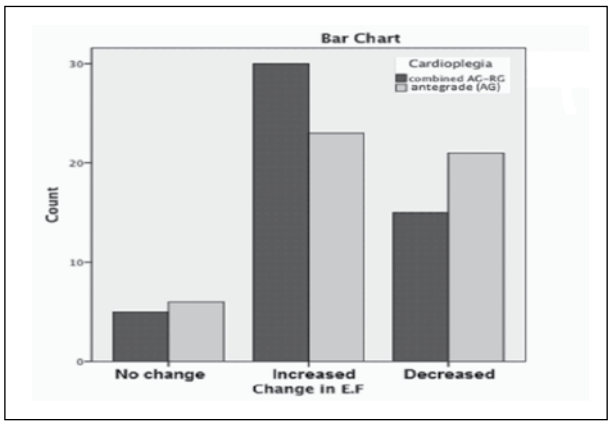

Fig. 1. Showing The Change in E.F (pre and post operatively) in the study

Fig:1 Showing that there was no significant change between both study groups, since 6 patients from group AR showed same E.F pre and post operative compared to 5 patients from group A, while 30 patient in group AR showed increase in post operative E.F compared to 23 patients from group A, and 15 patients from group AR showed decrease in post operative E.F compared to 21 patients from group A. There was no statistical difference between both groups in these parameters, although there was a trend for increased E.F post CABG surgery detected at day 6 from surgery.

Discussion

The optimal route of delivery of cardioplegia is still debatable in patients with ischemic heart disease. Cardiothoracic surgeons and anesthesiologists exhibit great concern about the comparison between different routes and composition of the cardioplegic solution in particular since myocardial protection is the cobblestone of improvement in such surgical procedures [11]

Since the introduction of retrograde route for cardioplegia administration through the coronary sinus by Lillchei and colleagues 1956 [12] Many studies have been postulated to investigate its effectivness in valve sureries until the late 1970s when intrest emerged in retrograde coronary sinus perfusion in coronary surgery [13]

Some studies raised concern that retrograde perfusion provided inadequate preservation of the right ventricle in particular [14], other studies even concluded that the combined use of antegrade and retrograde routes offered the same degree of myocardial preservation induced by antegrade cardioplegia alone[15], while others reported significant differences favoring retrograde than antegrade route for cardioplegia administration[16].

With respect to homogenous distribution, initial recovery rhythm, need for defibrillation, chemical or mechanical support, arrythmias and ECG changes, our study showed that the combined route for cardioplegia administration is superior than antegrade route alone, but that was not reflected in terms of ejection fraction.

In our study, the absence of statistical difference in preoperative demographic characters between both groups (table 1,2), absence of preoperative MI in addition to exclusion of risk factors such as emergency revascularization and poor left ventricular function and the uniformity of surgical technique for all patients using single aortic cross clamp technique without side "C" clamp for proximal anastmosis, one LIMA and two or three saphenous vein grafts, has made our results valuable and comparable to other studies in literature. Khalili and co-workers [17] study included two hundred patients who were distributed randomly into two groups. Cardioplegia was administered in first group using antegrade route while in second group via combined antegrade and retrograde route. The cardioplegia processing was similar for both groups. The rate of reduced cardiac ejection was assessed between both groups. Onorati and associates [18] study included one hundred forty eight patients who have done conventional CABG and categorized into two groups according to the route of cardioplegia delivery, antegrade route in eighty seven patients and antegrade / retrograde in sixty one patients. Echo-cardiography analysis was performed preoperatively and 6 days after surgery. Franke and colleagues [19] study included fifty eight patients who underwent elective CABG for 2 or 3 vessel coronary artery disease and were distributed equally into two groups, group I with antegrade and group II with retrograde application of crystalloid cardioplegia. Echocardiographic study was done for all patients preoperatively and prior to hospital discharge. Elwatidy and colleagues [20] included one hundred twenty eight patients which were categorized into three different techniques of cardioplegia administration; group A (n = 47) antegrade/ retrograde tepid blood cardioplegia, group B (n = 40) antegrade/ retrograde cold blood cardioplegia with topical cooling, group C (n = 41) antegrade crystalloid cardioplegia with topical cooling. Echocardiography was done preoperatively and 6 days after surgery. Franke and colleagues[19] reported an average number of diseased vessels to be 2-3 vessels with 32.7% having two vessel disease, while 67.2% were having triple vessel disease. Elwatidy and colleagues [20] reported average number of diseased vessels 2.8 with 32.7% having severe diffuse coronary artery disease, while 65.6% of the patients having moderate degree of coronary artery disease. Onorati and associates [18] reported average number of diseased vessels 3.2 ± 0.9. which is consistent to our study where the average number of diseased vessels in the study was 3.02 ± 0.82, indicating that most of the patients had triple vessel disease, while 20% had two vessel disease , 54% had three vessel disease and 18% had four vessel disease which is similar to mentioned studies. (table 3). Franke and colleagues[19], reported use of LIMA in 90% of cases, Elwatidy and colleagues[20], reported use of LIMA in all their cases, this is compared to 94% use of LIMA in our study population that is close to their studies (table 3). As regards ejection fraction; Elwatidy and colleagues[20], Franke and colleagues[19], Khalili and co-workers[17] and Onorati and associates[18] reported preoperative EF (EF-1) to be 63.0±13, 47.2±7.8, 47.22±9.7, and 51.5±8.7 respectively in their studies which is very close to our study "58.34±10" (table 5,6). Elwatidy and colleagues[20], Franke and colleagues[19], Khalili and co-workers[17] and Onorati and associates[18] reported average postoperative EF (EF-2) to be 57.5±10, 51.3 ± 4.8, 40.88±8.65 and 54.3 ± 6.8 respectively with no significant difference between both study groups which correlates with our study were the average EF after surgery (EF2) was "56.36 ± 9.8" (table 4,5,6) with overall no significant difference between both study groups.

We can conclude that, although the amount of change in ejection fraction pre and post operatively didn't show significant statistical difference with the different routes of cardioplegia administration (table 5,6, Fig.1) however, the combined route (ante / retro) allowed for better myocardial protection in terms of other important parameters as; the initial recovery rhythm, the need for chemical support, the need for defibrillation, the occurrence of post operative arrhythmias and ECG changes (table 3) which indicates that combining antegrade and retrograde cardioplegia did have a superior myocardial protection during CABG surgery but that was not interpreted in terms of E.F which could be contributed to the fact that the calculation of ejection fraction involves a number of mathematical assumptions such as ventricular geometry and can be criticized on that account. In addition to that, many

physiologic factors should be taken into consideration and are well known to affect the ejection fraction such as; the heart rate, the preload, the ventricular compliance, the afterload, and myocardial contractility itself, are all important factors that intervene in the calculation of ejection fraction, and so, it cant be used as a parameter of differentiation between two techniques for myocardial protection during surgery.[21]

Judgment is therefore required in evaluating the meaning of an ejection fraction measurement in a given patient; and the aforementioned factors should not invalidate the use of ejection fraction as a contractility index, but at least demonstrate that; it is neither better nor worse than other contractility indices in terms of the influence of other factors.[21]

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Is Combined Ante and Retrograde Cardioplegia Superior Than Selective Antegrade Cardioplegia in Patients With Left Main Coronary Artery Disease Undergoing CABG

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Background and objective: **The optimal route for delivery of cardioplegia in patients with ischemic heart disease undergoing CABG surgery is still controversial. The study was designed to find out whether combining retrograde to antegrade cardioplegia will provide better post operative course than using selective antegrade cardioplegia in patients suffering left main or left main equivelant CAD "coronary artery disease".**

Patient and Methods: **One hundred patients suffering left main / left main equivalent CAD were scheduled for conventional CABG surgery using cardiopulmonary bypass and median sternotomy. Patients were divided into two equal groups according to the route of cardioplegia administration. Group I used antegrade route (N=50) while Group II used combined antegrade and retrograde routes (N=50). Both groups were administered the same type of cardioplegia solution (St. Thomas II) cold blood cardioplegia).**

Pre-operative data such as age, sex, body weight, diabetes, hypertension, smoking, previous myocardial infarction and unstable angina were all recorded. Intra operative data such as aortic cross-clamp time (XCT), total bypass time (TBT), initial reperfusion rhythm after cross clamp removal, the need for defibrillation, chemical and/or mechanical support, were all recorded. Post operative data such as arrhythmias, ECG changes, inotropic support , post operative morbidities (respiratory, renal, and neurological), the need for re-exploration, and total ICU and hospital stay were all recorded.

Results and conclusion: **During the intra-operative course the following parameters were statistically lower in group II than group I; initial recovery with fibrillation, the need for defibrillation, and the need for inotropic support, on the other hand the TBT and XCT were longer in group II. During the post operative course, the early ECG changes were higher in group I. The total ICU stay, hospital stay, renal, neurological and respiratory complications, and the need for re-exploration didn't show any statistical differences.**

KEY WORDS: **Antegrade, Retrograde, Cardioplegia, CABG.**

The optimal delivery of cardioplegic solution in coronary artery bypass grafting is still controversial concerning optimal myocardial protection. [1]

The prime objective of coronary artery bypass grafting surgery is to obtain complete revascularization via bypassing all severe stenoses (at least 50% diameter reduction) in all coronary arterial trunks and branches having a diameter of about 1mm or more. [2]

Myocardial ischemia commonly complicates CABG surgery. This ischemia and then reperfusion affects both cardiac myocytes and coronary endothelial cells and appears to be a major factor contributing to perioperative myocardial damage. Generation of oxygen free radicals during the early phase of reperfusion has been recognized as the source of these injuries.[3]

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Various antioxidant agents and cardioplegic arrest techniques have been used to prevent myocardial injury and oxidative stress during coronary artery bypass grafting (CABG). However, these treatment modalities are not standardized for routine usage, and there is still a need to identify an effective and convenient agent to protect myocardial tissue against damage of ischemia–reperfusion injury during cardiac surgery.[4]

In the presence of coronary stenosis or occlusion antegrade cardioplegia is unable to deliver a sufficient amount of solution to the areas supported by the diseased artery. Since atherosclerosis does not occur in the coronary venous system and the coronary arterial system is not necessarily the only outlet for cardioplegia administration, the jeopardized myocardium can be perfused by retrograde delivery of cardioplegic solution.[5]

Because of low flow, heterogeneous distribution, and poor supply to the right ventricular wall, retrograde cardioplegia has been shown to be significantly less efficient than antegrade cardioplegia for myocardial protection.[6]

On the basis of the advantages and disadvantages of both cardioplegic techniques, it is expected that the combination of the two techniques might become a superior cardiac protective strategy, leading to significant improvement in myocardial protection for patients at high risk. [7]

Methodology

This work was conducted as a prospective randomized controlled study on 100 patients suffering from left main coronary disease (left main stem or left main equivalent) who were scheduled for isolated on pump CABG surgery from March 2012 to May 2014 at Kasr Al Ainy Hospitals - Egypt. The patients were divided into two groups according to the route of cardioplegia administration. Group I (N=50) with antegrade delivery of cardioplegia and Group II (N=50) with combined antegrade and retrograde delivery of cardioplegia. The route of cardioplegia delivery was the only variant between both groups. The criteria of exclusion of patients from the study included reoperation, emergency or combined procedures, off pump CABG, age less then 35 years or greater then 75 years, patients with severe comorbidities, patients with poor cardiac function (EF < 35%), patients with preoperative acute MI evident by new ECG changes, echo-cardiographic changes and biochemical tests .

All patients were diagnosed to have multivessel coronary artery disease based on selective coronary angiography.

Anasthesia protocol

Standard anesthesia protocol was followed in each patient, anesthesia was induced using thiopentone (3-4mg/kg), Fentanyl (5-7μg/kg) and vecuronium bromide (0.08-0.1mg/kg), the maintainance of anesthesia was carried out using isuflorane (0.8-1%) which was used as inhalation anesthesia according to hemodynamic parameters.

Cannulation for cardioplegia delivery

An Antegrade Cannula was routinely inserted in the aortic root in all the 100 patients. The cannula had two ports one for venting and the other for cardioplegia delivery. A Retrograde Cannula was inserted only in the 50 patients of Group II, this was done trans atrially guided by feeling the tip of the catheter negotiating the entrance of the coronary sinus from the diaphragmatic surface before going on bypass with the right side adequately filled which was performed successfully after a single attempt in 45 patients and multiple attempts in 5 patients.

In all cases a 14 fr. Retrograde cardioplegia cannula with self inflatable medium balloon and rigid insertion stylet, CHASE, Medical inc., Richardson., Texas was used. This cannula has a side arm for pressure monitoring in the coronary sinus.

Operative technique

In all patients there was uniformity in the operative technique, all distal and proximal anastmosis were performed with one aortic clamp application (no side bitting clamp).

Preparation and infusion of cardioplegic solution

In Group I, St.Thomas' Hospital no.II solution chilled to 4 °C was used, it was diluted with 200 cc patients' blood for every 800 cc of the solution, then infused in a dose of 15 ml/kg body weight initially and booster doses of 250 cc were delivered each 15 minutes. Topical cold saline was applied repeatedly around the heart. In Group II, half of the initial dose was given antegradely with high aortic root pressure and the other half was given retrogradely with coronary sinus pressure ranging between 30 and 50 mmHg, all subsequent doses were given retrogradely through the coronary sinus. The two routes of administration were never used simultaneously.

Intra Operative evaluation

The following parameters have been recorded:

- Total bypass time (min)
- Total ischemic time (min)
- Ease of weaning from CPB (initial reperfusion rhythm)
- Incidence of use of defibrillator (D.C shock)
- Average dose of inotropic support
- Incidence of post bypass ventricular arrythmias
- Incidence of post bypass persistent myocardial ischemia or infarction
- Incidence of post operative mortality

Statistical Analysis

Statistical analysis was done using IBM-SPSS statistical software for MAC © release 22 and Microsoft © Excel 2002. All data was presented as mean and standard deviations. Inter-group comparisons were made using unipaired t-test. Intra-group comparisons were made using ANOVA. P value less than 0.05 was considered statistically significant.

Results

The two groups of the study were similar in terms of number, age range, sex distribution, body weight and preoperative morbidity (smoking, hypertension, diabetes, ejection fraction range, extent of CAD, unstable angina and previous MI) with no statistical differences between these respects.

		Group				P*	Sig
		I) Ante		II) Ante and Retro			
		N	%	N	%		
Age	Mean±SD	60.3±7.85		59.8±9.02		0.8	NS
	Range	35-70		40-75			
Sex	Male	43		86%			
	Female	7		14%		0.766	NS
Weight	Mean±SD	86.7±16.4		88.6±16.3		0.5	NS
	Range	67-100		68-110			
Hypertension		36	72%	35	70%	0.826	NS
Diabetes		27	54%	27	54%	0.715	NS
Smoking		20	40%	24	48%	0.420	NS
History of MI		14	28%	13	26%	0.822	NS
Unstable Angina		13	26%	10	20%	0.476	NS
COPD		3	6%	4	8%	0.695	NS
History of CVS		2	4%	1	2%	0.558	NS
Preoperative EF	Mean±SD	58.54±10.7		58.14±9.40		0.8	NS
	Range	35-70		35-70			
Previous Myocardial Infarction		14	28%	13	26%	0.822	NS
Unstable Angina		13	26%	10	20%	0.476	NS

** Values are presented as numbers (%) or mean ± standard deviation as indicated*

**P value {S = significant, NS = non significant, HS = highly significant}*

Table 1. Description and comparison of preoperative personal and medical characteristics among both study groups

		Group				P*	Sig
		Ante		Ante and Retro			
		N	%	N	%		
Operative Category	Elective	47	94%	45	90%	0.461	NS
	Urgent	3	6%	5	10%		
Type of Left Main Disease	Left main stem	19	38%	16	32%	0.529	NS
	Left main equivalent	31	62%	34	68%		
Number of targets	1 graft	3	6%	0	0%	0.057	NS
	2 grafts	12	24%	8	16%		
	3 grafts	25	50%	29	58%		
	4 grafts	9	18%	9	18%		
	5 grafts	1	2%	4	8%		

** Values are presented as numbers (%) or mean ± standard deviation as indicated*

**P value {S = significant, NS = non significant, HS = highly significant}*

Table 2. Description of operative category and surgical conditions among both study groups

	Total	Group				P*	Sig
		I) Ante		II) Ante and Retro			
		N	%	N	%		
Use of LIMA	94	48	96%	46	92%	0.206	NS
Recovery with fibrillation	32	24	48%	8	16%	0.001	HS
Use of DC shock	32	24	48%	8	16%	0.001	HS
Use of inotropic support	37	27	54%	10	20%	0.001	HS
Use of intra-aortic balloon	1	0	0%	1	2%	0.315	NS

** Values are presented as numbers (%) or mean ± standard deviation as indicated*

**P value {S = significant, NS = non significant, HS = highly significant}*

Table 3. Description and comparison of intra-operative details among both study groups

	Group								P*	Sig
	I) Ante				II) Ante and Retro					
	Mean	SD	Min	Max	Mean	SD	Min	Max		
Cross clamp time	71.32	22.82	30	140	83.58	23.29	43	150	0.009	HS
Bypass time	101.92	29.38	50	193	113.38	26.43	65	188	0.043	S

** Values are presented as numbers (%) or mean ± standard deviation as indicated*

**P value {S = significant, NS = non significant, HS = highly significant}*

Table 4. Description and comparison of aortic cross clamp and total bypass time among both study groups

	Total	Group				P*	Sig
		Ante		Ante and Retro			
		N	%	N	%		
Inotropic support	38	17	34%	21	42%	0.410	NS
ECG changes	54	35	70%	19	38%	0.001	HS
Arrhythmias	14	7	14%	7	14%	1.0	NS
DC shock	2	2	4%	0	0%	0.153	NS
Overdrive pacing	2	2	4%	0	0%	0.153	NS

** Values are presented as numbers (%) or mean ± standard deviation as indicated*

**P value {S = significant, NS = non significant, HS = highly significant}*

Table 5. Description and comparison of early post operative (ICU) events among both study groups

	Group								P*	Sig
	Ante				Ante and Retro					
	Mean	SD	Min	Max	Mean	SD	Min	Max		
ICU stay time	56.4	14.3	48	120	56.4	18.5	48	120	0.9	NS
Hospital stay	7.4	0.83	7	14	7.56	1.19	7	12	0.4	NS

** Values are presented in numbers as indicated*

**P value {S = significant, NS = non significant, HS = highly significant}*

Table 6. Description and comparison of ICU and hospital stay among both study groups

		Total	Group				P*	Sig
			Ante		Ante and Retro			
			N	%	N	%		
Type of complication	Re-exploration	9	5	10%	4	8%	.280	NS
	Neurological	5	3	6%	2	4%	.310	NS
	Renal	3	1	2%	2	4%	.510	NS
	Wound infection	2	1	2%	1	2%	1.0	NS

** Values are presented in numbers as indicated*

**P value {S = significant, NS = non significant, HS = highly significant}*

Table 7: Description and comparison of post operative complications among both study groups

Discussion

The aim of cardioplegia is to provide optimal physiological preservation of the myocardium allowing surgical approaches to be done safely. Favorable outcomes with respect to postoperative ventricular function are in large part dependant on optimal intra-operative myocardial protection [8]

The multiplicity of cardioplegic solutions available, their method of delivery, patient selection and the methods used to determine myocardial injury have made it difficult to accurately determine which form of cardioplegia is the best [9]

It is increasingly important to understand the pathophysiologic and molecular players of ischemia as a two-fold phenomenon in which ischemic injury is only part of the truth and subsequent reperfusion injury has the potential to grossly outweigh the primary ischemic insult [10]

The rationale behind retrograde application is that distribution of antegrade delivered cardioplegia might be impaired due to ventricular hypertrophy or significant coronary artery stenosis and retrograde application, bypassing plagued vessels, might be of advantage. [11]

However, the problem with retrograde perfusion is purely anatomical. Many surgeons believe that Thebesian veins play a central role in the distribution of retrograde cardioplegia and, thus, is non-nutritive. Of course this cannot be true. [12] In studies conducted by Gates et al. from UCLA in Los Angeles on human freshly explanted hearts it became obvious that all regions of the heart can be homogenously perfused in a retrograde fashion [13]

Comparing our study to others in practice; **Khalili and co-workers, (2007)**,[14] study included 208 patients which were categorized randomly in 2 groups. The cardioplegia method in group 1 was antegrade and in group 2 was ante/retrograde. The preparation of cardioplegia solution was the same in both groups. **Onorati and associates,(2003),**[15] study included 148 consecutive patients with left main stem disease undergoing coronary artery bypass grafting , they were divided into 2 groups according to the route of cardioplegia delivery: antegrade in 87 patients (group A) and antegrade followed by retrograde in 61 patients (group B). **Franke and colleagues,(2001)**,[16] in a prospective randomized trial 58 patients undergoing elective coronary artery bypass grafting for two- or three-vessel coronary artery disease were divided into groups with antegrade (group A, n = 29) and retrograde (group R, n = 29) application of crystalloid cardioplegia (St. Thomas II). Patients with major risk factors were excluded. **Elwatidy and colleagues ,1999,** [17] study included 128 patients which were prospectively randomized to 3 techniques of myocardial protection; group I (n = 47) antegrade/retrograde tepid blood cardioplegia, group II (n = 40) antegrade/retrograde cold blood cardioplegia with topical cooling, group III (n = 41) antegrade crystalloid cardioplegia with topical cooling.

The comparability of our study to previously mentioned studies was good since; **Elwatidy and colleagues** [17], **Franke and colleagues** [16], **Khalili and co-workers**[14] and **Onorati and associates**[15] reported incidence of left main stem coronary stenosis 30.46%**,** 22.4%, 15.38 %, and 27.7% respectively in their studies compared to 35% in our study which is close to their studies (table 2). **Franke and colleagues**[16] reported average number of diseased vessels 2-3 with 32.7% having two vessel disease, while 67.2% of the patients referred for CABG were having triple vessel disease. **Elwatidy and colleagues**[17] reported average number of diseased vessels 2.8 with 32.7% having severe diffuse coronary artery disease, while 65.6% of the patients having moderate degree of coronary artery disease. **Onorati and associates**[15] reported average number of diseased vessels 3.2 ± 0.9. which is close to our study where the average number of diseased vessels in the study was 3.02 ± 0.82, indicating that most of the patients were having triple vessel disease, (20%) has two vessel disease , (54%) has three vessel disease and (18%) has four vessel disease (table 2).

Elwatidy and colleagues [17], **Franke and colleagues** [16], reported use of left internal mammary artery in 90.6% and 100% of the patients respectively compared to 94% in our study population which is close to their studies (table 3).

Comparing the results of our study to previously mentioned studies **Onorati and associates**[15], reported the number of patients who did not require any inotropic support at all was statistically higher in the group with combined cardioplegia; furthermore, there was no difference between the 2 groups regarding the number of patients requiring medium- and low-dose inotropic support. More patients who underwent antegrade cardioplegia delivery alone required a high dose of inotropic support 11.5% compared to zero % in those with the combined route (p= .004). **Franke and colleagues** [16], reported twelve patients in the antegrade group (41%) required nor epinephrine at the time of weaning from cardiopulmonary bypass compared to five patients of the retrograde group (17%, p = 0.037). Both studies correlates with our results where in group-I, 27 patients used high inotropic support compared to 10 patients in group-II which indicates that there was a trend towards higher incidence of significant use of inotropic support in group-I than group II, and that was statistically significant between both groups (p=.001-table 3).

Onorati and associates [15], reported 6.08% recovery with fibrillation compared to 32% in our study population (table 3). **Franke and colleagues** [16], **Onorati and associates** [15], reported that defibrillation of the heart after release of the aortic clamp was necessary in 12 , 4 patients of the A group and in 10, 5 of the AR group respectively (p = not significant) compared to our series there was statistical difference between the two groups where it was higher in group I than in group II (p= 0.01), where in Group-I twenty patients required D.C , while in Group-II eight patients required D.C (table 3). Moreover, There was a higher incidence of occurrence of post operative ECG

changes in group-I than in group-II with significant statistical difference between both groups (P=0.001) (table 5).

Elwatidy and colleagues [17], **Franke and colleagues** [16], **Onorati and associates** [15], reported an average bypass time 110.7 ± 28 minutes, 87 ± 23 minutes and 72.9 ± 25.3 minutes respectively compared to 107.65 ± 27.91 minutes in our study (table 4).

Elwatidy and colleagues [17], **Franke and colleagues** [16], **Onorati and associates** [15], reported an average cross clamp time 54 ± 3 minutes, 46 ± 13 minutes and 39.2 ±14.3 minutes respectively compared to 77.45 ± 23.06 minutes in our study (table 4).

Onorati and associates [15], reported average ICU stay 2.9 ± 1.3 days in those with antegrade route while 3.3 ± 2.4 days in those with combined route (p=0.144) which is slightly shorter with antegrade route but not statistically significant. However **Franke and colleagues** [16], reported stay at the intensive care unit was 1.7 ± 1.1 days for the antegrade group versus 1.4 ± 0.7 days for the retrograde group patients (p = not significant) but still shorter in the retrograde group. In our study, the mean ICU stay was 56.52 ± 16.4 hours. The average in Group-II was 56.4 ± 14.3 hours while in Group-I the average was 56.4 ± 18.5 hours, (table 6). There was no significant statistical difference between both groups (p = 0.9), this correlates with Onorati and associates study.

Onorati and associates [15], reported average hospital stay 8.7 ± 1.9 days in those with antegrade route while 8.2 ± 3.0 days in those with combined route (p=0.267) while in our study in Group-I the average hospital stay was 7.4 ± 0.83 days, while in Group-II the average was 7.56 ± 1.19 days, (table 6) with no statistical significant difference between both groups (p = 0.4) .

The comparability of our study was good because of the performance of operations in absence of pre-operative myocardial infarction, besides, major risk factors for increased myocardial ischemia such as emergency revascularization and poor left ventricular function were excluded from the study. Moreover, the uniformity of surgical technique in all patients "using single aortic cross clamp technique and one internal mammary artery and 2-3 venous grafts". As a consequence the pre and intra operative data showed no difference except for longer cardiopulmonary bypass time and aortic cross clamp time in group II (table 4) which may be contributed to the fact that the surgeons for each group are different and/or the time needed to insert the retrograde cannula.

