Axillary thoracotomy for open heart surgical closure of atrial septal defects in children

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Abstract: **Our paper discusses the utility of limited trans-axillary muscle sparing right thoracotomy approach for approaching the heart in comparison to the existing median sternotomy approach for ASD patch closure in children and discusses the advantages of this technique.**

Methodology: **This study was done in the Assiut university pediatric cardiothoracic surgery unit in the time period of 2010 to 2012. The study included 32 pediatric patients aged 2 – 9 years old (5.01 ± 1.86) admitted to the unit for surgical repair of their secundum ASDs. The patients were randomly allocated into one of two groups according to the approach used in their operation. *Group 1: Thoracotomy group* for 16 patients operated via a limited lateral trans-axillary muscle sparing thoracotomy through the 4th intercostal space. *Group 2: Sternotomy group* included 16 patients operated via the routine median sternotomy incision. Postoperative comparisons were made including: 1) Pain assessment by modified pediatric objective pain scale and analgesic requirements for post-operative pain relief. 2) The cosmetic results and the sight of the wound scar; and any wound problems were documented. 3) The assessment of quality of ASD repairs by transthoracic echocardiography during the hospital stay and at the first outpatient follow-up visit after 6 months.**

Results: **There was no statistically significant difference between the 2 groups as regarding their demographic data and operative times. Total in hospital pain score was high in sternotomy group than thoracotomy group, but did not reach statistically significant values. However, the requirement for additional pain control medication in the form of intravenous paracetamol were significantly lower in thoracotomy group than sternotomy group (2.56±0.727 and 3.31±0.704, respectively; P-value 0.011). Also, statistically significant differences were found between the 2 groups as regarding the incidence of late wound complications being more common in the sternotomy wound group. Postoperative echocardiography at discharge and at follow up revealed complete closure of the ASD in all cases of the two groups.**

Conclusions: **Muscle sparing trans-axillary lateral thoracotomy offers a viable alternative for mid-sternotomy and sub-mammary thoracotomy for pediatric open heart surgery in selected cardiac lesions. It has the advantage of a scar in hidden area under the arm that does not impede the future growth of the breast tissue and the pectoralis major muscle in addition to less postoperative pain and avoiding the possible sternotomy complications. This approach does not need any new instruments and hence no contraptions are necessary to perform the operation with this approach. Our results have shown satisfactory short-term results and better cosmoses.**

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Codex : o3/01/1301

Surgery for congenital heart disease has made great advances, and the focus has shifted from simply surviving the operation to the quality of life after surgical repair, especially when dealing with simple lesions such as atrial septal defects (ASDs). In children and young women, the appearance of the incision has been a significant issue, with concern that it could have an impact on the patient's psychological wellbeing and self esteem. Open heart surgery in pediatric age group is routinely done through a median sternotomy approach. This approach, in spite of being

widely used, has some drawbacks especially in this growing up group of patients; as the disfiguring scar in a prominently visible site in a potential teenager, added to this, the high incidence of keloid formation in such scars. Also there is high incidence of sternal deformity in the growing up sutured sternum. In addition the post-sternotomy pain is still a disabling postoperative problem.

To minimize these problems and avoid a visible midline scar, several approaches have been described. Most commonly, surgeons have tried using the anterolateral thoracotomy approach, originally described by Lewis and Taufic1 in 1952 [1]. In addition, there have been reports concerning the use of other access sites such as posterolateral thoracotomy [2, 3], and most recently using a short right lateral muscle-sparing trans-axillary thoracotomy [4, 5, 6].

From the practical point of thinking, the anterior thoracotomy appears to be more convenient being closer to the cardiac structure than other thoracotomies. However, many previous articles discussed the drawbacks of using the anterior thoracotomy in the children [7, 8, 9, 10]. The recognition of the maldevelopment of breast and pectoralis muscle with anterior thoracotomy approach in children spurred us to use the trans-axillary muscle sparing lateral thoracotomy approach.

The aim of this work is to discuss the utility of limited trans-axillary muscle sparing right thoracotomy approach for approaching the heart in comparison to the existing median sternotomy approach for ASD patch closure in children and discusses the advantages of this technique.

Cardiovascular

Patients & methods:

Preoperative data:

This study was done in the Assiut university pediatric cardiothoracic surgery unit in the time period of 2010 to 2012. The study included 32 pediatric patients aged 2 – 9 years old (5.01 ± 1.86) admitted to the unit for surgical repair of their secundum ASDs. All patients were diagnosed by preoperative echocardiography to have secundum ASDs not suitable for catheter closure (lacking one rim or more). The patients were randomly allocated into one of two groups according to the approach used in their operation. Written consent and approval was obtained from the parents or guardians after explaining the approach for them. So, the study included two groups of patients according the used approach;

Group 1: Thoracotomy group for 16 patients operated via a limited lateral trans-axillary muscle sparing thoracotomy through the 4th intercostal space.

Group 2: Sternotomy group included 16 patients operated via the routine median sternotomy incision.

Intraoperative data:

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

CPB circuit was primed with mannitol, sodium bicarbonate, and packed red cells to obtain a hematocrit 26%. CPB was initiated. The alpha-stat method of acid-base management was used. A mean arterial pressure (MAP) was maintained between 30-60 mm Hg during CPB.

The surgical approach:

Sternotomy group: routine midline full sternotomy was used for open heart surgical closure of the ASD.

Thoracotomy group: All the steps of the approach are illustrated in Figure (1). The patients were positioned with the chest in an 80° left lateral position and the pelvis in a corresponding 45° position. The right arm was brought over the head and supported by a sling. The anterior axillary line was marked with a pen (as anterior limit for the incision), as was the fourth intercostal space. A 4- to 5-cm incision was made, the subcutaneous tissue was undermined, the anterior border of the latissimus dorsi was set free of attachments, and the muscle was mobilized to expose the 5th rib. The approach to the rib was made anterior to the neurovascular pedicle of the long thoracic artery and nerve. A retractor (Langenbeck retractor) was inserted underneath the latissimus dorsi to retract both structures together to free the rib posteriorly and thereby avoid injury to the pedicle. The pleura was entered through the fourth intercostal space at the upper border of the 5th rib. The lung was retracted posteriorly and left lobe of the thymus gland was excised. The pericardium was opened 1 inch anterior and parallel to the phrenic nerve. The posterior pericardial border was suspended to the exterior, and the anterior was suspended interiorly to the rib periosteum. Once the pericardium was suspended, exposure was very satisfactory.

The right atrium was momentarily suspended to expose the aorta. Heparin was given, and the aortic and atrial purse-string sutures were prepared. A flexible aortic cannula was employed. In all cases, a side-biting clamp was made ready in case of difficult cannulation. Direct superior vena caval cannulation by a right-angled venous cannula was easily obtained followed by juxtacaval inferior vena caval cannulation. The superior vena cava can be controlled with tape. It must be noted that taping of the inferior vena cava (IVC) should always be carried out on bypass. Antegrade aortic root cardioplegia cannula was fixed. (Cannulation was easily accessible and no patient required iliac vessels cannulation). Once CPB was started, ventilation was stopped and aorta was clamped using a long aortic clamp, cardioplegia was given and intracardiac procedures were performed as usual.

In the case of a left superior vena cava, it can be temporarily compressed or cannulated trans-atrially, according to size. When de-airing, as well as the usual method, it is important to apply steady suction to the aortic root after de-clamping, in addition to syringe aspiration of the right superior pulmonary vein. When hemostasis was assured after terminating bypass, an intrapericardial drain was inserted. The pericardium was closed with interrupted sutures or a thin synthetic patch if part of it had been removed; another basal pleural drain was inserted. Intercostal nerve block was performed, the intercostal space was closed as usual, and the muscles, subcutaneous tissue and skin were sutured.

The associated **appendix (1)** shows pictures from the different operative steps and the postoperative look of the thoracotomy wound.

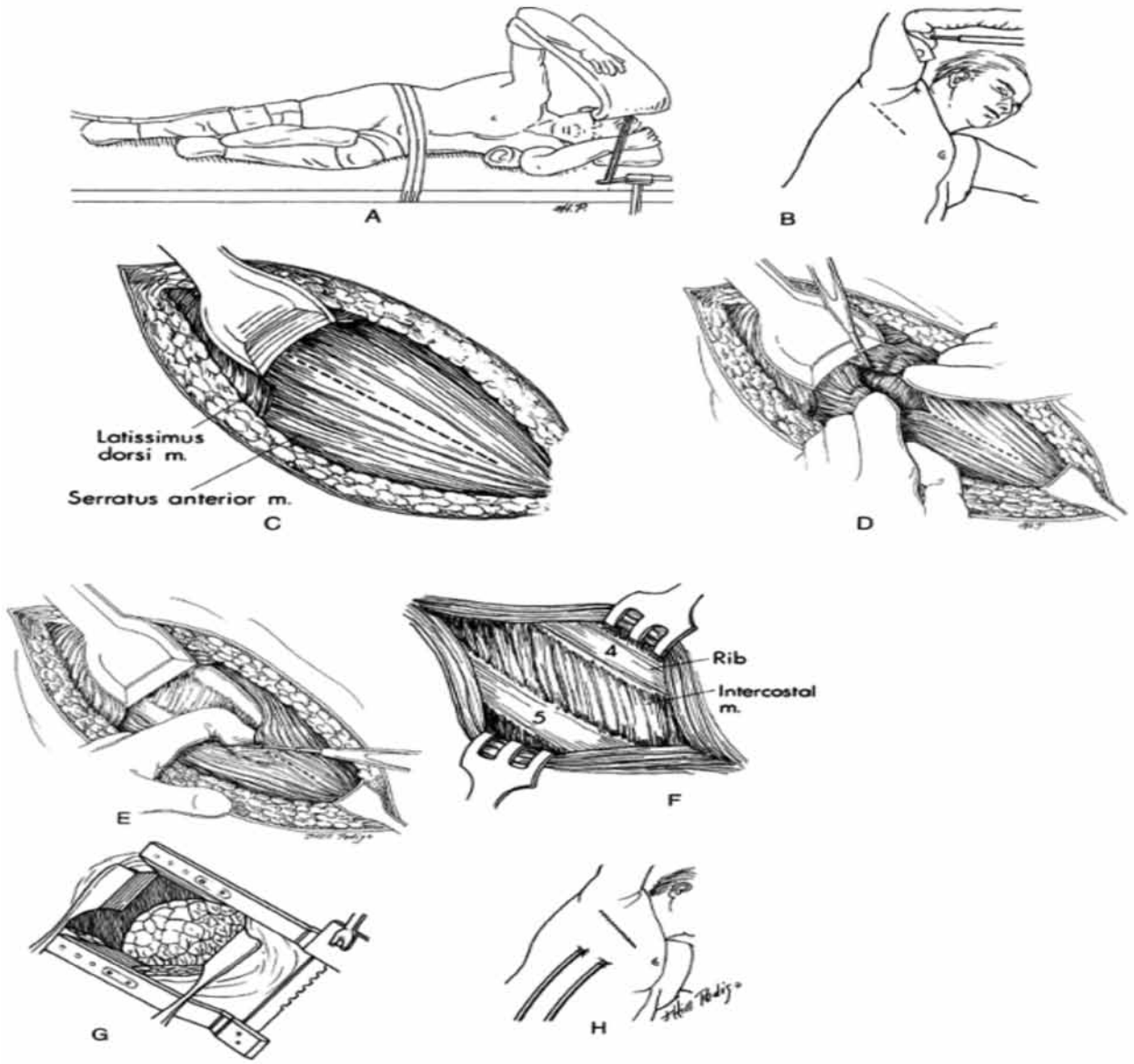


Figure (1): Axillary thoracotomy. A. The arm is abducted 90 degrees on a rest and padded with care. B. An incision is made in line with the desired interspace. It is not necessary to raise skin flaps. C. The latissimus dorsi muscle is retracted posteriorly to expose the serratus anterior muscle. D. The serratus is spread in the direction of its fibers, using the electrosurgical unit, being careful to avoid injury to the long thoracic nerve to the serratus anterior muscle. E. The anterior portion of the serratus is divided with the cutting current to expose the intercostal muscles. F. The intercostal muscles are divided near their inferior attachment to the rib. G. Two rib spreaders facilitate exposure. H. Generally, two chest tubes are used, and they are brought out near each other. [11]From Shields, Thomas W.; LoCicero, Joseph; Ponn, Ronald B.; Rusch, Valerie W. General Thoracic Surgery, 6th Edition, Lippincott Williams & Wilkins, 2005©.

Postoperative data:

Many patients were extubated on the operating table or few hours later in ICU. The criteria for extubation were as the standards for postoperative cardiac patients in the form adequate level of consciousness, hemodynamic stability, absence of arrhythmias, adequate airway reflexes, normothermia, acceptable mediastinal drainage blood loss and acceptable blood gas analysis.

The drains were removed the next morning if there was no significant bleeding and satisfactory radiographs. Patients were given physiotherapy if needed, before discharge. They were followed up by echocardiography before discharge, 15 days after discharge, and 6 months later.

Postoperative comparisons included:

I. Pain assessment by modified pediatric objective pain scale (see table – 1), where each criterion scores 0-2 to give a total score 0-10 where a total score < 5 means adequate analgesia was assessed immediately after extubation, then at 1,2,4,6,8,12,16,20,24 hours postoperative. Analgesic requirements for post-operative pain relief if their pain score is more than 4 in the form of total intravenous paracetamol given within the first 24 hours postoperatively (15 mg/kg per dose every 4-6 hours in the) and if pain persisted, morphine (0.1 mg/kg) was administered subcutaneously

II. The cosmetic results and the sight of the wound scar; and any wound problems were documented.

III. Quality of the repair was assessed by transthoracic echocardiography during the hospital stay and at the first outpatient follow-up visit after 6 months. These data and the clinical status at 6 months were available in all the patients. Follow-up was complete and ranged from 10 months to 2.5 years (median, 14 months).

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

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

Results

There was no statistically significant difference between the 2 groups as regarding the demographic data of their patients and their operative times (Table 2).

	Group 1 (mean±SD)	Group 2 (mean±SD)	p- value
Age	4.54±1.696	5.47±1.970	0.165
Weight	15.88±4.161	18.69±4.393	0.073
Ischemic time	31.25±5.222	28.69±5.413	0.183
Bypass time	39.56±5.750	36.12±4.717	0.075

Table (2): Patients, characteristics:

Total in hospital pain score was high in sternotomy group than thoracotomy group, but did not reach statistical significant value (3.44±1.031 versus 4.00±1.033, P>0.05) immediately after extubation in both groups respectively and this maintained during follow up in the first 24 hour postoperative for pain assessment also without reaching statistical significant value. Pain scores between both groups were compared using Mann-Whitney U-test in all tests p< 0.05 is considered significant (figure 1).

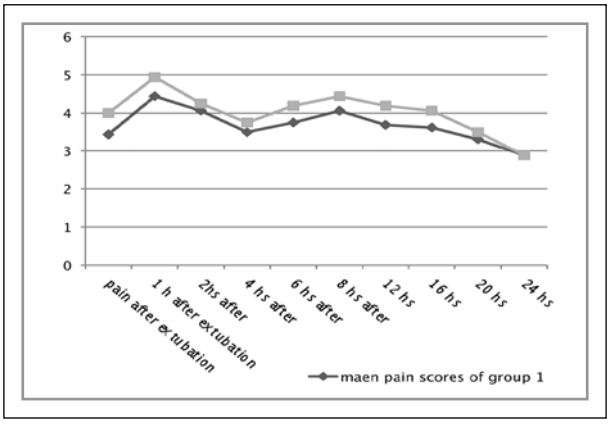


Figure 1: comparison of mean pain scores after extubation between patients of groups 1 and 2

The requirement for additional pain control medication in the form of intravenous paracetamol (15 mg/kg per dose every 4-6 hours for post-operative pain relief if their pain score is more than 4 in the first 24 hours postoperatively) were 2.56±0.727 and 3.31±0.704 in group 1 and 2 respectively so it was higher in sternotomy group than thoracotomy group with statistical significant value by fishers' exact test p< 0.05 (figure – 2). Number of patients who needed morphine (0.1 mg/kg) subcutaneously as rescue analgesic was 4 and 6 and it was administrated once only.

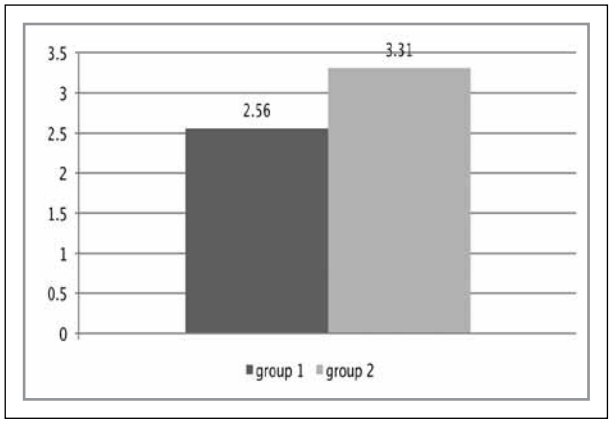
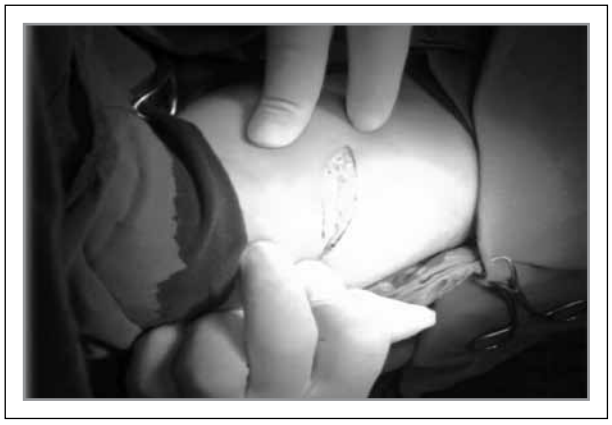
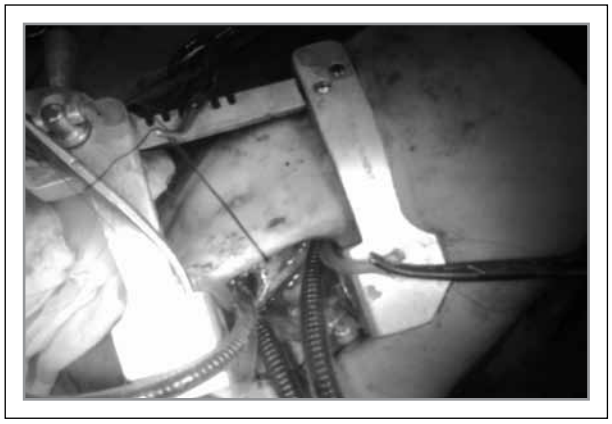


Figure 2: Number of doses of analgesia

Appendix 1: Pictures from the operations and the postoperative look of the wound



Picture 1: skin incision



Picture 3: Aortic and venous cannulation for cardiopulmonary bypass

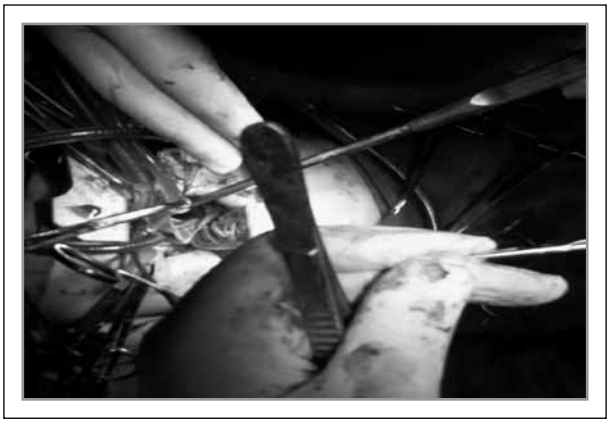
	Group 1	Group 2	P – value
Early:			
• infection, dehiscence	0/16	0/16	
Late:			
• Sternal or chest wall deformity.	0/16	5/16	0.043
• Sternal wire complications	0/16	7/16	0.007
• Keloid or hypertrophic ugly scar.	0/16	6/16	0.018

Table (3): Wound complications (number of patients had complications/total number of the group):

Statistically significant differences were found between the 2 groups as regarding the incidence of late wound complications being more common in the sternotomy wound group (Table 3)

Postoperative echocardiography at discharge and at follow up revealed complete closure of the ASD in all cases of the 2 groups.

Picture 2: opening of the pericardium



Picture 4: ASD exposure and patch closure

Pictures (5): showing the postoperative look of the thoracotomy wound scar

Discussion:

Most surgical corrections performed at the atrial level are considered simple and should lead to a perfect repair with an uneventful course. Atrial septal defects closure has the lowest estimated mortality approaching zero in all Congenital Heart Surgery Databases including our own results [13, 14]. Cosmetic aspect of a heart operation is seldom taken into consideration in view of the importance of achieving a safe and reliable cardiac repair, the quality of which not only affects the patient's life expectancy but also his or her life quality. If the same quality of repair, however, can be obtained with a cosmetically superior approach, many patients will opt for such an alternative. To some extent, this attitude has popularized the percutaneous approach to close simple atrial defects [15]. The pressure for a cosmetic approach is at times so great that some patients or their parents were ready to accept increased risks or less optimal results. The psychological burden of a full sternotomy should not be underestimated in children, teenagers, and young adults. The corporeal image is especially important at this time of life to promote positive self-esteem, and a deprecated image might lead to reactions of retreat or even depression. Finally, the conspicuous sternal incision is a lifelong reminder of a "heart problem" not only to the patient but to his entourage as well. This is certainly why the antero-lateral incision, even when it had resulted in thorax and breast deformity, was better accepted than the median sternal incision [16].

Anterolateral thoracotomy although being popular for open heart surgery in adults, several studies on its use for pediatric open heart surgery however, found that deformity of the future breast and pectoral muscle in this group of growing up children are common. From the practical point of thinking, the anterior thoracotomy appears to be more convenient being closer to the cardiac structure than lateral thoracotomy. However, many previous articles discussed the drawbacks of using the anterior thoracotomy in the children. The flaw is that it is very difficult to predict the quantum of the breast growth in individual female children after they attain puberty. In addition, it is reported in the literature that the breast tissue extends beyond the nipple-areola complex; obviously this tissue is susceptible to anterior thoracotomy incision. Cherian and collegues revealed in their experience that anterior thoracotomy incision infrequently crosses the future breast line and becomes cosmetically disfiguring [7]. There are several earlier reports that have revealed this drawback associated with the periareolar numb-

ness or hypoesthesia [8, 9]. Cherup and colleagues measured volume differences of the breast and pectoral muscle in 22 men and women who had undergone right or left anterolateral thoracotomy as children. Follow-up time was approximately 20 years. They found a volume difference greater than 20% in 60% of the patients by a method using plaster molds [10].

In our study, 32 pediatric patients aged 2 – 9 years old (5.01 ± 1.86) admitted to the unit for surgical repair of their secundum ASDs were randomly allocated into one of two groups according to the approach used in their operation; limited trans-axillary muscle sparing right thoracotomy approach in comparison to the existing median sternotomy approach. There was no statistically significant difference between the 2 groups as regarding their age and weight (table 2). Although the ischemic and bypass times were longer in the thoracotomy group than in the sternotomy group, however, this was because it was a new approach, there was a tendency to decrease in the cross clamping time with increasing experience. Neguyen and collegues found in similar study comparing ministernotmy and midaxillary thoracotomy for ASD closure that the ischemic time is longer in thoracotomy patients however the cosmetic result is much better in that group [6].

In our study, it is clear from the pictures of the patients that the incision in the axilla is simply invisible as long as the arm is not abducted. The axillary approach appears to be a good alternative to other chest incisions, including the anterolateral thoracotomy. It allows the safe correction of some cardiac defects and results in a cosmetically acceptable and almost invisible scar. The thorax showed no asymmetry postoperatively and during follow-up. The growth of the musculoskeletal elements of the thoracic wall appeared normal, probably because we spared the thoracic muscles and retained a normal space between the ribs. The axillary part of the ribs is midway between the anterior and posterior hinge points. The ribs and their attachments are thus minimally stressed when spread apart at this point. This is probably the reason why, in our experience, the ribs were never broken or disinserted at the chondrocostal junction. We also hope that the breasts will develop harmoniously in female patients because of our efforts never to cross the anterior axillary line and therefore never to violate the borders of the mammary gland. Also, in our study, it was apparent that wound complications as infection, stainless steel wire complications, and hypertrophic or keloid scars are less in the axillary thoracotomy group, actually not recorded, as compared with the sternotomy group that had statistically significant increased incidence of such complications.

As regarding postoperative pain, in our study there was clear increase in the severity of postoperative pain score along all postoperative hours in the sternotomy group than in patients of thoracotomy group, however, these increases did not reach statistical significance (Figure 1). As a consequence to the less postoperative pain scores experienced by thoracotomy group patients, there was less need for doses of IV analgesia which was statistically significantly less in the thoracotomy group compared the sternotomy group (Figure 2).

Finally, although the study sample was small, but it did provide useful data when compared with that of the more commonly performed sternotomy. Trans-axillary thoracotomy compared with posterolateral thoracotomy has the advantages of avoiding cutting into any muscle group resulting in definitely less postoperative pain and earlier recovery while keeping the advantage of avoiding the future breast area [17]. Kirby and coworkers have emphasized how little difference exists between a muscle-sparing thoracotomy and a VATS approach for lobectomy in terms of length of chest tube drainage, postoperative stay, and postoperative discomfort [18].

However, the axillary incision is still not suitable for many complex congenital cardiac lesions and the sternotomy is still the standard and most effective approach. Also, the axillary thoracotomy is not recommended for the occasional thoracic surgeon or for a difficult operation because the exposure is more limited than that of a posterolateral thoracotomy [11].

Conclusions

Muscle sparing trans-axillary lateral thoracotomy offers a viable alternative for mid-sternotomy and anterior thoracotomy for pediatric open heart surgery in selected cardiac lesions. It has the advantage of a scar in hidden area under the arm that does not impede the future growth of the breast tissue and the pectoralis major muscle in addition to less postoperative pain and avoiding the possible sternotomy complications. This approach does not need any new instruments and hence no contraptions are necessary to perform the operation with this approach. Our results have shown satisfactory short-term results and better cosmoses.

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Should the Ductus Arteriosus be Closed when Performing Blalock-Taussig Shunt? A Retrospective Study

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Introduction: Modified Blalock-Taussig shunt is the palliative procedure of choice for pulmonary oligemia when the definitive repair could not be performed safely. Closing the patent ductus arteriosus (PDA) during the procedure is still not clearly answered. The aim of this study was to compare the results of closure versus non-closure of the PDA during MBT shunt surgery in neonates and infants with complex congenital heart lesions.

Methods: This retropective study included 26 patients divided into 2 groups, 13 each, all of them have severely limited pulmonary blood flow (PBF), 11 had tetralogy of Fallot, 9 had pulmonary atresia with intact ventricular septum (PA/IVS), 4 patients with tricuspid atresia, they all had MBT through a sternotomy approach at our institution. Mortality, need for reinterventions were studied as primary outcomes.

Results: median age (34 days), the arterial duct was closed surgically in 13 patients, and left open in another 13 patients. Patients with a surgically closed ductus had a higher incidence of resuscitation events (30.7% versus 0%, p = 0.0012), reinterventions (30.7% versus 7.6%, p = 0.0015), and higher early hospital mortality (15% versus 0%, p = 0.01). Time to extubation and length of hospital stay did not differ between the two groups (p = 0.15 and p = 0.71, respectively). A trend toward a higher maximum vasoactive inotropic score in the group with a closed duct was observed.

Conclusions: Ductus closure is associated with increased incidence of resuscitation events, need for reintervention, and increased mortality during the early postoperative period.

Key words: Blalock,Shunt, Pulmonary atresia

Methods of palliating critical pulmonary oligemia in neonates and infants with complex congenital heart disease continue to evolve. After its introduction in 1945, the BT shunt became the palliative procedure of choice for children with cyanotic congenital heart malformations,[1] The modified Blalock-Taussig (MBT) shunt introduced by de Leval and colleagues,[2] has gained general acceptance and is widely used. The smaller subclavian artery of most neonates has been postulated to be a flow regulator allowing shunt flow to increase with growth until the conduit is the smallest vessel in the circuit.[2]

Despite numerous improvements in diagnosis, intensive care, and intraoperative management in recent decades, the overall mortality rate after the MBTS is still significant at 3%-16%.[3-5] Several studies have investigated risk factors for morbidity and mortality after the MBTS,[6-8] and have identified age, weight and underlying cardiac diagnosis as among the risk factors for death.

Currently, there is no clear consensus on how to approach the PDA during MBT procedures in neonates with duct dependent pulmonary blood flow (PBF). The PDA could be a source of competitive flow after MBT placement. Overshunting may lead to a drop in oxygen saturation with metabolic acidosis.[4] Concomitant patency of the ductus and the shunt has potentially harmful effects on coronary blood flow, particularly in patients with pulmonary atresia and intact ventricular septum where sinusoidal communications exist between the right ventricle and the coronary arteries and is a frequent cause of postoperative myocardial failure in such patients.[9] On the other

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Codex : o3/02/1301

hand ductal patency may be potentially life-saving in case of early shunt obstruction or postoperative increase of pulmonary vascular resistance.[10]

This retrospective study compared the results of closure versus non-closure of the PDA during MBT shunt surgery in neonates with complex congenital lesions.

Patients and Methods

From June 2011 to December 2012, 26 patients with complex congenital heart lesions underwent primary modified BT shunt operations by different surgeons from Cardiothoracic Surgery Department, Alexcandria University. The ductus was closed if still open as part of the surgery in half of the cases. We obtained the acceptance of our ethical committee for the study.

Patients mean age was 1.6 months (range, 11 days to 3 months), 18 neonates and 8 infants. Weights ranged from 3 to 5.5 kg with a mean of 3.8 kg. The disease spectrum is shown in Table 1. Only patients undergoing a primary MBT operation were included in this study. Babies who needed additional procedures were excluded, also if they have additional pulmonary blood flow they are excluded from the study.

Diagnosis	PDA closed (13)	PDA open (13)
Tetralogy of Fallot	5	6
Pulmonary atresia/Intact ventricular septum	4	5
Tricuspid atresia	3	1
Heterotaxy	1	1

Table 1. Morphology in 26 patients given a MBT shunt

Resuscitation events, need for reintervention, and mortality during the early postoperative period were considered primary outcome variables. The early postoperative period was defined as the first 48 postoperative hours including the time in the operating room. A resuscitation event was defined as need for adrenaline bolus or chest compression, or both. Reintervention was defined as unplanned surgery because of severe hypoxemia or low cardiac output. Time to extubation, maximum vasoactive-inotropic score as described by Gaies and colleagues,[11] and length of hospital stay were selected as secondary outcome variables.

Routine preoperative echocardiographic evaluation of intracardiac anatomy included left and right pulmonary artery size, confluence, main PA, orientation of the aortic arch and its branching pattern, the site of insertion of ductus. All patients were stabilized in the intensive care unit by maintaining adequate hydration, preventing hypothermia and hypoxia, and correcting any metabolic acidosis.

At surgery, the patient was carefully positioned with the neck extended by a shoulder roll. The sternum is vertically split and the thymus removed. The pericardium was opened in its cephalad portion, leaving it intact for a variable length near the diaphragmatic attachment for protection on resternotomy. The pericardium was suspended, and sharp dissection of the branch PA and the brachiocephalic artery and its branches was carried out. To enable smooth and unobstructed dissection of these vessels, the aorta was retracted to the other side, the superior caval vein was retracted laterally, and the right atrium was retracted inferiorly. A polytetrafluoroethylene (PTFE) graft of suitable diameter was selected (usually 3.5 for the average neonate, 4 mm for infants < 5 kg), and the proximal end was beveled. Heparin was routinely administered (100 IU/kg). The beveled end was anastomosed end to side to the subclavian artery, using a continuous 7/0 polypropylene suture. The other end of the graft was trimmed straight and after clamping and incising the pulmonary artery, distal anastomosis was carried out using a continuous 7/0 polypropylene suture. The length of the graft was adjusted so that it lay straight along the mediastinum without kinking and without distortion of the pulmonary artery. The graft was deaired from the distal anastomosis before releasing the subclavian clamp. Heparin was not reversed, 24 patients had a right sided shunt and 2 patients left sided. Patients were randomized blindly for PDA closure by a yes or no envelope before surgery, if the PDA to be closed it is closed by a single clip or ligature. Dopamine infusion at a dose of 5 to 10 ug/kg/minute was administered in all patients. Epinephrine infusion was added according to the clinical situation. Fraction of inspired oxygen depended on arterial saturations, with target values more than 80%. The sternum was closed in the standard fashion.

Postoperatively, all patients received mechanical ventilator support and continuous infusion of sufentanyl for 24 hours. They were extubated when hemodynamically stable with satisfactory arterial blood gas levels. Postoperative shunt patency was assessed by detection of shunt murmur and analysis of blood gases. Heparin was not routinely administered, but all patients received aspirin 5mg/kg daily.

Continuous data are presented as a median and range, nominal data are presented as percentage. Chi-square test for nominal data and t test for continuous data were used to compare the two operative groups (surgical closure or nonclosure of PDA). A p value less than 0.05 was considered significant.

Results

Both groups was similar in preoperative characteristics, the shunt size was similar in both groups (Table 2).

Baseline Characteristics	PDA (closed)	PDA (open)	p Value
Age, days, median	33	35	0.72
Weight, kg, median	3.6	4.2	0.72
Sex, male/female	7/6	7/6	0.99
Extracardiac anomaly	1	2	0.72
PA/IVS	4	5	0.56
Preoperative O2 sat % Median (range)	75 (62-85)	75 (54-90)	0.88
Preoperative Inotropic support	2	2	0.97
Preoperative mechanical Ventilation	3	2	0.72
Shunt size	3.5 (3.5-4)	3.5 (3.5-4)	0.99
Shunt side, right/left	12/1	12/1	0.99
Aortic arch branching Anomaly	1	1	0.99

Table 2 Preoperative and Operative Variables

Primary outcome variables

Resuscitation events

In the first 24 hours 4 patients needed resuscitation. All patients were from the PDA closed group (30.7% versus 0%, p = 0.0012). two of them survived and two (15%) died of low cardiac output during the following 24 hours.

Type of reintervention	Closed Ductus	Open Ductus
New shunt	2	0
Ductal reopening	1	0
Chest reopening	1	0
Control of bleeding	0	1

Table 3 Early Reinterventions in the first 24 hours

Early re-interventions

Five patients needed early postoperative interventions, 4 in the closed ductus group and one in the open ductus group (30.7% versus 7.6%, p = 0.015). Two patients received new shunts because of significant hypoxemia, due to acute shunt thrombosis. In the other two patients in the closed ductus group, the shunt was patent, the clip on the ductus was removed and hypoxemia improved in one patient while the last patient was successfully treated with urgent chest opening and delayed sternal closure.

One patient from the open ductus group, suffered from significant bleeding and low cardiac output, recquired resternotomy to control bleeding 3 hours after shunt operation.

Early mortality

Two patients died during the first 48 postoperative hours, both of them are from the closed ductus group (15% versus 0% in the open ductus group; p = 0.03). Both patients have a diagnosis of pulmonary atresia and intact ventricular septum, they had significant desaturation in the intensive care unit, underwent revision of the shunt. Despite the new shunt creation, they both died within the next 24 hours after surgery.

Secondary outcome variables

The median time to extubation was 48 hours (range 24 to 96 hours) in patients with closed PDA and 32 hours (range 24 to 88 hours) in patients with open PDA group (p = 0.15). The median length of hospital stay was 14 days (range, 8 to 32 days) in the PDA closed group and 10 days (range, 7 to 28 days) in the PDA open group (p = 0.71). Patients whose arterial duct was initially closed tended to have a higher maximum vasoactive-inotropic score (median 12.5; range, 5 to 75) compared to open PDA group (median 9, range, 0 to 50; p = 0.10). Higher mean and diastolic arterial pressures were observed in the closed ductus group during the first 24 postoperative hours. The arterial oxygen saturation remained significantly higher in the open ductus group during the first 24 hours after surgery.

At hospital discharge, Echocardiography showed spontaneous PDA closure in 8 patients (61.5%) where the ductus was left open, in the remaining patients the duct was smaller in size without pulmonary overcirculation.

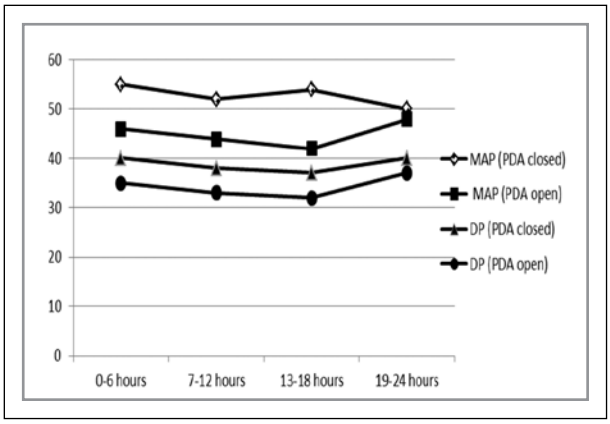

Fig. 1. Median mean arterial pressure (MAP) and diastolic arterial pressure (DP) in both groups during the first 24 hours postoperatively

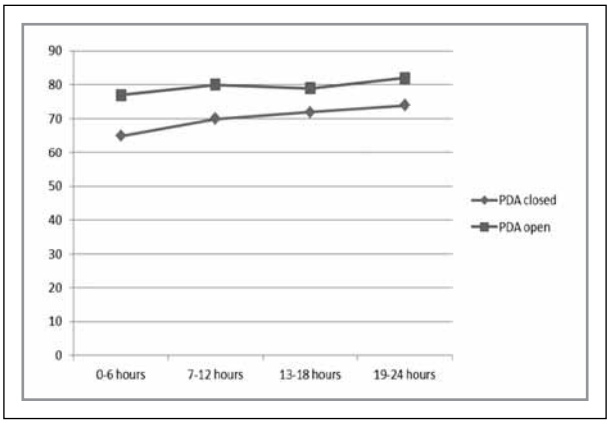

Fig. 2. Median arterial oxygen saturation(%

Discussion

Methods of palliating critical pulmonary oligemia in neonates and infants with complex cyanotic congenital heart disease continue to evolve. After its introduction in 1945, the BT shunt became the palliative procedure of choice for children with cyanotic congenital heart malformations.[1] Success of the shunt stems from its high patency rate, technical ease of creation and take-down, low operative mortality, and low complication rate.[8] The shunt should not supply excessive pulmonary blood flow that might result in elevated pulmonary vascular resistance or impair ventricular performance secondary to excessive volume load. The shunt should not distort the PA, particularly distally, and it should encourage uniform PA growth and development. New approaches such as arterial duct stenting,[13,14] or right ventricle-to-pulmonary artery shunts,[15] have not attained widespread use until recently.

Reports from several centers have shown advantages of the modified Blalock-Taussig shunt using a prosthetic graft as it preserves the integrity of the subclavian artery, thereby avoiding acute and chronic ischemic sequelae in the upper extremity. The incidence of kinking of the subclavian artery or pulmonary artery distortion is minimal.[2,7,12] The major advantages of a thin PTFE prosthetic graft are the non-wettable electronegative surface micropores allowing rapid fibroblast proliferation, and limited neointimal formation ensuring less thrombogenesis and better shunt patency. The material is light, requires no preclotting, and it can be penetrated easily with a 7/0 polypropylene suture needle.[6]

Most studies presented data from a thoracotomy approach.[2,5] During thoracotomy, the shunt is performed on the contralateral side of the duct in most cases, and the duct is not accessible to the surgeon. The median sternotomy remains a less demanding operation for shunt reconstruction, with greater control of the vessels and without the risk of lung compression and its attendant respiratory compromise and if cardiopulmonary bypass is needed it can be instituted.[16]

The choice to close the Duct or leave it open is not very clear, A group from Boston Children's Hospital reported in 1995 that sternotomy is 4 times better than thoracotomy and stated "a patent ductus arteriosus if present, may be ligated".[17] Similarly, one of the current gold standard textbooks of pediatric cardiac surgery did not give detailed suggestions for surgical PDA management: "Access to the patent ductus arteriosus for surgical closure to remove a source of competitive flow is always possible"(The current Boston Children's group approach was described recently by Jonas[17]: their usual practice is to " ligate the duct when it is clearly large of if there is an additional source of pulmonary blood flow". In the setting of pulmonary atresia, they generally do not ligate the duct.[17]

Surgical duct closure avoids competitive flow and avoids the risk that there will be excessive PBF during the period before spontaneous duct closure. This is a potentially lethal complication; particularly for the group of patients with pulmonary atresia and intact ventricular septum. The subsequent poor systemic perfusion, due to the excessive pulmonary runoff, is accompanied by a steal of coronary blood flow and impairment of myocardial performance.[9] However with choosing an appropriate shunt size (3.5 mm) in our study, we did not observe severe volume overload with myocardial failure resulting in death or requiring secondary ductal closure.

Three critical periods for undesirable events during the early postoperative hours were identified, first, after PDA closure, second after chest closure, lastly first 24 hours after the operation, when all adverse primary outcomes in the intensive care unit were observed, which may be related to technical problems with the BT shunt, acute decrease of PBF caused by increase pulmonary vascular resistance (hypoventilation or prostaglandin infusion cessation), hypovolemia or other factors.[18] We observed drop in saturation when the ductus

was ligated or clipped but did not need any further surgical management. After chest closure there was no major events. However, in the first 24 hours 4 patients in the closed ductus group needed surgical re-intervention two received new shunts because of shunt thrombosis, duct was reopened in one and the sternum was kept open in another. Only one event in the open ductus group related to bleeding which was controlled surgically. We speculated that changes in pulmonary vascular resistance are better tolerated with an open or gradually closing duct as an additional source of pulmonary blood flow, two of the hypoxemic events occurred immediately after tracheal suctioning which is suggesting the role of pulmonary vascular reactivity in the pathophysiology of hypoxemic events after MBT shunt.

Based on our experience, conservative management of low cardiac output syndrome with temporary increased pulmonary to systemic blood flow ratio (inotropic support, hypoventilation, sedation and muscle paralysis) appear to be a safer approach than to treat acute hypoxemic episodes after PDA closure.

Fifteen patients in this study had single-ventricle physiology; an adequate-sized ASD is essential in this subgroup for right to left shunting to maintain cardiac output. Those with restrictive ASD have decreased systemic flow. Probably, open PDA and a shunt adds to the volume load on the heart and increase the left atrial pressure, thereby further decreasing flow through the ASD, which is already limited, leading to systemic hypoperfusion.[4]

MBTS continues to be a relatively high risk procedure, despite being performed most commonly as a closed-heart procedure without CPB, Age, gender and race did not affect mortality, however, the risk increases as patient weight decreases, and the need for preoperative mechanical ventilation[20] We found that the four patients who needed surgical re-intervention in the closed ductus group were around 3 kg, the two patients who died have a diagnosis of pulmonary atresia and intact ventricular septum which shows that this diagnosis continue to have the highest risk of death after MBTS, which is similar to prior reports.[19,21]

The fate of the PDA after surgery is variable, 61.5% showed spontaneous duct closure on discharge, the remaining five patients (38.5%) showed residual duct flow but the duct was smaller in size.

In conclusion, surgical PDA closure during MBT shunt procedure is associated with higher rates of resuscitation events, reinterventions and increased mortality during the early postoperative period.

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Effect of diastolic dysfunction on short term outcome after coronary artery bypass grafting.

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Objectives: **Left ventricular (LV) systolic dysfunction is one of the main predictors of post-operative outcome after CABG. However, the effect of LV diastolic dysfunction (DD) is not fully investigated. The aim of this study is to evaluate the effect of significant LV diastolic dysfunction on short term in-hospital outcome after CABG.**

Patients and Methods: **In this non randomized retrospective study, 372 patients who underwent isolated CABG in Prince Salman Heart Center, King Fahad Medical City in Riyadh (December 2008 – December 2010) were screened. We excluded patients with moderate/severe LV systolic dysfunction and constituted 184 patients. The study included the remaining 188 patients who had no or mild LV systolic dysfunction with ejection fraction > 40%. Using Echocardiographic parameters for assessing LV diastolic function including; LA volume, transmitral blood flow, pulmonary venous flow and tissue Doppler, these patients were divided in two groups, group A including; 112 patients without significant DD (normal or only impaired relaxation) and group B including; 76 patients with significant DD (pseudonomal or restrictive filling).**

Results: **Both groups were comparable regarding age, gender, NYHA functional class, pre-operative cardiac risk factors and other comorbidities. Intra-operative data (number of grafts, need of DC shock, bypass time and cross clamp time) were almost equal in both groups. However, the need of inotropic support at the end of surgery was significantly higher in group B (60.5% vs. 36.6% p = 0.004)). Also, patients in group B showed higher incidence of low cardiac output syndrome (LCOS) post-operatively (36.8% vs. 22.3% p = 0.037), more use of inotropic support post-operatively (38.1% vs. 24.1% p = 0.007), and higher incidence of post-operative atrial fibrillation (14.4% vs. 9.21% p = 0.05). There was no statistically significant difference between both groups regarding cardiac death, IABP, ICU and total in-hospital stay.**

Conclusion: **Significant LV diastolic dysfunction does not affect the cardiac mortality or in-hospital stay after CABG. However, it predicts higher incidence of post-operative complications as low cardiac output syndrome, higher rate of inotropic support and atrial fibrillation.**

Keywords: Coronary artery bypass grafting; Diastolic dysfunction; outcome.

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Codex : o3/03/1301

Left ventricular (LV) systolic dysfunction is one of the main predictors of bad post-operative outcome after coronary artery bypass grafting (CABG); however, the effect of LV diastolic dysfunction (DD) is not fully investigated. Diastolic Dysfunction (DD) is a common consequence of myocardial ischemia or infarction in patients with coronary artery disease. Diastolic dysfunction leads to an elevation in left ventricular filling pressures and is responsible for significant mortality and morbidity. Echocardiogram is a reliable and reproducible method for diagnosis of LVDD. By Doppler echocardiogram diastolic filling abnormalities are classified into 3 groups depending on mitral inflow and pulmonary vein Doppler pattern, which are delayed relaxation, pseudonomal filling and restrictive filling [1,2,3]. Other complementary techniques to assess the DD are colour M mode inflow Doppler, tissue Doppler, LA volumes, strain rate and the time constant of ventricular relaxation (tau). DD is thought to be the earliest marker of myocardial ischemia [4,5,6] to have prognostic significance in heart failure [7,8,9] and to reflect the clinical functional status of patients without heart failure [10,11]. DD is a receiving now more attention in Cardiac Surgical patients since

echocardiographic measurements were developed. However natural history of patients with coronary artery disease and DD who undergo coronary artery bypass grafting (CABG) is not well done there are only few studies available which have assessed the significance of DD on early outcome after CABG. Bernard et al [12] reported that pre-operative ICU. Liu et al [13] and Vaskelyte et al [14] showed increased Cardiac morbidity and mortality after CABG in patients with DD. However one study failed to demonstrate the adverse outcome in ICU after CABG [15]. However the patients in this study had only a relaxation deficit. Nevertheless, the authors found the incidence of DD in CABG population were about 77%. The aim of our study is to evaluate the effect of significant LV diastolic dysfunction on short term in-hospital outcome after CABG.

Patients and Methods

This study was conducted in Prince Salman Heart Center, King Fahad Medical City in Riyadh. All consecutive patients from Dec. 2008 to Dec. 2010 who had a CABG were reviewed. Complete medical records of each patient were reviewed.

The echocardiographic parameters included assessment of diastolic dysfunction according to the Canadian consensus. Recommendation for the Measurement and Reporting of Diastolic Dysfunction by Echocardiography [2]. Diastolic function was assessed after complete study of the mitral inflow, pulmonary veins flow, LA volume, and tissue Doppler of the septal and lateral LV walls. Analysis of all these parameters will classify diastolic dysfunction into three grades (table I).

Grade I with mild diastolic dysfunction, the mitral E/A ratio is ≤ 0.8, DT is ≥ 200 ms, IVRT is ≥100 ms, predominant systolic flow is seen in pulmonary venous flow (S ≥ D), annular e= is ≤8 cm/s, and the E/e= ratio is ≤8 (septal and lateral).

Grade II with moderate diastolic dysfunction (grade II), the mitral E/A ratio is 0.8 to 1.5 (pseudonormal) and decreases by 50% during the Valsalva maneuver, the E/e= (average) ratio is 9 to 12, and e= is ≤ 8 cm/s. Other supporting data include an atria reversal (Ar) velocity ≥ 30 cm/s and an S/D ratio ≤ 1. In some patients with moderate diastolic dysfunction, LV end-diastolic pressure is the only pressure that is increased (ie, mean LA pressure is normal) and is recognized by A duration ≥ 30 ms. Grade II diastolic dysfunction represents impaired myocardial relaxation with mild to moderate elevation of LV filling pressures.

Grade III with severe diastolic dysfunction, restrictive LV filling occurs with an E/A ratio ≥ 2, DT ≤ 160 ms, IVRT ≤ 60 ms, systolic filling fraction ≤ 40%, mitral A flow duration shorter than Ar duration, and average E/e= ratio ≥ 13 (or septal E/e= ≥ 15 and lateral E/e= ≥ 12). LV filling may revert to impaired relaxation with successful therapy in some patients (grade IIIa), whereas in others, LV filling remains restrictive (grade IIIb).

Patients will be classified into 2 groups according to their DD. Group A with normal or mild DD (grade I) and group B with advanced DD (grade II and III).

The demographic and baseline patients' characteristics clinical data are explained in Table 2. LIMA was used as a routine arterial graft for all patients and Cardioplegia was administered with the Myotherm XP delivery set (Medtronic Inc, Minneapolis,USA), which mixes and cools oxygenated blood with a hyperkalemic crystalloid concentration in a 4:1 dilution to achieve a high potassium concentration.

The temperature of cardioplegia ranged from 4° to 8°C in all groups and Warm reperfusion "warm shot" was started immediately after the last distal anastomosis, and was performed with a constant flow rate of 150 ml/minute.

Low cardiac output syndrome (LCOS) was diagnosed if the patient required an intra-aortic balloon pump (IABP) to be weaned from cardiopulmonary bypass (CPB) or in the intensive care unit because of hemodynamic compromise. LCOS was also diagnosed if the patient required inotropic medication (dopamine, dobutamine, milnirone, or epinephrine) to maintain the systolic blood pressure >90 mm Hg and the cardiac output >2.2 L/min/m2 for ≥30 minutes in the intensive care unit after correction of all of the electrolyte and blood gas abnormalities and after adjusting the preload to its optimal value [16]. The intra-operative variables are shown in Table 3 which included duration of cardiopulmonary bypass in minutes, duration of aortic cross clamp time in minutes, number of grafts and the need of DC shock. Difficulty in weaning off cardiopulmonary bypass will be assessed if intra-operative use of inotropes +\- intra aortic balloon pump were necessary to separate the patients from CPB.

As shown in Table 4 post-operative variables included mortality (in-hospital all-cause mortality will be defined as death due to any cause occuring within the index hospitalization), duration of ventilation in hours including re-intubation, duration of ICU stay in hours, inotropic use in the intensive care unit, atrial fibrillation , ventricular arrhythmias (Ventricular Fibrillation, Ventricular tachycardia), LCOS(low output syndrome), Renal Failure, defined as more than 50% increase in creatinine level compare to pre-operative level or patient requiring dialysis, CVA and IAB use in ICU. All patients' data were collected prospectively and entered in a local data base then it was retrospectively analyzed.

Exclusion Criteria:

1. Cardiac surgery without CPB.
2. Combined surgery (CABG + valvular surgery).
3. Patients with pre-operative non-sinus rhythm including AF and pace maker rhythm due to difficulty in assessing the diastolic function.
4. Emergency CABG.

Statistics

All data and characteristics between these two groups were analyzed with the x2 test, multiple regression analysis and Fisher's exact test for non-continuous variables and the analysis of variance method if they were continuous. P value less than 0.05 was considered significant.

Results

Both groups were matched regarding the clinical data and baseline patients' characteristics as shown in (Table 2).

The intra-operative variables are listed in (Table 3). Patients in group A had longer cardio-pulmonary bypass and aortic cross clamp time (130.7±43.2 and 90.24±37.3 minutes), than group B (128±39.4 and 89.02±34.7 minutes) respectively and both were not statistically significant (P = 0.179 and 0.213).

Our results showed that both groups were comparable to each other regarding number of grafts, IABP and the need of DC shock.

On the other hand, intra-operative use of inotropes was more frequent in group B patients (60.5%) compared to group A patients (36.6%) and it was statistically significant (P =0.004).

Post-operative variables were summarized in (Table 4). The influence of diastolic dysfunction severity on post-operative variables was obvious in group B patients and had tendency to increase in some variables with statistically significant difference. Ventilation time in hours was prolonged in group B patients, 10.34 ±12.98 vs 8.31±6.8 (P = 0.06) , the need of inotropic support was more common in group B patients 29(38.1%) vs 27(24.1%) and P = 0.007. On the same direction, incidence of AF and low output syndrome were higher in group B patients 11(14.4%) vs 7 (9.21%) and 28(36.8%) vs 25 (22.3%) with P = 0.05 and 0.037 respectively.

Ventricular arrhythmia(VF,VT), renal failure and the use of IABP in surgical ICU were more frequent in group B patients 3(3.9%), 3(3.9%) and 1 (1.3%) Vs 4(3.57%), 3(2.6%) and 1 (0.89%) respectively and all these variables were statistically non significant. Also, duration of stay in surgical ICU and duration of hospital stay were shorter in group A patients 4.2 ±2.3 days Vs 4.3 ±4.2 and 10.7 ±2.3 days Vs 11.8 ±6.5 days respectively and all were statistically non significant. In our analysis, 4 patients died, with higher incidence in DD patients. Two patients in group B (2.63%) and 2 patient in group A (1.78%) and, it was statistically non significant (P = 0.09).

	E/A	DT (sec)	S/D	Ar (m/s)	e´(m/s)	E/e´
Normal	>1	<220	≥1	<0.35	>0.08	<15
Delayed relaxation	<1	>220	≥1	<0.35	<0.08	≤15
Pseudonomal filling	1–2	150–200	<1	≥0.35	<0.08	≥15
Restrictive filling	>2	<150	<1	≥0.35	<0.08	≥15

Table 1. Descriptors of Diastolic Dysfunction in Relation to Respective Physiology:
Ar = reverse flow velocity at the level of a pulmonary vein, owing the atrial contraction; DT = deceleration time; E/A = ratio of early to late filling wave velocity; e´= early flow velocity obtained with spectral Doppler tissue imaging; S/D = ratio of systolic to diastolic Doppler flow velocity in a pulmonary vein.

