Volume 23 **April - June 2015** **Number (2)**

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Journal of The Egyptian Society of Cardio-Thoracic Surgery

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

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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;

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General Information

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

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.

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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.

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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.

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

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Instructions:

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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 .

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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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- *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

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- *Corresponding author .*
- *Telephones, fax, and e-mail address*
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- *Ultramini-abstract (50 words; double-spaced) .*
- *Text (double-spaced).*
- *References (double-spaced; separate pages).*
- *Tables (double-spaced; separate pages).*
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- *Word count.*

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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

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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.

Is Penetrating Cardiac Injury Still a Big Challenge?

Cardiovascular

Dr. Ahmed M. Fathy Al-Ashkar

Dr. Gehad M. Mostafa Mahmoud

Dr. Ahmed M. Fakhry Abdelhamid

Background: **Despite the great improvement in trauma care, cardiac penetrating injuries continue to be a cause of significant mortality. Most penetrating injuries to the heart occur due to violence. Penetrating wounds from sharp objects have a better outcome than those injuries resulting from gunshot.**

Methods: **We study 2 groups of patients, underwent emergency thoracotomy due to isolated penetrating chest trauma, through the year 2012 and 2013 in *Kasr Al-Ainy* Hospital. Group A: includes 14 patients with cardiac or great vessels injury. Group B includes 40 patients with chest wall, diaphragm or lung injury.**

Results: **In Group A the mean age of patients was 23.5 ± 4.94 years. There were 13 males and one female. In Group B the mean age of patients was 26.43±7.2 years. There were 39 males and one female. We found that Group A patients had significantly more medial to MCL injury, more mean arterial BP < 70 mmHg on admission, less time to admission to the operating room, more need for blood transfusion, and more output from the chest tube. All these factors explain the more mortality in Group A patients (64%), while the mortality in Group B patients was (10%).**

Conclusion: **One of the great challenges for surgeons is penetrating injuries to the heart, which can be improved markedly through quick and appropriate intervention if they reach hospital alive. Cardiopulmonary machine must be available in the operating room as it has an important role in management of the penetrating cardiac injuries.**

Key words: **Penetrating cardiac injury – Heart trauma – Penetrating trauma – Emergency thoracotomy**

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Codex : o3/01/1504

Despite the great improvement in trauma care, cardiac penetrating injuries continue to be a cause of significant mortality. Most penetrating injuries to the heart occur due to violence. Penetrating wounds from sharp objects have a better outcome than those injuries resulting from gunshot. All injuries in the quadrangle outlined by the umbilicus, the suprasternal notch, and the two nipples carry the risk of cardiac injury. Urgent exploration should be performed in any unstable patient. In the stable patient, cardiac injury can be ruled out by echocardiogram. [1, 2]

Most cases of penetrating trauma to the heart die from complications such as cardiac tamponade, coronary artery laceration, exsanguination, disruption of conduction pathways, valvular disturbances or other associated fetal injuries such as mediastinal vascular injury. Twenty percent of penetrating injuries to the heart reach the hospital with signs of life, and the survival rate for those with recordable vital signs around 40–70%. [3]

The most commonly injured chamber due to penetrating trauma is the right ventricle, as it represents the majority of the anterior surface of the heart, whereas the left atrium is the least frequently injured, being small entirely posterior. [4]

Material and Methods

Over 2012 and 2013, there was 693 patients came to Kasr Al-Ainy University Hospital with isolated penetrating chest injury. Chest tube was inserted in 602 patients to treat hemothorax or pneumothorax, while 91 patients were admitted under observation for 24 hours without any intervention. Emergency thoracotomy was done for 54 patients. Those patients were divided into two groups:

Group A: includes 14 patients with cardiac or great vessels injury.

Group B includes 40 patients with chest wall, diaphragm or lung injury.

The patients of the two groups had isolated penetrating chest trauma and underwent emergency thoracotomy within 24 hours from their injury. We exclude all patients with blunt chest trauma from our study, as those patients usually had multisystem trauma which may affect our results.

On arrival to hospital emergency department all patients were resuscitated and evaluated according to Advanced Trauma Life Support protocol. Emergency chest tube was inserted in all patients except severely unstable patients as they were taken directly to the operating room (OR). The chest drain served a very important role in monitoring of any bleeding. The indications for emergency thoracotomy were initially draining more than 1500 ml, or bleeding of more than 250 ml per hour at a continued rate for three consecutive hours.

During the time of the study, in our hospital, the distance between the resuscitation room and the OR was less than 20 m. There was no delay in patient transfer to the OR especially unstable patients. Patients were operated either using antrolateral, posterolateral or median sternotomy according to the stability of the patient and the site of the injury.

Results

Group A, included 14 patients with cardiac or great vessels injury. We found that the age of patients in this group ranged between 18 – 36 years with a mean of 23.5 ± 4.94 years. There were 13 males (93%) and one female (7%). The mechanism of trauma was stab injury in 13 patients (93%) and gunshot in one patient (7%). The site of trauma was in the left side in 11 patients (78.6%), right side in 3 patients (21.4%), medial to the midclavicular line (MCL) in 13 patients (93%) and lateral to the MCL in 1 patient (7%).

The time elapsed to admission to the operating room in group A patients was ranging from 15 - 120 minutes with an average time 27.86 ± 27.51 minutes. The average mean arterial blood pressure on admission was 59.93 ± 10.17 mmHg ranging from 46 – 83 mmHg. The mean arterial blood pressure was < 70 mmHg in 11 patients (78.6%) and > 70 mmHg in 3 patients (21.4%). Hemoglobin level on admission was 7.64 ± 2.9 g/dl ranging from 5 – 14 g/dl. It was < 9g/dl in 10 patients (71.4%) and ≥ 9g/dl in 4 patients (28.6%). The need for blood transfusion was 3.57 ± 1.87 units ranging from 0-6 units.

Indication for emergency thoracotomy in group A patients was hemodynamic instability in 5 patients (35.7%), cardiac tamponade in 3 patients (21.4%) and initial chest tube output > 1500cc in 6 patients (42.9%). The average total output from the chest tube before operation was 2514.3 ± 773.37 ml ranging from 1100 to 3400 ml. Surgical approach was anterolateral thoracotomy in 6 patients (42.9%) and median sternotomy in 8 patients (57.1%).

The right ventricle was the most commonly involved cardiac chamber in 10 patients (71.4%), left ventricle in 2 patients (14.3%), right atrium in 2 patients (14.3%) and left anterior descending coronary artery in one patient (7.1%), pulmonary artery in one patient (7.1%).

Three patients of group A died intra-operatively, the average time of stay at the ICU was 52.45 ± 63.95 hours, ranging from 12 – 240 hours. The average time of stay on the ventilator was 34.36 ± 69.56 hours ranging from 3-240 hours. Postoperative re-exploration was needed in 2 patients. The average total hospital stay was 5.11 ± 3.22 days. The overall mortality was 9 patients (64.3%).

Group B include 40 patients with chest wall, diaphragm or lung injury. We found that the age of patients in this group ranged between 17 – 44 years with a mean of 26.43 ± 7.2 years. There were 39 males (97.5%) and one female (2.5%). The mechanism of trauma was stab injury in 34 patients (85%) and gunshot in 6 patient (15%). The site of trauma was in the left side in 22 patients (55%), right side in 18 patients (45%), medial to the MCL in 5 patients (12.5%), lateral to the MCL in 28 patient (70%) and back in 7 patients (17.5%).

The time elapsed to admission to the operating room in group B patients was ranging from 15 - 120 minutes with an average time 47.25 ± 35.72 minutes. The average mean arterial blood pressure on admission was 76.90 ± 13.36 mmHg ranging from 50 – 106 mmHg. The mean arterial blood pressure was < 70 mmHg in 10 patients (25%) and > 70 mmHg in 30 patients (75%). Hemoglobin level on admission was 8.76 ± 2.15 g/dl ranging from 4 – 14 g/dl. It was < 9g/dl in 18 patients (45%) and ≥ 9g/dl in 22 patients (55%). The need for blood transfusion was 2.33 ± 1.12 units ranging from 0 - 5 units.

Indication for emergency thoracotomy in group B patients was hemodynamic instability in 3 patients (7.5%), initial chest tube output > 1500cc in 24 patients (60%) and ongoing chest tube output in 13 patients (32.5%). The average total output from the chest tube before operation was 1931.3 ± 453.88 ml ranging from 1500 to 3500 ml. Surgical approach was anterolateral thoracotomy in 3 patients (7.5%), posterolateral thoracotomy in 33 patients (82.5%) and median sternotomy in 4 patients (10%).

The thoracic injuries identified at operations were chest wall and intercostals arteries injury in 17 patients (42.5%), lung injuries in 35 patients (87.5%), internal thoracic artery injuries in 4 patients (10%) and diaphragmatic injury in 5 patients (12.5%).

Two patients of group B died intra-operatively, the average time of stay at the ICU was 44.47 ± 50.16 hours, ranging from 2 – 240 hours. The average time of stay on the ventilator was 8.71 ± 8.14 hours ranging from 2-24 hours. Post-operative re-exploration was needed in 2 patients. The average total hospital stay was 6.05 ± 2.61 days. The overall mortality 4 patients (64.3%).

By comparison between group A & group B patients **(Table 01)**, we found that group A patients had significantly more medial to MCL injury, mean arterial BP < 70 mmHg on admission and more mortality. While there was no statistically significant difference as regarding left side chest injury and hemoglobin (Hb) < 9g/dl on admission.

Also, we found that group A patients had less time to admission to the operating room, lower mean arterial BP on admission, more need for blood transfusion, and more output from the chest tube. While, there was no significant difference between the patients as regard the age, hemoglobin level on admission, need for ICU stay, need for mechanical ventilator and total hospital stay **(Table 02)**.

	Group A		Group B		Chi square	
	No.	%	No.	%	X^2	P
Lt side chest injury	11	79%	22	55%	2.42	**0.12**
Medial to MCL injury	13	93%	5	12%	30.17	**0.001**
Mean arterial BP on admission (< 70 mmHg)	11	79%	10	25%	12.52	**0.002**
Hb on admission (< 9g/dl)	10	71%	18	45%	2.9	**0.09**
Mortality	9	64%	4	10%	F	**0.001**

F: Fissure test.

Table (1): Comparison between Group A & Group B patients:

		Mean	SD	T test	
				T value	P value
Age	Group A	23.50	4.94	1.4	0.17
	Group B	26.43	7,20		
Time to admission to the operating room	Group A	27.86	27.51	2.1	0.045
	Group B	47.25	35.72		
Mean arterial BP on admission (mmHg)	Group A	59.93	10.17	4.3	0.000
	Group B	76.90	13.36		
Hemoglobin level on admission (g/dl)	Group A	7.64	2.90	1.5	0.13
	Group B	8.76	2.15		
Blood transfusion (units)	Group A	3.57	1.87	2.4	0.031
	Group B	2.33	1.12		
Output from the chest tube (mL)	Group A	2514.3	773.37	2.8	0.008
	Group B	1931.3	453.88		
Need for ICU stay (hour)	Group A	52.45	63.95	0.43	0.67
	Group B	44.47	50.16		
Mechanical ventilator (hour)	Group A	34.36	69.56	1.2	0.25
	Group B	8.71	8.14		
Total hospital stay (days)	Group A	5.11	3.22	0.93	0.36
	Group B	6.05	2.61		

Table (2): Comparison between Group A & Group B patients:

Discussion

This study represents our experience in the management of 14 patients were found to have penetrating cardiac injuries after emergency thoracotomy during 2 years. We found that the age of patients in this group ranged between 18 – 36 years with a mean of 23.5 ± 4.94 years. There were 13 males (93%) and one female (7%).

These results are in agreement with many authors in literature as **Seamon et al. (2009)** who studied 283 patients with cardiac and great vessels injury between 2000 and 2007 at The Hospital of the University of Pennsylvania, Philadelphia, 272 patients were males (96.1%) while 11 patients were females (3.9%), the mean age was 27.1 ± 10.1 years. Also, **Refat et al. (2013)** who studied 115 patients presented by stabbed heart in Zagazig Emergency Hospital, Egypt, 109 patients were males (94.8%) while 6 patients were females (5.2%), the mean age was 28.5 ± 5.8 years. Also, **Mataraci et al. (2010)** who studied 20 cases with penetrating cardiac trauma between June 2005 and September 2008 at Kosuyolu Heart and Research Hospital, Turkey, 16 patients were males (80%) while 4 patients were females (20%), the mean age was 24.9 ± 10.1 years. [5, 6, 7]

The mechanism of penetrating cardiac injury was stab injury in 13 patients (93%) and gunshot in one patient (7%). It was due to violence assault in all cases. These results are similar to many studies like the study of **Kamali et al. (2011)** who studied 23 patients suffering penetrating cardiac injury evaluated between 1995 and 2009 at the Istanbul Okmeydani Training and Research Hospital, Turkey, 22 patients (95%) had stab wound and one patient (5%) with gunshot. Also, **Gao et al. (2004)** who studied 82 cases with penetrating wounds of the heart from January 1988 to December 2003 at Chongqing Emergency Medical Center, China, reported that 71 had been victims of stab wounds (86.6%) and 11 (13.4%) of gunshot injuries. And **Ngatchou et al. (2012)** had 13 patients (93%) with stab wounds and one patient (7%) with gunshot wounds. [8, 9, 10]

Our results differ from the studies reported from other communities like the study of **Asensio et al. (1998)** who studied 105 patients sustained penetrating cardiac injuries, at American College of Surgeons Level I urban trauma center, USA., 68 (65%) had gunshot injury and 37 (35%) had stab injury. Also, **Rodrigues et al. (2005)** who studied 70 victims of penetrating cardiac injuries, between January 1990 and January 2003, Ribeirao Preto medical emergencies centers, Sao Paulo, Brazil, reported 27 (38.6%) gunshot wounds and 43 (61.4%) stab wounds. And **Seamon et al. (2009)** reported 250 (88.3%) gunshot wounds and 33 (11.7%) stab wounds. [5, 11, 12]

Penetrating wounds caused by sharp objects have a better outcome than those resulting from gunshots. Bullets usually cause a fatal trauma and victims of gunshots usually fail to reach the hospital alive. Also, in our country; firearms are not freely accessible, except by special permit.

In a study reported from South Africa by **Clarke et al. (2011)** who studied 1186 patients over 3-year period, admitted to the surgical services in Pietermaritzburg with penetrating thoracic trauma. There were 1062 (90%) stab wounds (SW) and 124 (10%) gunshot wounds (GSW). About 108 (9%) patients required emergency operations. The mechanism of trauma in the operative group was gunshot wound in 4% of patients and stab wounds in 96% of patients. Over the same period 676 victims with penetrating thoracic injuries were taken to the mortuary. There were 135 (20%) thoracic gunshot wounds in the mortuary cohort. The overall mortality for penetrating thoracic injuries was 135 (52%) of 259 for gunshot wounds and 541 (33%) of 1603 for stab wounds of the chest. The increased severity of GSWs was confirmed by the observation that direct admission to the mortuary was twice in cases of GSW compared with SW. Gunshot wounds of the thorax remain more fetal than stab wounds. [13]

The site of trauma for penetrating cardiac injury patients was somewhat similar to the result of **Gao et al. (2004)** who had injuries in the right anterior chest in 9 patients (10.98%), left anterior chest in 55 (67.07%), through sternum 5 (6.10%), subxiphoid 11 (13.41%) and posterior chest 2 (2.44%). Also, **Degiannis et al. (2006)** reported that 46% of injuries were in the precordium. While in some studies like **Mataraci et al. (2010)**, the sites of injuries were on the right thoracic wall in 60% of patients and left thorax in 40% of patients. [7, 9, 14]

The time elapsed to admission to the operating room in patients with penetrating cardiac injury was similar to the study of **Gao et al. (2004)** who reported that the time taken to get the victim from the emergency department to the operating room was ranging from 15 - 180 minutes (average 24.6 minutes). [9]

The average mean arterial blood pressure on admission was somewhat similar to the results of **Rodrigues et al. (2005)** who reported that systolic blood pressure on admission was <90 mmHg in 64.3% of patients. Also, **Gao et al. (2004)** found that 47.6% of patients had systolic blood pressure < 80 mmHg on admission. **Gewely et al. (2010)** who studied 73 patients with cardiac stab wounds from August 1998 to July 2008 in Mansoura Emergency Hospital, Egypt, reported that 69.9% of patients were hemodynamically unstable on admission. [9, 12, 15]

Hemoglobin level on admission was 7.64 ± 2.9 g/dl. The need for blood transfusion was 3.57 ± 1.87 units ranging from 0-6 units. In **Gao et al. (2004)** study, the amount of blood transfused was 600 - 3,600 ml (average 1086.33 ml). [9]

Indication for emergency thoracotomy in patients with cardiac injury was concordant with many studies. In the study of **Ekim et al. (2010)** who studied 20 patients with penetrating heart injuries who operated between May 1999 and January 2010 at Yuzuncu Yil University Research Hospital, Turkey 80% of patients was hemodynamic unstable and cardiac tamponade was found in 80% of patients. Also, **Ezzine et al. (2012)** who studied 19 patients undergoing thoracotomy for penetrating cardiac injuries between the 1st of January 1994

and the 31st of December 2010 at Mohamed Thahar Maamouri Hospital, Nabeul, Tunisia, reported that 63% of patients was hemodynamic unstable and 21% of patients had cardiac tamponade. [1, 16]

The average total output from the chest tube before operation was 2514.3 ± 773.37 ml ranging from 1100 to 3400 ml. **Gao et al. (2004)** in his study reported that the amount of blood loss was 300–2,000 ml in the survivors (average 1,622.46 ml) and it was over 5,000 ml in 2 of 3 patients who died. [9]

Regarding the surgical approach that was used in patients with penetrating cardiac injuries, it was in agreement with many studies as **Aydin et al. (2011)** who studied 20 patients undergoing surgical intervention due to penetrating cardiac injury between 2001 and 2010, Medical Park Hospital, Istanbul, Turkey, there were 50% anterolateral thoracotomy and 50% sternotomy. Also, **Mataraci et al. (2010)** had 30% anterolateral thoracotomy and 70% sternotomy. Our results are different from other studies as **Kamali et al. (2011)**, all patients underwent left anterolateral thoracotomy initially. Also, **Gao et al. (2004)** had 97.6% anterolateral thoracotomy and 2.4% sternotomy. [7, 8, 9, 17]

The injured cardiac chambers in our study were similar to many studies like the study of **Aydin et al. (2011)** who had two patients (10%) presented with left ventricular injury, 12 patients (60%) with right ventricular injury, four (20%) patients with right atrium injuries and two (10%) patients with left atrium injuries. Also, **Gewely et al. (2010)** reported that the right ventricle was injured in 38.4% of patients, left ventricle in 34.2%, pulmonary artery in 5.5%, right atrium in 4.1%, left atrium in 11% and aorta in 6.8% of patients. In the study of **Ngatchou et al. (2012)** ten patients (71%) had right ventricle injury, three patients (22%) had injury of the pericardium, and one patient (7%) had left ventricle injury. [10, 15, 17]

The average time of stay at the ICU and the total hospital stay was in agreement with many studies. In the study of **Rodrigues et al. (2005),** the length of stay in the ICU for survivors was 2.79 ± 2.2 days, ranged from 1 to 10 days and the length of hospital stay for survivors was 7.4 ±3.2 days, ranged from 3 to 19 days. Also, **Mataraci et al. (2010)** reported that the mean duration of hospital stay was 6.5 ± 2.9 (4-18) days. [7, 12]

The overall mortality in patients with penetrating cardiac injuries was 9 patients (64.3%). Our mortality rate was higher than other studies as **Kamali et al. (2011)** who had mortality rate 43.5% and **Rodrigues et al. (2005)** who had mortality rate 32.9%. While in some studies mortality rate may reach 10% and 3.4% in the study of **Mataraci et al. (2010)** and **Gao et al. (2004)** respectively. [7, 8, 9, 12]

By comparison between group A & group B patients, we found that group A patients had significantly more medial to MCL injury, more mean arterial BP < 70 mmHg on admission, less time to admission to the operating room, more need for blood transfusion, and more output from the chest tube. All these factors explain the more mortality in patients with cardiac and great vessels injury (64%), while the mortality in patients with chest wall, diaphragm and lung injury was (10%).

During the period of the study, there was no cardiopulmonary machine in the operating room which has an important role in management of the penetrating cardiac injuries. This important factor may explain the increased mortality of patients with penetrating cardiac trauma.

Degiannis et al. (2006) studied 117 patients with a preoperative diagnosis of penetrating heart trauma underwent emergency thoracotomy at Chris Hani Baragwanath Hospital over 32 months period, South Africa, and found that mortality was (31%). While, **Loogna et al. (2007)** studied 61 patients underwent thoracic surgery for non-mediastinal injury during the same period in the same hospital, and found that mortality was (15%). Comparing these results with our results, we have more mortality in cardiac injury and less mortality in non-mediastinal injuries. [14, 18]

Conclusions

In penetrating chest trauma medial to MCL there is a highly expectation of a cardiac injury. So, antrolateral incision is the preferred incision which is easy and rapid. One of the great challenges for surgeons is penetrating injuries to the heart, which can be improved markedly through quick and appropriate intervention if they reach hospital alive. Cardiopulmonary machine must be available in the operating room as it has an important role in management of the penetrating cardiac injuries. If there is no postoperative complication, patients with penetrating chest injury usually have a short total hospital stay.

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Predictors of Outcome of Surgical Management of Prosthetic Mitral Valve Thrombosis or Malfunction

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Background: **Reoperation for prosthetic mechanical valve malfunction became more frequent due to the increasing number of patients replacement of the mitral valve for many pathologies such as degenerative or rheumatic valve disease.**

Method: **Our study included 40 patients with prosthetic mitral valve thrombosis or malfunction, who underwent re-replacement of mitral valve prosthesis (from the first of November 2013 till the end of June 2015) in *Kasr Al-Ainy* University Hospitals.**

Results: **Our patients were 11 males (27.5%) and 29 females (72.5%). The mean age was 35.8 ± 10.1 years. The overall mortality was 7 patients (17.5%). The main risk factors for hospital mortality were preoperative mean arterial blood pressure < 70 mmHg, heart rate > 100 /minutes, acute pulmonary edema, need for preoperative mechanical ventilation, cerebrovascular stroke, disturbed conscious level, preoperative renal dysfunction and low EF. Also, mortality was significantly positively correlated with long cross clamp time, long cardiopulmonary bypass time, need for high inotropic support after weaning from bypass, postoperative mechanical ventilation time, renal failure, stroke, chest infection and wound infection.**

Conclusion: **Low EF, hemodynamic instability, long operative time and renal dysfunction were especially associated with increased mortality. Earlier surgical management before the development of myocardial dysfunction and severe heart failure would improve the results of mitral valve re-replacement.**

Key words: **Mitral prosthesis malfunction - Mitral prosthesis thrombosis - Mitral valve reoperation - Stuck mitral.**

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Codex : o3/02/1504

Reoperation for prosthetic mechanical valve malfunction became more frequent due to the increasing number of replacement of the mitral valve for many pathologies such as degenerative or rheumatic valve disease. Many factors lead to prosthetic mechanical valve malfunction: pannus formation, thrombosis, prosthetic endocarditis and paravlvular leakage. [1]

There have been gradual decrease in perioperative risk for redo valve surgery over the past 20 years, mostly due to better myocardial protection, increased surgical experience and improved patient management. However, mortality rates remain higher than first-time valve replacement surgery. [2]

The aim of this work is to collect, review and analyze the data of patients with prosthetic mitral valve thrombosis or malfunction and evaluate the different variants that can affect the outcome of surgical intervention in these patients.

Material and Methods

This prospective study was conducted in Kasr Al-Ainy University Hospitals, and included 40 patients who were undergoing re-operation for management of prosthetic mitral valve thrombosis or malfunction over 20 months (from the first of November 2013 till the end of June 2015).

We included in our study all patients of both gender at any age who underwent isolated mitral valve re-replacement with or without tricuspid valve repair. Patients with Infective prosthetic endocarditis or with associated cardiac surgical procedure other than prosthetic mitral valve re-replacement were excluded from our study.

Full history was taken from the patients and their relatives with special emphasis on acute onset dyspnea including severity and duration of symptoms and history of embolism. The efficacy of the oral anticoagulation therapy is checked by serial INR level. Full general and local cardiac examination, routine laboratory investigations, ECG, chest X-ray and complete echocardiographic study was done for all patients.

Quantative data was expressed as mean and standard deviation (X±SD), and qualitative data expressed as number and percentage (No. & %). Categorical variables was compared using the Pearson's chi-square test or Fisher's exact test and independent continuous variables was compared by the unpaired Student t test. A P value of less than 0.05* was considered statistically significant, a $P > 0.05$ (non-significant).

Results

This study included 40 patients. They were 11 males (27.5%) and 29 females (72.5%). The age of our patients ranged between 20 - 73 years with a mean of 35.8 ± 10.1 years.

Regarding preoperative congestive heart failure, 11 patients came to the hospital with dyspnea NYHA class III (27.5%), and 29 patients came with dyspnea NYHA class IV (72.5%). Eleven patients reached the hospital with mean arterial blood pressure < 70 mmHg (27.5%). Four patients had acute pulmonary edema on admission and they need preoperative mechanical ventilation (10%).

Regarding associated comorbidities, 5 patients had cerebrovascular stroke (12.5%), 5 patients had renal dysfunction (12.5%), 4 patients had liver dysfunction (10%) and 3 patients had diabetes mellitus (7.5%). Seven female patients were pregnant (17.5%), 3 in the 1st trimester, 3 in the 2nd trimester and 1 in the 3rd trimester.

INR level on admission to the operative room was 1.64 ± 0.75, ranging between 1 – 3.6. Trial of thrombolysis by the cardiologists was done for 1 pregnant patient (2.5%). She was in the 2nd trimester and hemodynamically stable. She went to surgery after failure of thrombolytic treatment and becoming hemodynamically unstable.

Only 3 patients had history of two previous open heart surgery (7.5%). The time passed from the last mitral valve replacement was 63.5 ± 55.8 months, ranging between 5 – 240 months.

The time elapsed to admission to the operating room was ranging from 3 - 72 hours with a mean time 18 ± 22.9 hours. Patients admitted to the operating room urgently (≤ 24 hours) were 33 patients (82.5%), while 7 patients (17.5%) were admitted to the operating room electively (> 24 hours).

Echocardiography of the patients revealed that 5 patients (12.5%) had EF < 50, while 35 patients (87.5%) had EF ≥ 50. Pulmonary artery pressure was ≤ 60mmHg in 23 patients (57.5%), while it was > 60mmHg in 17 patients (42.5%). Regarding echocardiographic assessment of mitral valve prosthesis, elevated pressure gradient was found in 37 patients (92.5%) and paravalvular leak was detected in 3 patients (7.5%).

Intra-operatively, the cause of mitral valve malfunction was thrombus in 29 patients (72.5%), thrombus and pannus in 5 patients (12.5%) and pannus only in 3 patients (7.5%). Six patients needed tricuspid valve repair (15%). During weaning from cardiopulmonary bypass, high inotropic support was required in 14 patients (35%) and low in 26 patients (65%).

Cardiopulmonary bypass time was ranging from 100 – 280 minutes with a mean 129.3 ± 38.8 minutes. Cross clamp time was ranging from 70 - 180 minutes with a mean 89.6 ± 17.6 minutes.

One patient died intra-operatively and 39 patients transferred to the ICU. Another 2 patients died early in the ICU during the first 12 hours. Duration of postoperative mechanical ventilation in the ICU was ranging from 4 – 288 hours with a mean 34.8 ± 56.9 hours.

Six patients needed reexploration due to excessive postoperative bleeding (15.4%). Regarding postoperative complications, 5 patients were complicated with renal failure (13.5%), 3 patients had stroke (8.1%), 7 patients had chest infection (18.9%) and 2 patients had wound infection (5.4%).

The mean of the total ICU stay was 101 ± 74.3 hours, ranging from 40 – 430 hours. The mean of the total hospital stay for discharged patients was 10.6 ± 4.3 days, ranging from 6 - 27 days.

The overall mortality for patients with prosthetic mitral valve thrombosis or malfunction who underwent re-replacement of mitral valve prosthesis was 7 of the 40 patients (17.5%).

On trying to study variables affecting mortality, we found that mortality was significantly correlated with the following preoperative factors **(Table 01)**: mean arterial blood pressure < 70 mmHg, acute pulmonary edema, need for preoperative mechanical ventilation, cerebrovascular stroke, renal dysfunction and low EF.

Also, mortality was significantly positively correlated with long cross clamp time, long cardiopulmonary bypass time and need for high inotropic support after weaning from bypass **(Table 02)**. Regarding the post-operative factors **(Table 03)**, we find that mortality was significantly positively correlated with long postoperative mechanical ventilation time, renal failure, stroke, chest infection and wound infection.