Our study concluded that in patients with left main stem or left main equivelant CAD undergoing CABG, the combined route of cardioplegia administration showed better myocardial protection in statistical terms of; initial reperfusion to sinus rhythm "after release of aortic cross clamp", less need for intra-operative inotropic support., less need for D.C shock to revert the fibrillating heart to sinus rhythm and less incidence of occurrence of post operative ECG changes (table 3,5)

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Comparing Intranasal Dexmedetomedine and Ketamine For Preoperative Sedation and Anxiolysis in Children With Cyanotic Congenital Heart Disease

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Cyanotic children undergoing cardiac catheterization or presenting for operations are need adequate sedation and anxiolysis to facilitate parental separation and to prevent occurrence of spells

Aim and objective. **We studied the effects of intranasal dexmedetomedine versus intranasal ketamine given preoperatively or before catheterization in children with cyanotic congenital heart diseases as regards the hemodynamic parameters, o_2 saturation, onset of sedation, depth of sedation and behavioral changes from the time of administration till the time of induction.**

Materials and methods. **A total of 40 patients (6 months - 4 years) were randomly assigned into one of the two groups: Ketamine group (group K) and Dexmedetomedine group (group D). All patients received premedication 45 min before induction of anesthesia via intranasal route. The test drugs are dripped into both nostrils using a 3 ml syringe with the child in the recumbent position. Group (K): received 5 mg/kg intranasal ketamine (ketamine, 50 mg/ml; sigma) while group (D) receives1 μg/kg intranasal dexmedetomidine (Precedex, 200 μg/2 ml; Abbott, USA). The children were evaluated for the heart rate (HR), blood pressure (BP) and O_2 saturation (Spo_2) before administration of the drugs and every 15 minutes after intranasal drug administration until transfer to operating theatre. The onset time of sedation in both groups (time sufficient to transfer the child away from his parents without crying, i.e. sedation score 3) was determined. Patients were evaluated for sedation score 20 minutes after administration, for the behavior score every 5 minutes following administration and for the sedation status immediately before induction, modified from the Observer Assessment of Alertness and Sedation Scale (Table1). Sedation status and behavior were evaluated by the attending anesthesiologist at induction using the same scale (1 - 6) after 45 minutes of administration (just before induction of anesthesia).**

Results. **After 20 minutes significant statistical difference in the sedation and behavioral scores were observed between the two groups. Results indicated that group (D) had a significantly better sedation score and a lower behavioral score than group (K) between 25 minutes and 45 minutes. As regards the sedation status evaluated by the attending anesthesiologists at induction using the same sedation scale; significant statistical differences were observed between the two groups. The sedation status was significantly lower in group (D) than group (K) ($P < 0.01$). For the onset time of sedation, ketamine showed a statistically significant more rapid onset of sedation (p value < 0.01). No significant difference was observed between the two drugs in terms of haemodynamic parameters in the first 30 minutes, however statistically significant difference was observed after 45 minutes (p value < 0.05) and as regards the blood pressure and oxygen saturation there was no statistical difference between the 2 drugs within the first 45 minutes.**

Conclusion. **It was found that Dexmedetomidine is a superior sedative in terms of sedation score and behavioral score though ketamine showed more rapid onset. No significant difference was observed between the two drugs in terms of hemodynamics and oxygen saturation.**

Keywords: **Ketamine, dexmedetomidine, sedation, cyanotic, congenital heart**

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Fear of physicians, injections, operations, the operation theatre and the forced separation from parents make the operative experience more traumatic for young children and can cause nightmares and postoperative behavioral abnormalities. Preanaesthetic medication may decrease the adverse psychological and physiological sequelae of induction of anaesthesia in a distressed child [1].

An important goal of premedication is to have the child arrive in the operating room calm and quiet with intact cardiorespiratory reflexes. Various drugs have been advocated as premedication to allay anxiety and facilitate the smooth separation of children from parents. The ideal premedication agent in children should be readily acceptable and should have a rapid and reliable onset with minimal side effects. Effective use of sedative-hypnotic and analgesic agent is an integral part of providing patient comfort and safety. Choosing the appropriate agent or combination is crucial in order to alleviate noxious stimuli, stress and anxiety, while minimizing the risk of adverse effects.

Non pharmacologic-based methods may be used to initially allay anxiety in the child and parents before the procedure, including the involvement of child-life practitioners followed by a discussion of the planned procedure, duration, and plan for provision of sedation and analgesia. Careful attention to patient and parental preferences is important, and prior adverse experiences with certain drugs or methods of drug administration should be discussed and clarified, along with any drug allergies. Most patients with congenital heart disease (CHD) have had multiple hospital experiences and, as a result, not infrequently have definitive preferences in these areas. Recognition of the primary goals will allow selection of the optimal drug or drugs required to achieve satisfactory completion of the procedure with minimal patient risk, as the association between adverse patient outcome and drug over dosage or administration of multiple sedating medications has been recognized in several studies [2, 3]. Dexmedetomidine is an α-adrenoceptor-agonist dose-dependent α_2-adrenoceptor selectivity [4]. Because dexmedetomidine possesses anxiolytic, sedative, analgesic, and sympatholytic properties without respiratory depression [5, 6, 7, 8], it might be a useful adjunct for premedication, especially for patients susceptible to preoperative and perioperative stress. Dexmedetomidine does not appear to have any direct effect on the heart [9]. All effects of dexmedetomidine could be antagonized easily by administering the α_2-adrenoceptor antagonist atipamezole (antisedan) [10]. Also, Analgesic properties have been demonstrated in studies that used Dexmedetomidine as a sole analgesic after minor surgeries [11].

Materials and Methods

This study was done at the cardiac surgical unit of the Specialized Pediatric Japanese Hospital - Cairo University after the approval of the Institutional Ethical Committee and after obtaining written informed parental consent. Observations are collected during the period November 2012 - July 2013.

A total of 40 patients aged 6 months - 4 years, having cyanotic congenital heart disease presenting for cardiac surgery or catheterization were enrolled in randomized study. Exclusion criteria included chronic pain, central nervous system and gastrointestinal disorders, previous reactions to dexmedetomidine or ketamine, abnormal liver or kidney functions, diseases of the upper respiratory tract infections (URT) or history of recurrent epistaxis, history of frequent cyanotic spells that necessitates resuscitation.

General preoperative fasting precautions were used. Study candidates were chosen to be operated upon first to avoid prolonged fasting and dehydration that might aggravate anxiety. Exception to this was when more sick children were scheduled. The patients were randomly assigned using computer generated randomization into two groups: group K (ketamine) and group D (dexmedetomedine).

All patients received premedication 45 minutes before induction of anesthesia via intranasal route. The test drug was dripped into both nostrils using a 3 ml syringe with the child in the recumbent position. All study drugs were prepared by an independent investigator not involved in the study. Observers and attending anesthesiologists were blinded to the study drug given.

Group (K): received 5 mg/kg intranasal ketamine (ketamine, 50 mg/ml; sigma) while group (D) receives1 μg/kg intranasal dexmedetomidine (Precedex, 200 μg/2 ml; Abbott, USA)

The children were evaluated for the heart rate (HR), blood pressure (BP) and o_2 saturation (Spo_2) before administration of the drugs and every 15 minutes after intranasal drug administration until transfer to operating theatre.

The onset time of sedation in both groups (time sufficient to transfer the child away from his parents without crying, i.e. sedation score 3) was determined. Patients were evaluated for sedation score 20 minutes after administration, for the behavior score every 5 minutes following administration and for the sedation status immediately before induction, modified from the Observer Assessment of Alertness and Sedation Scale (Table 1). Sedation status and behavior were evaluated by the attending anesthesiologist at induction using the same scale (1 - 6) after 45 minutes of administration (just before induction of anesthesia).

A- Sedation scores (from 1-6):
• Does not respond to mild prodding or shaking.
• Responds only mild prodding or shaking.
• Responds only after name is called loudly or repeatedly.
• Lethargic response to name spoken in normal tone.
• Appear asleep but respond readily to name spoken in normal tone.
• Appear alert and awake, response readily to name spoken in normal tone.
B- Behavior score (from 1-4)
• Calm and cooperative.
• Anxious but reassurable.
• Anxious and not reassurable.
• Crying, or resisting.

Table 1. Evaluation Scale [12]

Statistical Analysis

Sample size was based on data obtained from previous studies on the adequacy of sedation using ketamine and dexmedetomidine.

Calculation of the sample size based on these studies revealed that at least 17 patients are required in each group to provide 80% power at a 0.05 level of significance. 20 patients were recruited in each group to compensate for dropouts during the study.

Data were collected, coded, tabulated and analyzed using SPSS v15.0 computer software. The statistical tests for the study were performed according to the nature of the independent and dependent variables analyzed. For the purpose of choosing a statistical test, variables were classified into two classes: categorical and numerical.

Categorical variables included the following variables: sex (male, female), diagnosis (fallot tetraology, transposition of great arteries TGA, pulmonary atresia, tricuspid atresia), surgery (Modified Blaclock – Thomas - Taussing (MBT) shunt, diagnostic catheterization, Senning and Glenn), sedation score (1 - 6), behavior score (1 - 4), sedation status (1- 6). Numerical variables include: age (month), weight (kg), sedation onset (minutes), Heart Rate (HR), Blood pressure (BP) and Oxygen Saturation (Spo_2).

Numerical variables were presented as mean and standard deviation (SD) while categorical variables were presented as number of cases and percent.

Dependent and independent variables were analyzed based on the above classification as indicated in the following table (Table 2).

Independent Variable	Dependent Variable	
	Categorical	*Continuous*
Categorical	χ^2	t-test, ANOVA

Table 2. Study statistical tests procedure

Results

The study included 40 patients with cyanotic congenital heart disease who presented for surgery or catheterization.

No statistically significant differences were noticed between the two groups with regard to age.

Measured variables

- Heart rate

The heart rate showed no statistically significant differences between the 2 groups within the first 30 minutes of intranasal adminstration. Significant statistical differences were observed after 45 minutes from intranasal dropping as dexmedetomidine showed decrease in heart rate in average of 10-15 beats /minute, while ketamine showed decrease in average of 5-10 beats / minute, with P value < 0.05 (Table 3 and Figure 1)

Time	Group	Range	Mean	+	SD	P value
HR 0 Minutes	Group (D)	(120-180)	140.25	+	16.82	
	Group (K)	(120-170)	143.35	+	16.45	0.5591
HR 15 Minutes	Group (D)	(116-166)	139	+	15.96	
	Group (K)	(120-171)	146.15	+	17.70	0.1876
HR 30 Minutes	Group (D)	(117-160)	134.3	+	13.26	
	Group (K)	(120-171)	142.15	+	18.58	0.1333
HR 45 Minutes	Group (D)	(116-150)	127.8	+	10.89	
	Group (K)	(112-170)	138.65	+	18.44	0.0306*

** Significant (P < 0.05)*

Table 3. Heart rate

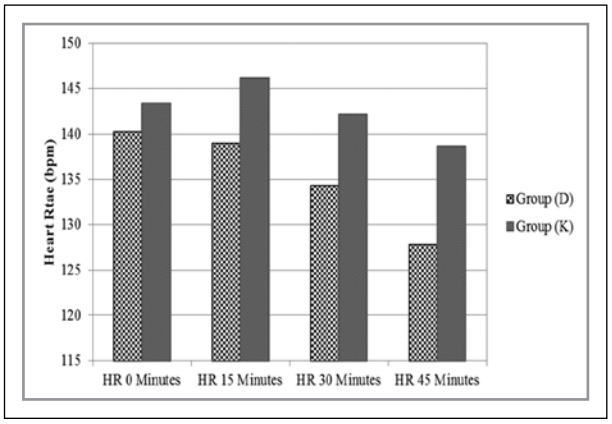

Fig. (1) Mean heart rate over time

- Blood pressure

Blood pressure was measured non-invasively every 15 minutes for each patient in both groups. For the analytical purposes, the blood pressure is converted into two measurements; Mean Arterial Pressure (mmHg) and Pulse Pressure (mmHg). The Mean Arterial Pressure was calculated as:

$$MAP \cong \frac{(2 \text{ X } DP) + SP}{3}$$

Where DP = diastolic pressure (mmHg), and SP = systolic pressure (mmHg).

The pulse pressure was measured as: systolic pressure (mmHg) - diastolic pressure (mmHg).

Blood pressure was reduced in both groups (as measured by MAP). However, no significant differences were observed between the two treatments, (Table 4).

Time	Group	Range	Mean	+	SD	P value
BP 0 Minutes	Group (D)	(45.3-76.0)	60.6	+	7.72	
	Group (K)	(50.0-70.0)	58.6	+	5.55	0.3494
BP 15 Minutes	Group (D)	(45.3-75.6)	59.0	+	7.35	
	Group (K)	(49.0-73.3)	59.2	+	6.50	0.9399
BP 30 Minutes	Group (D)	(52.7-74.0)	59.8	+	5.58	
	Group (K)	(45.3-83.0)	57.9	+	8.78	0.4121
BP 45 Minutes	Group (D)	(46.0-70.0)	57.0	+	6.22	
	Group (K)	(46.7-90.0)	57.8	+	8.82	0.7475

Table 4. Mean Arterial Pressure (MAP, mmHg)

- Oxygen saturation

Oxygenation was measured every 15 minutes using pulse oximeter for each patient in both groups. Administration of Ketamine and Dexmedetomidine reduced the Oxygen saturation. Oxygen saturation in the (D) group was more reduced than the (K) group. However, no significant difference was observed within the first 45 minutes, (P value > 0.05) (Table 5). It was observed that the lowest oxygen saturation reached with (D) group was 79%, while with (K) group was 78%.

Time	Group	Range	Mean	+	SD	P value
Oxygen Saturation 0 Minutes	Group (D)	(70%-89%)	80.40%	+	4.67%	0.4816
	Group (K)	(40%-92%)	78.35%	+	11.95%	
Oxygen Saturation 15 Minutes	Group (D)	(70%-89%)	80.05%	+	4.71%	0.5732
	Group (K)	(42%-92%)	78.45%	+	11.62%	
Oxygen Saturation 30 Minutes	Group (D)	(70%-88%)	79.70%	+	4.86%	0.619
	Group (K)	(44%-90%)	78.35%	+	10.97%	
Oxygen Saturation 45 Minutes	Group (D)	(70%-88%)	79.05%	+	5.11%	0.7934
	Group (K)	(45%-90%)	78.35%	+	10.67%	

Table 5. Oxygen saturation (SPO2 %)

- Onset time of sedation

Onset time of sedation is a cardinal variable measured as time sufficient to transfer the child away from his parents without crying (sedation score 3) measured in minutes. Significant statistical differences between the two groups (Group K and Group D) were observed. In most of patients it was noticed that onset time of sedation in (K) group; mean of (17.6 minutes) is more rapid than that of (D) group; mean of (23.2 minutes); (Table 6 and Figure 2).

	Mean	+	SD	P value
Group (D): Dexmedetomidine	23.2	+	2.6675	
Group (K): Ketamine group	17.6	+	1.6351	P<0.0001**

***Highly Significant. (P <0.01)*

Table 6. Onset time of sedation of the two groups

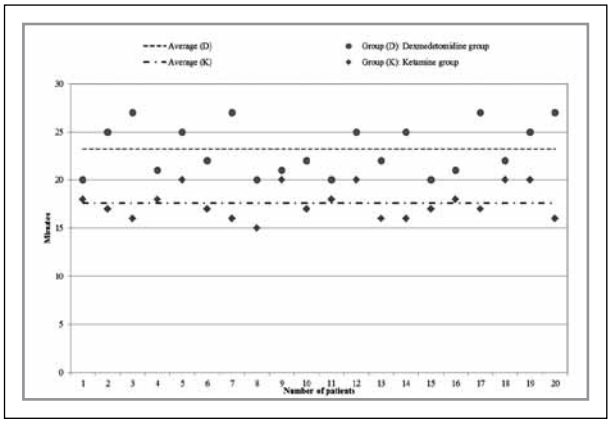

Fig. (2) Onset time of sedation for the two groups

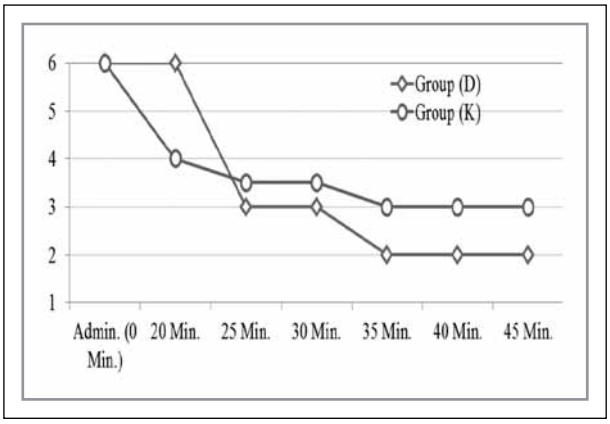

Fig. (3) Median of Sedation Score

- Sedation score

Sedation score was measured after 20 minutes of the administration and every 5 minutes to 45 minutes. Significant statistical differences were observed in group K after 20 Minutes, while in group D the significant statistical differences were observed after 25 minutes.

After 20 minutes significant statistical difference was observed between the two groups. This result indicated that group (D) had a significantly better sedation score than group (k) between 25 minutes and 45 minutes, (Table 7 and Figure 3).

Sedation Score	(Median & Range)		Between group Significance ($\chi 2$)
	Group (D)	Group (K)	
	n= 20	n= 20	
Admin. (0 Minutes)	6 (5 - 6)	6 (5-6)	P>0.05
After 20 Minutes.	6 (3 - 5)	4 (3 - 6)*	P <0.05
After 25 Minutes.	3 (2 - 4)*	3.5 (3 - 6)	P<0.05
After 30 Minutes.	3 (2 - 4)	3.5 (3 - 6)	P<0.05
After 35 Minutes.	2 (1 - 3)	3 (3 - 6)	P<0.05
After 40 Minutes.	2 (1 - 3)	3 (2 - 6)	P<0.05
After 45 Minutes.	2 (1 - 3)	3 (2 - 6)	P<0.05

**Significant. (P < 0.05)*

Table 7. Sedation Score over time

- Behavioral score

The behavioral score was significantly lower in group (D) than group (K). Behavioral score was measured every 5 minutes after administration. Significant statistical differences were observed between the two groups - Group (K): Ketamine group and Group (D): Dexmedetomidine group (Table 8 and Figure 4)

Behaviour Score	Group (D) (Median & Range)	Group (K) (Median & Range)	Between group Significance ($\chi 2$)
	n= 20	n= 20	
Administration (0 Minutes)	4 (3 - 4)	4 (3 - 4)	P>0.05
After 20 Minutes	3 (3 - 4)*	3 (2 - 4)*	P <0.05
After 25 Minutes	2 (1 - 4)	3 (2 -4)	P<0.05
After 30 Minutes	2 (1 - 4)	3 (2 -4)	P<0.05
After 35 Minutes	2 (1 - 3)	3 (2 -4)	P<0.05
After 40 Minutes	2 (1 - 4)	3 (2 -4)	P<0.05
After 45 Minutes	2 (1 - 4)	3 (2 -4)	P<0.05

**Significant (P < 0.05)*

Table 8. Behavioral score

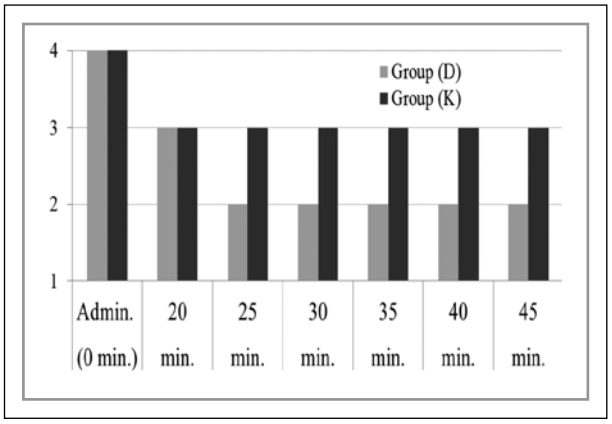

Fig. (4) Median of Behavior Score

- Sedation status

Sedation status evaluated by the attending anesthesiologists at induction using the same scale (the sedation score 1-6). Significant statistical differences were observed between the two groups. The sedation status was significantly lower in group (D) than group (K) – (Table 9 and Figure 5).

	Median	range	*P* Value (χ^2)
Group (D): Dexmedetomidine group	2	(1 - 3)	
Group (K): Ketamine group	4	(2 – 6)	0.0001**

*** Highly Significant. (P < 0.01)*

Table 9. Sedation status between the two groups

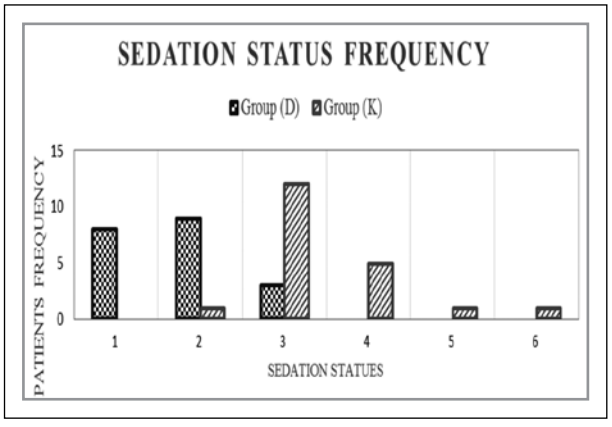

Fig. (5) Sedation status frequency between the two groups

Discussion

The performance of diagnostic and therapeutic procedures in children is safer and more likely to be successful when the patient does not move and when any associated pain and anxiety are effectively controlled. Pharmacologic and non-pharmacologic interventions that consider the child's developmental status and the clinical circumstances are often required to meet these goals. In addition, attention to the treatment of pain and anxiety associated with the child's condition is a requisite of acceptable and compassionate patient care [13].

Regardless of the sedation regimen implemented, pediatric cardiac patients have unique characteristics that need to be acknowledged. For example, the addition of supplemental oxygen can dramatically alter cardiac output, as well as alter the interpretation of catheterization data. Alterations in ventilation with positive pressure, hypo- or hyperventilation may alter pulmonary blood flow, again leading to data that may be difficult to interpret [14].

Dexmedetomidine, a centrally acting α_2-adrenergic agonist, has similar physiologic properties to clonidine. However, when compared with clonidine, it has a higher specificity ratio for the a2-adrenergic receptor as against the a1-adrenergic receptor (1600: 1 vs. 200: 1, respectively) and a shorter half-life (2 - 3 h vs. 8 - 12 h for clonidine). Dexmedetomidine acts through a G-coupled protein receptor. This results in reduced norepinephrine turnover and decreased central sympathetic outflow from the medullary vasomotor center with sympatholysis, decreased heart rate, and blood pressure. The central stimulation of dexmedetomidine on parasympathetic outflow and inhibition of sympathetic outflow from the locus ceruleus lead to increased activity of inhibitory neurons of the γ-aminobutyric acid system, resulting in sedation and anxiolysis. Dexmedetomidine also inhibits the release of substance P from the dorsal horn of the spinal cord, leading to primary analgesic effects and potentiation of opioid induced analgesia [15]. Through these mechanisms, dexmedetomidine provides sedation and anxiolysis, lowers the minimum alveolar concentration for inhalation agents [16], decreases perioperative opioid requirements, decreases shivering responses [17], and reduces the incidence of emergence delirium/agitation [18].

Ketamine is a hypnotic/sedative medication preferred by many in pediatric catheterization suites [19]. Among its benefits is the ability to protect airway reflexes with minimal effect on respiration with preserved cardiac function. Although some tout ketamine as having minimal hemodynamic effect, ketamine can significantly alter catheterization data [19]. Ketamine preserves cardiac function through increased sympathetic effects. Whether ketamine increases pulmonary vascular resistance remains to be elucidated [20]. Some have seen increases in systemic vascular resistance also.

This study compared the sedative effect of intranasal dexmedetomidine versus intranasal ketamine as a premedication agent in children with cyanotic congenital heart diseases scheduled for elective corrective or palliative cardiac surgeries or for diagnostic cardiac catheterization.

In the current study several parameters both clinically and psychologically were measured including heart rate, blood pressure, oxygen saturation, and sedation and behavior scores.

The heart rate after administration of either drug showed no statistically significant differences within the first 30 minutes from intranasal administration. However, significant statistical difference was observed between the two treatments after 45 minutes. The Ketamine group showed less decline mean hart rate (138.65 beats/minute) compared to Dexmedetomidine group (127.8 beats/minute).

Ketamine and Dexmedetomidine reduced the mean arterial blood pressure and oxygen saturation. However, no significant differences observed between the two treatment groups.

Morray et al 1984, studied Pulmonary and systemic vascular responses to ketamine (2 mg / kg, intravenously) during cardiac catheterization in 20 children with congenital heart lesions. Statistically significant, but clinically minor increases in heart rate were seen after ketamine [21]. There were no significant changes in systemic arterial pressure, or arterial oxygen saturation. These results were consistent with current study in terms of arterial blood pressure and oxygen saturation but on other hand, in current study, heart rate showed a decrease in average of 5-10 beats/ minute after 45 minutes.

In 2005, ***Berkenbosch, et al*** found that there were minor decreases in oxygen saturation (2.6 ± 2%) but heart rate and blood pressure parameters remained within normal limits for age following administration of dexmedetomedine for procedural sedation [22].

Kamal et al (2008) reported that oral dexmedetomedine at a dose of 3 μg/kg could be safely and effectively applied without haemodynamic side effects [23].

Concerning the onset time of sedation the current study showed that intranasal ketamine was (17.6 minutes) in average while that of intranasal Dexmedetomidine was (23.2 minutes).

Similarly, ***Malinovsky et al*** (1996) investigated the pharmacokinetics of ketamine given as IV dose, nasal dose and rectal dose in children [24]. They found that nasal ketamine peaks at 20 minutes. In a study done by ***Weber et al*** (2004) they compared serum ketamine levels in children who received 2 mg/kg of either IV ketamine or nasal ketamine [25].They found that IV levels peaked in the first three minutes whereas nasal peaked in 18 minutes which is consistent with the current study.

In a study performed by ***Mark D talon et al*** found that intranasal dexmedetomidine (1 μg/kg) has an onset of action of approximately 15 minutes when administered with a meter - dozed atomizer [26].

This study is consistent with the current study but in the current study the onset of sedation with intranasal dexmedetomidine started approximately at 23 minutes as it was administered by nasal drops rather than meter - dozed atomizer.

Another explanation for the delayed onset of sedation in the current study is the nature of the pathology of the study population who had cyanotic heart disease which my delay the systemic effect of drugs in some cases.

In another study of ***Yuen et al*** (2010) when intranasal dexmedetomidine of (1 μg/kg) was used for premedication in children, the median onset time of sedation was 25 minutes and the median duration was 85 minutes [27] which was consistent with the current study.

It was found that both drugs provided adequate sedation and easy separation from parents; however dexmedetomidine provided better sedative effect in terms of sedation and behavioral scores.