Variables	(Group A) patients with normal or mild diastolic dysfunction N=112	(Group B) patients with moderate or severe diastolic dysfunction N=76	P value
Age, years (Mean ± SD)	64 ±8	63 ±8	0.6
Male, n (%)	79(70.5%)	52(68.4%)	0.14
Diabetes mellitus, n (%)	45(40.1%)	30(39.4%)	0.7
Hypertension, n (%)	55(49.1%)	39(51.3%)	0.6
Chronic lung disease, n (%)	13 (11.6%)	9 (11.8%)	0.3
Peripheral vascular disease, n (%)	15 (13.3%)	11 (14.4%)	0.6
NYHA functional class III/IV, n (%)	30 (26.7 %)	21(28%)	0.4
CCS Angina class III/IV, n (%)	24 (21.5%)	18(23.5%)	0.7
Acute coronary syndrome, n (%)	42(37.5%)	29 (38%)	0.5
Recent MI, n (%)	19(16.9%)	13(17.1%)	0.1
Stroke, n (%)	1 (0.89%)	1(1.3%)	0.5
LV ejection fraction (Mean ± SD)	47±8	44±7	0.2

Table 2: Baseline patients' characteristics

Variables	(Group A) patients with normal or mild diastolic dysfunction N=112	(Group B) patients with moderate or severe diastolic dysfunction N=76	P value
CPB time, min (mean±SD)	130.7±37.2	128±39.4	0.179
AXC time, min (mean±SD)	90.24±37.3	89.02±34.7	0.213
Number of grafts, n (%)			
Three grafts	18 (16.07%)	13 (17.1%)	0.4
Four grafts	94 (83.92%)	63 (82.9%)	0.5
DC shock, n (%)	13 (11.6%)	10 (13.1%)	0.1
Inotropic support end of surgery, n (%)	41 (36.6%)	46 (60.5%)	0.004
IABP, n (%)	1 (0.89%)	1 (1.3%)	0.5

Table 3: Intra-operative variables:

CPB, cardiopulmonary bypass; AXC, aortic cross clamp; IABP, intra-aortic balloon pump

Variables	(Group A) patients with normal or mild diastolic dysfunction N=112	(Group B) patients with moderate or severe diastolic dysfunction N=76	P value
Ventilation time, hours (mean ± SD)	8.31±6.8	10.34 ±12.98	0.06
Inotropic support needed, n (%)	27(24.1%)	29(38.1%)	0.007
Atrial fibrillation, n (%)	7(9.21%)	11(14.4%)	0.05
Ventricular arrhythmias (VF, VT), n (%)	4(3.57%)	3(3.9%)	0.8
LCOS, n (%)	25 (22.3%)	28(36.8%)	0.037
Renal Failure, n (%)	3(2.6%)	3(3.9%)	0.07
CVA, n (%)	3(2.6%)	2(2.6%)	0.2
IABP use in SICU, n (%)	1 (0.89%)	1 (1.3%)	0.1
Duration of stay in SICU, d(mean±SD)	4.2 ±2.3	4.3 ±4.2	0.08
Duration of stay in hospital, (mean±SD)	10.7 ±2.3	11.8 ±6.5	0.15
In-hospital mortality, n (%)	2(1.78%)	2(2.63%)	0.09

Table 4: Post-operative variables:

LCOS, low Cardiac output syndrome; VF, ventricular fibrillation; VT, ventricular tachycardia; CVA, cerebro-vascular accidents; IABP, Intra-aortic balloon pump; SICU, surgical intensive care unit.

Discussion

It seems that for some time LV diastolic function was taken for granted and largely ignored and LV systolic function was thought of as the only function that truly predicted cardiac risk. The fact that diastolic heart failure (DHF) was referred to at one point as "heart failure with normal ejection fraction (EF)" lends credence to this assumption[15].

Left ventricular diastolic dysfunction (DD), defined as the inability of the ventricle to fill to a normal end-diastolic volume, during exercise as well as at rest, while left atrial pressure does not exceed 12 mm Hg[17]. Diastolic dysfunction and coronary artery disease (CAD) are interrelated. The complications of CAD, myocardial infarction or ischemia, are major contributors of diastolic dysfunction[18]. Diastolic dysfunction results from slowed and/or incomplete relaxation, high left ventricular (LV) afterload due to increased arterial stiffness, myocardial hypertrophy, myocardial fibrosis, compromised elastic recoil, impaired untwisting, diastolic remodeling and dys-synchronization [19]. The presence of diastolic dysfunction in patients who have suffered a MI indicates a poor prognosis with a higher risk of in-hospital or early mortality [20].

For patients (pts) with coronary artery disease (CAD) and severe left ventricular (LV) dysfunction coronary artery bypass grafting (CABG) is an alternative to cardiac transplantation [21].

It is proven that, CABG in patients with severe LV dysfunction prevents further myocardial damage, preserves the remaining myocardium and induces the recovery of systolic function of hypo-perfused and hypo-contractile LV myocardium segments. However, postoperative mortality rate in this patient group ranges from 1·6 to 40[22].

Our study highlights that the presence of diastolic dysfunction is associated with higher incidence of early adverse outcome after CABG. We found that patients with diastolic dysfunction had a significantly increased need of inotropic support at the end of surgery as well as post-operative and was associated with the postoperative complications like prolonged intubation, higher incidence of atrial fibrillation and low output syndrome.

Our study is compatible with the previous study done by Liu and associates [12] who reported preoperative DD was significant prognostic factor for cardiac events after CABG in patients with coronary artery disease.

In a similar way, Denault et al[23] developed a diagnostic algorithm which they then applied to a group of 74 cardiac surgical patients, to determine moderate to severe left ventricular diastolic dysfunction (LVDD) can predict difficult discontinuation of cardiopulmonary bypass. Patients with moderate to severe LVDD tended to have higher PCWP compared to those with normal to mild LVDD.

Difficult weaning from cardiopulmonary bypass was present in 60.5% of patients with moderate/severe LVDD, in contrast to 36.6% of patients with normal/mild LVDD.

Redfield and colleagues [24] in a study of 2042 randomly selected patients demonstrated that, the presence of even mild diastolic dysfunction reduces long-term survival. In addition, patients with elevated LVEDP (DD) could have associated secondary pulmonary hypertension, a variable linked with increased morbidity and mortality after cardiac surgery [25]. Separation from CPB is a crucial phase in the management of patients undergoing cardiac surgery. Bernard et al[11], in study of 66 patients, 52 had CABG alone and 14 had combined surgery, valvular and reoperations. The main finding of their study was that the presence of DD confers a fourfold increase in the probability of needing inotropic or vasoactive drugs to disconnect from CPB.

As secondary findings, we noticed a 40% incidence of DD in 188 consecutive patients undergoing CABG without systolic dysfunction. Relaxation abnormality was the most common form of DD observed. Half of our patients in each group had hypertension, and DD has been reported in as many as 90% of patients with hypertension, our observations are consistent with this previous study [26].

In addition, we observed that DD was present in patients with a history of previous myocardial infarction. These findings are consistent with the known relationship between coronary artery disease and DD, in which relaxation is affected before contractility. Because relaxation of the myocytes in diastole is a process that is energy dependent and thus sensitive to impaired perfusion, this is most likely the explanation of why DD is an early marker of ischemia [4].

In this report, Diastolic dysfunction was likely a predisposing factor for higher incidence of atrial fibrillation with statistically significant difference. Indeed, similar to the study of Melduni et al, [27] who studied 351 patients underwent coronary artery bypass grafting and/or valve surgery and concluded that LV diastolic dysfunction is a powerful, independent predisposing substrate for the initiation of post-operative AF.

The possible explanation is that, diastolic dysfunction is associated with an increasing stretch in pulmonary veins due to high left atrial pressure[28]. As previously reported by Chang et al. [29], the stretch-induced increase in the arrhythmogenic activity of the pulmonary veins due to impaired diastolic dispensability. Additionally, diastolic dysfunction was associated with higher incidence of post-operative complications. Our study showed that, the estimated incidence of ventricular arrhythmias (VF, VT), renal failure, IABP use in surgical ICU, duration of stay in ICU, hospital stay, and in hospital mortality all were more frequent in DD group in the absence of any significant difference.

Limitations

Our study has some limitations. First, late outcomes were not included in our analysis, second it is a single centre experience. Finally the surgical procedures were also performed

by four surgeons and three anesthetists from the same institute. For that, we would advise to investigate the effect of diastolic dysfunction on early and late outcome after CABG to be addressed in future and to be conducted in multicentre trials.

Conclusion

Significant LV diastolic dysfunction does not affect the cardiac mortality or total in-hospital stay after CABG. However, it predicts higher incidence of post-operative complications as low cardiac output syndrome, higher rate of use of inotropic support and atrial fibrillation.

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Myocardial Infarction Following Coronary Artery Bypass Grafting: Prevelance and Factors Affecting The Prognosis.

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Myocardial infarction after coronary artery bypass grafting is a serious complication and one of the most common causes of perioperative morbidity and mortality.

Objectives: **The aim of the study is to determine the incidence of perioperative myocardial infarction and to detect prognosis and hospital outcome and mortality related to perioperative myocardial infarction.**

Patients and methods: **The study included 50 patients who developed perioperative myocardial infarction out of 450 patients who underwent coronary artery bypass grafting (CABG) operation in cardiothorathic surgery department at National heart institute from May 2011 to November 2011 (6 months).**

Results: **Diabetes mellitus (DM), prolonged ACC time, prolonged ECC time, prolonged mechanical ventilation duration, impaired post operative ejection fraction and use of intra aortic balloon counter pulsation had a statistically significant relation to mortality in patients with perioperative myocardial infarction. The incidence of PMI was 11% and mortality was 18% in the study patients.**

Conclusions: **postoperative myocardial infarction is an important adverse event with highly negative effect on early mortality after CABG.**

KEY WORDS: **Myocardial infarction, coronary artery bypass grafting, heart failure, CK, CK-MB, on pump, off pump.**

Perioperative myocardial infarction (PMI) after coronary artery bypass graft surgery (CABG) is a serious complication and one of the most frequent causes of morbidity and mortality in these patients.[1]

During CABG, restoration of circulation to a previously hypoperfused area of the heart in most cases requires arresting of the heart to construct the anastmoses. In the arrested phase, myocardial metabolism and oxygen demands are diminished through infusion of a cardioplegic solution into the aortic root or coronary sinus, during this period however the heart is subjected to ischemia which may result in myocardial damage (one of mechanisms) [2].

A hemodynamically significant MI (one presenting as a low cardiac output syndrome or malignant arrhythmias) increases operative mortality and decreases long-term survival.[3]

Aim of Work

The aim of this work was to determine the incidence of perioperative myocardial infarction. To detect prognosis and hospital outcome and mortality related to perioperative myocardial infarction.

Patients and Methods

Fifty patients with perioperative myocardial infarction were included in this randomized clinical trial. Patients were selected from post operative (open heart) intensive care unit of national heart institute over period of six months. The patients included thirty- nine males and eleven females (age: 40-75years)

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Codex : o3/04/1301

Inclusion criteria

- Patients with multi-vessel disease including left main or left main equivalent with preserved left ventricular ejection fraction (more than or equals 45%).
- Perioperative myocardial infarction during ICU stay till discharge.

Exclusion criteria

- Non Q wave myocardial infarction.
- Patients who undergo coronary artery bypass grafting with associated valve replacement or aneurysmectomy.

Patients were enrolled into the study after approval from the ethical committee and informed consents were obtained. The duration of the study was 6 months.

All the patients were subjected to the following:

1- A full-detailed written Consent.

2- Full History taking and Full clinical Examination.

3- Investigations:

a- Preoperative investigations:

- Electrocardiogram and cardiac enzymes.
- Echocardiography with its findings about regional wall motion abnormalities and global systolic function.
- Coronary angiography.

b- Operative investigations:

- Electrocardiogram.
- Aortic cross clamp time duration.
- Extracorporeal circulation time duration.

c- Postoperative investigations:

- Serial Electrocardiogram.
- Serial cardiac enzymes (CK total and CK-MB).
- Echocardiography.

Study design:

- Randomized clinical trial.
- The study duration was six months.
- Follow up evaluation was performed every day during the study period till end of the study.
- Fifty patients with perioperative myocardial infarction out of 450 patients undergoing primary isolated coronary artery bypass grafting (CABG) during the period from May 2011 to November 2011.
- Patients were clinically evaluated daily for the first post operative days till patients discharge.

Identification of postoperative myocardial infarction:

- Appearance of new pathological Q-waves or new left bundle branch block (LBBB) in electrocardiogram.
- Cardiac enzymes (CK total and CK-MB) values more than five times the normal reference range.

Statistical analysis and data management:

Data were statistically described in terms of mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Mann Whitney *U* test for independent samples. P values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

Demographic data: Our study comprised 50 patients with a mean age of 55 years old (range from 40 to 70 years). Thirty nine patients (78%) were males and the remaining 11 patients (22%) were females.

Clinical data: Twenty nine patients were hypertensive (58%) with a mean systolic pressure of 140 mmHg and diastolic arterial blood pressure of 90 mmHg; all patients were

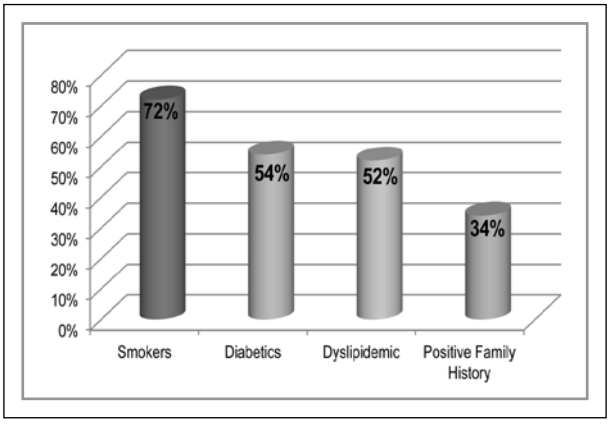

Fig 1. Risk factors of postoperative myocardial infarction.

on antihypertensive drugs before CABG. Twenty seven were diabetics (54%), twenty six patients were dislipidemic (52%), thirty six patients were smokers (72%) and seventeen patients with positive family history of ischemia (34%) (Figure 1).

Incidence of Myocardial Infarction following CABG:

In our study, out of total 450 patients had undergone coronary artery bypass graft CABG at national heart institute, of these 50 patients developed Myocardial Infarction postoperative (11%) (Figure 2).

Perioperative Myocardial Infarction and Mortality: There were 50 patients with perioperative myocardial infarction following coronary artery bypass graft) CABG, there were 9 reported dead (18%), and all deaths were cardiac-related., 4 patients (8%) died due to cardiogenic shock, 3 patients (6%) died because of ventricular fibrillation (VF) and 2 deaths (4%) due to ventricular tachycardia (V.T) (Figure 3).

Relation between Diabetes Melitus (DM) and Mortality

There were significantly increased mortalities among diabetics (8 out of 27 patients) compared with non diabetic patients (1 out of 23 patients, 11%), P value = 0.028.

Relation between Prolonged A.C.C time and Mortality

There was significantly increased mean ACC time in death patients as compared to survivals (88±17 vs 66±21 minutes) respectively, P value = 0.002 (Figure 4).

Relation between Prolonged E.C.C time and Mortality:

Again, there was statistically significant relation between increased mean ECC time in deaths as compared to survivals where the mean E.C.C time was (173±50 vs 117±43 minutes) respectively, P value = 0.003 (Figure 5).

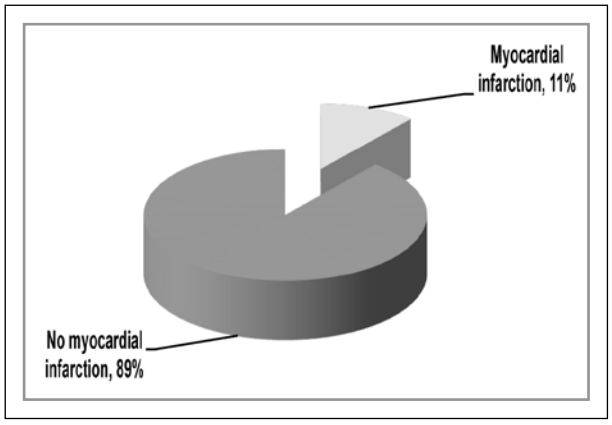

Fig 2. Incidence of myocardial infarction following CABG

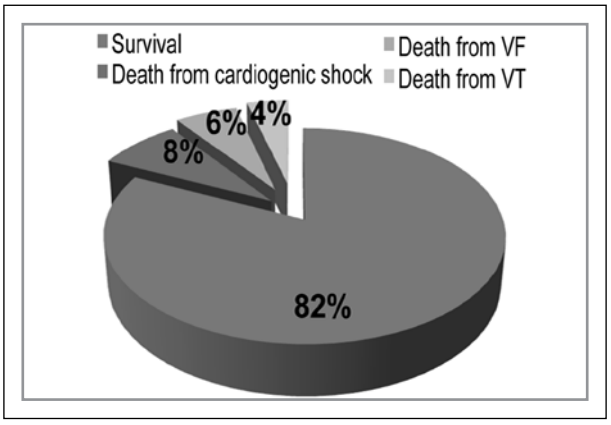

Fig 3. Cardiac causes of death in patients with perioperative myocardial infarction.

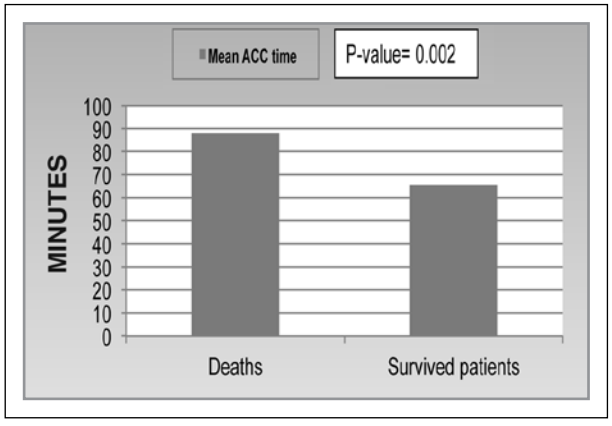

Fig 4. Relation between prolonged ECC time and mortality.

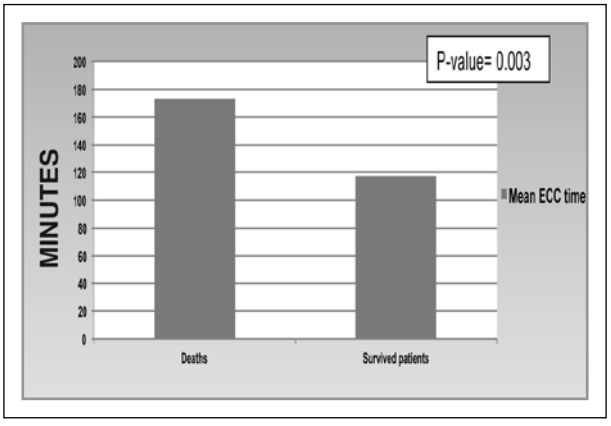

Fig 5. Relation between ECC time and mortality.

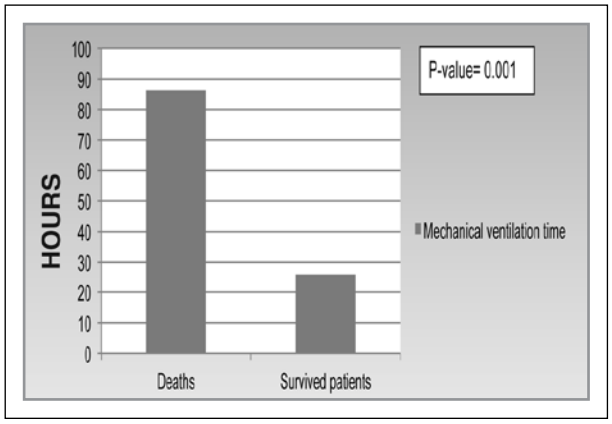

Fig 6. Relation between mechanical ventilation time and mortality.

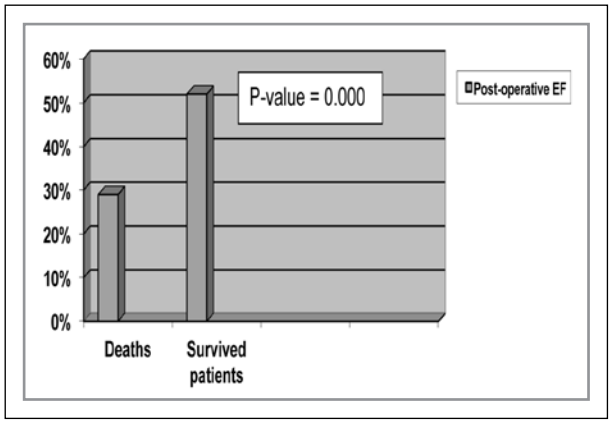

Fig 7. Relation between impaired postoperative ejection fraction and mortality.

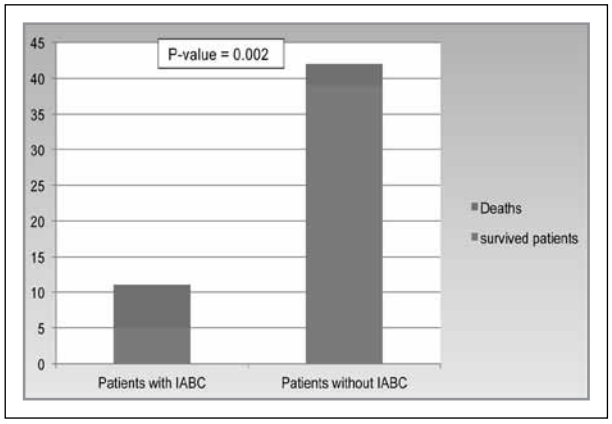

Fig 8. Relation between IABC and mortality.

Relation between Prolonged Mechanical ventilation and Mortality

Also, There was significantly increased mean mechanical ventilation duration time among deaths as compared to survivals (86±59 Vs 26±35 hours), respectively, p value = 0.001 figure (6).

Relation between impaired Postoperative Ejection Fraction (EF) and Mortality

There was significantly depressed mean LVEF% in deaths as compared to survivals (29%±4 Vs 52±7). P value =0.000 (figure 7).

Relation between IABC and Mortality

Among 11 patients who had IABC, 6 were died (67%) while among 39 patients who didn't have IABC, the reported mortalities was 3 (33%) with a significant p value 0.002 (Figure 8).

In our study, none of these factors (hypertension, dyslipidemia, family history, smoking, age, sex and prolonged inotropic support) has significant relation to mortality (P value > 0.05).

Discussion

This study concerning Perioperative Myocardial Infarction (MI), offers us the opportunity to add some data regarding this challenging complication. Coronary artery bypass grafting (CABG) is of considerable benefit for those in need of revascularization, however, it may be associated with significant perioperative and post operative myocardial damage and necrosis, which may occur in varying degrees.[4]

Multiple mechanisms have been proposed to explain myocardial injury after CABG. Intraoperative injury may result from cardiac manipulation, inadequate myocardial protection and intraoperative defibrillation, while post operative myocardial injury may be associated with acute loss of bypass grafts. Such damage is an important risk factor for both early and late mortality, and through a prospective clinical trial which has established that postoperative elevation of biochemical markers, above certain level, is indeed the consequence of perioperative myocardial infarction.[5]

The aim of the study was to determine the incidence of perioperative myocardial infarction, to detect prognosis and hospital outcome and the mortality related to perioperative myocardial infarction. The study included 50 patients who developed perioperative myocardial infarction out of 450 patients who underwent CABG operation.

In our study we found that, the incidence of perioperative myocardial infarction in national heart institute during 6 months

duration was 11%, as 50 patients developed perioperative myocardial infarction out of 450 patients underwent CABG operation.

This result goes hand in hand with the results of ***(Noohi et al., 2008)***, who studied 424 patients underwent open heart surgery at shaheed Rajae center cardiovascular medical center; and they found that 45 patients of them (10.8%) developed perioperative myocardial infarction.[6]

In a similar study done by ***(Force et al., 1990)***, he found that (10.6%) of patients undergoing CABG developed perioperative myocardial infarction. However this incidence is much lower than the incidence of perioperative myocardial infarction in the study done by ***(D.C.H Chang et al.,1997)*** in Canada which was 25% (7 patients had myocardial infarction out of 28 patients exposed to CABG). This difference may be explained by the use of modern cardiac protective techniques.[7]

In our study, there were 50 patients with perioperative myocardial infarction following CABG operation, 9 patients out of them had died (18%). This result goes hand in hand with the results of a study done on 424 patients who underwent open heart surgery at shaheed Rajae center cardiovascular medical center; where they found that the incidence of early mortality due to myocardial infarction is about (15%) ***(Noohi et al., 2008)***.[8]

As regard the risk factors for increasing mortality among patients with perioperative myocardial infarction, we demonstrated that aortic cross clamp time, extracorporeal circulation time, diabetes mellitus, prolonged mechanical ventilation, impaired postoperative ejection fraction and the use of intra aortic balloon counter pulsation, all have significant correlation with mortality.

The prolonged aortic cross clamp time (A.C.C) was directly related to mortality as it was higher in the 9 patients who didn't pass (mean A.C.C time 88.1 minute). In a different study done by ***Doenst T et al. in 2003***, they found that prolonged A.C.C time is an independent predictor of mortality in patients with preserved preoperative contractile function.[9]

The difference between the two studies is related to that our study was limited on patients undergoing CABG operation only and more on patients with perioperative myocardial infarction, while the other study was on all patients undergoing open heart surgery including valve replacements and congenital anomalies.

The prolonged E.C.C time was directly related to mortality as it was higher (Mean 173.3 minutes) in the 9 patients who didn't pass. In a different study done by ***(Wesselink et al., 1997)***, they found that prolonged E.C.C time is an independent predictor of mortality in all CABG patients (with or without perioperative myocardial infarction).[10]

In our study, we found that diabetes mellitus (D.M) is directly related to mortality, as 8 out 9 patients who didn't pass were diabetic with p-value 0.02. In a similar study done by ***Finlay et al. in 2003***, who found that 27% of diabetic patients undergoing CABG and known diabetic developed perioperative myocardial infarction, and diabetes was directly related to mortality either in patients with or without perioperative myocardial infarction.[9]

In another study done by ***William et al. in 2000***, they found that mortality after CABG surgery was 24%in patients without diabetes, diabetes was not significantly associated with increased long term mortality (the mortality rate at 48 months).[11]

The difference between our study and William study may be related to that our study was on perioperative myocardial infarction patients following CABG not all CABG patients; secondly William study was at long term mortality (48 months).

In our study, we found that prolonged mechanical ventilation is directly related to mortality, where the patients who didn't pass (9 patients) showed prolonged mechanical ventilation period (Mechanical ventilation period > 24 hour) with mean mechanical ventilation period of 86.22 hours.

In a similar study done by ***Leagare et al. in 2001,*** they studied 1829 patients undergoing CABG surgery found that the incidence of prolonged mechanical ventilation was 8.6% and prolonged mechanical ventilation was associated with significant mortality 18.5% as compared to CABG patients who didn't require ventilation for more than 24 hour (1.2 %).[12]

In our study, we found that impaired left ventricular systolic function is directly related to mortality as the ejection fraction ranged from 25- 35% in the 9 patients who didn't pass. In a similar study that included 7493 patients who underwent primary coronary artery bypass graft CABG between 1987 and 1996, they found that 576 patients were readmitted for heart failure, out of the 576 patients, 114 (20%) had had perioperative myocardial infarction which increased the risk of heart failure independently, and heart failure had a notable adverse effect on early and late survival ***(Steur et al., 2005)***.[12]

In our study, we found that use of IABC is directly related to mortality as 11 patients out of 50 patients underwent CABG operation needed IABC, 6 out of 11 patients had died (54.5% mortality).

While in another study done by ***(Anadolu et al., 2003)*** who studied 69 patients underwent CABG and required IABC support, found that 23 patients (33.3%) had died after using IABC, univariate analysis identified left ventricular end diastolic pressure, ventricular performance score, urgent operation and perioperative myocardial infarction as the risk factors for early death.[13]

The difference between two studies related to that our study was on patients with perioperative myocardial infarction after CABG operation only (Not all CABG patients) while Anadolu study was on all CABG patients with or without perioperative myocardial infarction, and since PMI is a significant risk factor

for early mortality, then it explains the difference between studies.

In our study, we found that sex differences did not significantly affect mortality among our study group patients (50 patients with perioperative myocardial infarction). In a different study done by ***Casimiro et al. in 2011***, who studied 2434 consecutive patients undergoing elective cardiac surgery with cardiopulmonary bypass between February 2004 and April 2009 in a tertiary level university hospital, found that perioperative myocardial infarction in women had a notable impact on excess mortality and ICU stay observed in patients ≥ 70 years of age. The difference between the two studies related to the variable study duration between the two studies (6 months versus 5 years) which allows to follow up more study patients.[1]

While our study goes hand in hand with the results of ***Lynda et al.*** in who studied 1487 patients undergoing isolated coronary artery bypass grafting surgery by one surgeon at the Toronto hospital between January 1982 and march 1993 (11 years and 2 months), found that operative mortality was not influenced by sex (1.4% for women versus 1.1% for men), also the incidences of perioperative myocardial infarction and need for intraaortic balloon support were similar in the two groups.[14]

Conclusion

- Postoperative myocardial infarction is an important adverse event with highly negative effect on early mortality after CABG.
- Regarding risk factors for increasing mortality among patients with perioperative MI, it was found that A.C.C time, E.C.C time, diabetes mellitus, prolonged mechanical ventilation, impaired post operative EF% and use of intra aortic balloon counter pulsation, all are positive predictors of increased mortality.

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Prognostic Impact of Previous Stenting on Outcome of CABG in Multivessel Disease Patients

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Background: **It is supposed that patients with a previous PCI are at higher risk for CABG. However, only a few studies are available and contradictory: some authors suggest that initial PCI may complicate the operation and may increase postoperative morbidity and mortality, Others describe no difference in postoperative morbidity and mortality.**

Patients and methods: **Fifty patients underwent CABG in the period between October 2012 and February 2013 in Cairo university hospitals. Patients were divided into two groups; group A (non stent group) and group B (stent group). Evaluation of intra and post operative findings in our patients was to determine whether previous PCI has a prognostic impact on surgical outcome in multivessel disease patients.**

Results: **The mean age of group A was 53.88 ± 7.8 years while for group B was 51.36 ± 8.056 years. Preoperative echocardiography and Coronary aniography showed no statistical difference. The mean number of grafts was higher in group A (non stent group) 3.28 ± 0.54 compared to 2.84±0.47 in group B and was statistically significant. Inotropes were found to be used more with the previous stent group than group A. In fact ICU stay was longer for group B than group A (53.68 ± 31.45 hrs versus 72.56 ± 54.44 hrs) with significant statistical difference.**

Conclusion: **Previous PCI has a negative impact on the outcome of subsequent CABG regarding morbidity. However there was no difference in the postoperative mortality.**

Key words: **CABG after stent, surgical revascularization after PCI.**

Despite all scientific evidences and the guidelines for the treatment of chronic coronary artery disease demonstrating the benefits of coronary artery bypass grafting (CABG), especially in patients with multivessel disease, there has been an exponential growth in percutaneous coronary intervention (PCI) with stents Since Gruntzig introduced it in 1977 , With technological advances and the experience accumulated over the years, the indication for PCI has expanded and procedures in multivessel coronary disease have become more common , Its " less invasiveness " is more attractive to patients . Around one-third of patients with multi-vessel disease treated with bare metal stents will require re-intervention within few years [1].

In this so-called "stent era", patients with coronary artery disease and class I indication for CABG are frequently submitted to PCI as initial alternative, before being convinced to surgical treatment. several studies have been published comparing the outcomes of CABG and PCI as the primary treatment for coronary artery disease. Beside the increase of age and co-morbidity, there are an increasing number of patients with a previous successful PCI in the present population of patients undergoing CABG [2].

With technological advances and changes in clinical practice, the respective values of coronary artery bypass surgery and percutaneous coronary intervention needed to be reassessed. The SYNTAX multicenter prospective randomized trial is an attempt to provide an evidence base to determine the best treatment option for patients in a real-world population seen by the surgeon and the interventional cardiologist in their daily practice [3].

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Codex : o3/05/1301

These studies clearly demonstrated that there was no difference between the two therapeutic modalities regarding mortality and non fatal myocardial infarction but patients treated with stenting wether bare metal stent or drug eluting stent required more often to repeat revascularization procedures related to restenosis [4].

The expanding indications for angioplasty have already had an unquestionable impact on the practice of coronary revascularization. Many patients are still referred for surgery owing to either the occurrence or threat of stent restenosis, which occurs with an average frequency of approximately 20-40% in the last decade, percutaneous coronary intervention (PCI) has undergone profound changes in techniques used to achieve revascularization and in patient selection [5].

It is supposed that patients with a previous PCI are at higher risk for CABG. However, only a few studies are available and contradictory: some authors suggest that initial PCI may complicate the operation and may increase postoperative morbidity and mortality, Others describe no difference in postoperative morbidity and mortality [6].

There remains a low but real need for emergent CABG after PCI, in which operative outcomes are less than ideal, especially in the post infarction patient, representing an area for cross-specialty collaboration [7].

In the current era of stent usage, percutaneous coronary intervention is more frequently performed as the initial revascularization strategy in multivessel disease before patients are finally referred to CABG. The aim of our study is to determine whether previous PCI has a prognostic impact on outcome in multivessel disease patients.

Patients and Methods:

Fifty patients underwent CABG in the period between October 2012 and February 2013 in Cairo university hospitals. Patients were divided into two groups:

- Group A: 25 patients without previous stents (non stent group).
- Group B: 25 patients with previous stent (stent group). According to whether they underwent previous PCI or not to discuss the prognostic impact of previous stenting on outcome of CABG in multivessel disease patients.

Inclusion criteria:

Patients enrolled in the study were scheduled for coronary artery bypass surgery and suffered from ischemic heart disease.

Exclusion criteria:

Patients with single vessel disease (as the study enrolled only multi vessels disease patients), combined CABG with other cardiac procedures, emergency CABG patients after PCI due to dissection or tamponade, redo CABG, significant carotid artery stenosis with CABG and preoperative co-morbidities (hepatic, renal and pulmonary).

Pre Operative Evaluation:

All patients in the 2 groups had full clinical history (Risk factors including: Age, Sex, Smoking, Hypertension, hypercholesterolemia, Previous MI or recent MI, Previous neurological problems: Disease severely affecting ambulation or day-to-day functioning, Pre operative heart failure, patients were functionally classified according to (NYHA), unstable angina, rthythm disturbance, previous symptoms or operations suggesting of extra cardiac arteriopathies, renal impairment and previous stenting, number of stents whether bare metal or drug eluting stents.

Complete clinical examination was performed for all patients, both general and cardiac to detect signs of heart failure, arrhythmia and signs of associated risk factors. Laboratory Investigations, Resting 12 lead Electro-Cardiogram (ECG), Plain chest X-ray (CXR), each patient was examined by 2D, M-mode and Doppler echocardiography within one month before surgery, Carotid Doppler and duplex was done for all patients to show any significant carotid artery stenosis and coronary angiography (catheter was reviewed regarding; presence or absence of left main disease, previous sites of stents and its type in group B and plan the number, sites of the diseased vessels which will need to be grafted.

Operative Evaluation:

Surgical access was through median sternotomy in all cases. All incisions and closure techniques were the same for both groups. Fine monofilament polypropylene suture (8-0 or 7-0) was used for all distal anastomoses. Proximal anastomoses were performed with fine monofilament polypropylene suture (5-0 or 6-0) for venous anastomoses and (6-0) suture for arterial anastomoses to the aorta.

Cardiopulmonary bypass conducted using membrane Oxygenator and a non-pulsatile flow of 2.2 -2.5 liters / min /m^2 body surface area. Myocardial protection is through repeated infusions of Antegrade warm blood cardioplegia solution every 15-20 minutes potassium chloride=0.3mEq/Kg over 3 minutes as initial dose and half the dose over 90 seconds every booster dose.

Time of aortic cross clamp, extra corporeal circulation, operative time, number of grafts (arterial and venous grafts), inotropes and IABP need were recorded.

POSTOPERATIVE DATA:

ICU events were recorded including; need for support, dose and duration, use of intraaortic balloon pump (IABP), perioperative MI diagnosed by ECG change plus cardiac enzymes with or without hemodynamic instability, re-opening for

bleeding, arrhythmias, peri- operative complications and ICU stay. Other complications were recorded also and it included; heart failure, superficial and deep wound infection, and hospital Stay. A post operative echo was done before discharge from hospital.

Results:

Demographic data :

The mean age of group A (non stent group) was 53.88 ± 7.8 years (range between 40 and 68) while for group B (stent group) was 51.36 ± 8.056 years (range between 38 and 65) with non significant statistical difference. Regarding sex distribution, each group enrolled 21 male and 4 females **(table 1).**

	Group A Mean ± SD	Group B Mean ± SD	P value
Age (years)	53.88 ± 7.80	51.36 ± 8.05	NS
Gender M/F	21/4	21/4	NS
Pre op. EF%	57.92±10.45	54.64±12.87	NS
Pre op. EDD	5.3 ± 0.56	5.49±0.71	NS
Pre op. ESD	3.58±0.68	3.75±0.7	NS

Table (1): Pre operative patient characteristics

SD: standard deviation, NS: non significant, M/F: male/female, op.: operative, E.F.: ejection fraction, EDD: end diastolic dimension, ESD: end systolic dimension.

Pre-Operative Data Analysis:

Echocardiography was routinely performed preoperatively (within two weeks), and showed non statistically significant difference in mean ESD , EDD, RSWMA, valvular lesions or E.F. as seen in table (1).

Preoperative Coronary aniography showed no statistical difference in number of diseased vessels (group A: 3.2± 0.4 compared to group B: 3.24 ± 0.43589) which was statistically not significant difference. All patients in group B had previous stents in LAD, while two patients had stent in the left circumflex and only one patient had stent in right coronary artery.

Operative analysis:

The mean number of grafts was higher in group A (non stent group) 3.28 ± 0.54 compared to 2.84±0.47 in group B and had statistically significant difference as seen in table (2), While the type of the conduits used was as shown in table (3).

	Group A Mean ±SD	Group B Mean ± SD	P value
Grafts(no)	3.28 ± 0.54	2.48 ± 0.47	0.00364*

Table (2): mean number of grafts in both groups.

SD: standard deviation, (no): number,

** P value < 0.05 was considered statistically significant.*

Type of conduits	Group A	Group B
LIMA	25	25
SVG	55	36
RADIAL A.	2	1

Table (3): type of the conduits used

LIMA: left internal mammary artery, SVG: saphenous vein graft, A: artery.

The mean total operative time had statistically significant difference and was longer in group B (stent group) than group A (206.44 ± 39.55 versus 181.8 ±33.4) respectively. The mean aortic cross clamp time had statistically significant difference and was longer in group B (83.48 ± 12.64 versus 75.2 ± 14.46) than group A. The mean CPB time was longer in group B than in group A (113.8 ± 19.32 vs 117.12 ± 16.14) but without statistical significance between the two groups (table 4).

	Group A Mean ± SD	Group B Mean ± SD	P value
Total op.(min)	181.8 ± 33.4 (range 120 - 250)	206.44 ± 39.55 (range 100 – 290)	0.0236*
ACC (min)	75.2 ± 14.46 (range 45 – 100)	83.48 ± 12.64 (range 60 – 105)	0. 036*
CPB (min)	113.8 ± 19.32 (range 80 – 160)	117.12 ± 16.14 (range 90 – 153)	NS

Table (4): Total operative time, Aortic cross clamp and CPB time in both groups.

SD: standard deviation, op.: operative, ACC: aortic cross clamp, CPB: cardiopulmonary bypass, NS: non significant.
** P value < 0.05 was considered statistically significant.*

Post Operative Data Analysis:

Inotropes were found to be used more with the previous stent group rather than group A (non stent group) with

statistically significant difference. However this was not the case with IABP which showed statistically non significant difference between both groups (table 5).

	Group A (number)	Group B (number)	P value
Inotropes	5	13	0.022*
IABP	1	2	NS

Table (5): inotropic need and IABP use in both groups.

** P value < 0.05 was considered statistically significant. IABP: intra aortic balloon pump.*

In fact ICU stay was longer for group B than group A (53.68 ± 31.45 hrs versus 72.56 ± 54.44 hrs) with significant statistical difference. Hospital stay was nearly the same in both groups. Table (6) shows these data.

	Group A Mean ± SD	Group B Mean ± SD	P value
ICU stay (hrs)	53.68 ± 31.45 (range 22 – 148)	72.56 ± 54.44 (range 16 – 250)	0.003*
Hospital stay (days)	10.04 ± 4.06 (range 6 – 19)	10.72 ± 3.99 (range 6 – 20)	NS

Table (6): Mean ventilation time, ICU stay and hospital stay in both groups.

** P value < 0.05 was considered statistically significant.*
NS: non significant, hrs: hours, ICU: intensive care unit.

Total morbidity was statistically significantly higher in the group B than group A where 5 patients in group A were affected, while 13 patients were affected in group B. On statistical analysis of individual morbidities, re-opening (1 patients versus 6 patients), superficial wound infection(2 patients versus 8 patients) were found to be statistically significantly higher in group B than group A. There were no statistical significant differences between the two groups in the other post operative morbidity (table 7).

Morbidity	Group A	Group B	P value
Total	5	13	0.0225*
Re-opening	1	6	0.047*
Wound infection	2	8	0.039*
Post op. M.I.	1	2	NS
A.F.	1	1	NS
Respiratory	0	1	NS

Table (7): difference of morbidity in both groups

** P value < 0.05 was considered statistically significant.*

NS: non significant, op.: operative, M.I.: myocardial infarction, A.F.: atrial fiberillation

Post operative echo was done for all patients about one weak post operatively and it emphasized that no statistical significant difference between the two groups were found in mean ESD (3.6 cm ± 0.749 versus 3.64 cm ± 0.829), mean EDD (5.21cm ± 0.7 versus 5.2 cm± 0.88) and postoperative E.F. (55.8% ± 8.8 versus 52.64% ± 10.65) where group A (non stent group) was better as shown in table (8).

	Group A Mean ± SD	Group B Mean ± SD	Pvalue
Post op. E.F. %	55.8 ± 8.8	52.64 ± 10.65	NS
Post op. EDD (cm)	5.21 ± 0.70	5.2 ± 0.88	NS
Post op. ESD (cm)	3.6 ± 0,749	3.64 ± 0.829	NS

Table 8: post operative echocardiography in both groups.

SD: standard deviation, NS: non significant, E.F.: ejection fraction, op.: operative, EDD: end diastolic dimension, ESD: end systolic dimension.

The only mortality case was in group B (stent group) and died in the 3rd day post operative due to extensive myocardial infarction.

Discussion:

When a patient is eligible for both procedures, PCI is often preferred than surgery. The initial choice of PCI is reinforced by the perception that patients can safely be referred to surgery after PCI. However depending on the studies on bare metal stents, from 6 to 13% of patients undergo CABG within 1 year after PCI, and from 13 to 26% within 10 years, which was perceived as a high recurrence rate [8].

Comparison was made between patients who used DES and those who used BMS, over 3 years. Patients with DES underwent total target revascularization more than those who used BMS, although the clinical syndromes at the time of presentation, resulting in the need for total target revascularization, for the two stent types were similar. This makes the clinical presentation post stent not always benign, with an MI including stent thrombosis occurring in up to one-third of the patients, regardless of stent type. Over the course of 3 years, patients with total target revascularization (most of them used DES) had a three-fold increase in the hazard of non-fatal MI or death compared to those without total target revascularization, independent of stent type. These findings suggest that, total target revascularization is often accompanied by a MI and makes its patients at particularly high risk for subsequent non-fatal MI or death [9].

Patients with prior PCI presented for CABG with more advanced symptoms and greater urgency, also prior PCI is an independent risk for in hospital mortality and worse outcome af-

ter CABG. *Eifert's group* stated that morbidity, mortality and reoperation rate was higher among the patients who did previous PCI prior to CABG [10]. Previous percutaneous coronary intervention before coronary artery bypass grafting in patients with diabetes mellitus and triple-vessel disease independently increases the risk for in-hospital mortality and major adverse cardiac events [11]. *Chocron* and associates focused on the preoperative EF of the patients and stated that patients with left ventricular ejection fraction <40% having a history of PCI prior to surgery had a worse outcome post-CABG than those without prior PCI [8]. On the other hand *Van den Brule and coworkers* stated that successful PCI independently has no role in affecting short and midterm outcomes of subsequent CABG [2].

There was no difference in mean age of both groups. But *Van den Brule and coworkers, Eifert and associates* and *Kalaycioglu* and colleagues studies showed difference [2, 10, 12]. This was found also with *Loponen* and colleagues when non PCI group age was 66.3± 9.0 and in PCI group was 64.5±10.1 so he statistically analyzes age groups. He found no difference between the two randomized groups, in age group from 65-74 and above 75, but the younger age group(less than 65) was more in the PCI group. He stated that the younger age group in the post PCI group was not coinciding with the severity of the disease such as number of diseased vessels or dyslipidemia as there was no difference between both groups in these parameters or with arteriopathy which was higher in the non PCI group in his study [13].

In our study the pre operative echo showed that the preoperative ESD, EDD and EF showed no difference. Also Other studies found no difference between PCI and non PCI group regarding the EF as *Eifert and coworkers* and *Kanemitsu and associates,* nor EF, ESD, EDD as *Chocron and colleagues* did [10, 7, 8].

The choice of the surgical technique is not affected by the presence of previous stent. OPCAB was equally used in both groups, this was proved by this study as well as *Chocron* and colleagues study [8]. In *Van den Brule and associates* and *Eifert* and coworkers study all patients were done on CPB, while with *Kanemitsu's team* all patients were done OPCAB [2, 10, 7] . The mean number of grafts was significantly higher in group A (3.28 ± 0.54) than in the PCI group. *Eifert and coworkers* found higher number of distal anastmosis (2.43±1.08 vs 2.08±1.08). Although the mean number of diseased vessels is equal preoperatively, the number of grafted vessels is higher in the non PCI group, this due to higher number of non graftable vessels in the PCI group [10]. Also total revascularization was highly signifcant for the non PCI group, this was expected because the number of grafted vesseles were higher in this group. These non graftable vessels are due to either propagation of post stent thrombosis to occlude the vessel totally, which is more common, or due to the propagation of atherosclerosis in previously diseased vessel left without intervention (less common). This made the anastmosis more challenging and risky for the surgeon.

In spite the higher numbers of distal anastomoses in group A, There were no statistical significant difference between the two groups in the mean bypass time (117.12 ± 16.14 minutes for group B versus 113.8 ± 19.32 minutes for group A), and statistically significant longer mean total operative time (206.44 ± 39.55 versus 181.8 ±33.4) and mean aortic cross clamp time (83.48 ±12. 64 versus 75.2 ± 14.46) was longer in group B than group A. This may be explained by the less maneuvers done on the vessels in group A such as endarterectomy and/or on lay patch anastomoses. *Eifert, Thielmann and their associates and Mack ,* showed also no difference in CPB times between the two groups, however *Van den Brule and colleagues* stated that only CPB time was shorter in the PCI group but ACC time was the same [10, 11, 14, 2].

Postoperative inotropes were found to be used more with the previous PCI group rather than group A, however for IABP usage, it was the same in both groups. The higher usage of inotropic support may be related to the lower incidence of total revascularization and higher incidence of preoperative MI. *Thielmann* and colleagues showed also no difference in the usage of IABP between both groups, however other groups has shown higher incidence of use of IABP in the PCI group [11, 8, 10].

Overall morbidity was high in the group B compared to group A (5 versus 13). The reasons for a higher post operative morbidity in the prior PCI group are not clearly understood however the PCI group patients were presented for surgery with more advanced symptoms and greater urgency. On further analysis of morbidity, the PCI group showed higher incidence of re-exploration, superficial wound infection. Other postoperative parameters were the same in both groups. Reopening for bleeding was due to the continous use of clopidogrel for long time preoperative (and till the operation in case of emergency operation). In the PCI group, asprin was not discontinued until the morning of the operation as a precaution against total stent occlusion and perioperative MI.

Some authers stated that previous PCI has no role in postoperative morbidity; *Eifert and associates*' results were so interesting, as it showed no difference in reopening but the PCI group received more units of packed RBCs, no difference in postoperative acute renal failure but the highest creatinine level was higher in the PCI group (1.95mmol±1.6 versus 1.61 ±1.4), no difference in postoperative MI but highest troponin level was in the PCI group. No difference in arrythmias, wound infection or neurological disorder but the number of patients required CPR was higher in PCI group. From these results we noticed that although sometimes there was no difference between both groups yet on deeper analysis there may be a difference [2, 10].

Other authors showed high morbidity in the PCI group [8, 11]. *Parwis Massoudy and coworkers* results were the same but also showed that the morbidity increases when the number of previous interventions increases [15]. *Thielmann* and associates also showed high incidence of reopening in the PCI group [11].

The ICU stay was longer for the PCI group (53.68 ± 31.45 hrs versus 72.56 ± 54.44 hrs) with significant statistical difference but the hospital stay was not different. Also, *Thielmann* and colleagues stated that ICU stay was longer in the PCI group, although both groups had the same hospital stay [11]. But others showed no difference in both ICU or hospital stay [2, 10]. The difference in the ICU stay in this study was due to the difference of the morbidity specially Re-openning and wound infection which prolong the ICU stay.

There was no significant difference in the in hospital mortality rate between the two groups (only one patient in group B). *Yap and coworkers* and *Kanemitsu group's* had found no difference in mortality, but *Kanemitsu group's* monitored the patients for the first 30 days only, while *Van den Brule and associates* had equal hospital mortality as well as 1 year postoperative [16, 7, 2]. On the contrary, *Thielmann and colleagues and Mack* stated that patients with prior PCI had higher in-hospital mortality [11, 14]. *Eifert and coworkers* showed higher mortality in the first 30 days post operative in the PCI group which decreases after that to be non significant between the two groups during the first five years post operative [10].

Before discharge, a postoperative echo was done for all patients. In this echo no statistical significant difference between the two groups were found in mean ESD (3.6 cm ± 0.749 versus 3.64 cm ± 0.829) or mean EDD (5.21cm ± 0.7 versus 5.2 cm± 0.88) but the postoperative EF (55.8% ± 8.8 vs. 52.64% ± 10.65) was better in group A.

Conclusion:

Previous PCI has a negative impact on the outcome of subsequent CABG regarding morbidity. However there was no difference in the postoperative mortality. Percutaneous Coronary revascularization should be carefully considered against the higher risk it provides for subsequent CABG.

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Bilateral mammary artery harvesting and sternal wound infection: Importance of skeletonization

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Objective: **The idea of this work is to highlight the relative risk of different grades of sternal wound infection in coronary bypass patients with utilization of bilateral internal mammary arteries and to evaluate the statistical impact of mammary artery skeletonization on this risk.**

Patients and Methods: **In Cairo University hospitals , this study was prospectively conducted between January 2009 and May 2010, it included a research population of 200 patients who underwent coronary bypass surgery.Out of these, one hundred cases received a left internal mammary artery (LIMA) with conduits other than the right internal mammary artery (RIMA) to complete the revascularization procedure,(LIMA) was constantly harvested in a pedicled fashion. The other hundred patients received bilateral internal mammary arteries (BIMA), in 60 cases, skeletonization of both mammaries was conducted and the pedicled fashion was the technique that took place in the remaining 40 cases.**

Results: **When broadly comparing both techniques, bilateral mammary harvesting significantly increased all grades - either deep (1.1% vs 3.3% vs 4.7%; P = .01) or superficial (4.8% vs 7.8% vs 12%; P = .002) - sternal wound infection. However, this gross result was encountered by a number of co-variables for each grade of infection, independent predictors for deep sternal infection included technique of harvesting (odds ratio, 4.1; 95% confidence interval, 1.4-12.1); the presence of peripheral arteriopathy (odds ratio, 3.1; 95% confidence interval, 1.2-8.5), and re-opeing for bleeding (odds ratio, 8.2; 95% confidence interval, 2.0-33.6) , whereas for superficial sternal wound infection independent predictors include the technique of artery harvesting (odds ratio, 3.0; 95% confidence interval, 1.6-5.4), diabetes (odds ratio, 1.7; 95% confidence interval, 1.0-2.9) and female sex (odds ratio, 2.2; 95% confidence interval, 1.2-4.2) . It worth noting that In diabetics, statistical evidence favouring single mammary versus bilateral skeletonized ones was NOT detectable (P = .4).**

Conclusions: **Although harvesting bilateral internal mammary arteries (BIMA) elevates the overall risk of sternal wound infection when compared to a single internal mammary procedure,yet, Skeletonization of (BIMA) could be resorted to as it is proved to significantly decrease this risk.This was statistically supported even in patients at high risk for wound infection.**

The use of bilateral internal mammary arteries (BIMA) in coronary bypass procedures proved to be very useful in decreasing the rate of second go revascularization duo to its prime long term patency rates and significant symptoms relief as compared to single internal mammary artery use.(1) Despite the encouraging results of percutaneous stenting techniques after evolution of drug eluting stents still the use of bilateral internal mammary arteries is superior for revascularization. (2)

Complications related to harvesting of bilateral internal mammary arteries (BIMA) were reported to be linked to impairment of sternal blood supply which in term results in various degrees of superficial , deep sternal wound infection and sternal instability especially in high risk groups of patients such as diabetics, COPD patients,obese ones and those with diffuse arteriopathy.(3)

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Codex : o3/06/1301

Our study aims to highlight the beneficial effect of using (BIMA) in a skeletonized fashion for coronary bypass in order to decrease the incidence of wound infection and sternal dehiscence,a complication that significantly increases procedure related morbidity and mortality.

Patients and methods:

• Study design :

This research was prospectively conducted in Cairo University hospitals between January 2009 and May 2010, it included 200 patients who underwent coronary bypass surgery (CABG). Out of these, one hundred cases received a left internal mammary artery (LIMA) together with other conduits chosen apart from the right internal mammary artery (RIMA) to complete the revascularization procedure, the left internal mammary artery was always harvested in a pedicled fashion. The other hundred patients received bilateral internal mammary arteries (BIMA), skeletonization of both mammaries was done in 60 cases, while in the remaining 40 cases,bilateral internal mammary arteries (BIMA) were harvested in pedicled fashion. Patients in need for combined and redo procedures were excluded and ethical committee approval was obtained.

Research population was followed during their hospital stay and over the next two months. We classified wound infections according to the guidelines definitions as reported by Disease Control and Prevention Centers .(4)

Superficial wound infection was considered when purulent discharge without sternal or mediastinal tissue involvement,while deep wound infection was considered if matched any of the following:

1. Positive culture for organism isolated from mediastinal fluid or tissue.
2. Visual prove of mediastinitis.
3. Fever and purulent fluid discharge.

• Surgical technique:

For standardization purposes,we used the same, antiseptic precautions, surgical site and skin preparation for all patients and same prophylactic antibiotic (1 gm of Ceftriaxone) one hour before induction of anaesthesia and post-operative antimicrobial chemotherapy.