Per-operative Factor	Mortality number	%	P value
• **Age**:			
- Died	38.9 ± 16.3		**0.395**
- Discharged	35.2 ± 8.7		
• **Sex**			
- Female	4/29	13.8%	**0.286**
- Male	3/11	27.3%	
• **NYHA class**:			
- III	0/11	0%	**0.073**
- IV	7/29	24.1%	
• **Mean arterial blood pressure**:			
- < 70 mmHg	4/11	36.4%	**0.047***
- ≥ 70 mmHg	3/29	10.3%	
• **Acute pulmonary edema**:			
- Present:	3/4	75%	**0.013***
- Absent:	4/36	11.1%	
• **Need for mechanical ventilation:**			
- Present:	3/4	75%	**0.013***
- Absent:	4/36	11.1%	
• **Cerebrovascular stroke:**			
- Present:	3/5	60%	**0.03***
- Absent:	4/35	11.4%	
• **Renal dysfunction:**			
- Present:	3/5	60%	**0.03***
- Absent:	4/35	11.4%	
• **Liver dysfunction:**			
- Present:	1/4	25%	**0.552**
- Absent:	6/36	16.7%	
• **Diabetes mellitus:**			
- Present:	1/3	33.3%	**0.448**
- Absent:	6/37	16.2%	
• **Pregnancy:**			
- Present:	2/7	28.6%	**0.355**
- Absent:	5/33	15.2%	
• **INR level:**			
- Died	1.6 ± 0.8		**0.236**
- Discharged	1.9 ± 0.5		
• **Trial of thrombolysis:**			
- Present:	0/1	0%	**0.825**
- Absent:	7/39	17.9%	
• **Previous open heart surgery:**			
- 1	1/3	33.3%	**0.448**
- > 1	6/37	16.2%	
• **Time to admission to the OR :**			
- Died	8.3 ± 6.8		**0.225**
- Discharged	20.1 ± 24.9		
• **EF :**			
- Died	54.9 ± 8.5		**0.015***
- Discharged	62 ± 6.4		
• **SPAP :**			
- Died	72.7 ± 21.5		**0.052**
- Discharged	56.7 ± 18.6		
• **Elevated pressure gradient in the Echo:**			
- Present:	7/37	18.9%	**0.552**
- Absent:	0/3	0%	
• **Paravalvular leak**:			
- Present:	0/3	0%	**0.552**
- Absent:	7/37	18.9%	

Table (1): Preoperative factors associated with mortality:

Intra-operative Factors	Mortality number	%	P value
• **Cross clamp time:**			
- Died	106.43 ± 35		**0.005***
- Discharged	86.1 ± 9.2		
• **Cardiopulmonary bypass time**:			
- Died	180 ± 73.9		**0.001***
- Discharged	118.6 ± 13.1		
• **Thrombus on the prosthetic mitral valve**:			
- Present:	7/34	20.6%	**0.289**
- Absent:	0/6	0%	
• **Pannus on the prosthetic mitral valve**:			
- Present:	1/8	12.5%	**0.569**
- Absent:	6/32	18.8%	
• **Weaning from bypass**:			
- High inotropic support	7/14	50%	**0.001***
- Low inotropic support	0/26	0%	

Table (2): Intra-operative factors associated with mortality:

Post-operative Factors	Mortality number	%	P value
• **Duration of mechanical ventilation****:			
- Died	206.5 ± 102.8		**0.001***
- Discharged	15.1 ± 14		
• **Need for reexploration***:			
- Yes	2/6	33.3%	**0.224**
- No	4/33	12.1%	
• **Renal failure****:			
- Present:	4/5	80%	**0.001***
- Absent:	0/32	0%	
• **Stroke****:			
- Present:	2/3	66.7%	**0.026***
- Absent:	2/34	5.9%	
• **Chest infection****:			
- Present:	3/7	42.9%	**0.016***
- Absent:	1/30	3.3%	
• **Wound infection****:			
- Present:	2/2	100%	**0.009***
- Absent:	2/35	5.7%	

** Intra-operative death = 1 patient*

*** Death intra-operative or early in the ICU = 3 patients*

Table (3): Post-operative factors associated with mortality:

Discussion

Our patients were 11 males (27.5%) and 29 females (72.5%). This sex distribution is similar to many studies like **Ahn et al. (2008)** who studied 20 patients underwent surgical intervention due to mechanical valve thrombosis from January 1981 through March 2006 at Seoul National University Hospital, Korea, 70% of patients were females and 30% were males. Also, **Akay et al (2008)** who studied 62 redo patients underwent mitral valve replacement, between September 1989 and December 2003 in Baskent University Faculty of Medicine, Turkey, 75.8% of his patients were females and 24.1% were males. [2, 3]

Our results differs from a study reported by **AbouelKasem et al. (2007)** who studied 50 patients underwent mitral valve re-replacement for prosthetic mechanical valve dysfunction in the departments of cardio-thoracic surgery, Kasr El-Ainy hospital, Cairo, over the period from February 2004 to March 2007, 28% of patients were females and 72% were males. This big difference is because he excluded pregnant females from his study. [1]

The age of our patients ranged between 20 - 73 years with a mean of 35.8 ± 10.1 years. This is in agreement with many authors in literature as **Fouda et al. (2014)** who studied the outcome of surgical management of 60 patients with mechanical mitral valve dysfunction from July 2011 till June 2013 at Kasr El-Ainy hospitals, Cairo, the mean age was 39 ± 10.14. Also, **Raboi et al. (2010)** who studied 129 patients underwent reoperation for obstructive mechanical valve between January 2003 and April 2007 at Al-Thawrah Hospital, Yemen, the mean age was 34.8 ± 13.4 years. [4, 5]

Our results differs from other communities like a study from Japan by **Matsuyama et al. (2003)** who Studied 92 patients underwent redo mitral valve surgery, between May 1983 and February 2003 at Tenri Hospital, Japan, the mean age was 56.4 ± 10.4 years (range 33 to 74). Also, a study from USA by **Potter et al. (2004)** who studied 106 patients underwent repeated mitral valve replacement between January 1993 and December 2000 at Mayo Clinic, Minnesota, USA, the mean age was 66 ± 12. In a study from UK by **Vohra et al. (2012)** who studied 49 patients underwent redo-MVR between January 2000 and 2010 at Southampton University Hospitals, UK, the mean age was 63 ± 13 years (range 21–80 years). [6, 7, 8]

In Egypt, the most common cause of mitral valve replacement is rheumatic heart disease which is common in young age. While in other communities like USA, UK and Japan, the most common cause of mitral valve replacement is degenerative mitral valve disease which is common in old age. This explains the difference between the age of our patients and the age in these studies.

Many patients reached the hospital with congestive heart failure and this is in agreement with many studies as the study of **Durrleman et al. (2004)** who studied 39 patients presented with prosthetic valve thrombosis and required surgical intervention at Montreal Heart Institute, Canada, he reported that severe congestive heart failure was found in 44% of his patients. Also, **Ahn et al. (2008)** reported that the most frequent clinical presentation was heart failure, presented in 65% of patients. [3, 9]

Regarding NYHA class, our results is concordant with the study of **Ahn et al. (2008)** who mentioned that all patients came with NYHA functional class III or IV at the time of diagnosis. Also, 84% of patients in **AbouelKasem et al. (2007)** study was in NYHA class III and IV. **Brandao et al. (2002)** who studied 146 patients underwent valvular reoperations for prosthetic valve dysfunction between July 1995 and June 1999 at the Heart Institute of the University of Sao Paulo Medical School, Brazil, reported that 91.1% of his patients were in NYHA class III and IV before surgery. [1, 3, 10]

The associated comorbidities were found in all other studies in a similar proportions as ours. **Brandao et al. (2002)** found that 4.8% of his patients with DM, 8.9% with stroke and 9.6% with renal dysfunction. Some studies with older aged patients as, the study of **Potter et al. (2004)** from USA showed a higher rate of comorbidities, 15.1% with DM, 18.9% with stroke and 8.5% with renal insufficiency. [7, 10]

As pregnancy is a risk factor for prosthetic valve thrombosis, many studies show a respectable proportion of pregnant

females, it may reaches 35% of the patients as in **Ahn et al. (2008)** study. **Lafci et al. (2006)** who studied 18 patients presented with PVT (78% had mitral valve thrombosis) between July 1997 and September 2005 at Ataturk Education and Research Hospital, Turkey, reported that 5.6% of patients were pregnant. Also, **Toker et al. (2006)** who studied 63 patients underwent reoperation for obstructive prosthetic valve dysfunction between January 1994 and April 2005 at Kosuyolu Heart and Research Hospital, Istanbul, Turkey, 7.9% of patients were pregnant. [3, 11, 12]

As inadequate anticoagulation and low INR level are risk factors of prosthetic valve thrombosis, many studies reported low INR level of patients. In study of **Ahn et al. (2008)** INR profiles when thrombosis was diagnosed were 1.66±0.64 (1.02-2.68). Also, 72% of **Lafci et al. (2006)** patients had INR < 2. [3, 11]

Bioprosthesis malfunction was in our study scope, but we didn't find any patient with bioprosthesis malfunction during the study period. This is because bioprosthetic mitral valve replacement is not common in our developing countries especially at the governmental hospitals due to its high cost and the patients don't accept unavoidable re-replacement of this valve.

Although, all mechanical prosthetic valves have an excellent record of durability up to 40 years, thrombosis of the mechanical valve may occur at any time even in the 1st week post-MVR. On the other hand, bioprostheses with their limited durability, usually do not fail suddenly, and take time until degeneration, fibrosis and calcification become sufficiently severe to require reoperation.

The time passed from the last mitral valve replacement was 63.5 ± 55.8 months, ranging between 5 – 240 months. And this is concordant with most researches that studied mechanical prosthetic thrombosis, as **Toker et al. (2006)** who found that the mean time to reoperation was 58.9 ± 56.1 months (rang: 1 – 252 months); **Lafci et al. (2006)**, the mean time to reoperation was 48.3 ± 15.4 months; **Durrleman et al. (2004)**, the mean time to reoperation was 39 ± 42 months. [9, 11, 12]

In researches that studied all types of prosthetic mitral valve dysfunction including bioprosthetic mitral valves, the mean time to reoperation is obviously longer. In the study of **Potter et al. (2004)**, 43% of his patients had mechanical mitral valves and 57% had bioprosthetic mitral valves, the mean time to reoperation was 138 ± 85.2 months. [7]

In the study of **Raboi et al. (2010)** the mean time to reoperation was 26 ± 19.2 months (rang: 4 days – 20 years); which is too short in comparison to our study and the other studies. He explained that, by the increased number of valve replacement operations performed at his cardiac center year by year, poverty and lack of adherence of patients to medical instructions especially anticoagulant therapy. [5]

Kasr Al-Ainy University Hospital is considered one of the biggest tertiary center in Egypt with 24 hours available high qualified staff and a large blood bank. Patients usually diagnosed by echocardiography as prosthetic mitral valve thrombosis and referred from other hospitals some times in other governments. They usually reach the hospital with congestive heart failure. So, the patients are prepared for operations in a short period.

In our study, 85% of our patients had mechanical mitral valve thrombosis. The time elapsed to admission to the operating room was short in comparison to other studies of mechanical prosthetic valve thrombosis, as in **Toker et al. (2006)** 65.1% of patients were operated on under emergency conditions. Also, in **Ahn et al. (2008)** 40% of patients underwent an emergency or urgent operations. In **AbouelKasem et al. (2007)** 58% of patients were operated urgently, this is because patients with prosthetic valve thrombosis were 36% only. [1, 3, 12]

Cardiopulmonary bypass time and cross clamp time in our results were similar to the results of **Toker et al. (2006)** who reported that the mean aortic cross clamp time was 85.5±36.4 minutes and total perfusion time was 135.3±68.73 minutes, and **Vohra et al. (2012)** reported that cardiopulmonary bypass time was 120 ± 56 min and cross-clamp time was 92±32 min. [8, 12]

These results were longer than the results of **Durrleman et al. (2004)** who reported that, the cross clamping time was 75 ± 32 minutes (range, 16-133 minutes), and the cardiopulmonary bypass time was 118 ± 48 minutes (range, 31-217 minutes), this is because only thrombectomy was done to 47% of the patients. Our results were shorter than the study of **Matsuyama et al. (2003)** who showed that aortic cross-clamp time was 105 ± 53 minutes and pump time was 185 ± 82 minutes. [6, 9]

We had a higher rate of reexploration in comparison to other studies as **Akay et al (2008)** 7.1%, **Lafci et al. (2006)** 5.6%, **Potter et al. (2004)** 3.8%, **Raboi et al. (2010)** 1.6% and **Vohra et al. (2012)** 4%. [2, 5, 7, 8, 11]

This may be explained by that 82.5% of our patients were operated on under urgent conditions, with a short time to admission to the operative room in comparison to the other studies. There was no time to correct the INR level in some patients, as 10 patient (25%) had INR ≥2.

There were 5 patients (13.5%) complicated with renal failure and needed dialysis. This was similar to the results of **Akay et al (2008)** 14.2%, **Potter et al. (2004)** 10.4% and **Vohra et al. (2012)** 12%. Some studies showed fewer patients was complicated with renal failure as **Toker et al. (2006)** 3.2%. [2, 7, 8, 12]

Total ICU stay was longer in comparison to **Akay et al (2008)** who reported that total ICU stay was 81.6 ± 38.4 hours. Total hospital stay was similar to the results of **Akay et al (2008)** who reported that total hospital stay was 9.1 ± 2.7 days. Our total hospital stay was shorter in comparison to **Ahn et al. (2008)** who reported total hospital stay was 16.9 ± 6.7 days and **Vohra et al. (2012)** who reported 17 ± 11 days. [2, 3, 8]

Our study showed that the overall mortality was 7 of the 40 patients (17.5%). This is similar to the results of **AbouelKasem et al. (2007)** 14%, **Fouda et al. (2014)** 15%, **Lafci et al. (2006)** 16.7%, **Raboi et al. (2010)** 17.8%, **Matsuyama et al. (2003)** 20% and **Toker et al. (2006)** 20.6%. Our mortality rate was higher than other studies as **Ahn et al. (2008)** 5%, **Akay et al (2008)** 6.4%, **Brandao et al. (2002)** 10.9%, **Potter et al. (2004)** 4.7% and **Vohra et al. (2012)** 12%. [1-12]

AbouelKasem et al. (2007) in his study reported that risk factors related to hospital mortality was the presence of pulmonary hypertension more than 60 mmHg, NYHA class of the patients reflecting the pathology of the stuck valve, high creatinine level more than 1.8 mg% and long cardiopulmonary bypass time. **Akay et al (2008)** also reported that low left ventricular ejection fraction (<35%), NYHA functional class IV, pulmonary edema, female gender, and urgent operations were found to be risk factors for mortality. [1, 2]

In the study of **Brandao et al. (2002)** he reported that prolonged extracorporeal circulation time, increased creatinine level, NYHA functional class were associated with higher mortality rates. While, **Toker et al. (2006)** found that the only factor affecting early hospital mortality was left ventricular ejection fraction. [10, 12]

Conclusions

Patients with prosthetic mitral valve thrombosis presenting to Kasr Al-Ainy hospitals are characterized by being young, more commonly females, with heart failure on presentation. Inadequate anticoagulation and low INR level are risk factors of prosthetic mitral valve thrombosis. Pregnant women with mechanical prosthetic heart valves are more vulnerable to prosthetic valve thrombosis. Low EF, hemodynamic instability, long operative time and renal dysfunction were especially associated with increased mortality. Earlier surgical management before the development of myocardial dysfunction and severe heart failure would improve the results of mitral valve re-replacement.

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Stem Cells Angiogenesis Versus Coronary Artery Bypass Graft in Ischemic Coronary Artery Disease (Experimental Study)

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Background: **Cardiovascular diseases are major global health problems, accounting for 17 million deaths worldwide each year, and the majority of these deaths are caused by ischemic heart disease.**

Objective: **To assess results of therapeutic coronary angiogenesis using stem cells therapy either intramyocardial injection or patch technique versus surgical revascularization as regard the development of new angiogenesis.**

Material and Methods: **In our study we operated on forty two dogs 28 males and 14 females (In Animal Experimental Research Centre, Faculty of Medicine Mansoura University) from october2010 till march 2014. All experimental animals were exposed to significant ischemia by creating stenosis of LAD,2 dogs developed myocardial infarction and were excluded from the study. One month later animals were randomly devided into four groups: Group I (10 dogs):left as control group. Group II (10 dogs): in which coronary artery bypass graft (LIMA to LAD) was done. Group III (10 dogs): in which stem cells intramyocardium implantation was done. Group IV (10 dogs): in which stem cells patches were used . One month later, all animals were sacrificed and heart was taken for pathological examination**

Results: **In our study There was no significant difference between all groups as regard age, weight, preoperative, and postoperative heart rate and percent of preoperative and post operative O2 saturation .As regard cardiac enzymes preoperative there were no significant difference between all groups. Post operative CK in control group was (5.57±.54 ng/dl) and post operative CK in group 4 was(2.82 ± 1.94 ng/dl) and in group3 was(2.93±.21 ng/dl) while in group 2 was (5.38±1.01 ng/dl) with p3value(< 0.001) highly signficant more than p1. LDH postoperative in control group was (509.00±65.90 IU/dl) and in group 4 was (208.00±27.41 IU/dl) with p3 was(< 0.001)and in group3 was (208.00±50.95 IU/dl) with p2 was(< 0.001) while in group 2 was (578.00±44.67 IU/dl) with p1 was (0.003). Figure of significance between p3 and p1 was higher. Treponin postoperative in control group was(2.89±.21 ng/dl) and in group 4 was(.06±.01 ng/dl) with p3 was (< 0.001) and in group 3 was(0.14±.23 ng/dl). with p2 was(< 0.001) while in group 2 was (3.14±.45 ng/dl) with p1(0.049). Figure of significance between p3 and p1 was higher .As regard fibrosis in control group was (7.88 ± 1.73 $\mu m^2/m^2$) and in group 4 was (2.53 ± 0.95 $\mu m^2/m^2$) with p3 was (< 0.001) and in group3 fibrosis was (3.93 ± 0.96$\mu m^2/m^2$). with p2 was(< 0.001) while in group 2 fibrosis was (5.39 ± 0.99 $\mu m^2/m^2$) with p1 was (0.204). As regard new vessels formation In control group was (2.24 ± 0.88 no/m^2) and in group 4 was (7.42 ± 1.18 no/m^2) with p3 (<0.001) and in group 3 was (5.39 ± 1.13 no/m^2) with p2 was (< 0.001) while in group 2 was (2.88 ± 1.22 no/m^2) with p1 was (0.089). Figure of significance between p3 and p1 was highly significant.**

Conclusion: **There was improvement in overall stem cell therapy regarding angiogenesis. We thought that stem cell therapy either injection or patch techniques for IHD may be a hope for patients not candidate for PTCA or surgical revascularization.**

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Codex : o3/03/1504

Cardiovascular diseases are major global health problems, accounting for 17 million deaths worldwide each year, and the majority of these deaths are caused by ischemic heart disease ***(Lunde and Aakhus, 2009).***

Treatment strategies traditionally focus on the use of antiplatelet aggregating agents, decreasing myocardial oxygen demand, coronary vasodiltation, and restoring myocardial perfusion using percutaneous coronary interventions and coronary artery bypass grafting (CABG). Although these modalities of treatment are effective and have reduced the death rate from CAD ***(Eagle et al., 1999),*** however, approximately 30% of patients either cannot undergo these procedures or receive incomplete revascularization by these techniques due to severe coronary atherosclerosis ***(Sellke et al., 1998).*** Many of these patients continue to experience residual anginal symptoms or myocardial ischemia despite maximal medical therapy. Therefore, an alternative strategy for revascularization is needed for these patients with refractory disease ***(Khan et al., 2002).***

Transplantation of stem cells represents a promising approach for cardiac repair post-myocardial infarction (MI),. ***(Mummery et al., 2010).*** Tissue engineering as angiogenesis therapy has more advantages compared to cell transplantation, such as cell delivery and persistence at the implant site. Cell patch therapy is a novel application of tissue engineering, which might repair the infracted myocardium via angiogenesis ***(Yokomuro et al., 2009).***

Material and methods:

In our study we operated on forty two dogs (In Animal Experimental Research Centre, Faculty of Medicine Mansoura University). All experimental animals were exposed to significant ischemia by creating stenosis of LAD, 2 dogs developed myocardial infarction and were excluded from the study. One month later animals were randomlly devided into four groups:

Group I (10 dogs): left as control group.

Group II (10 dogs): coronary artery bypass graft (LIMA to LAD) was done.

Group III (10 dogs): Intramyocardium implantation of stem cells was done

Group IV (10 dogs): stem cells patches were used

One month later, all animals were sacrificed and heart was taken for pathological examination to detect the effect of different modalities of management on new angiogenesis formation.

Techniques

Animal preparation and instrumentation:

Forty two dogs of either sex with a mean weight ranged from 24-38kg were anaesthitised with phenobarbitol(30mg.kg i.v), intubated and mechanically ventilated.

Thoracotomy was performed under sterile conditions through left fifth intercostal space, the lungs were retracted and the pericardium was opened.

Primary Step: induction of ischemia ,All dogs were exposed to ischemic stenosis by gradual occlusion of LAD by proline 5/0 in gradual manner guided by ischemic changes in ECG. Infarction occurred in 2 dogs and were excluded from the study.

Therapeutic Modalities:

1- LIMA to LAD anastomosis. Dogs for which coronary artery bypass graft was done by harvesting the internal mammary artery and anastomosis to LAD by proline 7/0 by using octopus.

2- **Stem cells implantation:** Mesenchymal stem cells (MSCs) were isolated from bone marrow of dog's femur. The aspirated cells were subjected to mononuclear cells (MNCs) seperation using ficoll. MNCs were then cultured on polypropylene flask in the suitable media Dulbecco's Modified Eagles media (DMEM)and incubated in co_2 incubator till desired number of stem cells reached. ($5x10^6$) direction of injecting needle was parrall to the myocardial surface with an acute angle without penetrating the left ventricular wall in 10 dogs.

3- **Stem cell patchs :**The stem cells patch consists of poly glycolic acid felt seeded with mononuclear blood cells applying at site of ischemia using fibrin adhesive tape: used in last 10 dogs.

Tissue sample collection and analysis:

Left ventricular tissue samples were stored immediately in liquid nitrogen or phosphate buffered formalin solution. Samples (1 cm3 each) were collected from the center of the ischemic area and the border zone fixed formalin paraffin embedded (FFPE) were processed for hematoxylin and eosin and Masson's trichrome for evidence of demuscularization and replacement fibrosis

Laboratory And Pathological Assessment:

1- Laboratory Blood Sample Analysis

Serial blood sample analysis of white blood cell count (WBC), creatine kinase MB fraction (CK-MB), and troponin I was performed before cell or saline injection and then post operative to assess inflammatory responses (WBC) and myocardial damage (CK-MB and troponin I).

2- Measurement of Vascular Density

The effect of stem cell transplantation on angiogenesis was evaluated in paraffin-embedded sections by counting the number of vessels in anterolateral wall sections (10 sections per heart) immunostained for the endothelial cell marker. The number of vessels was counted under a light microscope in 5 random fields (each field measuring 0.58 mm2), vascular density was expressed as the area of blood vessels in um2 per mm2 of each ventricular section.

3- Fibrosis Quantification

Trichrome staining was used to evaluate collagen deposition. Ten anterolateral sections from each heart were evaluated in their entirety and quantified. The results were expressed as um2 of fibrosis per mm^2 of each ventricular section. (The mean of surface area of ten slides of fibrosis per all ten surface area)

Statistics:

The data were collected on a precoded sheet. Data were statistically analysed using Statistical Package for the Social Sciences (SPSS). Discrete variables were presented as mean ± standard deviation and pie charts. Statiscal analysis were performed using Chi-square test to detect any statistical significance. Statistical significane were assumed at P value <0.05.

Results

In our study we operated upon 40 dogs. Our results were as follow:

Table (1) shows: age, weight, heart rate and O2 saturation in groups. There was no significant difference between control group and other 3 groups as regard age, weight, heart rate and O2 saturation

Table (2) shows Preoperative laboratory investigations in all groups. there was no significant difference as regard cardiac enzymes and white blood cells.

Table (3) shows Postoperative laboratory investigations in all groups p3 highly significant, p2 moderate significance, p1 significant

	Group 1	Group 2	Group 3	Group 4	P1	P2	P3
Age in month	27.10±2.08	27.80±2.49	28.10±2.13	27.60±2.37	0.495	0.332	0.626
Weight Kg	32.90±3.41	32.60±2.22	30.20±4.13	31.00±3.30	0.003	0.132	0.045
HR Pre-operative beat/min	111.00±8.76	115.00±12.69	115.00±5.27	108.00±6.32	0.313	0.134	0.448
HR Post-operative beat/min	111.00±5.68	104.00±5.16	101.00±3.16	100.00±.00	0.001	0.000	0.000
O2 sat pre %	99.60±.70	99.60±.52	99.60±.70	99.40±.52	1.000	1.000	0.472
O2 sat post %	96.80±4.71	99.50±.53	98.30±3.02	99.40±.52	0.039	0.242	0.047

NB: *P1 difference between control group and group 2, P2 difference between control group and group 3, P3 difference between control group and group 4.*

Table 1. Age, weight, heart rate and O2 saturation in groups.

	Group 1	Group 2	Group 3	Group 4	P1	P2	P3
WBC N/cc	6.41±1.04	6.95±0.83	7.25±1.07	7.25±0.92	0.213	0.056	0.056
CK ng/dl	0.87±0.06	0.86±0.13	0.93±0.09	0.86±0.09	0.907	0.140	0.833
Treponin ng/dl	0.05± 0.01	0.05±0.01	0.05±0.01	0.05±.01	0.847	0.441	0.562
LDH IU/dl	185.50±39.19	190.0±24.49	186.0±21.18	199.0±13.7	0.705	0.966	0.259

NB: *P1 difference between control group and group 2, P2 difference between control group and group 3, P3 difference between control group and group 4.*

Table 2. Preoperative laboratory investigations in all groups.

	Group 1	Group 2	Group 3	Group 4	P1	P2	P3
WBC N/cc	11.19±1.18	11.48±.91	9.50±1.27	10.08±.85	0.547	< 0.001	< 0.001
CK ng/dl	5.57±.54	5.38±1.01	2.93±.21	2.82±1.94	0.545	< 0.001	< 0.001
Treponin ng/dl	2.89±.21	3.14±.45	0.14±.23	0.06±.01	0.049	< 0.001	< 0.001
LDH IU/dl	509.00±65.90	578.00±44.67	208.00±50.95	202.00±27.41	0.003	< 0.001	< 0.001

NB: *P1 difference between control group and group 2, P2 difference between control group and group 3, P3 difference between control group and group 4*

Table 3. Postoperative laboratory investigations in all groups.

	Group1	Group 2	Group3	Group4	P1 value	P2 value	P3 value
Vascularity	2.24 ± 0.88	2.88 ± 1.22	5.39 ± 1.13	7.42 ± 1.18	0.205	<0.001	<0.001
Fibrosis $\mu m^2/m^2$	7.88 ± 1.73	6.72 ± 1.08	3.93 ± 0.96	2.53 ± 0.95	0.089	<0.001	<0.001

NB: P1 difference between control group and group 2, P2 difference between control group and group 3, P3 difference between control group and group 4

Table 4. Pathological evaluation as regard vascularity and fibrosis in all groups

Table (4) shows pathological evaluation as regard vascularity and fibrosis in all groups. As regard fibrosis there was highly significant difference between group2 and group 4 and moderate significant difference between group 2 and group 3 and as regard new vessel formation there was highly significant difference between group 2 and group 4 and moderate significant difference between group 2 and group 3

Discussion

In our study the results were as follow: no significant difference between group 2 (CABG) and group 3 (stem cell implantation) and group 2 and group 4 (stem cell patch) as regard age (month), weight (kg), heart rate (beat per mint) and O2 saturation pre and postoperatively ,and pre operative cardiac enzymes(CK, treponin and LDH). Post operative cardiac enzymes(CK, treponin and LDH). were highly significant difference in group 4(stem cells patch) p3 was(< 0.001) , moderate significant difference in group 3(stem cells intramyocardial injection) p2 was(< 0.001) and in group2 (CABG) were non signfcant from these results stem cells therapy either intramyocardial injection or patch technique had lower effects on myocardial and cardiomyocytes injuries than (CABG) .These results cope with the study of ***Silva and colleges (2005)*** who used stem cells intramyocardial implantation and cope with the study of ***Yokomuro and colleges (2009),*** who used stem patch technique.

As regard fibrosis, there was highly significant difference in group 4(stem cells patch) p3 was (< 0.001), significant difference in group 3(stem cells intramyocardial injection) p2 was (< 0.001) and in group2 (CABG) was non significant P1 was (0.089) from these results stem cells therapy either intramyocardial injection or patch technique had lower effects on myocardial collagen fibers formation than (CABG). As regard vascularity there was highly significant difference in group 4 (stem cells patch) p3 was (< 0.001), and group 3 (stem cells intramyocardial injection) p2 was (<0.001) while in group2 (CABG) was non significant p1 was (0.205) from these results stem cells therapy either intramyocardial injection or patch technique had better effects on myocardial angiogensis than (CABG). These results cope with the study of ***Van Laake and colleges (2010)*** as regarding fibrosis and vascularity (P < 0.001) from previous results we thought that stem cell therapy either intramyocardial injection or patch better than CABG as regard neoangiogensis and may be a hope for patient not candidate for PTCA or surgical revascularization.

Operschall and colleges (2000) used ameroid constrictor for ligation of LAD enlarging after 10 days to produce ischemia. They used angiography to detect coronary ischemia in their study after ameroid constrictor by 10 days.