Conclusion

It was found that Dexmedetomidine is a superior sedative in terms of sedation score and behavioral score though ketamine showed more rapid onset of sedation. No significant difference was observed between the two drugs in terms of haemodynamics and oxygen saturation. Further studies are recommended for the dexmedetomidine as an adjuvant anesthetic drug, especially in pediatric patients undergoing cardiac catheterization.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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Different Surgical Techniques In Mitral Valve Repair. A Two-Center Prospective Observational Study

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Background: **Mitral valve repair versus replacement remains controversial. Feasibility of its performance is highly variable in different mitral valve pathologies. We herewith study the effectiveness of the different repair techniques in different valve pathologies**

Patients and Methods: **This prospective observational study encompassed 150 consecutive patients with mitral valve disease undergoing MV repair due to different etiologies. The study was carried out in the CardioThoracic Surgery Departement, Assiut University and Cairo University hospitals from January 2010 till January 2013.**

Results: **Ages ranged between 10-82 years (mean 35 ± 2.5 years). There were 72 men (48%) & 78 women (52 %). Mean preoperative NYHA was 2.9 ± 0.2; LVEF % was 49 ± 0.6; PASP was 65 ± 3.2. Preoperative aetiology was RHD in 90 patients (60 %); IE in 2 patients (1%); Degenerative in 30 patients (20%); CAD in 9 patients (6%); CHD in 7 patients (5%); and SLE in 2 patients (1%). All patients were studied PO during mean follow-up period of 6 ± 0.5 months (range 3 - 8 months). In 6 cases (4%), MV repair was not successful and left massive MR, so MVR was done in (4 RHD & 2 IE). In 118 patients (78%), repair was successful (valve competence). Residual MR was detected in 32 patients (21%); being trivial in 9 cases (6%); mild in (≤ grade I) in 16 patients (11%); moderate in 1 patient (0.5 %); severe in 6 patients (4%). PO NYHA was 1 ± 0.5 in the competent repair patients & 2 ± 0.3 for the residual MR; while LVEF% was 56 ± 1.9 Vs. 52 ± 0.4 respectively. Twelve patients died (mortality 8%). 3 sudden deaths (2%) occurred (PO days 7,7,21); 4 patients (3%) had cerebral stroke (PO days 9,10,15,17); 3 patients (2%) died due to fatal arrhythmias; One patient (0.5%) had CHF; One patient (0.5 %) had cardiac tamponade. Morbidity occurred in 18 patients (12%): Transient SAM in 3 cases (2 %); Need for high inotropic support in 3 cases (2%) (1 of them needed combined IABCP); 3 patients (2%) had Pericardial effusion; 3 patients (2%) needed re-exploration for bleeding; 2 patients (1%) developed convulsive fits (acidosis); 2 patients (1%) needed long mechanical ventilation > 48 hours; 2 patients (1%) had transient nodal rhythm. PO mean NYHA class was 1 ± 0.5 for patients with competent repair; and 2 ± 0.3 for patients with residual MR (P < 0.05). By stepwise logistic regression, multivariate analysis revealed that the independent predictors of morbidity & mortality for MV repair were: IE associated with RHD (P<0.003; OR:15.51;CI:1.34-10.42); and CAD associated with RHD etiology (P < 0.04; OR:5.05; CI:1.27 – 7.19).**

Conclusion: **MV repair was followed by clinical & functional improvement evidenced by better NYHA class & LV function with low mortality & absence of valve-related complications.**

Key word: **mitral valve repair, rheumatic heart disease, ischemic mitral regurge**

Abbreviations: **CAD: Coronary Artery Disease IHD: Ischemic heart disease CHD: Congenital Heart Disease RHD: Rheumatic Heart Disease MV: Mitral Valve AML: Anterior mitral leaflet PML: Posterior mitral leaflet MS: Mitral Stenosis MR: Mitral regurge MVR: Mitral Valve Replacement SAM:**

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systolic anterior motion LVEDD: Left ventricular end-diastolic dimension LVESD: Left Ventricular end-systolic dimension LA-D: Left Atrial Diameter EF%: Ejection fraction CPB: Cardiopulmonary Bypass TTE: transthoracic echocardiography TEE: Transesophageal echocardiography CABG: Coronary Artery Bypass Graft ASD: Atrial Septal Defect DC Shock: Direct Countercurrent shock OC: Open Commissurotomy HCV: Hepatitis-C Virus CHF: Congestive Heart Failure IE: Infective Endocarditis PASP: Pulmonary Artery Systolic Pressure PO: Postoperative Statistical Significance : P value is significant if < 0.05 OR: Odds Ratio CI: Confidence interval.

Mitral valve repair was declared to be superior to valve replacement for degenerative mitral valve disease as it is usually-associated with improved LV function [1],[2] through preservation of the normal valvular tissue & subvalvular apparatus which reduced valve-related complications, as well as lower in-hospital & late mortality [3].

Repair of rheumatic mitral valves remains controversial, with significant variability in the feasible repair techniques as well as long-term outcomes. However, some advantages of valve repair are good LV function, absence of valve-related events and prolonged survival [4].

In contrast with degenerative MR, post-rheumatic mitral valve disease affects valve leaflets & its subvalvular apparatus ending by variable degrees of fibrosis then calcification, hence making it difficult to apply repair techniques herein. Classical techniques include commissurotomy, shaving diseased tissue, splitting of papillary muscle to improve mobility up to annuloplasty to enhance cooptation [5].We aimed to study the different surgical techniques in mitral valve repair, define the best surgical option in different mitral valve pathologies amenable for mitral valve repair, Compare the early postoperative outcome regarding the technique chosen in mitral valve repair & Finally to define the criteria amenable for mitral valve repair in our 2-centers over the early postoperative period of follow-up.

Patients and Methods

Patient Population:

This study was carried out after obtaining the approval of the local ethical committees and patients' written informed consent in Assiut University & Cairo University from January 2010 to January 2013 involving 150 consecutive patients with mitral valve disease due to different pathologies. All patients were scheduled for elective open heart surgery for mitral valve repair with or without aortic and tricuspid valve procedure.

Inclusion Criteria. Patients who had mitral valve disease (MS, MR or both), with or without aortic, tricuspid valve affection due to pathological features of : Rheumatic valvular heart disease; Ischemic heart disease; Degenerative lesions; Congenital anomalies, or immunological lesions.

Exclusion Criteria. Patients in whom urgent operative intervention was dictated; or patients who had previous mitral valve operation (redo-mitral) & those who did not complete the follow-up.

I. Preoperative Workout: Patients demographics were recorded in table (1); the preoperative clinical diagnosis is demonstrated in table (2); preoperative aetiological diagnosis is demonstrated in table (3); the preoperative echocardiographic data are demonstrated in table (4).

II. Intraoperative Management: After induction of anaesthesia routine midline sternotomy was done, followed by aortic-bicaval cannulation. CPB was then instituted with body temperature of 28 C°. After aortic cross-clamping, cardiac standstill during CPB was achieved with a hyperkalemic cold oxygenated blood cardioplegic solution delivered antegrade via aortic root. Inotropic support was started in case of evident systolic dysfunction of LV or RV as evident by intraoperative TEE.

Intraoperative data: Anatomical findings, surgical techniques used in mitral valve repair, cardiopulmonary bypass data (cross clamp time, total bypass time) were recorded as well as TEE

after the repair to assess the valve competence (tables 5, 6,7).

III. Postoperative Follow-Up Data: Follow-up was done using postoperative visits in the out-patient clinic by the surgical team using clinical examination and TTE data provided by the referring cardiologist. (tables 8,9,10,11).

Statistical Analysis:

Results were expressed as the mean ± standard deviation or as percentages. Differences will be examined for significance by univariate analysis (Student t test, chi-square test, or Fisher exact test as appropriate). Statistical analysis was performed with the SPSS (Statistical Program for Social Science) for Windows software, version 12.0. Multivariate analysis was done by stepwise logistic regression . All statistical tests will be performed at a significance level of 0.05. All p values of less than 0.05 will be considered to be significant.

Results

Preoperative patient demographic data for 150 patients with mitral valve disease due to different etiologies were studied. Ages ranged from 10-82 years (mean age 35 ± 2.5 ys).. There

were 72 men (48 %); and 78 women (52 %). Fourty five patients (30%) had AF; 66 (44%) had DM; 40 had HTN (26%). Mean NYHA class was 2.9 ± 0.2. **Table (1).**

Variable	Number	% ratio
Total Patient Number:	150	100
Age (years)		
Range	10 - 82	
Mean	35 ± 2.5	
Gender		
Women	78	52 %
Men	72	48%
Pulse		
Regular sinus	105	70%
Atrial Fibrillation	45	30%
Diabetes Mellitus	66	44 %
Systemic Hypertension	40	26 %
Mean NYHA class	2.9 ± 0.2	

Table (1): Preoperative patient characters

Preoperative clinical diagnosis was: MS only in 15 patients (10%); MR only in 90 patients (60%); combined MS & MR in 45 patients (30 %); there was associated aortic valve disease in 28 patients (20%); associated tricuspid disease in 50 patients (32%) **(Table 2).**

Clinical Diagnosis	No & ratio of Patients Number
Mitral Stenosis only	15 (10 %)
Mitral regurge only	90 (60 %)
MVD (Combined MS & MR)	45 (30 %)
MR + Aortic Valve Disease: AS 6 (4%), AR 20 (15%), AVD	2 (1 %)
MR + Tricuspid Regurge Valve Disease: TS 1 (0.5%), TR 47 (31%),TVD	1 (0.5%)

Table (2): Preoperative Clinical Diagnosis

Etiological Pathology was RHD in 90 patients (60%); Degenerative in 30 patients (20%); Ischemic Heart Disease in 9 patients (6 %); Congenital Heart Disease in 7 patients (5 %); Infective Endocarditis & SLE each in 2 patients (1%). RHD + Ischemic Heart Disease were present in 4 patients (3%), and RHD + Infective Endocarditis in 6 patients (4%). **(Table 3).**

Etiological Diagnosis	Patient Number	% ratio
Rheumatic Heart Disease	90	60%
Degenerative	30	20 %
Infective Endocarditis only	2	1 %
Congenital Heart Disease	7	5 %
Ischemic Heart Disease	9	6%
Systemic Lupus Erythematosus	2	1%
RHD + Ischemic Heart Disease	4	3%
RHD + Infective Endocarditis	6	4%

Table (3): Preoperative Etiological Diagnosis

Preoperative TTE displayed LA diameter of 5.5 ± 0.4; LVEDD 5.6 ± 1.3; LVESD 3.1 ± 1.1; LVEF% 49 ± 0.6; PASP 56 ± 3.2; & MVOA 0.7 ± 0.4 . **(Table 4).**

Echocardiographic parameter	Value
LA-D (mean cms ± SD)	5.5 ± 0.4
LVEDD (mean cms ± SD)	5.6 ± 1.3
LVESD (mean cms ± SD)	3.1 ± 1.1
LVEF% (mean ± SD)	49 ± 0.6
PASP (mean mmHg ± SD)	56 ± 3.2
MVOA (mean mms ± SD)	0.7 ± 0.4

Table (4): Preoperative Echocardiographic Data

II. Intra-operative (surgical) data: Mitral repair was done only in 92 (61%). Mitral repair was done in association with: removal of LA thrombus in 2 patients (1 %); Mitral and Tricuspid repair in 29 (19%); Mitral and Aortic repair in 4 (3%); Mitral repair & Aortic replacement in 9 (6%); Mitral repair with CABG in 9 (6%); Mitral repair with closure of ASD in 5 (4%). Weaning off-CPB was achieved by DC shocks only in 120 patients (80 %); versus DC with inotropics in 30 (20%). **(Table 5)**.

General Surgical Data	Value & %
Mitral repair only	92 (61%)
Mitral repair only + removal of LA thrombus	2 (1 %)
Mitral repair + Tricuspid repair	29 (19 %)
Mitral repair + Aortic repair	4 (3 %)
Mitral repair + Aortic replacement	9 (6 %)
Mitral repair + CABG	9 (6 %)
Mitral repair + Closure of ASD (partial A/V canal)	5 (4 %)
Weaning Off-CPB:	
DC shocks only	120 (80%)
DC shocks + inotropics	30 (20%)

Table (5): Intraoperative (Surgical) Data

Success of the MV repair techniques in different pathologies: Table 6.

Conversion rate: In 6 cases (4%), MV repair was not successful leaving moderate or severe MR, so MVR was done in (4 RHD & 2 IE).

Success of MV repair: In 118 patients (78%), repair was successful (valve competence). Residual MR was detected in 32 patients (21%); being trivial in 9 cases (6%); mild in (≤ grade I) in 16 patients (11%); moderate in 1 patient (0.5 %); severe in 6 patients ((4%)**.**

Type & no. of MV Pathology cases	Total no. of patients 150 (100%)			
	Successful (no MR) 118 (78%)		Residual MR 32 (21%)	
RHD (no. 90) 70 (78%)	5 (6%)	8 (8%)	1 (2%)	6 (6%)
Degenerative (no. 30)	22 (74%)	4 (13%)	4 (13%)	-
IHD (no. 10)	9 (90 %)	-	1 (10%)	-
CHD (no. 7)	6 (85%)	-	1(15%)	-
RHD + IE (no. 6)	4 (67%)	-	2 (33 %)	-
RHD + IHD (no. 3)	3 (100%)	-	-	-
SLE (no. 2)	2 (100%)	-	-	-
IE (no. 2)	2 (100%)	-	-	-
RHD + IHD (no. 3)	3 (100%)	-	-	-
SLE (no. 2)	2 (100%)	-	-	-

= competent valve with no MR Successful

Table (6): Residual MR in different pathologies

The different types of MV repair procedures are shown in table 7.

Repair Technique	Value & %
Annuloplasty	143 (95 %)
Carpentier Edwards (CE)	77 (51%)
Custom-made Dacron ring	43 (30%)
Custom-made Gortex ring	1 (0.5 %)
Saint Jude Medical (SJM)	16 (12%)
Sorin ring	3 (2%)
Commissural suture	3 (2%)
Exclusion of Left Atrial Appendage	79 (52%)
Artificial chordoplasty (Neo chordae):	60 (40 %)
Commissurotomy & Chordal fenestration	45 (30 %)
PML augmentation by pericardial patch	30 (15 %)
Papillary Muscle longitudinal split (papillotomy):	19 (13 %)
Chordal transfer	18 (12 %)
Cleft Plication	12 (8%)
Annular/leaflet edge Decalcification	10 (6 %)
PML height reduction by linear Plication	9 (6 %)
Vegetectomy	7 (5 %)
Quadrangular resection + Sliding plasty of PML	6 (4 %)
Papillary muscle sling (basal Dacron band)	4 (3 %)
Edge-to-Edge commissural repair	2 (1.5 %)
Folding plasty	2 (1.5 %)
Z-Plasty	1 (0.75%)
Plication of Papillary muscle base by 4^0 prolene	1 (0.75%)
Resection of leaflets free edge	1 (0.75%)

Table (7): Types of the Mitral Valve Repair Technique

Follow-up: Postoperatively all patients were studied during mean follow-up period of 6 ± 0.5 months (range 3 - 8 months).

Mortality & Morbidity :Twelve patients died (mortality 8%). 3 sudden deaths (2%) occurred (PO days 7,7,21); 4 patients (3%) stroked (PO days 9,10,15,17): 3 patients (2%) died due to fatal arrhythmias; 1 patient (0.5 %) died due to CHF; 1 patient (0.5 %) died due to cardiac tamponade **(Table 8)**.

Outcome	Pathology	Value & %
*Mortality	12 (8 %)	
(1) Sudden death (7^{th}., 7^{th}., 21^{st}.)	FED-RHD-RHD	3 (2 %)
(2)Stroke (9^{th},10^{th},15^{th},17^{th})	CHD (ASD/SV)-(RHD+IE)-(FED+IHD)-(RHD+FED,air emb)	4 (3 %)
(3) Fatal Arrhythmias	RHD-RHD-(RHD+IE)	3 (2 %)
(4) CHF	RHD*	1(0.5%)
(5) CardiacTamponade	FED	1(0.5%)
*Morbidity	18 (12%)	
(1) Transient SAM	RHD-FED-FED	3 (2 %)
(2) High inotropic support	RHD-RHD+IHD-RHD+IE	3 (2 %)
(3) Pericardial effusion	RHD-RHD-RHD+IE^	3 (2 %)
(4) Re-exploration for bleeding	RHD-RHD-RHD	3 (2 %)

(5) Convulsive fits (acidosis)	RHD-RHD (CRF+HCV)	2 (1 %)
(6) Prolonged mechanical ventilation > 48 hours	RHD-FED	2 (1 %)
(7) Transient nodal rhythm	RHD-RHD	2 (1%)

**(MRep+ARep:septal inj,repaired) #: Additional IABCP (RHD+IHD)*
^:(Vegetectomy)

Table (8): Mortality & Morbidity

Echocardiographic Data: TTE was done regularly postoperatively revealing postoperative events **(Table 9)**.

Parameter	118 (78%)	32 (21%)	Value
LA-D (mean cms ± SD)	4 ± 0.1	4.3 ± 0.5	< 0.03
LVEDD (mean cms ± SD)	5 ± 0.1	5.2 ± 0.3	< 0.01
LVESD (mean cms ± SD)	3.4 ± 0.1	3.6 ± 0.4	< 0.05
LVEF% (mean ± SD)	56 ± 1.9	52 ± 0.4	< 0.02
PASP (mean mmHg ± SD)	34 ± 4.5	56 ± 2.5	< 0.04
MVOA (mean cm2 ± SD)	2.3 ± 0.2	2.1 ± 0.3	0.22*
Coaptation Distance (mean ± SD)	0.5 ± 0.3	-	-

*MVOA: mean valve orifice area *: non-significant*

Table (9): Postoperative Echocardiographic Data

Clinical & Functional Outcome : (Table 10)

In 118 patients (78%), repair was successful causing clinical improvement in NYHA symptoms, fewer patients had AF, lesser time was needed for mechanical ventilation & ICU stay vs.residual mild MR.

Outcome	Successful repair 118 (78%)	Residual MR 32 (21%)	P Value
Mechanical ventilation (mean/hrs)	9 ± 1	12 ± 2.5	< 0.05
Mean Hospital Stay (days)	4 ± 1.5	5 ± 0.8	0.33*
Mean NYHA clinical class	1 ± 0.5	2 ± 0.3	< 0.05
AF (18 patients, 12%)	7 (4%)	12 (8%)	< 0.04
* Freedom from redo-surgery	100%	100%	-

** Freedom = no redo operation was done over the follow-up period*

Table (10): Postoperative Clinical Outcome

Independent predictors of non-favorable surgical outcome: (Table 11)

Using stepwise logistic regression test, the independent predictors of poorer prognosis were IE with RHD (P<0.005;OR: 2.442; CI: 0.077–2.544); and CAD with RHD etiology (P < 0.001; OR: 1.203; CI: 0.137–10.587).

Factor	OR	95 % CI
IE associated with (or not) RHD etiology	2.442	0.077–2.544
CAD associated with RHD etiology	1.203	0.137–10.587

OR: Odds Ratio CI: Confidence Interval IE: Infective Endocarditis

TABLE (11): Multivariate Logistic Regression Model for Prognostic Variables

Discussion:

We aimed to study the different surgical techniques in mitral valve repair in an attempt to define the best surgical option in different mitral valve pathologies amenable for mitral valve repair by Comparing the early postoperative outcome regarding the repair technique chosen in order to define the final criteria amenable for mitral valve repair in our institution(s).

Meta-analysis of various outcomes from 29 published studies addressing mitral valve repair was conducted by ***Shuhaiber & Anderson (2007)***[6] involving different etiologies: ischemic; degenerative/myxomatous; rheumatic and mixed. The summary odds ratio for early mortality, comparing replacement to repair, was 2.24 (1.78—2.80), while the summary total survival hazard ratio was 1.58 (1.41—1.78), replacement compared to repair, indicating worse outcomes among those undergoing mitral valve replacement. The risk of thromboembolism was lower in the repair group (summary hazard ratio = 1.86, replacement vs. repair), while there was no statistical difference in time to re-operation between the two treatment groups (hazard ratio = 0.88 [95% CI: 0.48, 1.62]).

In ***2001, Chauvaud et al,*** [7] reported successful MV repair in 95% of patients & freedom from reoperation in 82% and 55% at 10 and 20 years, respectively. Clinical series from ***Broussais Hospital*** [8] & ***Cleveland Clinic*** [9],[10] reported success of MV repair in 80% & 45% of RHD vs IE. Though not equally represented, our study detected success of MV repair in the same sequence of aetiologic pathology namely: Degenerative, Ischemic, congenital, immunological (SLE), then the post-rheumatic, ending by the mixed aetiology which harbored the worst prognosis (RHD+IE) and the (RHD+IHD) .

In ***1996, Carpentier et al*** [2] reported that MR due to extensive annular calcification needed the technique of “en

bloc" decalcification, annular reconstruction, and valve repair. Decalcification remained localized in 77% of cases involving > 1/3 annulus in 88% with operative mortality of 3% & no annular dehiscence or early reoperation. Other series documented mortality rate up to 9 % of valve repair in the setting of mitral endocarditis [12-14].

The first step of MV surgery for IE is radical resection of all infected and necrotic tissues within a 1–2-mm margin of normal tissue ***(Carpentier, 1984)***[4]. Feasibility of MV repair depends on the availability of healthy tissue after debridement & in case of entire leaflet or subvalvular involvement, prosthetic valve replacement is required. We successfully-performed vegetectomy before direct suture repair using 5^0 prolene in 6 patients (5%) having IE (2 IE solel &4 combined RHD+IE). In those 6 patients, we applied the techniques of artificial chordoplasty in 5 (3%), sutured a congenitally-present AL cleft (partial A/V canal) in 4 (2 %); partial leaflet resection and sliding plasty and chordal transposition each in 3 patients (2%). Multivariate stepwise logistic regression statistical analysis revealed that IE on top of RHD was an independent predictors of favoring morbidity & mortality following MV repair surgery. Our worse outcome was in IE especially when associated with RHD, calcification involving the annulus or leaflets, and CAD.

In ***1983,Carpentier***[1] stated that mitral commissurotomy is indicated in pure MS with commissural fusion, preserved leaflet mobility and non-fused subvalvular apparatus with an operative risk less than 0.5%. ***Selke et al (2005)*** [11], added that extensive commissural tissue resection during open commissurotomy is not recommended, because it is very difficult to reconstruct a new commissure, & so a 3-mm tissue ridge should be left from the annulus till the center of the orifice. According to ***Yau et al,*** [12], fenestration of fused commissural chordae, localized commissural calcification carefully-debrided by a rongeur first, when the patient has a Wilkin's Score ≤ 11, yields an increased mean MVOA from 1.1 to 2.37 cm2 [11]. Open commissurotomy & chordal fenestration was feasible in most of our MVD patients Commissurotomy & Chordal fenestration 45/150 patients (30 %) according to similar indications (ie: Wilkin's Score ≤ 11), when MV is mildly-calcific having an orifice's surface areas not < 1.0 cm2. Out of 45 patients, only 2 died; and 4 had morbidity. To date, none of our commissural repair cases needed redo-surgery for valve replacement postoperatively.

Mitral annuloplasty 1st. performed in ***1957 by Lillehei et al*** [4].corrects the ratio between anteroposterior (septolateral) and transverse diameter of the mitral annulus during systole (normally 3:4 and is inverted in annular dilatation). Regardless of the type of valvular dysfunction, all patients with chronic MR regurgitation display some degree of annular dilatation, and benefit from a complete remodeling annuloplasty [6-11] as it restores the physiological ratio with maximal orifice area during systole, keeps annular size & shape, prevents future annular dilatation, preserves leaflet mobility, and increases leaflet coaptation [12]. In our patients, annuloplasty was the mostly-used repair procedure in MR patients. Being implanted in 143 patients (95%). We used many forms of remodeling annuloplasty procedures: The carpentier Edwards ring, the SJM ring,the Sorin ring, as well as the custom-made Dacron and Gortex tubes and the commissural suture annuloplasty. All types of annuloplasty participated well and was the cornerstone for the overall success rate of MV repair.

In our study, we performed chordal transfer in 18 patients (12 %), most of whom had RHD, without complications. We, as well as others [10],[12], believe that chordal transfer is more durable than chordal shortening in AL prolapse although all patients who were submitted to both techniques did not need redo-surgery for technical failure.

PTFE (Gore-Tex) sutures have been used as artificial chordae when native chordae are not available. Microscopically, the suture was covered with a layer of endothelial cells and a thin collagen and fibrin coating and that is why PTFE suture retains its pliability, flexibility, durability and anticoagulant property. On the other hand, other suture material eg: the braided polyfilament sutures as Ticron and Ethibond (2^0 & 4^0) fail due to fibrous tissue deposition on their surface followed by cracking/breaking within a shorter time [20]. Some surgeons use artificial chordoplasty as their primary technique for correcting AML, whereas others reserve this technique to scenarios where chordal transfer or transposition is not feasible [39]. We used artificial chordoplasty in 60 (40%) of our patients to treat different lesions eg: rupture, shortening or elongation of chordae tendinae due to IE, FED, or advanced post-rheumatic subvalvular lesions, for which no appropriate native chordae was available for the repair. PTFE sutures allowed successful MV repair in these patients who would otherwise have had to undergo MV replacement. We concomitantly-used autologous glutaraldehyde-treated pericardium to reconstruct MV leaflet with PTFE sutures due to ruptured chordae (IE) in 4 patients (2%). Prosthetic ring implantation was always carried out afterwards to increase coaptation & reduce tension on the PTFE suture.

Sakamoto et al (2005)[13], applied Triangular resection for AML and quadrangular resection for PML with equal safety and durability with extremely-low PO incidence of SAM (< 1%). Similarly, we performed PML quadrangular resection together with either Sliding or Z-plasty of PML in 6 patients (4 %) and 1(0.5% respectively) without morbidity or mortality.

In ***2007, Rama et al***, [14] reported repair of chronic functional ischemic MR (IMR) aiming to restore a near to natural alignment between the mitral annulus and the laterally displaced papillary muscles. They applied papillary muscle approximation combined with a slightly-under sized ring annuloplasty resulting in mild or no MR at follow-up (mean 11.4 ± 3.6 months; range ± 7 to 14 months), with no mortality or morbidity. We similarly, implanted a circular band around

the base of both leaflets in 4 patients (3%) and plication of the PM base using 4^0 in 1 patient (0.5%) who had IE either alone or associated with RHD.

Twelve patients died (mortality 8%). 3 sudden deaths (2%) occurred (PO days 7,7,21); 4 patients (3%) stroked (PO days 9,10,15,17): 3 patients (2%) died due to fatal arrhythmias; 1 patient (0.5 %) died due to CHF; 1 patient (0.5 %) died due to cardiac tamponade. Morbidity occurred in 18 patients (12%) as: Transient SAM in 3 cases (2 %); Need for high inotropic support in 3 cases (2%) (1 of them needed combined IABCP); 3 patients (2%) had Pericardial effusion; 3 patients (2%) needed re-exploration for bleeding; 2 patients (1%) developed convulsive fits (acidosis); 2 patients (1%) needed long mechanical ventilation > 48 hours; 2 patients (1%) had transient nodal rhythm. Almost all types showed spontaneous improvement with medical treatment and were hence considered acceptable. Our-relatively-lower morbidity rate after MV repair surgery can be attributed to the competence of the repair procedure done and the strict monthly protocol used of prophylactic long-acting Penicillin antibiotherapy. Despite the similarity between causes of death in our group vs. others [4-12], our mortality rate (6%) seemed slightly-higher, may be due to our fewer number of patients. PO mean NYHA class was 1 ± 0.5 for patients with competent repair; and 2 ± 0.3 for patients with residual MR ($P < 0.05$). By stepwise logistic regression, multivariate analysis revealed that the independent predictors of morbidity & mortality for MV repair were: IE associated with RHD ($P<0.003$; OR:15.51;CI:1.34-10.42); and CAD associated with RHD etiology ($P < 0.04$; OR:5.05; CI:1.27 – 7.19).