Skeletonization technique was usually resorted to in patients at a potential risk for sternal infection due to their carriage of one or more risk factors, including diabetes, peripheral vascular disease, chronic obstructive pulmonary disease (COPD), obesity, chronic renal insufficiency, and advanced age

The technique applied for pedicled mammary harvesting is quite familiar by using electrocautery blade and the pedicle includes mammary artery, vena comitants, surrounding muscles and endothoracic facia, while in skeletonized harvesting technique we used low voltage electrocautery to extract the mammary artery alone from the veins and muscles, hemoclips were applied on artery branches before division, in both techniques we reached 1 cm from the mammary origin and down to the level of its bifurcation, also we used the right mammary artery either in situ passing it through the transverse sinus or as a free graft and its division occurred after monitored full systemic heparinization and we always opened the pleura involved in mammary harvesting and positioned a chest tubes in the corresponding spaces.

• Anesthetic technique :

Patients received their usual cardiac medications at early morning the day of surgery. Premedication consisted of diazepam 5mg and ranitidine 150 mg orally the night before surgery, at the morning of surgery, morphine 0.1 mg/kg IM is administered 2 hours before going to the operating room.

On arrival to the operating theatre , all patients were premedicated with IV midazolam 0.05 mg/kg. A five-lead electrocardiography using continuous ST segment analysis, pulse oximetry and non-invasive blood pressure monitoring were initiated. After performing modified Allen's test, an arterial catheter was inserted, under local anesthesia, into the suitable radial artery for invasive blood pressure monitoring using 20G arterial cannula.

General anesthesia induction consisted of fentanyl 5-8 μg/kg, midazolam 0.1-0.15 mg/kg and atrachurium 0.5 mg/kg. After the trachea was intubated, a right internal jugular central venous catheter was inserted. Anesthesia was maintained using isoflurane 0.5-1.5% in oxygen- air mixture (Fio_2=0.5) and its concentration was later adjusted as required by clinical situation (heart rate and blood pressure). Neuromuscular blockade was done by an infusion of atrachurium at a rate of 10 μg/kg/min.

In diabetic patients, tight glycemic control was achieved intra - operatively and in ICU by insulin infusion to maintain blood glucose level between 80-110 mg/dl

• Statistical analysis:

Continuous variables were analyzed using the Student t test . Nonparametric data were compared using the Fisher exact test . Stepwise logistic regression was used to identify independent predictors of sternal infection in the study groups. Continuous data are expressed as mean ± SD. Categorial variables are expressed as percentages. All statistical analysis was performed with StatView (version 5.0) for Windows 8.0 (SAS Institute Inc, Cary, NC).

Results

Regarding the preoperative variables , both groups (single and bilateral mammary) showed more or less similar

preoperative criteria with slightly younger age in bilateral mammary group - pushed by surgeons' preference to apply this technique in younger patients - and also, higher incidence of renal impairment and COPD (table 1).

Apart from equal body mass index , bilateral pedicled mammary sub-group showed a lower risk profile when compared to the bilateral skeletonized sub-group (Table 2).

Analysis of intra-operative data showed both groups (single and bilateral mammary) to have nearly similar operative variables with slightly higher number of grafts in the bilateral mammary group and so the cross clamp time was a little longer (Table 3).

Comparative analysis of postoperative data showed similar overall mortality in both groups , bleeding rate was higher in the bilateral mammary group (Table 4).

The incidence of deep wound infection was lower in single mammary group as compared to bilateral mammary group (2% vs 6%; P = .002; Figure 1) .

An attractive outcome was the one stated that patients with bilateral skeletonized mammaries showed a statistically insignificant lower incidence of infection as compared to the bilateral pedicled mammary sub-group in overall analysis manner (6.7% vs 10%, P = .28; Figure 1).

Deep wound infection had a lower incidence in the single mammary group as compared to bilateral skeletonized or bilateral pedicled mammary groups (2% vs 5% and 7.5%; P = .002; Figure 1)

Statistical processing of our research data could highlight independent predictors of both superficial and deep sternal wound infection. These included harvesting (BIMA) , diabetes mellitus and female sex for superficial infection. Whereas for deep infection,Harvesting (BIMA) , peripheral arteriopathy, and resternotomy for bleeding constituted the only independent predictors.

Variables	Bilateral mammary group N=100	Single mammary group N=100	p-value
Age (year)	55.8 ± 9.8	61.9 ± 8.1	<0.0001
Sex (M/F)	86/14	79/21	0.07
Timing Emergency Urgent	 5(5.0%) 32 (32%)	 3 (3.0%) 29 (29%)	 0.39 0.92
Hypertension	38 (38%)	62 (62%)	0.1
NYHA class	1.7± 0.9	1.6 ± 0.7	0.93
LVEF (%)	56 ± 8	51± 7	0.22
CAD (no. vessels)	2.6 ± 0.7	2.4 ± 0.8	0.0003
Creatinine >1.5 mg/dL	9 (9.0%)	4 (4.0%)	0.001
PVD	18 (18%)	11 (11%)	0.4
Type 2 DM	34 (34%)	29 (29%)	0.61
Type 2 DM - PVD	11 (11%)	7 (7.0%)	0.18
COPD	18 (18%)	6 (6.0%)	<0.0001
BMI (kg/m2)	26.8 ± 3.2	27.1 ± 2.1	0.4
Obesity (>30 kg/m2)	23 (23%)	26 (26%)	0.29
Preoperative stay (d)	5.1 ± 4.1	6.2 ± 4.0	0.38

Table 1: preoperative data of single and bilateral mammary harvest groups

NYHA, New York Heart Association; LVEF, left ventricular ejection fraction; CAD, coronary artery disease; PVD, peripheral vascular disease (carotid/aortoiliac/femoral); DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; BMI, body mass index.

Variables	Bilateral skeletonized mammary Group (no=60)	Bilateral pedicled mammary group (no=40)	p-value
Age (year)	61.6 ± 9.8	53.8 ± 9.1	<0.0001
Sex (M/F)	49/11	33/7	0.02
LVEF (%)	53± 9	55± 7	0.26
Creatinine >1.5mg/dl	5(8.3%)	2(5%)	0.0017
PVD	13(22%)	6(15%)	0.013
Type 2 DM	24(40%)	10(25%)	0.0039
COPD	11(18%)	6(15%)	<0.0001
BMI (kg/m^2)	26.8 ± 3.2	26.8 ± 3.2	0.9

Table (2): preoperative data of bilateral skeletonized and bilateral pedicled groups

LVEF, Left ventricular ejection fraction; PVD, peripheral vascular disease (carotid/aortoiliac/femoral); DM, diabetes mellitus; COPD, chronic obstruc- tive pulmonary disease; BMI, body mass index.

Variables	Bilateral mammary group no=100	Single mammary group no=100	p-value
No. of grafts	3.4±0.9	3.6±0.6	0.0003
Cross clamp time (in min)	48±14	40±11	<0.0001
Total pump time (in min)	76±19	62±23	0.31
Free RIMA grafts	67 (67%)	----------	--------

Table (3): operative details of single and bilateral mammary groups

RIMA, right internal mammary artery.

Variables	Bilateral mammary group no=100	Single mammary group no=100	p-value
Hospital death	2 (2%)	0	0.12
Stroke	0	0	-------
Low-output syndrome	11 (11%)	6 (6%)	0.7
Bleeding (mL)	863 ± 297	670 ± 212	<0.0001
Blood transfusion (U)	1.4 ± 2.1	0.9 ± 1.4	0.4
Resternotomy	12 (12%)	8 (8%)	0.49
ICU stay (d)	2.6 ± 0.7	2.4 ± 0.4	0.39
Postoperative stay (d)	7.2 ± 2.1	6.4 ± 2	0. 04
Follow-up (mo)	14.4 ± 1.5	12.8 ± 5.2	0.49
Overall mortality	3 (3%)	2(2%)	0.68

Table (2): preoperative data of bilateral skeletonized and bilateral pedicled groups

ICU, intensive care unit.

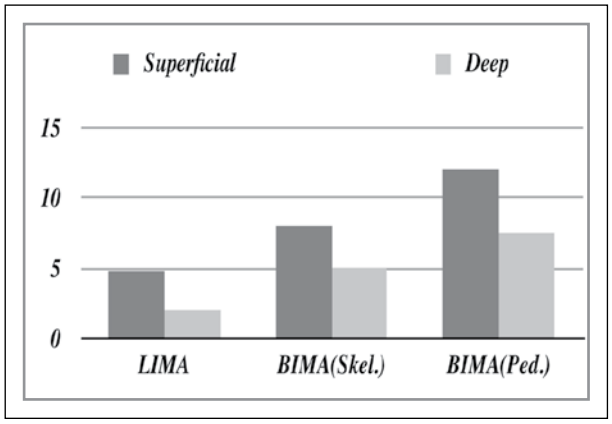

Figure 1: Incidence of superficial and deep wound infection in the research group

It worths noting that in both cases ie ;superficial and deep wound infection, a regression analysis condemned a double pedicled mammary harvest technique but not double skeletonized ones , as an independent risk predictor .

An important technical territory is the application of these techniques in diabetics, statistical isolation and analysis of these patients reveled a statistically insignificant difference in the incidence of deep wound infection between single mammary and bilateral skeletonized mammary groups but a much higher incidence was met in the bilateral pedicled mammary group which also showed a higher overall risk of deep infection even in non-diabetics (Figure 2).

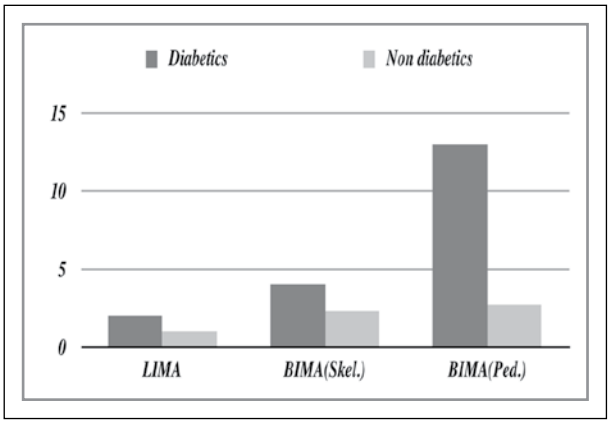

Figure 2; Impact of diabetes on prevalence of deep wound infection among research population

Discussion:

Our chart of results shows that bilateral mammary harvesting significantly increases the risk of sternal wound infection as compared to the use of single mammary, but resorting to skeletonization technique in case of bilateral mammary harvesting significantly decreases the risk of this serious complication . Although there is a significant multiplicity of risk factors in patients recruited for bilateral skeletonized mammary grafts, yet the incidence of wound infection is significantly lower in this group as compared to the bilateral pedicled mammary group, this broadly supports the applicability and safety of wide scale usage of bilateral skeletonized mammary grafts.

Many authors stated that the use of bilateral mammaries in CABG improves survival and decreases the need for interventional or surgical second go revascularization especially for younger age groups.(5)

Significant statistical evidence has been grown supporting the use of bilateral mammary conduits and highlighting its added benefit in all CABG patients, not only younger age patients but even older age groups up to 75 years being superior to single mammary approach . Also, the application of skeletonization technique enabled the expansion of bilateral mammary strategy increasing the number of performed anastomoses per patient with the same angiographic results as the bilateral pedicled mammary artery, thus augmenting the affinity to use bilateral mammary arteries in CABG procedure.(6)

Many surgeons prefer single mammary use because of the higher risk of sternal wound infection associated with harvesting both mammaries especially in high risk groups as patients with diabetes, COPD, obesity, renal impairment and those with peripheral vascular disease .(7)

However, it seemed justifiable that skeletonization technique gives the advantage of bilateral mammary revascularization and limits sternal ischemia by maintaining substantial blood flow carried by collaterals from preserved intercostal and sternal branches and the popularity of this technique is increasing.

Multiple articles supported the lower incidence of sternal infections in diabetic patients by using the bilateral skeletonized IMA with favorable long-term cardiac outcome. Our study, which included a significant number of diabetic patients (32%) , those who received BIMA grafting (10 pedicled and 24 skeletonized), and 29 received single mammary graft, also confirmed the benefit of skeletonization in this high-risk subgroup . In fact, among diabetic patients, the incidence of deep sternal infection was similar between patients who received a single mammary and those who received double skeletonized arteries and it is noteworthy that patients who received bilateral pedicled arteries had a strikingly higher incidence of deep sternal infection (Figure 2).(8)

However, as multiplicity of risk factors exponentially increases the incidence of sternal wound infection, a more conservative approach can still be justified in this situation . As an example, in our research, diabetics with co-existent chronic obstructive pulmonary disease, peripheral arteriopathy, and a body mass index greater than 30 kg/m2 had a greater rate of deep sternal infection (>20%), when compared to only -diabetes patients. Of note, apart from the harvesting technique,

in a low-risk population such as non-obese, non-diabetic males, the rate of a deep sternal infection was significantly low with no statistically significant difference between BIMA patients and single mammary group,which in turn elevates the value of BIMA use in this group.(9)

This research also highlighted re-exploration for bleeding as an independent and powerful risk factor for deep sternal infection. The reason lies in the added tissue injury and ischemia at a time when sternal blood flow is most critical for early healing and consequent sternal stabilization. Therefore, avoiding re-exploration is even more critical in patients receiving bilateral mammary grafting who already have a greater acute reduction in sternal blood flow. (10)

Furthermore, our study could prove that although a higher sternal infection rate is encountered in patients receiving bilateral mammary grafting, yet the overall mortality did not significantly differ from that in patients receiving a single mammary graft. Putting this together with the role of skeletonization in reducing sternal infection allowed a more liberal and safe use of both conduits on the great majority of patients undergoing coronary bypass grafting.

There were some fears from possibility of intimal injury during harvesting of the a skeletonized mammary artery and thus affection of graft long-term patency , this was denied in recent literature that did not find any evidence of endothelial damage or patency affection on follow up as compared with patient with pedicled mammary.(11)

Limitations of the Study:

Selection bias may be related to presence of more risk factors in the bilateral skeletonized mammary group as compared to the entire research population , but on the other hand it ensures that skeletonized mammary is safe to apply on a large scale of patients including those at high risk.

Conclusion:

Although skeletonization allowed us to include a significant number of high risk patients as candidates for the strategy of bilateral internal mammary (BIMA) grafting ,yet, this technique neither completely abolished the problem of sternal infection nor could catch up with the safety profiles (in terms of wound infection) obtained by a single mammary artery plan.

However, this research recommends to harvest both mammaries in patients with acceptable risk profiles but not those with multiple risk factors, and of prime importance is prevention of postoperative bleeding in patients receiving bilateral (BIMA) for CABG, as wound problems are significantly bound to sternal re-opening .

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No-Touch Aorta-Coronary Bypass Operation: Off Pump Composite Graft is an option

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Background: **Minimizing manipulation of the ascending aorta during coronary artery bypass grafting (CABG) could be achieved using Off-pump technique(OPCAB), in addition , the use of Y- graft configuration achieved adequate myocardial revascularization while avoiding manipulation of the ascending aorta either with bilateral internal mammary artery (BIMA) or left internal mammary artery (LIMA) and radial artery (RA) .Our research was designed to determine if saphenous veins can be suggested as composite grafts with the LIMA as an option.**

Patients and Methods: **Between February 2008 and October 2010, in Cairo University hospitals , we performed 100 cases of OPCAB without aortic manipulation in patients with multi-vessel disease , out of these, 64 cases received BIMA grafts, 28 received LIMA and RA (LIMA-RA) composite grafts and the remainder 8 cases were subjected to composite arteriovenous grafts. Euro - SCORE predicted risk of mortality was higher in patients who had a LIMA-vein composite graft (all p < 0.001) than those who underwent BIMA and LIMA-RA grafts,possibly due to older age , renal insufficiency or peripheral vascular disease.**

Results: **Over 2-years' survey period, there was no statistically significant difference in the 3 groups as regards freedom from myocardial infarction (MI) and repeat revascularization. In addition, no patient who received a LIMA-vein graft experienced perioperative myocardial infarction (MI). In spite of that,when it came to short term analysis, the overall 30-day mortality ranged around 1% - 7% in patients who had LIMA-vein grafts and 0.6% in both total arterial groups (p = 0.001). Neurological complications occurred in 2.5%, 0.6%, and 0.3% of patients, respectively (p = 0.3). Patients in the total arterial graft groups had better 3-year survival (> 95%) and freedom from major adverse cardiovascular and cerebrovascular events (> 75%) than those of LIMA-vein graft group.**

Conclusions: **Although the use of LIMA-vein composite graft is associated with a lower early and mid-term survival and higher complication rate, probably because of the higher patient risk profile,yet,it still constitutes a last resort in selected patients undergoing CABG without manipulation of the aorta when arterial grafts are not available or not recommended.**

Many authors reported an incidence range from 1% to 2.5% of major cerebrovascular accidents caused by embolization of atheromatous debris due to manipulation of the ascending aorta during coronary artery bypass grafting (CABG) [1, 2]. Which significantly results in higher perioperative mortality [3, 4] and reduced long-term survival [5]. Although off-pump CABG (OPCAB) abolishes the need for ascending aorta cannulation, still aortic manipulation is needed while fashioning the proximal anastomoses [6,7].

Based on this manner of thinking, the so-called aorta no-touch technique emerged as a strategy to reduce stroke risk through complete avoidance of handling the aorta, [8,9], this technique suggests a combination of OPCAB and total arterial revascularization,using either both internal mammary arteries (IMA) in situ or a composite arterial Y-grafts is fashioned using both IMAs or the left IMA (LIMA) and the radial artery (RA) [10]. As harvesting both mammaries is probably prohibited in patients with advanced age or those with insulin-dependent diabetes mellitus, chronic obstructive pulmonary disease or dialysis- dependent renal failure,and, on the other

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Codex : o3/07/1301

hand, radial artery harvesting is potentially troublesome in cases of positive Allen's test result, or RA calcification.A saphenous vein graft might form a satisfactory substituent in such patients, while still allowing aorta no-touch technique to take place.

The aim of this research is to evaluate results of the no-touch aorta strategy and to compare outcomes in patients with a LIMA-vein composite graft with those who had their Y-composites using either RIMA or radial artery conduits.

Patients and methods:

Study Design:

In Cairo University hospitals, between February 2008 and October 2010, No-touch aorta OPCAB operations without the use of any aortic clamping was performed in 100 cases of multi- vessel coronary artery disease,out of which, 64 cases received BIMA grafts, 28 received LIMA and RA (LIMA-RA) composite grafts and the remainder 8 cases were subjected to composite arteriovenous grafts, ethical aspects were permitted by our institutional ethical committee.

Abbreviations and Acronyms

BIMA : bilateral internal mammary artery
CABG : coronary artery bypass graft
CI : confidence interval
IMA : internal mammary artery
LIMA : left internal Mammary artery
MACCE : major adverse cardiac and cerebrovascular events
MI : myocardial infarction
OPCAB : off-pump coronary artery bypass
HR : hazard ratio
RA : radial artery

Exclusion criteria:

1. Patients who underwent on-pump CABG.
2. Cardiac procedures that entailed side occlusion clamping of the ascending aorta.
3. Combined cardiac surgeries such as carotid or arrhythmia procedures.
4. Intra-operative conversion to on-pump CABG.
5. Patients who underwent MID-CAB.

Accordingly, our results were fashioned in the form of two major variables:

1. Operative mortality(OM): which is defined as death as early as one month post-operative.
2. Peri-operative stroke which is defined as newly developed neurological deficit that should fulfill the following criteria:
   - Persistence for more than 72 hours.
   - Radiological confirmation by computed tomography.

Anesthetic technique :

Patients received their usual cardiac medications at early morning the day of surgery. premedication consisted of diazepam 5mg and ranitidine 150 mg orally the night before surgery, the day of surgery, morphine 0.1 mg/kg is given IM 2 hours before admission to the operating room.

On arrival to pre-induction room, all patients were premedicated with IV midazolam 0.05 mg/kg. A five-lead electrocardiography assisted with continuous ST segment analysis, pulse oximetry and non-invasive blood pressure monitoring were initiated. After performing modified Allen's test, an arterial catheter was inserted, under local anesthesia, into the suitable i.e; dominant, radial artery for invasive blood pressure monitoring.

General anesthesia induction consisted of fentanyl 5-8 μg/kg, propofol 1 mg/kg and cisatrachurium 0.15 mg/kg. After tracheal intubation , a right internal jugular central venous catheter was inserted. Anesthesia was maintained using isoflurane 0.5%, and its concentration was later adjusted as required by clinical conditions (heart rate and blood pressure). Neuromuscular blockade was done by an infusion of cisatrachurium at a rate of 3 μg/kg/min.

Surgical technique:

Routine median sternotomy,harvesting of the conduits and conduit assessment, below knee great saphenous vein is the most commonly used venous conduit, vein diameter ,wall thickness and pliability are thoroughly evaluated after gentle hydrostatic distension . Diameter mismatch exceeding 2:1 between the vein and LIMA is a technical contraindication to performing LIMA- vein composite graft.

Digital palpation was used to assess the aorta for the presence of significant atherosclerotic disease. Epiaortic echocardiography was occasionally used in selected patients.

After heparinization, the Y-anastomosis was fashioned,either between both mammaries, the LIMA and the radial artery or the LIMA and saphenous vein graft. Thereafter the distal anastomoses were performed with suction stabilizers (Octopus).

Follow up:

Follow-up was performed by personal contact, or phone contact with patients and family members, with supplemental

information supplied by referring cardiologists. This research was designed so as all subjects were followed yearly for two successive years. By the end of the survey the follow up was 96% complete.

Statistical Analysis:

Categorical variables were compared using the X2 or Fisher's exact test, and expressed as proportions ,while independent continuous variables were compared by an unpaired Student = st test or Kruskal-Wallis test as suitable ,and are expressed as mean ± standard deviation.

We examined 19 preoperative risk factors for early mortality by univariate and multivariate testing. Predictors of dichotomous adverse perioperative or post-operative outcome events were analyzed using univariate and multivariate logistic regression models with backward stepwise elimination and are expressed as hazard ratio (HR) and 95% confidence interval (CI). Event - free survival was calculated by Kaplan-Meier methods with 95% CI.

Independent predictors of short-term survival were determined with Cox proportional hazards analysis. p values less than 0.05 were considered statistically significant. All statistical analyses were performed using SPSS Statistics, version 17.0 (SPSS Inc, Chicago, IL).

Results:

1- Research group demography:

Table 1 shows the research group demography and Table 2 illustrates operative data. It worths notification that LIMA-vein composite was predominantly performed in older cases than total arterial revascularization, EuroSCORE (European System for Cardiac Operative Risk Evaluation) of this study group was 12.9 ± 12.1% which is significantly higher than rest of the research population . We did our best to accomplish complete revascularization, the incidence of under - revascularization was not significantly different between groups.

The number of performed anastomoses was significantly higher in the total arterial graft groups compared with the LIMA-vein graft group,we could achieve an overall average number of grafts of 2.9 ± 0.6.

2- Postoperative data :

- **PREDICTORS OF OPERATIVE MORTALITY.** According to analytical evaluation of the relative statistical weights; preoperative renal insufficiency, defined as a serum creatinine level greater than 2 mg/dL ($p < 0.001$), emergency operation ($p < 0.001$), and MI within 48 hours of operation ($p = 0.005$) were significant predictors of OM. Table 4 illustrates other mortality predictors of statistical significance. Contrary to the classic caution of most surgeons, targeting the ramus intermedius artery ($p = 0.9$) or left main disease ($p = 0.86$) were of no statistical significance.

Similarly, analytical imposition of the use of LIMA-vein composite grafts ($p = 0.06$) did not touch the threshold of statistical significance as an independent predictor of OM.

- **PERI-OPERATIVE MORTALITY:** Overall (OM) was 6%, LIMA-vein group showed significantly higher (OM) rate than total arterial groups (Table 3).

In this group,we had four deaths, one due to post-operative haemrrhagic stroke, one due to mediastinitis and the remainder were two cases of sudden cardiac death.

These two cases passed away 2 and 3 weeks after discharge respectively , attributed - most probably - to post-operative MI. The LIMA-RA group had a single in hospital mortality due to intractable arrhythmia and one patient in the BIMA group died due to mediastinitis.

- **NEUROLOGICAL COMPLICATIONS:** Out of our research population 7 cases (7%) suffered from serious neurologic complications. Three perioperative embolic strokes occurred in the BIMA group ,which did not appear in both the LIMA-vein or LIMA-RA groups .

Hemorrhagic stroke occurred once in the LIMA-vein group. Irreversible hypoxic brain injury after resuscitation was unfortunately encountered in three cases, a case was in the LIMA- vein group and the other two fell in the LIMA-RA group. Four of these 7 cases died, constituting two thirds of the overall OM.

From the technical aspect of view, it worths noting that postoperative myocardial infarction (MI) complicated two cases in the BIMA group and one patient in the LIMA-vein group . While the LIMA-RA group showed complete freedom from this complication. One patient in the LIMA- vein group required graft revisions to correct a kinked vein .

3- Follow-Up:

Over the research short-term survey, the total percentage of cerebrovascular accidents was

2.1% over the whole research population (1.5% in BIMA, 0.5% in LIMA-RA, and 12.5% in LIMA- vein groups ($p = 0.3$), on the other hand 3.0% of the patient population suffered from MI (1.5% in BIMA, 3.7% in LIMA-RA, and 12.5% in LIMA-vein groups ($p = 0.3$). The need for a second go vascularization procedure over our short-term survey did not show statistically significant difference between the 3 groups. Table 4. analyses data investigating independent predictors of death and MACCE . Accordingly,the use of a LIMA-vein graft was statistically insignificant as an independent predictor MACCE (HR, 1.8; $p = 0.04$) and short-term survival.

Preoperative variable	Total (n = 100)	BIMA (n = 64)	LIMA-RA (n = 28)	LIMA-Vein (n = 8)	p Value
Age (y)	63.8± 9.9	60.3 ± 8.0	61.1 ± 6.2	69.1 ± 6.3	0.001
Female sex %, (n)	82 (82)	89 (57)	75 (21)	50 (4)	0.001
Diabetes mellitus %, (n)	68 (68)	76.6 (49)	46.4 (13)	75 (6)	0.3
Hypertension %, (n)	72 (72)	67.1 (43)	85.7 (24)	62.5 (5)	0.3
Hyperlipidemia %, (n)	89 (89)	92.2 (59)	85.7 (24)	75 (6)	0.6
Obesity (BMI > 30) %, (n)	63 (63)	65.5 (42)	64.2 (18)	37.5 (3)	0.004
Preoperative MI %, (n) Total MI < 48 h MI 2–20 d MI 21–90 d	 40 (40) 10 (10) 7 (7) 23 (23)	 37.5 (24) 7.8 (5) 6.3 (4) 20.3 (13)	 39.3 (11) 10.7 (3) 7.1 (2) 28.6 (8)	 62.5 (5) 25 (2) 12.5 (1) 25 (2)	 0.02 0.005 0.06 0.3
Preoperative IABP %, (n)	1 (1)	0.0 (0)	0.0 (0)	12.5(1)	0.0001
Preoperative LVEF %	52.3 ± 12.9	54.6 ±11.8	53.8 ± 10.9	51.1± 10.2	0.2
Preoperative LVEF < 30%, %, (n)	5 (5)	1.6 (1)	3.6 (1)	37.5 (3)	0.3
Left main coronary artery disease %, (n)	32 (32)	28.1 (18)	36 (10)	50 (4)	0.5
Preoperative COPD %, (n)	6 (6)	4.8 (3)	7.2 (2)	12.5 (1)	0.5
Preoperative renal dysfunction (Cr level > 2 mg/dL) %, (n)	4 (4)	1.6 (1)	0 (0)	37.5 (3)	0.0001
Preoperative dialysis %, (n)	1 (1)	1.6 (1)	0.0 (0)	0 (0)	0.1
Peripheral vascular disease %, (n)	30 (30)	25 (16)	32.1 (9)	62.5 (5)	0.003
Preoperative stroke %, (n)	5 (5)	1.6 (1)	3.6 (1)	37.5 (3)	0.0001
Previous cardiac operation %, (n)	2 (2)	0.0 (0)	7.2 (2)	0.0 (0)	0.3
Previous coronary artery operation %, (n)	1 (1)	0.0 (0)	3.6 (1)	0.0 (0)	0.1
Previous PCI %, (n)	21 (21)	20.3 (13)	21.4 (6)	25 (2)	0.5
Timing of operation %, (n) Elective Urgent Emergent	 77 (77) 18 (18) 5 (5)	 75 (48) 17.2 (11) 1.6 (1)	 78.6 (22) 21.4 (6) 7.2 (2)	 87.5 (7) 12.5 (1) 25 (2)	 0.006 0.4 0.0001
Preoperative logistic EuroSCORE	5.1 ± 6.5	3.9 ± 4.9	4.1 ± 5.0	12.9 ± 12.1	0.0001

Table 1. Preoperative data of the research groups:

Intraoperative variable	Total (n = 100)	BIMA (n = 64)	LIMA-RA (n =28)	LIMA-Vein (n = 8)	p Value
Number of vessels grafted	2.9 ± 0.6	2.8± 0.7	2.9± 0.6	2.6 ± 0.8	0.001
Incomplete revascularization %, (n)	8 (8)	7.8 (5)	7.2 (2)	12.5 (1)	0.6
Left anterior descending artery %,(n)	98 (98)	98.4 (63)	100.0 (28)	87.5 (7)	0.7
Diagonal branches %, (n)	26 (26)	26.6 (17)	28.6 (8)	12.5 (1)	0.6
Ramus artery %(n)	9 (9)	7.8 (5)	14.3 (4)	12.5 (1)	0.9
First obtuse marginal artery%, (n)	49 (49)	40.6 (26)	64.2(18)	48.4 (5)	0.02
Second obtuse marginal artery %, (n)	16 (16)	15.6 (10)	17.9 (5)	12.5 (1)	0.3
Right coronary artery %, (n)	11 (11)	12.5 (8)	7.2 (2)	12.5 (1)	0.2
Posterior descending artery %, (n)	38 (38)	26.6 (17)	57.0 (16)	48.4 (5)	0.0001
Posterolateral branches %, (n)	6 (6)	3.2 (2)	7.2 (2)	25.0 (2)	0.04

Table 2. Intra-operative details:

Continuous variables expressed as mean ± standard deviation.

BIMA = bilateral internal mammary artery; BMI = body mass index; Cr = creatinine; LVEF = left ventricular ejection fraction; MI = myocardial infarction; PCI = percutaneous coronary intervention; RA = radial artery; COPD = chronic obstructive pulmonary disease; Euro SCORE = European System for Cardiac Operative Risk Evaluation; IABP = intraaortic balloon pump; LIMA = left internal mammary artery;

Complication	Total (n = 100)	BIMA (n = 64)	LIMA-RA (n =28)	LIMA-Vein (n = 8)	p Value
30-day mortality %,(n)	6.0 (6)	1.6 (1)	3.6 (1)	50(4)	0.0001
Low cardiac output syndrome %, (n)	13 (13)	12.5 (8)	14.3 (4)	12.5(1)	0.7
Postoperative IABP %, (n)	15 (15)	12.5 (8)	14.3 (4)	25 (2)	0.6
Postoperative MI %, (n)	3.0 (3)	3.2 (2)	0.0 (0)	12.5 (1)	0.5
Postoperative arrhythmia %, (n)	19 (19)	15.6(10)	21.4 (6)	37.5 (3)	0.4
New postoperative dialysis %, (n)	3.0 (3)	3.2 (2)	0.0 (0)	12.5 (1)	0.0001
Pulmonary complications %, (n)	5.0 (5)	4.9 (3)	3.6 (1)	12.5 (1)	0.4
Stroke %, (n)	7.0 (7)	4.8 (3)	7.2 (2)	25 (2)	0.8
Deep sternal wound infections %, (n)	4.0 (4)	3.2 (2)	3.6 (1)	12.5 (1)	0.5
Reopening for bleeding %, (n)	8.0 (8)	6.3 (4)	10.7 (3)	12.5 (1)	0.6
Reopening for graft revision %, (n)	1.0 (1)	0.0 (0)	0.0 (0)	12.5 (1)	0.2

Table 3. Distribution of Postoperative Outcomes for Each Group

BIMA = bilateral internal mammary artery;IABP = intraaortic balloon pump;LIMA = left internal mammary artery;

MI = myocardial infarction; RA = radial artery.

Outcome	*Hazard Ratio*	*95% CI*	*p Value*
Death	*1.1*	*1.0–1.1*	*<0.0001*
Age at operation	*2.6*	*1.4–4.6*	*0.007*
Peripheral vascular disease Incomplete revascularization	*3.1*	*1.2–5.6*	*0.02*
Preoperative renal insufficiency	*3.9*	*2.1–9.1*	*0.002*
MACCE	*1.0*	*1.0–1.1*	*0.04*
Age at operation	*2.1*	*1.3–2.9*	*0.02*
Preoperative MI	*2.6*	*1.6–4.1*	*0.004*
Incomplete revascularization Preoperative renal	*4.7*	*2.8–8.9*	*<0.0001*
insufficiency Use of LITA-vein composite graft	*2.0*	*1.0–3.4*	*0.04*

Table 4. Analysis for short-Term Death and Major Adverse Cardiac and Cerebrovascular Events

CI = confidence interval; LIMA = left internal mammary artery; MACCE = major adverse cardiac and cerebrovascular events; MI = myocardial infarction.

Discussion :

The use of BIMAs is associated with decreased revascularization rates and improved long- term survival [11]. They also enable the performance of OPCAB operations without manipulation of the ascending aorta, as an in situ or Y-configuration, without adversely affecting clinical status or graft patency rates [12].

In this study, we are assuming that the Y-graft can also be constructed with saphenous vein grafts (LIMA-vein composite) in a group of patients carrying prohibitive criteria to the total arterial strategy . The objective of this study was to determine if the saphenous vein could be used as a last resort in some harsh clinical scenarios where neither the RIMA nor the RA are available or usable.

Such a group of patients includes those requiring emergency CABG in whom expedient revascularization is of prime importance, elderly patients (>70 years), patients with insulin- dependent diabetes mellitus, chronic obstructive pulmonary disease, dialysis- dependent renal failure, or previous mediastinal irradiation .

This technique exhibited a significant technical advantage; in cases where the right system constitutes a surgical target , the saphenous vein always has an adequate length (which may prohibit the use of the RIMA or RA) . However , caliber mismatch between the LIMA and saphenous vein , varicosities ,wall thickening and potential kinks are limiting factors facing this technique.

Supplying the whole heart only by the LIMA is a technical detail that attracted attention of many surgeons, there was a question mark regarding functional adequacy of the LIMA especially under stressful conditions. The occurrence of the LIMA “string sign” beyond the Y-anastomosis due to potential steal phenomenon of the LIMA by the high-capacitance saphenous vein aggravated this inquiry. A short- term LIMA-vein Y-graft patency of only 88% was reported by Gaudino and coworkers [13] . However,in their study, this complication always took place in cases where the LIMA was used to revascularize a less than 70% stenosed target. In addition, Glineur and coworkers [14] reported even distribution of flow in both distal branches of the Y- composite with either free RIMAs or saphenous veins .

Although the LIMA-vein group showed a significantly higher OM than other groups (Table 3). Yet, there are many considerations;Two deaths of the total 4 that happened in this group were unrelated to the use of LIMA-vein as a composite graft. The other 2 patients had sudden cardiac deaths, which may be attributable to graft problems.

In addition, the higher logistic EuroSCORE (12.9 ± 12.1) due to older age and associated comorbidities presses the OM rates of the LIMA-vein group within acceptable limits.

Furthermore, statistical analysis of post-operative complications denied any detrimental effect of using LIMA-vein composite,we can also highlight the fact that total arterial procedures are technically more demanding and time-consuming. This could be a valid argument in favor of arteriovenous composites specially in emergency situations where complete and quick revascularization is of prime importance.

We therefore believe that an arteriovenous composite graft serves as a good alternative when other options for no-touch aorta OPCAB operations are limited.

No-touch aorta OPCAB is primarily indicated in patients with problematic ascending aorta (ie, a severely atherosclerotic or porcelain aorta) aiming at prevention of embolic strokes . In our research , a total of seven patients (7.0%) experienced serious neurologic complications.Out of them, 3 patients (4.8%) in the BIMA group , 2 patients (7.2%) in LIMA-RA and 2 patients (25%) in the LIMA-vein group (Table 3).

Although this research work did not generate a statistical station comparing rates of stroke between our study group and a conventional CABG group, yet , in the presence of such problematic ascending aorta we concluded that no-touch aorta OPCAB operations are associated with lower rates of serious neurologic complications.

This bare conclusion could obtain statistical umbrella by many parallel studies, Kapetanakis and his coworkers [15] reported a stroke rate with on-pump CABG that was 1.5 folds that with off-pump CABG with partial aortic clamping (2.2% versus 1.6% respectively) and 3 times that of the no-touch aorta OPCAB group (2.2% versus 0.8% respectively).

Our opinion was more evidently sustained by many nearby reports. Kim and his associates [16] as they reported an insignificant difference in stroke rates between conventional OPCAB and on-pump CABG,whereas both were higher than the no-touch aorta OPCAB technique.

Further more, partial aortic clamping was statistically condemned as an independent predictor for cerebral infarction by Kotoh and colleagues (HR, 11.1; 95% CI, 1.4–85.7; p = 0.02) [17].

Finally,it is important to highlight a certain dilemma, in spite of the better freedom from MACCE in patients of the BIMA and the LIMA-RA groups compared with those in the LIMA-vein group, when separately analyzing freedom from MI and the need for second go revascularization, there was no significant difference between the 3 groups. So, as previously illustrated, the lower freedom from MACCE in the LIMA-vein group was primarily driven by higher logistic EuroSCORE and not necessarily because of failure of the composite arteriovenous graft.

Limitations:

While designing this work , we ignored a number of co-variables that may diminish the rate of strokes in on pump CABG technique,such as automatic proximal aortic anastomotic devices or proximal aortic endoclamps , but it would be interesting to find out if these techniques could alter the outcomes of on pump technique against those of the no-touch aorta OPCAB technique.

The 3 groups that are compared have different risk profiles. The lack of direct attribution of our outcomes in high-risk patient population to the use arteriovenous composite graft was considered suggestive that the saphenous vein can indeed be used as a last resort in such patients.

Another limitation is the short-term and lack of angiographic follow-up, which could be optimal to evaluate the LIMA-vein composite. However , we believe that analysis of MACCE rates in such elderly study group adequately serves as a clinically important outcome measure, even without angiographic data.

Conclusions:

No-touch aorta OPCAB with either total arterial grafts or arteriovenous composites (Y- configuration) is a very beneficial technique in lowering the rate of both OM and perioperative stroke.While admitting that arterial conduits are always the surgeons' first choice, especially in younger patients, still a LIMA-vein composite should always be considered as a last resort in case a second IMA or RA conduits are not available.

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Early Outcome of Redo-Coronary Bypass Grafting: Is Total Arterial Revascularization Possible?

Tarek El Tawil MD*

Objective: **To evaluate the early outcome after redo-coronary artery bypass graft (CABG) using total arterial revascularization.**

Patients and Methods: **The study included 27 patients underwent redo-CABG. Preoperative arteriography was performed in all patients to document the coronary obstructions. The indications for redo-CABG were occlusion or severe stenosis of the grafts in 19 patients (70.4%), and progression of native coronary artery stenosis in 8 patients (29.6%). Dobutamine echocardiography was employed in all patients for evaluation of viable myocardium. Preoperative arterial Doppler studies and modified Allen's test were used to assess the radial artery (RA). Postoperative echocardiography was done for all patients.**

Results: **The early mortality rate was 7.4%. The postoperative complications were: postoperative myocardial infacrtion (MI) in one patient (3.7%), cerebral vascular accident in 2 patients (7.4%), re-exploration for bleeding in one patient (3.7%), and mediastinitis in 2 patients (7.4%). There was a postoperative significant improvement in mean ejection fraction (EF) when compared to preoperative mean of EF (P<0.05).**

Conclusion: **Total arterial revascularization in redo-CABG operations is possible with acceptable mortality and morbidity rates if anesthetic and surgical precautions were taken with proper selection of conduits.**

Keywords: **Redo, coronary bypass grafting, total arterial revascularization.**

Redo coronary artery bypass grafting (CABG) is known to be high-risk surgery [1]. It provides several technical challenges that distinguish it from primary CABG. These obstacles include repeat sternotomy, injury to previous grafts or the heart during dissection, quality and availability of conduits, a calcified ascending aorta, and more-advanced coronary disease involving the native vessels [2].

Efforts to improve the outcomes of surgical coronary revascularization have taken many forms, but among the most successful have been internal mammary artery (IMA) and radial artery (RA) grafts [3]. There is evidence from literature that the use of the RA, together with IMA in redo CABG achieved total arterial revascularization in most of cases and is associated with excellent result [4].

The aim of this study was to evaluate the early outcome after redo-CABG and to estimate if possible total arterial revascularization possible or not.

PATIENTS AND METHODS

The study included 27 patients underwent redo CABG between January 2007 and December 2009. Characteristics of patients underwent redo-CABG are shown in (Table 1). Of the 27 patients, 9 were female and 18 were male, and their ages ranged from 35 to 64 years (65.215.6± years). The interval period between the first CABG and the redo CABG ranged from 6 months to 16 years (10.26.3± years). The preoperative risk factors include: hypertension in 13 (48.1%), diabetes mellitus in 10 (37%), hyperlipidemia in 12 (44.4%), and smoking in 16 (59.2%).

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Codex : o3/08/1301

Preoperative arteriography was performed in all patients to document the coronary obstructions. Significant disease was defined as a reduction in arterial lumen diameter of at least its half [5]. Significant left main coronary artery luminal narrowing was classified as double vessel disease. On this basis, 4 patients (14.8%) had single vessel disease, 11 patients (40.7%) had double vessel disease, and 12 patients (44.4%) had triple vessel disease. The indications for redo operation were occlusion or severe stenosis of the grafts in 19 patients (70.4%), and progression of native coronary artery stenosis in 8 patients (29.6%). In the first CABG, Left internal mammary grafts were used in 25 patients (92.5%).

Dobutamine echocardiography was employed in all patients for evaluation of viable myocardium. The mean left ventricular ejection fraction (LVEF %) was 47.1 ± 13.4. Preoperative arterial Doppler studies were used to assess the radial arteries. In addition, a modified Allen›s test was performed before they are taken to the operating room.

Redo sternotomy was performed using an oscillating saw while lifting up the sternal wires. After completing the dissection around the heart, the standard on-pump CABG technique was applied, heparin was given at a dose of 300 to 400 IU/kg to obtain an activated clotting time of more than 450 seconds. During CPB, mean arterial pressure was maintained at 60 mm Hg and body temperature was cooled on average to no lower than 28°C. Intermittent cold blood cardioplegia was delivered in an antegrade or retrograde fashion as appropriate. Protamine sulfate was used to reverse the heparin once CPB was no longer required. No special blood conservation techniques were used other than nonhemic prime, retransfusion of all contents of the oxygenator at the end of CPB, and acceptance of normovolemic anemia.

Postoperative echocardiography was done for all patients. The evaluated parameters included: early mortality, postoperative complications, and postoperative ejection fraction. Early mortality was defined as an operative death or 30 days hospital death.

SPSS (Statistical Package for Social Sciences) for Windows 15.0 was used in the statistical description of the data. The characteristics and outcome of patients were presented as number and percentages for categorical variables and as mean ± standard deviation (SD) for continuous variables.

RESULTS

The operative data are shown in (Table 2). Mean cardiopulmonary bypass time was 126.3± 44.2 min., mean cross clamp time was 86.2±25.4 min., and mean number of grafts/patient was 2.6±0.66. The used arterial conduits were: right internal mammary artery (RIMA) in 25 patients (92.5%), radial artery (RA) in 22 patients (81.5%), and left internal mammary artery (LIMA) in 2 patients (7.5%).

The postoperative outcome is shown in (Table 3). The early mortality rate was 7.4%. The postoperative complications were: postoperative MI in one patient (3.7%), cerebral vascular accident in 2 patients (7.4%), re-exploration for bleeding in one patient (3.7%), and mediastinitis in 2 patients (7.4%). The mean postoperative LVEF (%) improved, and it was 55.3 ± 16.4, which was significantly higher than preoperative LVEF (P<0.05).

Characteristics	***Redo-CABG (n = 27)***
Age (years), mean ±SD	65.2±15.6
Sex: Male/Female	18/9
Risk Factors:	
Hypertension	13(48.1%)
Diabetes mellitus	10(37%)
Hyperlipidemia	12(44.4%)
Smoking	16(59.2%)
Reason for redo CABG	
Graft occlusion	19(70.4%)
New lesion	8(29.6%)
Interval (years), mean ±SD	10.2±6.3
Vessel disease:	
One vessel	4(14.8%)
Two vessels	12 (44.4%)
Three vessels	11(40.7%)
Used LIMA in first operation	25(92.5%)
LVEF (%), mean ±SD	47.1 ± 13.4

Table (1): Preoperative characteristics of 27 patients underwent redo-CABG.

COPD, chronic obstructive pulmonary disease; LIMA, left internal mammary artery; LVEF, left ventricular ejection fraction.

Variables	***Redo-CABG (n = 27)***
Cardiopulmonary bypass time (min.), mean ±SD	126.3± 44.2
Cross clamp time (min.), mean ±SD	86.2± 25.4
Number of grafts/patient, mean ±SD	2.6 ± 0.66
Type of arterial conduit:	
-RIMA	25(92.5%)
-RA	22(81.5%)
-LIMA	2(7.5%)

Table (2): Operative data of 27 patients underwent redo-CABG.

LIMA: left internal mammary artery. RIMA: right internal mammary artery. RA: radial artery.

Postoperative outcome	*Redo-CABG (n=27)*
Early mortality	2(7.4%)
Complications:	
Postoperative MI	1(3.7%)
Cerebral vascular accident	2(7.4%)
Re-exploration for bleeding	1(3.7%)
Mediastinitis	2(7.4%)
Postoperative LVEF (%), mean ± SD	55.3 ± 16.4

Table (3): Postoperative outcome.

DISCUSSION

As in primary CABG, the main goal in redo-CABG is the achievement of complete revascularization. But complete revascularization may not be possible owing to the high risk profile of the patients and technical difficulties [6].There are many problems in the operative technique of redo-CABG compared with that of the first surgery including the method of approach to the operative field, dissection of heart adhesion, method of myocardial protection, method of CBP and preservation of patent grafts [7].

Total arterial revascularization offers the potential to avoid the problems associated with vein graft failure. Bilateral internal mammary arteries (IMAs) are the conduits of first choice because of excellent short- and long-term patency and the possibility of improved survival [8]. The radial artery is easily harvested, versatile, has excellent handling characteristics, and has become the arterial conduit of third choice [9].

The results of the current study show that total arterial revascularization in patients undergoing redo coronary artery graft can be achieved with low postoperative rates of death and complications, if safe technical and anesthetic considerations were followed. The redo-sternotomy approach is the standard method of redo CABG. However, in patients this approach, many risks accompany dissection of the adhesion including injury to the myocardium, ascending aorta and patent grafts. Safe redo-sternotomy is one of the major steps to a good outcome following redo cardiac surgery. When approaching the sternum the surgeon should be mindful of the following principles: (1) Safe sternal reentry is one of the key factors for successful outcome; (2) Presume that there may be vital structures adherent to the back of the sternum all the time; (3) The time spent performing a redo sternotomy is not critical but safe entry should be; and (4) Visualization of the structures is important to avoid problems with catastrophic bleeding [10].

In the present study, injury of IMA and RA during harvesting was crucially avoided. Meticulous surgical technique should be applied in harvesting fragile IMA and RA vessels to prevent spasm or intimal tears causing dissection. Adequate flow should be confirmed before graft deployment to prevent the disastrous consequences of inserting a “bad” IMA or RA [11].

The acceptable early mortality rate after redo-CABG (7.4%) in the present study comes in agreement with the recent studies which showed that mortality rate in redo-CABG to vary between 4.2% and 11.4% [12-14]. In addition to the technical precaution, our acceptable mortality rate with low morbidity could be attributed to the use of total arterial revascularizton in such patients with redo-CABG, which come in agreement with other studies. The clinical benefits of RIMA and RA use over conventional technique have been established in other studies in literature. The randomized studies of Muneretto et al., [15-17] showing superiority of total arterial revascularization over conventional grafting, in patients who were older, more diabetic, and had a higher operative risk. In a randomized trial with low-risk patients, Myers et al., [18] compared total arterial revascularization (only IMA) with conventional grafting and found no differences in survival or cardiac events. Damgaard et al., [19] investigated clinical and angiographic outcomes after coronary surgery using total arterial revascularization, and concluded that within 1 year post-operatively, total arterial revascularization seems at least as safe and effective as conventional grafting.

Royse et al., [20] demonstrated that total arterial grafting was associated with reduced in-hospital mortality. More recently, Guru et al., [21] reported improved risk-adjusted survival and greater freedom from cardiac morbidity in patients with multiple arterial grafts (12% of patients with multiple arterial grafts) as compared to those with single arterial grafts.

In conclusion, proper preoperative and technical precautions in addition to the benefits of total arterial revascularization result in safe and effective redo-CABG operations using RIMA and RA as arterial conduits, with low mortality and morbidity rates and acceptable angiographic patency. Thus, total arterial revascularization in such patients with redo-CABG is possible. Further long-term large studies are recommended.

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Early and mid term results of tricuspid valve replacement with bioprosthetic valve in organic tricuspid valve disease

Tamer Farouk MD.

Background: **Tricuspid valve (TV) disease occurs with structurally normal valves (functional) or with organic valvular disease.** Organic disease is rare and comprises less than 1% of all valve operations**.**

Patients and methods: **Between January 2005 and December 2009, 20 patients with organic tricuspid valve disease underwent tricuspid valve replavement using bio prosthesis at Cairo university hospitals and other hospitals. Patients were evaluated early post operative and on midterm basis.**

Results: **Mean age was 33.2 ± 9.5 years. Cardiopulmonary bypass mean time was 106.5 ± 17.9 minutes, while aortic cross clamp mean time was 81.1 ± 19.2 minutes. The mean time needed for mechanical ventilation was 19.8 ± 22 hours. Four patients needed reopening for exploration of bleeding. Two patient suffered from sepsis and died from septic shock on the third and fourth post operative days. One patient had peri operative cerebro vascular event and died. Two patients suffered from complete heart block and required insertion of permanent pacemaker. The mean length of intensive care unit stay was 4.2 ± 1.4 days. The mean hospital stay was 11.85 ± 5 days. Patients were followed up for a mean of 34.2 ± 6.2 months by clinical evaluation and echocardiography. Only two patients did not show up for follow up. Fifteen patients (88.2%) had completed their follow up.**

Conclusion: **tricuspid valve replacement using bioprosthesis is a good choice in cases with organic disease not amenable for repair as seen in early and midterm follow up.**

Key words: **organic tricuspid valve disease- tricuspid valve replacement using bioprosthesis.**

Tricuspid valve (TV) disease occurs with structurally normal valves (functional) or with organic valvular disease. Tricuspid regurgitation (TR) in patients with normal leaflets is usually secondary to left heart pathology (ie, functional or secondary TR) [1]. In most cases of tricuspid valve disease, tricuspid valve repair is considered the procedure of choice. However, when tricuspid valve repair is not successful tricuspid valve replacement (TVR) should be considered [2]. In contrast, organic TV disease is rare and comprises less than 1% of all valve operations [3]. Selection of the suitable prosthesis is still debatable. Although modern aortic and mitral bileaflet mechanical valves provide excellent hemodynamic results, according to the literature, tricuspid prostheses are not completely satisfactory [3, 4].

Patients and methods:

Between January 2005 and December 2009, 20 patients with organic tricuspid valve disease underwent tricuspid valve replacement using bioprosthesis at Cairo university hospitals and other hospitals.

Patients were selected for this study based on the method of randomized clinical trials, after institutional and informed consent according to the following inclusion and exclusion criteria.

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Inclusion Criteria:

All patients with organic tricuspid valve disease requiring tricuspid valve surgery by echocardiography were included.

Exclusion Criteria:

The following patients were excluded from the study:

- Patients with functional tricuspid regurgitation.
- Patients with previous open heart surgery.
- Patients requiring preoperative intravenous inotropic drugs or mechanical ventilation.
- Patients with significant primary pulmonary, renal, heamatologic, hepatic, endocrine or metabolic pathology.

Preoperative evaluation:

All patients were subjected to complete history taking, clinical examination, full laboratory investigations, plain chest X-ray, ECG, echocardiography and if needed coronary angiography, myocardial perfusion scintigraphy and duplex scanning of the carotid arteries.

Operative Management:

In all the patients routine anesthetic techniques were used. All arterial and peripheral intravenous lines were placed.

Membrane oxygenators were used. Myocardial protection was carried out through systemic cooling to 28˚c, topical iced saline bath and most important by ante grade cold blood cardioplegia. Cardioplegia was infused into the ascending aorta at 4˚c with a pressure of 200 mmHg. Induced cardiac stand still was usually achieved within one minute. Cardioplegia was given every 30-40 minutes.

Surgical technique:

All patients were submitted to tricuspid valve surgery through median sternotomy.

Patients were submitted to tricuspid valve replacement with bioprosthetic valve after any concomitant procedure was done.

Some patients were submitted to trial of tricuspid repair using comissurotomy, De Vega suture annuloplasty, or segmental annuloplasty which was unsatisfactory either instantaneously or after weaning off bypass according to TEE showing severe degree of tricuspid regurgitation.

The following data were recorded for statistical analysis: Cardiopulmonary bypass time, cross clamp time, procedure done and any concomitant procedure if needed, use of inotropic support and vasodilator drugs.

Postoperative evaluation:

All patients were evaluated thoroughly during their intensive care unit stay (ICU) and during their hospital stay.

The time from arrival to the ICU until weaning from mechanical ventilation was calculated. Inotropes for cardiac support starts after weaning from cardiopulmonary bypass. Inotropics as adrenaline might be used if needed. Nitroglycerin may be used in cases with pulmonary hypertension. The need for reopening and its cause and intensive care unit (ICU) stay.

Patients were followed up during their hospital stay with the following: 12 leads ECG was done for all patients, Plain chest X-ray postero-anterior and lateral views were done. M-mode, two dimensional and Doppler echocardiography were performed for all patients. Other complications were evaluated as wound infection, thromboembolism, the need for permanent pace maker and hospital stay.

Follow up:

Clinical data on New York Heart Association (NYHA) functional status, postoperative morbidity, and mortality were tabulated. Patient clinical status and most recent transthoracic or transesophageal echocardiographic results were revised. Postoperative events were compiled and analyzed for reporting morbidity and mortality after operations. Need for reoperation and event free survival (thromboembolism, valve thrombosis or dysfunction, endocarditis and recurrent tricuspid regurgitation) were recorded. Follow up was 88.2% (15/17) completed.