In our study we used proline sutures to produce ischemia. We haven't coronary angiography to detect ischemia, we depend upon pathological evaluation as regarding fibrosis and decreased vascularity. Thus, we advice angiography evaluation of coronary ischemia. ***Sidi and colleges (2007)*** made transient coronary artery occlusion by ameroid constrictor in pigs, their weight were 50-55 kg and do CABG, their results were better as coronaries in pigs are large in diameter more than dogs.

Suematsu and colleges (2002) used Power Doppler Imaging for detection of harvest injury of internal mammary artery and their results were better in CABG as we don't have

power Doppler imaging in harvesting internal mammary artery. The luminal diameter of the LIMA at the level of the 4th intercostal space in 20 anesthetized mongrel dogs (weight, 15 to 21 kg) was determined by PDI and by histological examination.

The LIMA was dissected and skeletonized from its origin to its bifurcation. The presence of an intimal flap in the LIMA and Doppler signals in the pseudolumen indicate dissection, that is, harvest injury, of the LIMA ***(Suematsu and colleges, 2002).***

In our study, we used non skeletonized LIMA to LAD anastomosis. This does not cope with ***Suematsu and colleges (2002)***. ***Jaber and colleges (1998)*** in their study, they used Mongrel dogs underwent to LAD grafting. Mean graft flow and flow wave morphology for varying degrees of anastomotic stenoses were recorded using transit-time flow probes.

Their results were better as they used flow meter probe. In our study we depend on visual assessment of flow waveform morphology to detect anastomotic error in coronary artery bypass grafting.

Van Laake and colleges (2010) reported that 20 month of age (dogs) MI was induced under isoflurane anesthesia by ligation of the LAD, cells were injected in the infarcted or healthy myocardium of the free left ventricular wall using an insulin syringe with incorpored 29G needle. At 2 days, and 4, 12 and 24 weeks after surgery, animals were sacrificed and the hearts were fixed and processed for cryosections. Their results were similar to our results as regarding fibrosis and vascularity ($P < 0.001$). However, the difference between our study and Van Laake et al. (2010)is that they injected MSCs in both healthy and infracted areas, but in our study we injected these cells in the ischemic areas only.

Heeschen and Colleges (2006), after making coronary ischemia in dogs, used stem cells intravenous injection to reach ischemic tissue. Fibrosis was more significantly higher than our study ($P < 0.001$).

In our study, we used stem cell intramyocardial injection (direct implantation) in group 3 thus it gave better results as stem cells injection by intravenous route lead to dissemination in blood and the cells washed away from ischaemic zone. Thus, we advice stem cells direct intramyocardial implantation or better by stem cell patch which was used in our study (group 4).

In our study we found in group3 with stem cell intramyocardial injection the serial blood sample analysis as regard WBCs, cardiac enzymes (CK, treponin, LDH) measured before and after stem cell intramyocardial injection, decreased post-operative (Tables 2 &3). Also we found by histopathological examination, there was reduction in fibrosis (Table 4) and enhancement in myocardial neovascularization (Table 4).

This agreed with the study of ***(Silva and colleges, 2005).*** In our study we used, stem cells intramyocardial injection was done in 10 cases but in ***Hessen and Colleges (2006)*** used intravenous injection of stem cells. Our results as regard vascularity ($P<0.001$) and in ***Hessen and colleges (2006)*** was ($P = 0.041$). Thus we advice intramyocardial stem cells implantation . in our study. We depend on pathological evaluation of new angiogenesis as regard fibrosis and vascularity. But in ***Herreros and colleges (2003)*** depend on angiography and echo Doppler evaluation. We advice these tools to be avaliable

Conclusion

We suggest that stem cell therapy either intramyocardial injection or patch may be a hope for patient not candidate for PTCA or surgical revascularization.

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Is Custodiol an Equivalent Alternative For Conventional Blood Cardioplegia in Cardiac Surgery?

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Background: **Custodiol, an intracellular crystalloid cardioplegia, given as a single dose, that makes it attractive for surgeons as it prevents the interruption of the operation.**

Objective: **The main aim of this study was to verify whether Custodiol is as effective as conventional blood cardioplegia in protecting the myocardium during cardiac surgery.**

Methods: **Our study is a retrospective study in which patients' data were collected from the data base of the Armed Forces Hospital of South Region (AFHSR), Saudi Arabia, from March 2009 to March 2011. Patients' preoperative and intraoperative data, as well as postoperative outcome including 30-days mortality were compared between the Custodiol group and the group receiving blood cardioplegia. Ten study endpoints were determined; prolonged ventilation (>24 hours), re-intubation, intra-aortic balloon pump (IABP) insertion, atrial fibrillation, pacemaker implantation, stoke, infection, renal failure, 30-day mortality and 30-day hospital readmission.**

Results: **500 cases were subjected to cardiac surgery from March 2009 to March 2011 in the Cardiac Surgery Department, AFHSR. Using the propensity score model, we managed to match 65 Custodiol cases one-to-one to those given blood cardioplegia. Propensity-score matching was used to correct any possible bias accompanying the use of Custodiol. No statistically significant differences were recorded for any of the defined endpoints in this study.**

Conclusion: **Custodiol offers myocardial protection during cardiac surgery that is equivalent to that given by blood cardioplegia.**

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Deficient myocardial protection during long periods of ischaemic with subsequent reperfusion is a serious issue in cardiac surgery. Cardioplegic solutions improve the tolerance to ischaemia and reperfusion via conserving myocardial energy stores, preventing osmotic and electrolyte imbalances and buffering acidosis. The cardioplegic solutions are classified into two main groups. One is based on extracellular components and therefore rich in potassium, magnesium and bicarbonate, while the other is based on intracellular electrolytes (intracellular composed solution). Both proved to be valuable in preserving the myocardium as measured with the biochemical markers in biological models and in patients. However, the latter option seems to be more effective [1].

HTK histidine-tryptophan-ketoglutarate solution or Custodiol was described by Bretschneider in the 1970s [2]. It is considered an intracellular, crystalloid cardioplegia owing to its low sodium and calcium content. Sodium depletion of the extracellular space induces myocyte plasma membrane hyperpolarization thus causing cardiac arrest in diastole. On contrary, conventional 'extracellular' cardioplegic solutions which are high in potassium content cause cardiac arrest by inducing membrane depolarization [3]. High histidine content buffers the acidosis induced by building up of anaerobic metabolites during long ischaemic period; ketoglutarate potentiates ATP production during reperfusion; tryptophan causes stabilization of the cell membrane and mannitol decreases cellular edema and acts as a free-radical scavenger [4]. Custodiol components are presented in **(Table 1).**

	Custodiol	Blood cardioplegia at induction (4:1)	Blood cardioplegia (4:1) Maintenance
Sodium (mmol/L)	15	140	140
Potassium (mmol/L)	9	20	10
Magnesium (mmol/L)	4	13	9
Calcium (mmol/L)	0.015	_	_
Ketoglutarate (mmol/L)	1	_	_
Histidine (mmol/L)	198	_	_
Tryptophan (mmol/L)	2	_	_
Mannitol (mmol/L)	30	_	_
Glucose (mmol/L)	_	6	6
PH	7.02	7.2	7.4

Table 1. Composition of Custodiol and blood cardioplegic solutions used in this study

Custodiol is attractive for cardiac surgeons as it is delivered as a single dose and can offer myocardial protection for up to three hours [4,5] hence facilitating a proper technical flow of complex surgical procedures without interruption.

Patients and Methods

This study is a retrospective study in which patients' data were collected from the data base of our Cardiac Surgery Department records at Armed Forces Hospital of South Region (AFHSR), Saudi Arabia, from March 2009 to March 2011. Database records included all patient demographics, preoperative risk factors, surgical procedures, postoperative hospital events and the outcome of surgery including 30 day morbidity and mortality. Surgical operations in which Custodiol was received as cardioplegia were defined and compared with the rest of the cardiac surgeries in which blood cardioplegia was used.

Surgical Procedure

Hemodynamic monitoring was performed by inserting an arterial line in the radial and/or femoral artery, a central venous pressure line in the internal jugular vein and/ or Swan–Ganz catheter. All patients were administered general anesthesia in the traditional way. Surgical approach was carried out through a median sternotomy. An arterial cannula inserted in the ascending aorta/aortic arch or femoral artery was used to establish cardiopulmonary bypass (CPB).Venous drainage was achieved through a two-stage cannula inserted in the right atrium or bicaval cannulation via the superior and inferior vena cavae or the femoral vein.

Cardioplegic arrest was carried out after establishing CPB and aortic cross-clamping. Systemic temperature was reduced to 33°C in patients receiving HTK (Custodiol; Koehler Chemi, Alsbach- Haenlien, Germany). At 4°C, two-thirds of the Custodiol solutions were administered in an antegrade manner under an initial perfusion pressure of 80–100 mmHg. The residual one-third was given in a retrograde fashion. All cases received 25 ml/kg of Custodiol as a single dose over 5–7 min. Another half dose was administered after 3 hours of cross-clamping or incase any electrical or mechanical activity was encountered before this time.

In patients receiving blood-cardioplegia, systemic temperature was lowered to 34°C. For induction cardioplegia, one liter of tepid blood mixed at a ratio of 4:1 (blood: induction cardioplegic solution) at 28°C was used. Two-thirds of the solution was given in an antegrade fashion and one-third via the retrograde route. For maintenance cardioplegia, Tepid blood mixed at 4:1 (blood: maintenance cardioplegic solution), was repeated each 15–20 min via both antegrade and retrograde routes **(Table 1).** Just prior to the myocardium reperfusion, a 'hot shot' (warm blood) dose was given in a retrograde manner.

Study endpoints

Ten study endpoints were identified before the start of the study to be compared between both groups: prolonged ventilation (>24 hours), reintubation, intraaortic balloon pump (IABP) insertion, atrial fibrillation, pacemaker implantation, stoke, infection, renal failure, 30-day mortality and 30-day hospital readmission

Statistical analysis

Preoperative patients' data, operative variables and early postoperative outcomes were compared between the Custodiol and blood cardioplegia groups. Propensity-score matching was carried out for correction of the possible bias accompanying the use of Custodiol. A propensity score was generated for each patient using a logistic regression and considering Custodiol as the dependent variable. Baseline preoperative patients' data that were expected to affect patient selection and postoperative outcomes were included **(Table 2).** The c-statistic was calculated for the propensity model. Once generated, patients were matched one-to-one on basis of their propensity score without replacement utilizing the 'greedy' matching method with a fixed caliper width of 0.02.

After matching, standardized differences were calculated to show the extent of baseline variable balance in the way suggested by Austin [6]. Provided that sample sizes were fairly small in our study, a standardized difference of ≤20% was used to reveal a high degree of balance. Unpaired t-tests were used for comparing continuous data, whereas categorical postoperative outcomes were compared using McNemar's test. *P* value≤ 0.05 reflects statistical significance.

Results

A total of 500 cases were subjected to cardiac surgery in the period from March 2009 to March 2011 in the Cardiac Surgery Department, Armed Forces Hospital of South Region (AFHSR), Saudi Arabia. Using the propensity score model, we managed to match 65 Custodiol cases one-to-one to those to whom blood cardioplegia was delivered. The propensity score model worked perfectly with a c-statistic of 0.93 (95% CI: 0.91–0.95). **Table 2** shows the preoperative and operative patients' data across the two groups. Owing to the relatively small sample size, a standardized difference of ≤20% shown in all baseline variables, revealed an acceptable level of matching between both groups. **Table 3** displays the postoperative outcomes of Custodiol versus blood cardioplegia group. No significant differences were recorded for any of the defined endpoints in this study. These include; prolonged ventilation (>24 hours) (Custodiol: 22% vs blood cardioplegia: 25%, P =0.536), Re-intubation (Custodiol:9% vs blood cardioplegia:14%,P=0.453), Intra-aortic balloon pump insertion (Custodiol:11% vs blood cardioplegia:15%,P=0.861), atrial fibrillation (Custodiol:20% vs blood cardioplegia:17%,P=0.521), pacemaker (Custodiol: 5% vs blood cardioplegia:3%, P =0.609), MI (Custodiol: 2% vs blood cardioplegia:3%, P=0.219), stroke (Custodiol: 2% vs blood cardioplegia:2%, P =0.362), renal failure (Custodiol: 5% vs blood cardioplegia:6%, P =0.127), 30-day mortality (Custodiol: 6% vs blood cardioplegia:8%, P =0.213) and 30-days hospital readmission (Custodiol: 11% vs blood cardioplegia:17%, P=0.423).

Variable	Custodiol (n=65)	Blood cardioplegia (n=65)	P value
Age (years)	60±0.23	64±0.15	0.514
Females (no)	44 (68%)	49 (75%)	0.126
EF%	55.28±8.45	52.13±9.56	0.345
Hypertension	45 (69%)	41 (63%)	0.690
Diabetes	46 (70%)	47 (72%)	0.516
Hematocrit (g/dL)	35.54±7.34	39.68±5.17	0.173
Creatinine (μmol/L)	0.98±0.24	1.05±0.78	0.246
COPD	4(6)	3(5%)	0.681
Dyslipidemia	7 (11%)	6 (9%)	0.203
Myocardial Infarction	43(66%)	40 (62%)	0.321
Cerebrovascular event	3 (5%)	2(3%)	0.912
Arrhythmia	12(18%)	15(23%)	0.504
Pulmonary hypertension	22(34%)	20(31%)	0.456
PreviousCABG	3(5%)	2(3%)	0.701
Previous valve surgery	3(5%)	3(5%)	0.962
Operation			
AVR	20 (%)	22(34%)	0.177
MVR	10(%)	11 (17%)	0.583
CABG	19(%)	17 (26%)	0.148
AVR & CABG	4(6%)	5 (8%)	0.262
MVR & CABG	3 (5%)	3(5%)	0.283
Others	9(%)	7 (11%)	0.365
CPB (min)	115.09± 45.31	126 ± 60.08	0. 204
X-clamp (min)	87.12±38.16	98 ± 42.65	0. 405
Lowest core temp under CPB (ºC)	33.18±4.12	34.24±1.45	0.183

Table 2. Preoperative and intraoperative patients' data

Early postoperative	Custodiol (n=65)	Blood Cardioplegia (n=65)	P value
Prolonged ventilation (>24 hours)	14 (22%)	16 (25%)	0.536
Reintubation	6 (9%)	9 (14%)	0.453
IABP insertion	7 (11%)	10 (15%)	0.861
Atrial fibrillation	13 (20%)	11 (17%)	0.521
Pacemaker	3 (5%)	2 (3%)	0.609
MI	1(2%)	2 (3%)	0.219
Stroke	1(2%)	1 (2%)	0.362
Renal failure	3 (5%)	4 (6%)	0.127
30-day mortality	4 (6%)	5 (8%)	0.213
30-day hospital readmission	7(11%)	11(17%)	0.423

Table 3. Postoperative Outcomes

Discussion

Conventional blood cardioplegia has been used for many years to protect the myocardium. However, its repeated infusion every 15–20 min causes suspension of the surgical technique which is bothersome in long and technically complex cases making HTK-Custodiol an optimum option for such cases. A single dose of the HTK solution proved to be sufficient for myocardial protection for an extended period. The main factors underlying the success of the HTK solution in improving clinical outcomes are firstly; the buffer effect of histidine [7]. Kresh et al. reported that the buffering effect of protein such as histidine is probably better than bicarbonate in stabilizing intracellular pH and helping recovery of post-ischaemic biochemical and mechanical parameters [8]. In addition, Del Nido et al. stated that the significant buffering capacity of custodial can be effective in preserving myocardial adenosine triphosphate stores, improving post-arrest contractile function and minimizing myocardial necrosis [9]. Takeuchi et al. added that histidine promotes anaerobic glycolysis and improves recovery of high-energy phosphates and contractile function in the hypertrophied myocardium [10]. Secondly, ketoglutarate is a precursor of nicotinamide adenine dinucleotide (NAD) that potentiates ATP production during reperfusion. Moreover, it acts as an intermediary in the Krebs cycle. Thirdly, tryptophane stabilizes the cell membrane and lastly, the addition of mannitol reduces cellular edema [7].

Furthermore, HTK plays a role in preserving the coronary artery endothelium which might lead to improved functional cardiac recovery [11]. Yang [12] revealed that HTK is superior to the University of Wisconsin solution in protecting the endothelium-derived hyperpolarizing factor-mediated endothelium function in porcine small coronary arteries.

Braathan et al. cited cardioplegia with Custodiol for arresting hearts in more than 700,000 cases of open cardiac surgery [13]. However there are few studies comparing the effect of Custodiol with other conventional types of cardioplegia. Sakata et al. used the HTK solution for valve surgery and reported more spontaneous recovery without use of defibrillator and reduced necessity for inotropic drugs compared with the use of cold blood cardioplegia [1]. However, Fannelop et al. in an experimental study found that cold blood cardioplegia provides better myocardial protection and preservation of left ventricular function than HTK in the early hours after de-clamping [14]. Braathen et al. in a randomized study measured markers of myocardial injury and reported that HTK in elective mitral surgery protects the myocardium as much as the repetitive antegrade cold blood cardioplegia. Braathen et al. however, observed a significant increase in spontaneous ventricular fibrillation following cross-clamp removal in patients receiving HTK. Augmented fibrillation after declampimg has been related to conduction instability induced by inadequate intraoperative myocardial protection. The latter is caused by heterogeneous reperfusion, build up of oxidative stress and electrolyte imbalance across the cell membranes and reduced levels of adenosine triphophate. Despite this, Braathen et al. managed to show that the increase in spontaneous ventricular fibrillation did not influence the release of myocardial enzymes in comparison with blood cardioplegia [13].

The significant hyponatraemia that is caused by the rapid infusion of a large single dose of Custodiol (Na^+ 15 mmol/L) [15.16] has been reported as an issue of concern. In a study including 25 patients, Lindner et al. measured serum sodium and osmolality at different intra- and post-operative time-points [17]. Patients showed a significant reduction in serum sodium (15 mmol/L). However, there was not any significant alteration in osmolality thus suggesting an isotonic hyponatremia. Others have observed hyponatraemia without clinical consequences [18, 19]. Hyponatremia resulting from Custodiol administration is usually treated by using a haemofilter on the cardiopulmonary bypass circuit, or is prevented by aspirating the antegrade-directed cardioplegia from a retrograde cannula [20].

Conclusions

The results of this study supported by many other studies in the literature recommend the use of custodial in adult cardiac surgery Custodiol seems to offer myocardial protection that is equivalent to that of conventional blood cardioplegia. Moreover, a single dose cardioplegia strategy for myocardial protection has significant advantages for the performance of heart surgery particularly complex cardiac operations.

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Is Repair Preferable to Replacement Regarding Early Mortality and Complications for Management of Severe Chronic Ischemic Mitral Regurgitation?

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Background: **Ischemic mitral regurgitation increases the mortality rate in this category of patients. This study compares the outcome in patients having severe ischemic mitral regurgitation undergoing CABG in addition to either mitral valve repair or mitral valve replacement.**

Methods**: The present prospective study was performed in Cairo University hospitals, between April 2012 and April 2014. A total number of 60 patients with severe mitral regurgitation (4+) and concomitant coronary artery disease were included in our study. The patients were divided into two groups, the first group included 30 patients who underwent mitral valve repair and concomitant CABG; the second group also included 30 patients who underwent mitral valve replacement and CABG. CABG was performed in all patients in both groups using internal mammary artery and saphenous vein graft. The primary end of the trial was the improvement of left ventricular contractility as assessed by means of LVEF% echocardiographic measurement after 3, 6 and 12 months post-operative. Secondary end points included mortality, major adverse cardiac or cerebrovascular events as well as an increase in NYHA class ≥1 after 6 months and one year follow up.**

Results: **There was no statistically significant difference between the two groups regarding the preoperative echocardiographic findings, which indicated good matching in patients of both groups. There was a tendency to improvement in the EF% in both study groups which was a little bit better in the repair group in comparison to the replacement group, however there was no statistically significant difference between the two groups, in the repair group the postoperative EF% was 42.5±8.6, 45.6±8.5, 49.1±12.5 at 3,6,12 months respectively whereas in the replacement group the postoperative EF% was 41±7.8, 44.1±7.6, 47.3±7.6 at 3,6,12 months interval respectively with a *p*-value >0.05.**

Conclusion: **Patients who suffer from severe chronic ischemic mitral regurge show comparable mortality rates when subjected to CABG and mitral valve repair or mitral valve replacement. Although those patients who are subjected to mitral valve repair show an improved early mortality rate, however this survival advantage does not show statistical significance after one year.**

Keywords: **Severe ischemic mitral regurgitation, Mitral valve repair, Mitral valve replacement.**

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In severe ischemic mitral regurgitation, the use of mitral valve repair versus mitral valve replacement together with coronary artery bypass grafting (CABG) is controversial. Patients undergoing mitral valve repair may have a reduced incidence of thromboembolism and reduced requirement for anticoagulation as compared to patients undergoing mitral valve replacement[1]. Practice guidelines recommend surgery in patients with severe ischemic mitral regurgitation; however the evidence for repair versus replacement is still limited.

Ischemic mitral regurgitation is a result of adverse left ventricular remodeling following myocardial infarction with enlargement of left ventricular chamber, mitral annulus, apical and lateral displacement of papillary muscles, leaflet tethering. These processes cause impaired leaflet coaptation with resulting degrees of mitral regurgitation. Thus, the treatment of functional ischemic mitral regurgitation differs considerably from that of primary, degenerative mitral regurgitation[2].

Clinical studies have suggested that repair is associated with lower perioperative mortality[3-6], whereas replacement provides a better long-term correction with lower recurrence rate. This relation between a reduced operative morbidity and mortality in repair group and better long-term freedom from ischemic mitral regurgitation in the replacement group has generated a considerable conflict for this a high prevalence condition[4].

In this study, we compared the three, six and twelve months's outcome in patients with ischemic mitral regurgitation undergoing CABG with either mitral valve repair or mitral valve replacement.

Patients and Methods

The present prospective study was performed in Cairo University hospitals, between April 2012 and April 2014. Previous medical history, comorbidities and risk factors were collected and compared.

In our study 60 patients with severe mitral regurgitation (4+) and concomitant coronary artery disease were included. The patients were divided into two groups, the first group included 30 patients who underwent mitral valve repair and concomitant CABG; the second group also included 30 patients who underwent mitral valve replacement and CABG. We excluded in this study patients who had previous mitral valve surgery, who presented in a cardiogenic shock, and patients who had associated degenerative or rheumatic valvular disease.

All patients were operated upon using conventional cardiopulmonary bypass and myocardial protection using warm blood cardioplegia. Mitral valve repair was performed using restrictive annuloplasty in 100% of the repair group patients, resection of secondary chordae was performed as an additional repair in 15 patients (50%) of the repair group, and quadrangular resection of the posterior leaflet was performed in two patients (6.7%) of the repair group. In the repair group patients restrictive annuloplasty was performed using St. Jude ring in 16 patients (53.3%) and Carpentier Edwards ring in 14 patients (46.7%).

Mitral valve replacement was performed using mechanical bileaflet valves in 100% of the replacement group patients, St. Jude mechanical valve was used in 14 patients (46.7%) and Carbomedics valve was used in the remaining 16 patients (53.3%). CABG was performed in all patients in both groups using internal mammary artery and saphenous vein graft. Preoperative echocardiography was performed to assess LVEF%, LVESD and LVEDD in groups, preoperative NYHA class and Canadian class was obtained by thorough preoperative history and medical examination in both groups.

The primary end point of the trial was the improvement of left ventricular contractility as assessed by means of LVEF% echocardio-graphic measurement after 3, 6 and 12 months post-operative. Secondary end points included mortality, major adverse cardiac or cerebrovascular events as well as an increase in NYHA class ≥1 after 6 months and one year follow up.

Statistical Analysis

Data was collected and coded to facilitate data manipulation and double entered into Microsoft Access and data analysis was performed using SPSS software version 18 under windows 7. Simple descriptive analysis in the form of numbers and percentages for qualitative data, and arithmetic means as central tendency measurement, standard deviations as measure of dispersion for quantitative parametric data, and inferential statistic test:

- **For quantitative parametric data:**
  - In-depended **student t-Test** used to compare measures of two independent groups of quantitative data.
- **For quantitative non parametric data:**
  - Non Paired variables
  - Mann-Whitney test in comparing two independent groups.
- **For qualitative data:**
  - **Chi square:** test to compare two or more qualitative groups. The level of $p \leq 0.05$ was considered the cut-off value for significance.

RESULTS

There was no statistically significant difference between the two groups regarding the age, gender distribution. The prevalence of preoperative co-morbidities between the two groups as hypertension, congestive heart failure, renal insufficiency, DM and previous MI was statistically insignificant, also as regards to clinical evaluation of patients in both groups by Canadian classification, and preoperative NYHA classification with a *p*-value >0.05 **(Table 1)**.

There was no statistically significant difference between the two groups regarding the preoperative echocardiographic findings, LVESD in the repair group was 4.2±1 whereas in the replacement group was 4.4±0.85, LVEDD in the repair group was 6.1±0.73, whereas in the replacement group was 6.3±0.62, LVEF% in the repair group was 40.2±8.8 whereas in the replacement group was 39.2±7.4 with a *p*-value >0.05 which indicates good matching in patients of both groups **(Table 1)**.

Variables		CABG+MV repair (n=30)		CABG+MV replacement (n=30)		*p*-value	Sig.
		Mean (no)	SD (%)	Mean (no)	SD (%)		
Age (years)		54.2	9.8	56.3	8.2	0.4	NS
Sex	Male	20	66.7%	15	50%	0.3	NS
	Female	10	33.3%	15	50%		
Co-morbidities and medical history	Hypertension	20	66.7%	21	70%	0.9	NS
	CHF	4	13.3%	6	20%	0.7	NS
	Renal insufficiency	3	10%	5	16.7%	0.7	NS
	Diabetes mellitus	21	70%	22	75.9%	0.8	NS
	Previous MI	21	70%	22	73.3%	0.9	NS
	AF	2	6.7%	1	3.3%	0.9	NS
	Emergency	4	13.3%	8	26.7%	0.3	NS
Canadian Class	Class I	7	23.3%	5	16.7%	0.9	NS
	Class II	12	40%	12	40%		
	Class III /IV	11	36.6%	13	43.3%		
Preoperative NYHA class	Class I	2	6.7%	1	3.3%	0.4	NS
	Class II	9	30%	4	13.3%		
	Class III/IV	19	63.3%	25	83.3%		
Preoperative echo findings	LVESD	4.2	1	4.4	0.85	0.5	NS
	LVEDD	6.1	0.73	6.3	0.62	0.2	NS
	Preoperative LVEF%	40.2	8.8	39.2	7.4	0.6	NS

Table 1. ***Patient characteristics and preoperative Echocardiographic findings***

The number of bypass grafts in the repair group was 2.9±0.5 which was comparable with the number of grafts in the replacement group which was 2.9±0.4 with a *p*-value =0.8 which means that it was statistically insignificant. 21 patients (70%) of the repair group required intraoperative inotropic support, whereas 26 patients (86.7%) of the replacement group required intraoperative inotropic support with no statistically significant value (*p* value 0.2). Four patients from the repair group required an IAPB which was comparable to seven patients n the replacement group who needed an IAPB with no statistically significant difference **(Table 2)**.

The only noticed statistically significant difference between the two groups was the bypass and aortic cross clamp times. In the repair group the Bypass time was 124.9±17.5 minutes whereas in the replacement group the Bypass time was 133.03±11 minutes with a *p*-value of 0.03 which indicates statistically significant difference. In the repair group the aortic cross clamp time was 89.2±11.5 minutes whereas in the replacement group the aortic cross clamp time was 100.2±7.8 minutes with a *p*-value <0.0001 which indicates a highly significant statistical difference **(Table 2)**.

There was no statistically significant difference between the two groups regarding the postoperative need for mechanical ventilation, in the repair group was 10±6.7 hours whereas in the replacement group was 12.3±9.3 hours with a *p*-value 0.3.

There was no statistically significant difference between the two groups regarding the duration of ICU postoperative stay, in the repair group was 2.7±0.6 days whereas in the replacement group was 2.7±0.8 days with a *p*-value 0.9

There was no statistically significant difference between the two groups regarding the duration of in-hospital stay, in the repair group was 10.5±1.9 days whereas in the replacement group was 10.4±1.9 days with a *p*-value 0.8

Variables	CABG+MV repair (n=30)		CABG+MV replacement (n=30)		*p*-value	Sig.
	Mean (no)	SD (%)	Mean (no)	SD (%)		
Operative parameters						
Bypass time (min.)	**124.9**	17.5	133.03	11	**0.03**	**S**
Cross clamp time (min)	**89.2**	11.6	100.2	7.8	**<0.0001**	**HS**
Number of grafts	2.9	0.5	2.9	0.4	0.8	NS
Inotropic support	21	70%	26	86.7%	0.2	NS
Intra-operative aortic balloon	4	13.3%	7	23.3%	0.5	NS
Postoperative parameters						
Duration of mechanical ventilation (hours)	10	6.7	12.3	9.3	0.3	NS
Duration of ICU stay (days)	2.7	0.6	2.7	0.8	0.9	NS
Duration of hospital stay (days)	10.5	1.9	10.4	1.9	0.8	NS

Table 2. Operative and early postoperative results

Post-operative follow up echocardiography was performed after the operation and at 3,6,12 month's interval. There was a tendency to improvement in the EF% in both study groups which was a little bit better in the repair group in comparison to the replacement group, however there was no statistically significant difference between the two groups, in the repair group the postoperative EF% was 42.5±8.6, 45.6±8.5, 49.1±12.5 at 3,6,12 months respectively whereas in the replacement group the postoperative EF% was 41±7.8, 44.1±7.6, 47.3±7.6 at 3,6,12 months interval respectively with a *p*-value >0.05 which indicates that both types of operations achieve the same degree of improvement in LVEF% **(Table 3)**.