Conclusion:

MV repair led to clinical & functional improvement evidenced by better LV function, absence of valve-related events, low mortality, shorter ICU and hospital stay times. Compared to the higher costs of MVR, mitral repair represents a good alternative for MV diseases especially in eastern developing countries where the burden of financial issues is a serious concern. Mitral ring annuloplasty, pericardial PML augmentation, use of PTFE sutures for artificial chordoplasty were the most frequent & essentially-used procedures. MV repair was successful for correcting congenital, immunologic, degenerative, ischemic, rheumatic, then the IE pathologies respectively. It is to be mentioned that MV repair was newly introduced to Assiut University after the pioneering and devoted effort of the surgical team.

Recommendations: Due to the favorably- good results, and cheaper costs, we recommend encouraging use of MV repair techniques on a larger scale basis whenever its indications were available and fulfilled. More studies are also recommended in order to obtain more-solid results.

Study Limitations: The relatively-smaller patients' number; shortness of postoperative follow-up period & the lack of comparison between 2 large-number groups: repair versus replacement.

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Off-Pump Coronary Artery Bypass Graft Surgery as A Safe Procedure in Left Main Coronary Artery Disease

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Background: **The standard therapy for patients with left main coronary artery (LMCA) disease is coronary artery bypass grafting (CABG). Off-pump CABG (OPCAB) has recently become widespread internationally. Because of the concern about the ability to tolerate beating-heart surgery, patients with LMCA stenosis have been excluded from OPCAB. This study aim to assess safety of OPCAB in patients with LMCA disease.**

Methods**: 30 patients with multivessel coronary artery disease were selected, 15 patients had LMCA disease, the other 15 patients had coronary artery disease other than LMCA stenosis. All patients selected had no other valvular or congenital heart lesions & had good contractility. All patients were consented for the purpose of the study & schedualed to be operated by OPCAB. The study was done at the Kasr Alainy hospital and Alexandria armed forces hospital (Mostafa Kamel hospital) in the period between October 2013 to May 2014. We assessed both groups preoperatively to make sure that they were comparable groups. Study then compared early outcomes, including mortalities and morbidities, to assess safety of OPCAB in patient with LMCA compared to non LMCA patients.**

Results: **There was no statistically significant difference in preoperative data as regards the age, sex, medical history of importance and preoperative echocardiographic findings between both groups. All the patients completed the study. There was no mortality among the patients. Regarding intraoperative comparison, there was no statistically significant difference in the total operation time, number or type of grafts performed per patients, or any intraoperative events. The total ICU mechanical ventilation time and ICU and hospital stay didn't show any significant difference statistically between both groups. Postoperative complications including mortalities & morbidities did not show any significant difference between the LMCA group and non LMCA group.**

Conclusion: **These data (study) does support the concept that LMCA lesions don't carry any additional risks for modern OPCAB & is safe. LMCA disease patients may require additional anesthetic support during beating heart surgery that needs further evaluation. Patients with impaired contractility require studing separately as they were excluded from our study.**

Keywords: **CABG, Off-pump CABG, LMCA disease**

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Left main coronary artery (LMCA) disease represents a significant independent risk of mortality in ischemic heart disease patients. Patients identified with LMCA stenosis are acknowledged to be at increased risk when receiving medical therapy alone as compared with surgical revascularization [1-3].

The standard therapy for patients with LMCA disease is coronary artery bypass grafting (CABG). Compared to percutaneous coronary interventions (PCI), CABG carries a lower incidence of major adverse cardiac and cerebrovascular events (MACCE) including death, stroke and acute myocardial infarction [4].

Off-pump coronary artery bypass grafting (OPCAB) has recently become widespread internationally, and has produced good clinical outcomes. However, because of the concern about the ability to tolerate beating-heart surgery, patients with LMCA stenosis have been excluded from OPCAB [5]. LMCA stenosis have historically been recognized as a risk factor for early death among patients undergoing CABG [6, 7]. A number of recent reports have indicated the safety and efficacy of OPCAB in patients with LMCA disease [8–12].

This study is concerned whether LMCA stenosis was still a significant risk factor for OPCAB or is it safe. The aim of this study is to compare the early outcome and morbidities between patients with LMCA disease and patients without LMCA disease undergoing OPCAB operation to prove that LMCA disease is no longer an additional risk in OPCAB operation.

Patients (Materials) & Methods

This was a comparative observational prospective cohort study of 30 patients with coronary artery disease requiring CABG surgery. Patients were nonrandomly divided into two groups, Group A, 15 patients had LMCA disease while Group B, 15 patients had coronary artery disease other than LMCA stenosis. All patients were consented for the purpose of the study and underwent OPCAB operation. This study compared early outcomes and morbidities after OPCAB in the LMCA and non-LMCA disease group.

Primary data collection was done using checklist and data compilation form as research tools. There was no dropouts and the collected data was statistically applied & entered to MedCalc software programs to get the final results. The study was done at the Kasr Alainy hospital and Alexandria armed forces hospital (Mostafa Kamel hospital). Study cases were operated during 8 month period from October 2013 to May 2014.

Inclusion criteria for the study included patients requiring CABG with echocardiography findings of good contractility i.e. E.F. to be ≥ 40%, with no valvular or congenital abnormalities. Coronary angiography suggestive of LMCA stenosis ≥50% with or without other coronary lesions for group A and patients with non-LMCA stenosis lesions for group B requiring CABG.

Patients with associated valvular or congenital lesions were excluded from the study. Also patients with more than mild impairment in contractility i.e. E.F. < 40% were excluded.

Preoperative assessment included: History taking, Clinical examination, Laboratory investigations (Complete blood count, Liver function tests, Prothrombin time and concentration, Kidney function tests, Fasting blood sugar and Serum electrolytes), Electrocardiogram, Plain chest x-ray, Echocardiography and diagnostic coronary angiography.

Preoperative counseling in the preoperative visit prior to surgery, a brief explanation of the steps of the operation, the post-operative events and the intensive care stay.

Preoperative data recorded; was demographic data included age, sex and body mass index; clinical characteristics included smoking, hypertension, diabetes mellitus and insulin dependence, hyperlipidemia, chronic obstructive pulmonary disease, previous myocardial infarction and previous percutaneous coronary intervension; echocardiographic calculated ejection fraction and coronary angiography data showing number and names of vessels diseased and type of lesions.

Preoperative preparation included : a morning dose of cardiac medications. Intramuscular 10 mg morphine sulphate before transfer to the operating theatre was given to all patients.

Anesthetic techniques : After arrival in the preparation room a 14 gauge peripheral intravenous cannula was inserted using local anesthesia. Sedation was optimized using 0.03-0.07 mg/Kg midazolam. The intraoperative anesthetic technique was the same for all patients and consisted of a 20 gauge radial artery cannula was inserted using local anesthesia. Two blood samples were withdrawn from the arterial line, the 1st for preoperative baseline activated clotting time and the 2nd for baseline arterial blood gas analysis. Monitoring started using three or five leads ECG, pulse oxymetry and invasive B.P.. The induction of anesthesia was achieved with Fentanyl citrate (5 to 10 μg/kg), Thiopental (3 to 5 mg/kg) or Propofol infusion (3 to 4 mg/kg/hour) and Vecuronium bromide (0.1 mg/kg) or Pancuronium (0.02 mg/Kg). Endotracheal intubation was then done through the oral route with an appropriate sized endotracheal tube.. Anesthesia in all patients was maintained with inhalational Isuflorane 0.5-1.0 %. After induction, a triple lumen central venous catheter was inserted into the right internal jugular vein. A urethral catheter was also inserted. Anticoagulation was achieved with heparin (1 mg/kg) after the conduits were harvested. The activated clotting time was maintained at 300 seconds or greater. Heparin was reversed with protamine after completion of the anastomosis. Standard intraoperative monitoring techniques were used.

Surgical techniques : All Patients were positioned supine and a median sternotomy incision was the standered route for the heart. The conduits were harvested; left internal mammary artery and left or right long saphenous veins. The left internal mammary artery was harvested using an upward lifting retractor (Favaloro retractor). After fully mobilized, the artery was clipped by an atraumatic bulldog clamp after patient was fully heparinized to avoid clot formation. The great saphenous vein conduits were harvested simultaneously through one long incision or interrupted incisions. After conduits were ready, a specially designed chest retractor was used to maintain both exposure and a platform for the heart stabilizer; suction based heart stabilizers was the type used (Octopus 4.3; Medtronic). Grafting strategies were directed towards patients own condition and target vessels anatomical considerations,

In general, collateralized vessels have been grafted before collateralizing vessels; the last coronary target grafted is the collateralizing vessel, in most cases LIMA to LAD was the 1st graft performed, saphenous vein grafts were used successively for other targets as diagonals, obtuse marginal branches and right coronary targets.

Proximal anastomosis was performed using an aortic partial occlusion clamp. Vein graft anastomoses were commenced with 6-0 monofilament suture. De-airing the aortic root was done after the clamp was removed, before tying this suture, the vein grafts were kept occluded until they were de-aired with a 25-gauge needle.

After all grafts were done, hemodynamics were stable, protamine was introduced to reverse heparin effects, good hemostasis was commenced, 2 or 3 chest drains were left ,one in posterior pericardium and one in left pleura and one in right pleura if opened.

Wound closure was done as for conventional CABG by steel wire for sternum and absorbable sutures for the fascia, subcutaneous, and subcuticular layers.

Operative data collection; included operative time, number and type of grafts used, target vessels, intraoperative inotropics, intra-coronary shunt or intra-aortic balloon use and intraoperative hypotension or arrhythmias.

Postoperative sedation protocols for early weaning of mechanical ventilation were used, including the use of dexmedetomidine (precedex®) starting from sternal closure till weaned from mechanical ventilation. The weaning procedure was done gradually using continuous positive airway pressure and pressure support (10-15 cm H_2O) modes. Ventilatory support was gradually reduced at a rate of 1-2 cm H_2O CPAP and pressure support (PS) decrement.

Postoperative data collection; included mortality, total mechanical ventilation time, post-operative blood loss, intensive care unit stay (ICU), hospital stay and morbidities (DVT, fever, arrhythmias, other morbidities) were recorded.

Statistical analysis

Data was collected, verified and edited on a personal computer, then analyzed by MedCalc software program to get the final results. These results will be presented in tables & chart accordingly. The following tests were used:

- Arithmetic mean, standard deviation and hypothesis "t" test (Student test) for quantitative values.
- The chi-square test (x2) for qualitative values expressed as proportions.
- For all statistical comparisons, a P value of < 0.05 was considered significant and a P value of <0.01 was considered highly significant.

Results

The study was conducted on 30 patients; 15 of them (50%) had LMCA lesions (Group "A") and 15 (50%) had coronary lesions other than LMCA lesions (Group "B"). All the patients completed the study. There was no mortality among the patients. This study is concerned whether LMCA stenosis was still a significant risk factor for OPCAB or is it safe.

	Group A	Group B	P value	SIG.
Smoking	**12(80%)**	**8(53%)**	**0.28**	**N.S**
Hypertension	**14(93%)**	**14(93%)**	**0.47**	**N.S**
Diabetes Mellitus	**12(80%)**	**8(53%)**	**0.28**	**N.S**
Insulin Dependent	**12(100%)**	**5(62.5%)**	**0.096**	**N.S**
Hyperlipidemia	**15(100%)**	**15(100%)**		
ChronicObstructive PulmonaryDisease	**1(6%)**	**1(6%)**	**0.44**	
PreviousMyocardial Infarction	**2(13%)**	**4(26%)**	**0.66**	**N.S**
PreviousPercutaneous CoronaryIntervention	**0**	**1(6%)**	**0.914**	
Ejection fraction %	**55.6±7.4**	**53.4±5.7**	**0.36**	**N.S**
Number of vessels Diseased	**3.06±1.03**	**2.4±0.83**	**0.06**	**N.S**
Coronary lesions	**46**	**37**		
Left main	**15**	**0**		
Left anterior descending	**11(73%)**	**15(100%)**	**0.15**	**N.S**
Circumflex	**11(73%)**	**6(40%)**	**0.6**	**N.S**
Right coronary artery	**8(53%)**	**10(66%)**	**0.4**	**N.S**
Osteal lesions	**19(41%)**	**11(29%)**	**0.36**	**N.S**

Summary of preoperative evaluation

In group "A", age ranged from 46-71 years with a mean of 60.8 ± 7.8, while in group "B", age ranged from 42-69 years with a mean of 57.4 ± 8.11, *(P = 0.25)*. In group "A", there was 5 females (33%), while in group "B", there was no females (0%) *(P= 0.052)*. The mean body mass index in group "A" was 29.6 ± 4.3 Kg/m^2 and in group "B" was 29 ± 3.7 Kg/m^2 , (*P value =0.6)*.

The total operation time (from skin to skin) was 5.2 ± 1.11 hours in group "A". In group "B", the total time was 4.53 ± 0.83 hours, P value = 0.074. The number of grafts performed in group "A" was 38 grafts, with a mean of 2.5 grafts ± 0.91 grafts. The number of grafts performed in group "B" was 29 grafts with a mean 1.9 grafts ± 0.7 grafts, P value = 0.052 (non-significant). Of the total grafts done 14 arterial grafts were used in group "A" (36%) and 15 arterial grafts were used in group "B" (51%), with a P value of 0.326 (N.S).

Postoperative complications were assessed in both groups, there were no mortalities among both groups, one patient have had a sternal wound infection (6%) in group "A" and one patient have had a leg wound infection (6%) in group "A" with no statistical significance. None of the patients had a stroke, renal impairment needing dialysis nor myocardial infarction. Total blood loss intraoperative in group "A" was 460ml ± 195 ml. and 450ml ± 145 ml. in group "B" (P value = 0.87).

Patients of group "A" stayed in the ICU 4.3 ± 1.5 days, in group "B" patients stayed in ICU 3.5 ± 1.1 days (*p value* = 0.106). The total hospital stay in group "A" was 8.3 ± 2.6 and 7.2 ± 2.1 days in group "B". The mean ICU ventilation time in group "A" was 8.6 ± 6.4 hours, and in group "B" was 6.6 ± 3.2 hours, with a non-significant p value of 0.288.

		Group A	Group B	*P Value*	SIG.
Anastomosis to	**Left anterior descending**	15(39%)	15(51%)	0.46	N.S
	Diagonals	8(21%)	3(10%)	0.38	N.S
	Obtuse marginal	6(15%)	3(10%)	0.81	N.S
	Right coronary	3(7%)	5(17%)	0.37	N.S
	Posterior descending	(7%)3	2(6%)	0.73	N.S
	Intermedius	3(7%)	0	0.41	N.S
Intraoperative inotropics		6(39%)	2(13%)	0.227	N.S
Intra coronary shunt use		1(6.5%)	0	0.97	N.S
Intra-aortic balloon use		0	0		
Post operative inotropics		4(26%)	2(13%)	0.66	N.S
Intraoperative hypoxia		0	0		
Intraoperative hypotension		6(39%)	2(13%)	0.227	N.S
Intraoperative arrhythmia		0	0		
Intraoperative bradycardia		2(13%)	0	0.48	N.S

Summary of target anastomosis and intraoperative events

Discusion

From the current study, LMCA lesions don't carry any additional risks for OPCAB. OPCAB offers low mortality and an excellent clinical outcome for patients with LMCA disease & is safe. Regarding major morbidity and mortality, we did not detect any significant differences between both groups postoperatively. LMCA lesions didn't affect the completeness of revascularization and the total number of grafts per patient wasn't affected between groups, as well as the ICU stay and total hospital stay.

Preoperative patient comorbidities and cardiac characteristics were equally distributed in the two matched

groups. Regarding age, sex & body mass index distribution among both groups there were no statistical difference between them, although the LMCA group was a little bit older with more females. In LIU Tong study [13] and T. Suzuki study [8], there was no major difference between both studies and the current study and between groups in both studies and our study. Regarding clinical characteristics included smoking, hypertension, diabetes mellitus and insulin dependence, hyperlipidemia, chronic obstructive pulmonary disease, previous myocardial infarction and previous percutaneous coronary intervension were found in the same number of population of both groups with no statistical difference. In LIU Tong study [13] and T. Suzuki study [8], there was no major difference between both studies and the current study and between groups in both studies and our study except for diabetes mellitus & insulin dependence which was more in our study which is attributed to population characteristics but this was found to be equal in both groups in all studies. The analysis of these data indicates that both groups demographic and medical history was equally distributed with no statistical significance.

Preoperative echocardiography assessment was aimed to exclude patients with combined valvular or congenital diseases (needing the use of extracorporeal circulation) and exclude patients with poor left ventricular functions (i.e. E.F. ≤ 40 %). In Emmert M.Y. study [5] and LIU Tong study[13], there was no major difference between both groups in all studies but our study had high range of E.F.% due to exclusion of low E.F.% patients from the study unlike others. The number of vessel disease was equally distributed with no statistical significance between groups in our study, Emmert M.Y. study [5], T. Suzuki study [8] and LIU Tong study [13]. Coronary targets are highest in LIU Tong study therefore the number of grafts to be performed needs to be higher compared to our and the other two similar papers.

The total operation time (from skin to skin) and number of grafts performed per patient were comparable with no significant differences between groups and studies, in our study and T. Suzuki study [8]. In LIU Tong study [13], the mean number of distal anastomosis in LMCA patients was similar to that in the non-LMCA disease group with larger number of distal anastomosis due to the larger number of targets identified. Although arterial grafts were less in our study, it did not affect the end results as this variable was affecting both groups. Arterial grafts used were mainly LIMA, no radial arteries or RIMA were used in the our study. In T. Suzuki study [8] and LIU Tong study [13] arterial grafts were used more extensively including bilateral internal mammary, radial and gastroepiploic arteries. The greater use of intraoperative than postoperative inotropics in LMCA group may refer to the anesthetic team role in supporting the LMCA group hearts as it's more susceptible to ischemia, increased number of grafts performed and the pathology of target vessels itself in respect to more diabetes and females in LMCA group.

The mean ICU mechanical ventilation time was insignicantly different between both groups in our study, Emmert M.Y. study [5] and T. Suzuki study [8]. Our study had lower ICU mechanical ventilation time due to the use of short acting sedatives (as dexamedetomidine) other than long acting ones. Postoperative complications were assessed in both groups, there were no mortalities among both groups. In Emmert M.Y. study [5], T. Suzuki study [8] and LIU Tong study [13] mortalities were less than 2% in either groups, this may denote that OPCAB offers low mortality rates and better clinical outcome in patients with LMCA disease than both PCI [14] and conventional CABG [9]. Recently, many authors report the potential effects of OPCAB in myocardial protection [15, 16]. These effects are related to reduced release of cardiac enzymes, decreased need for inotropic support and fewer postoperative arrhythmias [17]. OPCAB surgery doesn't carry any increased risk of mortalities or morbidities as compared to conventional CABG in low risk patients [20], however; in high risk groups off-pump CABG carries a major decrease in observed mortality and short term outcomes when compared to conventional CABG [21].

One patient have had a sternal wound infection (6%) in group "A" and one patient have had a leg wound infection (6%) in group "A" with no statistical significance. In T. Suzuki study [8] two patients of LMCA group had sternal wound infection and one patient in non LMCA group with non-significant p value. None of the patients had a stroke, renal impairment needing dialysis, or myocardial infarction & none of the patients was re-operated for bleeding. In Emmert M.Y. study [5], T. Suzuki study [8] and LIU Tong study [13], stroke occurrence were less than 2%, renal failure requiring dialysis was less than 3% in LMCA groups with non-significant p value for all complications. The overall morbidities and mortality risks are the same in both groups finding no impact of LMCA disease over the usual risks of the procedure. The total ICU and hospital stay were insignicantly different between both groups in our study, Emmert M.Y. study [5] and T. Suzuki study [8].

This study with its time limitations may open the door for more large scale studies in both the number of participants and the follow up range, to achieve a more constant evaluation of the safety and efficacy of OPCAB in patients with LMCA lesions. There are, moreover, reports of similar long-term survival after OPCAB regardless of LMCA disease status [12, 13]. Exclusion of patients with LMCA lesion and low ejection fraction from this study may require separate evaluation of these more critical patients.

OPCAB is now considered safe as routine practice in treating coronary stenosis, especially in high risk patients including LMCA.

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Effect of Intact Pleura On Clinical Outcome After Left Internal Mammary Harvesting

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Objective: **To compare postoperative outcome and complications of intact versus opened pleura after left internal mammary (LIMA) harvesting during coronary artery bypass grafting (CABG).**

Patients and Methods: Sixty adult patients undergoing elective on-pump CABG were randomly divided into 2 groups: Group I (n=30) received LIMA harvesting with pleurotomy (not incidentally opened), and Group II (n=30) had intact pleura. Both groups were compared in terms of peri- and postoperative clinical and radiological outcomes. The patients were followed for respiratory complications on chest x-rays at 2nd, 5th and 30th postoperative day (POD). Atelectasis was scored using the radiological atelectasis score (RAS). Postoperative PaO2, PaCO2 and O2 saturation were evaluated 1h before extubation, 1h after extubation and after removal of chest tubes. Postoperative pain estimated by visual analogue scale (VAS) 1h and 12 h after surgery and after removal of chest tubes.

Results: **There were no differences in preoperative and perioperative variables between both groups. Patients with intact pleura (group II) had significantly lower blood loss (501.66 versus 763.33 mL; p = 0.001). The rate of postoperative pleural effusion and atelectasis were significantly lower in group II than group I at POD 5 (pleural effusion in 6.7 versus 36.7%; p = 0.005, atelectasis in 10 versus 30%; p = 0.04) and at POD 30 (pleural effusion in 3.3 versus 23.3%; p = 0.02, atelectasis in 3.3 versus 20%; p = 0.04). The scores of atelectasis was significantly lower in group II than group I at POD 30 (p = 0.03). Age > 65 years and opening of pleura were significant independent predictors of these respiratory complications. PaO2 was significantly higher in group II than in group I before extubation (p = 0.03) and after extubation (p = 0.04), while PaCO2 was significantly lower after extubation (p = 0.001). The intensity of pain was significantly lower in group II than group I at 12 hours after surgery (p = 0.0001) and after removal of chest tubes (p = 0.03).**

Conclusion: **Keeping the pleura intact during LIMA is significantly associated with early low rate of atelectasis and pleural effusion after CABG. Clinically, it significantly decreases postoperative amount of blood loss and intensity of pain.**

KEYWORDS: **Coronary artery bypass, pleural integrity, pleural effusion, atelectasis, postoperative pain**

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Left internal mammary artery (LIMA) to the left anterior descending artery (LAD) is still the gold standard conduit for coronary artery bypass grafting (CABG) as it provides increased survival and freedom from myocardial infarction, symptoms, and reinterventions compared to venous graft [1].

Opening of the pleura during LIMA harvesting is preferred by some surgeons to have better LIMA exposure and to reduce pericardial effusion and tamponade, but this method carries a high chance of pleural effusion and postoperative pulmonary complications which may be reduced when the pleura is kept intact [2].

Respiratory problems are one of the major factors affecting morbidity and mortality after CABG [3]. Based on recent evidence in literature, preservation of pleural integrity seems to contribute to decreased respiratory complications and improved clinical

outcomes, such as bleeding, pain and length of hospital stay [4]. However, preservation of pleural integrity is not advocated to be used as a routine for all patients during LIMA harvesting.

Therefore, the aim of the present study was to examine and compare the effects of preserved pleural integrity during CABG versus LIMA harvesting with pleurotomy on postoperative clinical outcome particularly postoperative respiratory complications and pain.

Patients and Methods

Selection of patients:

Sixty patients undergoing CABG between June 2011 and May 2014 were included in this prospective study, after obtaining a written informed consent from all of them. Patients were randomly assigned into two groups: Group I: the opened pleura (pleurotomy) group comprised 30 patients, and Group II: the closed (intact) pleura group was comprised another 30 patients. Each operation was performed by one of two cardiac surgeons. The randomization was carried out according to the surgeon's preferred method. Adult patients older than 18 years undergoing elective on-pump CABG were included. The exclusion criteria included: age more than 70 years, chronic renal failure, chronic obstructive pulmonary disease (COPD), coronary artery bypass graft associated with other procedures, coagulation disorders, previous cardiac surgery, ejection fraction <40%, redo surgery, emergency CABG, preoperative atelectasis or consolidation on chest x-ray and patients with incidental opening of pleura during CABG.

Anesthesia

Induction of anesthesia was performed with fentanyl (5 μg/kg), midazolam (0.1 mg/kg), pancuronium (0.1–0.15 mg/kg) and 2 mg/kg propofol. Maintenance of anesthesia was provided by fentanyl (0.5-1 μg/kg), pancuronium (0.1–0.15 mg/kg) and infusion of 1 mg/kg propofol.

Operative technique

Operations were performed through median sternotomy. Conduits were harvested and prepared. In group I patients, the left pleura was opened with the use of electrocautery. Harvesting of LIMA was performed using conventional pedicled technique with endothoracic fascia and the surrounding fat and muscle tissue accompanied with its vein. In group II, the left pleura was retracted with moisturized sponge and the pleura was kept intact. When left pleura was incidentally opened, the patient was excluded.

Standard cardiopulmonary bypass (CPB) was performed under moderate systemic hypothermia through aortic and two-stage venous cannulae using a roller pump, membrane oxygenation and identical priming solution. Heparin was administered at a dose of 300 IU/kg to achieve a target activated clotting time greater than 450 seconds. The aorta was cross clamped, and myocardial protection was achieved with antegrade cold crystalloid cardioplegic solution (15 mL/kg). Mean arterial blood pressure was maintained in the range of 60–80 mmHg. Distal anastomoses were performed by end-to-side or side-to-side techniques with a running 7/0 or 8–0 prolene suture. Proximal anastomoses were performed using 5–0 or 6–0 prolene suture during the heating period with the assistance of ascending aortic side-clamp. After the completion of CPB and cannula removal, heparin was neutralized with protamine providing an ACT less than 150 seconds. All of the patients received pericardial (28 Fr) and mediastinal (32 Fr) tubes, and patients in the pleurotomy group received an additional left intercostal (32 Fr) tube. Chest tubes were removed routinely on the 1st postoperative day, when the drainage became serous.