Data were collected, revised, verified and edited on a personal computer. Then, data were analyzed statistically.

The Following tests were used:

1. Arithmetic mean (x)
2. Standard Deviation (SD).

Results:

We reviewed 20 patients who underwent surgery for organic TV disease between January 2005 and December 2009 at Cairo university Hospitals and other hospitals. The pre operative characteristics are shown in Table 1. Mean age was 33.2 ± 9.5 years (range: 16- 52 years). There were 8 (40 %) males and 12 (60 %) females. Almost (95 %) all patients were dypnea functional class III–IV according to NYHA classification, 13 patients were in class III while 6 patients were in class IV and only one patient was in class II. The mean of the pre operative ejection fraction (EF %) was 50.8 % ± 4.7 % (range: 42% - 59%). Five patients (25 %) were suffering from symptoms and signs of right sided heart failure (two of them had ascites). Their pathologies included rheumatic, endocarditis (three patients were acute while 2 patients were sub acute bacterial endocarditis) and tumor. All patients with a diagnosis of secondary (functional) tricuspid disease were excluded from the study.

Double tricuspid valve disease (stenosis & regurgitation) was most common, in 10 patients (50%), followed by regurgitation in 8 patients (40 %) and isolated stenosis in 2 patients (10 %). Regarding pre operative cardiac rhythm, sixty five percent of patients had atrial fibrillation while the rest of the patients were normal sinus rhythm.

Intra operative variables are shown in table (2). Concomitant procedures included mitral valve surgery in 9 cases (45 %), double valve surgery (aortic and mitral) in 5 cases (25 %) and resection of tumor in one case. Isolated tricuspid valve replacement with bioprosthetic valve was done in 5 patients (25%), four of them were suffering from endocarditis while the fifth patient had tumor destroying the tricuspid leaflets and protruding into the right atrium and right ventricle with extension to right ventricular out flow tract. This patient suffered cardiac arrest on induction of anesthesia. She was resuscitated and emergency sternotomy and cannulation were performed. Tricuspid valve replacement was done. Cardiopulmonary bypass mean time was 106.5 ± 17.9 minutes (range: 70 – 130 minutes), while aortic cross clamp mean time was 81.1 ± 19.2 minutes (range: 45 – 102 minutes).

Both morbidity and in-hospital mortality were shown in Table (3). Postoperative renal failure, duration of ventilatory support, and lengths of intensive care unit and hospital stays were also shown in table (3). The mean time needed for mechanical ventillation was 19.8 ± 22 hours (range: 5- 75 hours). All patients needed inotropic support and vasodilator drugs (tridil). Four patients needed reopening for exploration of bleeding , only one had a surgical cause which was secured while the others had medical cause due to coagulopathy and low INR pre operatively. Low cardiac output syndrome was present in 3 patients. Two patient suffered from sepsis (active endocarditis) and died from septic shock on the third and fourth post operative days. One patient had perioperative cerebro vascular event as the patient did not regain her consciousness post operatively after cardiac arrest on induction of anesthesia, also she suffered from acute renal failure which necessitated dialysis twice. The patient died after one week due to multi organ failure. Two patients suffered from complete heart block and required insertion of permanent pacemaker. The mean length of intensive care unit stay was 4.2 ± 1.4 days (range: 2 – 7 days). The mean hospital stay was 11.85 ± 5 days (range: 3 – 24 days). On discharge, there was either no or mild tricuspid regurgitation by echocardiography.

Mid-Term Outcome:

Seventeen patients were discharged after tricuspid valve replacement with bio prosthetic valve. Patients were followed up for a mean of 34.2 ± 6.2 months (range: 26 – 48 months) by clinical evaluation and echocardiography. Only two patients did not show up for follow up. Fifteen patients (88.2 %) had completed their follow up.

No mortality was reported during follow up period. Valve-related mortality was defined as any death due to structural and non structural valve dysfunction, major bleeding event, or valvular endocarditis requiring an operation. No reoperations were needed for the study group. Indications for reoperation were for structural valve deterioration (SVD) or valve endocarditis. Event-free survival was achieved in our follow up period. It was defined as the freedom from thromboembolism, valve thrombosis, structural valve dysfunction, major bleeding event, endocarditis, recurrent severe TR, TV reoperation, and death. .

The use of warfarin for anticoagulation was routine in all cases except for those who had isolated tricuspid valve replacement were only on aspirin. Recent echocardiographic follow-up showed that 86.7 % of patients (13 / 15) had trivial or mild TR while 13.3 % of patients (2 / 15) had moderate TR. At the follow up period NYHA functional class was evaluated, there were 6 patients in NYHA class I and 9 patients in NYHA class II.

	Percentage and mean ± S.D.
Age (yrs)	33.2 ± 9.5
Sex (m/f)	8/12
E.F. %	50.8 ± 4.7
Rt.Side Failure	5 (25 %)
P.H.	13 (65 %)
T.V. Pathology	
Rheumatic	14 (70 %)
Endocarditis	5 (25 %)
Tumor	1 (5 %)
T.V. Disease	
Stenosis	2 (10 %)
Regurgitation	8 (40 %)
Double lesion	10 (50 %)
Preoperative rhythm	
Sinus	7 (35 %)
A.F.	13 (65 %)

Table (1) : pre operative patient characteristics

S.D.: standard deviation, yrs: years, m: male, f: female, E.F.: ejection fraction, Rt.: right, P.H.: pulmonary hypertension, T.V.: tricuspid valve, A.F.: atrial fibrillation.

	Percentage and mean ± S.D.
Operative procedure:	
T.V. replacement only	5 (25 %)
M.V. surgery	9 (45 %)
Double valve surgery	5 (25 %)
Tumor resection	1 (5 %)
CPB (min)	106.5 ± 17.9
Cross clamp time (min)	81.1 ± 19.2

Table (2) : intra operative data

S.D.: standard deviation, T.V.: tricuspid valve, M.V.: mitral valve, CPB: cardiopulmonary bypass, min: minutes.

	Percentage and mean ± S.D.
Mechanical ventilation (hrs)	19.8 ± 22
Re exploration for bleeding	4 (20 %)
LCO	3 (15%)
Renal failure	1 (5 %)
ICU stay (d)	4.2 ± 1.4
Hospital stay (d)	11.85 ± 5
Permenant pace maker	2 (10 %)
Mortality	3 (15 %)

Table (3) : post operative results

S.D.: standard deviation, hrs: hours, LCO: low cardiac output, ICU: intensive care unit, d: days

Discussion:

Organic TV disease is valvular dysfunction due to a primary structural pathology of the tricuspid valve, and not secondary to other valvular or cardiac disease. It is an uncommon valvular disease and hence there is limited experience for optimal surgical technique [5]. Repair is preferred initially in tricuspid valve pathologies. However, TVR may be performed in severe functional and organic tricuspid valve diseases in which repair are neither possible nor satisfactory [3]. The prevalence of TVR in the series by Ratnatunga [3], Spampinato [6], and McGrath [7] and their colleagues was 1.9%, 1.8%, and 1.7%, respectively. According to McGrath and colleagues [7], tricuspid valve operations constitute 5.7% of all valvular interventions. Sixty-seven percent of tricuspid operations are valve repairs and the remaining 33% are valve replacements.

Although a relatively simple technical operation, especially when performed as an isolated procedure, tricuspid valve replacement remains associated with significant operative mortality and suboptimal long-term survival. In our series of tricuspid valve replacements, early post operative mortality was 15 % which was compared to others 13% operative mortality with survival at 1, 5, and 10 years of 82%, 76% and 50%, respectively [8]. These results are consistent with the largest series of tricuspid valve replacements from the United Kingdom Heart Valve Registry, where 425 patients operated on between 1986 and 1997, that reported survival rates at 1, 5, and 10 years of 72%, 60%, and 43%, respectively [3]. Operative mortality for biological and mechanical prostheses in the UK series was 19% and 16%, respectively, compared with 15% in our study. Kaplan and colleagues showed an early mortality rate of 24.5% [9].

Tricuspid valve repair techniques may be either suture-based (De Vega, segmental annuloplasty) or using an annuloplasty ring or band. They are usually used in cases of secondary (functional) TR. Such repair techniques usually do not add significantly to the operative time and can be performed with low rates of morbidity and mortality. Tricuspid valve repair is associated with improved long-term survival and event-free survival in patients with functional TR [10]. However, their long-term durability is debatable (as guitar string sign) [10, 11]. Tricuspid valve replacement operations are associated with longer operative times and higher in-hospital mortality rates [3, 12, 13]. Residual TR is not as frequent as in patients undergoing TV repair [3, 13]. A study from the Cleveland Clinic examined 401 patients with TV disease and followed them for 10 years with echocardiography [15]. They showed that early survival was worse in those that had TV replacement versus repair. Late echocardiographic TV failure (moderate to severe TR) was associated with use of a TV repair annuloplasty strategy, similar to Singh and associates results [14].

Kawachi and associates [15] found that double or triple valve replacement cases (including TVR) had high operative mortality and long-term results were unfavorable. A high mortality rate with TVR within first 30 days indicates that patients with tricuspid valve replacement are generally surgical candidates with a poor prognosis [3, 16].

Many attempts were made to identify the best prostheses (mechanical or biologic) in the tricuspid position. There was a higher incidence of thrombosis with the mechanical valve, despite anticoagulation therapy. Many factors potentially contributed to thrombosis of tricuspid prostheses include low velocity of blood across the tricuspid valve and lower levels of prostacyclin (PGI2), a potent platelet aggregate inhibitor produced by the lungs, within venous blood [17]. Other group of surgeons has preferred the mechanical valve as most of their patients were relatively young s and the risks for reoperation being the highest for any valve [18]. Valve selection for the

tricuspid position is still debatable. Because of the low pressure (venous pressure), many surgeons prefer a bioprosthesis in the tricuspid position. Van Nooten and coworkers [19] suggest that large sized bioprostheses are preferable if a bioprosthesis is to be used. Low pressure and low stress in the right heart provide higher longivity for the bioprosthesis.

Mechanical prostheses have main disadvantages, such as the need for anticoagulation, risk of hemorrhage, risk of thromboembolism. On the other hand, the new bileaflet mechanical valves have good hemodynamic properties, low gradient, decreased turbulence, and optimal durability [3, 19]. Bioprostheses at the tricuspid position have a lower degeneration rate than those located in systemic circulation. However, long-term durability of tissue valves is limited due to fibrocalcification and degeneration [6]. The average time until bioprosthetic valve failure is reported at 7 years by Rizzoli and colleagues [16] and at 10 years by Del Campo and associates [20]. Bioprosthesis may be prefered for the some benifits. They do not require anticoagulation, they degenerate more slowly at the tricuspid position than at either the aortic or mitral position, their short-term durability is favorable, and the early reoperation rate is low which complies with our results as freedom from reoperation was for a mean follow up of 34.2 ± 6.26 months. The possible existence of contraindications to anticoagulation use, likelihood of pregnancy, older patients whose life expectancy is compatible with valve durability, socioeconomic status, lifestyle, inability to use drugs without help, limited access to healthcare facilities are reasons to use a bioprosthetic valve. Patients with drug addiction and with a history of endocarditis should also have a bioprosthesis implanted [4, 6, 20].

In a large series of cases whom underwent tricuspid valve replacements (35 bioprosthetic and 103 mechanical), during a 25-year period, freedom from reoperation at 15 years was 66 % ± 19.4 % (bioprosthestic, 55.1 % ± 13.8 %; mechanical, 86.0 % ± 6.2 %), and there were 10 cases of valve thrombosis in the mechanical group [18]. A meta-analysis of 1,160 tricuspid valve replacements (646 bioprosthetic compared to 514 mechanical) showed no difference in incidence of reoperation and only slight differences in survival at 1, 5 and 10 years [15]. Homografts are also recommended in the literature. Katsumata and coworkers [21] recommend homografts in patients with endocarditis. Mechanical prostheses should be preferred in young patients and in patients with mechanical prosthesis on the left heart [22]. Chang and co workers showed freedom from reoperation using the mechanical prostheses 16 years after the initial operation (86 %). Although there was no statistical difference, the incidence of reoperation was somewhat higher in the bioprosthetic valve group (2.68%/patient-year) than in the mechanical valve group (1.25%/patient-year) [2].

Conclusion:

Organic tricuspid valve disease is uncommon, optimal surgical intervention is a very ambitious goal. Tricuspid valve replacement with bioprosthetic valve should be a ready alternative to intra operative unsatisfactory outcome of tricuspid valve repair without hesitation. Early and mid term results showed safe usage of bioprosthesis.

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Cardiac Myxoma: Retrospective Analysis of 8-years Experience of Surgical Management

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Objectives: **This retrospective study aimed to collect, analyze and present cases with cardiac myxoma (CM) managed through 8 years duration.**

Patients & Methods: **Data extracted included age at time of presentation, gender, the dominant symptom, time from symptom onset to diagnosis and family history of cardiac tumors. Preoperative data included trans-thoracic echocardiographic (TTE) assessment and functional grading according to New York Heart Association (NYHA). Operative data included tumor localization and requirement for additional procedures. Postoperative (PO) data included morbidities, mortalities and recurrence.**

Results: **The study included 31 patients; 9 males and 22 females with mean age 52.9±13.9 years. Nine cases presented as acute cases and 22 cases had varied duration since diagnosis to present. Heart failure was the prominent presenting symptom; fatigability and general weakness, cough and other manifestations were also reported. Duration elapsed since diagnosis till operative interference for chronically presented cases 11.6±5.4; range: 5-24 months. One case had bi-atrial myxoma and 4 cases had valvular involvement, while the remaining cases had single-chamber myxoma with left atrium (LA) being the commonest location ~70% of cases. Five patients had additional procedures; 3 patients had CABG and 2 had mitral valve repair. All cases passed uneventful intraoperative course and only one case died during the immediate PO course. Development of new AF was the most frequent PO complication; however it was successfully controlled medically. Mean LA diameter was significantly decreased on PO TTE with significant improvement of functional status. Throughout the follow-up period, 4 died; one because of cardiac cause, two developed unrelated cancer and the 4th had acute renal failure for a total mortality rate of 16.1%. No myxoma recurrence was reported.**

Conclusion: **CM surgery is feasible and safe with significant improvement of echocardiographic data and functional outcome and minimal cardiac and non-cardiac morbidity apart from AF which was medically controllable. Two cases had cardiac-related and another 2 had non-cardiac mortality, but no recurrence was reported.**

KEYWORDS: **Cardiac myxoma, Surgical excision, Postoperative outcome, Recurrence**

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Codex : o3/10/1301

Tumors of the heart and the great vessels are very rare disease, and there are many disorders such as metastatic tumors and tumor-like lesions which do not fit into the usual concept of tumor or neoplasm; thus, it is very difficult to classify these tumors. Metastatic tumors are more frequent than tumors originated from the heart and great vessels; however, cardiac myxoma is the most frequent tumors in all cardiac tumors [1, 2].

Primary tumors of the heart are rare with an incidence varies between 0.0017 and 0.19% in unselected autopsy studies. Three quarters of primary heart tumors are benign and half of them are atrial myxomas. Other benign tumors are lipoma, papillary fibroelastoma, rhabdomyoma and fibroma [3, 4].

Myxomas are mesenchymal tumors, which can occur at any age, however, they mainly exist between the 30th and 60th year of life. This disease is approximately two to three times more prevalent in women than in men. About 75% of the myxomas are located in the left atrium, 20% in the right atrium and 5% in one of the ventricles. Multiple tumors in different ventricles have been described in a few patients. Myxomas are typically sporadic and isolated, only in around 5% of all cases this disease occurs as a familial disease. This group of patients are younger, frequently have multifocal tumors, but, there is no gender preference [5, 6, 7].

Most of the myxomas are pedunculated (seldom broad based) and are often located in the area of fossa ovalis, but they can also occur anywhere in the atrial wall, the vena cava or rarely at the heart valves. The tumor's mobility depends mostly on the length of the tumor stem. The clinical picture is determined by localization, dimension, condition and tumor mobility. Characteristically, the period until the diagnosis is made is highly variable, because the time free of symptoms can be quite long. Usually a local complication leads to symptoms and this requires further diagnostic tests. Most common complications are embolism, intra cardiac obstruction and obstruction of the ventricular outflow tract. Another common complication is the so called 'myxoma disease' with fever, arthralgies, polymyositis, weight loss and hypergammaglobulinaemia [8-10].

The current retrospective study aimed to collect, analyze and present cases with cardiac myxoma (CM) managed at a locality hospital throughout more than 10 years duration.

Patients & Methods

The current retrospective study was conducted at Cardiac Surgery Departments, King Fahad Medical City, Riyadh and North West Armed Forces Hospital, Tabuk , KSA and was based as a case-detection study aimed for collection of all cases of CM operated upon at the hospital since Jan 2005 till Jan 2013. Files of all CM cases managed at the hospital were enrolled in the study even if missed during follow-up.

Preoperative data

Preoperative assessment data included age at time of presentation, gender, the dominant symptom, time from symptom onset to diagnosis, functional status, and family history of cardiac tumors. Preoperative trans-thoracic echocardiographic (TTE) assessment of heart chambers' dimensions, left ventricular ejection fraction (LVEF) and valvular function was conducted. Pre-operative coronary angiography was performed in all patients older than 40 and in younger patients with suspected coronary disease (symptoms, ECG changes, regional wall motion abnormalities on TTE) or with coronary artery disease risk factors).

Operative data:

After the final diagnosis was made, all patients were operated on through median sternotomy with aortic and bicaval cannulation. Cold (4°C) cardioplegic solution prepared according to St Thomas formula was used to achieve moderate hypothermia (32°C), aorta cross-clamped and cardiopulmonary bypass initiated. In all cases, the myxoma was removed with adequate tissue margin, also when it was attached to valvular leaflets. In patients with anterior mitral leaflet and septal tricuspid leaflet involvement, the site of the removed stalk was covered with a small patch of autologous pericardium. After tumor excision, all cardiac chambers were inspected for fragments or additional foci of myxoma. Significant coronary artery stenoses were revascularised according to standard procedure, suturing the graft distally first with subsequent anatomizing to partially clamped aorta during the reperfusion period. Intra-operative localization of the tumor and the frequency of intra-operative events or additional procedures were reported.

Surgical and Functional outcome

During the early post-operative period short-term outcome was defined as the frequency of perioperative events including morbidities and its management and/or mortalities. Long-term outcome throughout the follow-up period included development of additional morbidities, recurrence at the same location, development of new lesions at other sites, and functional status assessment according to NYHA classification (Table 1) [11] and TTE was also performed.

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

Table 1. ***The New York Heart Association (NYHA) Functional Classification in a Patient with Heart Disease*** [11]

Statistical analysis

Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon; ranked test for unrelated data (Z-test) and Chi-square test

(X^2 test). Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

Results

The study included 31 patients; 9 males and 22 females with mean age 52.9±13.9; range: 27-69 years. Sixteen patients were obese, 6 patients were of overweight and 6 patients were morbid obese, while only 3 patients were of average weight, details of patients' enrolment data are shown in table 2.

Nine patients (29%) presented with acute manifestations; 6 had an attack of syncope and 3 had acute chest pain; CM in these nine patients was diagnosed during investigation for the underlying pathology for such acute presentation. The presenting symptoms of the remaining 22 patients were variable and in varied combinations; the prominent symptom was dyspnoea and heart failure in 9 patients, cough in 7 patients, 10 patients had general weakness with easily fatigability and 3 patients had history of an attack of neurologic stroke. Thirteen of chronically presented cases had operative interference within the range of 6-12 months after diagnosis; 4 cases were operated upon in range of 12-15 months after diagnosis; 3 patients had operated upon after more than 15 months of diagnosis and only two patients had operative interference within 4-5 months after diagnosis. Collectively mean duration elapsed since diagnosis till operative interference for the chronically presented cases was 11.6±5.4; range: 5-24 months, (Table 3).

Twenty-two patients had left atrial myxoma of which 21 lesions had intra-atrial septal myxoma and one patient had free left atrial wall myxoma. Three patients had right atrial myxoma of which 2 patients had intra-atrial septal myxoma and one patient had free right atrial wall myxoma. Two patients had left ventricular wall myxoma and one patient had right ventricular wall myxoma. One patient had two lesions one in left and the other in right atrium. Two patients had mitral anterior leaflet myxoma. Five patients had additional procedures; 3 patients had coronary artery bypass grafting (CABG) and 2 had mitral valve repair, (Table 4, Fig. 1 & 2).

Data				Findings	
Age (years)	Strata	≤30		3 (9.6%)	28±1 (27-29)
		>30-40		4 (12.9%)	35.8±2.2 (32-39)
		>40-50		6 (19.4%)	46±2.8 (43-49)
		>50-60		7 (22.6%)	57±2.2(54-59)
		>60		11 (35.5%)	67±1.9 (63-69)
	Total			31 (100%)	52.9±13.9 (27-69)
Gender	Males			9 (29%)	
	Females			22 (71%)	
Body mass data	Weight (kg)			38.3±1 (37-39)	
	Height (cm)			38.3±1 (37-39)	
	BMI (kg/m^2)	Strata	<25	3 (9.7%)	24.5±0.2 (24.4-24.7)
			25-30	6 (19.4%)	28.7±0.7 (28-29.7)
			>30-35	16 (51.5%)	33.7±1.1 (31.5-34.9)
			>35	6 (19.4%)	35.6±0.4 (35.3-36.4)
		Total		31 (100%)	32±3.6 (24.4-36.5)

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

Table 2. Patients' enrollment data

Data			Findings	
Presentation	Acute	Syncope	6 (19.4%)	
		Acute chest pain	3 (9.6%)	
		Total	9 (29%)	
	Chronic	Dyspnoea & HF	9 (29%)	
		Cough	7 (22.6%)	
		General weakness	10 (32.3%)	
		Previous stroke	3 (9.7%)	
		Total	22 (71%)	
Time lapsed since diagnosis till interference of chronic cases	Strata	<6	2 (6.5%)	4.5±0.7 (4-5)
		6-12	13 (41.9%)	8.8±1.5 (7-12)
		>12-15	4 (12.9%)	14.5±1.3 (13-16)
		>15	3 (9.7%)	22.7±1.5 (21-24)
	Total		22 (71%)	11.5±5.4 (4-24)

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

Table 3. Patients' presentation data and timing of surgical interference

Data			Findings
Intraoperative lesion localization	Left atrium	Intra-atrial septum	21 (67.7%)
		Free atrial wall	1 (3.2%)
	Right atrium	Intra-atrial septum	2 (6.5%)
		Free atrial wall	1 (3.2%)
	Both atria	Intra-atrial septum	1 (3.2%)
	Left ventricle		2 (6.5%)
	Right ventricle		1 (3.2%)
	Heart valves	Mitral	2 (6.5%)
		Aortic	0
		Tricuspid	0
Additional procedures	CABG		3 (9.6%)
	Mitral valve repair		2 (6.5%)

Data are presented as numbers; percentages are in parenthesis

Table 4. Operative findings

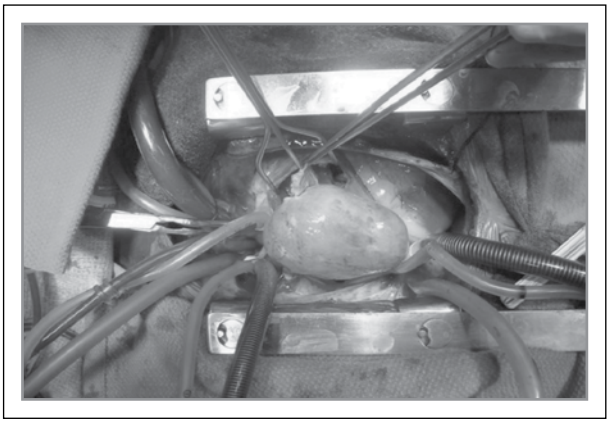

Fig 1. Shows intraoperative photo of large left atrial myxoma

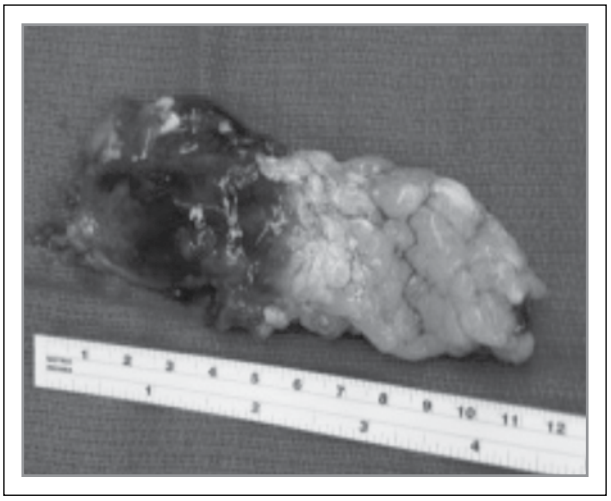

Fig 2. Shows postoperative photo of excised large left atrial myxoma

One patient had simultaneously myxoma excision and CABG, but unfortunately developed acute circulatory failure caused by perioperative myocardial infarction and died immediately postoperative; for immediate postoperative (PO) mortality rate of 3.2%. In the early PO period; 19 patients (63.3%) developed new AF after the operation and were successfully treated pharmacologically using potassium and magnesium supplementation and intravenous amiodarone. One patient (3.3%) developed non-fatal stroke which prolonged his ICU stay till 6 days; for an early PO cardiac morbidity rate of 66.7%, (Table 5).

Among the 30 survivors; two patients (6.7%) required prolonged chest drainage for 13 and 14 days, respectively for a mean total duration of chest drainage of 7.5±1.9; range: 5-14 days, (Table 5). Two patients (6.7%) developed superficial sternum infection and were successfully responded to conservative treatment; for an early PO non-cardiac morbidity rate of 13.3%, (Table 5).

Mean PO hospital stay was 13.9±1.3; range: 12-16 days; 13 patients had mean PO hospital stay of <14 days, while 17 patients had mean PO hospital stay of ≥14 days (Table 6).

		Data		Findings
Immediate PO	Mortality			1 (3.2%)
	Morbidity	Cardiac	AF	19 (63.3%)
			Stroke	1 (3.3%)
		Non-cardiac	Extended chest drainage duration	2 (6.7%)
			Sternum infection	2 (6.7%)
		No morbidities		6 (20%)
Late PO course	Lost			2 (6.7%)
	Mortality	Acute coronary syndrome		1 (3.3%)
		Acute renal failure		1 (3.3%)
		Metastasizing cancer breast		1 (3.3%)
		Cancer bladder		1 (3.3%)
		Total		4 (13.3%)
	Uneventful			24 (80%)

Data are presented as numbers; percentages are in parenthesis

Table 5. Patients' postoperative data

During follow-up, two patients were missed and among the remaining 28 patients, 4 patients died for a late PO mortality rate of 14.3%; cause of death was acute coronary syndrome occurred at 3-months after surgery, acute renal failure occurred at 14 months after surgery; the 3rd patient was female and developed cancer breast four years after CM surgery and had Patty's operation with axillary evacuation and PO radiotherapy, but unfortunately developed brain metastasis and died one-year after mastectomy. The 4th patient developed cancer bladder five years after CM surgery and had cystectomy and bladder reconstruction and died three years later, (Table 5). Mean duration of follow-up was 58.1±21.9; range: 3-96 months, (Table 6).

Data		Findings	
Duration of PO chest drainage	≤7 days	19 (63.3%)	6.5±0.6 (5-7)
	>7 days	11 (36.7%)	9.4±2.1 (8-14)
	Total	30 (100%)	7.5±1.9 (5-14)
Duration of PO hospital stay	<14 days	13 (43.3%)	12.7±0.5 (12-13)
	>14 days	17 (56.7%)	14.8±0.8 (14-16)
	Total	30 (100%)	13.9±1.3 (12-14)
Duration of PO follow-up	<24 months	2 (6.7%)	8.5±7.8 (3-14)
	24-48 months	6 (20%)	38.2±13.6 (30-45)
	>48 months	22 (73.3%)	69.1±12.5 (50-96)
	Total	30 (56.7%)	58.1±21.9 (3-96)

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

Table 6. Duration of postoperative chest drainage, hospital stay and follow-up

Findings	Before (n=30)	After (n=30)	P
Aortic annulus diameter (mm)	32.7±3	32.5±2.8	Z=1.342, p>0.05
Left ventricular end-diastolic diameter (mm)	44.9±2.9	42.9±6.1	Z=1.550, p>0.05
Left ventricular end-systolic diameter (mm)	29.7±3.4	28.9±4	Z=0.954, p>0.05
Left atrium (mm)	38.8±3.3	32.6±4.3	Z=3.862, p<0.05
Right ventricle in diastole (mm)	27.2±4.2	27.5±4.5	Z=0.862, p>0.05
Inter-ventricular septum (mm)	11±7	11.4±1.3	Z=1.269, p>0.05
left ventricular posterior wall diameter (mm)	10.6±1.4	11.2±1.6	Z=1.227, p>0.05
left ventricular ejection fraction (mm)	60.4±6.2	61±6.7	Z=1.032, p>0.05

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

Table 7. TTE findings of studied patients

NYHA class	Before (n=30)	After (n=30)	P
I	7 (23.3%)	18 (60%)	X^2=14.141; p<0.001
II	9 (30%)	8 (23.3%)	
III	11 (36.7%)	5 (16.7%)	
IV	3 (10%)	0	

Data are presented as numbers; percentages are in parenthesis

Table 8. Patients' distribution among NYHA functional classes as recorded before and after surgery

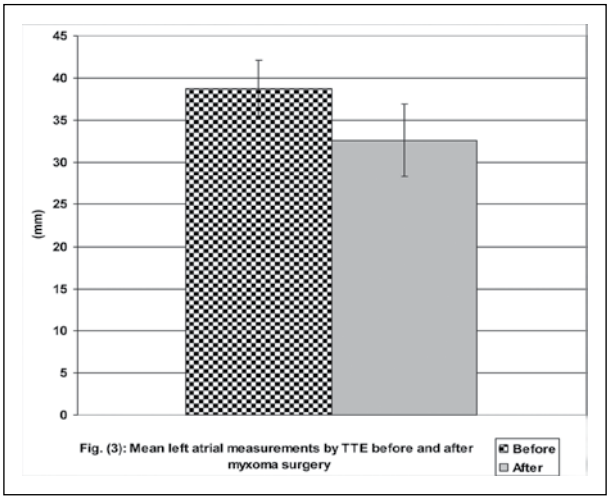

Fig. (3): Mean left atrial measurements by TTE before and after myxoma surgery

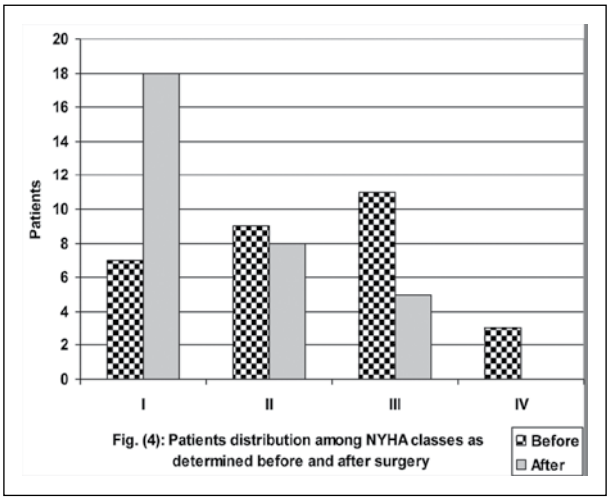

Fig. (4): Patients distribution among NYHA classes as determined before and after surgery

All echocardiographic data obtained at the end of follow-up of studied patients showed non-significant ($p>0.05$) difference compared to data obtained before surgery except left atrial diameter which was significantly decreased ($p<0.05$) after surgery compared to before surgery, (Table 7, Fig. 3). All patients showed significant ($p<0.05$) PO functional improvement as judged by their distribution among NYHA classes compared to distribution reported before surgery, (Table 8, Fig. 4).

Discussion

Cardiac myxoma despite being rare, are the most common type of heart tumor in adults [12], this less frequent incidence imposed its effect on clinical trials and so the current study was constructed as a retrospective study for evaluation of outcome of management of these cases in a locality hospital. Throughout a duration of 13 years, 31 cases were managed at the hospital; mean age was about 53 years, the majority were females about 70%, 9 cases presented as acute cases and 22 cases had varied duration since diagnosis to present and prepared for surgery and the presenting picture was mosaic with heart failure being the prominent presenting symptom, despite fatigability and general weakness, cough and other manifestations were reported.

In hand with these data; **Bordalo et al.** [13] retrospectively studied 40 cardiac myxoma patients through 7-year duration and found that mean age was 64, the overall F/M ratio was 1.9:1, asymptomatic tumors occurred in 48% of the total population, 23% of patients showed constitutional symptoms, 35% had hemodynamic/obstructive symptoms, and 15% presented with embolic events. **Porapakkham et al.** [14] studied 45 cardiac myxoma cases operated upon during 16-year period and found that mean age was 52 years, 76% were female, dyspnoea was the most common symptom 78%, followed by heart failure 38%, and stroke 18% and constitutional symptoms of weight loss, fatigue, and fever were found in 33%, 13%, and 11%, respectively and concluded that myxoma is a rare disease with a variety of clinical presentation. **Barreiro et al.** [15] retrospectively studied 78 cases with cardiac neoplasms and reported that the average age at diagnosis was 61 years, and tumors were twice as frequent among women, diagnosis was an incidental finding in one quarter of patients and in symptomatic patients, the typical presentation was of cardioembolic stroke or of congestive symptoms. **Zheng et al.** [16] retrospectively studied 66 patients with cardiac myxoma and reported that 61 cases had involvement of the left atrium, one case in both the right ventricular and left atria and the female: male ratio was 2.7:1.

The mosaic clinical presentation of cardiac myxoma patients, rarity of the tumor, the bad reputation of cancer as a leading cause for death and the association between cardiac surgery and tumor excision with the possibility of death may be the cause for late presentation of some cases; in support of this assumption the current study reported three cases had previous neurologic stroke and the most prominent presenting symptom was heart failure and about 20% of case presented later than 12 month after diagnosis.

In line with this assumption; **Smith et al.** [17] documented that atrial myxomas are the most common benign tumors of the heart and may present with a wide variety of symptoms, although 45% of patients present with neurological symptoms, a diverse range of systemic symptoms also occur. **Pérez Andreu et al.** [18] also reported that cardiac myxomas frequently present with neurological symptoms, especially ischemic events as either established stroke or transient ischemic attack, in younger patients with no cardiovascular risk factors.

The current study detected one case had bi-atrial myxoma and 4 cases had valvular involvement, while the remaining cases had single-chamber myxoma with left atrium being the commonest location ~70% of cases. Moreover, 5 patients had additional procedures; 3 patients had CABG and two had mitral valve repair. These data go in hand with **Barreiro et al.** [15] who reported in their retrospective study of 78 patients of cardiac neoplasms that myxoma (93.5%) was the most common diagnosis and typically affecting the left atrium (74.2%). **Choi et al.** [19] presented a rare case of giant bi-atrial myxoma nearly obstructing the orifice of the inferior vena cava in a 58-year old woman presented with exertional dyspnoea and intermittent chest discomfort.

All cases passed uneventful intraoperative course and only one case died during the immediate PO course. Development of new AF was the most prominent and frequent PO complication; however it was successfully controlled medically. Throughout the follow-up period, 2 cases were missed and 4 died; one because of cardiac cause, two developed unrelated cancer and the 4th had acute renal failure for a total mortality rate of 16.1%. No myxoma recurrence was reported throughout follow-up period; a finding indicating that competence of excision obviates the possibility for recurrence of myxoma which showed low liability for recurrence.

In support of this assumption; **Schurr et al.** [20] reported an overall survival rate was 91% at 40 years of follow-up. **Porapakkham et al.** [14] reported 10- and 15-year survival of 97% and a recurrence was found in one patient with multiple site tumors at eight-year follow-up and concluded that surgical resection provides excellent operative and long-term survival, but despite a very insignificant chance of recurrence, long-term follow-up is still necessary. **Barreiro et al.** [15] reported that surgical resection was curative for 95% of myxoma patients. **Carvalho et al.** [21] documented that recurrence of cardiac myxoma is a rare condition and was observed in about 3% of patients in sporadic cases, although it is more frequent in familial ones.

The obtained results and review of literature indicated the feasibility and safety of cardiac myxoma surgery with significant improvement of echocardiographic data and functional outcome and minimal cardiac and non-cardiac morbidity apart from AF

which was medically controllable. Also, the reported mortality rate was acceptable for such cases and only 2 cases had cardiac-related mortality. Throughout the study period, no recurrence of myxoma was reported in cases completed their follow-up visits.

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Does Downsizing Mitral Valve Annuloplasty Produced Better Results In Moderate Ischemic Mitral Regurge ?

Tarek Nosseir, MD

Introduction: **Ischemic heart disease may be complicated by mitral regurgitation (MR). Mitral valve (MV) insufficiency may occur acutely following acute myocardial infarction. It may also develop chronically in patients following post-myocardial infarction LV remodeling. Ischemic mitral regurgitation (IMR) is associated with increased mortality. Ischemic MR reduces survival even after coronary artery bypass grafting (CABG). Several studies have shown increased perioperative mortality for mitral valve repair (MVR) in this situation, but the subject remains controversial.**

Methodology: **Sixty patients had myocardial revascularization, half of them received restrictive annuloplasty and revascularization. The aim of this study was to find out if ring annuloplasty and revascularization reduces MR better than revascularization alone in moderate IMR by reporting mid-term findings.**

Conclusion: **The efficacy of adding mitral valve repair to coronary artery bypass grafting is well demonstrated by the decrease of mitral regurgitation grade, regurgitant volume, effective regurgitant orifice area and increase of coaptation length.**

KEY WORDS: **Mitral repair- Carpentier Edward ring- Coronary artery bypass grafting**

Patients with ischemic MR have higher incidence of cardiovascular mortality (29% vs. 12%) and heart failure (24% vs. 16%) than patients without ischemic MR at a mean of 3.5 years after MI [1]. The presence of ischemic MR was found to be a strong predictor of cardiac events independently of left ventricular systolic function [2]. The possible therapeutic approaches are: MV replacement with coronary artery revascularization, MV repair with revascularization, or revascularization alone. Significant reduction in MR can be expected in only about 10% of patients after revascularization alone [3], whereas MV repair or replacement can eliminate or decrease regurgitation in most cases. Although Shuhaiber and Anderson stated that MV repair or replacement did not reveal any significant differences in total survival, but MV repair is associated with lower 30-day mortality due to lower rates of thromboembolism, infections and risk of future reoperation [4].

Patients with functional ischemic mitral regurgitation undergoing elective CABG may benefit from additional mitral valve annuloplasty, according to results from the Randomized Ischemic Mitral Evaluation RIME trial. The study found that the combination of procedures, compared to CABG alone, improved functional capacity, left ventricular reverse remodeling, and mitral regurgitation and brain natruretic peptide BNP levels at one year follow up [5].

The standard surgical repair is undersized annuloplasty, resulting in a decrease in mitral annulus diameter and, thus, in an increase of leaflet coaptation [6]. However, it is reported that, despite adequate patient selection up to 7-30% of patients after mitral annuloplasty exhibit recurrent MR [7, 8].

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Patient and methods

We performed a study of 60 patients having Ischemic heart disease and moderate IMR (grade II and III). Group (A) undergoing CABG+ Mitral valve repair MVR (n=30) receiving Carpentier Edward ring and Group (B) CABG only (n=30) at Cairo University Hospitals between November 2009 and August 2012. Cases with mitral insufficiency due to other pathologies rather than ischemic MR were excluded.

Echocardiographic study

All patients underwent transthoracic echocardiographic evaluation prior to cardiac surgery, one week after the operation, and 6 to 19 months thereafter (median follow up was 12 months). During the cardiac surgery, transesophageal echocardiography was performed to assess the results of the annuloplasty. The mechanism of MR was categorized according to the Carpentier classification. Only patients with type I or IIIb were included in the study.

The severity of MR was evaluated in all patients on basis of effective regurgitant orifice area (ERO). Mitral regurge was graded from 0 to 4 following American Society of Echocardiography criteria.

Surgical procedure

Myocardial revascularization was performed in all patients with a mean of 1.9 ± 1.1 SD grafts per patient. In group A inspection of the mitral leaflets, annulus, chordae tendineae, and papillary muscles was performed during surgery. Ischemic MR was repaired by undersized ring annuloplasty. Carpentier-Edwards classic ring implantation was performed in all patients of group(A). The ring size varied from 28 to 32. In 18 patients, the ring size did not exceed 28.

Statistical analysis

The results are presented as mean (standard deviation), medium (range), distribution frequency or percentage. Logistic regression was used for univariate analysis of continuous variables. P< 0.05 was considered significant.

Results

In group (A) one death was recorded at day 17 due to respiratory failure and this may be attributed to pre operative chest condition (COPD). Group B was mortality – free.

For almost all the preoperative variables (Table 1), there were no statistically significant differences, except for the proportion of patients in NYHA class III/IV, with more patients in this class in the CABG+MVR group than in the CABG-only group (68.7% vs. 30.8%, p=0.012).

Variable	Group A	Group B	Significance level p
	n (%)	n (%)	
Age >60 years	10 (33.3)	9 (30)	NS
Male gender	17 (56.7)	16 (53.3)	NS
Obesity	2 (6.7)	3 (10)	NS
Hypertension	28 (93.3)	26 (86.7)	NS
Diabetes	8 (26.7)	12 (40)	NS
Smoking	12 (40)	10 (33.3)	NS
COPD	3 (10)	1 (3.3)	NS
Renal disease	2 (6.7)	1 (3.3)	NS
MI <30 days	15 (50)	14 (46.7)	NS
EuroSCORE ≥6	17 (56.7)	15 (50)	NS
NYHA class			0.012
I/II	10 (33.3)	21 (70)	
III/IV	20 (66.7)	9 (30)	

Table 1. Pre operative Characteristics of patients undergoing coronary artery bypass grafting with and without mitral valve repair

Post operative follow up ;

In Group A, the MR grade fell significantly following surgery (p<0.001). It was 3.46 ±0.5 in group B, whereas it was 0.98 ±1.39 in group A.

In group A Significant regurgitation (grade 3 and 4) recurred only in seven cases (23.3%): severe in 3 (10%) of them and moderate in the remaining 4 (13.3%).

Furthermore, the coaptation length, which is one of the predictors of successful MV repair, was significantly greater in Group A (0.72 ±0.2 cm vs. 0.21 ±0.09 cm, p < 0.001). Though, mitral annuloplasty did not influence coaptation depth (0.62 ±0.23 cm vs. 0.63 ±0.22 cm . In group B, the ERO was 0.44 ±0.16 cm2 and it was significantly lower in Group A 0.28 ±0.15 cm2 (p < 0.001).

Regurgitant volume was 57 ±25 ml in group B in comparison to 38 ±21 ml in group A (p < 0.001).Table II

Variable	Group A	Group B	Significance level p
MR grade	0.98±1.39	3.46±0.5	P0.001<
Coaptation length(cm)	0.72±0.2	0.21±0.09	P0.001<
Coaptation depth(cm)	0.62±0.23	0.63±0.22	NS
ERO(cm^2)	0.28±0.15	0.44±16	P0.001<
Regurgitnt volume(ml)	38±21	57±25	P0.001<

In this study, no significant changes were found in ejection fraction (42.6% ± 15%) versus (40.4% ± 10%) p=0.25.

Table 2 . Post operative Mitral regurge parameters in both groups (mid-term results)

Neither systolic nor diastolic dimensions showed any significant changes postoperatively. (Table II)

Variable	Group A	Group B	Significance level p
LV EDd (cm)	61.5 ±7.0	62.4 ±8.5	NS
LV ESd (cm)	46.5 ±8.6	46.7 ±9.5	NS
LV EDV (ml)	150.6 ±47.5	145.2 ±49.6	NS
LV ESV (ml)	92.2 ±41.8	93.6 ±43.8	NS
LV EDVI (ml/m^2)	80.4 ±23.8	77.4 ±24.6	NS
LV ESVI (ml/m^2)	49.3 ±23.8	50.0 ±22.7	NS
LVEF (%)	40.4 ±10	42.6 ±15	NS

Table 3. Postoperative echocardiographic assessment of cardiac chambers

Follow up echocardiographic studies showed that 23.3% of patients developed recurrent MR in group A. The univariate analysis showed that number of factors have an influence on the recurrence of MR in follow up period as presented in Table IV.

Variable	OR	95% CI	Significance level p
Length of coaptation	0.0022	0.0001-0.092	0.001
Coaptation depth	1.7	0.2-13.7	NS
EROA	1.85	1.26-2.72	0.002
vena cotracta of MR	1.42	1.1-1.85	0.007
Degree of MR	4.7	1.5-14.3	0.006
LV EDd	1.0	0.93-1.07	NS
LV ESd	0.98	0.93-1.07	NS
LVEF	0.98	0.94-1.03	NS
Lad	1.01	0.93-1.09	NS

The echocardiographic parameters dominate over the clinical risk factors as regard influence on recurrent MR. Table V

Table 4. Risk factors of mitral regurgitation recurrence detected by echocadiography – univariate analysis

Variable	OR	95% CI	Significance level p
Age	0.94	0.87-1.01	NS
Sex	1.01	0.33-3.0	NS
EuroSCORE	1.03	0.84-1.25	NS
MR by Carpentier classification	1.01	0.37-2.7	NS
Ring size	0.94	0.66-1.35	NS
IABP	2.1	0.62-7.01	NS
Prior MI	0.63	0.19-2.07	NS

The strongest risk factors were the coaptation length measured after mitral ring implantation (OR 0.0022; p = 0.001), followed by ERO (OR was 1.85; p < 0.002) and vena contracta (OR 1.42; p = 0.007). None of the clinical factors had a significant relation with the recurrence of MR in the follow up.

Table 5. Univariate analysis of clinical risk factors of recurrent mitral regurigtation

Discussion

The prevalence of moderate-to-severe IMR detected by transthoracic echocardiography and/or cardiac catheterization in myocardial infarction patients with coronary artery disease ranges from 3% to 12%. MV Repair is still a reasonable surgical option in many patients with IMR, mainly because of its reliability and reproducibility [9].

Bolling et al introduced the practice of overcorrecting by implanting symmetrical mitral ring one to two sizes smaller than indicated by the intertrigonal distance leading to significant improvement in short term results[10]. The rate of recurrent MR in the studied patients was relatively low (23.3%). The literature reports that severe MR may occur in up to 30% of patients after mitral annuloplasty [8]. Intraoperative assessment of surgical result plays an important role. Transesophageal echocardiography routinely performed during the operation can adequately distinguish between successful and unsuccessful annuloplasty. The rate of unsuccessful mitral annuloplasty is reported as approximately 20% [11]. The results of our study demonstrate that detailed echocardiographic examination can identify the patients who are likely to develop recurrent MR after undersized ring implantation. None of the clinical or procedure-related factors had an influence on MR recurrence in the studied population, even though- in the literature- the impact of procedure related factors and echocardiographic assessment was highlighted as an independent risk factor [12].

Several studies have emphasized the role of echocardiography in the prediction of MR recurrence. Calafiore and colleagues found that the coaptation depth of more than 11 mm was associated with an increased risk of recurrent MR in patients with dilated cardiomyopathy [13]. Recently, Kongsaerepong and his associates demonstrated in a group of patients with ischemic MR that the results of mitral surgery are influenced not only by tethering height, but also by mitral annular dimension and MR grade. The annular dimension of ≥ 3.7 cm in TEE, with a tenting area of ≥ 1.6 cm2 in long axis view and MR grade > 3.5, was associated with the failure of mitral annuloplasty in half of the patients during follow up [11]. Both the coaptation depth (tethering height) and tenting area reflect left ventricular remodeling resulting in mitral leaflet tethering. Our study did not confirm the predictive role of coaptation depth. However, these parameters have a burden of error, due to the difficulties presented by their measurements. Various results can be achieved depending on the annular plane estimation and on the quality of the echocardiographic view. Moreover, our study included patients with the mechanism of MR classified as Carpentier types I and IIIb, which differ dramatically in the expected measurements.

We found that coaptation length assessed within days after operation was the strongest predictor of MV regurgitation recurrence. This parameter can be assumed to be the same as the measurement obtained directly at the operation theatre. Approximately 40% of patients with the postoperative coaptation length of ≤ 6.7 mm had severe MR revealed by the follow up echocardiographic examination. Similarly, Braun and his colleagues aimed to achieve the coaptation length of at least 8 mm as the target of restrictive ring implantation, as this value was associated with very low incidence of MR recurrence (2.3%) [14].

The reduction of coaptation length reflects the remodeling of the left ventricle caused by ischemia. It can lead to either mitral annulus dilatation or papillary muscle displacement. The key role of ventricular remodeling was also considered as a risk factor of recurrent MR after undersized mitral ring implantation. Progressive postoperative remodeling, including further papillary displacement, may potentially be responsible for the failure of repair [7, 15]. Our study did not reveal any significant changes in LV dimensions. However, the mean follow up in our study was relatively short, which is particularly important in view of the Bax and his colleagues report. Its authors demonstrated that reverse remodeling of the LV is a gradual and time dependent process, by observing the operated patients for a period of 1.5 years [16].

Study limitations

Larger number of patients and longer follow up period are needed to assess the durability of repair in Ischemic mitral regurge.

Conclusions

MVRepair can be performed safely, concomitantly with CABG, in patients with moderate to IMR. The combined procedure leads to better mitral valve competency as shown by echocardiographic parameters. The measure of coaptation length was found to be superior to other echocardiographic parameters in the prediction of MR recurrence after mitral valve annuloplasty.

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Open Versus Endovascular Treatment of Aneurysms or Dissection of the Descending Thoracic Aorta

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***Introduction*: Surgical treatment of diseases of the descending thoracic aorta remains a therapeutic challenge and is associated with significant risk of mortality. The technique of endoluminal aortic stent-graft placement has been introduced for repair of descending thoracic aneurysms. In the high-risk setting of aortic dissection, endoluminal repair is a new therapeutic strategy which is yielding encouraging results.**

***The aim of this study* is the evaluation of endovascular treatment versus open surgical repair of descending thoracic aortic aneurysms and /or dissection regarding early mortality and morbidities.**

Patients and methods: This study was conducted as a retrospective and prospective non-randomized study including eighty-six patients with descending thoracic aneurysms and/or dissection. Data was collected from patients undergoing endovascular and surgical repair at Cairo university hospitals from September 2002 to September 2012.

***Results:* 86 patients were included in this study, 48 of which were treated by open surgical repair and 38 by endovascular stenting. The mean age for surgical candidates was 63.3 + 12 years while that for TEVAR patients was 49.5 + 8 years (p value <0.000). In the surgery group 46 patients (95.8%) were males while in the endovascular group 36 patients (94.7%) were males. Early mortality in the surgery group occurred in 6 patients (12.5%) compared to 4 patients (10.5%) in the endovascular group (*p* value 1.000). Paraplegia occurred in 2 patients (4.2%) after surgery while it occurred in one patient (2.6%) after endovascular stenting (p value 1.000). Stroke occurred in 1 patient (2.1%) in the surgery group. In the endovascular group 2 patients (5.3%) suffered from stroke (p value 0.581). Prolonged ventilation occurred in 2 patients (4.2%) in the surgery group while it didn't occur in any of the patients in the endovascular group (p value 0.501). Postoperative renal impairment occurred in 1 patient in both the surgery group (2.1%) and the endovascular group (2.6%) (p value 1.000). Wound infection occurred in 4 patients (8.3%) in the surgery group while none of the patients in the endovascular group suffered from wound infection (p value 0.126). In the endovascular group endoleak occurred in 2 patients (5.3%). In both patients the endoleak was type I and was treated successfully by a new stent after 8 and 10 months respectively after the original procedure.**

***Conclusion:* Open and endovascular repair represent two comparable options for the treatment of descending thoracic aortic aneurysms and dissections. No statistically significant difference was found between the 2 options regarding early mortality and morbidities.**

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Surgical treatment of diseases of the descending thoracic aorta remains a therapeutic challenge and is associated with significant risk of mortality[1]. Extracorporeal circulation for peripheral organ preservation and multiple techniques used for spinal cord protection have improved results yet surgical repair is still associated with significant mortality, and the cumulative morbidity in this aged population frequently exceeds 50%[2]. The highly invasive nature of this procedure usually requires a long recovery period, with return to wellbeing

frequently delayed up to 4 to 6 months postoperatively. In addition, high-risk patients previously denied surgical repair might become surgical candidates if a less-invasive endovascular option is available[3].

The preferred treatment for most patients with Stanford type B dissection is medical therapy. Nonetheless, the current mortality rate among patients who received medical therapy for type B dissection remains about 20%. The technique of endoluminal aortic stent-graft placement has been introduced for repair of descending thoracic aneurysms. In the high-risk setting of aortic dissection, endoluminal repair is a new therapeutic strategy which is yielding encouraging results[4].

Any decision to offer a patient with an aneurysm of the descending thoracic aorta a procedure, either open or endovascular, must balance the patient's expected prognosis and life expectancy without intervention against the risk of undergoing the procedure. At present, for descending thoracic aorta repairs, there is no level A or B evidence (results from prospective, randomized trials) to compare medical therapy with surgical intervention. Furthermore, there is no level A or B evidence comparing the results of open procedures with endovascular stent-graft procedures[5].

The aim of this study is the evaluation of endovascular treatment versus open surgical repair of decsending thoracic aortic aneurysms and /or dissection regarding early mortality and morbidities.

Patients and Methods

This study was conducted as a retrospective and prospective non-randomized study including eighty-six patients with descending thoracic aneurysms and/or dissection, 48 were treated by open surgical repair and 38 by endovascular repair. Their ages ranged from 16 to 76 years with mean age of 63 years for TEVAR patients and 49 years for surgery patients. Data was collected from patients undergoing endovascular and surgical repair at Cairo university hospitals from September 2002 to September 2012.

Inclusion criteria

1. Patients with descending thoracic aneurysms
2. Patients with Stanford type B aortic dissection (acute or chronic)

Exclusion criteria

1. Thoracoabdominal aneurysms
2. Mycotic aneurysms
3. Hemodynamically unstable ruptured aneurysm
4. Major operation (other than planned subclavian to carotid transposition or bypass) within 30 days

Operative technique for surgical patients

As per our protocol, insertion of a lumbar cerebrospinal fluid (CSF) drain was attempted in all patients prior to surgery with the exception of hemodynamically unstable patients undergoing emergent operations, patients with a therapeutic level of anticoagulation or patients with prior lumbar spine operation. Thoracic epidural cannula was also placed to be used for pain management postoperatively

A right radial arterial line and a right common femoral line were inserted.

A balance of fentanyl, midazolam, pancuronium, and inhaled isoflurane was administered to produce general anesthesia. A double lumen endotracheal tube was used to isolate the left lung.