There was no statistically significant difference between the two groups as regards to the occurrence of postoperative complications (bleeding, renal failure, postoperative low COP syndrome, and postoperative AF rhythm) with *p*-value >0.05.

From the mitral repair group patients, two patients out of thirty (6.7%) died, one of them died in the ICU on the fourth post-operative day from low cardiac output, this patient was from the Canadian class III with a preoperative NYHA class IV and the other patient died after 4 months from unknown cause, this patient was from NYHA class IV. From the replacement group four patients out of thirty (13.4%) died, two of them died in ICU on the 3rd and 4th post-operative days from low cardiac output and heart failure and required insertion of IAPB, they were from NYHA class IV and Canadian class IV; however the other two patients died after 5 and 10 months from unknown cause **(Table 4)**.

Although the rate of early death was in favour of the repair group in comparison to the replacement group but there was no statistically significant difference between the two groups in the occurrence of mortality with a *p*-value 0.6, which indicates that both types of operations achieve equal degree of safety and security.

Regarding NYHA classification, there was an increase in percentage of class I, and II patients, on the other hand there was clear decrease in percentage of class III, and IV patients after six and twelve months, which indicates improvement in NYHA classification in both study groups simultaneously with no statistical significance difference between two groups (*p*-value =0.4) **(Fig. 1)**.

Variables		CABG+MV repair (n=30)		CABG+MV replacement (n=30)		*p*-value	Sig.
		Mean	SD	Mean	SD		
LVEF% follow-up	Preoperative	40.2	8.8	39.2	7.4	0.6	NS
	After 3 m	42.5	8.6	41	7.8	0.5	NS
	After 6 m	45.6	8.5	44.1	7.6	0.4	NS
	After 12 m	49.1	12.5	47.3	7.6	0.5	NS

Table 3. Comparisons of post-operative echo follow up among different study groups

	Variables	CABG+MV repair (n=30)		CABG+MV replacement (n=30)		*p*-value	Sig.
		(no)	(%)	(no)	(%)		
Postoperative complication	Bleeding	1	3.3%	2	6.7%	0.9	NS
	Renal Failure	1	3.3%	2	6.7%	0.9	NS
	Postoperative low COP syndrome	1	3.3%	2	6.7%	0.9	NS
	Postoperative AF rhythm	8	26.7%	8	26.7%	1	NS
Mortality	Mortality	2	6.7%	4	13.4%		
	In hospital mortality	1	3.3%	2	6.7%	0.6	NS
	Follow up	1	3.3%	2	6.7%		

Table 4. Comparisons of post-operative adverse effects and mortality among different study groups

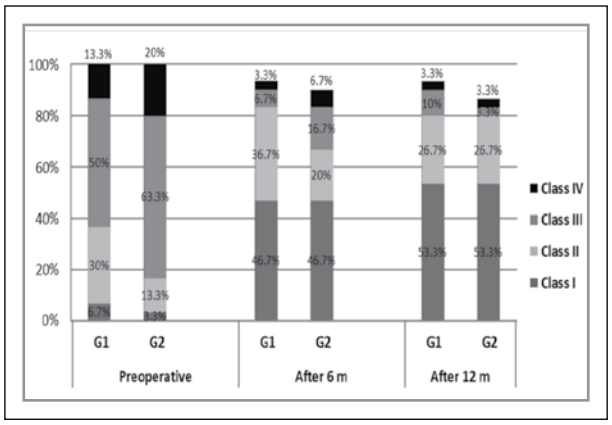

Fig 1. Preoperative and postoperative follow up of NYHA classification

Discussion

The most effective surgical technique for the treatment of severe ischemic mitral regurgitation remains controversial. In the past few years, the technique of mitral-valve repair has greatly exceeded that of replacement[7]. Recently, most surgeons have embraced mitral-valve repair over replacement, without a strong evidence base. According to 2008-2012 data from the Society of Thoracic Surgeons, 66% of mitral valve surgeries in patients undergoing CABG used a repair approach[8].

In our study we found that the early post-operative survival in the repair group was better than in the replacement group, although that it was statistically insignificant which may be attributed to the small number of patients that were included in our study, however this survival advantage was no longer evident over extended follow-up. Gillinov and colleagues[3], also concluded that there was no difference between the repair and replacement in the subgroup of patients with the highest comorbidity. Grossi and associates[4] and Tavakoli and associates[9], reported conflicting results. In the study of Grossi and associates[4], the hazard ratio was 0.45 in favor of repair provided that NYHA classification was removed from the analysis and in the study of Tavakoli and associates[9], the hazard ratio of death was 0.72 in favor of repair.

Our early in hospital mortality and total mortality rates in the repair group, were 3.3% and 6.7% respectively. These mortality rates were comparable or even lower than other studies owing to the smaller number in comparison to other studies ; 15% in the Tavakoli et al.[9], 14.6% in the Dion et al.[10] 9.3% in the Cohn et al.[11] and 9.2% in the Hendren et al.[12] studies. Our mortality rate was also comparable to that reported by Mohamed Sewielam et al.[13], who reported 2% early mortality rate in the repair group and total mortality of 4% as they included 50 patients in their study, which is smaller than our number of patients.

In our study, we found that there was a statistically significant difference between the repair group and the replacement group in regards of the bypass and cross clamp times in favor of the repair group, a finding that was not found in the study performed by Mohamed Sewielam et al.[13].

Our study indicated that prosthetic mitral valve replacement was not associated with more post-operative complications, a finding that was not reported by the Mohamed Sewielam et al.[13]. who reported that prosthetic mitral valve replacement is associated with more postoperative complications mostly related to anticoagulant therapy.

Our study is limited by its small number of patients in both groups with its disadvantage regarding low statistical power. The duration of follow up of the patients of our study was short

compared to other studies. Further prospective randomized trials with longer duration of follow up and larger patient's population may be in favor of mitral valve repair results.

Conclusion

Patients who suffer from severe chronic ischemic mitral regurge show comparable mortality rates when subjected to CABG and mitral valve repair or mitral valve replacement. Although those patients who are subjected to mitral valve repair show an improved early mortality rate, however this survival advantage does not show statistical significance after one year.

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Left Ventricular-Aortic Discontinuity with Aortic Root Abscess: Surgical Strategy and Early Outcomes

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Background: **Severe NVE or PVE may destroy the annulus and result in the formation of an aortic root abscess, which in turn represents one of the major causes of LV-AO discontinuity. We adopted a relatively simple procedure for active NVE or PVE with LV-AO discontinuity by performing debridement of necrotic and infected tissues as well as reconstruction of the aortic annulus followed by valve replacement.**

***Patients and Methods*: In this study, we reviewed retrospectively the medical records of patients in our department at Cairo University hospitals with aortic root abscess in the period between September 2009 and September 2014 (31cases): Group A: included 13 patients (41.9%) of aortic root abscess complicated by LV-AO discontinuity and Group B: included 18 patients (58.1%) who suffered from aortic root abscess not associated with LV-AO discontinuity. In Group A the mean age was 40 ± 9.3 years, seven were males and six were females while in Group B the mean age was 41±10.2 years, nine were males and nine were females.**

***Results*: Cross clamp and bypass times in Group A were significantly longer than in Group B, 160±13 and 208±17 minutes in Group A respectively and on the other hand 145±10 and 190±18 minutes in Group B respectively. Postoperative inotropic support as well as ICU and hospital stay in Group A were 88± 14 hours, 6.9±3.1 days and 15.4±2.3days respectively, while in Group B were 71±8 hours, 4.6± 2.9 days and 11.8±2.5days respectively which was statistically significant. The 30-day (early) mortality occurred in 3 patients (23%) from Group A and in 4 patients (22.2%) from Group B.**

***Conclusion*: In conclusion, left ventricular-aortic discontinuity is a serious complication of aortic valve endocarditis associated with a more difficult postoperative course. Surgical treatment of this complication continues to be challenging, but early results are encouraging. Annular reconstruction with simple or running Teflon-pledged sutures is safe.**

KEYWORDS: **Aortic valve endocarditis, Aortic root abscess, Left Ventricular-Aortic discontinuity.**

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Periannular and subvalvular extension of infection is a serious complication of native (NVE) and prosthetic (PVE) aortic valve endocarditis associated with high morbidity and mortality rates.[1-3] Spread of infection from damaged heart valves to adjacent tissues results in the formation of aortic root abscess. Periannular abscesses can rupture into surrounding structures leading to intracardiac shunts, pseudo-aneurysms or left ventricular-aortic discontinuity (LV-AO discontinuity).[4]

Abscess formation is defined as necrotic tissue in the aortic annulus or root while LV-AO discontinuity is defined as a separation between the aorta and left ventricular outflow tract of more than one third of its total circumference.[5] In LV-AO discontinuity, a part of circumference of the annulus loses its connection with the left ventricular outflow tract, sometimes just leaving the aorto-mitral continuity. Treatment of this serious complication consists of aggressive antibiotic therapy together with surgical repair.

We adopted a relatively simple procedure for active NVE or PVE with LV-AO discontinuity by performing debridement of necrotic and infected tissues as well as reconstruction of the aortic annulus with Teflon-pledged simple proline sutures followed by replacement of the valve with a mechanical prosthesis.

The objective of this study is to document the morbidity and mortality associated with aortic root abscess complicated by LV-Ao discontinuity as well as early outcome of our surgical strategy through reconstruction of the aortic annulus and valve replacement.

Patients and Methods

In this study, we reviewed retrospectively the medical records of patients in our department at Cairo University hospitals with aortic root abscess in the period between September 2009 and September 2014 (31cases). These patients were divided into two groups: **Group A** included 13 patients (41.9%) of aortic root abscess complicated by LV-AO discontinuity and **Group B** included 18 patients (58.1%) who suffered from aortic root abscess not associated with LV-AO discontinuity.

In group A nine patients (69.2%) developed aortic root abscess as a sequel of prosthetic aortic valve endocarditis (PVE) while in group B 10 (55.5%) patients developed aortic root abscess after prosthetic aortic valve.

All patients were diagnosed and initially treated at the Department of Cardiology and then referred to our department. Surgery was carried out at a median of 10 days after the initial diagnosis and management of infective endocarditis but at a median of 21 days in case of preoperative cerebral complications (one patient in Group A and two patients in Group B). Five patients needed emergency operations, two in Group A (15.4%) due to severe valve dehiscence (valve rocking) and refractory heart failure as well as three patients in Group B (16.6%) due to highly mobile vegetations and refractory heart failure from severe valvular or paravalvular regurgitation.

In Group A the mean age was 40 ± 9.3 years, seven were males and six were females while in Group B the mean age was 41±10.2 years, nine were males and nine were females. The overall logistic European system for cardiac operative risk evaluation was 9±5.2% in Group A and 9.5±3.4% in Group B. All Patients were followed up for 6 months post-operatively and received echocardiography before discharge from the hospital and after a period of 3 to 6 months. Preoperative characteristics were summarized in **Table 1**.

Characteristics		Group A	Group B	Statistical significance
Age		40 ± 9.3	41±10.2	Non-significant
Sex	Males	7(53.8%)	9 (50%)	Non-significant
	Females	6(46.2%)	9 (50%)	
LVEF (%)		53.4±7.1	54.4±3.8	Non-significant
Emergency		2 (15%)	3(16.6%)	Non-significant
Renal insufficiency (creatinie≥1.5)		3 (23%)	4(22.2%)	Non-significant
Cerebral embolism		1(7.7%)	2(11.1%)	Non-significant
Heart failure		1 (7.7%)	1(5.5%)	Non-significant
Splenic embolism		2 (15%)	2(11.1%)	Non-significant
Concomitant mitral valve endocarditis		2 (15%)	3(16.6%)	Non-significant
Logistic EuroSCORE		9±5.2%	9.5±3.4%	Non-significant

Data are shown as numbers (percentage) of patients

LVEF = *Left ventricular ejection fraction;* **Euro SCORE** = *European system for cardiac operative risk evaluation*

Table 1. Preoperative Patient Characteristics

Surgical technique

All patients were operated upon via median sternotomy and then cardiopulmonary bypass was established through aorto-bicaval canulation. Myocardial protection was performed using systemic hypothermia to 28°c, ice slush and cold blood selective antegrade cardiolplegia.

Our surgical strategy for aortic root abscess is based upon abscess cavity drainage with radical debridement of all infected and nonviable tissues. The abscess cavity and the sewing ring of the prosthetic valve were irrigated with antibiotic solution (Gentamycin). The resulting defects were reconstructed with autologous pericardium (primary cases) or Dacron patch (redo cases). In three patients of Group B the defects were less than 5mm in diameter and were directly closed with Teflon-pledged proline sutures.

The aortic root was only replaced through Bentall procedure using a double velor Dacron graft attached to the valve with 4/0 running polypropylene sutures in two patients from Group B and one patient of Group A due to extension of destruction to the coronary ostia. In cases with LV-AO discontinuity; the aortic annulus was reconstructed by 4-0 teflon-pledgeted simple or running polypropylene sutures reconnecting the endocardium of the LVOT with the aortic intima at the level of the original annulus to restore the ventricular-aortic continuity. In all patients the aortic valve was replaced by a mechanical prosthesis using pledgeted mattress sutures passed through the new annulus. Additional mitral valve surgery was done in three patients from Group A and four patients from Group B while additional tricuspid valve surgery was done in one patient of Group A as well as one patient of Group B. The following diagram **(Fig. 1)** summarizes the surgical techniques used in both groups.

Bacteriologic epidemiology

Blood cultures were negative only in two cases (15%) of Group A and two cases of Group B (11.1%). Staphylococcal species were more prevalent among patients with PVE than among those with NVE. Patients received antibiotic therapy directed against the isolated microorganisms, or vancomycin and broad-spectrum gram-negative coverage if a causative microorganism could not be isolated. All patients were maintained on postoperative intravenous antibiotic therapy for six weeks. The following **Table (2)** shows the organisms cultured from blood or intraoperative specimens.

Organisms	Group A	Group B
Staphylococcus aureus	3 (23%)	3 (16.6%)
Staphylococcus epidermidis	1 (7.7%)	2 (11.1%)
Escherichia coli	1 (7.7%)	2 (11.1%)
Candida	1 (7.7%)	2 (11.1%)
Streptococci species	1 (7.7%)	2 (11.1%)
Coagulase-negative staphylococci	1 (7.7%)	1 (5.5%)
Proteus	1 (7.7%)	1 (5.5%)
Enterococci	1 (7.7%)	2 (11.1%)
Pseudomonas	1 (7.7%)	1 (5.5%)
Negative cultures	2 (15%)	2 (11.1%)

Table 2. ***Organisms cultured from blood or intraoperative specimens***

Statistical analysis

Data were expressed as means ±SD. Continuous variables were analyzed by student *t* test. *p*-value <0.05 was considered to indicate statistical significance. Microsoft Excel was used for data collection and SPSS® v 10.0 was used for analytical statistics.

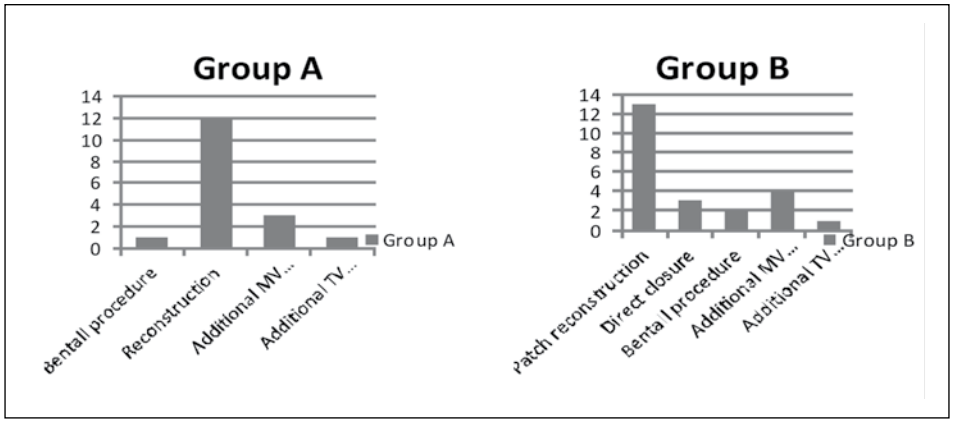

Fig 1. A diagram showing operative techniques used in both groups

Results

In-group A: Nine patients had annular abscesses beneath the left coronary cusp and four patients beneath the right coronary cusp, which extended further and resulted in LV-AO discontinuity.

In Group B, three Patients had fistulae between the left ventricle and the left atrium and three patients showed a fistula with the right atrium while in Group A, one patient had a fistula with the left atrium and one patient showed a pseudoaneurysm formation at the anterior part of aortic annulus **(Fig. 2)**

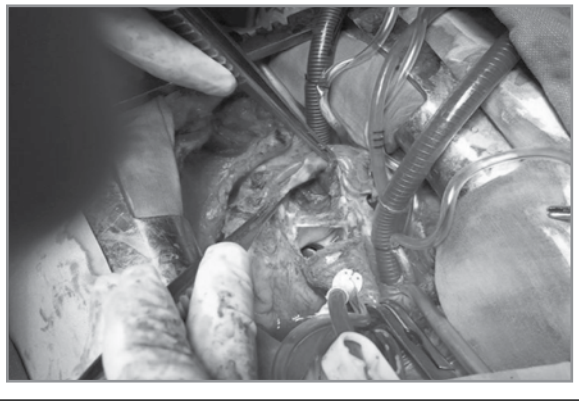

Fig 2. Aortic root abscess connected to a pseudoaneurysm anterior to the aortic annulus. The forceps is holding the wall of the pseudoaneurysm

Cross clamp and bypass times in Group A were significantly longer than in Group B, 160±13 and 208±17 minutes in Group A respectively and on the other hand 145±10 and 190±18 minutes in Group B respectively.

The duration of postoperative inotropic support as well as ICU and hospital stay in Group A were 88± 14 hours, 6.9±3.1 days and 15.4±2.3 days respectively, while in Group B were 71±8 hours, 4.6± 2.9 days and 11.8±2.5 days respectively which was statistically significant.

The thirty-day (early) mortality occurred in three patients (23%) from group A and in four patients (22.2%) from Group B. Causes of death included low cardiac output refractory to therapy and end-organ failure in group A as well as uncontrollable bleeding, refractory low cardiac output syndrome and persistent sepsis in Group B. **Table 3** shows postoperative data.

Follow up:

Four patients had recurrence of endocarditis, two in Group A (15%) after two and three months and two in Group B (11.1%) after three and four months from the initial surgery. All these patients were readmitted to the hospital and received antibiotics according to their blood cultures. One patient died from Group A shortly after due to septicemia with end-organ failure and one patient from Group B was reoperated upon for valve dehiscence but died intraoperatively due to refractory low cardiac output.

Postoperative data	Group A	Group B	Statistical significance
Cross clamp time	160±13min	145±10	Sig.
Total bypass time	208±17min	190±18	Sig.
Inotropic support (duration)	88± 14h	71±8h	Sig.
Ventilation time	23±17h	20±15h	Non-Sig.
ICU stay	6.9±3.1days	4.6± 2.9 days	Sig.
Reoperation for bleeding	1(7.7%)	2(11.1%)	Non-Sig.
Permanent heart block	1(7.7%)	1(5.5%)	Non-Sig.
Renal failure necessitating dialysis	2(15%)	3(16.6%)	Non-Sig.
Recent cerebrovascular stroke	0	1(5.5%)	Non-Sig.
Hospital stay	15.4±2.3 days	11.8±2.5days	Sig.
30 days mortality	3(23%)	4(22.2%)	Non-Sig.

Table 3. Summary of postoperative data

Discussion

Severe NVE or PVE may destroy the annulus and result in the formation of an aortic root abscess, which in turn represents one of the major causes of LV-AO discontinuity.[6] A delay in operation on the aortic root can cause fatal complications and complicate the surgical procedures.[7]

In our study, aortic root abscess associated with LV-AO discontinuity was more common in patients with PVE than patients with NVE. This may be due to circumferential spread of infection from the sewing ring of the prosthetic valve to the aortic annulus ending in its separation from LVOT.

The operative mortality rate is still disappointing, with reports 9.4% to 32%[8-9]. In our study patients with LV-AO discontinuity required longer cross-clamp and bypass times during surgery and were more likely to have postoperative low cardiac output syndrome requiring longer time of inotropic support than those with only aortic root abscess. This was in turn reflected on longer stay in the intensive care unit and in the hospital. However there was no statistical difference in early mortality among patients with aortic root abscess only and those complicated by LV-AO discontinuity.

Techniques of surgical repair are directed towards aggressive debridement of necrotic and infected tissues (although excessive debridement may cause complete heart block) together with reconstruction of the aortic annulus and root including repair with autologous or bovine pericardium and valve replacement with mechanical or stented biologic valves, as well as the use of valved conduits, homografts, xenografts, or autografts.[10-13] Homografts have the advantages over mechanical valves of no oral anticoagulation; better hemodynamics, possible use of the anterior mitral leaflet of the homograft to patch defects remaining from abscess resection and lower recurrent rate of endocarditis. However, homografts and xenograftes are often unavailable in our country especially for urgent surgery. Also some reports describe structural valve deterioration of stentless aortic bioprotheses.[14] In addition some reports have showed that homografts, and even autografts, are not immune to endocarditis, and reoperation for calcified failed aortic homografts remains a technical challenge due to severe adhesion.[15] Ross procedure requires lengthy cross-clamping and cardiopulmonary bypass, both of which potentially increase mortality and morbidity rates.[16]

We adopted our simple technique of directly reconstructing the annulus partly due to unavailability of homografts and partly due to the fact that our patients are relatively young and mechanical prosthesis might be a suitable choice for them. We irrigated antibiotics into both the abscess cavity and the valve sewing ring, but its efficacy is unclear as topical application of antibiotics still remains controversial.[17]

Finally, several limitations are associated with our study. The statistical power of the study is low due to the small patient population, and the follow-up might be too short to estimate complications over longer time.

Conclusion

In conclusion, left ventricular-aortic discontinuity is a serious complication of aortic valve endocarditis associated with a more difficult postoperative course. Surgical treatment of this complication continues to be challenging, but early results are encouraging. Annular reconstruction with simple or running Teflon-pledged sutures is safe.

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Midterm Results of Pericardial Strip Annuloplasty For Repair of Functional Tricuspid Regurgitation

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Backgrounds: **Functional tricuspid regurgitation due to left sided valvular lesions should be properly managed. It could affect functional state and survival. Many surgical techniques were developed with varying results.**

Objectives: **We investigated our midterm results of repair of functional tricuspid regurgitation using autologous pericardial strip.**

Patients and methods: **From January 2008 to December 2013, 50 patients (male: female 34:16, with a mean age 34±14 years) with moderate or severe tricuspid regurgitation were enrolled in our study. All had associated left sided valvular lesions (mitral in 33 patients, aortic in 2 and double valves in 15) that were managed by mechanical valve replacement. Tricuspid regurgitation was corrected by pericardial strip annuloplasty. The mean follow up period was 3 years.**

Results: **The overall survival rate was 98%. Manifestation of right heart failure improved in 14 of 16 patients (87.5%). Forty seven patients (94%) stayed in NYHA class I postoperatively. Freedom from recurrent moderated TR was 94% and 92% at one year and three years respectively.**

Conclusion: **Pericardial annuloplasty for repair of functional tricuspid regurgitation is an easy, inexpensive, reproducible and efficient technique.**

KEY WORDS: **Functional tricuspid regurgitation, Pericardial annuloplasty, repair**

Tricuspid regurgitation (TR) is mostly functional due left sided valvular lesions or myocardial disease. The underlying mechanism seems to be progressive annular dilatation and decreased leaflet coaptation.(1) Tricuspid regurgitation is usually managed during operations involving other valvular lesions. If left untreated, TR negatively influences functional state and survival.(2) While repair methods such as De Vega has good early results, still the late recurrence of TR is significant (3).

Here we present our experience in tricuspid valve repair using strip of autologous pericardium for repair of functional tricuspid regurgitation.

Patients and methods

This study was conducted under protocol approved by institution research ethics committee in King Abdul Aziz University Hospital (KAUH).

From January 2008 to December 2013, 50 patients underwent tricuspid annuloplasty for functional TR as part of their cardiac surgical procedure at KAUH. Patients were identified and preoperative, operative, and postoperative variables were retrieved from the prospective KAUH Cardiac Surgery Database.

Operative Techniques

All patients were operated upon via median sternotomy. Cardiopulmonary bypass was conducted using aortic and bicaval cannulation in the usual manner. Myocardial protection was achieved by warm antegrade blood cardioplegia

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The left sided valve lesions were managed first by valve replacement. Then the tricuspid valve was approached through right atriotomy with the aorta clamped or on beating heart. The tricuspid valve was carefully assessed.

We used the technique developed by Chang et al (4). We started by harvesting and preparing an autologous pericardial strip (8 to 10 cm in length, 5 to 8 mm in width). The smooth surface was kept upwards and was sutured to the tricuspid annulus with interrupted mattress sutures of 2-0 Ethibond suture (Ethicon, Inc, Somerville, NJ), starting from the posteroinferior aspect of the septal leaflet to the anterior septal commissure. Two- to three-millimeter-interval sutures in the autologous pericardial strip and 5 to 6 mm-interval sutures in the tricuspid annulus. By this way the tricuspid annulus could be shortened. (Fig. 1) After the procedure, we measured the annulus diameter using a valve sizer. In all patients, intraoperative assessment of the valve was done either by direct injection of normal saline solution 0.9% in the right ventricle (RV) through the valve in arrested heart or suctioning the coronary sinus in beating heart to evaluate any regurgitated flow from right ventricle to right atrium. Intraoperative transesophageal echocardiography was used to confirm adequacy of the repair. Transthoracic echocardiography combined with color Doppler flow study were used to assess TR grade pre and postoperatively. Median time of echocardiographic assessment was 1 year. TR was graded as 0 for no regurgitation, 1 for mild, 2 for moderate, 3 for moderate to severe, and 4 for severe.

Follow up

Follow-up data including age, sex, symptoms, functional status, echocardiographic data were obtained for every patient. Assessment was done at one month, 6 months, and 3years postoperatively.

Statistical Analysis

The data were entered and analyzed using the statistical package for social sciences (SPSS Inc, Chicago, IL, USA), version 16.00. The quantitative data were presented in the form of mean, standard deviation and range, and were compared using independent t-test. Chi-square test was used to compare qualitative data. We considered statistical significance when P value < 0.05 and confidential interval of 95 percent.

Results

We operated 50 patients with moderate or severe functional TR in conjunction with other valve lesions. Table (1) showed the preoperative characteristics

All patients had associated left sided rheumatic valvular lesion. Mitral valve pathology accounted for 96% of patients. No previous cardiac operations were performed. RV failure manifestations (jaundice, neck vein congestion, ascites, enlarged liver and pitting edema) were found in 16 patients (32%).

Age (mean ±SD)	34±14 (16-69)
Female sex	16 (32%)
Duration of illness	5.2 years ±1.04
Preop NYHA class	
VI	12
III	26
II	12
Manifestation of RV dysfunction	16
EF mean±SD	0.543 ± 0.834
≤ 0.4	2
TR	
Moderate	10
Moderate to severe	23
severe	17
TR	
+ mitral disease	33(66%)
+ aortic disease	2(4%)
+ double	15(30%)
PH	
Mean ± SD	75.59±13.12

Table 1. The preoperative characteristics

Operative data

Concomitant mitral valve surgery was performed in 66% of patients, and aortic valve surgery in 5 %. Triple valve surgery was performed in 29 % patients.

Operative data including associated valvular procedures, mean bypass time, number of tricuspid repair on beating or arrested heart and mean cross clamp time are shown in table (2)

Variable	values
Tricuspid + mitral	33
+ aortic	2
+ double	15
Bypass time (min):	
Tricuspid + mitral	92.80±7.75
+ aortic	105±7.78
+ double	124.45±12.65
Clamping time (min):	
Tricuspid + mitral	66.50±5.73
+ aortic	99.50±4.2
+ double	96.18±8.18
Tricuspid repair on beating heart	40 patients(80%)
Tricuspid repair on arrested heart	10 patients (20%)
Mean size of TV annulus (mm)	32.08±0.81
Inotropic support	44 patients (88%)

Table 2. Operative data

Intraoperative assessment of tricuspid valve repair showed competent valve in all cases.

Mortality

There was one (2%) early mortality (within 30 days of surgery or during the same hospitalization). That was a 20 years male patient with sickle cell anemia, renal failure on dialysis and low EF (0.40). He was operated for mitral valve replacement and TV repair and died on postoperative day 11 because of low cardiac output. No late deaths were recorded.

Morbidity

One patient was explored for bleeding and one developed mediastinitis that necessitated debridement and rewiring. Both patients recovered well and were discharged in stable condition. No complications were found related to pericardial strip annuloplasty e.g. dehiscence, thrombosis, calcification.