Postoperative follow-up

Chest x-ray was performed during ICU and hospital stays on morning of 2nd and 5th postoperative day (POD). All radiographs were examined by a radiologist. Pleural effusion was considered relevant when it passed the costophrenic angle. When there was a clear radiological shadow more than 15 mm in width, atelectasis was diagnosed. The chest x-rays were scored using the radiological atelectasis score (RAS). The presence of atelectasis is expressed by a 5-point score [5] (0=clear lung fields, 1=plate-like atelectasis or slight infiltration, 2=partial atelectasis, 3=lobar atelectasis, 4=bilateral atelectasis).

Partial oxygen pressure (PaO2), oxygen saturation (O2 Sat), and PaCo2 were evaluated and compared between both groups 1h before extubation, 1h after extubation and on 5th postoperative days. All patients received the same postoperative analgesic therapy, which consisted of oral non-steroidal analgesics. The pain intensity was evaluated at 1 hour and 12 hours after surgery and after removal of chest tubes by visual analogue scale (VAS) using a ruler marked from 0 to 10.

Data collection

The preoperative, intraoperative and postoperative data were prospectively collected in both groups and it included: age, gender, co-morbid risk factors (smoking, DM, hypertension, obesity), preoperative ejection fraction, number of grafts per patient, ventilation time, length of ICU stay, length of hospital stay, in-hospital motality, amount of blood loss, blood transfusion, re-exploration for bleeding, arterial blood gases, elevated hemi-diaphragm, wound infection, postoperative respiratory complications, postoperative intensity of pain.

Statistical analysis

Statistical analysis was performed with SPSS software (version 16, SPSS Inc, USA). The quantitative data were expressed as mean values ± standard deviation (SD). The Student t-test was used to compare means between two groups. Nonparametric Mann-Whitney was used when the assumption of normality of the data was rejected. The proportions were compared using the chi-square test or Fisher's exact test. To estimate association between postoperative respiratory complications and different risk factors, odds ratio (OR) and its 95% confidence interval (CI) were calculated. The multivariate logistic binary regression was used to obtain the independent factors for respiratory complications. Differences were considered significant at $P < 0.05$.

Results

The preoperative demographic and clinical characteristics of the patients were similar between both groups of the study (Table 1). Regarding peri- and postoperative clinical outcome and durations of hospital stay in the study groups (Table 2), there was no significant difference between both groups in number of grafts per patient, cross-clamp time, CPB time, mechanical ventilation time, duration of ICU stay, duration of hospital stay, number of patients required postoperative blood transfusion, in-hospital mortality, elevated hemi-diaphragm, re-exploration for bleeding, and incidence of wound infection. The amount of postoperative blood loss was significantly higher in groups I than in group B (763.33±384.82 mL versus 501.66±183.58 mL, p = 0.001).

Regarding postoperative pulmonary complications determined on radiological examination (Table 3), atelectasis on the 2nd postoperative day was seen in 3.3% in group I and 0% in group II (p = 0.31). On the 5th postoperative day, 30% had atelectasis in group I and 10% in group II, which was statistically significant (p = 0.04). Pleural effusion on the 2nd day was seen in 6.7% in group I and 3.3% in group II (p = 0.55). On the 5th postoperative day, 36.7% had atelectasis in group I and 6.7% in group II, which was statistically significant (p = 0.005). No respiratory insufficiency occurred in any of the study groups. There was no significant difference in atelectasis scoring on 2nd postoperative day; however there was a significant decrease in score of atelectasis in group II (p = 0.03) at 5th day after surgery (Table 4).

During hospital stay, the overall respiratory complications (one or more) diagnosed on chest x-ray were determined in 19 patients (63.3%) in group I and in 6 patients (20%) in group II, which was significantly different (p = 0.001). Analyzing the association of overall occurrence of respiratory complications after surgery with pre- and intra-operative risk factors in the study patients (Table 5) showed that age > 65 years and opening of pleura were only significant independent predictors of these complications after CABG.

The results of postoperative arterial blood gases are shown in Figures 1 and 2. PaO2 was significantly higher in group II than in group I before extubation (170±59.5 versus 137.7±58.8 mmHg; p = 0.03) and after extubation (169±54.3 versus 138.4±62.5 mmHg; p = 0.04), while PaCO2 was significantly lower in group II than group I after extubation (35.6±3.3 versus 39±4.4 mmHg; p = 0.001). There was no statistically significant difference in O2 saturation between both groups at any given time.

Regarding postoperative pain estimated by visual analogue scale (VAS) in the study groups (Table 6), there was no statistically significant difference between both groups when measured at 1 hour after surgery (p = 0.07), while it was significantly lower in group II than in group I at 12 hours after surgery (p = 0.0001) and after removal of chest drain (p = 0.03).

Variables	Group I (n=30)	Group II (n=30)	P-value
Age (years)	59.3±7. 6	56.5±7	0.14
Gender (M/F)	91/9	23/7	0.55
Smoking	11 (36.7%)	13 (43.3%)	0.59
Diabetes mellitus	6 (20%)	9 (30%)	0.37
Obesity (BMI > 30kg/m^2)	5 (16.7%)	7 (23.3%)	0.51
Hypertension	7 (23.3%)	9 (30%)	0.55
Ejection fraction (%)	57.83±9.51	60.36±10.50	0.33

BMI: Body mass index.

Table (1): Preoperative patient characteristics of the study groups

Variables	Group I (n=30)	Group II (n=30)	P-value
Number of grafts per patient	2.76±0.77	2.56±0.85	0.34
Cross-clamp time (min)	51.53±18.93	51.83±15.78	0.94
CPB time (min)	88.46±27.51	83.13±26.26	0.44
Ventilation time (hours)	10±3.1	9±3	0.21
ICU stay (days)	2.56±1.38	2.06±0.90	0.10
Hospital stay (days)	7.70±1.89	7.53±1.40	0.70
Blood loss (mL)	763.33±384.82	501.66±183.58	0.001*
Blood transfusion	3 (10%)	2 (6.7%)	0.64
In-hospital death	2 (6.7%)	1 (3.3%)	0.55
Elevated hemi-diaphragm	1 (3.3%)	0 (0%)	0.31
Re-exploration for bleeding	1 (3.3%)	0 (0%)	0.31
Wound infection	2 (6.7%)	1 (3.3%)	0.55

*CPB: cardiopulmonary bypass. * Significant difference*

Table (2): Peri- and postoperative clinical outcome and durations of hospital stay in the study groups

Time	Complications	Group I (n=30)	Group II (n=30)	P-value
POD 2	Atelectasis	1 (3.3%)	0 (0%)	0.31
	Pleural effusion	2 (6.7%)	1 (3.3%)	0.55
POD 5	Atelectasis	9 (30%)	3 (10%)	0.04*
	Pleural effusion	11 (36.7%)	2 (6.7%)	0.005*

*POD: Postoperative day. * Significant difference*

Table (3): Postoperative pulmonary complications in the study groups (radiological diagnosis)

Time	Groups	Atelectasis score					P-value
		0	1	2	3	4	
POD 2	Group I	29	0	1	0	0	0.31
	Group II	30	0	0	0	0	
POD 5	Group I	21	0	6	3	0	0.02*
	Group II	27	2	1	0	0	

*POD: Postoperative day. * Significant difference*

Table (4): Scoring of atelectasis in the study groups

Risk factors		Respiratory complications		Bivariate analysis		Multivariate analysis		
		Yes (n=25)	No (n=35)	OR	95% CI	OR	95% CI	P-value
Age (years)	> 65	4	12	0.36	0.10-1.3	0.15	0.02-0.87	0.03*
	< 65	21	23					
Gender	Female	9	7	2.25	0.70-7.2	1.6	0.36-7.66	0.50
	Male	16	28					
Smoking	Yes	12	12	1.76	0.61-5	2.3	0.57-9.2	0.23
	No	13	23					
Diabetes	Yes	5	10	0.62	0.18-2.1	0.60	0.09-3.7	0.58
	No	20	25					
Obesity	Yes	5	7	1	0.27-3.6	2	0.30-13.8	0.46
	No	20	28					
Hypertension	Yes	7	9	1.12	0.35-3.57	0.92	0.17-4.8	0.92
	No	18	26					
EF (%)	< 55	6	12	0.60	0.19-1.9	0.28	0.04-1.7	0.17
	> 55	19	23					
Clamping time (min)	> 70	3	7	0.54	0.12-2.35	0.55	0.09-3.3	0.52
	< 70	22	28					
Bypass time (min)	> 70	18	27	0.76	0.23-2.47	0.77	0.12-4.94	0.78
	< 70	7	8					
Pleural opening	Yes	19	11	6.9	2.1-22	15.5	3.2-73.7	0.001*
	No	6	24					

*OR: Odds ratio. CI: Confidence interval. * Significant predictor*

Table (5): Association of overall occurrence of respiratory complications per patient during hospital stay with pre- and intra-operative risk factors in the study patients

Time	Group I (n=30)	Group II (n=30)	P-value
1 h after surgery	1 (0-2) 1.06±0.78	1 (0-2) 0.73±0.66	0.09
12 h after surgery	3 (1-4) 2.66±0.8	2 (0-3) 1.63±0.76	0.0001*
After removal of chest tube	3 (2-4) 2.93±0.78	2 (1-4) 2.50±0.68	0.03*

*Data are expressed as median (range) and mean±SD, compared by Mann-Whitney U test. * Significant difference*

Table (6): Postoperative pain estimated by visual analogue scale (VAS) in the study groups

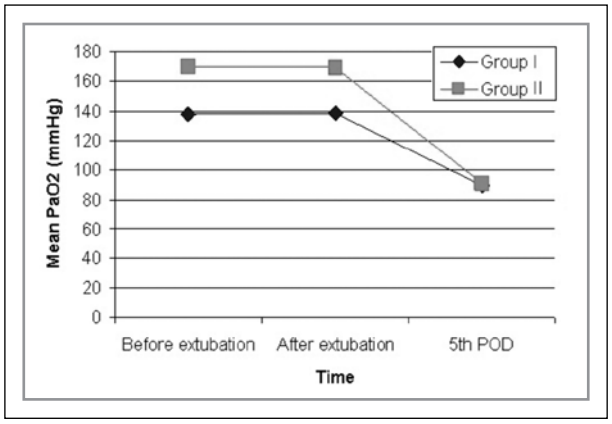

Fig. 1. Mean values of postoperative PaO2 before extubation, after extubation and at 5th postoperative day (POD) in group I (pleurotomy) and group II (intact pleura).

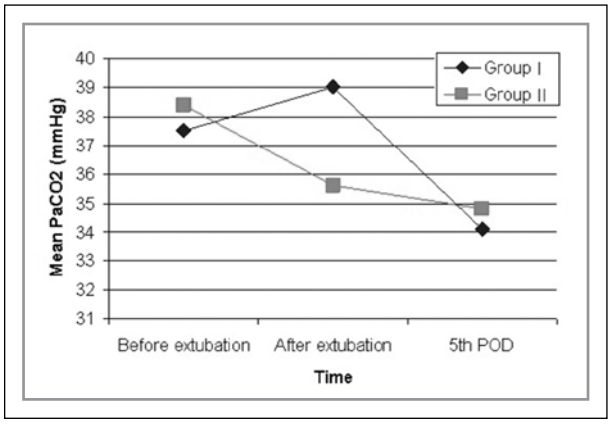

Fig. 2. Mean values of postoperative PaCO2 before extubation, after extubation and at 5th postoperative day (POD) in group I (pleurotomy) and group II (intact pleura).

Discussion

Pleurotomy during LIMA harvesting may have injurious effects which deteriorates postoperative clinical outcome after CABG, particularly postoperative respiratory complications and pain [3, 6]. The findings of the present study showed that patients with intact pleura had significantly lower blood loss than patients with pleurotomy (501.66 versus 763.33 mL; p = 0.001). Similar findings of were reported in multiple studies [7-9]. Moreover, some authors reported a significant reduction not only in blood loss but also in need for blood transfusion [10, 11].

Most of patients who bleed excessively in the early postoperative period after CABG have incomplete surgical hemostasis [12], this may explain why in the present study there was a decreased need for blood transfusion and re-exploration for bleeding in all patients, with insignificant difference between both groups despite the significant increase in amount of blood loss in group of pleurotomy. The reduction of blood loss when the pleura is kept closed might be explained by avoiding extensive dissection of the surrounding tissues in addition to good visualization of bleeding from small collaterals because of decreased surface area when compared to large surface area with opened pleura [8].

The rate of in-hospital mortality low and was insignificant between both groups (6.7% with pleurotomy and 3.3% with intact pleura; p = 0.55) in the present study. The reduced rates of in-hospital mortality and morbidity in the present study might be attributed to selection criteria of the study which excluded patients carry high risk to develop morbidity and mortality after CABG who had age more than 70 years, chronic renal failure, COPD, concomitant surgery, coagulation disorders, previous cardiac surgery, low ejection fraction, redo surgery or emergency CABG.

In the present study, the rate of postoperative pleural effusion and atelectasis were significantly lower in group of intact pleura than group of pleurotomy at POD 5 (pleural effusion in 6.7 versus 36.7%; p = 0.005, atelectasis in 10 versus 30%; p = 0.04) and at POD 30 (pleural effusion in 3.3 versus 23.3%; p = 0.02, atelectasis in 3.3 versus 20%; p = 0.04). The effects of pleurotomy on respiratory sequelae after internal mammary artery harvesting were examined also by Iyem et al [6] who found that preservation of pleural integrity during retrieval of IMA was associated with lower incidence of postoperative atelectasis and pleural effusion on the 2nd, 5th, and 7th postoperative days.

Multiple studies showed varied incidences of atelectasis and pleural effusion with each method which attributed to varied number of patients in these studies and difference in time at which these complications were evaluated. Up to 5 days after surgery, recent studies reported incidences of atelectasis ranged from 35% to 97.9% in group of pleurotomy and from 15% to 90.7 % in group of intact pleura [2, 14]. Also, the recent studies reported incidences of pleural effusion ranged from 12% to 97.8% in group of pleurotomy and from 2.5% to 68.2% in group of intact pleura [3, 10].

The development of atelectasis has been described as present in most patients with an incidence of around 90% of cardiac surgical patients [14]. In addition to the method of LIMA preparation and dissection, various other factors implicated in development of postoperative respiratory complications particularly the injurious effect of CPB as it initiates a maintained systemic inflammatory cascade which ultimately leads to pulmonary injury. In addition, concurrent absence of ventilation during lung deflation and diminished pulmonary perfusion during CPB leads to generation of free oxygen radicals with subsequent pulmonary injury [15].

We evaluated the radiological scores of atelectasis which was significantly lower in group of intact pleura at POD 5 ($p = 0.03$). The reduced severity of atelectasis when the pleura is intact may be related to reduced volume of hematoma in the pleural space as compared with large size of hematoma develop with opening of pleura and comprising the atelectatic segments [16].

In the present study, PaO2 was significantly higher in group of intact pleura than group of pleurotomy before extubation and after extubation, while PaCO2 was significantly lower after extubation. Similar findings were obtained by Oz et al [3], who reported that on 5th POD, PaO2 and O2 saturation were significantly higher and the PaCO2 was significantly lower in the intact pleura group than group of pleurotomy. There is an evidence that CABG surgery adversely affects arterial blood gas (ABG) determinations, and the additional trauma to the lungs and chest wall with IMA harvesting (pleurotomy, the placing of pleural drains) will result in deterioration of tissue oxygenation and hence it may reduce PaO2 and increase PaCO2 which lead to a longer recovery time [18].

The intensity of pain of our patients was measured by VAS and it was significantly lower in group of intact pleura than group of pleurotomy at 12 hours after surgery, and after removal of chest tubes. Similar findings were obtained by Bonacchi et al [8] who used also one-dimensional VAS scale to estimate postoperative pain intensity and reported the pain score at 1-12 hours after awakening were significantly higher in groups of pleural opening and group of incidentally opened pleura versus group of closed pleura, becoming similar after the chest tubes were removed. Moreover, other authors assessed postoperative pain quality and intensity by using multidimensional pain score, and they reported more annoying (troublesome) pain in group of pleurotomy five days after surgery [3, 7].

In addition to opening of pleura during LIMA harvesting, we found that age > 65 years was a significant independent risk factors of respiratory complications after CABG. Identification and assessment of risk factors associated with respiratory outcome would improve the quality of clinical management of patients undergoing cardiac surgery much more accurately [18]. Older aged patients (age ≥ 70 years old) is among the most important factors which could impose a greater risk on the CABG patients, as they need to be able to tolerate severely decreased levels of systemic oxygenation and systemic hypoxemia after myocardial revascularization [19]. Despite exclusion of patients aged more than 70 years in the present study, patients between 65 and 70 years old still comprise a risky group. This finding agreed with the previously reported fact in literature that the more age increases above 65 years, there is an increased risk for postoperative complications [20].

In conclusion, keeping the pleura intact during LIMA harvesting decreases amount of postoperative blood loss and pain, and it is associated with low rates of pleural effusion and atelectasis. We recommend further large scale, long term studies, comprising COPD and other risky patients, and comparing off-pump and on-pump CABG operations, to evaluate the impact of pleural integrity on outcome after CABG.

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Tyrone David Aortic Valve Sparing Operations: Mid Term Durability

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Alaa Farouk

Objectives we investigated the durability of Trone David for ascending aortic aneurysms at midterm.

Methods From September 2005 to September 2010,53 patients underwent Tyrone David Aortic valve sparing operation for ascending aortic aneurysm and aortic regurge. Clinical examination, transthoracic echocardiography and CT scan were done annually along with a phone interview every 6 month to detect aortic valve related adverse events

Results The mean follow up for survivals was 84.5±21.2 months. The operative mortality (30 days) was 7.54% (4/53). All patients left the hospital after an echocardiography done revealing less than mild AR. During follow up, 10 patients developed mild AR, 4 patients developed moderate AR(at 8,14,23and 57 months respectively), and 1 patient developed severe AR. The freedom from reoperation at 9 years was 97.6% among survivals.

Conclusion Aortic root valve sparing operation showed integral structural and functional durability at midterm.

Valve sparing operations were popularized over the last three decades[1]. The freedom from prosthetic valve related adverse events represented the goal for this trend[2]. Reimplantation of aortic root showed superior results than remodeling for the freedom from residual and progressive aortic regurgitation[3,4,5].

Although the reimplantation of the aortic root inside a tube graft offered a reasonable solution for limiting a progressive annular enlargement and consequent structural and functional aortic valve failure, necessitating reoperation[6,7] . Yet the results in patients who had a connective tissue disorder as Marfan syndrome and bicuspid aortic valve disease are controversial[8,9].

In this study we prospectively studied the mid-term aortic valve structural and functional deterioration, survival and risk or reoperation.

Patients and Methods

From September 2005 to September 2010, 53 patients underwent Tyrone David valve-sparing aortic root replacement at Cairo University hospitals. All patients had ascending aortic aneurysm and aortic regurgitation (AR). Patients with acute dissection, connective tissue disorders (Marfan), bicuspid aortic valve (BAV) and Patients with severe annuloaortic ectasia (aortic annulus ≥27 mm) were excluded from this study. Patients with chronic ascending aortic dissection were included.

Operative procedure

Aortic arch arterial canulation was done in 19 patients (35.9%) were the arch was free of significant disease. Femoro-atrial (37.7%) or axillary-atrial canulation (7.5%) was done in the rest of patients. 8 patients (15%) had an aortic arch involvement In the later situation, open clamp technique and circulatory arrest with retrograde cerebral perfusion was applied. Also systemic hypothermia to 25°c was done prior to circulatory arrest.

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Reimplantation was done via Excision of the diseased sinuses except for 5-8 millimeters, and detaching coronary artery buttons. The left ventricular outflow tract was dissected circumferentially to a level just below the aortic annulus. Then, placing the aortic cusps, annulus and sub-commissural triangles inside a straight tubular Dacron graft. Selection of the size of the graft depends on measuring the size of the aortic annulus with a standard valve sizer, and adding 7mm to it.

Haemostatic closure was secured with two suture lines. One by horizontal interrupted 2/0 braided polyester sutures enforced with Teflon pledgets, through the left ventricular outflow tract underneath the insertion of aortic cusps and tied on the outside. The second is done with a scalloped continuous 4/0 polypropylene sutures to align the base of the sinuses with the graft.

The three commissures are suspended inside the graft and secured with pledgeted 3/0 polypropylene suture. Neoaortic sinuses were created by plicating the graft with 5/0 polypropylene suture at the level of the commissures. The left and right coronary buttons were re- implanted as full thickness Carrel buttons using 5/0 polypropylene running suture enforced with native pericardium.

The cooptation level of the cusps was carefully inspected. Distal anastmoses were done with 3/0 polypropylene running suture enforced with native pericardium.

Follow up

Clinical examination, transthoracic echocardiography and CT scan were done annually along with a phone interview every 6 month to detect aortic valve related adverse events.

Statistical analysis

Continuous variables are expressed as the mean ± standard deviation. Categorial data were tabulated in 2^{x}n tables. Microsoft Excel was used for descriptive and analytical statistics.

Results

Patients' preoperative characteristics are described in Table (1). Patients were followed up for a maximum of 9 years. The mean follow up for survivals was 84.5±21.2 months. Three patients were lost for follow up at 3 years, and additional 2 at 6 years from the date of their operation. The total number of patients who completed the study was 42(79.24%)

Survival

The operative mortality (30 days) was 7.54% (4/53). Two patients died due to delayed recovery and consequent complications of prolonged mechanical ventilation and multiorgan failure. One patient died due to infective endocarditis that led to aortic root abscess, disruption of sutures and bleeding. Under coverage of antibiotics, a Bentall operation was done 20 days later, but there was a failure to wean off bypass. One patient died due intractable haemorrahge. He was a 73 old patient with ascending and arch aneurysm and weak tissue that barely hold the sutures. He was closed over packs and reopened after 4 hours, and then continued to bleed despite all medical and surgical measures. Finally, he died after 48 hours.

During the follow up, two patients were found dead due to hepatitis C virus complications at 5 years and one died at 8 years due to disseminated cancer prostate

Aortic regurge

All patients left the hospital after an echocardiography done revealing less than mild AR. There was no need for reoperation during the hospital stay. During follow up, 10 patients developed mild AR, 4 patients developed moderate AR(at 8,14,23and 57 months respectively), and 1 patient developed severe AR. The later patient was re-operated upon 30 month after the initial operation and the aortic valve was replaced by a mechanical valve. The freedom from reoperation at 9 years was 97.6% among survivals who completed the follow up.

Operative data

Most patients had a graft size 28. The Circulatory arrest was 24.7±6.9 minutes in patients when had a concomitant aortic arch surgery. 4 patients had a concomitant coronary artery bypass. 3 patients had a vein graft to Obtuse marginal, right coronary artery(RCA) and to the left anterior descending. These arteries were found stenotic in a preoperative coronary ct angiography. One patient had a vein graft to RCA due to right ventricular impairment and failure to wean of bypass. Operative data were listed in Table (2).

Charactaristic	
Age(years)	57.6±11.2*
Male gander	37/53(69.8%)
Hypertension	39/53(73.6%)
Diabetes	14/53(26.4%)
COPD	11/53(20.7%)
Ejection Fraction %	57.4±9.3*
Ascending aortic diameter (cm)	6.6±1.2*
Aortic Annulus (cm)	2.41±0.13*
Mild AR	2/53(3.77%)
Moderate AR	19/53(35.85%)
Severe AR	32/53(60.37%)

** data were expressed as mean±SD. COPD=Chronic obstructive pulmonary disease,AR=aortic regurge*

Table 1. Preoperative patient characteristics

Graft size 26	3(5.5%)
Graft size 28	37(52.8%)
Graft size 30	12(22.6%)
Graft sixe 32	1(1.9%)
Ischemic time (min)	165.6±29.9*
Bypass time(min)	203.6±32.3*

** data were expressed as mean±SD*

Table 2: Operative data

Discussion

Aortic valve replacement has been the standard of care operation for aortic regurgitation for many years. Advances in operative procedures and improved knowledge regarding the mechanism of AR contributed to the increased interest of repair techniques[10]. Type 1b AR patients caused by dilatation of sinotubular junction and aortic annulus were the target for aortic valve sparing procedures[11].The loss of dynamic distensiblity of aortic root[12], associated with reimplantation aortic valve sparing procedures, raised concerns about the durability of such technique[13].

Complex aortic valve pathologies were abandoned in this study. Repair of regurgitated bicuspid aortic valve is quite complex and associated with lesser 10 year freedom from reoperation[14]. Inferior results were found in Marfan patients undergoing valve sparing procedures, although the superiority of Tyrone David procedure over Yacoub technique in those patients[15]. Both Marfan and bisuspid aortic valve are associated with dilated aortic annulus and even if reasonable, it will dilate later[9].

Proper graft sizing and adjustment of the height of the commisures are the keys for durable valve repair. Failure to adjust will lead to leaflet prolapse and subsequent AR[16]. Proper leaflet cooptation was ensured before the sutures lifting the commisures were tightened.

Tyrone David reported an overall freedom from reoperation in the aortic valve at 10,15, and 20 years as 97.1%, 94.2%, and 94.2% respectively. He found that age by increments of 5 years was the only predictor for mortality[6]. Shrestha and colleagues reported in a study with a mean follow up of 10±2 years that the freedom from reoperation was 96%,91%, and 87% at 1, 5 and 10 years[17].

AS Tyrone David procures are quite complex and learning curve related results are obvious. Patients developed moderate AR at 8 and 14 months were done in the early phase of this series . Too narrow or too wide graft size was probably the cause. Although apparently proper cooptation was achieved at the time of surgery, but this was not enough for a longer duration. Aortic valve cusps must coapt above the level of the nadir of the aortic annulus and the cooptation length must be of at least 4mm in the central part[16]. The main cause of late aortic valve regurgitation is indefinite, some explained it by degeneration of aortic cusps and others proposed that this process was accelerated by rigid prosthetic aortic root[18].

Conclusion

The results of Tyrone David valve sparing aortic root replacement are acceptable in the mid- term for carefully chosen patients, regarding patient survival and valve durability.

Acknowledgement

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Surgical Management of Acute Myocardial Infarction

Amr Rouchdy

Objectives **to define the outcome of patients, undergoing surgery for complications of acute myocardial infarction (MI).**

Background **Despite the advances in the management of MI, with marked drop of the incidence of complications, mortality due to mechanical complications remains high.**

Methods **From December 2003 to June 2014, 23 patients underwent surgery for post MI mitral incompetence, ventricular septal defects (VSD) and free wall rupture (FWR).**

Results **All patients had a concomitant CABG with venous grafts. Acute ischemic mitral regurge was found in 47.8%, ischemic VSD in 47.8% and FWR in 8.7% of cases. The 30- day operative mortality was 39.1%. The ischemic time was 70.65±17.45 min. The ICU stay was 6.17±2.29 days. Post operative duration of IABP was 3.5±1 days.**

Conclusion **Patients with hemodynamic instability due to the mechanical complications of MI could be operated upon with an acceptable mortality.**

Despite the advances in the management of Myocardial Infarction (MI), including thrombolysis and primary percutaneous intervention[1], the incidence of related cardiogenic shock remained constant at 6-8% and represent 75-80 % of all patients with cardiogenic shock[2]. Related mechanical complications as severe MR(6.9%), ventricular septal defects (3.9%), and free wall rupture (1.4%) are the major surgically corrected causes[3].