The patient is then turned on his or her right side for a left thoracotomy. The angle of the shoulder to the table 70 degrees, so that the hips can be rotated more toward 45 degrees, which allows access to the femoral artery on the left side. The aorta was exposed by a posterolateral thoracotomy.

Circulation management consisted of left-atrial-to-femoral artery (or distal aortic) partial left heart bypass using extracorporeal circulation if an appropriate proximal cross clamp site was available. If no proximal clamp site was available or distal arch reconstruction was required, deep hypothermic circulatory arrest (DHCA) utilizing full cardiopulmonary bypass (CPB) via femoral artery—femoral vein bypass was utilized.

Proximal and distal anastomoses (using collagen coated Dacron tube grafts) were done and sequential clamping utilized when necessary. Attempts were made to reimplant intercostal arteries in all patients with dissecting aortic aneurysms and selectively in patients with atherosclerotic aneurysms.

Endovascular procedure

All procedures were performed in the catheter lab with patients under general anaethesia. A right radial/ brachial arterial line was placed for invasive blood pressure monitoring. A surgical cutdown to expose the common femoral artery was done.

A graduated-marker pigtail catheter (4–5 Fr, 110 cm long) is introduced via the controlateral femoral site or the left brachial artery through a small introducer (4–5 Fr, 11 cm long) . Several automated injections of contrast media are performed to correctly evaluate the morphology of the aorta. Then the stent is advanced to desired position over a super stiff guidewire.

Blood pressure is lowered with systolic blood pressure <90mmHg with cessation of mechanical ventilation before the stent is deployed. A final contrast injection is performed to assess apposition of stent-graft to aortic wall without

encroachment on nearby aortic branches at proximal or distal landing zones. Gentle balloon dilation of the stent-graft may be performed at the level of the proximal and distal attachment sites to secure optimal wall apposition of the stent-graft.

The Medtronic Valiant stent was used in 28 patients, the Cook Zenith stent in 6 patients and Jotec Evita stent in 4 cases in this study.

Postoperative Follow-up

A standard record of postoperative data was applied. A record was made of the following:

- Kidney function tests including: blood urea, serum creatinine
- Mechanical ventilator support and if it was prolonged.

Early mortality was defined as those deaths occurring within 30 days of the procedure or any mortality occurring within the period of hospitalization.

Operative morbidity defined as all complications beginning within 30 days of operation including:

- Neurological complications (stroke or paraplegia/ paraparesis).
- Renal complications (for the purpose of this study, postoperative renal impairment was defined as an increase in serum creatinine over baseline by more than 50% or need for renal replacement therapy).
- Respiratory complications (for the purpose of this study it was defined as a requirement for mechanical ventilation for more than 48 hours, reintubation, or tracheostomy).
- Other complications: hoarseness, postoperative bleeding (for surgical candidates) and endoleak (for TEVAR patients).

Data was statistically described in terms of mean ± standard deviation (± SD), and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student t test for independent samples. For comparing categorical data, Chi square (c2) test was performed. Exact test was used instead when the expected frequency is less than 5. p values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

Results

This study included 86 patients, 48 of which were treated by open surgical repair and 38 by endovascular stenting.

The mean age for surgical candidates was 63.3 + 12 years while that for TEVAR patients was 49.5 + 8 years (p value <0.000).

In the surgery group 46 patients (95.8%) were males while 2 patients (4.2%) were females. In the endovascular group 36 patients (94.7%) were males while 2 patients (5.3%) were females.

		Surgery	Endovascular
Female	Number	2	2
	% within group	4.2%	5.3%
Male	Number	46	36
	% within group	95.8%	94.7%

Table 1. Gender distribution in surgery and endovascular groups

Regarding the aortic pathology, in the surgery group 41 patients (85.4%) had descending thoracic aortic aneurysms, one of which was saccular and 3 were traumatic. In the endovascular group, 22 patients (57.9%) had aortic aneurysms, three of which were saccular.

Only 4 of the surgery group (8.3%) were treated for acute aortic dissection (Stanford type B) while 3 (7.9%) of the endovascular group were treated for the same pathology.

Fourteen (29.2%) patients from the surgery group were treated for chronic dissection while the number increases to 16 (42.1%) patients in the endovascular group.

A single patient (2.6%) in the endovascular group was treated for a penetrating atherosclerotic ulcer while none showed this pathology in the surgery group.

In the surgical candidates, 10 (20.8%) patients were leaking aneurysms/dissections while only 8 (21.1%) patients were leaking in the TEVAR candidates.

Preoperative renal dysfunction (serum creatinine >1.5mg/ dL) was found in 2 patients (4.2%) in the surgery group while it was found in 3 patients (7.9%) in the endovascular group.

In the surgery group, Total Circulatory Arrest (TCA) was done in 5 patients (10.4%).

Early mortality in the surgery group occurred in 6 patients (12.5%). Only one patient died intraoperatively due to myocardial failure. The other 5 patients died postoperatively ranging from 3-15 days after surgery.

Early mortality occurred in 4 patients (10.5%) in the endovascular group (*p* value 1.000) none of which occurred during the procedure but occurred from 1-4 days later due to causes such as cardiac arrhythmias and multiple organ system failure.

	Surgery	Endovascular	p value
Number	6	4	1.000
Percentage	12.5%	10.5%	

Table 2. Early mortality in surgery and endovascular groups

Paraplegia occurred in 2 patients (4.2%) after surgery while it occurred in one patient (2.6%) after endovascular stenting (p value 1.000). The patient regained some motor power in his lower limbs after C.S.F. drainage was done repeatedly as well corticosteroid therapy following the neurological insult. One patient in the surgery group presented with paraplegia before the operation and was not included in these statistics, as the neurological insult didn't occur as a complication of the procedure.

	Surgery	Endovascular	p value
Number	2	1	1.000
Percentage	4.2%	2.6%	

Table 3. Paraplegia in surgery and endovascular groups

Stroke occurred in 1 patient (2.1%) in the surgery group. This patient arrested with induction of anesthesia. In the endovascular group 2 patients (5.3%) suffered from stroke (p value 0.581) one of which was hemorrhagic in a patient with uncontrolled hypertension after the procedure.

	Surgery	Endovascular	p value
Number	1	2	0.581
Percentage	2.1%	5.3%%	

Table 4. Stroke in surgery and endovascular groups

Prolonged ventilation (for the purpose of this study it was defined as a requirement for mechanical ventilation for more than 48 hours, reintubation, or tracheostomy) occurred in 2 patients (4.2%) in the surgery group while it didn't occur in any of the patients in the endovascular group (p value 0.501).

	Surgery	Endovascular	p value
Number	2	0	0.501
Percentage	4.2%	0%	

Table 5. Prolonged ventilation in surgery and endovascular groups

Postoperative renal impairment (for the purpose of this study, it was defined as an increase in serum creatinine over baseline by more than 50% or need for renal replacement therapy) occurred in 1 patient in both the surgery group (2.1%) and the endovascular group (2.6%) (p value 1.000).

	Surgery	Endovascular	p value
Number	1	1	1.000
Percentage	2.1%	2.6%	

Table 6. Postoperative renal impairment in surgery and endovascular groups

Wound infection occurred in 4 patients (8.3%) in the surgery group while none of the patients in the endovascular group suffered from wound infection (p value 0.126).

	Surgery	Endovascular	p value
Number	4	0	0.126
Percentage	8.3%	0%	

Table (7): Wound infection in surgery and endovascular groups

Surgical complications such as hoarseness occurred in 3 patients (6.3%) probably caused by left recurrent laryngeal nerve injury during the procedure. Postoperative bleeding necessitating re-exploration occurred in 1 patient (2.1%)

In the endovascular group endoleak occurred in 2 patients (5.3%). In both patients the endoleak was type I and was treated successfully by a new stent after 8 and 10 months respectively after the original procedure.

Discussion

Surgery of the descending thoracic aorta is technically demanding and associated with substantial mortality and morbidity[6, 7]. The morbidity and mortality of these operations have spurred interest in less invasive, less traumatic methods of repair[8]. Thoracic endovascular aortic repair (TEVAR) represents a minimally invasive technique alternative to conventional open surgical reconstruction for the treatment of thoracic aortic pathologies.

To date, no randomized trials of TEVAR versus open surgical repair for descending thoracic aortic disease have been performed. Most published reports describing TEVAR consist of uncontrolled retrospective cohorts or case series. Recently, a number of nonrandomized phase II studies have compared endovascular repair with a concurrent or historical open surgical group. In the absence of definitive randomized

controlled trials, the value of TEVAR relative to conventional open surgical approaches will continue to be debated[9].

In this study, the surgery group included 46 males (95.8%) while 2 patients (4.2%) were females. In the endovascular group 36 patients (94.7%) were males while 2 patients (5.3%) were females. Coselli and colleagues(2004)[10] and Estrera and colleagues(2005)[11] both showed a higher male predominance (68% and 66% respectively) in their studies on descending thoracic disease patients.

In this study, preoperative renal dysfunction (serum creatinine >1.5mg/dL) was found in 2 patients (4.2%) in the surgery group while it was found in 3 patients (7.9%) in the endovascular group (p value 0.651). Narayan et al[12] (2011) showed a similar pattern with a preoperative renal impairment in 5% of patients in the surgery group and 12% in the endovascular group (p value 0.27). The higher percentage of preoperative renal impairment in the endovascular group may be attributed to higher mean age in the TEVAR group.

Elective surgical procedures performed by experienced cardiothoracic and vascular surgeons in good surgical candidates result in a relatively low (15%) surgical mortality rate for thoracic aortic aneurysm repair However, the operative mortality rate is nearly 50% in patients requiring emergency treatment[13].

In this study, early mortality in the surgery group occurred in 6 patients (12.5%), one patient died intraoperatively due to myocardial failure and the other 5 patients died postoperatively ranging from 3-15 days after surgery. Early mortality occurred in 4 patients (10.5%) in the endovascular group (p value 1.000) none of which occurred during the procedure but occurred from 1-4 days later due to causes such as cardiac arrhythmias and multiple organ system failure.

Hughes and colleagues (2010)[14] performed endovascular repair using FDA approved stents and showed an early mortality (30 day mortality) of 5.1%. This lower mortality compared to our study may be attributed to the fact that all patients were descending thoracic aneurysm patients unlike our study which included both aneurysm and dissection patients.

Dick et al (2008)[15] showed comparable results in their study including 136 patients, 78 treated by open surgical repair and 58 by endovascular technique. The early mortality was 9% in the surgery group and 8% in the TEVAR group (p value 0.254)

Zipfel and colleagues (2007)[16] and Bortone and colleagues (2004)[17] performed two studies with endovascular patients including 172 and 110 respectively. They showed an early mortality similar to our study (9.7% and 8% respectively)

In this study, paraplegia occurred in 2 patients (4.2%) after surgery while it occurred in one patient (2.6%) after endovascular stenting (p value 1.000).

Dick and colleagues (2008)[15] showed a statistically insignificant difference between the two techniques in their study. Paraplegia occurred in 3% of patients in the surgery group and 4% in the TEVAR group (p value 1)

Matsumura (2006)[18] compiled a worldwide survey including 1180 patients treated with endovascular stents and showed a similar (2.5%) percentage of patients suffering from paraplegia after endovascular stenting.

In our study, stroke occurred in 1 patient (2.1%) in the surgery group. In the endovascular group 2 patients (5.3%) suffered from stroke (p value 0.581).

Patel and colleagues (2008)[19] showed a higher incidence of stroke in their study, occurring in 6 surgery patients (14.6%) and 5 TEVAR patients (9.6%) (p value 0.53). This may be attributed to the fact that this study was performed in patients over the age of 75 years. Bozinovski and Coselli (2008)[20] performed their study on 76 patients with acute Debakey type III aortic dissection treated by open surgical repair and showed an incidence of stroke of 6.6%. Also Zipfel and colleagues (2007)[16] showed an incidence of stroke of 4.6% in their study, which included 172 patients treated by TEVAR.

Prolonged ventilation (which was defined as a requirement for mechanical ventilation for more than 48 hours, reintubation, or tracheostomy) occurred in 2 patients (4.2%) in the surgery group while it didn't occur in any of the patients in the endovascular group (p value 0.501). Dick et al (2008)[15] also showed statistically insignificant results in their study including 136 patients, with prolonged ventilation occurring in 7% of patients in the surgery group and 8% in the TEVAR group (p value 1.000).

Postoperative renal impairment (for the purpose of this study, it was defined as an increase in serum creatinine over baseline by more than 50% or need for renal replacement therapy) occurred in 1 patient in both the surgery group (2.1%) and the endovascular group (2.6%) (p value 1.000). Patel and colleagues (2008)[19] showed similar results in their comparative study including 136 patients with an incidence of stroke of 2.1% in both groups (p value 1).

Wound infection occurred in 4 patients (8.3%) in the surgery group while none of the patients in the endovascular group suffered from wound infection (p value 0.126). Dick and colleagues (2008)[15] also showed comparable results in their study with wound infection occurring in 6% of patients in the surgery group and 2% in the TEVAR group.

Surgical complications such as hoarseness occurred in 3 patients (6.3%) in our study probably caused by left recurrent laryngeal nerve injury during the procedure. Bozinovski and Coselli (2008)[20] showed a higher percentage of "left vocal cord paralsis" (39%) in their study. This study included only acute Debakey type III aortic dissection patients .

Postoperative bleeding necessitating re-exploration occurred in 1 patient (2.1%). Bozinovski and Coselli (2008)[20] showed a comparable percentage of reoperation for bleeding in their study (2.6%).

Dick and colleagues (2008)[15] showed a higher percentage of patients requiring reoperation for bleeding (7%). This may be attributed to the large proportion of patients in this study who were operated upon on an emergency basis (20%).

In this study, endoleak occurred in 2 patients (5.3%) of the TEVAR group.

Farber and colleagues (2005)[21] and Ellozy and colleagues (2003)[22] both showed comparable results to our study regarding endoleak (4 and 5% respectively).

Conclusion

Treatment of descending thoracic aortic pathologies still represents a challenge and poses significant risks of morbidity and mortality. Open and endovascular repair represent two comparable options for the treatment of descending thoracic aortic aneurysms and dissections. No statistically significant difference was found between the 2 options regarding early mortality and morbidities.

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The Y graft technique using bilateral skeletonized internal mammary artery in coronary artery bypass operation (CABG) is superior to the standard surgical strategy in Coronary Artery Disease (CAD)

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Background: **The use of the right internal mammary artery (RIMA) as part of "Y" graft sharing the pedicle of the left internal mammary artery (LIMA) can overcome the limitation of pedicled RIMA to reach different areas of the myocardium and also the reduced patency rate of the free RIMA GRAFT . The RIMA will be more versatile to reach more than one myocardial segment allowing a higher incidence of total arterial myocardial revascularization .The Y graft has Excellent late patency and it has been shown to be a factor able to improve on its own the survival of patients undergoing CABG surgery .**

***Objective*: To study the safety , feasibility and efficiency of the use of isolated RIMA as Y graft in the treatment of multi vessel ischemic coronary artery disease (CAD) technically and clinically by following the short term clinical outcome.**

Methods: **104 patients underwent myocardial revascularization using bilateral internal mammary arteries in a Y-graft configuration between November 2009 and May 2012 at Ain shams University Hospitals were included in this study . Ninety eight (93.2%) were males and 6 (5.8%) were females. whose ages ranged from 37 to 76 years (52.78 ± 7.9) .With a 100% were totally revascularized with IMA Y grafts with a mean of 3.01±0.66 of distal anastmosis and a 50%additional Saphenous venous grafts conduits were used to complete revascularization in 52 (50%) of patients. There was a selection bais practiced by the surgeons by avoiding morbidly obese patients, females with large breasts and chronic opestructive air way disease(COPD), redo cases ,patients with impaired hepatic or kidney function and patients with low ejection fraction. All relevant preoperative, intraoperative, and postoperative data were collected (and entered into statistical analysis using appropriate statistical methods using SPSS.program,17th edition). Twelve-lead ECG was performed preoperatively, at admission in the intensive care unit, and then daily until hospital discharge. ECG diagnostic criteria for perioperative myocardial infarction (MI) were new Q waves greater than 0.04 ms or a reduction in R waves greater than 25% in at least 2 leads or both .Uniquely in this study ,we routinely measured Cardiac troponin I (CTnI) it was measured pre cross clamp and at 6, 12, and 24 hours postoperative as an indicator of good intraoperative protection and good revascularization,**

Results: **One patients(1%) died intraoperative . Six patients were operated off-pump (5.8%). The mean number of anastomoses for patients was 3.01± 0.66 (range 2–4). The mean cross-clamp time was 54.37±14.9 min (range 16–95 min), and the mean extracorporeal circulation time was 87.27±23.9 min (range 40–150 min). Twenty eight patients (26.9%) were in actual need for inotropic support during the 1st 24 hours in ICU. The mean troponin I(6,12,24 hours)after surgery was (3.19±3.55 4.8±7, 3.2±2.8 ngm/ml)respectively. A linear regression analysis was carried on to monitor the effect of cardiopulmonary bypass time, and aortic cross clamp time on troponin I levels at 6,12, and 24 hours interval and these two factors had no significant effect. The incidence of postoperative arrhythmia was 5.8 %, peri-operative infarction 1.9 %. Five patients (4.8%) needed reoperation for postoperative bleeding. Three patients (2.9%) had superficial wound infection**

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Codex : o3/13/1301

while one patient had deep Sternal wound infection (1%) (mediastinitis)that needed exploration and debridement. Three patients (2.9%) had mild renal impairment , while 2 patients (1.9%) experienced severe renal impairment requiring dialysis or ultrafiltration. Four patients (3.8%) were readmitted to ICU after discharge for various complications.

Conclusion: **The technique of using composite Y graft from both internal mammary arteries for CABG is an ideal graft, efficient, safe and feasible.**

Coronary artery bypass grafting is the treatment of choice for patients with symptomatic multi vessels coronary artery disease [1]. The saphenous vein grafts undergo a degenerative change in the intermediate to long term that eventually limits graft patency. For this reason there is a new trend to use arterial grafts in younger patients. [2,3,4,5] The IMAs has high rate of long-term patency due to the low risk of intimal thickening and to the freedom from major atheromatous disease. [6] Therefore, the use of bilateral internal mammary artery (IMAs) grafts has gained more attention .The concept of using another bypass graft to an attached IMA was introduced by Mills [2] to avoid using vein grafts into a severely atherosclerotic ascending aorta. Sauvage [3] has employed this technique to bypass all coronary arteries supplying the left ventricle with IMA grafts,to overcome the deficiency in length of the free RIMA and to always bypass the the left anterior descending coronary artery (LAD) with the attached LITA [4,7] .This procedure provides additional length to reach a distal coronary artery branch and reduces sternal wound complication by preserving the first RIMA collateral artery [8]. The lower limb complications derived from the use of saphenous veins are avoided resulting in earlier ambulation, shorter hospital stay and a faster return to daily activities [9] . This study evaluated the course, and outcome of CABG operations using the composite Y graft composed of skeletonized BIMAs in ischemic patients.

Materials and Methods

Patients' selection: This study was conducted at Ain-Shams University Hospitals to evaluate the safety and efficacy of the Y graft in patients undergoing CABG as a method of total arterial revascularization. Between November 2009 to May 2012, 104 patients underwent CABG surgery with the double mammary y-graft technique for multi-vessels coronary artery disease were included in the the study. Our inclusion criteria were patients with multiple vessel coronary artery disease, of both sexes, scheduled for elective CABG and accepting to participate in the study by signing an informed consent. Our exclusion criteria included: redo cases, patients with recent (≤1 weeks) myocardial infarction (MI), impaired hepatic or kidney function (≥2 normal serum transaminase).Morbidly obese patients, those with low ejection fraction (below 30%),and those needing more than 4 distal anastomoses . All relevant preoperative, intraoperative, and postoperative data were collected (and entered into statistical analysis using appropriate statistical methods using SPSS.program,17th edition). Uniquely in this study ,we routinely measured Cardiac troponin I (CTnI) it was measured pre cross clamp and at 6, 12, and 24 hours postoperative as an indicator of good intraoperative protection and good revascularization,

Data Management and Analysis

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (SPSS 17 for windows; SPSS Inc, Chicago, IL, 2001). Data was presented and suitable analysis was done according to the type of data obtained for each parameter. The data were presented as the mean ± one standard deviation. Significance was assumed if the p value was equal or less than 0.05. Frequency and percentage were used for non-numerical data. Chi-Square test was used to examine the relationship between two qualitative variables ,Fisher's exact test was used to examine the relationship between two qualitative variables, Student T Test was used to assess the statistical significance of the difference between two study group means, in addition to the previous tests Linear regression was used to test and estimate the dependence of a quantitative variable based on its relationship to one or more independent variables

Surgical technique

Standard anesthesia and monitoring were used in all patients. Through a median sternotomy incision, the skeletonised left internal mammary artery (LIMA) was harvested in situ while the skeletonised right internal mammary artery (RIMA) was taken as a free graft sparing the first (upper most) branch of RIMA for maintaining sterna vascularization , then an end to side anastomosis is established between the proximal end of RIMA and the side of LIMA at level of pericardial reflection or pulmonary artery after heparinzation using 7/0 polypropylene sutures. Additional saphenous venous grafts were taken in some patients when required .Full heparinization is established, aortic and venous cannulae were inserted. Antegrade cardioplegia and venting were accomplished through another aortic cannula. All the distal-end anastomoses were fashioned with continuous 7/0 sutures on cross-clamp, and the top-end anastomoses were fashioned to the aorta on a side-biting aortic clamp using 6/0 sutures. Six operations were conducted off-pump. Twelve-lead ECG was performed preoperatively, on admission to intensive care unit, and then daily until hospital discharge. The incidence of dysrhythmias was recorded with transient ischemic events (ST segment elevation ≥ 1 mm). ECG diagnostic criteria for perioperative myocardial infarction (MI) were new Q waves greater than 0.04 ms or a reduction in R waves greater than 25% in at least 2 leads or both. Cardiac troponin I (CTnI) was measured in serial venous blood samples preoperative, and at 6, 12, and 24 hours postoperatively for evaluating the adequacy of myocardial revascularization and protection.

Results

The average cardiopulmonary bypass time was 87.27±23.9 minutes, while the average aortic cross clamp time was 54.37±14.9 minutes. The mean time per graft for all patients in the study was 18.5 ± 4.5 minutes. The number of distal coronary targets ranged from 2 to 4 with a mean of 3.01± 0.66. RIMA and LIMA targets was as shown in table (1) (2).

	Frequency	Percent	Valid Percent	Cumulative Percent
Diagonal	5	4.8	4.8	4.8
Int-OM	9	8.7	8.7	13.5
LAD	8	7.7	7.7	21.2
LAD-Diagonal	1	1.0	1.0	22.1
LAD-LAD	1	1.0	1.0	23.1
OM	10	9.6	9.6	32.7
RCA	52	50.0	50.0	82.7
RCA-PDA	18	17.3	17.3	100.0
Total	104	100.0	100.0	

RIMA: *right internal mammary artery;* **LAD***: left anterior descending artery;* **Int***: Ramus intermedius artery;* **OM***: obtuse marginal artery;* **RCA***: right coronary artery;* **PDA***: posterior descending artery.*

Table 1. Coronary targets of RIMA

	Frequency	Percent	Valid Percent	Cumulative Percent
Diagonal	1	1.0	1.0	1.0
LAD	93	89.4	89.4	90.4
LAD-Diagonal	1	1.0	1.0	91.3
OM	9	8.7	8.7	100.0
Total	104	100.0	100.0	

LIMA: *left internal mammary artery;* **LAD***: left anterior descending artery;* **OM***: obtuse marginal artery.*

Table 2. Coronary targets of LIMA

SVGs were used in 52 (50 %) patients . Although ,almost one third (35.6%) of patients did not need any inotropic support on coming off cardiopulmonary bypass(CPB) 57 patients (54.8%) needed minimal support (50ng/kg/min adrenaline or less) while only 4 patients (3.8%) were in need for higher dose

Postoperative characteristics

The average hospital stay was 10.8±6.4 days. The mean Intensive Care Unit (ICU) stay was 39.88± 28.1 hours. The average ventilation time was 11.59 ± 11.9 hours. Twenty eight patients (26.9%) were in actual need for inotropic support (excluding renal dopamine) during the 1st 24 hours in ICU. Six patients (5.8 %) had perioperative arrhythmias. Five patients (4.8%) needed reoperation for postoperative bleeding. Three patients (2.9%) had superficial wound infection that was treated conservatively with repeated dressing and antibiotics while one patient (1%) suffered from mediastinitis that needed exploration and debridement. Three patients (2.9%) had mild renal impairment (serum creatinine less than 3mg/dl), while 2 patients (1.9%) experienced severe renal impairment requiring dialysis or ultrafiltration. Four patients (3.8%) were readmitted to ICU after discharge for various complications.; 1 patient had embolization to the lower extremity; and 1 patient fully awakened had a cerebral stroke 12 hours later. Two patients had low cardiac output. Echocardiography was done to all patients postoperatively (usually one week after surgery) the mean ejection fraction was 56.2± 3.7% compared to a mean of 53.4 ± 4.7% preoperative which was a significant rise (P value <0.001). The mean troponin I(6,12,24 hours)after surgery was (3.19±3.,55 4.8±7, 3.2±2.8 ngm/ml)respectively. A linear regression analysis was carried on to monitor the effect of cardiopulmonary bypass time, and aortic cross clamp time on troponin I levels at 6,12, and 24 hours interval and were found of no significant effect on troponin I levels.

Discussion

Is single internal mammary artery (SIMA) versus bilateral internal mammary artery (BIMA) are better? The use of bilateral IMAs resulting in higher long-term survival and less recurrent angina than results of using single IMA as in a study performed at Cleveland Clinic. [10] Also the benefits of BIMA grafts increased with duration of follow up and with special reference to the need for redo surgery . Endo and colleagues reported clinical outcome at short period of follow up (median of 6.1 years) the incidence of death, myocardial infarction, and need for redo CABG was lower in the BIMA group (p = 0.06).[10] Anastomosis between the IMAs have a good patency rate,as the IMAs are identical in diameter and thickness and are rarely atheromatous. The main risk is injury to the intima of opposite wall during arteriotomy of the LIMA. In a recent angiographic study of symptomatic post-CABG patients, patency rates for the LIMA at 10 and 15 years were 95 and 88%, respectively, while SVG patencies were 61 and 32% at the same time intervals [11].The IMA remains free from obstruction because of its low risk of intimal thickening due to abundant elastic media and its freedom from significant atherosclerosis [12]. Anastomosing the free RIMA to the attached LIMA can bring the RIMA more closer to the distal circumflex and right coronary artery branches ,this make total arterial revascularization more feasible utilizing both IMA grafts[13].

In our study RIMA was nearly used to bypass more distal artries to RCA, OM ,LAD and D as indicated in table (1). With this procedure, the principle of bypassing the LAD with the in situ LIMA, the graft with the greatest patency, is preserved[14]. Some preoperative risk factors in our study were comparable to the risk factors reported by Andrea Dell'Amore et al[12], especially smoking which had exactly the same percentage as in 64.4% while other risk factors varied between studies being more evident for diabetes mellitus in our study (47.1%), compared to 23% in Andrea Dell'Amore et al. Diabetes is a strong risk factor for death in patients with CAD, probably both because of its effect as coexisting condition and because of its accelerating effect on the arterio sclerotic process .The percentage of diabetic patients in our study didn't vary a lot in comparison to the percentage of DM among the total patients who underwent CABG in our cardiac center during the same interval , neither did the percentage of patients with hypertension or dyslipidemia. Patients of our study were selected randomly concerning these risk factors especially DM. Also, patients with previous myocardial infarction were not excluded from the study. Leg incisions and their complications are eliminated by using Y graft. Four patients (3.8%) had superficial wounds infection of the leg incisions in those patients in whom SVGs was used . The use of other arteries that are more prone to spasm and intimal hyperplasia is avoided [15] . In our study no radial artery was used. No or few graft is anastmosed to the ascending aorta, reducing the chance of embolization in our study only1 patient had embolization to the lower extremity and this patients was known to have a preoperative peripheral vascular disease; and 1 patient had a cerebral stroke 12 hours later, on analysis of preoperative data of this patient he was having severe uncontrolled hypertension and diabetes . Reliance upon the Y grafts to supply sufficient flow, has gained increasing interest for total arterial grafting due to superior long-term results, for this reason we should ensured preoperatively of the adequacy of the left subclavian artery because LIMA carry all blood supply to the myocardium in case of Ygrafts by either angiography ,Doppler or CT angiography . Inadequate perfusion by IMA grafts intraoperatively can be detected, before or just after coming off cardiopulmonary bypass, by electrocardiographic changes or new wall motion abnormalities on the transesophageal echocardiogram(TEE). Immediate placement of an SVG to the area suspected of insufficient perfusion is usually the only measure that corrects the problem. The cause of this hypoperfusion has been attributed to spasm and flow capacity [14,16] of the graft. We believe, however, that reduction in IMA flow is most often the result of even slight narrowing of IMA coronary anastmoses or kinking or stretching of the IMA. When flow through the IMAs after completion of the Y graft was inadequate ,redoing the anastmoses resulted in excellent flow in both limbs of the graft. Inadequate flow to the right coronary branch was caused by kinking of the artery, repositioning of the Y graft release the kink in the IMA, and the electrocardiogram and echocardiogram immediately returned to normal .If there is any doubt about the adequacy of flow, the safest approach is to place SVG to the suspected area before removing the patient from cardiopulmonary bypass, in our study we had 3 patients with abnormal ECG and wall motion abnormalities by (TEE)and we attributed this to inadequate flow in *the Y grafts and we used SVGs to the suspected hypoperfused areas ,two patients* were improved and one patient did not make it and died from intractable ventricular fibrillation . Experience with Y grafts can prevent this problem. In our study we depended on our judgment by testing the free flow of the "Y" graft before anastmosing it to distal target. It would be ideal to obtain intraoperative Doppler to ensure adequate flow in the Y graft and also postoperative echocardiography to ensure adequate reperfusion with the Y graft. RIMA and LIMA are the most proper arterial conduits to be used for coronary reavscularisation[16] . Calafiore et al demonstrated a better patency rate for free RIMA as part of composite grafts from the in situ LIMA when compared with those attached to the aorta. The authors stated that the lower patency rates of free arterial grafts arising from the aorta were related to exposure of these grafts to turbulence and its associated risk of intimal damage. [8,16] The meticulous harvesting of the skeletonised LIMA and RIMA, preparation of both, then fashioning the composite Y graft are the corner stone in the safety and efficacy of the operation as a preliminary step before proceeding through the surgery. [9,17] The most critical steps in the operation is preparation of LIMA, as it is responsible for the entire flow to the bypass grafts, to avoid spasm and allowing for good adequate blood flow through the graft by dilating it with diluted papaverine and other arterial vasodilators . This technique was used in all our patients to decrease the incidence of LIMA spasm as much as possible .A high concentrations of troponin I were associated with a cardiac cause of death and major clinical outcomes[10,15]. Authors postulated that the cut off value of cardiac troponin I as an indicator of perioperative myocardial infarction is 10-15 ng/ml [11,13,20]. In our study, two patients had an increase in troponin I levels in all samples withdrawn above that cutoff. One of them had postoperative myocardial infarction confirmed by elevated ST segment in ECG, and the other had an elevated cardiac troponin I preoperative (11ng/dl). Hazelrigg and colleagues found clinically that the risk of wound complication was almost five times greater with bilateral IMA grafting than with SVG and three times greater than the risk with single IMA grafting [21]. In Chocron's series, 117 patients underwent revascularization by bilateral in situ IMA grafts with a sternal wound infection rate of 0.9%. Although the difference between the two series was not significant[21]. The reported incidence of mediastinitis range from 1.3% to 4.7% in patients with BIMA grafting . In diabetic patients undergoing CABG mediastinitis can be as high as 10%. [22], However, Ioannidis and colleagues reported slight increase of the risk from 0.4% to 1.3%, and similar results with Matsa and colleagues found increased the risk from 1.7% to 2.6%.[24] BIMA grafts are not contraindicated in diabetes, per se, unless the patient is significantly obese or has significant chronic lung disease. skeletonisation technique results in superior sternal blood flow preservation and reduces risk of wound healing in all patients and in diabetics in particular. [10] Kouchoukos et al [23] reported that the use of bilateral IMA was associated with increase risk of sternal infection (6.9%) versus unilateral IMA (1.9%). However the advantage of using the skeletonized BIMA is the preservation

of collateral blood supply to the sternum, enabling more rapid healing, decreasing the risk of infection and decreasing the time for pulmonary recovery[12,13]. However, Andrea Dell'Amore and other [12,18] stated that they found no evidence of this relationship in those receiving bilateral skeletonized IMA as long as there is strict control on postoperative hyperglycemia. They found postoperative sternal infection in their study 3.1 % while the reoperation for postoperative bleeding was 7.1%. They referred this to their way of sternal closure as they reinforce both hemisternum with double longitudinal wire. Our bleeding ,re-exploration rate was 4.8% however ,it had no impact on rate of sternal and mediastinal infections. Instead, we used to close the sternum of all our patients with 5 interlocking metal wires taken as figure of eight with strict control of hyperglycemia in both diabetic and potentially diabetic patients. We used to shift diabetic patients who are on oral hypoglycemic drugs to 4 doses of insulin (3 doses regular insulin before meals and measuring blood sugar level 2 hours after each meal) plus long acting insulin (lantus) for basal insulin rate to establish full control on blood sugar preoperative. Intraoperative and postoperative, insulin infusion was used without hesitation in order to control elevated levels in blood sugar. For all diabetic patients , and even potentially diabetic patients we use HbA1c. HbA1c occurs when haemoglobin joins with glucose in the blood. Haemoglobin molecules make up the red blood cells in the blood stream. When glucose sticks to these molecules it forms a glycoslated haemoglobin molecule, also known as A1c and HbA1c. The more glucose found in the blood the more glycated haemoglobin (HbA1c) will be present .which identifies average plasma glucose concentration ,due to the fact that red blood cells survive for 8-12 weeks before renewal, by measuring HbA1c, an average blood glucose reading can be returned. For non-diabetics, the usual reading is 4-5.9%.For people with diabetes, an HbA1c level of 6.5% is considered good control, although some people may prefer their numbers to be closer to that of non-diabetics. People at greater risk of hypoglycemia may be given a target HbA1c of 7.5% . HbA1c levels should be measured and repeated depending on the person with diabetes and their history of control and treatment objections. Generally, the following are considered best practice in HbA1c regularity. Once per 3 months if trying to get better control .Once per 6 months if good control achieved and maintained . Postoperative hyperglycemia was controlled through an aggressive intravenous insulin infusion aimed at maintaining glucose levels in the 150 to 200-mg/dL , with this way the incidence of deep sternal wound infection was significantly decreased . In our study the deep and superficial sternal wound infection rate was 3.9% which is not different from the usual incidence (3-5%) during the last 3 years in our hospital with the usual surgical technique with single arterial graft. In recent study the rate of mediastinitis ranging from 0.4% to 2.6% in CABG patients and from 0.5% to 3.3% in diabetic patients [22]. The beneficial effect can be referred to the statistically significant increased sternal perfusion with skeletonized BIMA compared to pedicled BIMA. This was shown clearly in a randomized, double-blind within-patient comparison study, in which patients were randomized to receive one skeletonized and one pedicled internal mammary artery graft. [24] A recent study concluded that off-pump skeletonized BIMA grafting is associated with better long-term survival than single IMA grafting, without increasing the risk of deep sternal infection in diabetic patients. [25] The advantage of using the skeletonized BIMA is the preservation of collateral blood supply to the sternum, enabling more rapid healing, decreasing the risk of infection and decreasing the time for pulmonary recovery.[15,17] The technique of IMA harvesting with a wide musculofascial pedicle may have accounted for more severe impairment of the postoperative pulmonary function. The low incidence of postoperative pulmonary dysfunction in patients with IMA harvesting with a skeletonized vessel is due to a lesser extent of surgical trauma and injury to the chest wall. The technique of IMA harvesting with a skeletonized vessel may be the method of choice to reduce the incidence of postoperative pulmonary dysfunction [26] .We recorded a mean postoperative ventilation time of 10.06±4.66 hours, a mean ICU stay of 39.88±28 hours, and a mean postoperative hospital stay of 10.8±6.37 days, while the study of Andrea Dell'Amore et al recorded nearly the same periods by means of 6.7 hours for ventilation time, 37.8 hours for ICU stay, and 10.3 days for postoperative hospital stay, which are very near values to our recordings[12].

Conclusion

The technique of using composite Y graft from both internal thoracic arteries for coronary revasularisation is relatively efficient, and safe. Total revascularization with the IMA is the most ideal bypass graft as it has the potential to significantly increase long-term event-free survival and dramatically reduce the need for reoperation in patients with three-vessel disease. The procedure can be performed with acceptable morbidity and mortality including those with poor ejection fraction or left main disease, and even in some patients requiring reoperation. The use of venous conduits adjuvant to the arterial Y graft for coronary revascularization does not affect the short term outcome. No increase in postoperative sternal wound infection is associated with BIMAs harvesting in diabetic patients, as long as strict adherence to sterile technique, careful opening of the sternum in the middle, tight secure approximation of the sternum with many sutures, and elimination of dead space when closing the fascia and control postoperative hyperglycemia are measures that will most likely assist in reducing infections in the diabetic patients.

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Posterior pericardiotomy and separate left 5th intercostal space tube decrease cardiac and pulmonary complications after coronary artery bypass grafting operations.

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Objectives: **In this study we aimed to reveal the importance of the posterior pericardial window after the completion of the coronary bypass surgery to drain the pericardium. And the best choice for insertion of the chest drains, and their effect on the post-operative complications.**

Material and methods: **This study was applied for 300 patients of isolated coronary artery bypass grafting,prospectively selected, in the Saudi German Hospital (Al Madinah Monuarah) in the Kigdom of Saudia Arabia, between January, 2010 and January,2011.**

We investigated a group of 150 patients in whom a posterior pericardiotomy was performed at the end of the procedure and the left chest tube drain was fixed separately in the left 5th intercostal space midaxillary line(group A), versus a control group, in whom the posterior pericardiotomy was not performed and the left tube was fixed in the anterior mediastinum and directed to the left pleura(group B).

Results: **There were no significant statistical differences in the demographic and pre-operative clinical data; age, gender,body weight,Height,body surface area or associated clinical conditions(diabetes, smoking, dyslipidemia or smoking). while in the post-operative data there were significant statistical difference in the incidence of atrial fibrillation(10% in group A;30% in group B),the amount of the postoperative pericardial effusion was more in group B, whether small, moderate, large or very large; early postoperative as well as late. The incidence of left basal lung collapse and the left pleural effusion was higher in group B.(44.6%),while in A it was (2.6%). The ICU stay, and total hospital stay, and other data showed no significant difference statistically.**

Conclusion: **Posterior pericardiotomy is an easy simple incision to do, draining any pericardial collection into the left pleura, decreasing the incidence of early and late pericardial effusion and the consequent complications (tamponade and atrial fibrillation).The left pleural tube inserted in the left 5th intercostal space separately, is better draining the s**

KEYWORDS: **Posterior pericardiotomy,CABG,atrial fibrillation,Tamponade.**

The post-operative cardiac and pulmonary complications after cardiac surgery are some times fatal or catastrophic, one of these, is the cardiac tamponade. It is clinically suspected and diagnosed easily and early, ensured by echocardiography (TTE or TEE) and treated early so its incidence is low, 0.02% to 1%(1-3). In cardiac surgery especially in CABG surgeries, we have a large raw surface, the sternal edges, the thymic fat, the pericardial fat, the edge of the pericardium the mammary bed, the dissected epicardium and the grafts or the cardiac incisions or sites of cannulation for CPB, we may even see a hematoma not just an effusion which may compress cardiac chambers. (1,4). Moreover, cardiac patients usually receive preoperative anticoagulants and sometimes there is no space of time to stop, even, mostly we start early anticoagulants after surgery, or there may be the effect of the CPB on coagulation cascade, these factors ,all, make the post operative period is a hard time. There is high incidence of pericardial effusion after cardiac surgeries, with varying degrees, as proved by echocardiography,

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Codex : o3/14/1301

it is of the large effusion in 30% of cases presented with postoperative pericardial effusion. In 50% of those patients it is posterior, while in 45% it is circumferential. Anterior collection is uncommon, if any ,it is usually blood clots. The hemodynamic changes early occurring are good guide for early interference (1,5-7).

Late pericardial effusion and hemodynamic instability and Dressler s syndrome may also happen due to improper drainage. Death, graft occlusion, compression of the heart and hypotension in a compromised heart and compromised patient may occur, rarely lead to stroke. All are drawbacks of improper drainage of the pericardium(8,9). Irritation of the heart and consequent supraventricular arrhythmias, mainly AF, may account for a major sector of complications due to improper drainage of the pericardium, up to 30-40%. Rarely ventricular arrhythmias were recorded or reported. (1,6,7)

The left lung which is usually exposed after the pleura been opened especially in CABG, is not far away of this, the left basal collapse may lead to fever, shortness of breath and early pleural effusion, mostly mild or moderate. (5-11% and may reach up to 20%) leading to delayed recovery. (10,11)

All these may lead to long ICU and hospital increased costs, and various kinds of infections. So it is important to drain properly the pericardium and the left pleura after cardiac surgery, mainly CABG, the most performed operation. (6,10,12). The degree of postoperative pericardial effusion could be classified according to the national US Guideline clearing house (www.guideline.gov) as shown in table 1:by the 2-dimention echocardiography (13).

Grade	Amount of collection
Small: l	Less than 10mm echo-free space in diastole
Moderate: ll	More than or equal 10mm echo free space in diastole
Large: lll	More than or equal 20mm echo-free space in diastole
Very large: IV	More than or equal 20mm echo-free space in diastole with compression of the heart

Table 1 :echocardiographic evaluation of postoperative pericardial effusion.

Materials and Methods

This study was performed in 300 cases in the cardiothoracic surgery department, prospectively randomized to be submitted to CABG. Patients with associated valve disease for surgery, ventricular aneurysms will be repaired, MIDCABs, COPD, dense pleural adhesions ,emergency CABG after thrombolytic therapy, and sever left ventricular function impairment, will be excluded from the study.Patients were divided into 2 groups, each group 150 patients. Group A, in which pericardiotomy was performed ,and left intercostal chest tube fixed, and group B, the control group in which the pericardium was not opened, all the cases were operated for CABG on beating heart with no use of the cardiopulmonary bypass, all the cases were operated by the same team over one year.

Surgical procedures

All the cases were approached via full sternotomy. The left internal thoracic artery (LITA) was harvested in all the cases after the left pleura opened fully. The right internal thoracic artery(RITA) was not harvested in these cases. Radial artery and saphenous veins were harvested and used as grafts.

We had a posterior pericardial holding stitch taken in the posterior pericardium about 5cm inferior and lateral to the inferior pulmonary vein.

At the end of the hemostasis, we performed a longitudinal incision staring from this point to the diaphragm, parallel to the left phrenic nerve. Two chest tubes of size 32 F, were used in all the patients, all were of the same brand. (Thoracic Trocar &Cannula-Pacific Hospital Supply-pashco@pashco.com.TW.-Taiwan). A single separate stab was done at the lower end of the mid-line skin incision, introducing from this stab a chest tube, penetrating the rectus sheath, positioned in the anterior mediastinum. The other tube was inserted separately in the left 5th intercostal space midaxillary line ,directed to the apex of the left thoracic cavity (in group A). In group B, the pericardial stitch were removed without making the pericardiotomy, we made two separate stabs at the lower end of the midline chest skin incision, two tubes inserted penetrating the rectus sheath, the right was the anterior mediastinal drain, the left was directed to the left pleura via the pericardial fat and rested on the left copula of the diaphragm. We never positioned a retro-cardiac tube for our experience with this bad position which caused sometime injury of the epicardium, myocardium, coronary veins and injury or occlusion of the grafts to the PDA or the PL coronary arteries. also may lead to arrhythmias due to continuous friction with the heart. The used bottles in all cases were Atrium. (Atrium Medical Corporation., Hudson, New Hampshire, USA).

The two drains in group B were connected to one bottle, while in group A, each tube was connected to a single bottle. The two bottles were connected to low suction system in the ICU (5-10mm Hg) continuously. The tubes were occasionally milked every hour to ensure patency.

Indications to remove the drains

Despite the controversy ,when to remove the tubes, as some centers have a routine to remove it second postoperative day as long as there are amounts below 1000cc,yet we removed it when :it was serous or if the amount drained was less than 20cc/ hour. We followed the patients with continuous monitoring on bed in the ward and daily 12-lead ECG at 8AM ,and 8PM.,and daily plain erect CXR- PA view, in the ICU and in the ward. At the follow-up, after hospital discharge, weekly for one month, to detect development of pleural effusion and any arrhythmias. Two-dimensional echocardiography was done just before tubes removal, whatever the timing of drains removal, and it was variable for all patients, then one day before hospital discharge.

After hospital discharge, follow up echocardiography was performed at 2 weeks, 1 month and 3 month after discharge ,in the OPD.The presence of pericardial effusion was assessed by criteria described by Martin and colleagues(Mayo clinic .com). The maximum diastolic separation between the pericardium and the epicardium was measured at the level of the tip of the mitral valve leaflet.Any effusion greater than 10mm was considered significant.Cases of posterior effusion were reported and followed –up at the OPD after discharge, patients with mild effusions were discharged to be followed-up, patients with moderate or large effusions were delayed to monitor the development of tamponade or arrhythmias.

Statistical analysis

was carried out using the SPSS software. (SPSS Inc, Chicago IL). Clinical data were expressed as numerical, percentage, mean± SD. and as p value. (P< 0.05 showed significant statistical difference).

Results

The operated patients were 150 in each group,prospectively randomized, with a range of age 34-63 years old, and a mean age of 51.6±9 years in group A, in group B the range of age was 37-64years old with mean of 50.77±9years. The p-value was insignificant. (<0.22).

There was 141 males (94%) in group A, and 142 (94.6%)in group B, with p-value (<0.8).(Table-2),(figure-1)

There was no clinical significance in both groups regarding the associated clinical status (hypertension-diabetes-smoking-lipid profile). Also the preoperative recent myocardial infarction (MI) had no effect on the outcome.

19 patients in group A(12.6%) and 21pqtients in group B (14%) had recent MI, with p-value(<0.4).The preoperative EF% in both groups was almost equal(the mean EF was;44% in group A and 44.19% in group B**(table2,3& figure 1,2).**

We had no operative or postoperative mortalities in both groups , we did not have any complications related to the proposed procedure, whether the pericardiotomy or the intercostal and the mediastinal tubes.

We did not have any significant difference between both groups regarding the mean duration of surgery which was 2.69±0.3hours in group -A , and 2.73±0.4 in group- B ,with p-value (0.25);and no impact of the number of distal anastomoses on the outcome. The ICU and the total hospital stay showed no difference in both groups; p-value (0.53 and 0.6)respectively. The total drain from the tubes showed significant difference between both groups as in group A ,it was 653±112cc while in B it was 395.9±66cc(mean ± SD) with p-value (<0.001) ,this showed the better drainage using the separate intercostal tube(**table- 4)(figure-3).**

In group A, we did not have tamponade, yet one patient was only explored for surgical bleeding from a mammary branch and was controlled and survived, during the period of bleeding, the hemodynamics were stable as he was receiving volume replacement and the CVP was always maintained. The indicators for bleeding were the draining tubes and the hemoglobin drop, the mediastinum and the left pleura were always drained.

In group B had 4 patients with cardiac tamponade; all were reexplored ;3 had surgical bleeding;2 from the steel wire, one from the sternal mammary bed, the fourth from slipped clip on the radial artery. All presented with high CVP, tachycardia, low blood pressure and the last one was about to arrest, during these ;3 of them had little increase in the drain which was bad indicator for bleeding as most of the blood was collecting in the pericardium. All the 4 patients were re-explored and survived without any residual effect, but we add pericardiotomy and separate chest tubes for the four patients after the reexploration. The p value<0.025 showing statistical significant difference. There were significant statistical differences between both groups regarding the early and late pericardial effusion by all its grades: Early and late there were only recorded cases of small or minimal amounts of collection which might be due to decreased size of the performed window, but no registered case of moderate or large size effusions whether early or late. In group B, there were early cases of small amounts double that of group A, (A=15 cases-10% while in B= 39 cases-26%) p value <0.04. Moderate pericardial effusion was 52.6% (early) and 33.3% (late).while the large effusion was 21.3% (early) and 24.7% (late), **(figure -5**). in group B only 6 cases required subxiphoid drainage, due to cardiac compression affecting the hemodynamics of this effusion; the others were on routine anti-inflammatory and diuretics with slow response with no effect on the hemodynamics. There was more pleural effusion in cases of group B than in A,(4cases in A-2.6%, and 67cases in B-44.6%)the effusion in patients of group A was just recess obliteration, while in B it varied from mild (23cases-15.3%),

moderate effusion, exceeding the angle up to the mid-lung zone, (38 cases-25.3%),and massive pleural effusion exceeding the mid-lung zone,(6cases-4%).The underlying left basal lung collapse was the same as with the pleural effusion, figure(4). There was significant effect of the procedure on the occurrence of arrhythmias especially the AF, as it was 10% in group A and 30% in B, with p<0.01;there were no significant difference between both groups as regards atrial flutter(0.6 % in A and 1.3% in B), and ventricular arrhythmias, 2%in A, and 2.6 % in B, (**table -5**)(**figures:4-5-6).**

	group A(n=150)	Group B(n=150)	p- value	Significance
Age	Mean:51.6+_9 y	50.77 +_9y	0.22	NS
Gender M/F	141/9 (94%)	142/8(4.6%)	o.80	NS
Weight(kg)	82±6.3	81±8.2	0.62	NS
Height(cm)	172±5.3	173±7.6	0,50	NS
BSA	1.73±0.2	1.78±0.3	0.37	NS

M=male, F=female, NS=not significant.

Table 2. Patients demographic data:

Parameter	Group A(n=150)	Group B(n=150)	p- value	Significance
Diabetes	84(56%)	78(52%)	0.37	NS
Hypertension	62(41.3%)	82(54%)	0.64	NS
Renal impairment	9(6%)	11(7.3%)	0.15	NS
Preoperative Ejection fraction	44%	44.19%	0.8	NS
Hyperlipedemia	69(46%)	73(48.6%)	0.45	NS
Recent myocardial infarction	19(12.6%)	21(14%)	0.4	NS

Table 3. Preoperative clinical status.

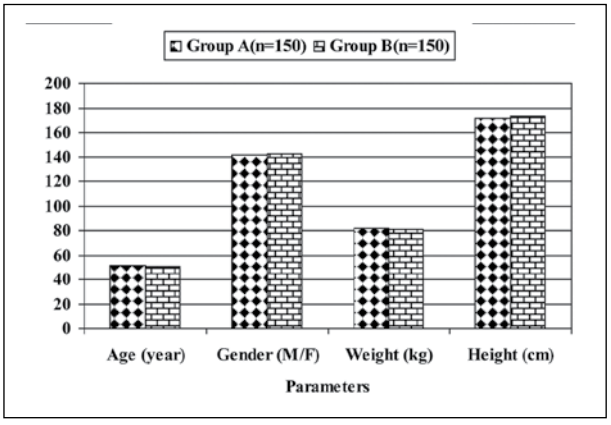

Fig 1. Demographic data of both groups.

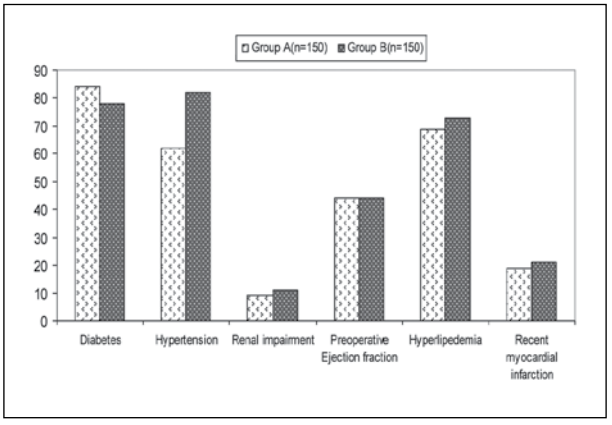

Fig 2. Preoperative clinical status.

Parameter	Group A	Group B	P –value	Significance
Operation duration(hr)	2.69±0.3	2.73±0.4	0.25	NS
Number of grafts	3.7±1.1	3.9±1.3	0.8	NS
Total drain/cc	Mean:653.12+_112cc	395.9+_66CC	0.001≤	Significant
ICU .stay.	Mean:2.154 days	2.6	0.53	NS
Total hospital stay	Mean:6.36 days	8.94	0.6	NS

Table 4. Operative and hospital stay data

	Group A Number percentage	Group B Number percentage	P-value	Significance
Tamponade.	O 0%	4(n)=2.6%	0.025	significant
Early pericardial. effusion (After drain removal.)	Small:15 10%	Small:39 26% Moderate:79 52.6% Large:32 21.3%	0.04 0.0013 0.007	significant
Late pericardial .effusion (Two weeks after discharge)	Small:4 2.6%	Small:63 42% Moderate:50 33.3% Large:37 24.7%	0.009 0.003 0.0027	significant
Pleural effusion.	4 2.6%	67 44.6%	0.004	significant
Basal lung. Collapse	4 2.6%	67 44.6%	0.004	significant
Re-explorat.	1 0.6%	4 2.6%	0.015	Significant
Subxiphoid .drain	0 0%	6 4%	0,006	significant
Ventricular.arrhythmias.	3 2%	4 2.6%	0.5	NS
Atrial flutter	1 0.6%	2 1.3%	0.11	NS
Atrial fibrillation	15 10%	45 30%	0.01	significant

Table 5: postoperative complications:

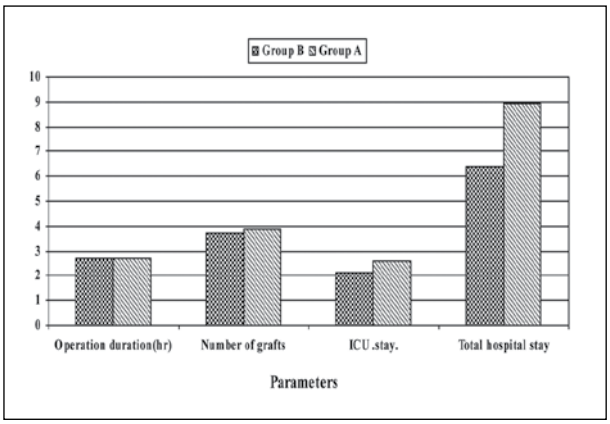

Fig 3. Operative and hospital stay data.