Follow up

Follow up was complete. Two patients persisted with RV failure manifestations and continued medical treatment. They had recurrent TR more than grade II. The remaining patients showed clinical improvement and stayed in NYHA class I. No cardiac reoperations occurred. All left sided prosthetic valves were well functioning. Transthoracic echocardiographic study of tricuspid valve repair was done predischarge, at one year (early) and at 3 years (midterm). Freedom from recurrent moderated TR was 94% and 92% at one year and three years respectively. Data are shown in table (3)

Variable	values	
	No.	%
Early TR		
≤ mild	47	94
Moderate	2	4
severe	1	2
Midterm TR		
≤ mild	46	92
Moderate	3	6
severe	1	2

Table 3. Postoperative echocardiographic assessment of TV

Discussion

Functional TR represents a challenge to cardiac surgeons regarding indications and choice of proper repair method. It is crucial to achieve satisfactory anatomical and physiological correction to ensure favorable long term results (5). Residual TR negatively affects functional status of patients postoperatively and redo operations for isolated TR have high mortality rate (6). The concept that TR will improve after correcting left sided valvular lesions might be justified only for mild TR with normal TV annulus and valvular structure (7). Recent AHA/ACC guidelines recommended intervention for patients with severe TR who are undergoing surgery for left sided valvular lesions (Class I, level evidence C). Repair should also be considered in cases of mild or moderate TR with either tricuspid annular dilatation (>40 mm diameter or 21 mm/m2 diameter indexed to body surface area on preoperative TTE; >70 mm diameter on direct intraoperative measurement) or prior evidence of right heart failure (Class IIa, level evidence B).(8) Many studies emphasized the importance of TV annulus in repair decision irrespective of degree of TR (9). In our study we included 10 patients with preoperative moderate TR for repair. Considering the high mortality rate of tricuspid valve replacement, many repair methods were developed for better outcome (10). De Vega repair is simple, easy, not expensive method with good early results. However, long term results reported by some series showed high recurrence rate particularly in patients with pulmonary hypertension or severe annular dilatation (3,11). There is an increasing evidence to support ring annuloplasty over conventional De Vega stitch with respect to recurrent TR and survival (12). Repair without ring exposes the tricuspid annulus to elevated PAP and RVSP with consequent dilatation and regurge. As an alternative to rigid rings, Chang et al constructed flexible autologous pericardial ring in 1998. In a comparative study including 117 patients repaired by suture annuloplasty (De Vega or Kay) and 217 patients repaired by autologous pericardial strip they found the latter superior in terms of long-term recurrence-free survival (4). Thirty-three (11.1%) of their patients had significant residual TR. We believe that such method of repair might be very appropriate especially with our patients with rheumatic valvular disease and pulmonary hypertension. It has advantages over rigid rings being flexible thus can maintain annular contraction and contribute to RV function. In addition, it is without cost and this economic advantage is appreciated especially in developing countries. We applied the same surgical technique described by Chang et al but we modified it regarding estimating the length of pericardial strip. Chang et al calculated the length as approximately $^{2}/_{3}$ to ¾ x 2 π R (R = radius of tricuspid valve). We applied a simple way that we decided it according to the appropriate tricuspid obturator sizer, by measuring along its rounded margins between the two notches (13). We had 4 patients (8%) with ≥ grade II residual TR which is comparable to other studies (4, 14,15). Two of those patients continued to have manifestations of RV failure and under medical treatment. We may decide for redo operation if they do not improve. Otherwise the remaining patients showed marked clinical improvement of RV function and stayed in NYHA class I. Our study has some limitations. It is a retrospective observational study including few number of cases. We need to carry out a prospective randomized study

to compare it with De Vega stitch and rigid annuloplasty in the future. And lastly we showed early and mid term results which are encouraging, so long term results would be very valuable.

In conclusion, we found repair of functional TR using autologous pericardial strip an easy, reproducible, inexpensive and efficient technique.

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Preoperative Oral Carbohydrate Treatment Improves Postoperative Outcomes In Cardiac Surgery

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Background : **Some studies showed that it was perfectly safe to allow patients to drink clear fluids as water, coffee, tea without milk and juice until 2 hours before elective surgery.**

Objective : **The aim of our study was to investigate whether preoperative oral intake of carbohydrate rich drinks could improve outcomes and reduce stress response post cardiac surgeries.**

Methods: **This prospective randomised study was conducted over 50 patients scheduled for on pump cardiac surgeries at Ain Shams university hospital. After institutional review board approval and obtaining written consents, the patients were randomly divided into fasting group and CHO group. In fasting group, patients received induction with NPO starting from midnight. In CHO group, patients received induction with 600 ml of carbohydrate rich drink in the evening before the procedure and 150 ml of the drink 2 hours before operation. The following were monitored in all patients as exogenous insulin requirements to keep blood sugar below or equal to 10 mmol/l was used as marker), postoperative discomfort using numeric rating scale, and length of ICU stay and postoperative vital data.**

Results: **The length of ICU stay was significantly longer in fasting group compared with CHO group (p-value less than 0.001) ,postoperative inotropic support requirements were similar in both groups and time of mechanical ventilation was significantly longer in fasting group compared with CHO group (p-value less than 0.001). There was no significant difference regarding numeric rating scores among the study groups except for thirst sensation where (p value = 0.035). There was no significant difference regarding postoperative insulin requirements among the study groups(p=0.824).**

Conclusion: **This study suggested that although preoperative carbohydrate intake does not reduce insulin requirements postoperatively, it may improve other clinical outcomes, in terms of reduced inotropic support, time of mechanical ventilation, patient thirst sensation and length of ICU stay .**

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Some studies showed that it was perfectly safe to allow patients to drink clear fluids as water, coffee, tea without milk and juice until 2 hours before elective surgery.

Postoperative insulin resistance was characterising feature of the catabolic response to surgical injury [(1)]. The association with stress hyperglycemia was commonly observed especially in critical illness and leads to an increase of postoperative complications [(2)]. Intensive insulin therapy to normalise glucose levels reduces morbidity and mortality in critically ill patients [(3)]. Traditional overnight preoperative fasting acted as additional metabolic stress superimposed on surgical insults and other trauma [(4)]. New concepts were designed to minimise stress reactions by improving nutritional status before operation [(4)].

In animal studies, rodents that were fed before stress induction showed improved muscle and cardiac function, better immunologic performance, and most promi-

nently, better survival rates with complete recovery after haemorrhage and endotoxemia when compared with fasting subjects [4, 5]. A carbohydrate (maltose and fructose)-rich, clear beverage (CHO) was developed for preoperative clinical use [4].

CHO elicits endogenous release of insulin, comparable to a small breakfast in halting the overnight fasting metabolic state, and can be taken up to 2 hours before elective surgery [1]. In ASA I-II patients, CHO significantly reduced preoperative discomfort, postoperative nausea and vomiting, loss of lean body mass and muscle strength [4,6], without adverse effects [7]. Preoperative IV glucose administration and oral CHO caused significant reductions of PIR [8,9,10], and seemed to speed up the recovery measured by reduced length of hospital stay (LOS) [11].

Particularly in cardiopulmonary bypass (CPB)-guided cardiac surgery, the commonly associated systemic inflammatory response syndrome (SIRS) leads to marked anti-insulinergic metabolic disorders and was a major cause of peripheral insulin resistance [12]. Whether metabolic stress response in cardiac surgery patients was reduced by CHO has not been investigated. However, preoperative IV glucose treatment had been shown to benefit cardiac surgery patients; it had been associated with reduced postoperative impairment to cardiac muscle suggested by cardiac enzyme decrease, fewer complications such as serious arrhythmias, need for vasopressor and inotropic agents, and shorter durations of ventilatory support requirements and stay in the intensive care unit (ICU)[13-16].

The aim of this prospective study was to investigate whether the preoperative oral intake of carbohydrate rich drinks in patient undergoing onpump cardiac surgeries attenuated postoperative insulin requirements , improved postoperative patient discomfort, dose of inotropic support used postoperatively, length of ICU stay and duration of postoperative mechanical ventilation .

Materials and Methods

After institutional review board approval of Ain-Shams university and written informed consent .This prospective randomised parallel group study was conducted over 50 ASA II-III aged from 50-65 years old, undergoing elective on pump cardiac surgeries performed at Ain Shams University Hospitals, this study was carried out between April 2012 and July 2013.

The patients were randomly divided by allocation concealment method into 2 groups , fasting group and CHO group. In fasting group (25patients) , patients received induction with NPO after midnight. In CHO group (25 patients) patients received induction with 600 mL of carbohydrate rich drink (12.5 g/100 mL carbohydrate, 12% monosaccharides, 12% disaccharides, 76% polysaccharides, and 285 mosmol/kg; Nutricia Preop; Pfrimmer Nutricia GmbH, Germany)in the evening before the procedure and 150 mL of carbohydrate rich drink 2 hours before the procedure.

Exclusion criteria included conditions likely to impair gastrointestinal motility or enhanced gastrointestinal reflux, potentially difficult airway management, ASA physical status > IV, non-elective or emergent surgery, presence of infection, pregnancy, fructose intolerance or patient refuse the protocol of the study.

Pre-anaesthetic check and investigations as CBC, coagulation profile, ehocardiography and coronary angiography and on night of surgery, preoperative evaluation was performed. In the preparation room, the anaesthesiologist secured a 18 gauge cannula and Premedication was standardised to midazolam 0.05 mg/kg i.v, and an infusion of Ringer acetate was started. Standard monitoring was used in the form of 5 lead electrocardiogram with ST segment monitoring, pulse oximetry ,end tidal CO2 , invasive arterial blood pressure.

Prior to induction of anaesthesia , a baseline laboratory evaluation was done including prothrombin time, haemoglobin, hematocrite and fibrinogen level.

Induction of anaesthesia was done using thiopental (5-7 mg/kg), fentanyl (5 mic/kg), pancuronium bromide (0.08 mg/kg) for patient intubation .

Anaesthesia was maintained with isoflurane 1.2%, fentanyl (3-5mic/kg), and pancuronium bromide 0.01mg/kg and patients were ventilated by volume controlled mechanical ventilation, to maintain the end expiratory carbon dioxide from 34-36 mmHg.

Nasopharyngeal and skin temperature and urine output were monitored .

Surgery were performed to all patients by the same surgical team.

After median sternotomy ,Cardiopulmonary bypass was instituted with 1500 ml crystalloid priming volume and mild hypothermia (32° C) with a Trillium affinity NT oxygenator and a Sarns CPB machine at a flow rate of 2.6 l .min -1.m-2.

Myocardial protection was achieved with cold blood cardioplegia at 20°C During CPB ,homologous donor packed RBCs are transfused if HB is below 6 g.dl -1. Systemic heparinisation was carried out before CPB with un-fractionated heparin at an initial dose of 300 IU.Kg -1. An elite activated clotting time (ACT) above 400 was targeted.

This was achieved with additional heparin doses of 100 IU.Kg-1 if necessary. The effect of heparin was reversed at the end of CPB with protamine 1 mg for every 100 U of heparin administered The anaesthesiologist administered the protamine into the central line by continuous infusion over a period of 15 min. A second dose of protamine 50 mg was administered if the ACT remained at more than 150 sec.

After surgery all patients were transferred to the ICU during the peri-operative period.

Inotropic treatment was prospectively defined as dopamine ≥5 μg.Kg^{-1} and epinephrine, and vasopressor treatment as dopamine >10 μg.Kg^{-1}.min^{-1} and norepinephrine per se.

Primary outcome measure

Insulin requirements was deliberately chosen as a surrogate marker to estimate peripheral insulin resistance, assuming accurate maintenance of equivalent glucose levels among the two study groups ***(17)***.

Adjustments of insulin dose were based on a continuous insulin infusion therapy protocol and adjusted according to hourly blood glucose measurements. We were attempting to maintain blood glucose levels between 4.4.-6.1 mmol/L, we chose a wider range of 4.4-10 mmol/L. When blood glucose level was ≥ 8 mmol/L, insulin infusion was initiated at a starting dose of 2 IU/hr. If blood glucose level on which insulin was started ≥ 10 mmol/L, the starting dose of insulin was set at 4IU/hr. If the glucose level was ≥ 12 mmol/L, the dose amounted 6IU/hr.

Secondary outcome measures

Both intra- and postoperative inotropic requirements in both groups were recorded. Duration of mechanical ventilation and ICU stay were recorded in both study groups.

Patients rated five subjective discomfort variables of thirst, anxiety and agitation. The data regarding complaints were rated using a numerical scale of 1 (none), 2 (mild), 3 (moderate), 4 (severe)..

The systems used were horizontal, ungraded scales bounded by vertical lines from 0 to 100 mm, signifying the minimal and maximal extreme values of variables ***(6,7)***.

Because no pilot study had ensured that drink flavour didn't cause bias, the CHO group were asked to evaluate the taste of their drinks.

Heart rate and blood pressures were recorded at 1, 4, 8, 12, 18, 24 hours postoperatively.

Statistical analysis:

EpiInfo® version 6.0 program was used for calculations of sample size, statistical calculator based on 95% confidence interval and power of the study 80% with α error 5%.

The collected data was coded, tabulated, and statistically analysed using SPSS program (Statistical Package for Social Sciences) software version 17.0.

Descriptive statistics were done for numerical parametric data as mean±SD (standard deviation), while they were done for categorical data as number and percentage.

Inferential analyses were done for quantitative variables using independent t-test in cases of two independent groups with parametric data.

Chi-square:

The hypothesis that the row and column variables are independent, without indicating strength or direction of the relationship. Pearson chi-square and likelihood-ratio chi-square. Fisher's exact test and Yates' corrected chi-square are computed for 2x2 tables.

Qualitative variables were compared using Chi-square test.

P value <0.05 was considered significant.

Results

Regarding the demographic and clinical characteristics, there was no significant difference among study groups. (table1)

There was no significant difference difference among the study groups regarding the surgical data.(table2)

There was no significant difference in insulin requirements among the study groups(table3)

After initiation of CPB weaning until the end of operation and during postoperative period, there was no significant difference regarding the inotropic requirements than did the fasting patients.(table3)

There was significant reduction in the time of mechanical ventilation of CHO group compared with fasting group.(table3)

ICU stay was significantly shorter in CHO group compared with fasting group.(table3)

There was significant reduction regarding numeric scale score of thirst among study groups.(table 3)

There was no significant difference regarding numerical scale scores between the 2 study groups with respect to anxiety and agitation.(table3)

There was no significant difference in the mean arterial blood pressure between the two study groups at all time points. (table 4)

There was a no significant difference in mean heart rate between the two groups at all time points.(table 5)

		Groups		Test	
		CHO Group	Fasting Group	t/X²	P-value
Age	Range	65.000-55.000	65.000-50.000	0.371	0.715
	Mean±SD	3.368±58.700	3.843±58.100		
BMI	Range	34.000-25.000	35.000-24.000	0.073	0.943
	Mean±SD	2.914±28.400	3.199±28.300		
EF	Range	70.000-40.000	70.000-54.000	-0.206	0.839
	Mean±SD	8.062±58.100	4.448±58.700		
Sex	Female	10 (%40)	8 (%32)	0.868	0.768
	Male	15 (%60)	17 (%68)		
ASA	II	17 (%68)	16 (%64)	0.360	0.849
	III	8 (%32)	9 (%36)		
Type of DM	Type I	5 (%20)	7 (%28)	0.110	0.745
	Type II	10 (%40)	12 (%48)		
HTN		15 (%60)	13 (%52)	0.083	0.775
CABG		13 (%52)	14 (%56)	0.006	0.943
Valve replacement surgery		12 (%48)	11 (%44)	0.020	0.887

BMI= body mass index EF= ejection fraction DM= diabetes mellitus HTN= hypertension

Table 1:Demographic and clinical data :

Surgical factors		Groups				Test	
		CHO Group		FastingGroup		t/X²	P-value
Total bypass time	Mean±SD	99.7±25.9		97.2±25.8		0.342	0.733
Cross clamp time	Mean±SD	74.1±19.5		75.6±19.4		0.273	0.786
Number of grafts	1	3	23.1	2	14.3	1.615	0.656
	2	2	15.4	3	21.4		
	3	7	53.8	9	64.3		
	4	1	7.7	0	0.0		

Table 2:Surgical data

		Groups		Test	
		CHO Group	Fasting Group	t/X²	P-value
Time of MV(hr)	Range	8.000-12.000	18.000-24.000	13.844	<0.001
	Mean±SD	9.200±1.476	21.100±2.283		
ICU stay(days)	Range	1.000-2.000	3.000-4.000	9.000	<0.001
	Mean±SD	1.400±0.516	3.500±0.527		
Inotropic support(number of pts)		10 (40%)	12 (48%)	0.812	0.775
Intropes in ICU		7 (28%)	12 (48%)	2.2	0.145
Dose of Insulin given		5.5±2.01	5.8±3.70	0.225	0.824
Numerical scale rating	Thirst	1(1-2)	4(3-4)	3.745	0.035*
	Agitation	2(2-3)	3(2-3)	1.123	0.491
	Anxiety	2(2-3)	2(2-3)	0.000	1.000

MV= mechanical ventilation ICU=Intensive care unit

Table 3: Time of MV , ICU stay, inotropic support, insulin dose and numerical scale rating:

MBP	Groups						T-Test	
	CHO Group			Fasting Group				
	Mean	±	SD	Mean	±	SD	T	P-value
T 1	67.257	±	7.313	68.784	±	4.421	-0.565	0.579
T 4	67.698	±	7.669	65.660	±	4.836	0.711	0.486
T 8	66.456	±	10.056	63.207	±	9.647	0.737	0.470
T 12	64.273	±	7.192	66.029	±	5.287	-0.622	0.542
T 18	63.692	±	7.150	63.497	±	6.361	0.064	0.949
T 24	63.809	±	6.529	66.235	±	5.289	-0.913	0.373

MBP=mean arterial blood pressure T1,4,8,12,18,24=1,4,8,12,18,24 hour(s) post-operative

Table 4: Mean blood pressure :

HR	**Groups**						**T-Test**	
	CHO Group			**Fasting Group**				
	Mean	**±**	**SD**	**Mean**	**±**	**SD**	**T**	**P-value**
T 1	87.900	±	4.932	91.300	±	4.498	-1.611	0.125
T 4	92.400	±	3.134	94.600	±	5.739	-1.064	0.301
T 8	88.800	±	4.984	91.400	±	4.402	-1.236	0.232
T 12	91.600	±	2.413	90.400	±	4.248	0.777	0.447
T 18	89.800	±	6.443	90.100	±	6.064	-0.107	0.916
T 24	90.000	±	3.944	87.500	±	6.654	1.022	0.320

hour(s) post operative 1,4,8,12,18,24=HR=heart rate T1,4,8,12,18,24

Table 5: Heart rate

Discussion

In this prospective randomised clinical trial, patients who received preoperative carbohydrate rich fluids had significantly reduced time of mechanical ventilation and length of ICU stay with insignificant difference in insulin requirements and numeric rating scores compared to preoperative fasting.

As insulin requirement didn't differ among our study groups, it seemed that CHO administration before elective on pump cardiac surgery did not affect PIR in those patients. This contrasts with findings from previous investigations performed with ASA I-II patients which had identified significant reduction in PIR using a hyper insulinemic –euglycemic clamp technique ***(9,11)***.

Yagmurdur, et al.who showed that CHO group **was** less hungry, thirst, anxious and stabilised mean arterial blood pressure($P<0.05$) [18] **.**

Hatice et al.(2001) in their study showed that preparation with oral carbohydrate before spinal anaesthesia had advantages overnight fasting during the peri-operative period by increasing patient well being, improving insulin response but in this point it did not agree with our study which showed that CHO had no effect on insulin resistance[19]**.**

In other clinical trials, preoperative IV carbohydrate administration before cardiac surgery had also led to markedly improved cardiac performance given alone or combination with IV lipids or insulin and potassium carbohydrate was found to

reduce the incidence of cardiac insufficiency and other complications i.e., fibrillation or need for vasopressors [13,14,15,16].

In particular, ***Lazar et al. (1997)*** reported reduced inotropic supports postoperatively after peri-operative administration of IV glucose-insulin-potassium to patients undergoing urgent GABG surgery. However, the need for inotropic support defined as dopamine ≥2 μg/kg/min compared with our definition of ≥5 □g/kg/min did not differ significantly in their study[13].

Hausel et al. (2001) using VAS for a large sample size of ASA I-II patients undergoing abdominal surgery (n=252), also found no difference in thirst after the morning drink,this agreed with the results of our study [7].

Henriksen et al. (2003) showed contrasting results in his study (n=48) comparing CHO administration with fasting in patients before elective bowel resection. In that study patients showed no difference even in thirst. Preoperative administration of CHO seemed to reduce intraoperative requirements for inotropic drugs[6].

A former study ***Quiros and Ware*** [5] and recently by **van *Hoorn et al.* (20)** had investigated the cardiovascular effects of prestress nutrition versus starvation in rats within hemorrhage induced hypotension and ischemic / re-perfusion models, respectively. Both studies showed consistent, significantly improved cardiac function indicated by higher cardiac output and stroke volume and slower heart rates in fed versus fasted animals.

Harsten, et al. found that postoperatively, patients in the carbohydrate group experienced less pain at 12, 16 and 20 h (median scores 20, 30 and 34 vs. 7, 5 and 0 mm; $P < 0.05$). This study disagreed with our findings regarding pain scores.

A retrospective analysis of prospectively collected data showed that patients treated with preoperative CHO were discharged from hospital approximately 20% more quickly then those fasted over night suggesting that the treatment enhances recovery after surgery [11].

These results were consistent with those of our study.

The major limitation of this study was the small sample size that limited any type of sub analysis.

Conclusion

CHO intake doesn't reduce insulin requirements postoperatively but it seems to improve other aspects of clinical outcomes in terms of reduced ICU Study and duration of postoperative mechanical ventilation.

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Early Experience of Video-Assisted Thoracoscopic Surgery in Management of Thoracic Trauma Patients

Thoracic

Moustafa F. Aboollo, MD.

Background: **As described in the literature, VATS can be used in acute setting of thoracic trauma as a diagnostic or therapeutic tool as well as for managing the short-term or long-term complications of trauma. In stable trauma patients, VATS is safe and tolerated better by the patients than thoracotomy, with less postoperative complications.**

Objective: **The aim of this work is to evaluate the role of Video-Assisted Thoracoscopic Surgery (VATS) in management of thoracic trauma in the acute settings.**

Patients and methods**: Eighteen patients of thoracic trauma were studied prospectively. Hemodynamic stability in thoracic trauma patients who had significant injury was the main inclusion criterion. Patients were resuscitated and stabilized in emergency room, and then laboratory and radiological evaluation were done accordingly. Thoracoscopy was done on either emergency basis (from time of trauma to day two), or early post-traumatic (from day two to day seven from trauma). Mechanism of trauma, impact of trauma, operative results of thoracoscopy and postoperative outcome of patients were reported.**

Results: **Eighteen patients of thoracic trauma were included; twelve(66.6%) with road traffic accidents (RTA), three (16.6%) with penetrating chest trauma, two (11.1%) with injury due to fell from height (deceleration) and one patient with blast injury with foreign body impaction in the lung. Eleven patients (61.1%) were operated emergently and seven patients(38.9%) were operated early after trauma. All patients were males. Preoperative diagnosis was; 5 patients with hemothorax (27.7%), 6 with pneumothorax (33.3%), and 7 patients with hemopneumothorax (38.8%). All the patients, except two with penetrating trauma, had variable degrees of lung contusion and ribs fractures. No cases were re-operated after VATS, no cases of mortality.**

Conclusion**: In stable trauma patients, VATS is a reliable and effective procedure that can be done safely in the acute settings and tolerated well by the patients, with less postoperative complications.**

Thoracic injuries following trauma is an important cause of morbidity and mortality [1] and there is no doubt that a tube thoracostomy and emergent thoracotomy are typically performed to control bleeding in patients with hypovolemic shock. When patient vital signs are stabilized, the next step is treating posttraumatic complications.[2]

Video-assisted thoracoscopic surgery (VATS) has been established as safe and effective for major thoracic procedures such as pulmonary resection. VATS has also been used in the management of thoracic trauma in the acute settings for evacuation of residual hemothorax following tube thoracostomy, managing thoracic bleeding in stable patients, prevention and treatment of empyema, assessment and repair of persistent air leak, diagnosis and repair of diaphragmatic injuries and also removal of foreign bodies[3-6]. As a minimal access procedure, it reduces the morbidity associated with a negative or non-therapeutic thoracotomy and also avoids chronic post-thoracotomy pain observed in 5 to 25% of patients.[7] Jackson and Ferreira, described thoracoscopy to diagnose diaphragmatic injuries in victims with penetrating injury to the left lower chest.[8]

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Codex : o4/01/1504

Jones *et al*.,[9] performed emergency thoracoscopy under local anesthesia on 36 trauma patients presenting with hemothoraces, which had high output from the chest tubes. Thoracotomy was avoided in 44% of these patients, based on the findings on thoracoscopy. Also VATS has been described post-trauma for the management of the complications of trauma (e.g., empyema or retained hemothorax).

Patients and Methods

This is a prospective study to evaluate the benefits of video-assisted thoracoscopy in managing trauma patients with significant thoracic injury. We included eighteen patients with thoracic trauma of different etiology who were admitted to Thoracic Surgery Unite, King Abdullah Hospital, K.S.A. in the period between November 2013 and February 2015. All patients were hemodynamically stable at time of the procedure including; twelve patients of road traffic accidents (RTA) (66.6%), three with penetrating stab injury (16.6%), two patients with fell from height (11.1%), and one patient with blast injury (5.5%). Regarding the timing of intervention, all patients were done either on emergency basis (trauma day one or two) or early post-trauma (day three to day seven).

Exclusion criteria included

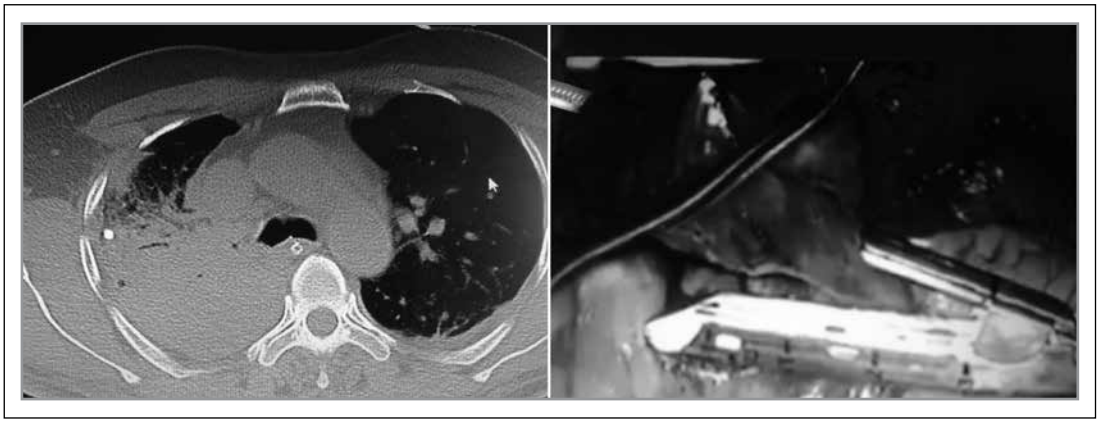
1- Hemodynamically unstable patients including patients with major cardiac or vascular injury who are candidates for thoracotomy or sternotomy,

2- Patients with history of previous thoracotomy because of expected pleural adhesions.

3- Patients who can't sustain single lung ventilation (due to chronic pulmonary disease or bilateral lung injury).

Patients were resuscitated and stabilized in the emergency department under the supervision of a multidisciplinary trauma team and then were evaluated by chest X-ray and further imaging modalities as indicated. Tube thoracostomy was performed in all patients based on clinical or radiological evidence of hemothorax and/or pneumothorax. Informative consent was signed by every patient or his sponsor, stressing on the fact that the procedure can be converted to open thoracotomy at any time as indicated.

All procedures were done under general anesthesia using double-lumen endotracheal tube, however when necessary, single-lumen tubes were utilized with bronchial blockers. A complete surgical set for thoracotomy was kept stand-by in case of need for thoracotomy. Patients were put in the lateral decubitus position as for thoracotomy. The scope port (10 mm) was done at the sixth or seventh intercostal space in the mid- axillary line, or at the opening for chest tube. A 30-degree camera was introduced and the pleural cavity was explored thoroughly and then other ports (usually two) were done under thoracoscopic vision. Lesions encountered were dealt with accordingly. The decision for open thoracotomy was taken in only one patient in whom there was complete disruption of the right lower lobe bronchus, due to fall from height, and thoracoscopic repair was not feasible. After completion of the procedure, either one or two wide pore chest tubes (28-32 Fr) were inserted to drain the pleural cavity.