Emergency surgical revascularization in cases with cardiogenic shock related to rupture myocardium is associated with high mortality (19-50%) and morbidity[4].

The purpose of this study is to review retrospectively the surgical results of cases that had a carcinogenic shock as mechanical complications of ST elevation acute myocardial infarction (STEMI).

Patients and Methods

Between January 2003 and June 2014, 23 consecutive patients underwent a surgical repair for VSD, MR, or Free wall rupture associated with coronary revascularization. Preoperative patient characteristics were collected including echocardiographic data. The time interval from the onset of infraction to surgery was recorded. Operative data, mortality and morbidity were analyzed. The time from the onset of infarction to admission to the operative room was noted.

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Preoperative preparation

All patients were stabilized medically using inotropes, intraaortic ballon pump(IABP) and mechanical ventilation to achieve heamodynamic stability. Failure to adjust was an indication for an immediate surgery. During the time frame of the study, 27 patients died shortly after being diagnosed and before preparation for surgery.

Operative techniques

All patients had full median sternotomy, Bypass initiated using aorto-bicaval canulation. Cold blood home-brew cardioplegia was administered associated with topical cooling by ice slush. Systemic hypothermia to 28°c. In one case there was a posterior VSD associated to inferior pseudoanerysm . the pseudoaneurysm was opened and the original myocardial defect enlarged, then a double dacron patch techniquewas used to close the posterior VSD and the myocardial hole. In one case there was a crack in an apical infarction with leakage in the pericardium. There was a significant amount of clots . A Dor procedure was done along with CABG (SVG to LAD)

VSD Closure

In cases of anterior VSD, the septum was inspected via an anterior ventriculotomy in the area of the most scarred myocardium, and via right atriotomy. After careful debridement of all necrotic tissues, the VSD was closed using separate, interrupted, and pledgeted 4/0 polypropylene sutures. A fashioned Dacron patch was used at least 1 cm beyond the free margin of the VSD (Fig1). Then the ventricultomy was closed supported by 2 dacron strips in a linear fashion in 2 layers. The first layer is interrupted and the second is continuous using 3/0 polypropylene sutures.

Mitral surgery

Three patients out of twelve patients with acute severe mitral regurgitation had the mitral valve replaced by an artificial mechanical valve (two of them size no 25 and the third size no 27). Those patients had a multiple rupture chordae and the mitral valve deemed irreparable.

Two patients had a repair of a single rupture chorda using polytetrafuroehylene suture and tight prosthetic complete ring. Seven patients had a repair by tight ring only. Ring Size 28 was used for males and 26 for females.

Statistical analysis

Statistical analysis Microsoft excel version 2010. Data are expressed as mean ±SD for continuous data and as a percentage for categorical data.

Results

Preoperative patient characteristics were shown in table (1). All patients had a concomitant coronary artery bypass grafting (CABG) using only saphenous vein grafts. The distribution of coronary revascularization were shown in Figure (1). The ischemic time was 70.65±17.45 min and the bypass time was 115.17±54.3 min. All patients were weaned of bypass with maximum doses of inotropes and IABP. In all cases adrenaline and noradrenaline was used initially. Millrinone was used in 6 cases done after 2009. The loading dose was 50μ/kg followed by a maintenance dose of 0.4/kg/min. Postoperative data was shown in table (2).

Mortality

The total mortality in the first month was 39.1 %(9/23). 4/23(17.4%) patients failed to wean off bypass and died. Two patients (8.7%) had uncontrollable bleeding and were closed over packs. Both died several hours later in the ICU. One patient died due to multiorgan failure at the fifth postoperative day. One patient died in the 11th postoperative day due to severe respiratory infection secondary to prolonged intubation. One patient died in the 20th postoperative day out of septicemia and mediastinitis.

Charcartistics	Patients (n=23)
Male/Female	21/2
Age (years)	53.6±5.6
Hypertension	16/23(69.5%)
Diabetes	9/23(39.1%)
Chronic obstructive pulmonary disease	4/23(17.4%)
Acute mitral regurgitation (MR)	11/23(47.8%)
Anterior Ventricular septal defect (VSD)	9/23(39.1%)
Posterior VSD	2/23(8.7%)
Anterior VSD+MR	1/23(4.35%)
Posterior VSD+ Free wall rupture	1/23(4.35%)
Free wall rupture	1/23(4.35%)
VSD Diameter(cm)	1.6±0.53
EF%(ejection fraction)	39.6±4
Preoperative IABP	19/23(82.6%)
Preoperative intubation	11/23(47.8%)
Preoperative cardiogenic schock	18/23 (78.2%)
Time from MI to diagnosis(days)	7.17±4.86
Time from MI to Surgery(days)	Range (4-29), median (12)

Table 1: Preoperative characteristics

ICU stay (days) (n=17)	6.17±2.29
Mechanical Ventilation(days)	5.95±2.6
Duration of IABP(days) (n=17)	3.5±1
Duration of Inotropes(days) (n=17)	6.3±2.3
Initial dose of adrenaline(μ/kg/min)	0.146±0.065
Initial dose of noradrenaline(μ/kg/min)	0.134±0.64
Residual Shunts	3/11(27.2%)
Postoperative EF%* (n=14)	42.1±2.9
Hospital stay (days) (n=15)	20.5±9.5

** at 30 days postoperative echocardiography among survival*

Table(2): Postoperative data

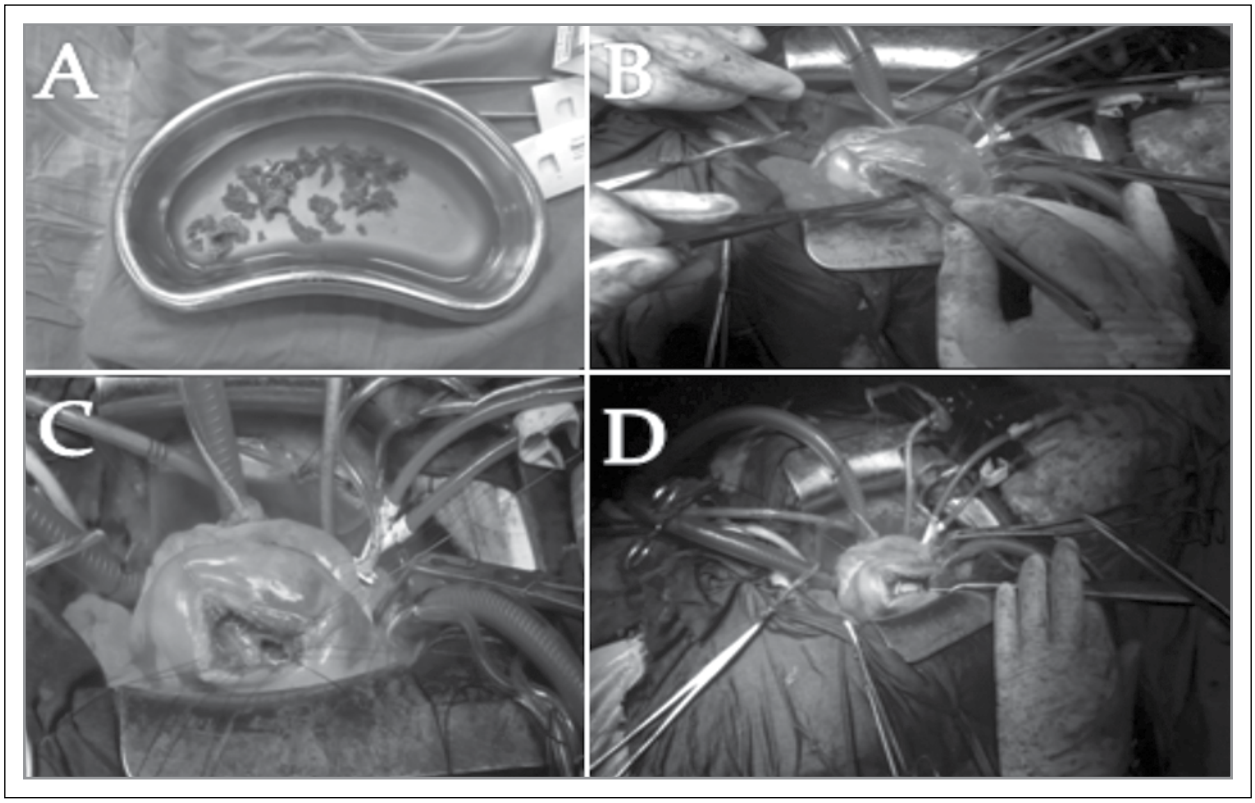

Fig 1. Closure of anterior VSD. A=necrotic tissues,B=vsd location,c= interrupted sutures, D= patch deployed

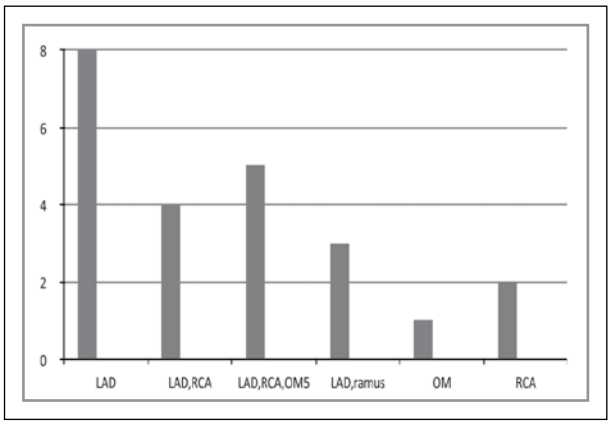

Fig 2. Distribution of coronary bypass grafts
LAD=left anterior descending artery, RCA=right coronary artery, OM=obtuse marginal.
Vertical axis represents the number of patients

Discussion

Mechanical complications attributed to STEMI have been associated with the worse outcome. Cardiogenic shock occurs in 10% to 27% of cases in the first 2 weeks[5]. Eighty five percent of patients with ischemic VSD die in the first 2 months[6]. Late repair of acquired VSD is technically easier due the maturity of tissues and scar formation, and the operative survival is about 70% of such patients[7]. However, persistence of shock despite of IABP and inotropes is associated with 100% mortality[8].

Labrousse et al recommended an early surgical repair[9], despite the higher risk due to friability of tissues and poor myocardial function[10].Coskun et al operated on 41 patients with ischemic VSD. The time interval from rupture to surgery was 23.1 days. Their mortality was 32%[11].

With acute ischemic mitral regurgitation, a fair ejection fraction often represents a severe left ventricular impairment. A higher prevalence of pulmonary oedema and mechanical ventilation dependence is secondary to the sudden regurgitant volume into the left atrium. Although surgery carries a risk of 40% in hospital mortality, yet it is considered as a surgical emergency[12].

Despite the success of percutaneous luminal angioplasty in reducing the amount of mitral regurgitation[13]. Yet , many cases did not benefit from revascularization alone and needs surgical correction[14].

(IABP) is now the most frequently used support for a failing heart in cardiac surgery to reduce mortality. The later ranges from 18.8% to 19.6% for preoperative insertion, from 27.6%

to 32.3% for intraoperative insertion, and from 39% to 40.5% for postoperative insertion. By increasing the cardiac output without increase in oxygen demands, in a pulsatile manner, IABP may improve end organ perfusion and reduce the inflammatory response post bypass and myocardial infarction (MI). IABP augments coronary artery bypass grafts when IABP is instituted prior to CPB[15,16,17].

The strategy of preoperative insertion of IABP, and the sole use of venous grafts, and prompt diagnosis and management of such patients, lowered the mortality rate in such high risk group of patients. Tissue friability and end organ damage were the most common causes of mortality. Prolonged ICU and hospital stay with a longer duration of mechanical ventilation were an additive factor.

Patient with intense hemodynamic instability (5/23), who were operated early had the worse outcome regarding mortality (4/9). Patients who had a late surgery with controlled haemdynamics and improved cardiac functions had a better outcome.

Residual shunts detected by intraoperative trans esophageal echocardiography (TEE) that occurred in 27.2% of patients who had VSD closure were due to friability of tissues. Those patients had the worse haemodynamics, they operated earlier after their initial infraction and eventually they died intraoperatively due to failure to wean of bypass or shortly in the ICU. Most of the VSD,s done were relatively small (1.6±0.5 cm). Bigger VSD were associated with larger infarctions and worse hemodynamic. Most of this patient died before being operated upon.

Conclusion

Patients with hemodynamic instability due to the mechanical complications of MI could be operated upon with an acceptable mortality. Proper stabilization of cardiac functions and waiting for infarction maturation led to a better outcome.

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Massive Hemoptysis: A Comparative Study Between Two Therapeutic Strategies

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Background: **Massive hemoptysis is an uncommon but life threatening event associated with a high mortality rate in the absence of adequate treatment. Treatment options include conservative medical therapy, surgery, and bronchial artery embolization. The decision for adopting a specific modality is affected by the underlying cause of the hemoptysis as well as the expertise of the cardiothoracic center providing care .This study is a comparison of therapeutic outcomes for life-threatening hemoptysis between two therapeutic strategies.**

Methods: **Patients admitted with massive hemoptysis at two thoracic surgery centers in the southern region of Saudi Arabia during the period from January 2004 to December 2013 were studied. For each patient, baseline demographics, comorbid conditions, initial clinical presentation, initial vital signs, cause of hemoptysis, CT Scan results, microbiologic results, pathologic examination of lung tissue resected, management strategy, hospital length of stay, morbidity, mortality, and vital status at discharge were recorded. All data were collected and subjected to statistical analysis.**

Results: **Eighty four patients were managed surgically on an emergency basis and in the other fifty nine patients bronchial artery embolization were attempted before surgery. The characteristics of patients and underlying diseases were similar in both groups .The management and the outcome were significantly different between the 2 groups of patients .**

Conclusions: **Bronchial artery embolization has been regarded as an effective technique in the emergency treatment of life-threatening hemoptysis. Surgical management still plays an important role as a therapeutic strategy .**

Massive hemoptysis is an uncommon but life threatening event associated with a high mortality rate in the absence of adequate treatment. It calls for immediate medical attention to control the airway and evacuate the clots by bronchial toileting, as well as to identify the source of bleeding (1-4).

The mortality rate depends mainly on the underlying etiology and the magnitude of bleeding (5).

The definition of life-threatening hemoptysis varies widely in the literature. It was defined as expectoration of at least 600ml of blood per 24 hours, 200ml of blood per hour in a patient with normal or nearly normal lung function, 50ml of blood per hour in a patient with a chronic respiratory failure, more that two episodes of moderate hemoptysis (at least 30ml) within a 24 hours despite the use of IV vassperessin, or hemoptysis requiring intubation (6-8).

Treatment options include conservative medical therapy, surgery (pulmonary resection), and bronchial artery embolization. The decision for adopting a specific modality is affected by the underlying cause of the hemoptysis as well as the expertise of the cardiothoracic center providing care (8, 9, 10).

This study is a comparison of therapeutic outcomes for life-threatening hemoptysis between two therapeutic strategies.

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Patients and Methods

From January 2004 to December 2013, 143 patients with massive hemoptysis were admitted at two thoracic surgery centers in the southern region of Saudi Arabia (Asser Central Hospital in Abha and Military Hospital in Khamis Mushait).

All patients were admitted under chest physicians and assessed by cardiothoracic surgeons and transferred to the intensive care unit. Strict bed rest was enforced. Arterial blood gases were monitored. Intravenous access was obtained, blood was cross-matched and baseline serum chemistry and coagulation studies were done.

Standard medical treatment (including correction of hypoxemia with high concentration of oxygen through a force musk or mechanical ventilation if needed, systemic vasopressors, sedatives, caugh suppressants, antibiotics in case of suspected bacterial infection, anti-tuberculous drug in case of documented active tuberculosis, blood transfusion and vaso-active drugs (epinephrine or norepinephrine) to control hypertension if needed) was started.

Detailed medical history, physical examination and chest roentgenograph were done. Sputum specimens were submitted for microscopic study and culture bacteria, acid fast bacilli and fungi and cytologic examination.

Patients wre intensively monitored and electively intubated if there was danger of airway compromise,

Flexible bronchoscopy was performed for assessment, airway toilet, adrenaline flush, cold saline lavage, and identification of the bleeding source.

Computed tomography of the thorax was performed for patients who are hemodynamically stable.

Patients in whom bleeding could not be controlled were referred for emergency surgery (Group A) or bronchial artery embolization (Group B). Patients in whom bleeding could be controlled were excluded from our study.

Pulmonary functions were not possible due to active hemoptysis.

In the first consequent 84 patients (Group A): after confirming hemodynamic stability, the patients were prepared for rigid bronchoscopy followed by thoracotomy and resection of the affected lobe or lung in the same setting as the facility of bronchial artery embolization was not available at that time. Under one lung anesthesia, posterolateral thoracotomy was done. The affected part of the lung parenchyma was found to be destroyed and densely adherent to the chest wall causing extensive bleeding at the time of mobilization and making the procedure hazardous and time-consuming. Careful dissection and minimal lung mobilization was done to approach the hilum. While the following 59 patients (Group B), bronchial arteriography and bronchial artery embolization using a seldinger technique through femoral access were attempted in all of them. The surgical option of pulmonary resection was only considered if the hemoptysis is continuous after bronchial artery embolization or failure to achieve stable cannulation of the vessel by the catheter tip.

For each patient, baseline demographics, comorbid conditions, initial clinical presentation, initial vital signs, cause of hemoptysis, CT Scan results, microbiologic results, pathologic examination of lung tissue resected, management strategy, hospital length of stay, morbidity, mortality, and vital status at discharge were recorded.

All data were collected and subjected to statistical analysis. Data were expressed as the mean I standard deviation. Differences were considered significant when the probability value was less that 0.05.

Results

During the 10-year study period, 143 consecutive patients referred to our unit with massive hemoptysis after failure of conservative management by chest medical and ICU teams. The patients were divided into two groups according to the management strategy for these patients.

Group A: 84 patients (67 males and 17 females) with a mean age of 53 $\pm$ 5.2 years (range from 32 to 69 years). These patients were managed surgically on an emergency basis.

Group B: 59 patients (47 males and 12 females) with a mean age of 49 $\pm$ 3.2 years (a range of 43 to 62 years). In these patients bronchial artery embolization were attempted before surgery. Hemoptysis was successfully controlled in 46 patients.

The characteristics of patients and underlying diseases were similar in both groups (Table I).

The management and the outcome were significantly different between the 2 groups of patients (Table II).

In Group B patients, surgery was done in thirteen patients after failure of bronchial artery embolization to control bleeding. Seven of them died during surgery.

Discussion

The definition of massive hemoptysis varies widely in the literature, from blood loss volumes of 200 – 1000ml per day(5-8). However, hemoptysis should be evaluated not in terms of the volume of bleeding but from the standpoint of its threat (airway obstruction and anemia or hypotension severe enough to require blood transfusion) (10) several therapeutic strategies have been applied in the clinical setting, with variable results (11,12,13).

Bronchial artery embolization has been regarded as an effective technique in the emergency treatment of life-threatening

Variables	Group A = 84		Group B = 59		P Value
	Number	Percentage	Number	Percentage	
Age (years)					
Average	32 – 69		43 – 62		N.S
Mean	53 ± 5.2		49 ± 3.2		N.S
Sex					
Male	67	79.8%	47	79.7%	N.S
Female	17	20.2%	12	20.3%	N.S
Underlying disease					
Tuberculosis	26	31%	18	30.5%	N.S
Cancer	15	17.9%	11	18.64%	N.S
Mycetoma	11	13%	7	11.9%	N.S
Bronchiectasis	14	16.7%	11	18.64%	N.S
Necrotizing Pneumonia	7	8.3%	0	0	N.S
Others	11	13.1%	12	20.3%	N.S
History of smoking	51	60.7%	37	62.7%	N.S

N.S = non significant

Table I. Patient characteristics of the 2 groups of patients

Variables	Group A = 84		Group B = 59		P Value
	Number	Percentage	Number	Percentage	
Operative Done					
Pneumonectomy	7	8.33%	0	0%	S
LUL lobectomy	31	36.9%	6	10.2%	S
RUL lobectomy	20	23.81%	4	6.8%	S
RML lobectomy	6	7.14%	0	0%	S
LLL lobectomy	11	13.1%	2	3.4%	S
RLL lobectomy	9	10.71%	1	1.7%	S
Blood transfusion	62	73.8%	46	78%	N.S
Mechanical ventilation at admission	13	15.5%	4	6.8%	S
Failed interventional radiology	-	-	13	22%	-
Mortality	32	38.1%	7	11.9%	S

S = significant *N.S = non significant*

Table II. Management and outcome of the 2 groups of patients

hemoptysis (14, 15). Surgical management still plays an important role as a therapeutic strategy (16). However, it is important for attending physicians in charge of patients with life-threatening massive hemoptysis to be familiar with the merits and limitations of each therapeutic morbidity, and make adequate decisions promptly during diagnosis and treatments (10).

The patients characteristics, the underlying pathology and the surgery done in our patients was similar to other studies (17, 18, 19, 20, 21). In Group A patients, surgery was the first-line therapy. While in Group B patients, bronchial artery embolization was used as a first-line therapy. This helps us to delay surgery for the patients to be prepared and stabilized before sur-

gery. Some authors suggested that surgical treatment is beast performed at a later date for obtaining successful outcome (22). There was significant difference in outcome between our two groups of patient. This was similar to the results in another series (10,22,23,24,25).

Conclusion

1. Bronchial artery embolization is an effective therapeutic tool in the management of life-threatening massive hemoptysis..
2. Surgery should be considered when bronchial artery embolization is unavailable or bleeding is unlikely to be controlled by that approach.
3. A multidisciplinary team approach for management of life-threatening massive hemoptysis is able to achieve good outcomes in affected patients.

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Comparative Study Between Small Bore Catheter Drainage, Therapeutic Thoracentesis, and Diagnostic Thoracentesis For Management of Uncomplicated Parapneumonic Effusion in Children

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Objective: **The initial management of parapneumonic effusion in children is still not standardized; we compared 3 methods of managing more than minimal uncomplicated parapneumonic effusion in children.**

Methods: **72 cases were included in the study and were classified into 3 groups; group I (Diagnostic thoracentesis), Group II (Therapeutic thoracentesis) and group III (Small bore catheter drainage). Clinical, laboratory and radiological data were analyzed before and after procedures including the need for re-intervention.**

Results: **The primary outcome (treatment failure) was significantly higher in group I than other groups (54.2% in group I vs. 20.8% in group II and 25% in group III), as regard secondary outcomes; there was a highly significant increase in post procedure analgesic requirements in group III than other groups , post procedure duration of fever (>37.5 °C) was significantly higher in group I than other groups , while post procedure duration of IV antibiotic treatment and hospital stay were significantly lower in Group II than other groups.**

Conclusion: **Therapeutic thoracentesis was as effective as, but more simple and economic than small bore catheter drainage in management of uncomplicated parapneumonic effusion in children as regard curability and prevention of subsequent complications, while diagnostic thoracentesis was significantly less effective.**

KEY WORDS: **(parapneumonic effusion, thoracentesis and small bore catheter drainage)**

Thoracic

Parapneumonic effusions (occurring in association with pneumonia) are one of the most common causes of exudative pleural effusions in the world; they are present in about 40% of children hospitalized with pneumonia and approximately 10% of those children require surgical intervention in any stage during their course of illness.[(1)]

The American College of Chest Physicians (ACCP) categorized patients with parapneumonic effusions into four separate risk categories for poor outcome according to three variables (pleural space anatomy, pleural fluid bacteriology and pleural fluid chemistry): categories 1 (very low risk), 2 (low risk), 3 (moderate risk), and 4 (high risk). The panel's consensus opinion supported drainage for patients with moderate (category 3) or high (category 4) risk for a poor outcome.[(2)]

This categorization of ACCP is more important in daily practice than the traditional classification of thoracic empyema into 3 stages (exudative, fibrinopurulent and organizing) which is difficult to be accurately estimated at presentation of the patient or at any time later in the course of the disease.[(3)]

In order to categorize patients with pleural effusion other than category 1, the pleural fluid should be sampled either by diagnostic thoracentesis, therapeutic thoracentesis

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or small bore catheter drainage. Although there are no studies comparing the three methods; Light RW preferred either a therapeutic thoracentesis or the insertion of a small bore catheter.[4]

There is still a need to standardize hospital procedures for initial management of parapneumonic effusion in children.[5]

Aim of the work

The objective was to compare three methods of managing uncomplicated parapneumonic effusion in children; diagnostic thoracentesis, therapeutic thoracentesis and small bore catheter drainage.

Patients and Methods

This prospective study was conducted in pediatric and cardiothoracic departments, Tanta University Hospital; a tertiary referral hospital in Delta area in Egypt; on 72 admitted children with more than minimal uncomplicated parapneumonic effusion during the period from October 2011 till July 2014.

All children with proved pneumonia were evaluated with postro-anterior and lateral chest x-ray; if the diaphragms couldn't be seen throughout their entirety, the possibility of a parapneumonic effusion was evaluated with ultrasound, CT scan or lateral decubitus radiographs; patients with minimal parapneumonic effusions (< 10 mm in lateral decubitus chest X-ray) were excluded because they often resolve conservatively and thoracentesis is not indicated. But if there was more than minimal fluid; the fluid was sampled and the sample was sent for physical, chemical and bacteriological analysis.

For the purpose of sampling and management patients were randomly distributed into 3 equal groups:

Group I (Diagnostic thoracentesis):(24 cases)

Aspiration of amount of pleural effusion sufficient for physical, chemical and bacteriological analysis (no drainage)

Group II (Therapeutic thoracentesis):(24 cases)

Thoracentesis was completed to tap the chest dry.

Group III (Small bore catheter drainage): (24 cases)

The procedure was generally done under deep sedation with intravenous ketamine and local anesthesia in the operating room or the intensive care unit under complete aseptic conditions (local anesthesia was used alone in co-operative children older than 8 years); imaging guidance was not utilized for catheter placement.

Small bore catheters (8 French) were placed by the Seldinger technique and secured with a prefabricated dressing with or without additional skin sutures.

Small bore catheters were used for complete drainage of pleural effusion, and were left in place to drain effusion as it was formed and was removed when pneumonia subsided clinically and radiologically.

Parapneumonic effusion was considered complicated and excluded from the study if one or more of the following characters were present:

1. Pleural fluid was purulent.
2. Pleural fluid bacterial smear or culture was positive.
3. Pleural fluid glucose was less than 60 mg/dl
4. Pleural fluid pH was less than 7.20.
5. Pleural fluid LDH was more than three times the upper limit of normal.
6. Large free-flowing effusion (>hemithorax), loculated effusion, or effusion with thickened parietal pleura.

Patients with complicated parapneumonic effusion and empyema at presentation were excluded from the study as they were managed with different modalities as chest tubes, intrapleural administration of fibrinolytics, or thoracotomy.