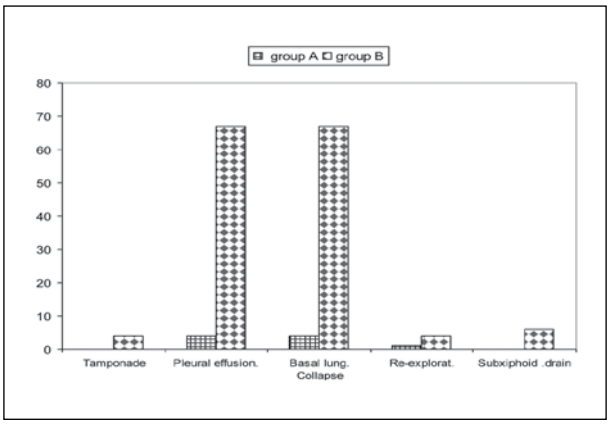

Fig 4. post operative complications in both groups.

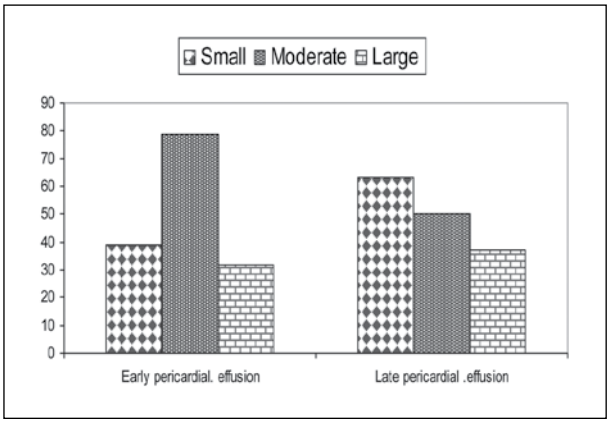

Fig 5. Postoperative early and late pericardial effusion.

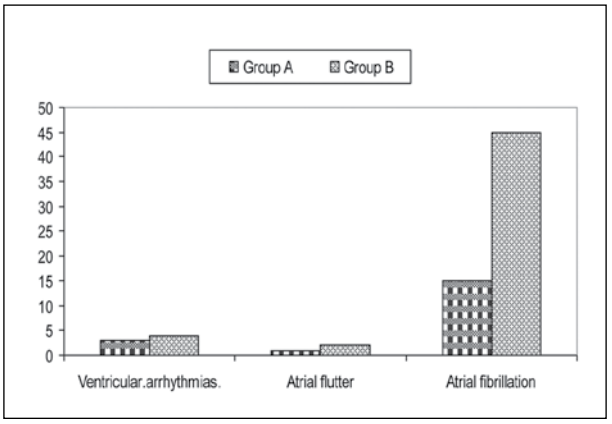

Fig 6. Posstoperative arrhythmias.

Discussion

Proper drainage , proper placement and patency of the tube drains are the key for smooth safe postoperative course, with the increasing number of cases and their complexity ,medically, it is not accepted to have a lot of complications due to bad drainage.(7)

Reports have mentioned the role of the pericardial effusion in the development of the arrhythmias especially , AF , and the high incidence of AF with cases of operated CABG, which is 15-30% and may be 40%,,though various causes, have been proposed, yet the definite causes and the prophylaxis are not yet clear, yet one cause may be the pericardial effusion ,early digitalization was previously described to decrease its incidence, and the role of beta blockers had been proposed.(14-17) the deleterious effect of the improperly drained pericardium is clear ,causing even tamponade, though rare yet may be fatal in early and late post-operative periods.(18)

The anterior pericardium is a tight narrow space ,but it is well drained as it is lying between two squeezing organs, the sternum in the front and the heart posterior ,so anterior collection is not common ,it is occupied by clots rather than effusion which is concentrated mainly posterior or posterior and lateral, the role of percutaneous echocardiography guide drainage have been described and practiced ,but we have our experience in the subxiphoid drainage which is easier, more convenient, could be done under local anesthesia in critical patients and no new incision is required ,so we prefer it regarding as superior to pericadriocentesis .(18) (19)

Mulay and associates (20) have reported that posterior pericardiotomy could drain posterior in the left pleural space thereby reducing the development of pericardial effusion, eliminating the possibility for tamponade and decreasing the incidence of supraventricular arrhythmias.(20)(21)(22)(23)

They demonstrated that patients subjected for posterior pericardiotomy had an 8% AF incidence ,while those not having it were more exposed,36%.(20)(23)

Other authors had shown that , posterior pericardiotomy decreases the pericardial effusion with no effect on the SVTs,20%in comparison with the conventional technique, 26%. (Asimakopoulos and coworkers).(11)

But this may be due to the inclusion of the bad left ventricle or myopathic patients and the intake of the beta blockers preoperatively.(23)

Erkan and his colleagues excluded these patients from their study and they got better results yet insignificant statistically on the SV arrhythmias ,but there was significant statistical difference regarding the AF.(22)(23)

Both of them declared that there is no significant effect of this technique on the lung and pleural effusion.

Our study revealed the significant effect of posterior pericardiotomy together with separate insertion of the left drain in the ICS, and we had a better drain for both the pericardium and left pleura, these reduced significantly the incidence of AF from more than 30% to 10%,and pericardial effusion yet still statistical insignificant difference in tamponade yet numerically it is less by using this technique, though there is little statistical significance, yet the posterior pericardiotomy was acting as a safety valve in cases of bleeding ,giving us a clue to bleeding as well as it drains the pericardium preventing the tamponade ,this was clear in the only patient explored for bleeding in group (A), as he never tamponade all through, while the other group gave a clear picture of tamponade in the 4 patients due to the absence of the safety valve (posterior pericardiotomy), although there were clear numerical differences in this aspect yet statistically it is not that clear ;this may be due to its rarity showing no statistical difference which may need mega analysis.(21,22,6,7)

The SV arrhythmias and the tamponade in our study showed the same trend as in the study of Asimakopoulos as we included patients receiving beta blockers and low EF% patients.(11)

In contrast to other studies we had significant statistical difference regarding the basal lung collapse and the pleura effusion , the drain was better in group A, giving more amount with an average difference of about 300cc which was enough to stagnate in the recess leading to more reaction and subsequent basal lung collapse , this may be due to the separate chest tube in the pleura draining it optimally.(13)(11)(23)

Conclusion

Posterior pericardiotomy is acting like a safety valve; it is a safe easy incision to make saving the patient from tamponade ,early and late pericardial effusions ,and shares in the decreasing incidence of arrhythmias mainly the AF. Together with separate left pleural tube it reduces the pulmonary basal collapse and the pleural effusion which may cause postoperative fever and shortness of breath, delaying the recovery causing more costs and longer hospital stay.

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Prosthetic Cardiac Valve Replacement "CardiaMed": Evaluation of Short-term Outcome

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Objectives: **To determine short-term outcome of valve replacement (VR) using CardiaMed valve.**

Patients & Methods: **The study included 39 patients; 19 patients were assigned for aortic VR and 20 patients for mitral VR. All patients underwent clinical status rating using New York Heart Association (NYHA) classification and echocardiographic data collected preoperatively and at the end of follow-up. Operative and postoperative (PO) details and valve-related complications were defined. Thirty-days PO and late mortality were determined. Patients' satisfaction with the surgical outcome was graded using a 5-point scoring system.**

Results: **Immediate PO complications included cardiac rhythm related complications in 11 patients, infectious complications in 9, high-serum creatinine in 3 and para-valvular leak (PVL) in 3 patients. Two patients developed endocarditis, but one patient deteriorated and died on the 18th PO day. Another patient developed massive gastric bleeding during the 5th PO month and died on the next day. At the end of 20 months follow-up, the frequency of patients among NYHA classes and its mean value were significantly improved compared to preoperative frequency. Patients had AVR showed significant improvement of estimated Echo parameters in comparison to preoperative data, while patients had MVR showed significantly improved pressure gradient, however, other parameters were non-significantly different. Twenty-five patients were satisfied, 11 patients found results are good and only 2 patients found the outcome poor with non-significant difference between patients had AVR and MVR.**

Conclusion: **Cardiamed prosthetic VR is safe and effective for functional and echocardiographic improvement and provided satisfactory short-term outcome.**

Keywords: **Cardiamed prosthetic valve, Valve replacement surgery, Functional outcome, Patients' satisfaction.**

Both mechanical and bioprosthetic heart valves have become more durable and less thrombogenic, possessing excellent clinical outcomes and hemodynamic features. However, lifelong anticoagulant therapy is inevitable for patients with mechanical prosthetic valves, and those with bioprosthetic valves have higher risks of structural valve dysfunction than those with mechanical ones. In mechanical valves, bileaflet prosthetic heart valves are more preferably implanted than tilting disc valves, and surgeons choose some of them for valve replacement according to their own preference and the patients' informed consent [1, 2, 3].

Many long-term clinical results showed excellent clinical performances of mechanical prostheses. Mechanical prosthetic heart valves have an extremely low rate of structural failure and, with proper anticoagulation, the risk of thromboembolism is similar to the use of bioprosthetic ones without anticoagulants. Therefore, mechanical prostheses would be the choice for patients with longer life expectancy and no contraindication for anticoagulation [4, 5, 6].

Cardiamed valve, a prosthesis that was designed to be free from the shortcomings intrinsic to the valves like St. Jude Medical prosthesis. The housing and leaflets of

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Codex : o3/15/1301

the Cardiamed valve are made from solid isotropic pyrolytic carbon. Due to uniqueness of the technology for production of the solid pyrolytic carbon, which is unavailable to the other current world manufacturers of heart valve prostheses, the material has unique properties with respect to its strength and reliability [7, 8].

Comparison of the main characteristics for both types of material used for heart valve applications included specific weight; both types of material have the same specific weight about 2.1 g/cm^3, hardness; both types of material have sufficient hardness above 1000 Mpa, isotropy; both types of material are isotropic, but in contrast to the coated material, the degree of isotropy for the solid material is not just validated but is inspected for each workpiece in order to be sure of isotropic properties of the material, anisotropic inclusions due to fluctuations in the manufacturing processes could occur in both types of material, control over this phenomenon in the coated material is done by validation process which is incapable to provide complete assurance. The absence of anisotropic inclusions in the solid material is verified for each workpiece. Strength; the solid material is 1.5 stronger than the coated material [7, 8].

The current prospective study aimed to determine the short-term outcome of valve replacement using CardiaMed valve.

Patients & Methods

The current prospective study was conducted at Cardiosurgery departments, Benha University Hospital and Naser Institute since Jan 2011 till Feb 2012 to allow a minimum follow-up period of 12 months for the last case operated upon. All patients assigned for single valve replacement, either aortic or mitral were included in the study. Exclusion criteria included end-stage cardiac failure, irreversible major organ failure or terminal cancer with expected survival for <12 months, cerebro-vascular disease or neurological deterioration, active endocarditis, sepsis or active infection at time of implantation, any previous prosthetic valve replacement, multiple valve disease, emergency cardiac surgery.

All patients underwent preoperative full history taking and clinical examination, and laboratory investigations. Clinical status was rated using the New York Heart Association (NYHA) classification and echocardiographic data were collected preoperatively and at the end of follow-up.

All patients were operated with cardiopulmonary bypass (CPB) under moderate hypothermia (32–34ºC). A cold hyperkalemic crystalloid solution was used for myocardial protection. Postoperatively all patients were admitted to the intensive care unit (ICU). Anticoagulation therapy was initiated on the first postoperative (PO) day with heparin administration (5000 units subcutaneously, every 8 hours in order to achieve a partial thromboplastin time (PTT) between 60 and 80s. Oral intake of cumarin was started concurrently with heparin on the 1st PO day if possible. The target International Normalized Ratio (INR) was 2 to 2.5 for aortic valve replacement (AVR) and 2.5 to 3.5 for mitral valve replacement (MVR). Follow-up for anticoagulant monitoring was scheduled at time of discharge from the hospital and monthly or bimonthly postoperatively. For patients with atrial fibrillation who have mechanical valves, an INR of at least 2.5 is recommended, but for aged patients with some risk factors for cerebral bleeding, an INR is below 2.5 [9].

Perioperative mortality was defined as death occurring within 30 days of cardiac surgery, or death prior to hospital discharge regardless of cause. Late mortality was defined as mortality after 30 days of cardiac surgery and hospital discharge. The cause of death was classified as being non-cardiac, cardiac but of a valve related cause (due to valve related complications) or cardiac of a non-valve related cause (heart failure, myocardial infarction, arrhythmia, sudden death). The valve related complications were defined according to the guidelines for reporting mortality and morbidity after cardiac valve interventions as hemorrhage, thrombo-embolism, prosthetic valve endocarditis, device thrombosis, structural valve deterioration and non-structural dysfunction including paravalvular leak [10-13].

Patients' satisfaction with the surgical outcome was graded at end of follow-up using a 5-point scoring system with 4: highly satisfactory, 3: satisfactory, 2: good, 1: poor and 0: unsatisfactory.

Statistical analysis

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

Results

The study included 39 patients; 17 males and 22 females with mean age of 43.4±10.7; range: 24-56 years. Sixteen patients were obese, 15 patients were overweight and 8 patients had average BMI, with a mean total BMI of 29±3.3; range: 21-34.5 kg.m^2. Seven patients were smokers, 5 patients were Ex-smokers and 27 patients were never smokers. Twenty-one patients had associated co-morbidities in varied combinations, (Table 1).

Nineteen patients were assigned for AVR; 10 for aortic regurgitation, 5 for aortic stenosis and 4 for combined lesion. Twenty patients were assigned for MVR; 8 for mitral regurgitation, 5 for mitral stenosis and 7 for combined lesion. As regards etiology of valve disease; 17 patients had rheumatic valve disease, 8 patients had degenerative valve disease, 5 patients had endocarditis-related valvular disease,

4 patients had bicuspid aortic valve and 2 patients had aortic valve anuloectasia. Concerning the frequency of disease-related morbidities; 11 patients had previous cardiac surgery, 13 patients had atrial fibrillation, 8 patients were maintained on anticoagulant therapy and 9 patients had SPAP ≥50 mmHg. Twenty-one patients were of functional status III, 7 patients were of functional status II, another 7 patients were of functional status IV and 4 patients were of functional status III, (Table 2).

Mean aortic ischemia time was 54.9±5.5; range: 45-65 minutes; 10 patients were exposed to ischemia for <50 minutes, 21 patients for 50-60 minutes and 8 patients for >60 minutes. Mean CPB time was 86.8±13.7; range: 60-110 minutes and mean total operative time was 176.2±1.4; range: 130-220 minutes, (Table 3).

All patients passed surgery uneventful without intraoperative complications or mortalities. Five patients (12.8%) required mechanical ventilation for more than 24 hours, mean ICU stay was 2.9±1.1; range: 1-5 days and mean total hospital stay was 6.7±2.5; range: 3-14 days. Fourteen patients developed cardiac rhythm related complications; 11 developed arrhythmia and 3 developed ventricular fibrillation, however all cases were controllable. One patient developed pneumothorax and required drainage till complete resolution within 4 days after surgery. Nine patients had varied infectious complications. One patient developed transient ischemic attack and three patients had serum creatinine >1 mg/dl. Three patients developed para-valvular leak (PVL), but fortunately it was mild leak that did not require re-operation and was followed conservatively, (Table 4).

Throughout the first 30-day, two patients had mitral valve replacement developed prosthetic valve endocarditis, both were followed conservatively, but unfortunately, one patient showed deterioration and developed a stroke on the 13th day after surgery and died on the 18th PO day. Another patient developed massive gastrointestinal bleeding during the 5th PO month, but unfortunately he was away from the hospital and badly managed at home and died on the second day of development of the bleeding attack. All survivors attended the hospital for follow-up for a mean duration of follow-up of 20.1±2; range: 16-24 months. Throughout the follow-up period, no valve-related complications were reported.

Data				Findings
Age (years)	Strata	<30		7 (18%)
		30-40		8 (20.5%)
		>40-50		11 (28.2%)
		>50		13 (33.3%)
	Total			43.4±10.7 (24-56)
Gender	Male			17 (43.6%)
	Female			22 (56.4%)
Anthropometric data	Weight (kg)			84.2±9.7 (63-95)
	Height (cm)			170.3±3.6 (161-178)
	BMI (kg/m^2)	Strata	<25	8 (20.5%)
			25-30	15 (38.5%)
			>30	16 (20.5%)
		Total		29±3.3 (21-34.5)
Smoking	Non-smokers			27 (69.2%)
	Ex-smokers			5 (12.8%)
	Still smokers			7 (18%)
Associated co-morbidities	Arterial hypertension			13 (33.3%)
	Peripheral vascular disease			2 (5.1%)
	Diabetes mellitus			4 (10.3%)
	Renal dysfunction			1 (2.6%)
	Dyslipidemia			4 (10.3%)
	Endocarditis			5 (12.8%)

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

Table 1. Patients' enrollment data

		AVR	MVR	Total
Diseased valve status	Stenosis	10 (52.6%)	5 (25%)	15 (38.4%)
	Regurgitation	4 (21.1%)	8 (40%)	12 (30.8%)
	Combined disease	5 (26.3%)	7 (35%)	12 (30.8%)
	Total	19 (48.7%)	20 (51.3%)	39 (100%)
Etiology of valve disease	Rheumatic	4 (21.1%)	13 (65%)	17 (43.6%)
	Degenerative	5 (26.3%)	3 (15%)	8 (20.5%)
	Endocarditis	3 (15.8%)	2 (10%)	5 (12.8%)
	Myxametous	1 (5.3%)	1 (5%)	2 (5.1%)
	Bicuspide	4 (21.1%)	0	4 (10.2%)
	Anuloectasia	2 (10.5%)	0	2 (5.1%)
Disease-related morbidities	Previous valve surgery	3 (15.8%)	8 (40%)	11 (28.2%)
	Atrial fibrillation	2 (10.5%)	11 (55%)	13 (33.3%)
	Anticoagulation	1 (5.3%)	7 (35%)	8 (20.5%)
	SPAP (≥50 mmHg)	1 (5.3%)	8 (40%)	9 (23.1%)
NYHA class	I	3 (15.8%)	1 (5%)	4 (10.2%)
	II	4 (21.1%)	3 (15%)	7 (18%)
	III	9 (47.3%)	12 (60%)	21 (53.8%)
	IV	3 (15.8%)	4 (20%)	7 (18%)
	Mean±SD	2.63±0.96	2.95±0.76	2.79±0.86
EF (%)	<35	3 (15.8%)	2 (10%)	5 (12.8%)
	>35-45	2 (10.5%)	1 (5%)	3 (7.7%)
	>45-55	5 (26.3%)	7 (35%)	12 (30.8%)
	>55-65	6 (31.6%)	7 (35%)	13 (33.3%)
	>60	3 (15.8%)	3 (15%)	6 (15.4%)
	mean±SD	53.9±10.8	55.7±10.4	54.7±11.1

Data are presented as mean±SD & numbers; ranges & percentages in parenthesis; SPAP: systolic pulmonary artery pressure; NYHA: New York Heart Association; EJ: ejection fraction.

Table 2. Patients' preoperative clinical data

Data		Findings
Aortic ischemia time (min)	<50	10 (25.6%)
	50-60	21 (53.8%)
	>60	8 (20.8%)
	Total	54.9±5.5 (45-65)
CPB time (min)		86.8±13.7 (60-110)
Operative time (min)		176.2±19.4 (130-220)

Data are presented as mean±SD & numbers; ranges & percentages in parenthesis; CPB: cardiopulmonary bypass

Table 3. Patients' operative data

Functional outcome as determined by evaluation of NYHA class showed significant improvement at the end of follow-up period, both as the frequency of patients among classes and as a mean total value of the classes. The higher improvement reported in patients had mitral valve replacement compared to those had aortic valve replacement could be attributed to the higher frequency of mitral valve patients among low-function classes preoperatively, (Table 5, Fig. 1).

Echocardiographic data of patients had AVR determined at end of follow-up showed significant ($p<0.05$) improvement of estimated parameters in comparison to preoperative data. On contrary, MVR significantly ($p<0.05$) improved pressure gradient across the valve, however, other parameters showed non-significant ($p>0.05$) improvement in comparison to preoperative data, (Table 6).

Data			Findings
Mechanical ventilation >24 hr			5 (12.8%)
ICU stay (days)			2.9±1.1 (1-5)
Total hospital stay (days)			6.7±2.5 (3-14)
Mortalities			0
Postoperative complications	Cardiac complications	Arrhythmia	11 (28.2%)
		Ventricular fibrillation	3 (7.7%)
	Pneumothorax		1 (2.6%)
	Infectious complications	Endocarditis	2 (5.2%)
		Superficial wound infection	2 (5.2%)
		Chest infection	2 (5.2%)
		Urinary tract infection	3 (7.7%)
		Total	9 (23.1%)
	Neurological complications		1 (2.6%)
	Renal insufficiency (serum creatinine> 1mg/dl)		3 (7.7%)
	Para-valvular leak		3 (7.7%)

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

Table 4. Patients' immediate postoperative data

		Preoperative (n=39)			End of follow-up (n=37)		
		AVR	MVR	Total	AVR	MVR	Total
I		3 (15.8%)	1 (5%)	4 (10.2%)	8 (44.4%)	5 (26.3%)	13 (35.1%)
II		4 (21.1%)	3 (15%)	7 (18%)	9 (50%)	12 (63.2%)	21 (56.8%)
III		9 (47.3%)	12 (60%)	21 (53.8%)	1 (5.6%)	2 (10.5%)	3 (8.1%)
IV		3 (15.8%)	4 (20%)	7 (18%)	0	0	0
Sig.	X^2=				31.404	66.430	43.249
	p				<0.001	<0.001	<0.001
Mean±SD		2.63±0.96	2.95±0.76	2.79±0.86	1.61±0.6	1.84±0.6	1.73±0.6
Sig.	Z				3.819	4.185	5.652
	p				<0.001	<0.001	<0.001

Data are presented as mean±SD & numbers; ranges & percentages in parenthesis. Sig.: significance; p: significance versus preoperative data

Table 5. Patients' NYHA data determined at end of follow-up in comparison to preoperative data

			Pressure gradient (mmHg)	EF (%)	EDV (ml)	ESV (ml)	LVPWD (cm)
AVR	Preoperative		43.5±12.7	56.8±9	172.1±28.7	74.4±10.2	1.4±0.28
	End of follow-up		12.3±4.4	62.4±4.9	142.8±30.9	46.9±11.8	1.17±0.19
	Sig.	Z	3.725	2.366	2.819	3.660	2.729
		p	<0.001	=0.018	=0.005	<0.001	=0.006
MVR	Preoperative		16.5±1.9	56.5±12.3	146.4±17.4	58.4±12.6	1.03±0.15
	End of follow-up		7.9±0.9	58.6±8.5	137.9±10.8	56.5±7.6	0.96±0.27
	Sig.	Z	3.825	1.604	1.772	0.521	0.830
		p	<0.001	>0.05	>0.05	>0.05	>0.05

Data are presented as mean±SD; ranges are in parenthesis. Sig.: significance; p: significance versus preoperative data; AVR: aortic valve replacement; MVR: mitral valve replacement; EF: ejection fraction; EDV: end-diastolic volume; ESV: end-systolic volume; LVPWD: Left ventricle posterior wall dimension

Table 6. Patients' Echocardiographic data determined at end of follow-up in comparison to preoperative data

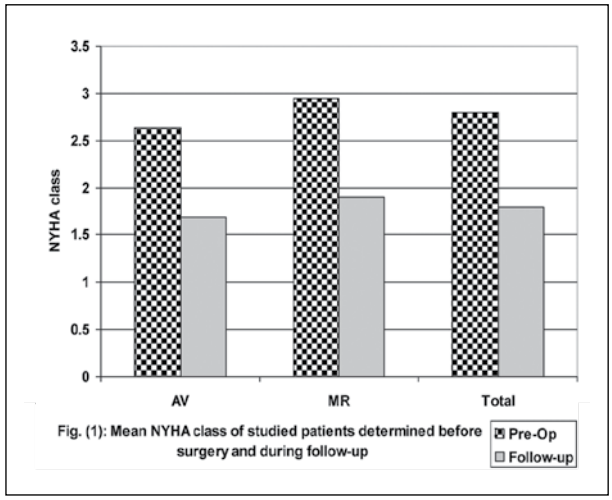

Fig. (1): Mean NYHA class of studied patients determined before surgery and during follow-up

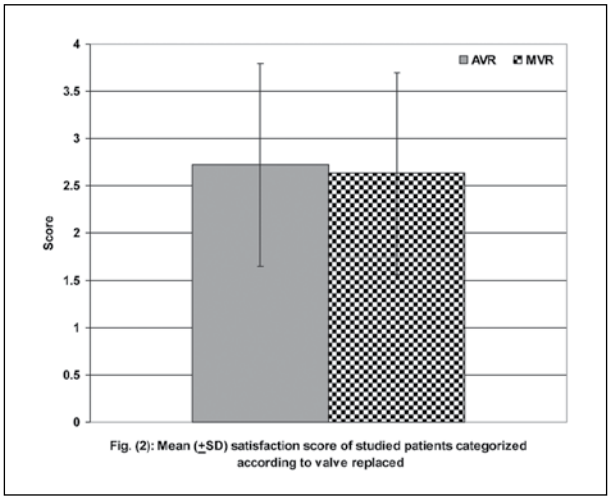

Fig. (2): Mean (±SD) satisfaction score of studied patients categorized according to valve replaced

		AVR	MVR	Total
Score	1	1 (5.6%)	1 (5.3%)	2 (5.4%)
	2	5 (27.8%)	6 (31.6%)	11 (29.7%)
	3	6 (33.3%)	7 (36.8%)	13 (35.2%)
	4	6 (33.3%)	5 (26.3%)	11 (29.7%)
Mean		2.94±0.94	2.84±0.9	2.89±0.9

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

Table 7. Patients' satisfaction scoring determined at end of follow-up

Eleven patients showed high satisfaction; 14 patients were satisfied, 11 patients found results are good and only 2 patients found the outcome poor. There was non-significant (p>0.05) difference between patients had AVR and MVR as regards mean satisfaction score and frequency of patients among score strata, (Table 7, Fig. 2).

Discussion

The current study reported favorable outcome of valve replacement using Cardiamed prosthetic valve manifested functionally as significant improvement of patients' distribution among NYHA classing system with significantly better mean total score compared to preoperative data. Moreover, implantation of Cardiamed valve significantly reduced the

pressure gradient across the valve both in case of AVR and MVR. In line with these data; **Nemchenko & Eliseev** [14] evaluated the results of MedEng "Cardiamed" bicuspid mechanical mitral valve implantation in comparison to St. Jude, ATS and Carbomedics valves and found the peak gradient on the prosthesis was significantly lower with MedEng and the survival rate, freedom from thromboembolism and reoperation rates were 98%, 95.9% and 99% after 1-year follow-up.

The 30-day mortality rate was 2.6% and the late-mortality rate was 2.6% for a total mortality rate of 5.2% till the end of 20 months follow-up. In hand with these data, **Zheleznev et al.** [8] reported a hospital mortality rate of 4.2% after MVR using Cardiamed prosthetic valve.

Moreover, the reported mortality rates coincided with that reported with the implantation of other types of prosthetic valves; **Van Nooten et al.** [15] reported an in-hospital mortality rate of 4%. **Rodrigues et al.** [16] reported operative mortality for AVR and MVR of 7% and 7.5%, respectively with freedom from late mortality was 81.8% at 10 years for MVR and 83% for AVR, and freedom from valve-related death at 10 years for the MVR cohort and AVR was 85.6% and 88.7%, respectively. **Kaer et al.** [17] found that 4.9% of their series died of postoperative complications and concluded that valve replacement surgery is still an effective therapy for valvular diseases in Xinjiang area and enhancing preoperative care for elders and patients with poor cardiac function can decrease the perioperative complications and mortality rate so as to improve the surgical efficacies. **Taniguchi et al.** [18] reported early death within 30 days after ATS Open Pivot mechanical valves implantation of 2.5 % and a total 10-year survival rate after the operation of about 82.7%.

On contrary, the reported mortality rates were lower compared to **Ragnarsson et al.** [19] who reported a 30-day mortality rate of 9% after isolated MVR and attributed this high figure to the severity of the underlying heart disease.

Concerning valve-related complications; 3 cases (7.7%) had PVL which was mild and managed conservatively. The reported frequency of PVL was low compared to that reported by **Wąsowicz et al.** [20] who found a total rate for PVL of 12% and its presence was associated with postoperative infection. However, in line with the conservative management, **Wąsowicz et al.** [20] found that at the 1-year transthoracic echocardiographic follow-up detected only 2 of 27 patients had residual leak after MVR and none after AVR. Also, **Cho et al.** [21] documented that in patients who develop PVL after AVR, repeat surgery may be deferred, while in patients with PVL after MVR, more aggressive therapeutic approaches should be considered. **Kuwabara et al.** [22] explored the pathogenesis of PVL after valve replacement and attributed leak after AVR to laxation of sutured threads without frequent sites, while after MVR to cutting annulus tissue around the anterior commisurae after MVR.

As regards infective complications, 9 patients developed infections; 2 of them had valve-related endocarditis, but unfortunately, one patient showed deterioration and developed a stroke on the 13th PO day and died on the 18th PO day. Such event could not be attributed to faulty anticoagulant therapy nor to valve-related thrombosis, as this is the only event recorded throughout the follow-up period and considering this case to be unique in the series it represents a frequency of 1.3% /patient-year of follow-up which coincided with that previously reported by **Taniguchi et al.** [18] who found the incidence of valve-related complications with the ATS mechanical heart valve prostheses was 2.19 %/pt-yr; of these, the incidence of thromboembolic events and bleeding complications were 1.22 and 0.87 %/pt-yr, respectively.

The effectiveness and safety of the Cardiamed prosthetic valve and the follow-up free of valve-related thrombosis could be attributed to the inherent distinguishing features of this type of prosthesis; wherein the occluder is made as two leaflets that pivot from open position to closed position, the sewing cuff is made of special warp knitted polyester fabric, the valve housing is reinforced with a stiffening ring made of titanium alloy and the leaflets rotate around the central axis of the valve housing without restricting the rotating blood flow and eliminate the localization of all stasis zones in the bloodstream. Moreover, the valve generates the swirling of blood flow in the heart chambers thus improving the washing of inner cardiac structures. The valve leaflets have a special aerodynamic shape for creating smoothly spreading blood flow, thus preventing blood flow turbulence and speeding valve closure and opening. The valve generates a controlled regurgitant blood flow for proper washing of its hinge mechanism. The valve has a barrier projecting above the sewing cuff that protects valve orifice from pannus ingrowth that covers sewing cuff [23, 24].

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Renal dysfunction after CABG in patients with preoperative mild renal impairment

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Introduction: **Acute changes in renal function after coronary bypass surgery are not well understood and incompletely categorized, and represent a challenging clinical problem. Many reports have described the results of coronary surgery in patients with end-stage renal disease but, there have been a limited number of studies reporting the outcome of patients with mild or moderate renal dysfunction and not on dialysis. The objective of that study was to evaluate the influence of a pre-operative mildly increased creatinine serum level (1.3–2.0 mg/dl) on postoperative mortality, morbidity and renal functions in CABG patients aiming to provide recommendations helpful to improve post-operative prognosis and to minimize postoperative renal dysfunction in CABG patients.**

Patients & methods: **That prospective non-randomized study included 50 patients undergone elective coronary artery bypass grafting (CABG) on cardiopulmonary bypass in Kasr Al-Ainy University Hospital, Cairo University in the period between June 2011-May 2012 after obtaining the approval of the local ethical committee. Patients were divided into 2 groups according to their preoperative serum creatinine value: Group(1) Patients having serum creatinine values falling in our institution's normal range of 0.3 mg/dl to 1.2 mg/dl. Group(2) Patients having serum creatinine values equal to or above 1.3 mg/dl and reaching up to 2.0 mg/dl**

Results: **both groups were matched regarding preoperative parameters as :age, sex, BMI and risk factors for IHD except that group 2 showed significantly higher incidence of DM. Intra operative result showed that patients with impaired renal function showed lower intraoperative urine output than patients with normal renal functions. Postoperative results showed that patients with impaired renal functions showed a significantly higher duration of post-operative ICU stay and overall hospital stay. Post-operative mortality was higher for patients with impaired pre-operative renal functions.**

Conclusion: **Pre-operative mild impairment of renal function in patients candidates of CABG carries the risks of intraoperative decreased urine output, post-operative decreased urine output, impaired renal functions, prolonged ICU stay and prolonged total hospital stay and increased mortality. Further studies on larger number of patients are needed to clarify these points.**

Myocardial revascularization has been an established mainstay in the treatment of CAD for almost half a century. Coronary artery bypass grafting (CABG) is arguably the most intensively studied surgical procedure ever undertaken and it has witnessed significant technological advances, especially the use of arterial grafts. [1]

Undergoing open heart surgery in general and CABG in specific carries various risks, some are generally related to undergoing any surgery as; sepsis, infection or DVT. Others particularly related to undergoing myocardial revascularization include; post perfusion syndrome, nonunion of the sternum, myocardial infarction, late grafts stenosis, stroke, vasoplegic syndrome & renal dysfunction. [2]

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Codex : o3/16/1301

Acute changes in renal function after coronary bypass surgery are not well understood and incompletely categorized, and represent a challenging clinical problem.[3] Many reports have described the results of coronary surgery in patients with end-stage renal disease [4-5] but, there have been a limited number of studies reporting the outcome of patients with mild or moderate renal dysfunction and not on dialysis. Yet, the proportion of patients with this clinical status is much higher than that of patients with dialysis-dependent renal failure, hence it is important to identify and characterize the risk in this subgroup of patients[6] .

The objective of that study was to evaluate the influence of a pre-operative mildly increased creatinine serum level (1.3–2.0 mg/dl) on postoperative mortality, morbidity and renal functions in CABG patients aiming to provide recommendations helpful to improve post-operative prognosis and to minimize postoperative renal dysfunction in CABG patients.

Patients and methods

That prospective non-randomized study included 50 patients undergone elective coronary artery bypass grafting (CABG) on cardiopulmonary bypass in Kasr Al-Ainy University Hospital, Cairo University in the period between June 2011-May 2012 after obtaining the approval of the local ethical committee.

Consent for participation in that study was obtained from each patient individually. Patients were divided into 2 groups according to their preoperative serum creatinine value:

Group 1: Patients having serum creatinine values falling in our institution's normal range of 0.3 mg/dl to 1.2 mg/dl.

Group 2: Patients having serum creatinine values equal to or above 1.3 mg/dl and reaching up to 2.0 mg/dl.

Patients who had done combined open heart procedures for example CABG alongside valve replacement surgery, and/or Patients who had done previous open heart surgery were excluded from that study. Patients with preoperative serum creatinine levels equal or above 2.1 mg/dl ,and/or Patients on regular dialysis were also excluded.

Through that study a number of risk factors were being evaluated in order to determine their direct effect on PRD (postoperative renal dysfunction).

Preoperative Factors

A Separate data collection sheet was done for each patient included in that study. Pre-operative data included; history data focusing on age,sex,IHD risk factors as diabetes mellitus, hypertension and dyslipidemia, history of COPD or peripheral vascular disease. Clinical data included body mass index, general and local cardiological examination. Data of chest CXR and echocardiography were also included.

Pre-operative renal function assessment was done using serum creatinine level done by ELISA with a reference range up to 1.2mg/dl. Estimation of GFR was done using Cockroft and Gault (CG) formula (ref):

$$\text{eGFR} = \frac{(140 - \text{age}) \times \text{lean body weight [kg]} \times (0.85 \text{ for females})}{\text{Cr [mg/dl]} \times 72}$$

Some recent studies claim that the proportion of patients developing renal dysfunction following CABG increased with advancing age. This could be due to the expected renal functional deterioration with age.

Hypertension contributes to progressive renal failure by inducing myointimal hyperplasia of afferent arterioles, causing glomerular ischemia (hypertensive glomerular sclerosis), which is likely to increase the susceptibility of the kidneys to glomerular changes during cardiopulmonary bypass.

Due to the renal manifestations of type 1 diabetes mellitus, it was included as one of the highly considerable preoperative risk factors.

Patients with angina of NYHA class III or greater is expected to be one of the risk factors due to the greater likelihood of concomitant renal vascular disease. Conditions that cause occult renal ischemia, such as reduced ejection fraction and peripheral vascular disease were also suspected as risk factors for PRD. Since renal ischemia is generally silent, unlike ischemia of the coronary, cerebral, and peripheral vascular beds, which is usually overt, history of cerebrovascular disease was thought to be of prognostic value.

Also, history of hypercholesterolemia and/or hypertriglyceridemia, and a high above normal BMI were added to the suspected preoperative risk factors because of the increased risk for atherosclerosis and subsequent ischemic complications especially renal ischemia.

The presence of cardiomegaly was assessed as one of the risk factors for PRD. The patient was considered cardiomegalic with cardiothoracic ratio >0.50 demonstrated on a preoperative chest x-ray and/or left ventricular end diastolic diameter (LVEDD) of 5.6 cm or more as visualized by echocardiography.

Intra-operative Factors:

All patients had done CABG through median sternotomy, using LIMA as a standard graft for LAD, and SVG for the rest of the grafts needed. Cardiopulmonary bypass was conducted using non-pulsatile flow, mild hypothermia (34°C) to provide the systemic perfusion pressure electively maintained between 55–85 mmHg. Warm blood enriched Cardioplegia was used in all patients of the two groups. A bloodless prime was standardly used in more than 95% of the cases, if the preoperative hematocrit was greater than 35%. Blood was not administered unless the hematocrit falls below 20–22% during cardiopulmonary bypass (CPB).

Hemofiltration was used in patients if the serum potassium level raises more than 5.5mEq/dl and/or when the hematocrit dropped to 20-22%.

The following intra operative parameters were recorded as: Total bypass time. Total cross clamp time. Urine output on bypass. The need for hemofiltration and the amount filtered. The use of inotropic support for weaning from CPB (cardio-pulmonary bypass). The need for IABCP(intra-aortic balloon counter pulsation). The number of blood units transfused. The number of Grafts done. And ABG results (pH and BE) were recorded at the beginning before starting the procedure (baseline) and after weaning off cardiopulmonary bypass

Postoperative Factors

The postoperative parameters recorded were: Duration of mechanical ventilation. Length of ICU stay. Daily urine output in 1st 3 days. Fluid balance in the 1st 3 days. Serum creatinine level in the 1st 3 days. Drugs (Types and doses of diuretics and antibiotics). Postoperative serum creatinine during the first 3 days. A patient was considered to have postoperative renal dysfunction (PRD) with a rise of ≥ 0.9 mg/dl above his/her baseline creatinine reading.) and the Need for dialysis. Generally, the need of dialysis in our practice was limited to patients with volume overload i.e. persistently elevated CVP(central venous pressure) readings with inadequate urine output, Intractable acidosis not responding to conventional corrective mechanisms, Severe hyperkalemia (above 6 mEq/dl) not responding to medical treatment, and Persistent anuria not responding to diuretic (Lasix) infusion.

Statistical Analysis

Data were collected, verified and edited on a personal computer then analyzed by SPSS (Statistical package for the social science) version "A". Results were expressed as mean values ± standard deviation (SD).

The following tests were used:

1) Arithmetic mean, standard deviation and hypothesis "t" test (Student test) for quantitative values.
2) The chi-square test (x^2) for qualitative values expressed as proportions or Fisher's exact test if n<5.
3) For all statistical comparisons, a P value of <0.05 was considered significant and a P value of <0.01 was considered highly significant.

Results

Table (1) showed that both groups were matched regarding preoperative parameters as :age, sex, BMI and risk factors for IHD except that group 2 showed significantly higher incidence of DM.

Parameter	Group 1	Group 2	p
Age (y)	53 ± 9.07	54 ± 8.81	0.7
Sex m **f**	21 4	22 3	0.67
Smoking y **n**	16 (64%) 9 (36%)	11 (44%) 14 (56%)	0.15
HTN y **n**	18 (72%) 7 (28%)	21 (84%) 4 (16%)	0.3
DM y **n**	12 (48%) 13 (52%)	19 (76%) 6 (24%)	0.04
Dyslipidemia y **n**	7 (28%) 18 (72%)	11 (44%) 14 (56%)	0.24
CVA y **N**	0 25 (100%)	1 (4%) 24 (96%)	1
PVD y **n**	1 (4%) 24 (69%)	4 (16%) 21 (84%)	0.35
COPD y **n**	14 (56%) 11 (44%)	8 (32 %) 17 (68%)	0.09
NYHA I **II** **III** **IV**	3 (12%) 15 (60%) 7 (28%) 0	7 (28%) 7 (28 %) 9 (36%) 2 (8%)	0.08
BMI kg/m²	28.38 ± 3.706	26.87 ± 4.515	0.12
Serum creatinine (mg/dl)	0.8076±0.1479	1.4628 ± 0.1834	<0.01
eGFR ml/min/1.72m²	98.8679±27.9999	58.6137 ± 17.391	<0.01
Cardiothoracic Ratio (CTR) cm	0.5400 ± 0.052	.5540 ± 0.059	0.380
FS %	42.1600± 11.44	43.1859 ± 20.22	0.826

Regarding operative results, Table (2) showed that patients with impaired renal function showed lower intraoperative urine output than patients with normal renal functions. Otherwise, there was no other significant difference between study groups regarding other operative variables studied.

Table 1. Preoperative results of both groups.

		Group 1	Group 2	p
Graft no	**1**	1 (4%)	1 (4%)	
	2	9 (36 %)	6 (24 %)	
	3	13 (52 %)	17 (68%)	0.69
	4	2 (8%)	1 (4%)	
Total bypass time (min)		99.28 ± 31.47	99.16 ± 29.50	0.989
Total cross clamp time (min)		59.84 ± 24.77	61.08 ± 20.32	0.847
Need for IABCP (no of patients)		1 (4%)	4 (16%)	0.35
Need for hemofiltration		2 patients (8%)	7 patients (28%)	0.13
Use of inotropic drugs		7 patients (28%)	12 patients (48%)	0.15
Urine output (ml/d)		932 ± 508.86	612 ± 432.36	0.021
Baseline PH		7.394 ± 0.03	7.384 ± 0.032	0.497
Baseline BE		-0.36 ± 3.7993	-0.976 ± 3.2064	0.538
PH (after weaning from CPB)		7.42 ± 0.06	7.40 ± 0.05	0.15
BE (after weaning from CPB)		0.436 ± 3.90	1.1 ± 3.5	0.54
Number of blood units		2.60 + 0.82	3.0 + 1.08	0.146

Regarding postoperative results ,Table (3) showed that patients with impaired renal functions showed a significantly higher duration of post-operative ICU stay (figure 1) and overall hospital stay (figure 2). Also, they had significantly higher mean serum creatinine levels, and lower urine output.

Table 2. Operative results of both groups.

	Group 1	Group 2	p
Duration of mechanical ventilation (hours)	9.2 ± 5.05	33.8 ± 99.01	0.22
Duration of ICU stay (days)	3.56 ± 1.530	6.28 ± 6.017	0.033
Duration of hospital stay (days	9 ± 3.096	12.64 ± 6.389	0.014
Serum creatinine D1 (mg/dl)	1.192 ± 0.339	1.616 ± 0.406	0.001
Urine output D1 (ml/d)	3,020.40 ± 639.456	2,300 ± 657.647	0.035
Serum creatinine D2(mg/dl)	1.232 ± 0.422	1.792 ± 0.703	0.001
Urine output D2 (ml/d)	3,658.40 ± 983.335	3127.6 ± 737.904	0.036
Serum creatinine D3 (mg/dl)	1.152 ± 0.503	1.832 ± 0.845	0.001
Urine output D3 (ml/d)	3,675.20 ± 615.570	3,476 ± 957.658	0.386

There was no difference between both groups regarding post-operative need for dialysis .One patient in group 2 needed dialysis post-operatively due to persistently elevated CVP readings with inadequate urine output not responding to diuretic (Lasix) infusion, and severe hyperkalemia (above 6 mEq/dl) not responding to medical treatment.

Table 3. Post-Operative results of both groups.

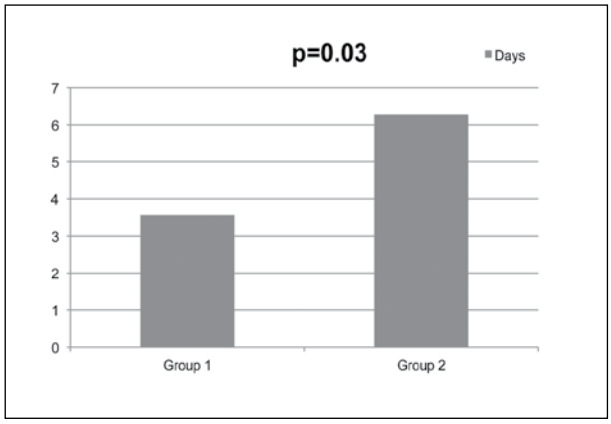

Fig 1. Comparison of duration of post-operative ICU stay between study groups.

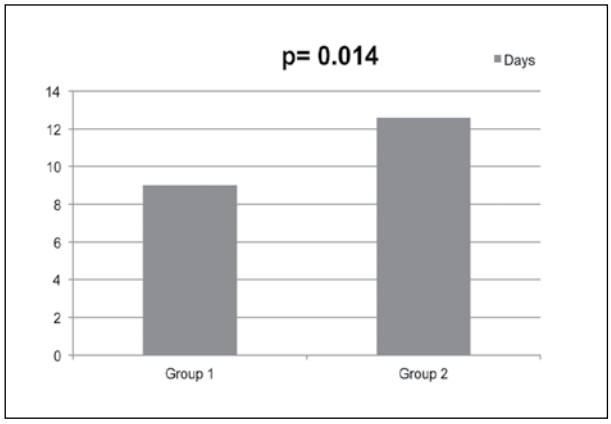

Fig 2. Comparison of total duration of hospital stay between study groups.

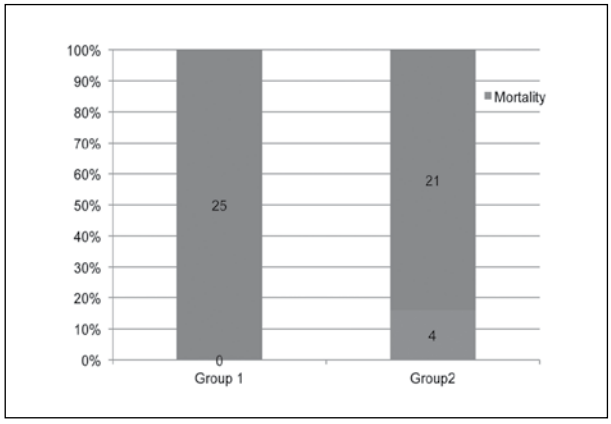

Fig 3. Post-operative mortality in study groups.

Postoperative mortality

No postoperative mortality was recorded in group 1, while 4 cases(16%) were among group 2 patients. 2 of these patients never recovered conscious postoperatively. The third patient died of ventilation acquired pneumonia (VAP) due to multiple prolonged intubation periods regarding the patient's co-morbid asthmatic state. The fourth patient died of a massive postoperative myocardial infarction. There was no significant statistical difference between both groups as regards postoperative mortality (p value 0.110). (Figure 3)

Discussion

Postoperative renal insufficiency remains a serious complication following CABG as it is associated with increases in mortality, morbidity, and intensive care unit (ICU) stay that can end by the requirement for hemodialysis. Postoperative acute renal failure (ARF) develops in 5% to 30% of patients who undergo cardiac surgery, and it is associated with a high risk of death (up to 80%) in cardiac surgical patients. [7]

Several studies have examined the risk factors associated with the development of ARF after CPB.[8] These include female gender, reduced left ventricular function or the presence of congestive heart failure, diabetes, peripheral vascular disease, preoperative use of an intra-aortic balloon pump, chronic obstructive pulmonary disease, the need for emergent surgery, and an elevated preoperative serum creatinine. This last factor is perhaps the most predictive.[9]

It has been found that post-CABG surgery creatinine values typically increase and peak on the second postoperative day, returning to preoperative levels by the fourth or fifth day.[10] The precise level at which renal dysfunction begins to adversely affect outcome is unknown.[11] Clinical impression suggests that even mild or moderate elevations of serum creatinine levels have an adverse effect on outcome. One of the first studies attempting to address this issue focused on moderate (>150 μmol · L^{-1}) elevations of preoperative serum creatinine levels.[12] In a more recent study of 93 patients, Durmaz and colleagues looked at the effect of milder elevations of the preoperative serum creatinine level and found levels greater than 2.5 mg/dL (>200 μmol · L^{-1}) in non–dialysis-dependent patients to increase the risk of postoperative dialysis, prolonged hospital stay and in-hospital mortality.[13] However, the effect of a more borderline elevation of preoperative serum creatinine levels has not been investigated in a large multivariable model that included other potential preoperative and intraoperative contributors to morbidity and mortality.[14]

Several other risk factors for postcardiac surgery renal failure have been identified but are more controversial. These include factors specifically related to the bypass procedure itself, such as cross-clamp time [10], duration of CPB [15], pulsatile versus nonpulsatile bypass flow[16], normothermic versus

hypothermic bypass [17] and on- versus off-pump coronary artery bypass (OPCAB) surgery. One of the most controversial risk factors is OPCAB versus traditional on-pump CPB. OPCAB obviously removes the bypass circuit but can be associated with greater hemodynamic instability secondary to ventricular compression as the heart is manipulated to access the coronary arteries.[18]

There are a number of available renal function tests; each examining a different aspect of the kidney's function. [19] The GFR is probably the single most important marker of renal function. Tubular function can be assessed as urinary B-NAG, α1-microglobulin, retinol binding protein, and plasma pro- and anti-inflammatory cytokines.

The classical determination of renal function by GFR normally requires a 24-h urine collection, but changes in renal function can occur more rapidly than this. The possibility of measuring GFR more frequently led Sladen and colleagues to investigate the utility of a clearance estimate based on a 2-h urine collection. In the intensive care unit or postoperative care area, this estimate of GFR may be a good biomarker of change in renal function.[20]

Despite serum creatinine concentration being affected by many factors other than glomerular filtration rate (GFR), such as age, sex, and body size; it is still the most readily available clinical measurement of renal dysfunction. GFR is probably the best overall index of renal function. The gold standard for determining GFR is to measure the clearance of exogenous substances such as inulin, chromium-51 ethylenediamine tetraacetic acid, technetium-99m labeled diethylenetriamine penta-acetate, and iodine-125 labeled iothalamate. However, the techniques used in determining GFR are time-consuming, labor-intensive, and expensive, which make them unpractical for routine monitoring. For this reason, the estimated glomerular filtration rate (eGFR) was recommended in evaluating renal function.[21] The formula that has been used most commonly is the Cockcroft-Gault formula.[22] More recently, the National Kidney Foundation of American recommended using the Modification of Diet in Renal Disease (MDRD) equation to estimate GFR.[23] Even so, the method that best predicts in-hospital and long-term outcome after CABG is still unknown.[24]

Although the kidney has numerous functions, in clinical practice the unique functions of the kidney are both the excretion of waste products of nitrogen metabolism and production of urine. Thus, for clinical research, ARF has to be defined as an abrupt and sustained decrease in glomerular filtration, urine output, or both. Once glomerular filtration has reached a steady state, it can be quantified by measuring 24-hour creatinine clearance or estimate clearance from the plasma concentrations of creatinine. Unfortunately, the accuracy of creatinine clearance is limited because as GFR falls, creatinine secretion is increased, and thus the rise in plasma creatinine is less, resulting in a potentially large overestimation of GFR. Therefore, creatinine clearance represents the upper limit of what the true GFR is under steady-state conditions. Furthermore, as patients with ARF are not in steady state, creatinine clearance will not accurately reflect GFR.[25,26]

The urine output is a very rarely studied variable in publications concerning ARF after cardiac surgery, although, urine output is more sensitive to changes in renal function than biochemical markers.[27] However, it is far less specific except when severely decreased or absent; the changes in urine output often occur long before biochemical changes are apparent.[28]

Thus, the new recommendation for the definition of ARF should take into consideration both renal functions, the excretion of creatinine and the production of urine. This new recommendation for ARF has not yet been widely validated so a certain classification of ARF known as RIFLE (for Risk, Injury, Failure, Loss, End-stage kidney disease) can be utilized by clinicians to identify and consistently classify patients with impaired renal function and ARF following CABG.[29,30]

Several groups have developed clinical scoring systems that help to predict the risk for ARF with CPB.[9] The aim is to select patients who are at high risk and then to adopt strategies that would offer renal protection. A score is given on the basis of 13 preoperative factors and ranges from 0 to 17.[14] (Table 5).

	GFR Criteria	Urine Output Criteria
Risk	Increased plasma creatinine x 1.5 or GFR decrease > 25%	<0.5 mL · kg^{-1} · h^{-1} x 6 hours
Injury	Increased plasma creatinine x 2 or GFR decrease > 50%	<0.5 mL · kg^{-1} · h^{-1} x 12 hours
Failure	Increased plasma creatinine x 3 or acute plasma creatinine ≥350 μmol/L or acute rise ≥44 μmol/L	<0.3 mL · kg^{-1} · h^{-1} x 24 hours or anuria x 12 hours
Loss	Persistent acute renal failure = complete loss of kidney function > 4 weeks	
ESKD	End-stage kidney disease (>3 months)	

Table 4. The RIFLE [a] Classification Scheme for Acute Renal Failure.

These clinical scoring systems require validation across several medical centers before their routine use can be adopted. Furthermore, given that these scoring systems attempt to identify a small number of high-risk patients, they will have good negative predictive power but necessarily low positive predictive power. However, they provide a very useful framework to identify patients who are at risk and may benefit from peri- or intraoperative renal protective strategies.[9]

Table (5): Cleveland Clinic Foundation Acute Renal Failure Scoring System

Risk Factor	Points
Female gender	1
Congestive heart failure	2
LV ejection fraction < 35%	1
Preoperative use of IABP	2
COPD	1
Insulin-requiring diabetes	1
Previous cardiac surgery	1
Emergency surgery	2
Valve surgery only (reference to CABG)	1
CABG + valve surgery (reference to CABG)	2
Other cardiac surgeries	2
Preoperative creatinine 1.2 to < 2.1 mg/dl	2
Preoperative creatinine > 2.1 mg/dl	5

Postoperative renal dysfunction has some variable degrees, extending from transient renal dysfunction to renal failure requiring replacement therapy.[31]The use of continuous renal replacement therapy (CRRT) is a rare but devastating complication of CABG.[32] It is thought that severe forms of postoperative renal dysfunction requiring dialysis have increased morbidity and mortality despite dialysis and supportive intensive care.[33]

Conclusion

Coming to the conclusion of our study, PRD has been shown to be more likely in diabetics, patients with pre-existing renal dysfunction, patients who had a low urine output on bypass, patients out of the OR on noradrenaline, and those who received banked blood units. It's also been shown that serum creatinine on the first three postoperative days and urine output on the first two days were proved to be significant indicators of PRD.

Pre-operative mild impairment of renal function in patients candidates of CABG carries the risks of prolonged ICU stay and prolonged total hospital stay and increased mortality. Further studies on larger number of patients are needed to clarify these points.