Right; Lacerated apical part of the right lung while resection by stapler. Patient No. 11
Left; Patient with blast injury with F.B. impaction on the surface of the lung. Patient No. 18

Results

Eighteen chest trauma patients were operated, all of them were males, with range of age 32.8 (18-55 years). Twelve patients had injuries due to road traffic accidents (66.6%) in the form of; five hemothoraces, four pneumothoraces, and three patients with hemopneumothorax, all were associated with multiple fractured ribs and ipsilateral lung contusions of variable degrees, and the indication of thoracoscopy was due to either high drainage after chest tube insertion which does not reaching the criteria for open exploration (four patients, 33.3%), or due to continuous air leak (three patient, 25%), or retained hemothorax (three patients, 25%), or failure of the lung to expand after the 3rd day of trauma (two patients, 16.6%). Regarding operative findings; from the three patients with high output there were two patients with oozing from the intercostal muscles and fractured rib sites which was electrocauterised and in one patient it was from lung laceration which was controlled by stapler. Continuous air leak (3 patients) was due to lung tears and all were controlled using either stapler with superadded tissue glue (BioGlue) on the stapler line or direct tissue glue application when the tear is superficial. In patients with retained hemothorax (all three patients; 2 were operated in the 4th day and one patient in the 3rd day), blood clots (between 400-500 ml) were evacuated with suction irrigation and explorations were otherwise negative. There were two patients with RTA and failure of the lung to expand after the 3rd day, this was due to immature adhesions in the pleural cavity and adhesiolysis was done with complete postoperative lung expansion.

Three patients(16.6%) with penetrating stab injury to the chest were operated; two in the right side with hemopneumothorax and one to the left with pneumothorax and suspected diaphragmatic injury due to low stab in the 8th intercostal space in the back. In thoracoscopy, one patient with stab in the right side had lung tear that was treated by endosutures, and the second patient with right stab had injury to the associated intercostal artery which was clipped and the lung was free. The patient with left stab had a 2 cm transfixing wound in the diaphragm, without visceral herniation and normal contrast CT abdomen, this tear was repaired.

	Age/ years	Trauma type	Diagnosis	Indication for VATS	OR Day	Intraoperative Findings	Procedure	ICT stay	Hosp. stay
1	31	RTA	Hemothorax	High output	1st	Fracture site oozing	Hemostasis	4	6
2	38	RTA	Hemothorax	High output	1st	Fracture site oozing	Hemostasis	4	6
3	47	RTA	Hemothorax	High output	1st	Lung tear	Stapler	5	7
4	18	RTA	Hemothorax	High output	1st	Lung tear	Stapler	5	7
5	23	RTA	Hemothorax	Ret. Hemothorax	4th	Blood clot	Evacuation	2	6
6	22	RTA	Pneumothorax	Lung Fail to expand	3rd	Adhesions	Ahesiolysis	3	6
7	21	RTA	Pneumothorax	Air leak	1st	Lung tear	Stapler	4	6
8	29	RTA	Pneumothorax	Air leak	2nd	Lung tear	Tissue glue	4	8
9	55	RTA	Pneumothorax	Lung Fail to expand	4th	Adhesions	Adhesiolysis	2	7
10	42	RTA	Hemo-pneumo.	Ret. Hemothorax	3rd	Blood clot	Evacuation	3	8
11	29	RTA	Hemo-pneumo.	Air leak	1st	Lung tear	Stapler	4	7
12	42	RTA	Hemo-pneumo.	Ret. Hemothorax	4th	Blood clot	Evacuation	4	9
13	43	Stab	Hemo-pneumo.	Air leak, high output	1st	Lung tear	Endosuture	4	6
14	19	Stab	Hemo-pneumo.	High Out put	1st	Intercostal	clipped	2	4
15	21	Stab	Pneumothorax	Diaphragmatic injury	1st	Diaphragmatic injury	Repair	2	5
16	28	F.F.H	Hemo-pneumo.	High output	1st	Lung tear	Tissue glue	3	15
17	31	F.F.H	Pneumothorax	Air leak	1st	Bronchial avulsion	Conversion	5	13
18	52	Blast	Hemo-pneumo.	Lung cont., F.B.	6th	Laceration	F.B. extraction, wedge resection	5	12

F.F.H. : Fell from height. F.B. : Foreign body. cont. : contusion. Hemo-pneumo. : Hemopneumothorax.

Two patients (11.2%) with injury due to fell from height; one patient with bilateral lung contusion mainly on the right side with right hemopneumothorax, he was mechanically ventilated in emergency room (using single lumen endotracheal tube) due to head injury, right thoracoscopic exploration on 1st day revealed a non-expanding hilar hematoma with massive middle and lower lobe contusion with multiple lower lobe superficial tears treated by tissue glue application alone. The other patient with fell from height had right side pneumothorax with massive air leak with non-conclusive CT findings, on thoracoscopy there was complete avulsion of the right lower lobe bronchus and this patient was converted to open thoracotomy for repair of the bronchus. The last patient (5.5%) was involved in blast injury with impaction of metal foreign body in the surface of right upper lobe. This patient was referred from other hospital after four days of injury on mechanical ventilation, having right hemopneumothorax and apical consolidation with right chest tube and was admitted to intensive care unit. On the fifth day of injury thoracoscopy was done and the foreign body was extracted with apical wedge resection of lung laceration.

All patients with penetrating injury (3 patients) and patients who fell from height (2 patients) and six patients with RTA had thoracoscopy in the first day of injury (on emergency basis) with total of eleven patients(61.1%). The rest of seven patients(38.9%) (six with RTA and one with blast injury) was operated between the 2nd to the 6th day after trauma (early post-traumatic). All patients had either one or two chest tubes according to the severity of injury, and chest tube period was calculated till the second tube is removed. The average period before chest tube removal is 3.6 (2-5 days) and average hospital stay of 7.6 (4-15 days).

Three patients (16.6%) were admitted to ICU after surgery (two with trauma due to fell from height, and that patient with blast injury who was already admitted to ICU). No cases were re-operated after VATS. No cases of wound infection. Only one patient had postoperative pulmonary infection that was treated conservatively. No cases of mortality were encountered. Patients were followed up for at least one month after discharge in the outpatient clinic with no reported events.

Arrangement of patients according to type of trauma, and preoperative diagnosis:

Discussion

VATS has typically been described for the management of subacute or chronic complications of thoracic trauma and there is little data regarding the use of this technique in the more acute setting.[10] Thoracoscopy in trauma patients was first described by Branco[11] in patients with penetrating chest injuries in 1946, then subsequently described by Jackson and Ferreira in 1976 to diagnose diaphragmatic injuries incurred by penetrating trauma to the lower chest.[8] In 1981, Jones, *et al*.,[9] reported the performance of emergency thoracoscopy with local anesthetic in patients with ongoing bleeding following tube thoracostomy placement for traumatic hemothoraces. Despite these early reports, VATS did not become more established in the management of thoracic trauma until recently. However, the use of thoracoscopy in the trauma setting has followed the expansion of VATS in elective thoracic procedures.[10]

There is no doubt that urgent thoracotomy remains the access of choice in patients with shock due to life-threatening thoracic injuries. However, a majority of hemodynamically stable thoracic injuries can be managed with tube thoracostomy initially or as a definitive care.[12] It is in this group of hemodynamically stable patients that thoracoscopy or video-assisted thoracic surgery (VATS) has a definite role for timely assessment and treatment of intrathoracic injuries.[12] It allow full exploration of the pleural cavity and much less invasive and incapacitating than thoracotomy, also complications are uncommon and rarely occur when the procedure is performed by one who mastered the technique.[13] Compared to thoracotomy, VATS is reported to have fewer postoperative complications, better postoperative pain control, fewer wound and pulmonary complications,[3] shorter time to resumption of normal activity and shorter chest tube duration time.[14]

As described in the literature it can be used in an acute setting as a diagnostic or therapeutic tool, and we addressed this role in our study, as well as for managing the short-term or long-term complications of trauma. Indications for thoracoscopy within 24 h post-injury include the evaluation and treatment of persistent hemo- and pneumothoraces, as well as other injuries such as suspected diaphragmatic tears, esophageal injuries, and other mediastinal wounds.[15] Also VATS has been described post-traumatic for the management of the short term complications of trauma like empyema or retained hemothorax.[16]

All of our patients were males with average age 32.8 (range 18-55), of them 12 patients (66.6%) with road traffic accidents and 2 patients (11.2%) with injury due to fell from height. This coincide with the fact that RTA predominates in middle age males. These data also agree with that of Gabal[17] who operated on 80 trauma patients all of them were males, most of them (81.25 %) are victims of road traffic accident, and 13.75% due to fell from height.

Timing of VATS is a crucial point in its effectiveness in trauma management, as its early performance allows early re-expansion of the lung that can restore lung function rapidly and improve clinical outcomes.[18] We operated eleven patients (61.1%) in the first day of trauma including five patients with high chest tube drainage, four with continuous air leak, and one with suspected diaphragmatic tear, and all of these patients were spared thoracotomy which would be the end results if VATS was not done. In a study by Goodman *et al*.,[10] VATS was shown to be well tolerated and effective in managing thoracic trauma in hemodynamically stable patients within the first 24h after injury. These results also agree with Gabal[17]

who operated most of his patients(77 patients) in the first day of trauma except 3 patients with retained hemothorax who were done on day seven.

Our results are also similar to that of Milanchi *et al*.[19] who studied 23 thoracic trauma patients, all patients were hemodynamically stable before and during the procedure, sixteen (69.5%) of them were spared thoracotomy by thoracoscopic procedure. Also, in a meta-analysis done by Villavicencio *et al*.[20] thoracoscopy was shown to prevent 62% of trauma patients from undergoing a thoracotomy or laparotomy, which agree with our results.

Managing retained hemothorax is one of the most critical treatments for blunt chest trauma. Although these retained hemothoraces may be spontaneously reabsorbed 4–6 weeks after trauma, excessive retained hemothorax may lead to additional complications. First, the hemothorax collapses the lung parenchyma. As accompanied by lung contusions and posttraumatic pneumonia, the collapse can produce an entrapped lung and cause acute respiratory failure in the initial phases.[21] Then, fibrothorax may develop in later phases, further reducing pulmonary function. Second, when the hemothorax is contaminated with microbials, empyema may occur. We operated on three patients(16.6%) with retained hemothorax, all performed within five days of trauma. Our results also coincide with study of Bradley *et al*.[22] and O'Connor *et al*.[23] as regarding timing of the procedure.

VATS should not be performed as an end to itself, but rather simply as an additional approach with specific indication and contraindications, and conversion to a thoracotomy should not be considered a failure. In our study, the rate of conversion to thoracotomy was 5.5% (one patient only) because thoracoscopic repair of bronchial tear was not feasible, and this coincide with the reported rates in the literatures.[19]

The average chest tube period was 3.6 days(range2-5 days), which coincide with that reported in the literatures, and this was reflected on the length of hospital stay that was 7.6 days(4-15 days) which is near to that of Gabal[17] results (9.1 days) and Milanchi *et al*.[19] which was 12 days.

Conclusion

VATS is a well tolerated, reliable, and effective procedure that can be easily applied to patients experiencing acute chest trauma with few complications. However, the scientific evaluation of the global impact of thoracoscopy in the management of thoracic injuries is currently limited to descriptive series, some of them using historical controls, and a few non-randomized prospective studies. Until more well-designed, prospective, randomized studies emerge which compare thoracoscopy to standard management protocols in defined patient populations with thoracic injuries, the potential benefit of thoracoscopy in chest trauma remains unvalidated and its value is limited to isolated patients depending on individual surgeon's preferences and skills.

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Modified French Window Double Edge Closure Technique in Decreasing Post-Thoracotomy Pain

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***Background*: We set out to determine whether there is a difference in postoperative pain and recovery after the patient undergoes modified French window exposure-double edge technique vs the standard posterolateral incision.**

***Methods*: This was a prospective randomized study where thirty consecutive patients underwent thoracotomies for different thoracic surgical procedures. Patients were divided into two groups according to the type of thoracotomy performed. Group A: included fifteen patients underwent conventional posterolateral thoracotomy (PT) and Group B: included fifteen patients underwent Modified French Window Double Edge Technique (DE). Postoperative pain score was recorded postoperatively daily until the seventh day and after discharge at 2, 4, and 8 weeks. The two groups were compared regarding preoperative, operative, and postoperative data.**

***Results*: Patients in both groups were matched for preoperative variables. Operatively, there were no significant differences between the two groups regarding type of operation, side of thoracotomy, length of skin incision and operative time. Time needed for ambulation and total hospital stay were significantly shorter in group B. The need for postoperative analgesia and epidural doses were significantly lower in group B, also the need for postoperative analgesia at one week, two weeks, one month, and two months were significantly lower in group B. Regarding postoperative pain score, patients in the modified French window double edge technique group had a highly significant lower pain scores during the first two months after operation.**

***Conclusions:* Modified French window double edge closure technique is safe, easy, and effective in decreasing post thoracotomy pain with subsequent earlier ambulation and lesser use of analgesics.**

***KEYWORDS:* Thoracotomy, Postoperative pain, French window, Double Edge.**

Recovery from thoracotomy depends on a number of variables, including preoperative morbidity, disease burden, extent of surgery, and perioperative analgesia. Post-thoracotomy pain can be severe, and it has been reported to be present in 21- 49% of patients even 1 year after undergoing the surgical procedure [(1)]. Among the factors that have been investigated as potentially influencing the levels of acute and chronic pain following thoracotomy has been the choice of incision [(2)].

Post-thoracotomy pain is probably the most severe pain experienced after surgery[(3)]. Studies have shown that high levels of immediate postoperative pain are associated with an increase in the likelihood of chronic pain [(4)].

In many studies, it is emphasized that long-lasting postoperative pain often present several weeks after thoracotomy might be due to intercostal nerve impairment. Stretching or damages of the intercostal nerves, transection of their cutaneous branches may contribute to the development of an important neuropathic component of postoperative pain [(5)].

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Techniques to protect the intercostal neurovascular bundle of the rib above during thoracotomy through intercostal muscle flap harvesting and others to protect the intercostal neurovascular bundle of the rib below through intra-costal sutures or edge closure had led to reduction in acute and chronic post-thoracotomy pain [6].

Reports of decreased postoperative pain are consistent with studies that have demonstrated less intercostal nerve dysfunction following thoracotomies. However, few data are available to demonstrate whether the type of incision can affect chronic pain and physical functioning following major thoracotomy [7].

The classic approach to thoracotomy is the posterolateral incision, and many thoracic surgeons have moved to utilizing a variety of incisions to approach the thoracic cavity aiming for better exposure, improved recovery, and better cosmetic results and reduced postoperative pain. In our study, we aimed to determine whether there is a difference in postoperative pain and recovery in modified French window exposure-double edge technique compared to the standard posterolateral incision.

Patients and Methods

This was a prospective randomized study where thirty consecutive patients underwent thoracotomies for different thoracic surgical procedures in cardiothoracic surgery department in Menoufia University Hospital from October 2012 to October 2014. Patients were divided into two groups according to the type of thoracotomy performed.

Group A: included fifteen patients underwent conventional posterolateral thoracotomy (PT) where the incision started at the mid- axillary line and continued posteriorly for 2 to 3 cm below the scapular tip. The latissimus muscle is divided with cautery, and the serratus muscle can often be spared. At the end of the procedure, the intercostal space was closed by pericostal suturve (four Z sutures using No. 2 polyglycolic acid).

Group B: included fifteen patients underwent Modified French Window Double Edge Technique (DE) where the thoracic cavity is entered using the standard thoracotomy incision but without using chest retractor, instead, rib resection of about one cm from both anterior and posterior ends of the corresponding rib (caudal rib) was made after freeing the neurovascular bundle. The intercostal insertion on the superior aspect of the divided rib was freed and the "rib flap" hung into the chest. The exposure was optimized by tacking the rib inside the chest using a 0-silk suture passed around the divided rib segment (fig. 1).

An angiocatheter was inserted through the skin into the chest approximately three intercostal spaces below the level of the incision. A crimped polypropylene suture was passed through the angiocatheter and was used to loop the ends of the silk suture, pulled through the angiocatheter, and clamped on tension at the skin surface, tacking the rib inside the chest wall. At this point, there was a "window" created that allows for the performance of the procedure (fig. 2).

Once the procedure had been performed closure of the intercostal space by double-edge closure technique using four to six simple sutures (No2 polyglycolic acid) with passage of sutures from the upper border of rib above to the lower border of rib below after freeing the neurovascular bundle at the suture site (fig. 3).

All patients had a thoracic epidural catheter inserted just prior to induction of general anesthesia and removed on the 3rd postoperative day. Postoperative analgesic protocol was standardized in all patients plus on demand doses of epidural analgesia (10 mL of 0.25% bupivacaine).

Postoperative pain (quantitated by the visual analogue scale) was assessed by 11-point scale (0= no pain, 10= maximal imaginable pain) [8] and pain score was recorded postoperatively daily until the seventh day and after discharge at 2, 4, and 8 weeks.

Fig 1. Resection of about one cm from anterior and posterior rib end

Fig 2. French window.

Fig 3. Closure of intercostal space by simple suture (double edge closure technique)

Patients younger than 18 years, and patients with previous thoracotomy, sternotomy or chronic pain disease such as rheumatoid and flail chest were excluded from the study.

The two groups were compared regarding preoperative, operative, and postoperative data.

Results

This study included thirty patients underwent thoracotomies for different thoracic surgical procedures. Fifteen patients (group A) underwent posterolateral thoracotomy (PT), and fifteen patients (group B) underwent thoracotomy using modified French window- double edge closure technique (DE). Demographic analyses demonstrated no differences in age and sex between the two groups (table1).

Operatively, there were no significant differences between the two groups regarding type of operation, side of thoracotomy, length of skin incision and operative time (Table 2).

Postoperative characteristics (table 3) showed no significant differences between the two groups in the amount and duration of chest tube drainage. Time needed for ambulation and total hospital stay were significantly shorter in group B.

	Group A (No = 15)		Group B (No = 15)		Test of significance	P value
Age (years) Mean ± SD	**38.13 ±12.86**		**39.33±9.10**		**Mann-Whitney 0.18**	**0.852(NS)**
	No	**%**	**No**	**%**	**χ^2**	
Sex						
Male	**11**	**73.3 26.7**	**11**	**73.3**	**0.20**	**0.65(NS)**
Female	**4**		**4**	**26.7**		

Table 1. Distribution of the studied groups regarding their age and sex.

	Group A (No = 15)		Group B (No = 15)		Test of significance	P value
Operative time (minutes)	**150.33 ±44.53**		**152.33±46.47**		**t=0.12**	**0.905(NS)**
Skin incision length	**18.53±3.83**		**18.86±3.86**		**t=0.23**	**0.814(NS)**
	No	**%**	**No**	**%**	**χ^2**	
Type of operation						
• **Biobsy**	**2**	**13.3**	**1**	**6.7**		
• **Bullectomy**	**1**	**6.7**	**3**	**20.0**		
• **BPF**	**1**	**6.7**	**3**	**20.0**		
• **Decortication**	**3**	**20.0**	**3**	**20.0**		
• **Empyectomy**	**2**	**13.3**	**2**	**13.3**		
• **Lobectomy**	**3**	**20.0**	**2**	**13.3**		
• **Pleurectomy**	**2**	**13.3**	**2**	**13.3**		
• **Pneumectomy**	**1**	**6.7**	**0**	**0.0**		
Side of operation						
• **Right**	**11**	**73.3**	**10**	**66.7**	**0.32**	**0.58(NS)**
• **Left**	**4**	**26.7**	**5**	**33.3**		

BPF= Broncho-pleural fistula

Table 2. Operative data

The need for postoperative analgesia and epidural doses were significantly lower in group B (DE) with a mean number of 2.06±1.09 doses injected in the epidural catheter during the first three postoperative days versus 5.40±1.80 doses in group A (PT) and the difference was found to be highly significant (p= 0.001), also the need for postoperative analgesia at one week, two weeks, one month, and two months were significantly lower in group B (table 4).

Pain was quantitated by the visual analogue scale [8] and reported daily in the first week during hospitalization and two weeks, one month, and two months after hospital discharge. Patients in the modified French window double edge technique group had a highly significant lower pain scores during the first two months after operation (table 5).

	Group A (N=15)	Group B (N=15)	Mann-Whitney Test	P-value
	Mean ±SD	Mean ±SD		
Drainage	342.67 ±136.61	313.33±163.08	0.49	0.617(NS)
Hospital stay	7.26 ±1.83	5.53±2.09	2.36	0.018(S)
Ambulation time	15.73 ±3.61	10.0±3.58	3.41	0.001(S)

Table 3. Postoperative characteristics

Analgesia	Groups		Mann-Whitney Test	P-value
	A (N=15)	B (N=15)		
	Mean ±SD	Mean ±SD		
1st week	1.06 ±0.25	1.46±0.51	2.43	0.015(S)
2nd week	1.06 ±0.25	1.60±0.50	t=3.63	0.002(S)
1st month	1.26 ±0.45	2.0±0.0	4.09	<0.001(HS)
2nd month	1.46 ±0.51	2.0±0.0	3.24	0.001(S)
Epidural dosage	5.40 ±1.80	2.06±1.09	3.98	<0.001(HS)

Table 4. Postoperative analgesia and epidural doses

Duration	Groups		Mann-Whitney Test	P- Value
	A (N=15)	B (N=15)		
	Mean ±SD	Mean ±SD		
1st day	5.33 ±0.89	2.80±1.08	4.43	<0.001(HS)
2nd day	4.40 ±0.82	2.73±1.03	3.74	<0.001(HS)
3rd day	4.0 ±0.75	2.0±0.84	4.36	<0.001(HS)
4th day	3.20 ±0.77	1.73±0.79	3.97	<0.001(HS)
5th day	3.06 ±0.59	1.33±0.61	4.59	<0.001(HS)
6th day	2.80 ±0.56	1.0±0.65	4.59	<0.001(HS)
7th day	2.20 ±0.77	0.60±0.50	4.29	<0.001(HS)
2 weeks	1.80 ±0.77	0.40±0.50	4.12	<0.001(HS)
1 month	1.40 ±0.63	0.30±0.40	4.00	<0.001(HS)
2 month	0.73 ±0.70	0.30±0.40-	4.00	<0.001(HS)

Table 5. Postoperative pain score

Discussion

One of the most common problems that face general thoracic surgeons after thoracotomy is pain [9]. Post-thoracotomy pain is very severe, probably the most severe pain experienced after surgery. It is also unique as this pain state has multiple bad effects including: respiratory failure due to splinting, inability to clear secretion by coughing with resulting pneumonia and facilitating the incapacitating chronic pain [10].

It has been reported that metallic thoracic retractor crushes the intercostal nerve in the intercostal muscle when the retractor is opened [11]. The French window thoracotomy technique was initially reported in the Japanese literature in 2006 by Blair [11] but in our study modified French window technique was used for opening of thoracotomy without chest retractor that was used before by Blair.

Regarding the type of operation, we used the modified French window technique for a variety of thoracic procedures including: biopsy 1 case (6.7%), bullectomy 3 cases (20%), decortication 3 cases (20%), empymectomy 2 cases (13.3%), lobectomy 2 (13.3%), pleurectomy 2 (13.3%) and closure of bronchopleural fistula 1 (6.7%). However, we did not use this technique for procedures requiring wide operative fields as pneumonectomy. These results doesn't match with that of Blair[11] who used the French window thoracotomy for pneumonectomy in 12 patients. The explanation of this difference is that in the study of Blair, there was availability of thoracoscopic camera that helped in completing the resection procedures via the French window.

In our study we used the double edge closure technique to prevent strangulation of the intercostal nerve at the caudal and the cranial rib. While Sakakura et al. used only one edge technique by suturing through the narrow space between the caudal rib and intercostal neurovascular bundle without drilling holes in the caudal rib [6]. In the study of Bayram et al. [12], the intercostal muscle underneath the fifth rib (cranial rib) was partially dissected along with the intercostal nerve, corresponding to the holes on the sixth rib.

On the other hand, Cerfolio and associates [9] reported that drilling small holes in the caudal rib, known as "intra-costal sutures," can reduce pain caused by strangulation of the intercostal nerve on the caudal side of the thoracotomy. According to this report, intra-costal sutures caused significantly less pain during 3 months after surgery compared with conventional pericostal sutures.

In our study, we found that the patients who had modified French window double edge technique experienced significantly earlier postoperative ambulation with less need for epidural analgesia and less pain during the first week and this significant difference in pain score was maintained through the first two months postoperatively. Our results agrees with the findings of Sakakura and colleagues[6] who reported that the use of edge closure technique to protect the lower intercostal nerve during posterolateral thoracotomy closure resulted in significant pain reduction up to six months postoperatively.

Allama reported that harvesting of intercostal muscle flap and intra-costal suture reduce post-operative thoracotomy pain[13].

In our study, patients who had modified French window double edge technique experienced significantly earlier postoperative ambulation with less needs for epidural analgesia. We found that the combination of modified French window technique during opening together with double edge closure is more efficient in decreasing post-thoracotomy pain.

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In Locally Advanced Non Small Cell Lung Cancer (IIIA&IIIB): Is The Addition of Endobronchial Electrosurgery Significantly Improve Subjective Response And Progression Free Survival ?

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Background: **Approximately 30% of new non small cell lung cancer (NSCLC) cases with locally advanced disease (stage IIIA&IIIB); 12% have stage IIIA and 17.6 % presented with stage IIIB disease.**

Aim of this study: **The aim of the study is the evaluation of the role of endobronchial electrosurgery (argon plasma coagulation (APC) & electrocautary) in relieving obstructive symtoms of bronchial carcinoma and its effect on progression-free survival (PFS).**

Patients & Methods: **Thirty-eight patients (31 males and 7 females, their mean age was 61.37 ± 6.23), presented with locally advanced (stage IIIA & IIIB) NSCLC, were randomized as group A and compared with a historical retrospective group of patients B, that included 45 patients (35 males and 10 females, with mean age of 64.58± 8.13 years) .In group A, patients were treated with induction chemotherapy (phase I), followed by chemoradiotherapy (phase II) and endobronchial electrosurgery using interventional bronchoscopy performed under general anesthesia and using flexible scop. While patients in group B were treated retrospectively with induction chemotherapy followed by chemoradiotherapy like those of group A but without interventional endobronchial electorsurgery. Evaluation of dyspnea, cough, and hemoptysis scales, chest CT-scan, pulmonary function tests (PFTs), arterial blood gases (ABG) and quality of life outcomes were done for all patients in both groups before starting treatment,then one week and one month after treatment.**

Results: **The therapeutic bronchoscopic electrosurgery provided significant immediate relief of symptoms in the majority of patients of group A (29/38) while patients in group B provided a delayed relief of symptoms started 4 weeks after the beginning of treatment . The overall response rate of dyspnea was 90% and 55.8%, for cough 91.7% and 54.2%,and for haemptysis 100% and 73.33% in group A &B respectively (P<0.003),while in obstructive pneumonia,the response rate was 86.45%,and 43.73% in both groups respectively (P =0.001).The addition of bronchoscopic electrosurgery (APC and electrocautary) to chemoradiotherapy in group A patients resulted in significant improvement of progression free survival (P=0.005).**

Conclusion: **The result of this study showed that the addition of endobronchial electrosurgery to chemoradiation in patients of locally advanced NSCLC significantly improve both subjective response and progression free survival.**

KEYWORDS: **Locally advanced NSCLC, electrosurgery, chemoradiation, subjective response, and PFS.**

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Codex: o4/03/1504

Locally advanced NSCLC (stage IIIA&IIIB) accounts for approximately one third of all NSCLC patients and has become a focus for combined modality therapy (chemoradiation) [1-7]. In recent years, following potentially curative treatment for NSCLC, local relapse and brain metastases were the common sites for treatment failure constituting 30% & 45 % respectively [8-12]. Almost 30% of lung cancer patients have thoracic symptoms which may only be caused by the endobronchial component of their disease such as cough, haemoptysis, breathlessness and obstructive pneumonitis[13-17]. Best palliative therapy is usually provided by external irradiation,with or without chemotherapy[10,18,19]. In an emergency, however, or if relapse occur after external irradiation or prior resection, endoscopic management may be more effective [12,20,21]. When the main component of the airway obstruction is endoluminal,endoscopic disoblitration provides immediate and safe relief of symptoms [22,26,28].This may be achieved by various techniques including mechanical tumor removal, laser (NdyAG CO_2 and argon), electrocautary, cryotherapy and brachytherapy are the alternatives[21-25,27,29,30].

Aim of This Study

The aim of the study is to evaluate the outcome of endobronchial electrosurgery (argon plasma coagulation and electrocautary) in relieving symptoms and increasing progression free survival in inoperable locally advanced (stage IIIA & IIIB) NSCLC patients who received induction chemotherapy followed by chemoradiation.

Patients and Methods

This study was conducted in the Clinical Oncology and Cardiothoracic surgery departments in Zagazig University Hospitals during the period from July 2008 to September 2014. Thirty eight patients with unresectable (stage IIIA & IIIB) NSCLC, thirty one males and seven females, their mean age was 61.37±6.25 years, were recruited in this study as group (A) and compared to a historically retrospective treated group (B), including 45 patients (35 males and 10 females with mean age 64.58±8.13 years) who treated without endobronchial electrocautary.

Patients's selection:

Patients with histologically proved NSCLC were eligible, they had to have stage IIIA & IIIB disease according to the classification system of American Joint Committee on Cancer Staging System for lung cancer **(AJCC, 2002).**

Inclusion Criteria:

To be eligible in the study, patients had to have: unresectable endobronchial tumor when its main component is endoluminal, present in the main or lobar bronchi. The performance status of the patients should be 0 - 2 according to WHO classification, Age between 18 and 75 years, No prior treatment for lung cancer, No other concurrent or previous malignancy. A serum billirubin level less than 1.5 mg/dl, a serum creatinine level of less than 1.2 mg/dl, a leucocyte count of more than 4000/ml,and platelet count of more than 150,000/ml.