Patients with chronic lung diseases (except for asthma), cystic fibrosis, malignancies, immunodeficiency or recent thoracic operative intervention were also excluded.

All management approaches were taken included appropriate treatment of the underlying pneumonia by the appropriate IV broad spectrum antibiotics according to the clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Disease Society of America (IDSA) till the results of cultures appeared.[6]

Data collected included history, clinical presentation, laboratory tests and outcomes; the primary outcome was treatment failure, defined as the need for re-intervention (therapeutic thoracentesis, small bore catheter drainage, chest tube or thoracotomy). Secondary outcomes included post procedure analgesic requirements, maximum temperature, duration of fever (>37.5 °C), duration of antibiotic treatment, duration of hospital stay and complications of the procedure.

Statistical analysis

The collected data were organized, tabulated and statistically analyzed using SPSS software statistical computer package version 13. For qualitative data, comparison between two or more than two groups; Chi-square test (X2) was used. For quantitative data, the mean and standard deviation were calculated. For comparison between more than two means, analysis of variance (ANOVA) test was used followed by Tukey HSD Test. A p-value of less than 0.05 was considered statistically significant.

Results

Seventy two children with more than minimal uncomplicated parapneumonic effusions were included in our study and were randomly distributed into 3 equal groups that were homogenous groups as regard age, sex, history, clinical parameters, and white blood cell count (Table 1).

The primary outcome (treatment failure) was significantly higher in group I (Diagnostic thoracentesis) than other groups (54.2% in group I vs. 20.8% in group II and 25% in group III; P-value = 0.028), as shown in (Table 2); the most common cause of treatment failure in all groups was the development of empyema in 13 cases that was treated by chest tube drainage, followed by the development of loculations in 7 cases that was treated by thoracotomy and decortication.

Secondary outcomes are shown in (Table 3): There was a highly significant increase in post procedure analgesic requirements in group III (Small bore catheter drainage) compared to other groups (P-value = 0.00001), Post procedure duration of fever (>37.5 °C) was significantly higher in group I (Diagnostic thoracentesis) than other groups (P-value = 0.0007), while post procedure duration of IV antibiotic treatment was significantly lower in group II (Therapeutic thoracentesis) than group I and post procedure duration of hospital stay was significantly lower in group II (Therapeutic thoracentesis) compared to other groups (P-value = 0.0011).

No complication occurred in our study except for local infection at the site of insertion of small bore chest drains in 2 cases in group III.

		Group I (Diagnostic thoracentesis) (N= 24)	Group II (Therapeutic thoracentesis) (N= 24)	Group III (Small bore catheter drainage) (N= 24)	p. value
Age (m)		51 ± 31.3	52.42 ± 24.9	42.79 ± 30.8	0.47
Sex	Male	12	9	13	0.485
	Female	12	15	11	
Respiratory rate at presentation		43.17 ± 12.2	42.25 ± 12.9	43.54 ± 13.1	0.94
Oxygen saturation at presentation (%)		92.2 ± 4.95	93.58 ± 5.32	94.5 ± 4.06	0.26
Pre procedure white blood cell count/uL		16258 ± 8249	19867 ± 7391	18675 ± 6020	0.22
Pre procedure duration of illness (d)		6.13 ± 3.08	6.04 ± 3.32	6.29 ± 2.96	0.96
Pre procedure maximum temperature (°C)		39.6 ± 1.29	39.79 ± 1.51	39.53 ± 1.55	0.81

Table 1. Pre procedure history, clinical presentation and laboratory tests

Primary Outcome	Group I (Diagnostic thoracentesis) (N= 24)	Group II (Therapeutic thoracentesis) (N= 24)	Group III (Small bore catheter drainage) (N= 24)	p. value
Treatment Failure	13 (54.2%)	5 (20.8%)	6 (25%)	0.028*
Causes of failure				
Persistent uncomplicated effusion	2	1	1	
Development of empyema	7	3	3	
Development of loculations	4	1	2	
Re-interventions				
Therapeutic thoracentesis	1	0	0	
Small bore catheter	1	1	1	
Chest tube	7	3	3	
Thoracotomy	4	1	2	

**Significant or P<0.05*

Table 2. Primary outcome (treatment failure), causes of failure and type of re-intervention

Secondary Outcomes	Group I (Diagnostic thoracentesis) (N= 24)	Group II (Therapeutic thoracentesis) (N= 24)	Group III (Small bore catheter drainage) (N= 24)	p. value
Post procedure need for analgesia	3	4	19 [a]	0.00001*
Post procedure maximum temperature (°C)	38.2 ± 0.98	38.5 ± 1.31	38.6 ± 1.34	0.47
Duration of fever (>37.5 °C) post procedure (d)	9.17 ± 3.89 [a]	5.75 ± 2.83	6.21 ± 2.7	0.0007*
Duration of IV antibiotics post procedure (d)	10.0 ± 4.15	6.54 ± 2.69 [b]	8.08 ± 2.87	0.0024*
Duration of hospital stay post procedure (d)	10.88 ± 4.76	6.79 ± 3.01 [a]	9.88 ± 3.39	0.0011*

**Significant or P<0.05* *[a]Significantly lower than other groups* *[b]Significantly lower than group I*

Table 3. Secondary outcomes

Discussion

Parapneumonic pleural effusion, even without purulent content, usually behaves like empyema, with a strong tendency toward loculation resulting in a significant increase in morbidity and mortality.[7]

The incidence of pediatric empyema and its complications is increasing because of the increasing virulence of pathogens that cause pleural infections and so effective treatment of pediatric empyema is dependent upon rapid diagnosis and frequent reassessment of response to therapy.[8]

Many studies encourage more potent management approaches in managing all stages of parapneumonic effusions, for example; Gates et al. encouraged early thoracotomy or video-assisted thoracoscopic surgery (VATS) in complicated parapneumonic effusions for better results and shorter hospitalization.[9]Another multi-institutional study showed that the effectiveness of thoracoscopy in children with parapneumonic pleural effusion at the fibrino-purulent stage was 88%.[10]Moreover, some authors found that VATS as a primary intervention has significantly decreased the number of procedures, duration of chest tube drainage and length of hospital stay for children with parapneumonic effusions.[11]

Taking in mind that uncomplicated parapneumonic effusion can progress rapidly to fibrinopurulent or organized empyema and the significant percentage of false negative results for Gram stain and culture;[12]uncomplicated parapneumonic effusion should not be considered a simple complication of pneumonia that will resolve spontaneously but a step in the way to empyema.

Diagnostic and therapeutic thoracentesis were always considered safe procedures in the hand of well-trained doctors, with the additional benefit of relieving symptoms by therapeutic thoracentesis.[13]

The use of small bore (8 – 14 F) wire guided chest drains has become more common, so the British Thoracic Society (BTS guidelines) recommended small bore catheters for the treatment of pneumothorax and uncomplicated pleural effusion.[14]

We agreed with Cafarotti et al. about the effectiveness and tolerability of small bore wire guided chest drains in uncomplicated pleural effusions, although we did not try to use them in case of development of empyema as they get blocked in most cases and this fact was also confirmed by the same authors (74.2% of cases in their study).[15]

Light RW preferred therapeutic thoracentesis or the insertion of a small bore catheter than diagnostic thoracentesis to sample parapneumonic effusions that were more than minimal. The advantage of inserting a small bore catheter was the continuous removal of the effusion as it was formed, while the advantage of a therapeutic thoracentesis was the removal of all fluid by one puncture, but if the fluid recurred, a repeated thoracentesis or a small chest tube should be inserted.[4]

Our results were in agreement with Light RW in the superiority of therapeutic thoracentesis and small bore catheter drainage over diagnostic thoracentesis, as complete removal of uncomplicated parapneumonic effusions improved the clinical condition and decreased subsequent complications that need more interventions.

We preferred therapeutic thoracentesis than small bore catheter drainage in management of uncomplicated parapneumonic effusions for the following reasons: need no sedation in children less than 8 years, more economic, simple, less painful, significantly decrease the duration of hospital stay, and no fear of dislodgment or local infection at the site of insertion.

No complication occurred in our study except for local infection at the site of insertion of small bore chest drains in 2 cases in group III. In a study by Bartter et al.[16]on 506 cases; the incidence of pneumothorax as a complication of thoracentesis was 11% (2% required tube thoracostomy), while in the study of Horsley et al.[17]; two cases (2/52) with pneumothorax (3.8%) were recorded as a complication of small bore wire guided chest drains insertion and both of them resolved spontaneously, and no cases had drains sites infections, while in the study of Cafarotti et al.[14]; only 4/1092 cases (0.18%) had drains sites infections.

The lower incidence of complications in our study may be explained by our protocol of managing children with parapneumonic effusions by thoracic surgeons.

Conclusion

Therapeutic thoracentesis is as effective as small bore catheter drainage in management of uncomplicated parapneumonic effusion in children as regard curability and prevention of subsequent complications, while diagnostic thoracentesis was significantly less effective.

Considering the simplicity of therapeutic thoracentesis than small bore catheter drainage; we recommend therapeutic thoracentesis in management of uncomplicated parapneumonic effusion in children.

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Chronic Unexplained Respiratory Symptoms in Children; Are They Worth Bronchoscopy?!

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Objective: **Delay in diagnosis and treatment of radiolucent FB (foreign body) inhalation in children usually occurs and may lead to prolonged suffering and serious complications. The study was carried out in Tanta University Hospital to determine the importance and safety of rigid bronchoscopy in children with chronic unexplained respiratory symptoms and vague (unclear) history suggestive of FB inhalation**

Methods: **130 children with chronic unexplained respiratory symptoms were included in the study and were classified into 2 groups; group I: aged less than 3 y (107) and group II: aged more than 3 years (23), all children were subjected to complete history taking, physical, radiological and bronchoscopic examination.**

Results: **88 children (67.7%) had FBs (84 in group I and 4 in group II) and 11 (8.5%) had other positive bronchoscopic findings .Most of FBs were peanuts (43.2%) and were present in the right bronchus (44.3%). In group I; the presence of FBs didn't significantly affect physical or radiological findings, while the reverse was true in group II.**

Conclusion: **Bronchoscopy should be done in all children younger than 3 years with chronic unexplained respiratory symptoms even in the absence of history, physical or radiological signs suggestive of FB inhalation, while these factors should be considered in older children.**

Key words **(radiolucent FB inhalation and rigid bronchoscopy)**

Foreign body (FB) aspiration in children can be a very serious event frequently having considerable social and economic consequences and sometimes resulting in fatal outcomes.[1] This problem often occurs in patients less than 3 years and result in significant health hazards, and of course increases morbidity and mortality.[2]

Moreover, there is often a delay in diagnosis of radiolucent FB inhalation in children because there are no specific clinical manifestations. Usually, there is a suggestive history of choking, while the classic clinical presentation "coughing, wheezing, and diminished air entry" is not seen except in 40% of cases.[3]

Atypical or prolonged respiratory symptoms in children (cough and wheezy chest especially in the absence of known pulmonary diseases such as asthma, or chronic pulmonary infection) are the cornerstone in suspicion of FB aspiration. Any delay in diagnosis and treatment should be avoided to prevent serious complications such as bronchiectasis.[4,5]

In children with a frank history of choking and persistent cough, dyspnea or any abnormal physical or radiological findings; rigid bronchoscopy is mandatory to diagnose and remove FBs,[6] while children with persistent symptoms but without a frank history of choking are still in the gray zone where the hesitation to do bronchoscopy leave them suffering a lot.

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Aim of the work

The objective is to determine the importance and safety of rigid bronchoscopy in children with chronic unexplained respiratory symptoms and vague (unclear) history suggestive of FB inhalation with respect to their physical and radiological signs.

Patients and Methods

This prospective study was conducted in Tanta University Hospital; a tertiary referral hospital in Delta area in Egypt; on 130 children with vague (unclear) history suggestive of FB inhalation and chronic unexplained respiratory symptoms (cough, wheezes, asthma of sudden onset, or recurrent/non-resolving pneumonia) that did not respond to appropriate medical treatment for at least 4 weeks, all of them were subjected to rigid bronchoscopic examination during the period from October 2010 till July 2014.

Vague (unclear) history suggestive of FB inhalation includes:

1. Recurrent cough episodes with eating.
2. Eat peanuts and melon seeds usually with older children.
3. Play with toys of small particles usually with older children.

Exclusion criteria:

1. Frank history of foreign body inhalation
2. Radio-opaque FB inhalation detected by radiological examination

As the problem of FB inhalation often occurs in children less than 3 years, the patients were classified into two groups:

Group I: children aged less than 3 years

Group II: children aged more than 3 years

To study the effect of the presence of FBs in the airways; children in each group were sub-classified into 2 subgroups according to the presence or absence of FBs detected by rigid bronchoscopy:

FB subgroup: (type and site of FB were reported)

No- FB subgroup: (any other abnormal finding was reported)

All patients were subjected to complete history taking (including: age, duration of symptoms, and medication received), complete physical examination (including signs suggestive of FB inhalation as asymmetrical auscultation; localized decreased breath sound or localized wheezes and crackles), and radiological examination by chest x ray or computed tomography for signs suggestive of FB inhalation as air trapping, atelectasis, or pneumatic infiltration.

All patients underwent rigid bronchoscopy under general anesthesia in the presence of an experienced thoracic surgeon and anesthesiologist. Routine prophylactic antibiotics and corticosteroid (prednisolone 1 mg/kg) were given to prevent infection and edema after bronchoscopy. The size of the bronchoscope was determined according to the child's age. After induction of intravenous anesthesia, insertion of bronchoscope was done; sometimes with the help of direct laryngoscopy; tracheobronchial tree was examined, if FB was present; it was extracted using a suitable foreign body forceps. Bronchial lavage was done and specific antibiotics were administrated according to the type of isolated microorganism and the results of culture and sensitivity test.

Duration of bronchoscopy was calculated from the time of induction of anesthesia till recovery and complications of bronchoscopy were reported in all cases.

Statistical analysis

For qualitative data, Chi-square test (X2) was used for comparison between the two groups. For quantitative data, the range, mean and standard deviation were calculated. For comparison between means of two groups; student's t-test was used. A p-value of less than 0.05 was considered statistically significant.

Results

130 children underwent rigid bronchoscopy for suspected radiolucent foreign body inhalation; 107 children (82.3%) were in group I (Age < 3 y group) and 23 (17.3%) were in group II (Age > 3 y group); 88 children (67.7%) had FBs in their airways and 11 (8.5%) had other positive bronchoscopic findings as mucus plug, bronchial stenosis, and extra luminal compression, while 31 cases (23.8%) had normal bronchoscopic examination. (Table 1)

Of the 88 children who had FBs; 84 (95.5%) were in group I and the incidence of FB aspiration peaked in the second year of life (60 cases), accounting for 68.2% of the total.

The presence of FB was significantly higher in group I 84/107 (78.5%) than in group II 4/23 (17.4%); while there was no significant difference between the 2 groups as regard other positive bronchoscopic findings (mucus plug, bronchial stenosis, and extra luminal compression). (Table 1)

From the eighty eight FBs inhaled; Peanuts were present in 38 cases (43.2%) and seeds in 14 cases (15.9%), food particles were present in 24 cases (27.3%) and plastic objects in 12 cases (13.6%). According to the distribution of FBs; 16 cases (18.2%) were in laryngotracheal area, 39 cases (44.3%) in the right bronchus, and 33 cases (37.5%) in the left bronchus, there was no significant difference between the 2 groups as regard site of FB. (Table 1)

Bronchoscopic findings	group I (n=107)		group II (n=23)		X2	P
	n	%	n	%		
Normal	15	14.03%	16	69.6%	32.16	0.0001*
FB	84	78.5%	4	17.4%	32.33	0.0001*
Mucus plug	5	4.67%	2	8.7%	0.601	0.438
Bronchial stenosis	2	1.87%	1	4.3%	0.516	0.473
Extraluminal compression	1	0.93%	0	0%	0.217	0.642
Type of FB						
Peanuts	38		0			
Seeds	14		0			
Food particles	22		2			
Plastic objects	10		2		7.333	0.0619
Site of FB						
Laryngeo-tracheal	16		0		1.827	0.401
Right side	36		3			
Left side	32		1			

**Significant or P<0.05*

Table 1. Distribution of Bronchoscopic findings in both groups

As regard duration of symptoms, the mean duration of symptoms was 7.25 ± 2.78 (ranged from 5:18) weeks; there were no statistical differences between group I and II, and between FB and No-FB subgroups as regard duration of symptoms. (Table 2)

As regard duration of bronchoscopy, the mean duration of bronchoscopy was 16.42 ± 5 (ranged from 8:33) minutes, it was significantly prolonged in group I (17.06 ± 4.90) than group II (13.43 ± 5.03). In group I; duration of bronchoscopy was also significantly prolonged in FB subgroup (18.33 ± 4.44) than No-FB subgroup (12.39 ± 3.51), while in group II; there was no significant difference between FB subgroup (13.75 ± 3.40) and No-FB subgroup (13.37 ± 5.38). (Table 2)

Physical signs suggestive of FB inhalation (asymmetrical auscultation) were present in 42 children out of the 130 children (32.3%); they were equally distributed in both groups (32.7% in group I and 30.4% in group II). In group I; physical signs were non significantly distributed in FB subgroup (35.7%) and No-FB subgroup (21.7%), while in group II; they were significantly higher in FB subgroup (75%) than No-FB subgroup (21.1%). (Table 3)

Radiological signs suggestive of FB inhalation (air trapping, atelectasis, and/or pneumatic infiltration) were present in 35 children out of the 130 children (26.9%); they were equally distributed in both groups. In group I; radiological signs were non significantly distributed in FB subgroup (23.8%) and No-FB subgroup (30.4%), while in group II; they were significantly higher in FB subgroup (100%) than No-FB subgroup (21.1%). (Table 3)

No mortality or failure were encountered in our study, minor complications of bronchoscopy occurred in 3 cases (2.3%) all in group I; laryngeal edema in 2 cases (1 in each subgroup) and subcutaneous emphysema in 1 case (in FB subgroup), all of which were treated conservatively.

Discussion

Atypical or prolonged unexplained respiratory symptoms in children are the cornerstone in suspicion of FB aspiration. [4] We were interested to study this category of children with persistent symptoms but without a frank history of choking who still in the gray zone where the hesitation to do bronchoscopy may lead to serious complications.

		Duration of symptoms (weeks) Range Mean ± SD	Duration of bronchoscopy (minutes) Range Mean ± SD
All patients (n=130)	**Group I (n=107)**	5-16 7.21 ± 2.74	8-33 17.06 ± 4.90
	Group II (n=23)	5-18 7.39 ± 2.98	9-30 13.43 ± 5.03
	P-value	0.783447	0.001733*
Group I (n=107)	**FB subgroup (n=84)**	5-16 7.44 ± 2.95	10-33 18.33 ± 4.44
	No-FB subgroup (n=23)	5-13 6.39 ± 1.59	8-22 12.39 ± 3.51
	P-value	0.104495	0.00001*
Group II (n=23)	**FB subgroup (n=4)**	5-8 6 ± 1.41	9-17 13.75 ± 3.40
	No-FB subgroup (n=19)	5-18 7.86 ± 3.16	9-30 13.37 ± 5.38
	P-value	0.315454	0.893973

**Significant or P<0.05*

Table 2. Distribution of patients regarding duration of symptoms and duration of bronchoscopy.

		Physical Signs		Radiological Signs	
		n	%	n	%
All patients (n=130)	**Group I (n=107)**	35	32.7%	27	25.2%
	Group II (n=23)	7	30.4%	8	34.8%
	P-value	0.832		0.349	
Group I (n=107)	**FB subgroup (n=84)**	30	35.7%	20	23.8%
	No-FB subgroup (n=23)	5	21.7%	7	30.4%
	P-value	0.663		0.517	
Group II (n=23)	**FB subgroup (n=4)**	3	75%	4	100%
	No-FB subgroup (n=19)	4	21.1%	4	21.1%
	P-value	0.033*		0.003*	

**Significant or P<0.05*

Table 3. Distribution of patients regarding physical and radiological signs suggestive of FB inhalation

A paroxysm of cough during eating or playing with small particles toes may give warning to FB aspiration. However, a symptomless period after first paroxysm, may lead to negligence for days or even months, followed by symptoms such as wheezing, cough, sudden onset of asthma, and recurrent or non-resolving pneumonia.[7]

Many studies have shown that about 50% of patients with proved FB inhalation have no frank history of aspiration episode, and without an adult witness; 20% of children were misdiagnosed and improperly treated for at last 1 month before they were correctly diagnosed.[8] Sometimes duration of mistreatment before correct diagnosis and removal of FB could be long and ranged from 1 month to 132 months.[4] Duration of symptoms in our study was less; ranging from 5 to 18 weeks (mean 7 weeks), and all cases had vague (unclear) history of FB aspiration either because the parents didn't witness the episode of choking or they underestimated its importance.

In our study, only 88 cases (67.7%) had FBs in their airways, this was lower than that found by Midulla et al. (85.4%)[9] and Ayed et al. (87.7%)[6], this is because we excluded cases with frank history of choking and those with radioopaque FB, while they did not. But actually in our study, 99 cases (76.3%) had great benefit from bronchoscopy either by removal of foreign materials (FB or mucus plug) or diagnosing other relevant problems (bronchial stenosis and extra luminal compression), this percentage could be increased by better selection of children older than 3 years (only who had positive physical or radiological findings).

FB aspiration is a real problem in children especially those under the age of 3 years (95.5% of all FB detected in our study) peaked in the second year of life (68.2%). This went with the results of other studies as the study of Midulla et al. where 90% of cases were under the age of 3 years and 52.9% were in the second year of life.[9] This may be explained by the poor chewing ability from absence of molars and premolars, the tendency to put all objects in the mouth, the immature protective cough reflex, and the tendency to eat during playing and to have frequent and vigorous inspiration when laughing, or crying in children of this age-group.[10,11]

Most FBs are organic in nature (86.4% in our study) and they are mainly seeds, nuts and food particles according to variations in culture, region and nutritional habits, and this went with the results of other studies.[4,12]

The presence or absence of physical signs (e.g. asymmetrical auscultation) or radiological signs (e.g. air trapping, atelectasis, and/or pneumatic infiltration) suggestive of FB inhalation depends on the site of FB and the size of bronchus; in case of unilateral partial obstruction of the bronchus, blocking expiratory passage of air due to a valve effect; asymmetrical auscultation and air trapping exists, in case of unilateral complete obstruction of the bronchus; asymmetrical auscultation and atelectasis or pneumatic infiltration exists, while all these signs are often absent in case of laryngeo-tracheal FBs.[13]

In our study; the presence of physical or radiological signs suggestive of FB inhalation wasn't significantly related to the presence of FB in children less than 3 years old, while the presence of either one of them was directly related to the presence of FB in children older than 3 years. This may be explained by the relatively larger airways that make it difficult for a FB to be impacted in the trachea in older children and it usually seats in a more distal bronchus where it declares its presence by obvious physical and radiological signs, So we can depend on physical and radiological examination in diagnosis of FB inhalation only in old children, while in children younger than 3 years the presence of vague history suggestive of FB inhalation and chronic unexplained respiratory symptoms is worth a bronchoscope.

Our results are consistent with Midulla et al.[9] who stated that radiological findings could help in confirming the presence of a foreign body in the airways but negative findings did not exclude that.

We agree with Ayed et al.[6] about the small percentage of minor complications of bronchoscopy which were treated conservatively; 1.9% in their study and 2.3% in ours; they all occurred in children less than 3 years old and so bronchoscopy in younger children should be restricted to an experienced thoracic surgeon and anesthesiologist.

Duration of bronchoscopy was significantly prolonged in group I than group II especially in the presence of FB; this most probably was related to the smaller airways and narrow visual field in younger children.

Conclusion

Bronchoscopy should be done in all children younger than 3 years with chronic unexplained respiratory symptoms even in the absence of history, physical or radiological signs suggestive of FB inhalation, while these factors should be considered in older children.

Recommendations

Similarity between symptoms of aspirated FB and those of common problems as asthma and upper respiratory tract infection makes diagnosis of FB aspiration too late in children with vague history. We need more education for parents and physicians to prevent this serious problem and to increase the index of suspicion and to encourage early bronchoscopic intervention.

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Revision of 480 Cases of Trauma Among Different Age Groups In Khamees Area

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Aim of the work: **assessment of the presentation and mechanisms of chest injuries sustained in different age groups, and their impact on management options.**

Patients and Methods: **We retrospectively reviewed the records of480 patients with blunt chest trauma who were treated between December 2012 and June 2014 they were stratified into 4 age groups:**

≤ 20 years old, 21 : 40 years old , 41 : 60 years old and ≥60 years old . Clinical data, mechanism of injury, associated injuries, treatment strategies, and morbidity and mortality were analyzed.

Results: **The majority of patients were male (78.4%) and the largest age group was 21: 40 years old (39.3 %). Motor vehicle accidents accounted for 95% of cases. Combined injuries (79.5%) were more common than isolated chest injuries (20.5 %). Combined injuries involved bone fractures (39.5%), head injury (10.3%), and abdominal trauma (19.7%). Most blunt chest injuries were treated conservatively (90%). exploratory thoracotomy or VATS were required in 8.3% for clotted hemothorax, empyema, and massive air leak and massive hemothorax.**

Mortality was 5.1% (25 patients), predominantly in the adult group (55.3%).

Conclusion: **recognition and treatment require high index of suspicion. The majority of chest injuries can be managed by simple tube thoracostomy. Combined injuries are major causes of morbidity and mortality. As the majority of such injuries are related to motor vehicle accidents, preventative strategies should be enforced.**

Keywords: **accidents, traffic, age groups, multiple trauma, thoracic injuries, wounds, non-penetrating.**

Trauma is one of the most sudden, dramatic, and often irreversible medical conditions, and it is associated with significant morbidity and mortality.[1] Chest injury alone is responsible for 25% of trauma-related deaths and is a contributing factor in another 25%.[1] Approximately 80% of blunt chest trauma cases are due to road traffic accidents. Data on the pattern of such injuries based on different age groups are limited[2] Furthermore, the strategies for dealing with these patients in comparison with multi trauma patients need to be optimized in local area with a high incidence of R.T.A. exposure. We examined our experience of isolated chest trauma versus multiple trauma and associated morbidity and mortality to add to our understanding of the pattern of presentation and management strategies.

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Patients and Methods

This study was approved by our institutional review board. A retrospective review was carried out on all patients who were admitted to our center, Khamees Mushayt general hospital – Abha suffering from isolated blunt chest or combined multiorgan injuries secondary to trauma between December 2012 and June 2014. During this period 480 patients were admitted due to general trauma, of which 100 patients (21 %) had isolated blunt chest trauma. 380 patients (79 %) suffered multiorgan injuries (polytrauma). All

the cases were evaluated with regard to age, sex, mechanism of injury, associated injuries, management strategy, and short-term outcome. Patients were included in the study if they had sustained blunt chest injury either in isolation or in combination with other system injuries. The patients were classified into 4 age groups according to age, Group 1 < 20 years old (130 patients 27.1 %). Group 2 from 21: 40 years old (196 patients 40.8%) .Group 3 from 41: 60 years old (82 patients 17.1%). Group 4 > 60 years old (72 patients 15%).