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Support Rings of Bovine Internal Jugular Vein Grafts Provide No Additional Benefits

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Background: **Repair of the right ventricular outflow tract (RVOT) often requires interposition of a valved conduit between the right ventricle and the pulmonary artery. Allografts are conduit of choice but their limited availability necessitates consideration of alternatives. The contegra conduit (Medtronic, Inc.) is an alternative xenograft tissue for RVOT reconstruction, available in supported and unsupported types. We compared the outcome of these two types of the Contegra.**

Method: **Fifty patients with supported (*S*, n =19) and unsupported (*U*, n = 31) Contegras were discharged alive from April 2001 to December 2006. The commonest diagnosis were truncus arteriosus (n=16) and pulmonary atresia and ventricular septal defect (n=15). Patients' characteristics were comparable and conduit z-scores were similar in both groups. Echocardiograms at follow-up were retrospectively reviewed. Conduit dysfunction was defined as right ventricular outflow tract (RVOT) obstruction with peak echo-Doppler gradient > 40 mmHg, or grade III/IV conduit regurgitation. Conduit failure was defined as conduit replacement, catheter or surgical intervention or conduit-related late death. Follow-up was 96% complete at a median of 34 months.**

Reults: **Postoperative mean gradient was 20.4 ± 23 mmHg (S) and 15.8 ± 19 mmHg (U), p = 0.51. Mean conduit regurgitation was 3.0 ± 1.1 (S) and 2.8 ± 1.1 (U), p=0.53. Moderate valvular regurgitation was seen in 68% (S) and 63% (U), p = 0.48. Overall survival was 95.1% at 5 years with n2 late deaths. Thirteen patients required conduit replacements and 5 catheter interventions. Freedom from graft dysfunction at 2 years were 40% for group S and 50% for group U (p=0.163). One year and 4-year freedom from conduit failure were lower in group S (58% and 37%) compared to groups U (81% and 72%), p=0.016. Conduit oversize was an independent risk factor for dysfunction. Neonates and small conduits were independent risk factors for conduit failure.**

Conclusion: **The addition of support rings on the Contegra valved conduit resulted in a lower freedom from graft failure. No positive impact was seen in reducing conduit dysfunction. We would not recommend its use over the conventional unsupported Contegra.**

KEY WORDS: **Contegra, support rings, Right ventricle outflow**

Repair of the right ventricular outflow tract in children may require interposition of a valved conduit between the right ventricle and the pulmonary artery. Allografts traditionally prevail as a conduit of choice.[1-4] but their limited availability necessitates consideration of other alternatives.[5-7] The Contegra conduit (Medtronic, Inc, Minnesota USA) is a bovine jugular vein with a naturally incorporated trileaflet valve that is increasingly used as an alternative xenograft tissue for RVOT reconstruction with reports of outcome both encouraging,[6,8-14] as wellas discouraging.[15-23] One mode of failure of the conduit is progressive dilatation,[8,9,11,15,23-26] and subsequent incompetence[7-9,17,24,27-29] of its valve. An improvised version of the conduit with two external, cloth covered polypropylene rings provides additional support at the annulus and at the sinotubular junction to alleviate this problem as well as to prevent compression by the sternum.[21] Little is known about the outcome following these design modifications of the Contegra.[15,24]

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In the present study, we evaluated the outcomes of these two types of conduit when used for right ventricular outflow tract reconstruction in a pediatric population.

Patients and Methods

The study was approved by our Research Advisory Committee and the need for informed consent was waived. Preoperatively all patients received detailed information on the Contegra conduit and provided their written consent for implantation. This was a retrospective review that included only patients who received Contegra grafts in the pulmonary position as their first valved conduit. From April 2001 to December 2006, 50 of 55 patients who survived at least 30 days after operation (operative mortality 9%) were divided into those who had the ring-supported Contegra (Group S, n=19) and those who had the unsupported Contegra (Group U, n =31)

Operative Technique

All procedure were performed with conventional cardiopulmonary bypass, with moderate to deep hypothermia, and cold crystalloid cardioplegia. Deep hypothermic circulatory arrest was needed in 5 patients, who required simultaneous repair of aortic arch anomalies. The Contegra conduit was implanted away from the midline as well as positioning the valve as distal as possible to avoid sternal compression. The anastomosis with the RV is carried out wither by fashioning the proximal end in an oval shaped manner to create a smooth right ventricular outflow or by a side-to-side anastomosis with the conduit wall and closure of the proximal end of the conduit. [30] No additional material was necessary because there was ample tissue from the proximal conduit ends. The decision to use either supported or non-supported conduit was made at the deiscretion of the surgeon. To delay relative conduit stenosis from somatic outgrowth, conduits were generally oversized with a mean Z-score of 2.53 ± 0.93 (Table 1).

Follow-up

All patients were prescribed with acetylsalicylic acid 15 mg/kg daily at discharge. They were seen in outpatient clinics by pediatric cardiologists at 1 month after discharge and every 6 months thereafter. Echocardiography was carried out at every follow-up. Conduit gradient was documented as the highest gradient recorded at the subvalvular, trans-valvular or supravalvular (distal anastomosis) levels. Conduit regurgitation was graded by colour flow Doppler as absent (0), trivial (I), mild (II), moderate (III, reverse flow from the bifurcation level), and severe (IV, reverse flow from the pulmonary artery branches). Conduit aneurysm formation was defined as conduit dilatation more than 1.5-X the initial diameter. Graft dysfunction is defined as peak echo-Doppler gradient > 40 mm Hg at any RVOT/conduit level or as grade III/IV graft (pulmonary) regurgitation. If a problem was detected or suspected, cardiac catheterization and angiography were performed. Interventional dilatation was considered for peak gradient of > 40 mmHg at catheterization. Indication for conduit replacement was RVOT/conduit obstruction not amenable for interventional dilatation, with right ventricle pressure at least 75% of the systemic pressure or poor right ventricular function, or grade III/IV regurgitation with aneurysm of the conduit. Conduit failure is defined as need for conduit replacement, catheter or surgical intervention or conduit-related late death.

	Group S	Group U	p value	Total
N	19	31		50
Mean age (months)	6.2 ± 11	14.4 ± 21	0.077	11.3 ± 18
Age < 1 month(%)	32	23	0.521	30
Weight (kg)	4.6 ± 3.4	6.9 ± 4.4	0.047	6.0 ± 4.1
Male (%)	47	74	0.055	64
Truncus arteriosus (%)	42	23	0.144	48
PA/VSD (%)	42	48	0.665	46
BSA (m2)	0.26 ± 0.12	0.35 ± 0.16	0.033	0.32 ± 0.15
Contegra size (mm)	13.5 ± 2.0	15.3 ± 2.0	0.003	14.6 ± 2.1
Contegra Z-score	2.56 ± 0.94	2.52 ± 0.94	0.869	2.53 ± 0.93
Oversized conduits (%)	41	25	0.266	36
CPB (mins)	142 ± 30	129 ± 38	0.189	134 ± 36
Cardioplegica arrest (mins)	76 ± 42	73 ± 41	0.806	76 ± 41
DHCA (%)	7.8	8.2	0.938	8.1
ICU stay (days)	12.6 ± 11	9.1 ± 14	0.367	10.4 ± 13
Hospital stay (days)	19 ± 12	20 ± 24	0.877	19.5 ± 20

Abbreviations: PA/VSD, Pulmonary Atresia with ventricular septal defect; CPB, cardiopulmonary bypass; DHCA, deep hypothermic circulatory arrest; ICU, Intensive care unit.

Table 1. Patient demographics, conduit sizes and length of stay

Data Analysis

Continuous variables are expressed as mean ± standard deviation (SD) or median and range, and categorical data are expressed as proportions/percentages. Categorical variables were compared using the X^2 test, and independent continuous variables were compared by using the two-tailed Student's t test. Comparisons of related variables were performed to assess conduit dysfunction and failure. Eight variables analyzed as possible predictors of outcomes were age less than 1 month at the time of operation, male gender, diagnosis of truncus arteriosus, correction of TOF/pulmonary atresia + VSD, small conduits (Contegra size 12 and 14 mm), oversized conduits (> 3 SD), ring support, cardiopulmonary bypass time and aortic cross-clamp time. Analyses were carried out by using logistic regression models with stepwise backward procedure. Results are described as odds ratios (OR) and 95%-confidence intervals (CI). Event-free survival was calculated by the Kaplan-Meier method with 95% confidence limits and the log rank test to compare factor levels. The p values less than 0.05 were considered statistically significant. The statistical analyses were performed using SPSS 13.0 software package (SPSS Inc, Chicago, IL).

Results

Patient demographics, implanted sizes and lengths of stay are displayed in Table 1. Eighteen patients were female and 32 were male. Median age was 4.3 months (range 7 days to 8.5 years). Thirteen patients (26%) were neonates (<1 month of age) and 14 patients (28%) were older than 1 year. Forty-two (84%) of patients were less than 10 kg. Perioperative characteristics of patients in both groups were similar except that group S have lower body surface area (p=0.03) and received smaller diameter grafts (p=0.003). There was however no difference in the mean Z-scores of the conduits used in both groups. Small conduits (sizes 12 and 14 mm) were implanted in 16 patients; 2 in group S and 14 in group U (p=0.013). Oversized conduits (Z score >3) were implanted in 17 patients; 4 in group S and 13 in group U (p=0.218). The intra-operative variables and post-operative lengths of stay were also similar. Table 2 shows the underlying cardiac malformations with a preponderance of the repair of truncus arteriosus (32%) and pulmonary atresia with ventricular septal defect (30%).

Follow-up was 96% complete at a median of 34 months (range 1 to 74). An increase in peak RVOT gradient from 6.2 ± 4.5 to 18 ± 21 mmHg was observed (p=0.001) during this period. These findings were consistently found for both groups, and appears graphically that the peak gradients across the supported conduit increased at a higher rate with time but the difference between the groups were not statistically significant (p=0.91). Severe conduit regurgitation was observed in 41% of patients; 47% in Group S and 36% in Group U (p=0.531). Overall conduit regurgitation increased significantly from 2.6 ± 1.1 to 2.9 ± 1.1 (p=0.029) but was non-progressive in the latter half of the follow-up. This increase was observed in both groups but there were no difference between the groups (p=0.43). No episode thromboembolism was noticed during follow-up. Figure 1 shows that there was no difference in freedom from conduit dysfunction at 2-years; 40% for Group S and 50% for Group U (p=0.163).

Six patients (12%) required catheter interventions at a median of 10.9 months (range 3.3-26 months); 5 for distal anastomotic stenosis (3 bilateral, 1 right and 1 left) and 1 for conduit stenosis. One patient died as a complication of dilatation and stenting of the right pulmonary artery. Thirteen patients (26%) underwent conduit replacement at a median interval of 10.2 months (range 4-50 months) with the indications shown in Table 3. Of these, 9 patients were from Group S (47%) and 4 from Group U (13%), p=0.18. The mean interval for conduit replacement due to distal anastomotic stenosis was shorter than for conduit stenosis (8.8 ± 5.0 vs. 30 ± 25 months) but was not statistically significant (p=0.067). There was also no difference in the mean diameter of the conduits replaced due to these indications (distal anastomotic stenosis 13.3 ± 1 mm vs. conduit stenosis 14.7 ± 3 mm, p=0.343). There were no operative mortalities following conduit replacement operations.

Procedure	Group S (19)	Group U (31)	Total (50)
Truncus Arteriosus	9	7	16
PA/VSD	5	10	15
Yasui[1]	1	5	6
Pulmonary Insufficiency/Stenosis	1	4	5
Rastelli	0	3	3
TOF/APVS	2	1	3
Ross/Konno-Ross	1	1	2

Abbreviations: PA/VSD, Pulmonary Atresia with ventricular septal defect; RV-PA, right ventricle to pulmonary artery, TOF/APVS, Tetralogy of Fallot/Absence pulmonary valve syndrome

[1]Yasui-single-stage biventricular repair of aortic atresia/hypoplasia and ventricular

Table 2. Underlying cardiac malformations

Age at Initial op	Diagnosis	Size (mm)	Ring	Interval (months)	Replaced with	Indication	
7 d	Truncus arteriosus	14	-	6.2	Pulm Homograft	Distal Stenosis	Anastomotic
28 d	VSD, Aortic Atresia	14	-	11.4	Pulm Homograft	Distal Stenosis	Anastomotic
21 m	TOF	16	-	13.6	Pulm Homograft	Conduit Stenosis	
1 m	PA/VSD	14	-	14.1	Pulm Homograft	Conduit Stenosis	
8 m	PA/VSD	12	+	4.2	Aortic Homograft	Distal Stenosis	Anastomotic
26 d	Truncus Arteriosus	12	+	4.4	Contegra	Distal Stenosis	Anastomotic
6 m	PA/VSD	12	+	5.3	Aortic Homograft	Conduit Stenosis	
9 d	Truncus Arteriosus	12	+	7.3	Aortic Homograft	Conduit Stenosis	
15 d	VSD, IAA, LVOTO	14	+	8.6	Aortic Homograft	Distal Stricture	Anastomotic
6 m	PA/VSD	14	+	17	Aortic Homograft	Distal Stenosis	Anastomotic
1 m	Truncus Arteriosus	12	+	23.1	Pulm Homograft	Aneurysmal Dilatation	
26 m	TOF/APVS	20	+	36.8	Contegra	Conduit Stenosis	
7 d	VSD, IAA, Arch hypoplasia	14	+	48.8	Pulm Homograft	Conduit Stenosis	

Abb: VSD, ventricular septal defect; PA/VSD, Pulmonary Atresia with ventricular septal defect; TOF/APVS, Tetralogy of Fallot/absent pulmonary valve syndrome; LVOTO, left ventricular outflow tract obstruction; IAA, Interrupted Aortic Arch

Table 3. Indications for conduit replacement

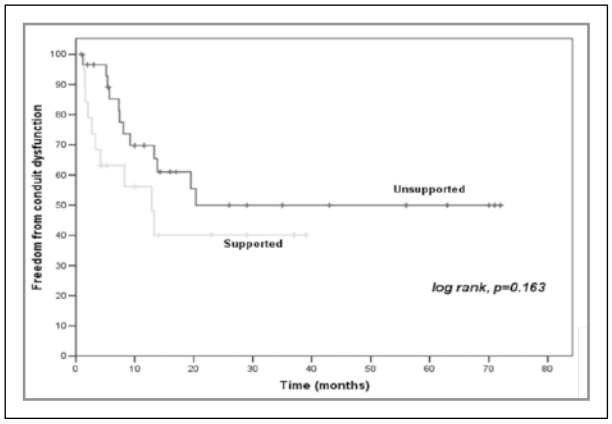

Fig 1. Kaplan-Meier curves for freedom from conduit dysfunction

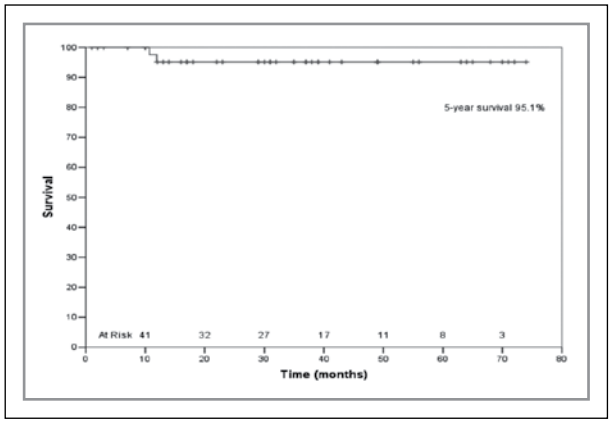

Fig 2. Overall survival

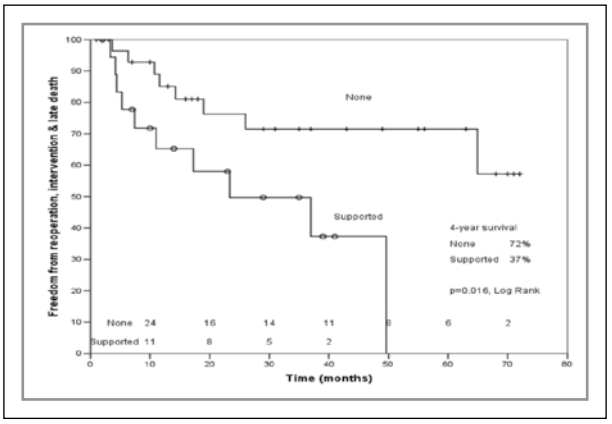

Fig 3. Kaplan-Meier curves for freedom from conduit failure

Two late deaths (4.0%) occurred at 11 and 12 months postoperatively, one for conduit endocarditis and one following the catheter intervention mentioned above. Overall patient survival was 95.1% at 5 years (Figure 2) and conduit survival was 42 ± 12% at 4 years. One-year and 4-year freedom from conduit failure were lower in Group S (58% and 37%) compared to Group U (81% and 72%) as shown in Figure 3 (p=0.016). The independent risk factor of dysfunction was conduit oversize (p=0.017, OR 5.5, CI 1.4-2.2)and of conduit failure were neonates (p=0.048, OR 5.2, CI 1-26) and small conduits (p=0.01, OR 18, CI 2-167).

Discussion

Following its introduction in 1999, the Contegra bovine internal jugular vein graft has been increasingly utilized as a viable alternative for the repair of the RVOT in children. Favourable reports have been produced, tantamount to outcome of the time-honoured allografts.[7,10,14,28,31,32] Nevertheless conflicting reports of its poor results have also been contemporarily published, with resounding words of caution over its use.[16,17,21] Of major concern is the tendency to progressive dilatation of the conduit, culminating in aneurysmal formation of its parts. Children at risk of systemic or supresystemic post-operative right ventricular pressures, such as pulmonary atresia with ventricular septal defect, are particularly at danger of this complication. Sekarski and co-workers reported significant conduit dilatation in 4 patients with suprasystemic conduit pressures secondary to peripheral pulmonary stenosis.[8] This group of patients frequently form a significant majority of recipients of the conduit,[7,8,10,11,20,26] and in our present report they compromise 30% of the study population. Similarly in children in whom postoperative pulmonary hypertension is expected, such as following repair of truncus arteriosus, the delicate valve leaflets of the conduit may succumb to the pressure strain and plummet into incompetence. Conduits explanted for severe regurgitation had been found to be significantly dilated and their valve leaflets mostly vanished.[9,19]

Conduit regurgitation was almost universally found in our group of patients but it was not significantly different whether the grafts had support or not. We observed up to 47% regurgitation in the group with ring-supported Contegra but regurgitation was non-progressive beyond one year of follow-up. Sekarski and co-workers had similarly reported the non-progressive nature of this problem, but only 1.6% of their patients had severe conduit regurgitation.[8] Brown and co-workers found no regurgitation in 68% of their patients at discharge and 54% at a follow up of almost 30 months,[10] and Corno et al also reported absence of severe conduit regurgitation that was maintained for 26.4 months in 67 patients.[11] Sierra et al reported 8% rate of regurgitation of the Contegra as compared to 3.4% in homografts used in the RVOT.[28] The higher incidence (41%) of regurgitation in our study population could be explained by the high prevalence of oversized grafts (36%), in concert with the findings of Karamlou et al where conduit Z-score greater than 3% was associated with higher incidence of severe regurgitation.[33]

The ring-support of the Contegra was designed to maintain valve geometry and preserve competency as well as prvent irs dilatation. From their experience with aneurysmal dilatation of unsupported conduit, Boudjemline et al suggested that synthetic rings in supported conduits would be preferable as it could avoid dilatation of the valve and thus preserve its function.[15] This recommendation was echoed by Sinzobahamvya and co-workers.[7] Corno et al reported a 10-12% increase in internal diameters of the Contegra by ECG-gated multi-slice CT scan,[11] but Breymann et al who used exclusively non-supported Contegra conduit had nevertheless found neither significant conduit dilatation nor progressive conduit regurgitation in more than 100 patients followed up over more than 2 years.[31,34] There was also no incidence of aneurysmal dilatation in 27 truncus arteriosus patients with Contegra implanted as reported by Hickey and co-workers.[29] Our study showed no difference in the incidence, degree as well as progress of regurgitation regardless of conduit ring support and of interest the single conduit replaced for aneurysmal dilatation was in a ring-supported graft. Brown and co-workers reported 9 patients with ring-supported conduits where the degree of conduit valve insufficiency and the gradient across the conduit was not any better than 51 other patients who received unsupported conduit.[10]

The ring support for the Contegra could prevent distension of the valve segment of the graft but could not eliminate conduit dilatation and aneurysmal formation as these occur beyond the confines of the rings. All of three exchanges due to conduit failure reported by Morales and co-workers were due to aneurysmal dilatations at the proximal anastomosis.[25] Rastan and co-workers reported significant conduit dilatation in infants less than 1 year of age with persistently elevated post-operative RV pressure.[9] This implies that factors which predispose to conduit failure are largely not rectifiable by the ring-support of the conduit as reported by many others as well.[8,26] In our study the use of oversized conduits was a risk factor for conduit dysfunction and the implantation in neonates as well as conduit of small diameters were risk factors for conduit failure. Boethig et al found that Contegra were free from reoperations for sub-valvular and valvular stenosis for up to 4 years.[32] Within the same period 10 reoperations were carried out for supra-valvular stenosis, underscoring the point that damage occurred external to the area presumably safeguarded by the rings. These auntors also discovered that implantation in infants less than 1 year of age was an independent risk factor for supra-valvular stenosis and the use of Contegra by itself was not, reiterating the argument that patient factors outweigh conduit factors in the development of stenosis.

Sekarski and co-workers had observed conduit obstruction in 2 of their patients secondary to sternal compression.[8] Intuitively, the ring support could prevent sternal compression but we had observed 4 of our patients with ring-support developing in-conduit obstruction. A wide range of microscopic evidence of in-conduit stenosis had been reported including neo-intimal and adentitial inflammation, thickening, infiltration by lymphocytes, macrophages and spindle cells, giant-cell reaction, fibrin peel deposition and valve cusps encrustation by thrombus.[9,16-18,20,26] All these could play a greater role in the presence of the rings. In-conduit stenosis could also be a result of conduit overgrowth. Hicket et al reported that the risk of conduit replacement for in-conduit stenosis was a gradually increasing late hazard after 1-2 years and smaller

conduit z-score was an independent risk factor for accelerated in-conduit stenosis.[29] Morales et al reported a gradual decline in freedom from conduit stenosis at 1, 2 and 3 years of 100%, 92% and 82% respectively in 77 conduits followed over 20 months.[25] Although both reports most likely involved unsupported Contegra, it is reasonable to think that the supporting sings could possibly intensify in-conduit stenosis as it eliminates any possibility of conduit expansion. Its promoted feature of preventing extern al compression is nullified by the conceivable acceleration of in-conduit obstruction.

The 72% 4-year survival rate of unsupported Contegra in our study is well within the range reported by others.[7-9,20,26,28,29,32]Various factors considered significant in diminishing the survival of the conduit included small size conduits,[8,20,29] operative age less than 1 year,[8,9] small pre-existing pulmonary artery sizes,[8] and higher RV/LV post-operative pressure ratio.[26] Unlike our report none of these had evealuated the impact of ring-support on conduit survival and we clearly established an appalingly lower survival rates for the supported Contegra.

The study was limited by the lack of evaluation of pre-operative pulmonary artery sizes and intra-operative right ventricular pressure ratios on the outcome of the Contegra. Additionally there was no post-operative histological analysis of the failed conduits that were removed to elucidate the etiology of their malfunction. All things considered we conclude that the ring-support for the Contegra conduit has no significant impact on the development and progression of conduit regurgitation, the incidence of conduit dilatation and the rate of conduit stenosis. On the contrary, the outcome of the Contegra with ring-support was poorer as compared to its unsupported counterpart. We recommend that its use be categorically avoided.

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Tepid Cardioplegia Versus Cold Blood Cardioplegia For The Benefit of Clinical Post Operative Outcomes In Coronary Artery Bypass Grafting Cabg) In Patients With High Risk

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Reperfusion injury contributes significantly to myocardial dysfunction following ischemia. Cardiac insult from poor myocardial protection may extend hospital stay and result in death or cardiac dysfunction. Recent studies stated that warm or tepid blood cardioplegia may hasten the return of myocardial metabolic and contractile function earlier because aerobic myocardial metabolism can be maintained and ischemic injury minimized during aortic cross-clamping and consequently improve postoperative cardiac and clinical outcomes . In our study 160 patients undergoing coronary artery bypass grafting (CABG) in Ain Shamas university hospitals. Written consent was taken from all patients. The use of intermittent antegrade cold (4°C) blood cardioplegia in 80 consecutive patients from March 2008 to October 2012 was compared with intermittent antegrade tepid (28°C) blood cardioplegia in 80 consecutive patients in the same period . The two groups were similar, except the tepid group included patients with reduced ejection fraction, NYHA class and more combined procedures as mitral valve repair or replacement in 8 cases and aortic valve replacement in 1 patient among the population of the this group compared to the cold blood group , in which only one patient a mitral valve repair was done in addition to CABG procedure. In the tepid group there were some clinical benefits were detected like; Time required for return of normal sinus rhythm after cross clamp release were shorter, reduced usage of intraaortic balloon pumping postoperatively (5% in tepid group versus 10% in cold blood group) and reduced incidence of use of defibrillation (7.5% in tepid group versus 25% in cold blood group), there was a decrease in the incidence of atrial fibrillation. We believe that these were due to better myocardial protection from tepid cardioplegic temperatures as indicated from the measurement of the CTn I levels post operatively as it was raised in both group after aortic cross clamping but it was significantly higher in the cold blood group especially after 6,9, 12 hours (1.4±.07, 2.1±1 .9,3.09 ±.15) respectively versus tepid group (1.2±.07, 1.9± 1.9, 2.8±.15) P value=less than 0.001 .There was no significant difference in mortality, use of inotropics supports ,perioperative myocardial infarction , renal or cerebrovascular complication between the two groups. Intermittent tepid blood cardioplegia is clinically useful and safe strategy to facilitate cardiac surgery while minimizing intraoperative myocardial damage in patients undergoing open heart surgery and especially in patient at high risk with poor ejection fraction and more sever NYHA class symptoms.

Intraoperative myocardial damage after successful CABG remains a major contributor to postoperative cardiac damage and its associated morbidity and mortality[1]. .Cardioplegia is an important strategy to facilitate cardiac surgery while limiting intraoperative myocardial injury. The appropriate temperature of cardioplegic solution is not yet settled. Many studies showed that tepid cardioplegia resulted in better early recovery of postoperative myocardial function, less creatine kinase-MB release, and reduced need for defibrillation immediately after aortic cross clamp release, compared with cold cardioplegia.[2]. The aim of this study was to investigate the clinical results of using tepid instead of cold antegrade blood cardioplegia in patients undergoing open heart surgery with more severe symptoms and poor ejection fraction.

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Patients and Methods

A 160 patients with coronary artery disease undergoing CABG from March 2008 to October 2012 in Ain shamas university hospitals were included in the study. They were randomized to either antegrade cold blood or tepid cardioplegia groups. Solution delivered through the coronary ostia every 30 minutes throughout the period of aortic cross clamping. Postoperative troponin-I levels is used as a marker of myocardial damage ,Serial venous blood samples were drawn just before cardiopulmonary bypass and after aortic unclamping at 6, 12, and 24 hours. CTnI concentrations were measured by a specific immunoenzymometric assay ,results were compared between the 2 groups. A 12-lead electrocardiogram was recorded before the operation, at 2 hours, and then daily after the operation. Electrocardiogram diagnosis criteria for perioperative myocardial infarction (PMI) were new Q-waves of > 0.04 ms and a reduction in R-waves of > 25% in at least two leads. CTnI diagnosis criteria for PMI were CTnI peak concentrations of >3.7 g/L, and CTnI concentration of> 3.1 g/L at 12 hours or > 2.5 g/L at 24 hours, as determined by Mair and colleagues[2,3]. Intermittent cold blood cardioplegia (4°C) was used in 80 consecutive patients comprised the cold group. Tepid blood cardioplegia(28°C) was used in 80 patients comprised the tepid group. A pump that mixed oxygenated blood with cardioplegic solution in a 4:1 ratio. It was passed through a cardioplegia line into the aortic root via a 14F cardioplegia cannula. Initial cardioplegia was achieved using a high-potassium solution (16 mEq·L–1) over 1 min, followed by maintenance doses containing 8 mEq·L of potassium over 4 min.[3]. All doses were given at a pressure of 180 to 200 mmHg to achieve an infusion rate of 0.30 to 0.45 L·min.[1]Cardioplegia was delivered every 30 min or earlier if the heart resume activity. Hot shots were given in the tepid group for 5 min just before release of the aortic cross clamp. The cardio pulmonary by pass(CPB) was instituted with a single two-stage right atrial cannula or bicaval cannulae in case of combined procedures, an ascending aortic perfusion cannula, and an ascending aortic cardioplegia and vent cannula. Standard CPB management included a membrane oxygenator , non-pulsatile flow of 2.4 L·min–.[1,2,3]mean arterial pressure > 50 mm Hg, moderate hemodilution (hematocrit 20%–25%), Systemic temperatures were kept at30°C–33°C in the majority of cases in both groups. The surgical technique was the same in both groups. The left internal mammary artery (IMA) was used in 98% of patients. The radial artery was used in 25% of cases and long saphenous vein was used in all patients to complete revascularization , the proximal end was usually anastomosed to the aorta using a partial occlusion clamp. Demographic, clinical, and outcome data were collected. The collected data was revised, coded, tabulated and introduced to the PC using Statistical package for Social Science SPSS 17 (SPSS Inc, Chicago, IL). Data was presented and suitable analysis was done according to the type of data obtained for each parameter Descriptive statistics: Mean, Standard deviation (± SD), Minimum and maximum values (range) for numerical data. Frequency and percentage of non-numerical data. Analytical statistics: Quantitative data were analyzed by the use of Student's test or analysis of variance as indicated .The distribution of qualitative variance was analyzed by compared Chi square test as indicated. Multivariate logistic regression was used to detect independent risk factors for hospital mortality and postoperative morbidity.

RESULTS

The two groups were similar in demographic profile, except: symptom and NYHA class in the tepid group was more severe and there were more combined procedures like mitral valve repair or replacement or aortic valve replacement. The types of operations performed and NYHA class of the patients are summarized in Table 1.

		cardioplegia				
		Cold blood		tepid		
		Count	Column N %	Count	Column N %	Significance*
Diagnosis	ACABG					
	CABG	78	97.5%	70	87.5%	
	CABG+AVR	0	.0%	1	1.3%	NS
	CABG+MVR	1	1.3%	1	1.3%	
	CABG+MVREPAIR	1	1.3%	7	8.8%	
	II	57	71.3%	47	58.8%	NS
NYHA class	III	19	23.8%	29	36.3%	
	IV	4	5.0%	4	5.0%	

Table 1.

In the tepid group, there were more combined operations 9 patients versus one patient in the cold blood group. There were also more mitral valve procedures. There was no significant difference in the percentages of patients who had total arterial grafting. The left IMA was used in 98% of all patients and its usage was similar in both groups. The number of distal anastmoses was similar in both groups .Mean cross clamp time in the tepid group was slightly longer (51.69±12.17) versus (50.55±10.56) in cold group p value 0.53 which is not significant statistically. The bypass times (73.64±12.66) were shorter in tepid cardioplegia group versus cold blood group (75.28±10.26) P value 0.10 ,reflecting rapid and early recovery of myocardial contractile muscles back to normal sinus rhythm after release of the cross clamp but it was not statistically significant. The rates of MI, difficulty from weaning from bypass neurological accidents, dialysis, respiratory complication, pleural effusions or pneumothorax requiring insertion of intercostals tube, ventricular rhythm disturbance, mortality, were not significantly different. Clinically significant but not statistically significant outcome was the rates of atrial fibrillation 2 patients in tepid group (2.5%) versus 8 patient(10%) in cold blood group, reoperation for bleeding or other complication, need for IABP postoperatively, and delayed sternal closure. We found out that, age and cardioplegia temperature were a constant and strong elements that play a role in the development of postoperative atrial fibrillation. Also cardioplegia temperature was found to have influence for the need for IABP postoperatively or delayed sternal closure. There was a strongly clinically but not statistically significant reduction in the use of IABP in the tepid group (10% versus 5%). The value of tepid cardioplegia was most apparent mainly in patients of the tepid group as the ejection fraction was less than those of cold blood cardioplegia with a mean ejection fractions (48.9% tepid versus 52.05% cold blood cardioplegia P value=.008). There were a significant reduction in the post operative low cardiac output as it was 5% in cold blood cardioplegia group versus 1.3% in tepid group also the CTn I levels post operatively was raised in both group after aortic cross clamping but it was significantly higher in the cold blood group especially after 6,9,12 hours (1.4±.07,2.1±1.9,3.09±.15) respectively versus tepid group (1.2±.07,1.9±1.9,2.8±.15) P value less than 0.001. Analysis of other differences between the cold blood group versus tepid blood groups as regard to mortality (3.8%versus 2.5%), MI (10 %versus 6.3%), use of IABP (10 %versus 5%) or cardiac supports (26.3%versus 17.5%) was found not statistically significant. The need for delayed sternal closure was higher in those who had cold cardioplegia (3.8 versus 0%). In the tepid group, there were slightly decrease in the rates of atrial fibrillation 2.5 versus 10%), reexploration (2.5%versus 7.5%). Mortality (2.5 %versus 3.8%) . However, none of these differences reached statistical significance, probably because of the small sample size. Analysis of the influence of high-risk subgroups between cardioplegia temperature and clinical outcomes did not reveal any differences for the same reason related to the small sample sizes.

DISCUSSION

Buckberg and colleagues.[4,5] suggested that cardioplegia did not need to be cold to be effective. The optimal clinical benefit of blood cardioplegia are temperature-dependent; they occur at 37°C and are probably less effective when the temperature goes down .[5,6,7,8] The standard technique of delivery is intermittent infusion of cold (4°C–10°C) blood or crystalloid cardioplegia solution via the aortic root. Buckburg said that electromechanical arrest is associated with a 90% decrease in myocardial oxygen consumption at 37°C, whereas hypothermia of 10°C–20°C produces only a further 7% to 8.6% reduction. Hypothermia delays the recovery of myocardial metabolism and ventricular function.[1,4,5] Cold blood cardioplegia has deleterious effects on mitochondrial metabolism, use of substrate, and membrane stability.[8,11,12] Cold cardioplegia has been shown to hinder mitochondrial state ,respiration and a decrease in citrate synthetase activity, which persists up to 1 hour after reperfusion. This goes with our result as the bypass time was slightly shorter in the tepid group (73.64±12.66) versus the cold group(75.28 ±14.43) reflecting early recovery of myocardium after removal of cross clamp ,also the need for defibrillator after clamp removal was reduced in the tepid group 6 patients versus 20 patients in the cold group .Teoh and colleagues[13,14] found that a hot shot immediately prior to release of the cross clamp resulted in prolongation of electromechanical arrest, improved aerobic metabolism, and increased diastolic compliance. This effect was thought to be due to early recovery of temperature-dependent mitochondrial respiration and adenosine triphosphate generation. Warm induction has also been shown to benefit energy-depleted hearts .Trials have shown improved ventricular function, fewer anaerobic byproducts, and better metabolic function with warm cardioplegia.[2,3,15] this goes with our result as low cardiac output syndrome was (1.3% tepid group versus 5% in the cold group)Some studies showed improvements in clinical outcome and mortality but this was not evident in our study. Martin and colleagues [3,11,12] found an increased incidence of neurological events. This might be related to the normothermic body temperature used in the warm group. The incidence of postoperative strokes in our study was similar in both groups . It has been suggested that tepid blood cardioplegia may have the benefits of better metabolic and contractile recovery associated with warm blood cardioplegia and the hypothermic protection against ischemic insult associated with cold blood cardioplegia. Several randomized trials have evaluated tepid blood cardioplegia in elective myocardial revascularization[8,15,16]. Even the clinical outcome of operative outcomes and mortality were not significantly improved in these studies, lab and echocardiographic investigations for the efficacy of myocardial protection tended to indicate that tepid blood cardioplegia was superior than cold or warm blood cardioplegia. In our study, there was a decrease in the incidence of atrial fibrillation, use of postoperative IABP,and time required for return of normal sinus rhythm after cross clamp release. We believe that these were

due to better myocardial protection from tepid cardioplegic temperatures as indicated from the measurement of the CTn I levels post operatively as it was raised in both group after cross clamping but it was significantly higher in the cold blood group especially after 6,9 ,12 hours (1.4±.07,2.1±1.9,3.09±.15) respectively versus to tepid group (1.2±.07,1.9±1.9,2.8±.15) P value =less than 0.001 which document the good clinical benefit of tepid blood cardioplegia in preserving of good myocardial muscles after a period of ischemia that follow aortic cross clamp. fig1 show CTnI in both groups.

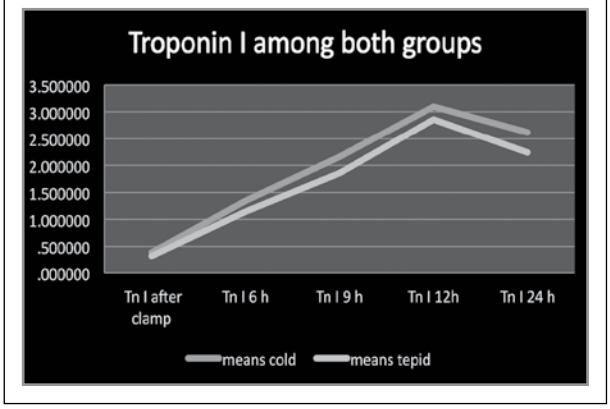

Fig 1. TroponinI release among both groups

The misfits of this study include the small samples size ,the two groups were not equal as the tepid group patients were more symptomatic with reduced mean ejection fractions and also more patients with combined procedures as mitral valve repair or replacement and aortic valve replacement. It was concluded from this study that the use of intermittent antegrade tepid blood cardioplegia for myocardial protection is safe and clinically appropriate strategy during cardiac surgery. Clinical benefit was most apparent in high-risk patients with low ejection fraction or those patients with associated pathology as ischemic mitral valve disease or aortic valve disease specially calcific aortic stenosis. The advantages are probably not evident in low-risk patients, and larger study is needed to prove this subject.

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Vein patch versus long on-lay left internal mammary artery patch for reconstruction of diffusely diseased left anterior descending coronary artery: Short and mid-term results

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Background: **A diffusely diseased coronary artery has been a significant therapeutic challenge for cardiologists and cardiac surgeons. Diffuse coronary artery disease is now more frequently treated surgically. The progressive application of noninvasive methods to achieve myocardial revascularization has contributed to the selection of patients with distinctly less attractive anatomic substrates for surgery. The major goal of coronary artery bypass surgery is to achieve complete revascularization of diseased arteries. Interestingly, it has been reported that incomplete revascularization of the left anterior descending artery (LAD) results in higher mortality than when other coronary arteries are left ungrafted. Previously, coronary endarterectomy was the chosen technique for reconstruction of diffusely diseased and occluded coronaries. Long reconstruction is one of the Coronary Artery Bypass Grafting (CABG) methods for treating severely or diffusely diseased coronary arteries. The greatest advantage of this method is that the myocardium supplied by the side branches of the diffusely diseased coronary artery can be revascularized simultaneously.**

Objectives: **To compare the short and mid-term results of venous patch versus mammary artery patch reconstruction in cases of LAD coronary artery long lesion.**

Patients and methods: Patients candidate for surgery were operated under general anesthesia. Monitoring lines were established. Trans-oesophageal probe was acquired. Long lesions in LAD coronary artery were reconstructed either with venous patch or mammary artery patch. Postoperatively, aspirin was started in the first postoperative day.

Results: **Most of our patients were male. Hypertension was found in 80% of patients of Group I and 76% of patients of Group II. Fourty percent of patients of Group I were diabetic and 36% of patients of Group II were diabetic. Four patients of Group I suffred from unstable angina preoperatively compared with 2 patients in Group II. Twenty percent of patients of Group I suffered from postoperative complications while 24% of patients of Group II suffered from complications. These complications ranged from re-exploration for bleeding, sternal revision, wound infection, pneumothorax and POMI (post operative myocardial infarction). During follow up one patien in Group I had Myocardial infarction compared with two patients in Group II.**

Conclusion: **Patch reconstruction, either venous or arterial seems to be a good solution for diffusely diseased left anterior descending coronary artery.**

KEYWORDS: **vein patch, mammary artery patch, left anterior descending coronary artery**

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Codex : o3/19/1301

A diffusely diseased coronary artery has been a significant therapeutic challenge for cardiologists and cardiac surgeons[1].

During the last decade, the progressive application of noninvasive methods to achieve myocardial revascularization has contributed to select patients with less attractive anatomical substrate for surgery[2].

According to different studies, in up to 25% of cases with a diffuse Coronary Artery Disease (CAD), standard coronary artery bypass technique cannot be safely performed and the condition is often deemed inoperable[2].

Previously, coronary endarterectomy was the chosen technique for reconstruction of diffusely diseased and occluded coronaries. Although this procedure gives acceptable results, the risk of perioperative events is higher and the long-term prognosis significantly worse than Coronary Artery Bypass Grafting (CABG) alone. Coronary reconstruction without endarterectomy is an attractive option because it avoids removing the protective endothelium from the coronary artery[3].

Long reconstruction is one of the Coronary Artery Bypass Grafting (CABG) methods for treating severely or diffusely diseased coronary arteries. The greatest advantage of this method is that the myocardium supplied by the side branches of the diffusely diseased coronary artery can be revascularized simultaneously[1].

The aim of this work is to compare the short and mid-term results of venous patch versus mammary artery patch reconstruction in cases of LAD coronary artery long lesion.

Materials and Methods

This study was conducted on 50 patients at the department of cardiothoracic surgery, Zagazig university hospitals between March 2011 and March 2013. Patients fulfilled the following criteria:

- Long lesion in the left anterior descending coronary artery.
- Patients who underwent coronary endarterectomy were excluded.
- No accompanying valvular heart disease or left ventricular aneurysm.
- No cardiogenic shock, heart failure or chronic obstructive pulmonary disease.
- Not a redo CABG.

Patients were divided into 2 groups:

Group I (25 patients): patients having venous patch reconstruction.

Group II (25 patients): patients having internal mammary artery patch reconstruction.

Methods:

- **History:** Personal, complaint, present, past and family history.
- **Examination:** General and local.
- **Investigation:** Complete blood picture, liver and kidney function tests, cardiac enzymes, 12 lead resting electrocardiogram (and exercise ECG), chest X-ray, echo-cardiogram and coronary angiography.

Operative procedures

Patients candidate for surgery were operated under general anesthesia. Monitoring lines were established. Trans-oesophageal probe was acquired. Long lesions in LAD coronary artery (> 2 cm) were reconstructed either with venous patch or mammary artery patch.

Patients were divided into 2 groups: group I undergoing reconstruction using venous graft patch on which mammary artery is grafted (implanted) and group II undergoing reconstruction using mammary artery patch.

In all patients, we used CPB with normothermia. The LAD is incised near the distal lesion and extended distally and proximally, then the LIMA patch or venous graft patch was sewn in place with 7/0 polypropylene suture. The anastomosis was performed. so, the ostia of diagonal perforators were included in the new lumen. Care was taken not to leave the venous patch pendulus. After venous patch is inserted, the LIMA is implanted at its hood.

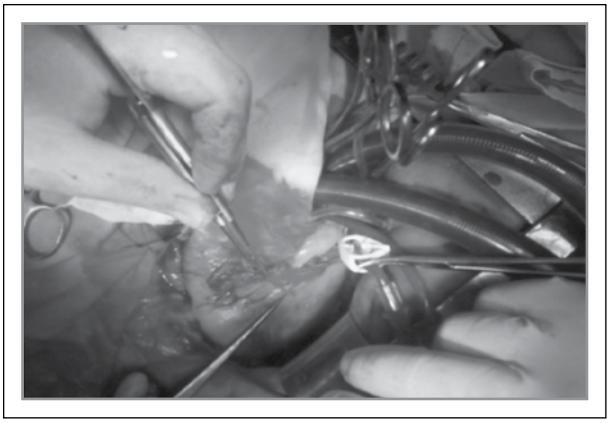

Fig 1. Mammary artery patch on LAD coronary artery.

Postoperative care

- Patient in Intensive Care Unit (ICU) was monitored for surgical drains, units of blood and blood products needed, complete blood count, liver and kidney function , coagulation profile, ECG, cardiac enzymes .
- Aspirin was started in the first postoperative day.
- Follow-up by office visit, ECG, echocardiography and coronary angiography (if possible).

Statistical analysis

Data were entered, checked and analyzed using Epi-Info version 6 and SPP for Windows version 8. The arithmetic mean as an average describes the central tendency of observations. The Standard Deviation (SD) measured dispersion of the results around the mean. Student t test was used when comparing two means. Chi-squared test was used for difference between two or more qualitative variable.

For all above mentioned statistical tests done, the threshold of significance is fixed at 5% level (p-value). The results was considered: Significant when the probability of error is less than 5% ($p < 0.05$), non-significant when the probability of error is more than 5% ($p > 0.05$) and highly significant when the probability of error is less than 0.1% ($p < 0.001$). The smaller the p-value obtained, the more significant are the results.

Results

The mean age in Group I was 59 ± 8 years ranging 50-74 years and in Group II was 52.9 ± 9.1 years ranging 40-66 years.

Most of our patients were male (60% in Group I and 84 % in Group II).

Hypertension was found in 80% of patients of Group I and 76% of patients of Group II.

Fourty percent of patients of Group I were diabetic and 36% of patients of Group II were diabetic.

The other predisposing factors are shown in table (2).

The mean preoperative ejection fraction was 53.8 ± 8.1% in Group I and 51.2 ± 11.3% in Group II.

Four patients of Group I suffred from unstable angina preoperatively compared with 2 patients in Group II.

The mean number of bypasses per patient were 2.88 ± 1.05 in Group I ranging 1-5 and 2.88 ± 0.8 in Group II ranging 1-4 while the mean number of arterial bypasses in Group I were 1.44 ±0.8 ranging from1-3 and in Group II were 1.48 ± 0.8 ranging 1-4.

The mean cardiopulmonary bypass time was 87.7 ± 29.3 minutes in Group I and 96.4 ± 31 minutes in Group II.

The mean cross clamp time was 58.5 ± 19.7minutes in Group I and 66.6 ± 19.2 minutes in Group II.

The mean ICU stay was 1.6 ± 1.1 days in Group I and 2.13 ± 1.5 days inGroup II and the mean intubation time was 13.3 ± 4.9 hours inGroup I and 14 ± 6.8 days in Group II.

Twenty percent of patients of Group I suffered from postoperative complications while 24% of patients of Group II suffered from complications. These complications ranged from re-exploration for bleeding, sternal revision, wound infection , pneomothorax and POMI.

The mean hospital saty was 8.1 ± 1.8 days in Group I and 8.95 ±3.4 days in Group II.

During follow up one patien in Group I had Myocardial infarction compared with two patients in Group II.

The follow up echocardiography revealed that ejection fraction after 6 months in Group I was 52.5 ±7.3 % and 51.9±6.8 % in Group II.

The hospital mortality was zero in both groups and after 6 months 1 patient died in each group while after 2 years 2 patients died in Group I and 1 patient in Group II.

	Group I (n = 25)	Group II (n = 25)	P
Age(years)			
Mean ± SD	59 ± 8	52.9 ± 9.1	0.052 (NS)
Range	50-74	40-66	
Gender			
Male	15 (60%)	21 (84%)	0.058 (NS)
Female	10 (40%)	4 (16%)	

Table 1. ***Demographic data***

	Group I (n = 25)	Group II (n = 25)	P
Hypertension	20 (80%)	19 (76%)	0.73 (NS)
DM(Diabetes Mellitus)	10 (40%)	9 (36%)	0.77 (NS)
Hyperlipidemia	15 (60%)	17 (68%)	0.66 (NS)
Smoking	16(64%)	15(60%)	0.76(NS)
COPD	3 (12%)	1 (4%)	0.6 (NS)
Aortic wall atherosclerosis	2 (8%)	1 (4%)	1 (NS)
Peripheral vascular disease	8 (32%)	7 (28%)	0.75 (NS)

Table 2. ***Risk factors***

	Group I (n = 25)	Group II (n = 25)	P
EF(%)			
Mean ± SD	53.8 ± 8.1	51.2 ± 11.3	0.35 (NS)
Range	30-65	30-70	
Unstable angina	4 (16%)	2 (8%)	0.66 (NS)

Table 3. ***Preoperative Ejection Fraction(EF) and unstable angina***

	Group I (n = 25)	Group II (LIMA) (n = 25)	P
Number of bypass/ Patient			
Mean ± SD	2.88 ± 1.05	2.88 ± 0.8	1 (NS)
Range	1-5	1-4	
Number of arterial bypass/Patient			
Mean ± SD	1.44 ±0.8	1.48 ± 0.8	0.85 (NS)
Range	0-3	1-4	
CardioPulmonary Bypass (CPB) time (minutes)			
Mean ± SD	87.7 ± 29.3	96.4 ± 31	0.31 (NS)
Range	33-132	36-168	
Aortic Cross Clamp time(minutes)			
Mean ± SD	58.5 ± 19.7	66.6 ± 19.2	0.14 (NS)
Range	14-98	29-110	

Table 4. ***Operative findings***

	Group I (n = 25)	Group II (LIMA) (n = 25)	P
Intubation time(hours)			
Mean ± SD	13.3 ± 4.9	14 ± 6.8	0.68 (NS)
Range	8-28	8-38	
ICU stay(days)			
Mean ± SD	1.6 ± 1.1	2.13 ± 1.5	0.23 (NS)
Range	1-5	1-7	
Complications	5 (20%)	6 (24%)	0.73 (NS)
Blood replacement(ml)			
Mean ± SD	613.6 ± 385	593.3 ± 291.5	0.83 (NS)
Range	240-1700	200-1500	
Reopen for bleeding	3 (12%)	1 (4%)	0.6 (NS)
Sternal revision	0 (0%)	1 (4%)	1 (NS)
Infection	2 (8%)	3 (12%)	1 (NS)
Pneumothorax	0 (0%)	1 (4%)	1 (NS)
Myocardial infarction			
N	1	2	1 (NS)
S	0	0	
Hospital stay(days)			
Mean ± SD	8.1 ± 1.8	8.95 ±3.4	0.31 (NS)
Range	5-13	6-19	
EF at 6 months(%)	52.5 ±7.3	51.9±6.8	0.45 (NS)
Mortality			
In-hospital	0 (0%)	0 (0%)	1 (NS)
6 Months	1 (4%)	1 (4%)	
2Years	2 (8%)	1 (4%)	

Table 5. ***Postoperative findings***

DISCUSSION

For decades diffusely or extensively diseased LAD was considered a challenge and the results of surgical revascularization and PTCA were not satisfactory.

Several surgical attempts were tried. Sequential grafting helped in multiple lesion but not in long lesion. Endarterectomy had many issues like the immediate need for anticoagulation & the myo-fibro-intimal proliferation.

Barra & Colleagues reported long patch reconstruction of diffusely diseased LAD with plague exclusion[8].

Vein patch reconstruction started in the 1980's with good short term results[4].

In our study we compared between the long LIMA patch & venous patch with LIMA Implantation for long diffusely diseased LAD.

The Choice of technique was dependant on surgeon preference and surgical expertise.

In our study the mean age was less than those in other studies, this may be attributed to lower age group of coronary patients in Egypt. The gender of the patients was consistent with other studies noting that ratio of female patients were higher in venous patch group.[1,2,5,6]

As for predisposing factors, Hypertension accounted for higher percentage than other studies [1, 2, 3, 6, 7] with no significant difference between the two groups. This may be attributed to the nature of our patient or due to smaller group of patients we have than other studies elaborating a statistical coincidence.

As for other predisposing factors our results were the same as other studies with no significant difference between the two groups. The mean EF in our groups were 53.8 & 51.2% which were higher than **Nishi et al**[6] and consistent with the result of **Fukui et al and Santini et al**[1, 2] and less than those of **Prabhu et al.**[3].

Sixteen percent in group I and eight percent in group II suffered from unstable angina preoperatively which is lower than the results of **Fukui et al.**[1] with no significant difference between the two groups, this may be attributed to the system of selection of cases we follow.

The mean number of anastmosis/patient were 2.88 in both groups which is less than other studies[5, 6] and this may be attributed to surgical decision or the unfavorableness of diseased vessels in Egyptian patients.

The mean CPB time and cross clamp time in our study were lesser than other studies [2, 6] this may be attributed to lesser number of number of bypass/patient and avoiding the usage of endarterectomy. The post op. intubation & ICU stay in our study were consistent with other studies[1, 5].

The mean ICU stay in our study groups were 1.6 and 2.13 days respectively with no significant difference between the two groups and similar results as other studies [1,2,3].

The same was found in the results of post-operative intubation time and consistent with other studies[1, 5].

The postoperative complications accounted for 20% and 24% in Group I and Group II respectively with no significant difference between the 2 groups .

This percentage of complications is lower than the most of the results of other studies[1]. This may be attributed to the system of selection of cases preferred by surgeons and avoidance of endarterectomy with its complications.

The major varieties of complications included re-exploration for bleeding, sternal revision , wound infection and Post Operative Myocardial Infarction (POMI)*.

After 2 years of follow-up 2 patients died (8%) in Group I and only one patient in Group II(4%) this percentage is consistent with **Fukui et al.[1]; Prabhu et al.[3] and Fukui et al.[5]**.

Patients had follow up by echoDoppler study at six months. Estimated 6months-ejection fraction showed a non significant difference between both groups compared to the pre-operative one though noting that it improved in Group II and decreased in Group I.

Twelve patients developed recurrent chest pain in the mid term follow up period (7 patients from Group I and 5 patients from Group II).

Myocardial perfusion scan was done to the whole 12 patients and was negative for myocardial stress inducible ischemia in 5 patients.

Seven patients had stress inducible ischemia (in territories other than the LAD), 7 patients had coronary angiography to clarify coronary anatomy and assess patency of the grafts.

All seven patients showed excellent patency of the LIMA graft and the arteriotomy patch segment, although mild relative ectasia was noted especially in the vein patch group along the arteriotomy segment.

After coronary angiography, patients with hemodynamically significant stenosis were revascularized accordingly.

Myocardial perfusion scan and coronary angiography statistics could not be done due to small patient numbers.

Study limitations

Our results could have been biased by small sample size and further studies are recommended recruiting larger number of patients. Also, long term follow up is recommended to monitor symptoms, cardiac events and to come up with necessary investigations whenever needed.

CONCLUSION

Patch reconstruction, either venous or arterial seems to be a good solution for diffusely diseased left anterior descending coronary artery. Though no significant difference between the two groups in short and mid-term results, long-term follow-up is needed to assess the choice of the type of patching used.