For the patients in the study, the following investigations were performed:

Computed tomography scan with intravenous contrast of the chest and upper abdomen, MRI brain, radionuclide bone scan, complete blood cell count and serum chemistry, pulmonary function tests and complete physical examination .Lung function tests were performed using computerized pulmonary function apparatus (ZAN 100, computerized pulmonary function apparatus 7).

Intervention Bronchoscopy:

Endobronchial bronchoscopy procedures were performed under general or local anesthesia.The flexible scope was either passed directly or via an endotracheal tube. Interventional bronchoscopic modalities; Argon plasma coagulation (APC) and EES, endobronchial tube was inserted, fibre optic bronchoscope (FOB) was inserted through it. Ventillation was assisted, controlled intermittent positive pressure ventilation (IPPV) or manual by hand bag also via endobronchial tube (ETT) intraoperative monitoring included: continuos pulse oxymerty, electrocardiogarphy and intermittent non-invasive measurement of blood pressure were performed. With electrocautery, the monopolar probe was pressed against the tumor base and applying 20-40 watt of energy until sufficient blanching was apparent .The patient was contacted with a metallic plate near the area of electrocautery application. Inspired oxygen concentration were kept at 30 % if possible. The pulsed mode and low inspired oxygen concentration were chosen to minimize the risk of interventional penetrating injury or airway fire. Coagulated or vaporized tissues were removed mechanically or with suction . In the cases of bulky tumor, electrocautary was asked to coagulate the tumor base to shut off vascular structures and to reduce the risk of bleeding when tumor tissues were removed with suction or mechanically. During treatment with APC,the operator activates the argon gas source and the high frequency surgical unite together in an intermittent way, so that the argon gas passes in the APCP to be ionized at its distal end by the tungesten electrode. Thereby a high frequency electrical energy was transmitted to the tissues without contact .The argon gas flow is set at rate 0.5-2 l/m and

the electrical power from 30-50 watts. The power setting and the argon gas flow could be increased or decreased by the use of up and down switch. At retreatment session continued until >75% reopening of the normal airway lumen had been achieved. Symptoms were recorded and scored before treatment, then one week and one month after completion of treatment using the Speiser symptoms score .The primary endpoints were symptoms response for each of the four measured symptoms . All patients were reexamined by bronchoscopy for evaluation of endobronchial response one month after completion of treatment . The extent of obstruction using endoscopic criteria before and after treatment was scored using the obstruction score described by Spiser and Spratling. Definitive reexpansion of atelectasis or post-obstructive pneumonia was assessed one and 4 weeks after the end of the entire course of treatment by means of (PFTs, and CT scan). Acute and chronic pulmonary and oesophoygeal toxicities were recorded according to Radiation Therapy Oncology Group (RTOG), acute toxicity criteria at one month of treatment. Quality of life assessment using EORTC QLQ-30 and LC-13 version 3 questioners before treatment and at one week and one month following treatment

Induction Chemotherapy

Chemotherapy consisted of cisplatine 60 mg / m^2 as one hour infusion on day 1 & 8, before cisplatine administration,patients received adequate hydration with 1000 ml of 0.9% normal saline, Duiresis was started with 40 mg frusemide, cisplatine was given in 1000 ml normal saline. After cisplatine administration,patients were given 2000 ml of 0.9% normal saline together with 30 MEQ of magnesium chloride over 2 hour period. Adequate antiemetics (dexamethasone 8 mg, ondanstrone 8 mg and ranitidine 50 mg) were given intravenously 30-60 minutes before cisplatine and the following days. Etoposide was given at of 150 mg\m^2 in 500 ml of 0.9%normal saline over one hour infusion on days 3,4 & 5. Most patients were hospitalized for chemotherapy treatment .Chemotherapy was postponed on day 22 if patient had a WBCs count less than 2500/ul, or platelet count less than 100,000/ul and chemotherapy restarted after correction and all reached normal levels.

Chemoradiation

A total dose of 60 Gy was delivered to the primary tumor and the mediastinal nodes at 2 Gy per fraction,5 days per week using computerized 3-D planning system (Linac,Elekta 151204,presice plan,release 2.12,477.08) machine. Regional lymphatics including the supraclavicular lymph nodes when the primary was in the upper lobe or main stem bronchus were included in initial radiation volume .The field included a 2-cm margin on the ipsilateral hilar lymph nodes and a 1-cm margin on the contralateral hilar lymph nodes. The subcarinal lymph nodes were included to 5 cm below the carina. The regional lymphatics were treated to a total dose of 50 Gy at 2 Gy per fraction followed by a boost dose to primary tumor and all lymph nodes >2.5 cm in diameter visualized on CT scan before chemotherapy. The boost dose included a 2.5 cm margin around the radiologically visible tumor and the dose continued to 60 Gy .The spinal cord dose was limited to 45 Gy .Concomitent chemotherapy was started on day 2 of radiation therapy (cisplatine 50 mg\$m^2$ on day 2 and 8,and etoposide 100mg \$m^2$ on day 4,5&6) every 21 days.

Post Program Therapy

At any time during chemotherapy or radiotherapy,patients who developed a disease progression & \or drug toxicity discontinued the program and alternative treatment or best supportive care was offered to them .At the end of radiotherapy patients who achieved a complete response were followed up without treatment and patients who achieved a partial response were prepared to receive a maintenance chemotherapy for 2 cycles of cisplatine &etoposide.

Response Evaluation:

Response were assessed using standared WHO criteria .During induction chemotherapy ;chest radiography and blood tests were repeated after each course of treatment. CT-scan after induction chemotherapy and at the end of concurrent chemoradiotherapy.

Statistical Analysis

The demographic, clinical, radiological, physiological and pathological data gathered together with the patients outcome were tabulated and statistically analysed and coded, entered and cheked to an Epi-info file using Epi-info version 10 computer packages . Data were summarized using: the arithmetic mean as an average describing the central tendancey of observations .The standard deviation SD as a measure of despersion of the results around the mean,the number of observations for each variable studied(NO).The Chi -square test (X2),comparison of means: ANOVAand multiple comparison tests (LSD and PAIRD-t test).For all the above mentioned statistical tests,the threshold of significans is fixed at the 5% level (p-value).A P-value equal or less than 0.05 indicates significant results, and a p-value <0.01 indicates very high significant results.

Results

In the current study we included 83 patients with unresectable stage III NSCLC referred to Cardiothoracic Surgery and Clinical Oncology and Nuclear Medicine Departments, Zagazig University Hospitals, during the period from July 2008 to September 2014. Patients were divided into 2 groups: Group A received chemoirradiation and (electrocautery or APC), and group B received chemoirradiation alone (historical group).

	Group A NO	%	Group B NO	%
Sex				
Male	31	81.6	35	84.4
Female	7	18.4	10	15.6
WHO				
0	7	10.4	6	13.3
1	14	36.8	16	35.6
2	20	52.6	23	51.1
AJCC Stage				
IIIA	20	52.6	21	46.7
IIIB	18	47.4	24	56.3
Median age (range) years	57 (36-75)		55 (32-69)	
Site of endobronchial tumor				
Rt lung				
Lt lung	36	94.7	41	91.1
	2	5.3	4	8.2
Histological types				
Squamous cell carcinoma	26	68.4	30	66.7
Adenocarcinoma	9	23.7	10	22.2
Large cell carcinoma	3	7.9	5	11.1

Table 1. Patients Charactarestics

Site of endobronchial tumor	Group A		Group B		P value
	No.	%	No.	%	
Rt. main bronchus	8	21.05	9	20	> 0.05
Rt. upper lobe	14	36.8	18	40	> 0.05
Rt. middle lobe	9	23.68	12	26.66	-
Rt. lower lobe	5	13.15	2	4.44	> 0.05
Lt. main bronchus	1	2.63	1	2.23	> 0.05
Lt. upper lobe	1	2.63	2	4.44	> 0.05
Lt. lower lobe	0	0	1	2.23	> 0.05

Regarding the site of localization of endobronchial tumor, there was no significant difference (P > 0.05).

Table 2. Comparison between two patients group according to the site of endobronchial tumor

Number of bronchoscopic session	Group A	
	No.	%
1	15	39.4
2	13	34.2
3	7	18.42
4	3	7.89

Table 3. The number of endobronchial bronchoscopic sessions in group A patients.

Fifteen patients in group A needed only one endobronchial session to relief their symptoms with complete excision of endoluminal mass, while 13 patients needed 2 sessions, 7 patients relived after 3 sessions and 3 patients after 4 sessions

Site of endobronchial tumor	Group A No. of improved patients/No. of patients with symptoms		Group B No. of improved patients/No. of patients with symptoms		P value
	No.	%	No.	%	
Cough					
Patients with symptoms pre-treatment	38/38	100	45/45	100	
Past one week	31/38	81.57	26/45	57	< 0.001*
Past one month	35/38	92.11	33/45	73.3	< 0.05*
Dyspnea					
Patients with symptoms pre-treatment	29/38	76.3	32/45	71.1	
Past one week	27/29	94.6	28/32	87.5	< 0.01*
Past one month	25/29	86.2	24/32	76	> 0.05
Haemoptysis					
Patients with symptoms pre-treatment	18/38	47.3	29/45	64.4	
Past one week	18/18	100	23/29	79.31	<0.001*
Past one month	18/18	100	26\29	89	>0.05

** Significant difference*

Table (4): Comparison between both groups according to symptoms score response rates one week and one month after treatment.

One week after treatment, group B was significantly lesser than group A as regards improvement of all endobronchial symptoms (Cough, Dyspnea, Haemoptysis).

One month after treatment, group B was lesser than group A as regards improvement of Cough, while there was no significant difference symptoms (Dyspnea, Haemoptysis and obstructive pneumonia).

Site of obstruction	Group A		Group B	
	No. of patients 20\38	Mean±SD	No. of patients 26\45	Mean ±SD
Main bronchi				
Pre-treatment	8	8 ± 0.0	9	5.25 ± 1.5
Post treatment	3	3 ± 0.0	9	2.5 ± 1.0
P value	<0.05			
Lobar bronchi				
Pre-treatment	12	12 ± 0.0	17	11.7 ±0.36
Post treatment	4	4± 0.0	17	19.81±1.03
P value	<0.01			

Table 5. Comparison between both treatment groups according to obstruction score pre treatment and one month after completion of treatment.

There was significant difference between both groups as regard mean obstruction score of either main or lobar bronchi one month after completion of treatment (p<0.05).

Group A showed statistical significant difference mean obstruction score in both main and lobar bronchi, pr-treatment and one month after completion of treatment (P <0.01).

Site of endobronchial tumor	Group A		Group B		P value
	No.	%	No.	%	
I) Patients with atelectasis before treatment	8/20	62.5	19/26	73.07	
- Complete disappearance	3/8	37.5	6/19	31.57	
- Partial disappearance	5/8	62.5	13/19	68.4	> 0.05
- No change	-		-		
- Progression	-		-		

Table 6. Radiological assessment of atelectasis in both groups one month after completion of treatment.

There was no significant difference between two groups as regards changes involving atelectasis one month after completion of treatment.

EORTC QLO-C30	Group A	Group B	P value
I) Global health status			
• Pre-treatment	50.65±15.14	57.79±19.81	> 0.05
• One week post-treatment	81.82±9.63	85.71±18.35	< 0.01
• One month post-treatment	89.66±9.63	84.42±22.32	> 0.05
P_1 value	< 0.001	< 0.01	
P_2 value	< 0.001	< 0.001	
II) Functional scales			
1 .Physical functioning			
• Pre-treatment	74.09 ± 14.8	64.09 ±25.87	> 0.05
• One week post-treatment	42.27 ± 9.58	41.36 ± 15.51	< 0.01
• One month post-treatment	32.73 ± 6.84	39.09 ± 13.93	> 0.05
P_1 value	< 0.001	< 0.01	
P_2 value	< 0.001	< 0.001	
2.Role functioning			
• Pre-treatment	76.14±16.25	82.95 ± 17.02	> 0.05
• One week post-treatment	43.18±10.25	54.55 ± 14	0.001
• One month post-treatment	34.09±5.84	48.86 ± 18.07	> 0.05
P_1 value	< 0.001	< 0.001	
P_2 value	< 0.001	< 0.001	
3. Emotional functioning			
• Pre-treatment	69.89 ±13.35	78.41 ± 14.89	> 0.05
• One week post-treatment	40.34 ±11.98	47.16 ± 12.61	> 0.05
• One month post-treatment	40.34 ± 11.98	47.16 ± 12.61	> 0.05
P_1 value	< 0.001	< 0.001	
P_2 value	< 0.001	< 0.001	
4.Cognitive functioning			
• Pre-treatment	81.36 ± 25.28	86.36 ±14.2	> 0.05
• One week post-treatment	69.55 ± 8.43	74.32 ± 10.25	> 0.05
• One month post-treatment	69.55 ± 8.43	74.32 ± 10.25	> 0.05
P_1 value	> 0.05	< 0.05	
P_2 value	> 0.05	< 0.05	
5.Social functioning			
• Pre-treatment	76.82 ± 21.19	84.09 ± 15.9	> 0.05
• One week post-treatment	69.55 ± 11.56	78.55 ± 15.08	> 0.05
• One month post-treatment	69.55 ± 11.56	78.55 ± 15.08	> 0.05
P_1 value	> 0.05	> 0.05	
P_2 value	> 0.05	> 0.05	

PI: means probability of difference between pre-treatment and one week post - treatment

P2: means probability of difference between pre-treatment and one month post- treatment

Table 7. Comparison between different patient groups according to quality of life outcomes (EORTC QLQ- C30) (Global health status and Functional scales) Bergman et al.,(1994)(31) pre-treatment, one week and one month after completion of treatment

One week after completion of treatment:

- Group A was significantly different than group B as regards global health status and (physical, role) Functional scales.
- There was no significant difference between all patient groups as regards other Functional scales.
- Group A showed significant difference as regards changes in global health status and (physical, role, emotional) functional scales, pre-treatment and one week after completion of treatment.
- Group B showed significant difference as regards changes in global health status and (physical, role, emotional and cognitive) functional scales, pre-treatment and one week after completion of treatment.

One month after completion of treatment:

- Group A was significantly different than group B as regards changes in physical functional scales only.
- There was no significant difference between both treatment groups as regards other functional scales and global health status.
- Group A showed significant difference as regards changes in global health status and (physical, role, emotional) functional scales, pre-treatment and one month after completion of treatment.
- Group B showed significant difference as regards changes in global health status and (physical, role, emotional and cognitive) functional scales, pre-treatment and one month after completion of treatment.

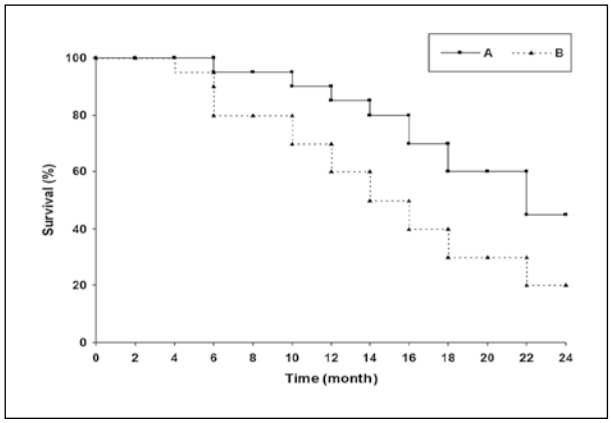

Fig 1. 2-year progression free survival in both groups.
The 2-year progression free survival showed statistical significant difference between the two groups (P < 0.05).

DISCUSSION

Lung cancer is the most commonly diagnosed cancer and the leading cause of cancer death worldwide. Primary surgical resection is actually considered, whenever feasible, the gold standard for lung cancer treatment; however, only 30-40% of patients survive more than 5 years and almost 95% of the whole population requires palliative treatment at a certain point of their disease history **(Weinberg et al., 2010)[32].**

Approximately 75% of patients with non-small cell carcinoma of the lung (NSCLC) present with locally advanced or metastatic disease which renders them inoperable and virtually incurable. Nearly, 25 % of NSCLC patients present with locally advanced intrathoracic disease (stage IIIA and IIIB) **(Weinberg et al., 2010) [32].**

Patients with stage IIIA and IIIB, locally advanced NSCLC receive external beam radiotherapy with chemotherapy as standard treatment. The highest survival rates are seen with patients who receive concurrent chemoradiotherapy, which a 4-year survival rate of 21% and a median survival of 17 months **(Rosenzweig et al., 2005) [33].**

Thirty percent of lung cancers cause partial or complete obstruction of the airway with consequent respiratory distress, bleeding and infection. These patients require palliation only; endoscopic management should play an important role since conventional treatment with chemotherapy/radiotherapy alone yielded unsatisfactory immediate restoration of a viable airway; Nd:YAG laser, electrocautery, argon plasma coagulation, intraluminal brachitherapy and stenting allow better results in terms of patency of the airway and immediate palliation of symptoms. Preliminary endoscopic management contributes to improve quality of life and functional status, allows better evaluation of tumor extension and staging, and contributes to prevent infectious complications, especially when chemotherapy is to be administered **(Venuta et al ., 1999) [34].**

When the main component of the airway obstruction is endoluminal, endoscopic disobliteration provides immediate and safe relief of symptoms. This may be achieved by various techniques including mechanical tumor removal, lasers (eg, Nd-YAG, CO_2, argon), electrocautery, cryotherapy, photodynamic therapy, and brachytherapy are the alternatives **(Crosta et al., 2001) [35].**

It is clear from the available data that electrocautery and argon plasma coagulation are superiorly cost effective compared with Nd-YAG laser resection, i.e. allowing outpatient treatment under conscious sedation with better haemostasis, due to less complicated procedures and cheaper applicators. Success rate has been in the order of 70-80%, which is comparable to other " debulking techniques **(Bolliger et al., 2006) [36].**

Argon plasma coagulation (APC) is a form of non contact electrocoagulation. The non contact approach offers advantages over other forms of electrocoagulation. Avoiding tissue contact

and probe adhesion to friable tissues decreases the risk of bleeding. It also allows the bronchoscopist to treat a larger area very quickly **(Santa Monica CA,USA ., 2015)**[37]

Radiotherapy is an effective treatment modality in the palliation of most respiratory symptoms among patients with inoperable non-small cell lung cancer (NSCLC) .Radiotherapy can give considerable relief of troublesome chest pain and the more systemic symptoms of anorexia, tiredness and nausea. This is probably because XRT treats the gross tumor bulk in the thorax in addition to the endobronchial component of the disease thereby improving the quality of remaining life. **(Langendijk et al., 2001)** [38]**.**

The more presence of endobronchial disease does not in itself constitute an indication for endobronchial therapy. Standard surgical, medical, and radiation treatments remain the primary therapeutic modalities for patients with bronchopulmonary malignancies. Interventional bronchoscopy must be contemplated in the context of multidisciplinary management of these patients (**Santa Monica, CA, USA., 2015)**[37].

With increasing numbers of lung cancer patients, increased need for sophisticated interventions for these patients and expanding role of Zagazig University Hospitals in its surrounding environment; interventional bronchoscopy unit with APC and electrocautery was established in 2008.This study may provide answers for many questions about the impacts of interventional bronchoscopic modalities as palliative tools in patients with central airway obstruction caused by non-small cell lung cancer and their comparison with other treatment modalities of NSCLC.

In the present study, table (1) showed that the mean age of patients were 60.82 and 60.72 years in groups A, and B respectively.

Mallick et al., (2007)[49] reported that the mean age was 57 years (range 35-75 years). **Stout et al., (1997)** [40] reported a mean age of 68 years (range 40-84). Similarly, **Sistermanns and Hoffmanns (1999)**[41] reported a median age of 53 (range 46-75). **Boxem et al., (2001)** [42]demonstrated a mean age of 62 (range, 47-79) years. **Abratt et al., 1995**[43] stated that the mean age was 59 years.

Lung cancer has a tendency to develop preferentially in aged people **(Furukawa et al., 2003)**[44]**.**

In the present study, table (1) showed that the patients were predominantly male in all patient groups. Male to female ratios were 9:2 and 7:2 in groups A, B respectively. **Mallick et al., (2007)**[39] reported that the patients were predominantly male (98%). **Boxem et al., (2001)**[42] demonstrated that most of patients were males; Male to female ratio was 5.7:1. **Abratt et al., (1995)**[43] stated that 74% male, 26% female.

Worldwide, lung cancer is by far the most common cancer in males (19-21% of all new cancers) and the fifth most frequent cancer in females (5% of all new cancers) **(Noppen, 2002)**[45]**.**

As regard the performance status (PS) according to WHO in our study, table (1) showed that all patients included in this study had good PS either 1 or 2 to tolerate different therapeutic procedures used (External beam irradiation and therapeutic bronchoscopy under local or general anaesthesia). Also **Mudad and Zakris (2000)**[46] reported patients with PS 0, 1, 2 constituting 4.4%, 65.2% and 30.4% respectively. **Abratt et al., (1995)**[43] stated that PS 1, 2 constituting 56%, 44% respectively.

As regard the histopathological subtypes, table (1) showed that squamous cell carcinoma was the commonest pathologic subtype among the studied patients groups, followed by adenocarcinoma. While large cell carcinoma was the least frequent one.This was in agreement with **Mallick et al., (2007)** [39] who found that squamous cell carcinoma was the predominant histology (82%). **Povedano et al., (2005)**[47] demonstrated that squamous cell carcinoma was the most common (52%) cell type. Also, **Onishi et al., (2003)**[48] reported that squamous cell carcinoma was the most frequent histopathologic type constituting 71.9% followed by adenocarcinoma 21.9% and lastly large cell carcinoma accounting for 6.2%. **Abratt et al., (1995)** found that Squamous, adenocarcinoma and large cell were 51%, 33%, 10%. On the other hand, **Clamon et al., (1994)**[49] reported that adenocarcinoma was the most frequent subtype followed by squamous cell carcinoma and large cell carcinoma, constituting 50%, 40% and 10% respectively.

In the present study, according to American Joint Committee on Cancer Staging System (AJCC, 2002) table (1) showed that all patients included in this study were stage IIIA and IIIB. We chose these stages in our study as, nearly, 35% of NSCLC patients present with locally advanced intrathoracic disease (stage IIIA and IIIB) **(Weinberg et al., 2010)**[32] The 5-year survival rate for patients with stage IIIB disease is approximately 5 % **(Rees and O'Brien, 2001)**[50]**.**

Similarly, **Langendijk et al., (2001)** and **Lovgren et al., (2008)**[51] reported that 44%, 56 % were stage IIIA and IIIB respectively. **Choy et al., (2001)**[52] reported that 50% of the patients had stage IIIA and the other 50% had stage IIIB. While the trial reported by **Sistermanns and Hoffmanns (1999)**[41] 27.5 % and 72.5 % of patients had stage IIIA and stage IIIB NSCLC respectively.

As regards obstruction scores of main and lobar bronchi, table (5) showed that 62.5% reduction in the obstruction score of main bronchi were seen overall in groups A one month after completion of treatment. While, in lobar bronchi, there was considerable improvement in the obstruction score across group A one month after completion of treatment.

Concomitant bronchoscopic electrocautery or APC during XRT provides higher response rates for reopening of obstructed airway mainly when obstructing tumours present in the main bronchus. This result may be due to the localization of endobronchial mass in the main airway made it more accessible and easier to be manipulated via fibroptic bronchoscopy as in our study; FOB was introduced into endotracheal tube which may limit the mobility of FOB to distal airways.

Mallick et al., (2007)[39] demonstrated that there was considerable improvement in the obstruction score across all patient groups (combined XRT+ bronchoscopic therapy and bronchoscopic therapy alone) .The mean initial score was 5.04 and the mean post treatment score was 1.99. A 61% reduction in the obstruction score was seen overall. This reduction was highly statistical significance ($p < 0.001$).

Mallick et al., (2007)[39] also demonstrated that the improvement in obstruction scores between the treatment groups were 57and 44% in those treated with combined XRT+ bronchoscopic therapy and bronchoscopic therapy, respectively. The difference was not statistically significant ($p = 0.066$).

Santa Monica (2015)[37] demonstrated that patients with endoluminal masses had pre treatment reduction of the healthy airway lumen that averaged 76 ± 24.9%.

Immediately after APC and mechanical debulking, the obstruction decreased an average of 26 ± 30.5%. Seven patients required an additional bronchoscopic procedure for the removal of devitalized tissue 48 to 72 h after the initial APC treatment. This second intervention further decreased the overall post treatment bronchial obstruction to a mean value of 18.4± 22.1%.

In our study, Table (4) illustrated that higher rates of radiological re-expansion assessed with chest radiograph and CT scan of the chest were observed with XRT and bronchoscopic therapy compared to bronchoscopic therapy or XRT alone.

Bronchoscopic therapy debulked only endobronchial mass, while XRT reduced the volume of intrathoracic mass either (endobronchial or extrabronchial), so both modalities were complementary to each other not alternatives.

Povedano et al., (2005) observed the following perioperative complications: 2 episodes of temporary hypoventilation leading to a severe, life-threatening desaturation, although both patients were able to recover; 4 (1.2%) cases of severe hemorrhaging accompanied by significant desaturation.

Mallick et al., (2007) stated that the radiotherapy-related morbidity was low. Acute grade I odynophagia was seen in 32 of the 95 patients (33.7%) patients. All acute complications were self-limiting. No grade II—III or IV acute complications were seen.

Mallick etal., (2007) demonstrated that ten out of the 95 (10.5%) patients developed radiological features of post-radiation fibrosis without evidence of disease progression. All of these patients had received XRT. Only one of these patients is symptomatic for fibrosis.

Sistermanns & Hoffmans, (1999) stated that occasional pulmonary toxicity has been recognized. It remains low in frequency, but, judiciously, one should probably use targeted volumes to spare normal lung tissue, standard fractionation, and select patients with reasonably good pulmonary reserves.

The incidence and degree of radiation pneumonitis depend on the total dose, fractionation and volume of lung irradiated. The threshold dose for radiation pneumonitis appears to be approximately 20 to 25 Gy and large fraction size (>2.67 Gy) was the major predictive factor for pneumonitis **(Martel et al., 1994)**[53]

In the American Society of Clinical Oncology abstract, **Sistermanns and Hoffmanns, (1999)** reported that pneumonia up to grade 3 and grade 2 radiation pneumonitis occurred. The authors noted that the toxicities were manageable, and no fatalities were reported.

Many radiation oncologists continue to treat clinically uninvolved mediastinal and hilar nodes, a traditional technique that necessarily includes much of the esophagus. Restricting the „ volume to be irradiated offers the possibility of reducing normal tissue exposure and allowing a higher total dose of radiotherapy without increasing normal tissue toxicity **(Hayman et al., 2001)(54).** The use of targeted volumes and the selection of patients with adequate pulmonary function tests would be a logical approach to managing potential pulmonary toxicities **(Souquet et al., 1993)(55).**

This variations in the results of post-treatment complications may be due to advanced patient age; presence of associated comorbidities, poor performance status, less preoperative pulmonary reserve or may be due to different bronchoscopic procedures used rigid bronchoscope or different sedations during general anaesthesia or different XRT fractionation dose applied.

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Postoperative Outcomes of Vertical Muscle Sparing Thoracotomy Compared With Standard Posterolateral Thoracotomy in Thoracic Surgery

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Background: **Although the thoracotomy incision is guided in part by the exposure required, both cosmoses and the potential for improved recovery are important factors to be taken into account. The aim of this study is to compare vertical muscle sparing thoracotomy (VMST) and standard posterolateral thoracotomy (PLT) for postoperative pain and physical function during and after hospitalization.**

Methods: **This study included fifty patients underwent thoracotomies for different thoracic surgical procedures. Patients were divided into two groups according to the type of thoracotomy performed. Group A, included twenty five patients underwent conventional posterolateral thoracotomy (PLT) and group B, included twenty five patients underwent vertical muscle sparing thoracotomy (VMST). All patients were followed up during the post-operative hospital stay and after discharge at one week, two weeks and one month intervals.**

Results: **Time of opening of the thoracotomy was significantly longer in group B (VMST), while closure time was significantly longer in group A (PLT). Overall, the operative time was not significantly different in both groups. During the first postoperative week, shoulder motion range was significantly higher in VMST group and postoperative pain was significantly higher in the PLT group. But at one month follow up, these differences became statistically non-significant. There was no significant difference between the two groups regarding cosmetic satisfaction. Patients in group B (VMST) returned to work and almost normal activity after discharge earlier than patients in group A (PLT).**

Conclusion: **When comparing patients who had undergone vertical muscle sparing thoracotomy to those who had undergone standard posterolateral thoracotomy, pain and recovery of function including shoulder girdle movement were significantly improved only in the early postoperative period (POD 7), otherwise the rates of occurrence of chronic pain and morbidity are equivalent.**

KEYWORDS: **Thoracotomy, Vertical thoracotomy, Muscle sparing thoracotomy, Postoperative pain.**

Over years, various incisions have been used to approach the thoracic cavity and since the times of Hippocrates, surgeons have been incising the chest with curative intent. As knowledge has been accumulated and techniques refined, the thoracic surgeon is now armed with a vast array of incisions from which to choose. The difficulty lies in choosing the right one [1].