All patients presented initially to our emergency department. After an initial assessment with basic Clinical, Radiological (chest x-ray, computed scan, ultra sound) and, Laboratory fixed bases. Combined injuries include head injuries 53 patients (11%). Abdominal injuries 91 patients (19%). Orthopedic injuries 187 patients (39%) and variant combined 149 patients (31%).

Variables were compared between the 4 groups using appropriate bivariate statistical methods. Categorical variables between the groups were compared using the chi-squared test. Statistical analysis was performed using SPSS version 17 (SPSS, Inc., Chicago, IL, USA).

Results

Of the 480 patients reviewed, 376 (78.4%) were male and 104 (21.6%) were female. Ages ranged from 9 months to 88 years, with a mean age of 34.6 years. The main cause of blunt trauma was a motor vehicle accident which occurred in 456 (95 %) cases (Table 1). Intensive care unit admission was required for 135 (28.1 %) patients; isolated chest injuries were less common than combined injuries (20.5 % vs. 79.5%). The pattern of isolated chest injuries among the (4) age groups is shown in (Table 2). Combined injuries involved bone fractures 187 patients (39 %), head injuries in 53 patients (11%), and abdominal trauma 91 patients (19%) ,The additional injuries combined with chest trauma in each age group are summarized in (Table 3). In elderly patients (> 60 years old), the majority of isolated chest injuries (91%) were rib fractures with associated pneumothorax, hemothorax, or both, which were managed by simple tube thoracostomy; Only (9%) of elderly patients sustained rib fractures with no associated hemothorax or pneumothorax. But in the remaining 91% it was more serious as it showed variable grades of lung contusion that necessitated critical care unit admission with ventillatory support. In the second group, (96.4%) of isolated chest injuries were rib fractures that did not require more than chest tube insertion due to associated pneumothorax or hemothorax or hemopneumothorax. Exploratory thoracotomy or VATS were required in 13 cases only (2.7%). Seven of them due to clotted hemothorax,. The highest mortality rate was seen in the second age group. The overall hospital mortality was in patient (5.1%). Fourth group showed less mortality 1.5% as exposures were less. Most of the mortalities related to second age group were 3% of the total.

Mechanism of Injury	No. of Patients
Motor vehicle accident	456 (95 %)
Passenger	338
Pedestrian	112
Motorcyclist	5
Fall from a height	7
Direct blow to chest	18

Table 1. Mechanism of blunt injuries in 480 patients

Isolated chest Injury	< 20 years	21-40 years	41-60 years	>60 years
No. of patients	17(17%)	39(39%)	36(36%)	8(8%)
• Rib fractures	7 (41%)	20 (51.3%)	8 (22.2%)	4(50%)
• Fractures with hemo/ pneumothorax/ hemopneumothorax need ICT insertion	5 (29.4%)	9 (23%)	17 (47.2%)	2(25%)
• Parenchymal lung injury	2 (11.8%)	3 (7.7%)	3(8.3%)	1(12.5%)
• Lung contusion	3 (17.6%)	7 (18%)	8 (22%)	1(12.5%)

Table 2. Isolated chest injuries stratified by age

	Group 1	*Group 2*	*Group 3*	*Group 4*
No. of patients	53 (14%)	91 (24%)	187 (49%)	149(39.2%)
Bone fractures	18 (34%)	32 (35.2%)	70 (37.4%)	71(61.2%)
Abdominal injury	6 (10.2%)	19 (20.9%)	72 (38.5%)	32(27.6%)
Head injury	5 (9.4%)	12 (13.2%)	20 (10.7%)	8(6.9%)
Combined	24(45.3%)	28(30.8%)	25(15%)	5(4.3%)

Table 3. Additional injuries in each age group

Discussion

Blunt chest **injuries** are usually caused by motor vehicle accidents. The relationship between age and the incidence of blunt injuries related to motor vehicle accidents has been reported previously.[2–4] However, data on the pattern of presentation and management strategies among different age groups sustaining blunt injuries are rather limited[6] In this study, we sought to identify the pattern of isolated chest injuries versus combined injuries sustained in blunt trauma in different age groups. This should ultimately help in directing resources to both treatment and preventative strategies, leading to a more cost effective and optimal approach with satisfactory outcome.

As shown in our study, the middle age group (21-40 years) had the highest incidence of blunt injuries, and consequently sustained the highest morbidity and mortality. It seems logical that strict regulations should be in place, concentrating on this high-risk group. Approximately more than half of the patients in this group required tube thoracostomy, whereas the others required only conservative management.This were also observedby others.[5,6] However, in those who sustained combined injuries, extremity fractures were more prevalent than abdominal or head injuries as obtained by Sirmali and his colleagues[10]. Specific to chest injury, minimizing pulmonary complications by maintenance of pulmonary and tracheal hygiene, effective eradication of pleural fluid, blood, and air, together with more readily used analgesia in the form of epidural infusions, should ultimately lower the associated mortality and morbidity as reported by [7,8] . As observed in our study. If conservative management is not sufficient and intrathoracic organ injuries are detected, an early or late thoracotomy(according to standard indications) or VATS should be performed or tube thoracostomy . Rib fractures usually heal rapidly if complications are handled properly, but associated pain can prevent proper respiration and coughing, leading to atelectasisdue to retained secretions with pneumonia, especially in the elderly as concluded by[7]. The simple effective methods of epidural infusion, adequate pain relief, and chest physiotherapy with the use of bronchoscope for suction is of great importance in decreasing the complications associated with chest injuries. These roles should be applied as well in patients with combined injuries as adequate fast ultimate diagnosis of the injured systems and success to save the victim depends on correct diagnosis and link between injured system to apply priorities of management .In our practice, chest physiotherapy is employed routinely from first day in all cases of chest injury either isolated or associated with other systems. Bronchoscopic suctioning of secretions was required in 34 of patients (7%) of all cases, of which 27 (56.3%) were in second group, 13 (38.3%) in the third group, and 2 (5.9%) in first group. Epidural infusion for pain relief was used in 28 (5.8%) cases, of which 16 (57.1%) were in the second group and 11 (39.3%) in the third group and in one patient only in first group. In our study the indication for epidural pain relief is intractable pain that is not controlled by calculated doses of oral or intravenous analgesia as recorded in [12]. In our series, the elderly (>55 years old) sustained the highest incidence of isolated chest injuries or combined with orthopedic injuries compared to other age groups. However, most of these isolated injuries were ribs fractures with unilateral pneumothorax or hemothorax, as reported by, [12]. The high incidence of rib fractures either isolated or in combination with skeletal injuries in the third group was attributed to their higher incidence of osteoporotic changes, leading to a more serious outcome of blunt injuries, and consequently high mortality.[9] On the other hand, the second group was the only group to suffer bilateral rib fractures with bilateral hemothoraces or pneumothoraces in association with abdominal and\ or head injuries. This reflects more high-speed trauma sustained in this group compared to the elderly and younger groups. Furthermore, the incidence of lung contusions and parenchymal lung injury were highest in the third group, as interstitial lung diseases are predominant. The rate of mortality in our series was low overall (5.1%), and predominantly in second group. Our findings highlight the severity of chest injuries among the second and third groups. Predisposing factors for rib fractures and associated thoracic injuries or with other organs injuries vary according to age group, [10-12] as in our study; the higher prevalence of osteoporosis in the elderly predisposes them to rib and bony fractures as a result of even trivial trauma than any other age group. In second group, the incidence of fractures and abdominal injuries was related to the high energy transfer sustained in high-speed motor vehicle accidents.[10-11-12] These factors ultimately dictated the mortality observed in our study population.

Conclusion

Timing of diagnosis is crucial. Preventative strategies should also go hand-in-hand with faster diagnosis and more aggressive management of those in this high-risk category. Chest radiography must be performed on initial presentation. Recognition and treatment depends heavily on a high index of suspicion combined with the appropriate diagnostic tests and a multidisciplinary approach. The majority of blunt injuries can be managed successfully by simple tube thoracostomy prior or with surgical exploration, if required. Successful management of major chest injuries requires a prompt diagnosis and collaboration between surgeons, anesthetists, intensive care unit teams, radiologists, and physiotherapists. These multidisciplinary approaches lead to our low overall mortality. We recommend that such an approach be employed in any center dealing with chest injuries, either on bases of isolated or combined injured victims.

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Early Outcome of Surgical Resection for Bronchiectasis in Children

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Objective: **To evaluate the early outcome of surgical treatment of bronchiectasis in children.**

Patients and Methods: **The study included 30 children patients, aged between 3-12years, who underwent surgical resections for bronchiectasis. Preoperative evaluation included clinical history, physical examination, routine blood tests, chest X-ray and chest high resolution computed tomography (HRCT). Posterolateral muscle sparing thoracotomy was performed in all patients. Complete resection was defined as the anatomical resection of all affected segments. All specimens had pathologic confirmation of bronchiectasis. The outcome of surgery was evaluated for one year of follow-up, at three, sex and twelve months.**

Results: **There were 18(60%) males and 12(40%) females' patients with mean age of 8.2±4.5 years at presentation. The most common symptom was chronic productive cough in 22 (73.3%). Post-infectious bronchiectasis was the most common etiology in 17(56.7%). The types of resections were lobectomy in 23(76.7%), lobectomy with segmentectomy in 5(16.7%), and segmentectomy in 2(6.7%). Twenty six patients (86.7%) had complete resection. There was no mortality. The postoperative complications included: atelectasis in 2(6.7%), prolonged air leak (> 10 day) in 1(3.3%), empyema in 1(3.3%), and pneumonia in 1(3.3%). After surgery, 19(63.3%) patients were asymptomatic, 8(26.7%) had improved, and 3(10%) showed no improvement.**

Conclusion: **Most of the children with bronchiectasis get benefit from surgery, especially when total excision is accomplished.**

Keywords: **- Bronchiectasis, lung resection, children**

Thoracic

Bronchiectasis is permanently dilated airways caused by chronic bronchial inflammation secondary to inappropriate clearance of various micro-organisms and recurrent infections in the airways [1]. It remains an important cause of chronic suppurative lung disease in the developing world [2].

Though there is a gradual decrease in the prevalence of bronchiectasis, it is still a cause of mortality and morbidity among children in developing countries [3]. Early diagnosis and appropriate treatment of bronchiectasis are effective in order to prevent lung abscess, empyema and, bronchopleural fistula, hemoptysis or cor pulmonale [4].

The treatment of bronchiectasis is multimodality, and includes therapy with antibiotics, anti-inflammatory agents, and airway clearance. Nowadays, resection and lung transplantation are rarely required due to advanced of antibiotics [5]. Surgical treatment of bronchiectasis in children is reserved for saccular or fusiform bronchiectasis with relevant symptoms such as growth retardation, bronchorrhea intense, recurrent infections, or severe or recurrent hemoptysis [6].

Surgical treatment of childhood bronchiectasis has not been discussed extensively because of decline in prevalence and experience with this disease. It is controversial as to indications of surgical resection of bronchiectasis in children, benefit from surgery

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and technical considerations that may affect the outcome. Therefore, this study aimed to evaluate the outcome of surgical treatment of bronchiectasis in children.

PATIENTS AND METHODS

Patients

The study included 30 children patients, aged between 3-12 years, who underwent surgical resections for bronchiectasis, between January 2011 to December 2013, at Cairo University and Al- Minia University Hospitals. Patients were chosen as candidates for surgical treatment according to the following criteria: localized bronchiectasis documented by high resolution computed tomography (HRCT), symptoms such as chronic productive cough, repeated or significant hemoptysis, lung abscess, empyema, and unresolved pulmonary infections, and failure of medical treatment. Medical therapy constituted use of systemic antibiotics based on culture and sensitivity of sputum, mucolytic agents, expectorants, postural drainage, humidification, anti-inflammatory agents, and bronchodilators.

In all the patients, preoperative evaluation included clinical history, physical examination, routine blood tests, chest X-ray and chest HRCT.

All patients received intensive chest physiotherapy during the preoperative period. Patients were given antibiotics on the basis of the sputum and/or bronchial aspirate culture. For patients reporting sputum production, chest physiotherapy and expectorant and preoperative antimicrobial therapy were continued until the daily volume of sputum decreased to a minimum. Prophylactic antibiotics were given for 48 hours before the operation in patients with negative culture.

Operative Technique

Operations were carried out under general anesthesia. Rigid bronchoscopy was performed for aspiration and clearance of bronchus and exclusion of foreign body obstruction. Endotracheal tube was inserted. Posterolateral muscle sparing thoracotomy was performed at the 5th intercostal space with patients at the lateral decubitus position. The type of resection was chosen according to the involved zone for pulmonary parenchymal preservation. Complete resection was defined as the anatomical resection of all affected segments. Lobectomy was performed if the disease was limited to one lobe. Excessive bronchial dissection was avoided, and peribronchial tissues were preserved. The bronchial stump was manually sutured with non-absorbable materials with enforcement pleural or intercostal muscle flap. The ligation of large vessels was supported by 4/0 proline suture material. Bronchi were closed up using 2/0 non-absorbable sutures. In other patients, stapler was used and BioGlue on resected sites. All specimens had pathologic confirmation of bronchiectasis.

Postoperative Care and Follow-up

The majority of patients were extubated in the operation room. All patients were followed up for at least 12 hours in intensive care unit (ICU). The thoracic drains was removed after cessation drainage, and no air leakage (3-5days).

Postoperative complications were monitored for 30 days. Operative mortality was defined as a patient's death within 30 days postoperative. The outcome of surgery was evaluated for one year of follow-up, at three, sex and twelve months according to the following criteria: asymptomatic (complete absence of preoperative symptoms that led to surgery), improved (marked reduction in preoperative symptoms but needing antibiotic therapy occasionally), no change (no reduction in preoperative symptoms, and no decrease in hospital admissions or medical therapy requirements), and worse (frequent exacerbations of disease requiring hospitalization).

Statistical analysis

All data were collected and tabulated using Microsoft Excel sheet. The descriptive statistical analysis was done using the SPSS statistical pocket program (version 15). The categorical data were expressed as number and percent while the continuous parameters were expressed as number and standard deviation (SD).

RESULTS

Mean age of the patients was 8.2±4.5 years at presentation. Eighteen (60%) were males, 12(40%) were females. There is a period of 6±4.1 years between the start of symptoms and the diagnosis of bronchiectasis. Main symptoms were chronic productive cough in 22(73.3%), recurrent chest infection in 14(46.7%), wheezing in 6(20%), and hemoptysis in 2(6.7%). Post-infectious bronchiectasis was the most common etiology in 18(60%). bronchiectasis was idiopathic in 8 patients (26.7%).

Preoperative evaluation showed that left lower lobes were commonly involved in 22 patients (73.3%), followed by right lower lobes in 6 patients (20%), and right upper lobe in 2 patients (6.7%).

The mean operative time was 105.2±33.4 min and postoperative hospital stay was 10±4.2 days. The types of resections were lobectomy in 23(76.7%), lobectomy with segmentectomy in 5(16.7%), and segmentectomy in 2(6.7%). Twenty six patients (86.7%) had complete resection, and 4 patients (13.3%) had incomplete resection.

The postoperative pathological results showed bronchiectasis in all patients. There was no mortality. Postoperative complications occurred in 5 patients and thus the morbidity rate was 16.7%. These complications were observed in 2(6.7%) of 26 patients who underwent complete resection and in 3(75%) of 4 patients who underwent incomplete resection.

The postoperative complications included: atelectasis in 2(6.7%), prolonged air leak (> 10 day) in 1(3.3%), empyema in 1(3.3%), and pneumonia in 1(3.3%). After surgery, 19(63.3%) patients were asymptomatic, 8(26.7%) had improved, and 3(10%) showed no improvement.

Variables	Children with Bronchiectasis (n=30)
Age (years)	8.2±4.5
Sex:	
Male	18(60%)
Female	12(40%)
Symptoms:	
Chronic productive cough	22(73.3%)
Recurrent chest infection	14(46.7%)
Wheezing	6(20%)
Hemoptysis	2(6.7%)
Etiology:	
Post-infectious	18(60%)
Idiopathic	8(26.7%)
Pulmonary sequestration	2(6.7%)
Obstruction due to foreign body	2(6.7%)
Affected side:	
Left lower lobes	22(73.3%)
Right lower lobes	6(20%)
Right upper lobes	2(6.7%)

Table (1): Demographic and clinical characteristics of the studied patients.

Variables	Children with Bronchiectasis (n=30)
Mean operative time (min.)	105.2±33.4
Intercostal chest tube (days)	5±2
Postoperative hospital stay (days)	10±4.2
Types of resection:	
Lobectomy	23(76.7%)
Lobectomy with segmentectomy	5(16.7%)
Segmentectomy	2(6.7%)
Complete resection	26(86.7%)
Incomplete resection	4(13.3%)

Table (2): Operative results of the studied patients

Variables	Children with Bronchiectasis (n=30)
Postoperative complications:	
Atelectasis	2(6.7%)
Prolonged air leak	1(3.3%)
Empyema	1(3.3%)
Pneumonia	1(3.3%)
Postoperative symptoms:	
Asymptomatic	19(63.3%)
Improved	8(26.7%)
No change	3(10%)

Table (3): Postoperative outcome of the studied patients.

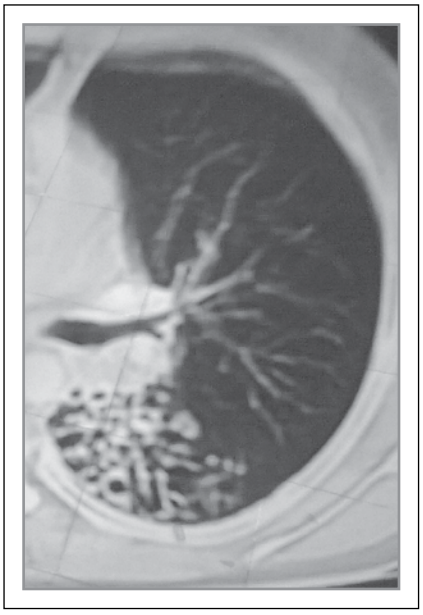

Fig 1. Chest CT revealed bronchoectasis in left lower lobe

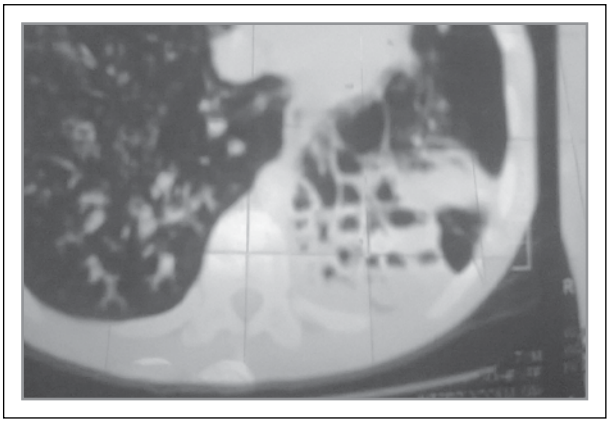

Fig 2. Chest CT revealed honeycomb appearance of left lower lobe bronchoectasis.

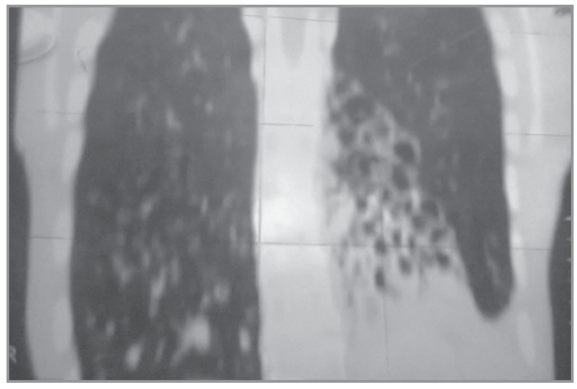

Fig 3. Chest CT revealed bronchoectasis in left lower.

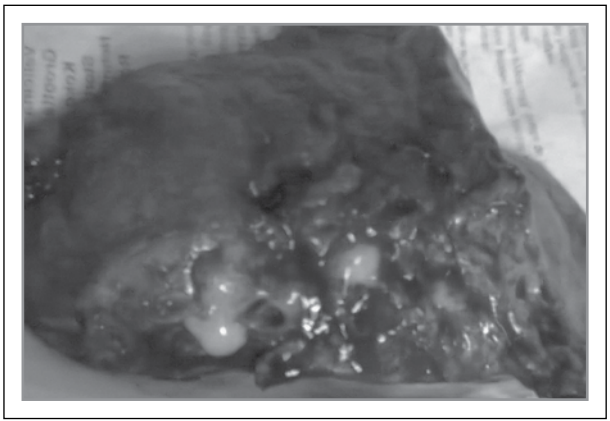

Fig 4. Specimen of lobectomy revealed pus discharged from dilated bronchioles.

DISCUSSION

Bronchiectasis is an uncommon disease, most often secondary to an infectious process that results in the abnormal and permanent distortion of one or more of the conducting bronchi or airways, with a reduction in clearance of secretions and in the expiratory airflow [7]. First described by Laennec in 1819, later detailed by Sir William Osler in the late 1800s, and further defined by Reid in the 1950s, bronchiectasis has undergone significant changes in regard to its prevalence, etiology, presentation, and treatment [8].

In the present study, the main symptoms were chronic productive cough in 22(73.3%),{ recurrent chest infection in 14(46.7%), wheezing in 6(20%), and hemoptysis in 2(6.7%)}. Similarly, other studies in the literature show that cough and sputum production were the most common symptoms [9, 10]. Wheezing is reported to be the main symptom in 20% of children with Bronchiectasis [11]. Six patients (20%) in the present study had recurrent wheezing as a main symptom. Hemoptysis is a frequent symptom in adult patients with bronchiectasis, whereas it is a relatively uncommon in pediatric patients [12]. In the present study, hemoptysis was noted in only 4 patients (6.7%).

Early surgical intervention on bronchiectasis presented in children was recommended to avoid retarded growth in spite of presentation when evident bronchiectasis in HRCT.

In the present study, bronchiectasis lesions were identified most commonly in the left lower lobe, followed by the right lower lobe and right upper lobe. Bronchiectatic lesions are most commonly found in the lower lobes, probably because mucociliary clearance is facilitated by gravity in the upper lobes [11, 12]. Bronchiectasis presented in early childhood due to repeated non-treated pneumonia, congenital or foreign body inhalation. So, we recommend better and early treatment of pneumonia, bronchoscopic examination of unrelieved pneumonia to exclude foreign body aspiration (FB), and chest computerized tomography (CT) if chest X-ray was inconclusive.

In the present study, post-infectious bronchiectasis was the most common etiology in 18(60%). Infection and inflammation are important in the pathogenesis of bronchiectasis [13]. Recurrent pneumonia is the major preceding factor leading to bronchial damage [14]. Some authors showed that pre-existing pneumonia is the most common cause of non-cystic fibrosis bronchiectasis [15]. In the present study, etiologies in 8 patients (26.7%) could not be detected. Previous studies have reported that an underlying cause for bronchiectasis can be determined in about 70% of patients, with the remainder 30% being labeled as idiopathic [16].

The present study evaluated outcome after surgical resections in children with bronchiectasis. Surgical options for bronchiectasis are limited because many patients have generalized disease. Lobectomy may be curative for a small number of patients in whom disease is limited to a single lobe and difficult to control by medical treatment alone [17].

The goals of surgical therapy are to improve the quality of life for those patients in whom medical treatment has failed and to resolve complications such as empyema, severe or recurrent hemoptysis, and lung abscess [18]. Complete and anatomical resection should be done with preservation of as much lung function as possible to avoid cardio-respiratory limitation [19]. It was reported that the symptoms persisted when incomplete resection was carried out [20]. In the present study, complete resection in 86.7% of our patients, and after surgery, 19(63.3%) patients were asymptomatic, and 8(26.7%) had improved postoperative course (90% benefited from the operation). In the light of these findings, it could be suggested that complete resection should be performed for the surgical treatment of bronchiectasis. Incomplete resection should only be used for more affected side and other side later on, when surgical appearance of lung less than appear in HRCT, and palliative treatment of certain life-threatening symptoms.

In the study by Sirmali et al., [3] there were 93.7% of cases had complete resection, and the outcome, based on the responses of patients postoperatively, was perfect in 73.3%, and improved in 23.3% (96.6% benefited from surgery). In the study by Otgun et al., [21] there were 76% of cases had complete resection and 85% benefited from surgery. In the study by Haciibrahimoglu et al., [22] 64.7% were asymptomatic after surgery and clinical improvement was noticed in 23.5% (88.8% benefited from surgery), and the complete resection resulted in a significantly better clinical outcome than incomplete resection.

Complete resection of bronchiectatic parenchyma while saving as much normal lung parenchyma as possible is the mainstay of surgical treatment. This aim can be achieved by lobectomy in most patients (76.7%), but other resection types, such as wedge or segmental resection, can also be used in less affected areas. In the study by Otgun et al., [21] the types of resections in 54 children who underwent surgery for bronchiectasis were lobectomy (63%), pneumonectomy (18.5%), lobectomy with segmentectomy (11.1%), segmentectomy (3.7%), and bilobectomy (3.7%).

In the present study postoperative complications occurred in 5 patients and thus the morbidity rate was 16.7%. Near similar results are reported in recent studies. Otgun et al., [21] reported that intra-operative and postoperative complications were encountered in 4 (7.4%) and 4 patients (7.4%), respectively. In the study by Haciibrahimoglu et al., [22] the morbidity rate was 17.6%.

Post-operative air leak was present only in one patient whose bronchial stump closed manually due to previous empyema. No difference between manual with enforcement and stapler with BioGlue in incidence of air leak but difference in time and cost. Post-operative atelectasis was treated by more physiotherapy, pneumonia was treated by antibiotic, empyema was treated by antibiotic and prolonged chest tube, and prolonged post-operative air leak was treated by early revision of stump closure by intercostal muscle flap.

In the present study, postoperative complications were observed in 2(6.7%) of 26 patients who underwent complete resection and in 3(75%) of 4 patients who underwent incomplete resection. When suggestive lung regions are not excised, with the aim of sparing as much lung tissue as possible, more postoperative complications occur and a second operation that carries a higher morbidity and mortality might be required to remove the residual diseased tissues [3]. Therefore, if affected areas that could be determined by HRCT were not appearing intra-operative, these parenchymal areas should be resected to perform complete resection. Incomplete resection and rapidly progressive bronchiectasis on non operated side were the main cause of no improvement.

In conclusion, pulmonary resection for bronchiectasis in children can be done by general thoracic surgeon with low mortality and morbidity, once confirmed with HRCT and failed short term medical treatment. The involved bronchiectatic sites should be resected completely for the optimum control of symptoms to avoid retarded growth.

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