Although the thoracotomy incision is guided in part by the exposure required, both cosmoses and the potential for improved recovery are important factors to be taken into account. Posterolateral thoracotomy is the standard traditional approach for most thoracic procedures. It provides an excellent access and can be very easily extended if it is necessary [2].

Preservation of major chest wall muscles such as the latissimus dorsi that stabilizes and rotates the scapula facilitating shoulder motility have been described as an advantage in muscle sparing thoracotomies, although there is little objective evidence

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demonstrating to what degree the quality of life of a patient is influenced by this procedure [3]. More recently, minimally invasive approaches utilizing video-assisted thoracoscopic surgery (VATS) and robotic surgery have provided a larger selection of incisional options [4].

The muscles of the thorax are concerned with aiding respiration and with movement of the shoulder girdle; incision across these muscles leads to paralysis of the caudal portion of the transected muscle. In addition, chest wall pain causes the patient to refuse to use the muscles that aggravate the pain. The effect is a region of non-contractile chest musculature that has the same effect as infarct has on the heart. The tidal volume goes down, and the respiratory rate rises. To provide the same amount of alveolar ventilation, the minute ventilation must increase, because a greater portion of the tidal volume ventilates only the dead space. The region of the chest with muscle injury does not expand during inspiration, and functional residual volume falls below normal which increases the risk of micro atelectasis [5].

Few data are available to demonstrate whether the type of incision can affect chronic pain and physical functioning following major thoracotomy [6]. We conducted a prospective randomized study in order to compare vertical muscle sparing thoracotomy (VMST) and standard posterolateral thoracotomy (PLT) for postoperative pain and physical function during and after hospitalization.

Patients and Methods:

This was a prospective randomized study carried out in cardiothoracic surgery department in Menoufia University Hospital from Jan. 2012 to Jan 2015, during which, fifty patients underwent thoracotomies for different thoracic surgical procedures. Patients were divided into two groups according to the type of thoracotomy performed.

Group A: included twenty five patients underwent conventional posterolateral thoracotomy (PLT) where the incision started at the mid- axillary line and continued posteriorly for 2 to 3 cm below the scapular tip. The latissimus muscle is divided with cautery, and the serratus muscle can often be spared.

Group B: included twenty five patients underwent vertical muscle sparing thoracotomy (VMST) where an incision was made parallel to the anterior border of the latissimus dorsi , either in the posterior axillary line (posterior to anterior border of LD muscle) or in the mid axillary line (anterior to anterior border of LD muscle). The incision extended from axillary hairline down to a distance of 10 to 15 cm. The anterior aspect of the latissimus was identified and mobilized then retracted posteriorly. The posterior aspect of the serratus anterior is identified. The serratus was then mobilized and retracted anteriorly exposing the chest wall. The latissimus and serratus muscles were retracted with a self-retaining retractor placed at a right angle within the chest spreader (Fig. 1).

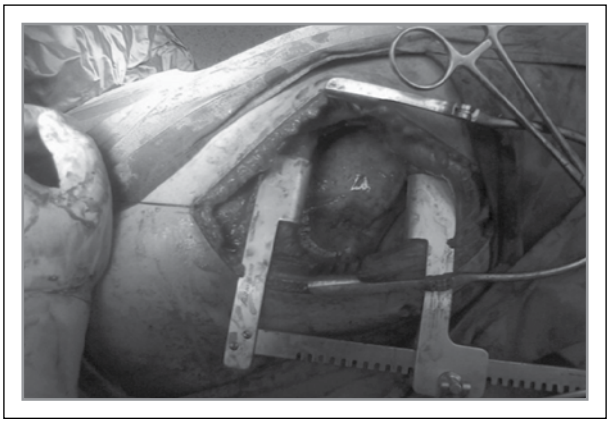

Fig.1: The latissimus and serratus muscles were retracted with a self-retaining retractor placed at a right angle within the chest spreader.

Patients with chest wall or shoulder girdle deformities, operations on tumors invading the chest wall and Patients with previous thoracotomy at the same side were excluded from the study.

All operative data regarding intraoperative complications, field of surgery and times of opening and closure of thoracotomies were obtained and recorded.

All patients were followed up during the post-operative hospital stay and after discharge at one week, two weeks and one month intervals recording postoperative morbidity, mortality, hospital stay, shoulder girdle movement, wound healing and cosmetic satisfaction by the patient. Postoperative pain (quantitated by the visual analogue scale) was assessed by 11-point scale (0= no pain, 10= maximal imaginable pain) [7]. The two groups were compared regarding preoperative, operative, and postoperative data.

Results

This study included fifty patients underwent thoracotomies for different thoracic surgical procedures. Twenty five patients (group A) underwent posterolateral thoracotomy (PLT), and twenty five patients (group B) underwent vertical muscle sparing thoracotomy (VMST). Demographic analyses demonstrated no differences in age and sex between the two groups (Table 1).

Patients were also matched for the number of chest tubes, length of operating time, and duration of chest tube drainage. Time of opening of the thoracotomy was significantly longer in group B (VMST), while closure time was significantly longer in group A (PLT). The field of surgery was significantly larger in PLT group (table 2).

Concerning the recorded intra- and postoperative data, intraoperative blood loss and postoperative chest drainage volume were found to be in favor of the VMST and the difference between the two groups was statistically significant.

No transfusions were required and total hospital stay time was not proven to be different in Group A and B. Patients in the VMST group demonstrated a significantly higher incidence of wound seroma postoperatively and three patients (12%) developed wound infection (Table 3).

The analysis of shoulder motion range demonstrated a highly significant difference between both groups ($p< 0.001$) in favor of the VMST group one week postoperatively as the mean range of abduction of shoulder joint after 1 week was 146.40±9.94 for VMST group versus 122.80± 8.90 for PLT group. By the end of the first month the range of abduction of shoulder joint improved in both groups with a slight higher degree in the VMST group but the difference was found to be statistically non-significant (table 4).

Pain was quantitated by the visual analogue scale [7] and reported during hospitalization and one month after hospital discharge (table 4). Within the first week, postoperative pain was significantly higher in the PLT group with higher analgesic requirements; and on thirty days follows up; patients in the PLT group still had a trend toward higher pain scores but without any statistical significance.

Ten patients (40%) were unsatisfied in their thoracotomy wound in group A versus five patients (20%) in group B. and there was no significant difference between the two groups regarding cosmetic satisfaction ($p = 0.148$) (Fig.2).

Patients in group B (VMST) returned to work and almost normal activity after discharge earlier than patients in group A (PLT) with a mean of 13.40±4.04 days versus 21.88± 5.99 days for PLT group, and the difference was found to be highly significant ($p<0.001$).(table 5).

	Groups				Test	P-value
	A (N=25)		B (N=25)			
	no	%	no	%		
Age Mean ±SD	37.84±12.54		41.92±16.91		Mann-Whitney=1.02	0.308(NS)
Sex						
Male	18	72.0	18	72.0	-	-
Female	7	28.0	7	28.0		

Table 1. Distribution of the studied groups regarding their age and sex

	Groups		Test	P value
	A (N=25)	B (N=25)		
	Mean ± SD	Mean ± SD		
Operative Time	184.27±85.91	176.40± 88.61	**t** =0.43	0.663 (NS)
Opening time (min)	22.16± 4.27	34.20±5.58	**t** =8.55	<0.001 (HS)
Closure time(min)	28.84± 3.19	19.80±3.22	**t** =9.94	<0.001 (HS)
Field size	19.04± 1.69	14.48±1.04	**t** =11.44	<0.001 (HS)

Table 2. Distribution of the studied groups regarding operation characteristics

	Groups			P-value
	A (N=25)	B (N=25)		
Intraoperative Blood loss	88.68± 18.29	73.20±17.25	**t** =3.07	0.003(s)
Wound Complications				
Seroma	3 (12%)	11 (44%)	χ^2 =7.38	0.025(S)
Infection	2 (8%)	3 (12%)		
Hospital stay(days)	5.80± 3.57	6.80±3.42	**t** =1.20	0.229(NS)

Table 3. Operative and Postoperative data

	Groups		P value
	A (N=25)	B (N=25)	
	Mean ± SD	Mean ± SD	
Range of abduction of shoulder joint: -after 1 week	122.80± 8.90	146.40±9.94	<0.001
-after 1 month	156± 7.8	160± 9.3	0.290
Postoperative pain: VAS			
-after 1 week	5.2± 0.9	5.1± 0.6	<0.05
-after 1 month	2.4± 1.2	2.2± 1	0.42

VAS= visual analogue scale.

Table 4. Postoperative Pain and Shoulder joint movement

	Groups		Test	P value
	A (N=25)	B (N=25)		
	Mean ± SD	Mean ± SD		
Return to work & normal activity(day)	21.88± 5.99	13.40±4.04	**t** =5.86	<0.001 (HS)

Table 5. Distribution of the studied groups regarding return to work & normal activity

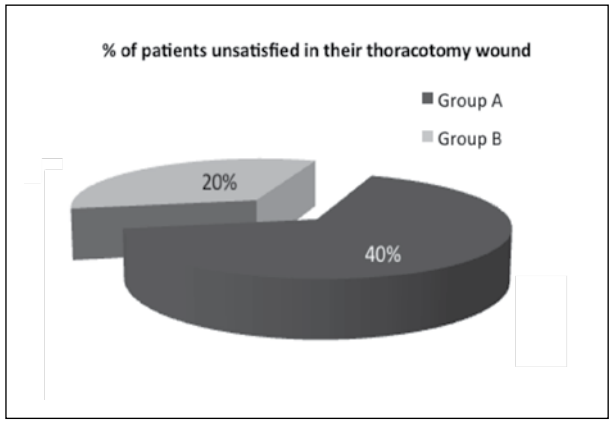

Fig. 2: Distribution of the studied groups regarding cosmetic satisfaction

Discussion

The traditional PLT has been the standard incision for pulmonary procedures over the past decade. MST has been devised to produce less postoperative pain and better cosmetic results while reducing soft tissue injury and complications [8].

In our study, we demonstrated a significantly higher intraoperative blood loss and postoperative chest drainage volume in VMST group; the amount lost was not substituted and in that way there was no different management in the clinical practice and both groups were matched for the number of chest tubes and duration of chest tube drainage. Similar results were reported by Kalliopi et al. [9]. While Kim et al. recorded no significant difference in the amount of blood loss [10].

We found that, time of opening of the thoracotomy was significantly longer in group B (VMST), while closure time was significantly longer in group A (PLT). Overall, the operative time was not significantly different in both groups. We recommend that its better avoid the VMST in emergent or urgent cases due to long time to enter the chest and a significantly smaller field of surgery. This was also agreed by the study performed by Ashour[11] who performed VMST on fifty four patients and stated that the time taken to enter the pleural cavity was significantly long (35 minutes) but closure time was less than 10 minutes.

We had found that the exposure permitted by VMST incision is smaller than that afforded by a posterolateral thoracotomy, but we think that both incisions provide sufficient access for most thoracic procedures. Ashour M. [11] used muscle sparing thoracotomy for a wide range of procedures and noted that exposure was inadequate only in 4% of cases.

Total hospital stay was not statistically different between both groups, the reverse was recorded by Hideki and colleagues [12] who found a significantly shorter hospital stay with muscle sparing thoracotomy.

Many authors believe that since latissimus dorsi and serratus anterior are neither transected nor stretched, shoulder

motion might be influenced [13], a hypothesis also supported by this series during the first week following thoracotomy where analysis of shoulder motion range demonstrated a highly significant difference between both groups in favor of the VMST group. By the end of the first month, the range of abduction of shoulder joint was not significantly different between both groups. Hesham Alkady[14] also found a quite satisfactory results in muscle sparing thoracotomy due to the advantages of minimum trauma and maximum preservation of chest wall function.

The study of Kalliopi et al. [9] did not demonstrate any difference in shoulder function favoring the MST over PLT within 1 or 2 months postoperatively. Only in the immediate postoperative period a statistical difference was observed concerning a wider range of shoulder dysfunction in the PLT group. On the other hand, Andrew et al. [6] reported that postoperative physical activity levels were significantly less than those reported preoperatively, with a trend toward better functioning in the MT groups after 8 weeks.

A significant reduction in postoperative pain as determined by the visual analogue scale was shown only one week after thoracotomy in Group B, but not later on POD30. Similar results were reported by Kalliopi et al. [9] on the contrary, Landreneau et al. [15] demonstrated that there was no statistical difference in early and late post-thoracotomy pain between PLT and MST.

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Outcome of Chemical Pleurodesis in Refractory Hepatic Hydrothorax Using Povidone-Iodine 10%

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Background: **There are no clear guidelines for best management of hepatic hydrothorax. We aimed to detect outcome of pleurodesis using povidone iodine 10 % in patients with refractory hepatic hydrothorax after drainage of pleural effusion using heamodialysis central venous line 12 French.**

Methods: **This is a non-randomized prospective study on 123 patients having hepatic hydrothorax. Patients were divided into two groups: group A (75 patients) who underwent chemical pleurodesis using povidone iodine 10% through hemodialysis central venous catheter inserted by Seldinger technique, group B (48 patients) who subjected only to repeated sessions of thoracentesis according to their symptomatology. All patients were followed up after 3 months by chest x-ray to detect presence or absence of effusion.**

Results: **In this study, only 17.3% of patients in group A showed failure of pleurodesis with recurrence of effusion within 3 months however all patients in group B still having pleural effusion and in need for further sessions of thoracentesis every now and then. Three patients in group A died after 3, 6 and 7 months of pleurodesis. No mortality was reported in the successful group. We found statistical significant relationship between failure of pleurodesis and bilirubin level >3 mg/dl, number of pleurodesis sessions and increased duration of drainage. Patients with massive effusion, moderate ascites and reduced albumin level had more percentage of failed pleurodesis but not statistically significant. Complications observed were pain after pleurodesis in 60 patients, hypotension after drainage in 6 patients, hepatic precoma in 2 patients with no statistical significant relationship between failure of pleurodesis and occurrence of complications.**

Conclusions: **Drainage of hepatic hydrothorax with hemodialysis central venous catheter 12 french and pleurodesis using Povidone iodine 10% is safe, effective and well tolerated procedure, superior to repeated thoracentesis, has limited complication with accepted outcome, and should be taken as a first line of treatment after failure of medical treatment in patients who are not candidate for and/or waiting liver transplantation. Increased bilirubin level ,increased duration of drainage and number of pleurodesis sessions were found to be predictors of failure of pleurodesis.**

Key words: **Pleura, pleural effusion, pleural**

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Codex : o4/04/1506

Hepatic hydrothorax could be defined as the presence of pleural fluid greater than 500 cc in a patient with hepatic pathology after exclusion of primary cardiac or pulmonary disease [1]. It is encountered in approximately 10% of patients with advanced liver disease [2]. Approximately 85% of hepatic hydrothorax affect right side, 13% affect left side and 2% found to be bilateral [3].

It is important to notice that capacitance of pleural cavity does not exceed usually 1-2 litres of pleural fluid; beyond this volume, significant symptoms like dyspnea begin to appear. Different mechanisms of pleural fluid formation have been postulated in patients with liver cirrhosis including passage of ascitic fluid through diaphragmatic defects and or through transdiaphragmatic lymphatics. Another cause is

hypoalbuminaemia resulting in decreased plasma oncotic pressure and pleural effusion formation [4]. Management of hepatic hydrothorax aims mainly on control of liver function with marked salt restriction and adequate diuretics [5, 6].

Up till now there are no guidelines for the best management of hepatic hydrothorax. Treatment modalities for hepatic hydrothorax are medical management, repeated thoracentesis, transjugular intrahepatic portosystemic shunt (TIPS), pleurodesis, surgical repair of diaphragmatic defect and liver transplantation [7].

The aim of the current study is to detect outcome of pleurodesis using povidone iodine 10% in patients with refractory hepatic hydrothorax after drainage of pleural effusion using hemodialysis central venous catheter 12 French.

Patients and methods:

This study is a non-randomized prospective study carried out during the period from December 2012 till June 2015 on 123 patients presented with refractory hepatic hydrothorax after failure of adequate medical treatment in the form of salt restriction and diuretics to control amount of effusion. Patients included in the study were divided into 2 groups, group A including 75 patients who were symptomatic, subjected to repeated thoracentesis every 2-3 weeks with rapid reaccumulation of pleural fluid and accepting the procedure of insertion of hemodialysis central venous catheter 12 french and pleurodesis and group B including 48 patients who preferred to be subjected to repeated thoracentesis according to their symptomatology. Both groups were matched regarding age, sex and clinical characteristics.

We excluded from the study patients with bilateral pleural effusion, massive ascites, patients with history of encephalopathy or recent attack of hematemesis, patients with child C classification and patients with hepatocellular carcinoma.

All patients were subjected to full history taking, clinical examination and laboratory and radiological investigations including complete liver function test, prothrombin time and concentration, pleural fluid aspirate that was sent for physical, chemical analysis, cytological examination and gram stain, chest X-ray to detect amount of effusion, CT chest to exclude encysted effusion and abdominal US to detect amount of ascites and pathology of liver disease.

After explanation of procedure and expected complications to patients and taking informed consent, all patients in group A were subjected to the procedure in the following manner: Under local anesthesia in the operating room and under complete aseptic technique, we used hemodialysis central venous catheter set 12 french that was inserted using Seldinger technique in the fifth intercostal space midaxillary line with the patient in setting position. The catheter was connected to standard thoracic drainage system. In every setting we evacuated 1500cc of pleural effusion and then we closed catheter. After every session of drainage, administration of salt free human albumin 5% was done. Drainage was continued till it became less than 150 cc pleural fluid in 24 hours and chest x ray showed complete resolution of effusion, then pleurodesis was done by injecting 20 ml of 10% Povidone Iodine (Betadine®, **manufactured by Nile Co. for Pharmaceuticals and Chemical Industries, Cairo, Egypt; licensed by Mundi** Pharma AG, Basel, Switzerland) diluted in 80 ml saline and 10 ml of 1% lidocaine. Catheter was clamped for 4 hours, during this period, patients were instructed to move and change their positions every 15 minutes. After 4 hours, catheter was declamped and amount of effusion was observed. We removed catheter if drainage became less than 100 cc of pleural fluid. If drainage seems to increase, then another session of pleurodesis was done. No patients, in our study, needed more than 2 sessions of pleurodesis.

Patients were observed for possibility of complications of procedure including pneumothorax, chest pain, chest wound infection, hypotension after drainage, fever and hepatic encephalopathy. Follow up chest x-ray was ordered to be done 3 months after procedure in group A and group B patients. Success of treatment was defined as the patient is asymptomatic with complete resolution of pleural effusion in chest x-ray done three months after procedure. Failure of treatment was defined as recurrence of pleural effusion within three months of effusion as detected by follow up chest x-ray.

Statistical analysis was performed using Statistical Package for Social Science (SPSS version 19). Data were expressed in terms of frequencies (number of cases) and percentages for categorical variables and mean ± standard deviation (±std) for continuous variables. For comparing categorical data, Chi-square (X2) test was performed. Fisher's exact test was used when one or more of the cells have an expected frequency of five or less. When the group was compared for continuous variable, student's unpaired t test was used. P values of <0.05 were considered statistically significant.

Results:

This study included 123 patients diagnosed to have hepatic hydrothorax with failure of medical treatment to control accumulation of pleural effusion. We divided patients into 2 groups: group A included 75 patients subjected to catheter insertion and pleurodesis and group B included 48 patients treated by repeated thoracentesis. Both groups were matched regarding age sex and clinical characters (amount of effusion, degree of ascites, albumin level, bilirubin level and etiology of effusion). Follow up chest X-ray done 3 months after procedure in group A or as follow up in group B patients with repeated thoracentesis showed that success rate was 82.7 % in group A patients while all patients enrolled in group B did not show complete resolution of effusion and still in need for repeated thorcentesis sessions (Table 1).

By analyzing group A, the mean age of patients was 56.84 ± 6.50. There were 42 (56%) male patients and 36 (44%) female patients. Right sided pleural effusion was found in 69 (92%)

patients. Amount of pleural effusion as detected by chest x-ray was moderate in 28 patients and massive in 47 (62.67%) patients. Four patients had no ascites, 36 patients with mild ascites and 35 patients with moderate ascites. Albumin level was less than 2.8 gm/dl in 34 (45.3%) patients and bilirubin level was less than 3 mg/dl in 36 (48%) patients. Causes of effusion were viral, bilharzial or mixed viral and bilharzial in 26, 24 and 25 patients respectively. Duration of drainage was 5.29 days ± 0.96 and only 9 (12%) patients needed 2 sessions of pleurodesis. In this study, 13 (17.3%) patients showed failure of pleurodesis with recurrence of pleural effusion within 3 months of procedure. Of those patients, 3 patients died after 3, 6 and 7 months of pleurodesis due to course of liver disease and not related to procedure. No mortality was reported in the successful group (Table 2).

	Group A (n=75)	Group B (n=48)	P value
Success (n=62)	62 (82.7%)	0 (0%)	<0.0001*
Failure (n=61)	13 (17.3%)	48 (100%)	

**statistically significant*

Table 1. Success and failure of pleurodesis versus repeated thoracentesis

Character	Number of patient (%)
Age (mean±std)	**56.84± 6.50**
Gender	
Male	**42 (56%)**
Female	**33 (44%)**
Site of effusion	
Right	**69 (92%)**
Left	**6 (8%)**
Amount of effusion	
Moderate	**28 (37.33%)**
Massive	**47 (62.67%)**
Ascites	
No	**4 (5.33%)**
Mild	**36 (48%)**
Moderate	**35 (46.67%)**
Albumin (gm/dl)	
<2.8	**34 (45.33%)**
>2.8	**41 (54.67%)**
Bilirubin (mg/dl)	
<3	**36 (48%)**
>3	**39 (52%)**

Table 2. Group A patient characters

		Failed pleurodesis(N=13)	Successful pleurodesis (N=62)	P value
Age (yrs)	**Mean ±STd**	59.23±5.29	56.34±6.65	**0.146**
Gender	**Male (n=42)**	10 (23.81%)	32 (76.19%)	**0.095**
	Female (n=33)	3 (9.09%)	30 (90.91%)	
Site of effusion	**Right (n=69)**	11 (15.94%)	58 (84.06%)	**0.280**
	Left (n=6)	2 (33.33%)	4 (66.67%)	
Amount of effusion	**Moderate (n=28)**	2 (7.14%)	26 (92.86%)	**0.072**
	Massive (n=47)	11 (23.40%)	36 (76.60%)	
Ascites	**No (n=4)**	0 (0%)	4 (100%)	**0.051**
	Mild (n=36)	3 (8.33%)	33 (91.67%)	
	Moderate (n=35)	10 (28.57%)	25 (71.43%)	
Albumin (gm/dl)	**<2.8 (n=34)**	9 (26.47%)	25 (73.53%)	**0.056**
	>2.8 (n=41)	4 (9.76%)	37 (90.24%)	
Bilirubin (mg/dl)	**<3 (n=36)**	1 (2.78%)	35 (97.22%)	**0.001***
	>3 (n=39)	12 (30.77%)	27 (69.2%)	
Cause of effusion	**Bilharzial (n=26)**	1 (3.85%)	25 (96.15%)	**0.064**
	Viral (n=24)	5 (20.83%)	19 (79.17%)	
	Mixed (n=25)	7 (28%)	18 (72%)	
No of pleurodesis sessions	**Once (n=66)**	9 (13.64%)	57 (86.36%)	**0.022***
	Twice (9)	4 (44.44%)	5 (55.56%)	
Duration of drainage (days)	**Mean ± Std**	6.15±1.21	5.10±0.78	**<0.001***

**statistically significant*

Table 3. Examined variables compared in failed and successful pleurodesis

In our study, we found that there were statistical significant relationship between failure of pleurodesis and bilirubin level >3 mg/dl, number of pleurodesis sessions and increased duration of drainage. We found that patients with massive effusion, moderate ascites and reduced albumin level had more percentage of failed pleurodesis but not statistically significant (table 3).

Complications in our study (Fig 1) was pain after pleurodesis in 60 patients, hypotension after drainage in 6 patients, hepatic precoma in 2 patients with no statistical significant relationship between failure of pleurodesis and occurrence of complications. No reported pneumothorax, chest wound infection or pleurocutaneous fistula in patients included in the study.

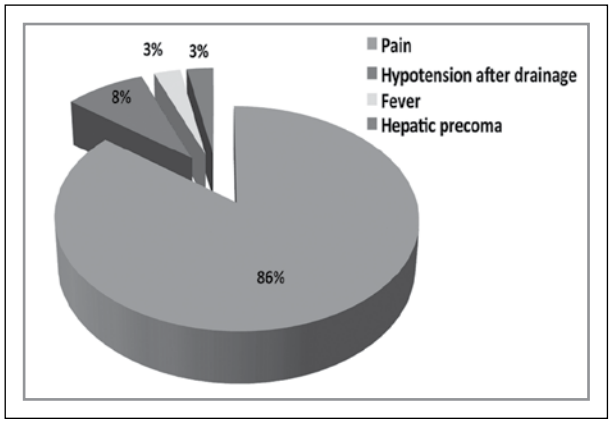

Fig. 1: Complications of procedure

Discussion

Hepatic hydrothorax is a common problem in Egypt due to the high incidence of viral hepatitis, bilharzial periportal fibrosis or combination of both. All these pathologies contribute to the development of portal hypertension and occurrence of ascites and hepatic hydrothorax.

Management of hepatic hydrothorax is a challenging issue. The main curative treatment is liver transplantation that had some problems including donor availability, long waiting time and its high cost [8].

Transjugular intrahepatic portosystemic shunt (TIPS) is another mode of treatment with some disadvantages like shunt occlusion and thrombosis, high mortality rate and high incidence of post TIPS encephalopathy [9]. Transjugular intrahepatic portosystemic shunt is considered technically difficult in Egyptian patients with bilharzial periportal fibrosis that makes creation of stent intrahepatically very difficult [10].

Insertion of chest tube for drainage of hepatic hydrothorax is associated with high output drainage with marked fluid and electrolyte depletion, renal failure, impaired immunological function and death, so insertion of chest tube in those patients is a relative contraindication [11,12]. Chest tube insertion is also associated with high incidence of pleurocutaneous fistula that continues to discharge for long time [13].

In our study, we used hemodialysis central venous catheter 12 french. This helped us to make control of drainage of pleural effusion and was comfortable to patients, easy to be inserted under local anaesthesia with no blockage and had no incidence of pneumothorax or pleurocutaneous fistula. This is to our knowledge the first study that used this type of catheter. There was a study by Bediwy et al who used Pigtail catheter in draining different types of pleural effusion including hepatic hydrothorax. They reported 19.6% cases of pneumothorax and 3.92% blockage of the catheter [14]. Another study by El-Raiding et al used central venous catheter for draining hepatic hydrothorax with accepted results [15]. The use of small bore catheter in draining most types of pleural effusion was studied with good results [16].

The agreement about pleurodesis in patients with hepatic hydrothorax carries some controversies. The chance of failure of pleurodesis could be expected to be high due to rapid reaccumulation of pleural fluid from ascitic fluid and inability to make complete apposition between parietal and visceral pleura [17]. We think that the challenge will be in how to make complete evacuation of pleural fluid before pleurodesis without fluid and electrolyte disturbances.

In our study, the success rate of pleurodesis was 82% (62 of 75 patients). This percentage is considered accepted by comparison to other studies. Lee et al in Korean study showed 72.7% successful pleurodesis after drainage of effusion with or without video-assisted thoracoscopic surgery (VATS) [18]. Ferrante el al. documented that 52% of symptomatic hydrothorax can be controlled by single session of pleurodesis and this percent increased to 73% after two sessions of pleurodesis [19]. Sclerosing agent used in pleurodesis acts to make destruction of visceral and parietal mesothelium with adhesion formation [20].

Different sclerosing agents were used in literature in hepatic hydrothorax including Doxycycline, Bleomycin, OK 432, Vibramycin and Talc. In this study, we chose Povidone Iodine 10% as sclerosing agent. It is well known antiseptic solution, inexpensive, available and not known to have hepatotoxic effects [21, 22]. It was used also by Helmy et al. in 8 patients with refractory hepatic hydrothorax, comparing it with talc and vibramycin with good results [23].

In our study, we excluded patients with child C classification and those with massive ascites. Those patients had poor general condition and are not expected to cease pleural fluid drainage through catheter. We found that increased duration of drainage, need for another session of pleurodesis and elevated bilirubin level more than 3 mg /dl are predictors of failure of pleurodesis. This is attributed to the advanced liver disease in those patients. Mortality was reported only in patients with failed pleurodesis reflecting that failed pleurodesis could be considered as a predictor of poor survival. This is similar to

results given by Lee et al. who reported that success of treatment was a prognostic significance of better survival [18].

Complications in our study were minimal and not serious. No patients had pneumothorax, pleurocutaneous fistula, fluid and electrolyte disturbances and hepatic encephalopathy. No mortality was related to procedure itself.

Conclusion

To conclude drainage of hepatic hydrothorax with hemodialysis central venous catheter 12 french and pleurodesis using Povidone iodine 10% is safe, effective and well tolerated procedure ,has limited complication with accepted outcome, superior to repeated thoracentesis and should be taken as a first line of treatment after failure of medical treatment in patients who are not candidate for and or waiting liver transplantation. Increased bilirubin level, increased duration of drainage and number of pleurodesis sessions were found to be predictors of failure of pleurodesis

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