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Role of Thoracoscopy in the Diagnosis and Treatment of Intrathoracic Lesions: Sohag Experience

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Background and aim of the study **Since thoracoscopy was originally described in 1910, the application has been limited mainly to the diagnosis and treatment of pleural disease [1]. Advances in endoscopic surgical equipment and re-finement of surgical techniques have expanded the role of thoracoscopy to include multiple procedures that previously could only be performed by open approaches [2]. The objective of this study is to evaluate the role of video-assisted thoracoscopic surgery (VATS) in the diagnosis and / or treatment of intrathoracic lesions at Sohag university hospital.**

Patients and methods **VATS was performed on 156 patients, there were 97 male (62 %) and 59 female (38 %), patients age (17- 67, mean 44 years). The procedures performed included diagnosis and / or treatment of pleural disease (N=44), pericardiectomies (N=12), resection of solitary pulmonary nodule (N=6), lung biopsy (N=19), biopsy from mediastinal tumors(N=30) and resection of small benign mediastinal lesions (N=5), sympathectomy (N=6), evacuation of clotted hemothorax in trauma patients (N=31), and thoracoscopic esophagomyotomy in (N=3) cases of achalasia.**

Results **There was no mortality related to the procedure. Injury to the lung with air leakage and mild bleeding which was controlled occurred in 12(7 %) patients. Injury to intercostal vessels with minor bleeding occurred in 10 (6%) patients. Emergency open thoracotomy was done in 5 cases (3%). Mean hospital stay 5 days (2 day to 10 days), the average time for removal of the chest tube was 4 days (range, 1 to 11days). Subcutaneous emphysema occurred in 3 % of patients, fever in 14 %, and persistent air leak in 2 % of patients.**

Conclusion: **VATS provides a potentially less invasive, safe, and effective mean to diagnosis and treatment a variety of intrathoracic diseases. VATS techniques have limited morbidity and reduce hospital stay for major operations. Thoracoscopy's ultimate acceptance should be based on the results of controlled, randomized trials.**

Since thoracoscopy was originally described in 1910, the application has been limited mainly to the diagnosis and treatment of pleural disease [1]. Advances in endoscopic surgical equipment and re-finement of surgical techniques have expanded the role of thoracoscopy to include multiple procedures that previously could only be performed by open approaches [2].

The objective of this study is to evaluate the role of video-assisted thoracoscopic surgery (VATS) in the diagnosis and / or treatment of intrathoracic lesions at Sohag university hospital.

Patients and methods:

This study was conducted between January 2006 and December 2011, where the experience of Sohag university hospital (south Egypt) in VATS was evaluated. VATS was performed on 156 patients during this period, there were 97 male (62 %) and 59 female (38 %), patients age range from 17 years to 67 (mean 44 years). Ethics committee approved the study. Written informed consents were obtained from the entire patient.

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Codex : o4/01/1301

The procedures performed included diagnosis and / or treatment of pleural disease (N=44, 28%), pericardiectomies (N=12, 7%), resection of solitary pulmonary nodule (N=6, 4%), lung biopsy (N=19, 12%), biopsy from mediastinal tumors(N=30, 19%) and resection of small benign mediastinal lesions (N=5, 3%), sympathectomy (N=6, 4%), evacuation of clotted hemothorax in trauma patients (N=31, 20%), and thoracoscopic esophagomyotomy in (N=3, 2%) cases of achalasia.

Procedure details:

All procedures are performed under general endotracheal anesthesia with a double-lumen tube for selective lung ventilation. Thoracoscopy is usually performed through one or several small less than 2 cm skin incisions made along the intercostal spaces. Patients are placed in the lateral decubitus position, involved side up, although some procedures such as thoracic sympathectomy are performed with the patients in the supine position.

VATS was performed with rigid thoracoscope (model Karl Storz Endoskope SC-WU 24-A1515), that was 10 mm in diameter and 0 degree optical telescope connected to video-camera (Karl Storz HD Teleskope ,Karl Storz endo), and to a light source (Xenon nova 300). A 10 mm thoracoport was inserted with the blunt dissection technique in the six intercostal spaces in the midaxillary line. A 0 degree telescope was then introduced to explore the thoracic cavity to identify any pulmonary, pleural, or mediastinal pathology, and to plane the position of the other ports. The other ports were generally one space higher (the fourth or fifth intercostal space) in the anterior or posterior axillary lines. Five to ten mm thoracoports were used to introduce the operating instruments (biopsy forceps, endoscopic scissors, electrocautery, suction-irrigation instruments, and grasping forceps). Pleural adhesions were coagulated and sectioned. Lung was retracted by endoscopic retractors.

Upon completion of the procedure, a chest tube is inserted under direct visualization through one of the trocar sites. The remaining trocar sites are closed with an absorbable suture. Postoperatively, patients are returned to a hospital room and not routinely placed in an intensive care unit unless they were seriously ill preoperatively (who were in an intensive care unit preoperatively, chronically ill, or with limited pulmonary reserve).

Results:

There was no mortality related to the procedure, while 5 patients with advanced malignancy died of progression of their disease within 2 months postoperatively. Accidental injury to the lung was done while insertion of the trocar with air leakage and mild bleeding which was controlled occurred in 12 (7 %) patients. Injury to intercostal vessels by the trocar with minor bleeding occurred in 10 (6%) patients. Emergency open thoracotomy was done in 5 cases (3%), 2 cases due to mediastinal bleeding which not controlled by thoracoscope, 2 cases sever intercostal bleeding that need thoracotomy, one case due to injury to the azygos vein, all cases was controlled and passed smoothly without any morbidity or mortality.

Postoperatively, transfer to intensive care unit was not routinely required except in patients who were chronically ill, or were in an intensive care unit preoperatively, or in patients with limited pulmonary reserve (22 patients). Hospital stay in the remaining 134 elective patients who were not hospitalized preoperatively due to chronic or terminal illness averaged 5 days (range, 2 day to 10 days).

Intercostal tube was inserted routinely in all patients; the average time for removal of the chest tube was 4 days (range, 1 to 11days). Patients in whom an air leakage or fluid collection was not anticipated (sympathectomy and mediastinal biopsy), chest tubes usually removed in the second postoperative day.

In our study postoperative pain is usually not so sever, and mostly related to the chest tubes, and parenteral pain medication was required for longer than 48 hours in only 18 (11%) patients after tube removal, and in most patients parenteral pain medication not needed more than 12 hours after removal of the tube. Fever occurred in 22 (14%) patients in the post-operative period, air leak more than one week occurred in 4 patients (2%), subcutaneous emphysema in 5 (3%) patients.

Pleural diseases:

Thoracoscopy was done for 44 patients with pleural disease, the indications for thocoscopy, procedure done, and the results are shown in table (1).

Mediastinal diseases:

VATS was done for 35 patients with mediastinal disease, 30 diagnostic and 5 therapeutic, the indication, procedure, and the results are shown in table (2).

The other intrathoracic diseases:

The indication of VATS in other intrathoracic diseases, the procedure done, and the histopathological results are listed in table (3).

Comment:

Video-assisted thoracoscopic surgery (VATS) offers several advantages over the more conventional techniques; namely, it 1. Potentially permits access to the entire pleural cavity, including both the parietal and visceral pleura, 2. Allows for directly visualized biopsies, certainly for representative tissue for diagnosis, and 3. Affords control of bleeding, 4. lysis of adhesions allow inspection, 5. Recovery time from surgery (shorter hospital stay and a shorter duration of tube drainage compared with thoracotomy) [3, 4], and the level of postoperative pain is markedly reduced. Lastly [5] the small incisions used are better tolerated than the older larger open thoracotomy incisions. In our study we found that by thoracoscopy it is possible to get

NO. of Patients	Indication (diagnosis)	Procedure	Results (pathology)
30	Idiopathic (undiagnosed) pleural effusion	Biopsy and pleurodesis	20 Malignant 8 Benign 2 Not diagnostic
7	Recurrent malignant pleural effusion	pleurodesis	----------
5	Pleural thickening	biopsy	2 Mesothelioma 2 Metastatic 1 Non specific
2	Pleural mass	biopsy	2 Mesothelioma

Table (1): Thoracoscopy in 44 patients with pleural disease

No. of Patients	Indication (diagnosis)	Procedure	Results (pathology)
17	Mediastinal lymphadenopathy	biopsy	6 Hodgkin lymphoma 4 Non Hodgkin lymphoma 5 Metastatic 2 Tuberculosis (T.B)
13	Mediastinal mass	biopsy	3 Neurogenic tumors 2 Neuroblastoma 2 Teratoma 3 Thymoma 1 Seminoma 2 Squamous cell lung cancer
5	Mediastinal cyst	Excision drainage	2 Pericardial cyst 1 Hygroma cyst 1 Mediastinal abscess

Table (2): VATS in 35 patients with mediastinal disease

No. of patients	Indication (diagnosis)	Procedure	Results (histopathology)
12	Pericardial effusion	Drainage And biopsy	3 Renal failure 3 T.B 4 septic pericarditis 2 malignant
6	Solitary pulmonary nodule	Excision	3 Metastatic 2 Primary malignancy 1 Benign
19	Diffuse Lung disease	Biopsy	5 Primary carcinoma 4 Metastatic lesions 4 Iinterstitial pulmonary fibrosis (IPF) 4 T.B 2 Non specific
6	4 Hyperhidrosis 2 Raynaud's disease	Sympathectomy	
31	Clotted hemothorax	Evacuation	
3	Achalasia	Esophagomyotomy	

Table (3): VATS in 77 different intrathoracic diseases

good access to the entire thoracic cavity with less invasive and morbid approach without interference with the adequacy of the procedure.

With rapid improvements in endoscopic instrumentation and surgical ability, the facility with which thoracoscopic surgical procedures can be performed increases [1]. Minimally invasive thoracic surgery utilizing small incisions and specially adapted video-endoscopic instruments (VATS), allows the performance of surgical procedures in the chest cavity which affords a quicker and less painful convalescence for the patient. Many procedures which were previously performed with larger incisions can now be done thoracoscopically, with comparable results [4]. In our study, diagnosis and treatment of many intrathoracic diseases as pleural diseases, pericardial effusion drainage and pericardiectomy, mediastinal lesions (diagnostic and therapeutic), pulmonary biopsy and resection of localized solitary nodule, thoracic sympathectomy, chest trauma, and esophagomyotomy can often be performed more simply and more expeditiously than by standard open techniques.

Thoracoscopy, using either simple rigid or VATS, had very high sensitivity (80 – 100%) for both benign and malignant pleural disease [6, 7, 8]. Thoracoscopy increase diagnostic yield for pleural effusions after thoracocentesis and closed pleural biopsy specimens are non-diagnostic. Thoracoscopy successfully identified 131 of 150 (88%) malignant cases whereas repeated pleural cytologic study and closed needle biopsy specimen study the day before surgery yielded positive results in only 62 of 150 (41%) malignant cases [8]. Harris et al [9], reported thorcoscopy had a diagnostic sensitivity of 95% for pleural malignancy and 100% for benign disease. In our study 32 out of 34 (94%) cases of pleural disease was diagnosed by thoracoscopy, which nearly the same results with other studies.

Mediastinal lesions can be diagnosed by various procedures as, classic mediastinoscopy described by Carlens in 1959 [10], the anterior mediastinotomy proposed by Mc Neil and Chamberlain [11]. Both procedures present the advantage of technical simplicity, but their field of examination is limited [12]. Multiple lesions or those that are inaccessible by these methods can be diagnosed by thoracoscopy [13]. Furrer and colleagues [14], contrasted the diagnostic effectiveness of cervical mediastinoscopy, anterior mediastinotomy and VATS, and reported that VATS provided the diagnosis in 100% of cases, where diagnosis was made in 88% of cases when using the first two techniques. In our study, VATS was done for 35 cases of mediastinal disease (31 diagnostic and 4 therapeutic), where we got the diagnosis in 100% of cases.

In parenchymal lung lesions ultimately, one third of patients with diffuse lung disease will undergo open lung biopsy to establish a diagnosis [15]. Open lung biopsy has an operative mortality of 1.7 % and risk for serious morbidity of 2.5 % in selected patients [14, 16]. Thoracoscopic lung biopsy has been proposed as an alternative to open biopsy when bronchoscopic transbronchial biopsy specimens are indeterminate [4]. Ferson et al. [17] retrospectively compared 47 patients who underwent VATS lung biopsy with 28 historical control patients who underwent open wedge biopsy via limited thoracotomy. The mean operative time was significantly longer in the VATS group (69 vs 93 minutes respectively), but there were significantly more complications in the open group (including more bleeding and prolonged air leaks). The duration of hospital stay was shorter in the VATS group (mean 4.9 to 12.2 days). In our study VATS was done for 25 patients (6 solitary pulmonary nodule, and 19 diffuse pulmonary disease), complete excision was done for the 6 SPN, and biopsy for the other cases, we got the diagnosis in all cases (table 3), the mean operative time 93.2 minutes, the mean hospital stay was 7.6 days.

With rapid improvements in endoscopic instrumentation and surgical ability, the facility with which thoracoscopic surgical procedures can be performed increases [1]. Many procedures which were previously performed with larger incisions can now be done thoracoscopically, with comparable results [4]. In our study, VATS esophagomyotomy was done for 3 cases of achalasia with significant decrease in lower esophageal pressure, no major complications, and mean hospital stay 4 days. With VATS and single lung ventilation we got a good view for the mediastinum and addressed 12 cases of sever pericardial effusion (7 was in tamponade), where relieve the tamponade with good sized pericardial window and minimal complications (2 cases of arrhythmias).

In chest trauma, thoracoscopy provides an effective and safe modality by which to initially evaluate and often manage stable patients with blunt or penetrating chest trauma [17]. In our study, we used thoracoscopy in 31 patients with chest trauma and clotted hemothorax, where evacuation of the pleural cavity and removing the thin pleural peel was done successfully in all cases.

Known complications of thoracoscopy include bleeding, empyema, wound infection, prolonged air leak, tumor seeding at the entry site, and death [18, 19]. The incidence of subcutaneous emphysema with thoracoscopy ranges 0.5 to 7 % [20, 21]. The risk of infection appears to be low, with only 5 (0.5%) infections recorded in a collected series of 1,125 patients [22]. Post-operative fever were reported in (16%), and persistent air leak in only 2 % of 817 simple rigid thoracoscopy [14]. In our study, subcutaneous emphysema occurred in 3 % of patients, fever in 14 %, and persistent air leak more than one week in 2 % of patients.

Conclusion:

VATS provides a potentially less invasive means for diagnosis and treatment of a variety of intrathoracic lesions. It is safe and effective in the diagnosis of benign and malignant pleural diseases. It is safe and effective method for biopsy and diagnosis of diffuse parenchymal lung disease. In addition because of its less invasive nature and decrease morbidity compared to the standard open approach, the role of VATS was expanded to include a number of clinical situations as, high diagnostic

accuracy for indeterminate pulmonary nodule, mediastinal lesion and lymphadenopathy, pericardiectomy, sympathectomy, chest trauma, and esophagomyotomy without interference with the adequacy of the procedure, and with comparable results, Thoracoscopy's ultimate acceptance should be based on the results of controlled, randomized trials.

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Viscum and vincristine for chemical pleurodesis in case of malignant pleural effusion with positive pleural fluid cytology

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Viscum and vincristine are anti neoplastic drugs used as sclerosing agents for malignant pleural effusion. Positive pleural fluid cytology in malignant pleural effusion has been associated with high incidence of pleurodesis failure.

Aim and methodology: **Efficacy and safety of viscum and vincristine in chemical pleurodesis were evaluated in 120 patients with malignant pleural effusion with positive pleural fluid cytology.**

Results and conclusions: **Success rate of pleurodesis was insignificantly higher in viscum group 70% than in vincristine group 63.33%, while viscum achieved much better success rate (75%) than vincristine (30%) in second trial pleurodesis. As regard complications of pleurodesis; the incidence of fever was 17.5%, pain 20.83%, empyema 2.5% and loculated effusion 10.83%, with no significant differences between both drugs.**

KEY WORDS **(viscum, vincristine, and pleurodesis)**

The presence of malignant cells in pleural fluid that is usually detected by cytological examination is related to the grade of involvement of the pleural surface by carcinoma. **(1)**

Positive pleural fluid cytology in malignant pleural effusion has been associated with high incidence of pleurodesis failure, this is because pleural fluid cytology reflects the degree of tumor infiltration to the pleura, and so the area of residual healthy pleura suitable for pleurodesis. **(2)**

Using non anti neoplastic drugs as tetracycline, talc slurry, iodopovidone, and bleomycin has been associated with lower rate of pleurodesis success in patients with positive pleural fluid cytology. **(3)**

Anti-neoplastic drugs as viscum album **(4,5)** and vincristine **(6,7)** were found to be effective sclerosing agents for malignant pleural effusion, but the efficacy of those agents has not been evaluated in cases with high incidence of pleurodesis failure as in case of positive pleural fluid cytology.

Aim of the work

The objective is to evaluate the efficacy and safety of viscum and vincristine in chemical pleurodesis for malignant pleural effusion with positive pleural fluid cytology.

Patients and Methods

This study was conducted on 120 patients with malignant pleural effusion with positive pleural fluid cytology in cardio-thoracic surgery department, Tanta university hospital in the period from August 2010 to December 2012.

Inclusion criteria:

1. Malignancy was proven by positive pleural fluid cytology.
2. Pleural effusion causing dyspnea, cough or chest pain that improved after drainage.
3. Recurrent pleural effusion following thoracocentesis.

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Codex : o4/02/1301

4. Complete lung re-expansion after thoracocentesis and after chest tube insertion.

Exclusion criteria:

1. Poor performance status or very short life expectancy.
2. Hepatic, renal, cardiac or malnutritional co-morbidity that may affect pleural fluid accumulation.
3. Encysted pleural effusion.
4. History of chest surgery or radiotherapy of the affected side.
5. Inability to follow up for 3 months.

All patients were subjected to the following:

A- Pre-pleurodesis: Demographic, clinical, laboratory and radiological data were collected.

B- Chest tube insertion under local or conscious sedation in the 5th or 6th intercostal space in the mid axillary line; size ranged from 28 to 32 French.

C- Pleurodesis:

After complete evacuation of pleural fluid and radiographic confirmation of complete lung re-expansion, pleurodesis was done irrespective to the daily amount of drainage.

As pain and fever were always the most common complications after pleurodesis; intravenous narcotic analgesics and paracetamol were given routinely before the procedure, and 10 ml of xilocaine 2% was injected intrapleurally 10 minutes before injection of the sclerosing agent.

Patients were randomly distributed to 2 equal groups:

Viscum group (60 patients): Intrapleural injection of 5x1 ml of Viscum Fraxini-2 (each 1 ml contains Mistletoe extract equivalent to 10000 ng Lectins) mixed with 100 ml of normal saline.

Vincristine group (60 patients): Intrapleural injection of 2 mg Vincristine mixed with 100 ml of normal saline.

The tube was clamped immediately after injection of the sclerosing solution and remained clamped for 4 hours. During this time the patient was observed as regard fever and pain and was advised to do full inspiratory breathing to ensure full dispersion of the drug in the pleural space.

Patients were considered to have chest pain if they had chest discomfort after the intrapleural injection. Fever was reported if temperature increased one or more degree Centigrade above the temperature before the intrapleural injection and for 48 hours after pleurodesis.

The tube was unclamped to allow drainage and was removed when the daily drainage is less than 100 ml, if this was not achieved in more than 3 days this was considered early failure of pleurodesis and another trial with the other sclerosing drug and same steps were done; removal of chest tube and recurrent thoracocentesis was the option if pleurodesis failed again.

D- Post-pleurodesis follow up:

Patients were followed clinically and radiologically every 3 weeks for the 3 months following pleurodesis.

The efficacy of pleurodesis was evaluated as follow:

-Success: No re-accumulation of pleural effusion that induced symptoms and need re-intervention in the 3 months of follow up.

-Failure: Drainage more than 100 ml/ day for more than 3 days after pleurodesis (early failure) or re-accumulation of pleural effusion that induced symptoms or need re-intervention in the period of follow up (late failure).

Delayed complications as empyema and loculated effusions during follow up were recorded.

Statistical analysis

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

Results

This study was conducted on 120 patients who had malignant pleural effusion with positive pleural fluid cytology, there were 53 (44.17%) males and 67 (55.83%) female with a mean age of 50.3 years. 54 (45%) cases had right and 66 (55%) had left pleural effusions. As regard type of cancer; there were 36 (30%) lung cancer, 41 (34.17%) breast cancer, 19 (15.83%) lymphoma, 10 (8.33%) mesothelioma, 3 (2.5%) metastatic adenocarcinoma, and 11 (9.17%) of unknown etiology.

There was no significant differences between group I and group II as regard age (table 1), gender (table 2), side of pleural effusion (table 3), and origin of primary cancer (table 4).

The overall success rate of pleurodesis was 66.67% which was insignificantly higher in viscum group 70% than in vincristine group 63.33% (table 5). The incidences of early and late failure in both groups were insignificantly different.

(Table 6) shows that the incidence of success of second trial pleurodesis with viscum after vincristine failure (75%) was significantly higher than second trial pleurodesis success with vincristine after viscum failure (30%).

As regard complications of pleurodesis; the incidence of fever was 17.5%, pain 20.83%, empyema 2.5% and loculated effusion 10.83%, (table 7) shows that there was no significant differences between group I and group II as regard the incidence of complications.

Age (Years)	Viscum group (n=60)	Vincristine group (n=60)	t-test	P
Range	25 - 74	27 - 75	0.98	0.33
Mean ± SD	49.4 ± 12.6	51.5 ± 10.9		

Table (1): Distribution of patients regarding age.

Gender	Viscum group (n=60)		Vincristine group (n=60)		X2	P
	n	%	n	%		
Male	24	40	29	48.33	0.85	0.36
Female	36	60	31	51.67		

Table (2): Distribution of patients regarding gender.

Side	Viscum group (n=60)		Vincristine group (n=60)		X2	P
	n	%	n	%		
Right	23	38.33	31	51.67	2.15	0.14
Left	37	61.37	29	48.33		

Table (3): Distribution of patients regarding the side of pleural effusion.

Cancer type	Viscum group (n=60)		Vincristine group (n=60)		X2	P
	n	%	n	%		
Lung cancer	20	33.33	16	23.33	0.63	0.43
Breast cancer	22	36.67	19	31.67	0.33	0.56
Lymphoma	8	13.33	11	18.33	0.56	0.45
Mesothelioma	3	5	7	11.67	1.75	0.19
Metastatic adenocarcinoma	2	3.33	1	1.67	0.34	0.56
Unknown	5	8.33	6	10	0.1	0.75

Table (4): Distribution of patients regarding cancer type.

Pleurodesis	Viscum group (n=60)		Vincristine group (n=60)		X2	P
	n	%	n	%		
Success	42	70	38	63.33	0.6	0.44
Early failure	10	16.67	16	26.67	1.8	0.18
Late failure	8	13.33	6	10	0.3	0.57

Table (5): Distribution of patients regarding success of pleurodesis.

Second trial pleurodesis	with vincristine after viscum failure (n=10)		with viscum after vincristine failure (n=16)		X2	P
	n	%	n	%		
Success	3	30	12	75	51	0.02*
Failure	7	70	4	25		

**Significant or P<0.05*

Table (6): Distribution of patients regarding success of second trial pleurodesis.

Complications	Viscum group (n=60)		Vincristine group (n=60)		X2	P
	n	%	n	%		
Fever	9	15	12	20	0.45	0.5
Pain	11	18.33	14	23.33	0.52	0.47
Empyema	1	1.67	2	3.33	0.34	0.56
Loculated effusion	8	13.33	5	8.33	0.78	0.38

Table (7): Distribution of patients regarding complications.

Discussion

Pleural effusion is a frequent complication of disseminated and advanced malignancy. Pleurodesis, instillation of an intrapleural sclerosing agent, obliterates the pleural space, prevent fluid re-accumulation and improve its symptoms. Sclerosing agents are either irritant substance that creates no septic inflammation to induce adhesion as talc and tetracycline or anti neoplastic agents that kill intra-pleural malignant cells. **(8)**

The success rate of pleurodesis (70%) in viscum group was nearly equal to other 2 studies that used viscum in pleurodesis; in a study by Kim JJ et al.; viscum was used in pleurodesis for malignant pleural effusion; the success rate was 71%. **(4)** And in the other study by Stumpf C. and Schietzel M.; intrapleural instillation of viscum lead to significant decrease of tumor cells in malignant pleural fluid and 72% success rate of pleurodesis. **(5)**

In a study of Vidyasagar MS et al.; 2 mg vincristine was used as a sclerosing agent for malignant pleural effusions and twelve procedures out of 15 achieved complete resolution of pleural fluid with a success rate of 80%. **(6)** but in our study vincristine was used in a larger number of patients (sixty) and the success rate of pleurodesis was (63.33%), in another study; vincristine proved its efficacy in pleurodesis in a rare case of persistent bilateral pleural effusion complicating metastatic malignant melanoma. **(7)**

The success rate of pleurodesis was 70% in viscum group and 63.33% in vincristine group after 3 months follow up; this is comparable with the success rate of pleurodesis in malignant pleural effusion (either with or without positive pleural fluid cytology) in the study of R.M. Bakr et al. **(9)** where the final reported success rates of pleurodesis after 3 months follow up were 70% for bleomycin, 80% for doxycycline and 80% for povidone iodine, and 50% for 5-fluorouracil, and in the study of W. Shouman et al. where using tetracycline, talc slurry, iodopovidone and bleomycin, resulted in an insignificantly different success rates of 80%, 80%, 66.6%.73.3%, at 30 days and, 66.6%, 73.3%, 60%, 66.6%, at 60 days respectively. **(3)**

The antineoplastic drugs; viscum and vincristine were used for chemical pleurodesis in 120 patients with positive pleural effusion cytology. The success rate was 66.67% which is much better than using non anti neoplastic drugs as tetracycline, talc slurry, iodopovidone, and bleomycin in cases with positive pleural fluid cytology in the study of W. Shouman et al. **(3)** where the cases with positive pleural fluid cytology were 39 and pleurodesis was successful in 17 cases (43.6%) only; this may be due to the additional antineoplastic effect of viscum and vincristine on pleural malignant cells that decrease fluid production.

The success rate of pleurodesis was insignificantly higher in viscum group than in vincristine group (70% and 63.33%) but the difference was significant in case of second trial pleurodesis with viscum after vincristine failure (75%) and in case of second trial pleurodesis with vincristine after viscum failure (30%); this may point to the potential power of viscum as a sclerosing agent in highly resistant cases.

In our study the incidence of fever was 17.5%, pain 20.83%, empyema 2.5% and loculated effusion 10.83%.

The incidence of fever and pain in our study was much lower than in the study of R.M. Bakr et al. **(9)** where 40 patients received chemical pleurodesis with bleomycin, doxycycline, povidone iodine and 5-fluorouracil, the incidence of fever was 15/40 (37.5%) and the incidence of pain was 21/40 (52.5%); This may be explained as they used 10 ml 2% xilocaine locally like us but we additionally used prophylactic intravenous narcotic analgesics and paracetamol routinely before the procedure. In the 60 patients who received chemical pleurodesis with tetracycline, talc slurry, iodopovidone and bleomycin in the study of W. Shouman et al. **(3)** 15 (25%) had chest pain and 15 (25%) had fever. In their study 20 ml 2% xilocaine was installed intrapleurally 30 minutes before any chemical agent was injected.

In our study the incidence of empyema was 2.5% which is much less than other studies as R.M. Bakr et al. **(9)** where the incidence of empyema was 4/40 (10%) this may be explained by the intent in our study to shorten the duration of chest tube as much as possible. in our protocol; pleurodesis was done after complete evacuation of pleural fluid and radiographic confirmation of complete lung re-expansion irrespective to the daily amount of drainage, and it was removed when the daily drainage is less than 100 ml but if this was not achieved in 3 days, another trial of pleurodesis with the other sclerosing drug was done, removal of chest tube and recurrent thoracocentesis was the option if pleurodesis failed again, while in R.M. Bakr et al. **(9)** chest tube was left routinely for 3 days after pleurodesis, and then removed when the fluid drained was less than 250 ml/day.

Conclusion

Viscum and vincristine are both effective and safe in chemical pleurodesis in malignant pleural effusion with positive pleural fluid cytology with no significant difference as regard success and complications, but viscum achieves better results than vincristine in second trial pleurodesis. Also the routine use of local anesthetic and prophylactic intravenous analgesics and antipyeritics and following protocol that shorten the duration of chest tube leads to low rate of complications.

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Results of Surgical Management of Intrathoracic Extrapumonary Hydatid Cysts

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Background: **Chest wall, mediastinal, pericardial and pleural locations of the hydatid cysts has been presented very rarely and has already been called as intrathoracic extrapulmonary cysts.**

Methods: **Our study was conducted retrospectively between January1992 to January2012 in cardiothoracic surgery department Zagazig university hospitals; the data of 25 cases suffered from intrathoracic extrapulmonary hydatid cysts were revised, 20 males and 5 females, the main age group was 30.5 years ranged between 6 to 61 years.**

Results: **Chest pain (76%) which was the main complaint in our study and single right side lesion were the common finding. Pleural lesions were (68%) in our study and considered the common site for intrathoracic extrapulmonary hydatid cysts. Morbidity were low in our series, anaphylaxis was the famous complications (16%) and recurrence noted in one case, and no mortality .**

Conclusion: **we conclude that surgical treatment of intrathoracic extrapulmonary hydatid cysts is safe and curative with minimal morbidity and mortality.**

Keywords: **Hydatid cyst, extrapulmonary, intrathoracic, cystectomy.**

Hydatid cyst is an infection caused by the cestode Echinococcus and mainly occurs in sheep grazing areas (1), usually located in various tissues, although they are mostly seen in the liver and the lung (2,3).

Chest wall, mediastinal, pericardial and pleural locations of the hydatid cysts has been presented very rarely and has already been called as intrathoracic extrapulmonary cysts (4,5,6). Pleural hydatid cysts were the most common lesions amongextrapulmonary intrathoracic hydatid cysts (7). The aim of this study is to evaluate the surgical results for management of extrapulmonary intrathoracic hydatid cysts.

Patients and methods

1. Study population

Our study was conducted retrospectively between January 1992 to January 2012, in cardiothoracic surgery department Zagazig university hospitals;the data of 25 cases suffered from intrathoracic extrapulmonary hydatid cysts were revised, 20 males and 5 females, the mean age group was 30.5±6 years ranged between 6 to 61 years.

2. Pre-operative assessment

The data collected includes clinical history, x- ray chest, CT chest and pulmonary function tests were performed in some cases.

Diagnosis of extrapulmonary intrathoracic hydatid cyst depends on radiological, laboratory, and sometimes skin tests in few patients, the final diagnosis confirmed by surgical exploration and histopathological examination **(picture 1).**

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Codex : o4/03/1301

3. Surgical technique:

Surgery consisted of exploration of the chest through thoracotomy and evaluation the cystic lesions involved either pleura, chest wall, diaphragm, mediastinum and pericardium (**picture-2).**Dissection and separation of the lesions from surrounding structures as lung, esophagus and pericardium. Before opening the cyst we aspirate the water contents and in some cases injection of concentrated saline inside the cyst to decrease the incidence of the direct dissemination. First we try to resect the cyst in one block with the surrounding pleura to avoid rupture of the cyst; if the cyst opened or ruptured we removed the content and trying to remove all cystic walls ,and the affected surrounding tissues**(picture-3).**

4. P*atient follow-up*

Follow up of our patients in outpatient clinic was done postoperatively for one year; follow up was done for recurrence, postoperative morbidity and mortality.

5. Statistical analysis:

This study included 25 patients collected retrospectively from 1992 to2012.All the data were statistically managed as tables and graphs with the use of Microsoft Excel 2007 program.

Results

The data of 25 cases suffered from intrathoracic extrapulmonary hydatid cysts were revised, 20 males and 5 females, the main age group was 30.5±6 years ranged between 6 to 61 years.

Chest pain (76%)which was the main complaint in our study ,dysphagia in (16%) ,and dyspnea in (24%)of patients. Any patient can complain of more than one symptom .single lesions were presented in (72%) of cases, multiple lesions in (28%),on the left side(32%) of these lesions presented while (56%)on the right side, Either single or multiple lesions could be distributed to the right or left side, (**table -1) (Fig. 1)**

Concerning the different intrathoracic extrapulmonary locations where the hydatid cysts could be developed, the pleural lesions were (68%) in our study and considered the commonest site for intrathoracic extrapulmonary hydatid cysts,media stinal(8%),diaphragmatic(16%),pericardial(4%)and chest wall(4.%)(**table-2) (Fig. 2)** . Morbidity was low in our series, anaphylaxis was the famous complications (16%),bleeding in 2cases(8%),empyma in 1 case(4%) ,recurrence noted in one case, and no mortality in our series(**table- 3) (Fig. 3**) .

Parameter	Number of patient(25)	Percentage
Age (year)	30.5±6(6-61)	
Male	20	80%
Female	5	20%
Chest pain	19	76%
Dysphagia	4	16%
Dyspnea	6	24%
Single lesion	18	72%
Multiple lesions	7	28%
Left sided cysts	8	32%
Right sided cysts	14	56%
Recurrent cases	1	4%

Table (1) Patients characteristic

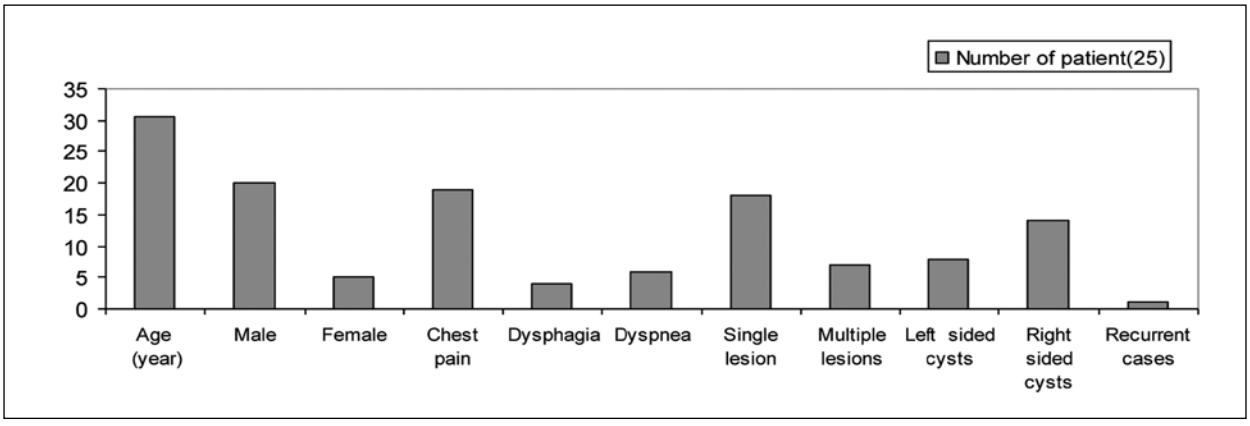


Fig 1. Patients clinical characteristics.

Location	Number	Percentage
Pleural	17	68%
Mediastinal	2	8%
Diaphragmatic	4	16%
Pericardial	1	4%
Chest wall	1	4%

Table (2) Locations of the hydatid cysts according to the operative data

Parameter	Number of patient	Percentage
Anaphylaxis	4	16%
Bleeding	2	8%
Empyema	1	4%
Recurrence	1	4%
Mortality	0	0

Table 3 morbidity and mortality

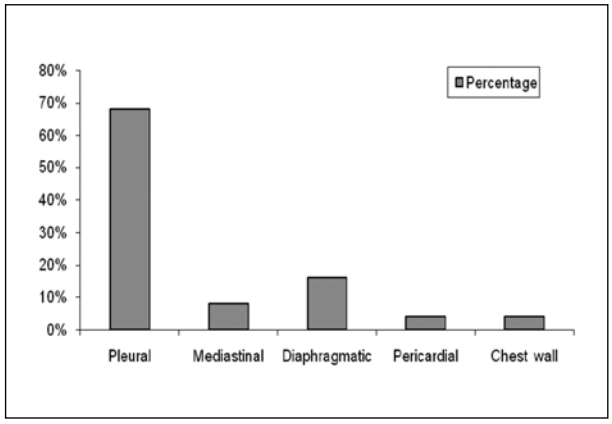


Fig 2. Locations of the hydatid cysts according to the operative data.

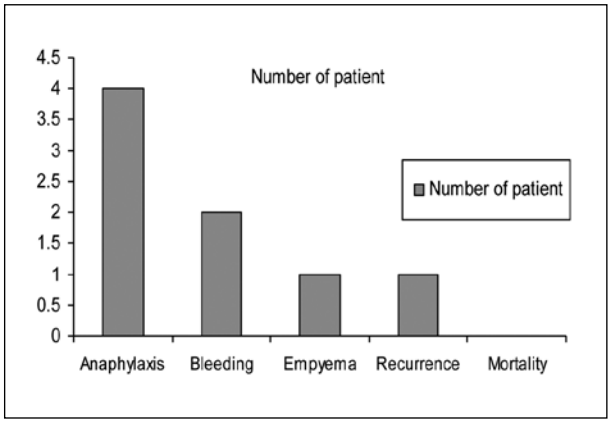
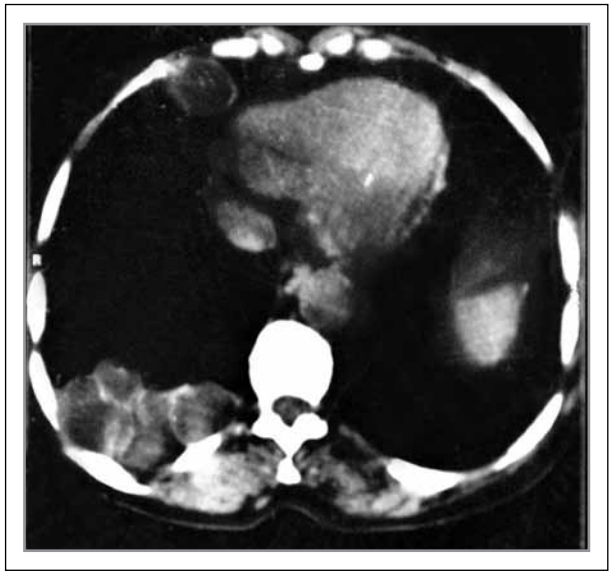


Fig 3. Morbidity and Mortality .



Picture 1. CT chest show multiple extrapulmonary hydatid cyst

Picture 2. Pleural hydatid cyst.

Picture 3. Multiple extrapulmonary hydatid cyst

Discussion

Although echinococcosis has been rare in developed countries, greater population mobility and migration may lead to increase of this clinical entity. Echinococcosis remains a substantial public health problem in many devolping countries(8-9).Hydatid cysts can be found in various tissues .Although the liver and the lung are the usual locations,but they can be located in various other tissues(10). Extrapulmonary intrathoracic hydatid cysts are very rare and mostly of pleural or mediastinal origin(11). However ,a diaphragmatic hydatid cyst is more rare entity.In the few number of diaphragmatic hydatid cysts usually the patient has hepatic usually at the same time of diagnosis or befor(12-13).Hydatid cysts of pleura ,fissures ,mediastinum,pericardium,chest wall and diaphragm,called intrathoracic extrapulmonary cysts and they can cause variety of symptoms(14).

The most common symptom between cases of intrathoracic extrapulmonary hydatid cysts was chest pain in70% of cases ,and another group of symptoms due to intrathoracic compression by the hydatid cysts.(15)..In our series of extrapulmonary intrathoracic cases the most common symptom was chest pain in 76%,dysphagia 16%,and dyspnea in 24.**Rafik** Ulku, etal reported through his study of series of 14 cases patients diagnosed as extapulmonary inrathoracic hydatid cysts. The most common location was the pleura(56.13%),while the diaphragmatic location in (21.42%),mediastinal location was in(14.28%)and pericardial location in(7.14%) .

In our series the distribution of extrapulmonary intrathoracic hydatid cysts was mostly pleural(68%),medistinal(8%),diaph ragmatic(16%), pericardial (4%), and chest wall involvement in (4%). So the intrathoracic extrapulmonary hydatid cyst distribution showed that pleural involvement is the most frequent,then diaphragmatic followed by mediastinal the the least.frequncy was the pericardial and chest wall.

Dermal tests,biochemical tests and imaging techniques like plain x-rays,ultrasonography,computed tomography and magnetic resonance imaging are usually accurate in diagnosis of pulmonary and hepatic hydatid cysts.Although serologic tests are also used they have a lesser value in diagnosis because of the false negative and false positive results(16,17).However in cases of unusual localization of hydatid cyst with atypical radiological appearance the exact diagnosis are not usually reliable ,and difficulties in diagnosis may lead to incorrectly surgical approach. Precise diagnosis usually achieved during surgical intervention.(18).

In our series it was obvious that it is possible to achieve satisfactory reliable diagnosis not with the use conventional radiographic methods including chest-xray,computed tomography, ultrasonography only ,but also with surgical exploration of the lesion.

When intrathoracic extrapulmonary hydatid cyst identified,it should be awared that cystectomy and capitonage are too conservative. More aggressive procedures such as wide resctions and reconstruction of the surrounding tissues can complete extirpation without spillage and subsequent recurrence(19). In our series our surgical intervention consisted of,exploration of the chest and evaluation of the extrapulmonary hydated cystic lesions involved ,either pleural,chest wall,diaphgram,mediastinum , and pericardium.. Dissection and separation of the lesions from the surrounding structures,as lung,osphaegus,and pericardium,befor opening of the cyst we aspirate the fluid content of the cyst and in some cases direct injection of hypertonic saline inside to decrease the incidence of the dissemination. Usually we started trial to resect the cyst in one block with the surrounding pleura to avoid rupture of the cyst. If the cyst ruptured or opened, we removed all the contents of the cyst and excised all the cyst wall.

Mediastinal hydatid cysts has rarely reported. It creates pressure symptoms such as dysphagia due to oesphgeal compression(20,21). In our series we reported 2 cases of mediastinal hydatid cysts(8%),one of them associated with diaphragmatic eventiration due to compression of the phrenic nerve ,both of the 2 cysts resected completely.

In our study we diagnosed 4(16%) cases of diaphragmatic hydatid cyts .All these cases managed surgically by complete cystectomy. After removal of the cysts 2 cases showed under surface diaphragmatic defects which were repaired surgically.

Hydatid disease of the chest wall is very rare and may lead to rib erosion, so surgery has to include complete cystectomy and rib resection.(22).

In our study we detect one case with intrathoracic extrapulmonary hydatid cyst adhesive to the chest wall and in close contact with a rib which was severely eroded; this case was managed by complet c and rib resection.

Conclusion

Hydatid cysts can form in different anatomic sites .Extrapulmonary intrathoracic location of hydatid cysts are uncommon .This rarity may lead to difficulties in diagnosis, and unexpected necessary wide resection and reconstructive procedures. Surgical approaches that are very conservative may lead to spillage and recurrence. The definite location of an intrathoracic extrapulmonary hydatid cyst usually confirmed during surgical intervention. The surgical procedures necessarily needed for the extrapulmonary intrathoracic type obviously differ as surgical intervention from the conventional location as pulmonary or hepatic, The surgical procedure should be selected according to the site of the cyst .complete extirpation and reconstruction of the surrounding affected tissues are preferred than cystostomy and capitonage, to avoid recurrence, so it is mandatory to resect all the affected tissues totally. To guard safely against recurrence. Post operative course of antihelmenthic should be prescribed.

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Cystotomy and Capitonnage for Pulmonary Hydatid Cyst in Upper Egypt, multicenter experience

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Objective: **Hydatid disease is the most severe helminthic zoonosis with an important public health. Hydatid cyst is caused by the tapeworm Echinococcus granulosus. It usually involves liver and lungs in humans. Surgical intervention is the definitive therapy.The goal of surgery is to remove the cyst while preserving as much lung tissue as possible. The aim of our study was to present the results of current parenchyma-sparing surgical treatment of pulmonary hydatid cysts with its complications.**

PATIENTS AND METHODS: **Between 2009 – 2013, 40 patients with pulmonary hydatid cyst treated surgically. there were 31 males and 9 females, aged from 20–48 years old, with long history of contact with animals or travelling aboard . Cystotomy and capitonnage were performed for most cases.**

RESULTS: **Cystotomy and capitonnage were done for most (37 out of 40) patients without intra/postoperative complications or mortality. No recurrence recorded during 12 months follow up.**

CONCLUSION: **Cystotomy and capitonnage procedure is safe and easy method for surgical management of pulmonary hydatid cyst.**

KEYWORDS : **Hydatid cyst , cystotomy , lung .**

Hydatid disease is the most severe helminthic zoonosis with an important public health. Hydatid cyst is caused by the tapeworm Echinococcus granulosus. It usually involves liver and lungs in humans [1]. Rudolphi *(1808)* first used the term hydatid cyst. It is frequently encountered in the sheep and cattle raising regions of the world and has been observed in Australia, New Zealand, South Africa, South America, Mediterranean counties of Europe, Asia, and Africa [2,3].

Hydatid cyst is a parasitic infestation caused by larva form of Echinococcus. It occurs frequently in liver *(55-75%)* and lung *(15-25%)*, the two organs can be affected simultaneously in about *(5-13%)* [4].

Pulmonary Hydatid cysts are uncommon in non endemic regions like Egypt. Humans are intermediate host. This disease occurs when humans ingest the hexacanth embryos of the dog tapeworm. Pulmonary Hydatid cysts are classified as simple, complicated, and ruptured. Pulmonary hydatid cyst is very rare to have calcified wall. Calcification does not always mean that the cyst is dead [5].

Computerized Tomography *(CT)* is the main diagnostic tool for pulmonary hydatid cyst as it is efficient in locating and detecting smaller cysts, finding their relation to surrounding organs, and for follow up. Usualy it reveals the cyst with smooth margin [5].

Surgical intervention is the definitive therapy.The goal of surgery is to remove the cyst while preserving as much lung tissue as possible. One lung ventilation*(OLV)* provides safety for the patient and better operative field. It is important to avoid any accidental spilling of hydatid fluid into operative field [5].

The aim of our study was to present the results of current parenchyma-sparing surgical treatment of pulmonary hydatid cysts with its complications.

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PATIENTS AND METHODS

This study was conducted at the Cardiothoracic Surgery departments in Minia, Qena, and Sohag universities (Upper Egypt), between January 2009 and December 2013, forty patients with pulmonary hydatid cyst were included in this study. The age, sex, clinical picture, number of cysts, side of affection, associated liver hydatid cyst was recorded ***(table 1)***. Chest x-ray, and ***CT*** findings were analyzed.

The patients were assessed with pre-operative clinical/ radiological and laboratory investigations. All patients underwent imaging with postero-anterior and lateral chest x-rays, thoracic computed tomography and abdominal ultrasonography or abdominal computed tomography and complete blood count/biochemical parameters. The diagnosis was made based on the clinical findings and indirect diagnostic methods (radiological) ***(figure 1).*** Indirect hemagglutination test was performed in the suspected cases.

Technique:

Posterolateral thoracotomy approach was used in all patients. Pericyst was incised after aspiration of cyst contents by 50ml syringe, so the cyst was lax and avoid rupture during cystotomy ***(figure 2).*** Pleural cavity and operative field were covered with pads soaked with 10% povidone-iodine solution to prevent dissemination of disease in pleura. Then, cyst was enucleated from the cavity, and residual cavity was obliterated by separated multiple purse string sutures starting from the deepest level ***(figure 3).*** In 3 cases the cyst was peripheral and wedgeresection was done. One lung ventilation was used to decrease the risk of aspiration of hydatid fluid and dissemination to the other lung.

Variable	Number of patients
Total number of patients	40
Male/female	31/9
Age (years)	20 -48
Number of cysts	48
Single cyst	36 cases
Multiple cysts	4 cases
Location of cysts	
Rt lower lobe	28 patients
Rt middle and lower lobe	4 patients
Lt lower lobe	7 patients
Lt upper lobe	1 patient
Associated liver cysts	2 cases

Table (1): preoperative patients' characteristics

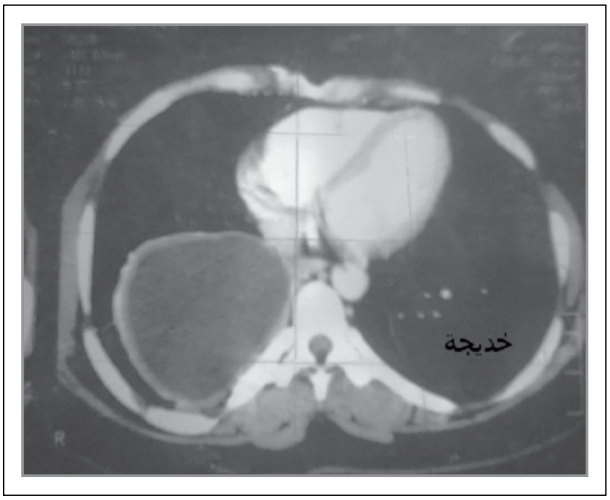

Fig 1. CT chest scan (mediastinal window) showed large hydatid cyst in right lower lobe.

The inner cavity was irrigated with saline solution and cleaned with gauze compresses soaked in povidone-iodine. The bronchial stumps were closed using 3-0 polyglactin. Capitonage was performed at the cyst area using 3-0 polyglactin. In the tow patients with associated liver cysts, diaphragmatic incision (phrenotomy) was performed following thoracotomy, and cystotomy was performed for the liver cyst by co-operation with general surgeons. Following resection of the liver cyst, biliary leakage was checked, a drainage tube was inserted and the diaphragm was sutured using non-absorbable sutures. Two chest tubes, one apical and the other basal, were placed in the thorax after hemostasis.

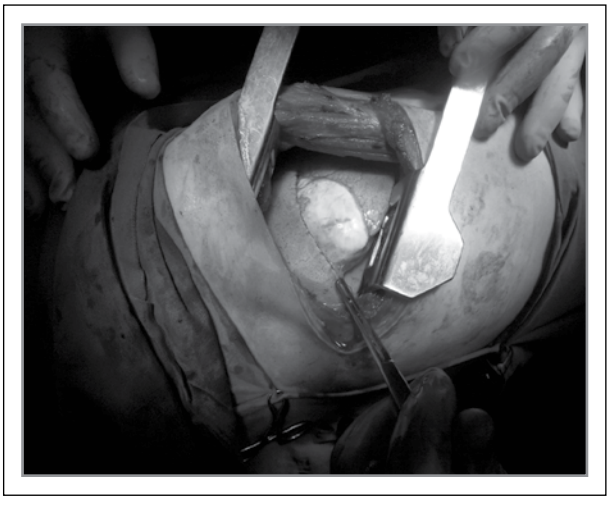

Fig 2. Photo showed posterolateral thoracotomy with large pulmonary hydatid cyst.

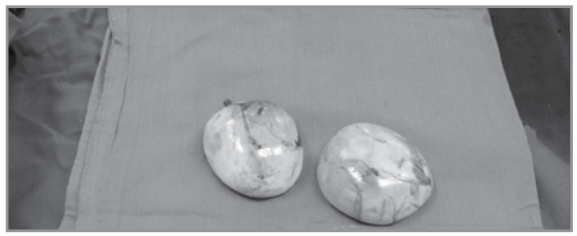

Fig 4. Two intact hydatid cysts after extraction (not tense after aspiration)

Postoperatively, the patients was given full course of albendazole treatment (10-15mg/kg albendazole) for 21 days in three periods, It prevents recurrence and complications.

RESULTS

Forty patients with lung hydatid cysts (2 with combined lung and liver cysts) were included in the study. These 40 patients underwent 42 operations. All operations were performed by thoracic surgeons, and co-operation with general surgeon when associated with liver hydatid cyst. The gender distribution of the patients was: 31 males and 9 females. The cyst was perforated in 5 (12.5%) out of 40 patients. The most common presentation was coughing (19 patients 47.5%), other presentation are sudden onset of chest pain and dyspnea (5 perforated cysts), dyspnea (5 patients), flank pain (2 patients), and in 9 (22.5%) patients it discovered accedentally.

The hydatid cysts were located in the right lung (80%), in the left lung (20%) and more common in lower lobes. There were concomitant liver cysts in two patients. The total number of cysts in 40 patients was 48. The mean cyst diameter was 10.9 cm (4-20 cm). The mean length of postoperative hospital stay was 8.2 days (5-16 days). There was no hospital Mortality. Five (12.5%) patients developed postoperative complications (There were atelectasis in 2 patients, prolonged air leake in 2 patients, and hemoptysis in one patient).

During the follow up period (12 months), there were no recorded complications or cyst recurrence, Follow up was done by clinical examinatin, chest x-ray and CT.

DISCUSSION

The primary treatment for lung hydatid cyst is surgical. Medical treatment should be preferred in patients who cannot undergo surgery and in patients with recurrence or multiple cysts. Cystotomy alone or cystotomy and capitonage operations are methods of choice for achieving optimal parenchymal preservation. Anatomic resections such as pneumonectomy, lobectomy and segmentectomy are usually avoided [6]. Kavukcu et al.,[6] performed 1118 operations in 1032 patients with lung hydatid cyst and none of the patients required anatomic lung resection.

In our series, we didn't need anatomic resection and in most patients parenchyma-preserving techniques such as cystotomy and capitonage were preferred. Wedge resection was performed for the 3 cysts with peripheral localization.

Concomitant pulmonary and hepatic hydatid cysts may occur in 4%-25% of patients. Single stage operation for pulmonary and hepatic hydatid cysts was found to be a safe procedure with low morbidity and mortality [7]. So, we performed right thoracotomy and phrenotomy for two cases.

All pulmonary hydatid cysts should be surgically treated as soon as possible after their diagnosis in order to avoid complications [8]. Several operative techniques are used to manage pulmonary hydatid cyst. The objective is resection of intact cyst and preserving pulmonary tissue. Most authors do not advocate cystectomy (Perez - Fontana method) because it increases the risk of air leaks and postoperative bleeding [3]. Some authors recommend leaving the cavity open without capitonnage. It is clear that leaving a potential cavity might allow infection, hematoma, and abscess formation. Uncontrolled spillage of the cyst contents may cause secondary pleural and bronchogenic hydatidosis [3]. Mahmodlou et al., [9] were dealing with residual cavity in an uncapitonnage manner by removing the thin margins of the pericyst and closing the bronchial openings at the cavity floor. That study had result 4.7% incomplete lung expansion and infection later on and 0.7% persistent air leak.

We used cystotomy and capitonnage to remove hydatid cyst intact without spillage of its contents and closure of residual cavity to avoid its complications in the majority of our cases (except the 3 cases with peripherally located cyst). Our results were without any air leak or infection.

Surgery for pulmonary hydatid cysts with the use of mini-thoracotomy proved to be a method of choice. The access permits early recovery and shorter rehabilitation period , allowing to perform the second liver surgery on the 3rd -7th day after the first operation [10]. Concomitant pulmonary and subdiaphragmatic hepatic cysts can be treated effectively and safely in a single stage operation via a right postero-lateral thoracotomy and Phrenotomy[7]. We performed lung and liver hydatid cyst via right thoracotomy trans-diaphragmatic approach in one stage.

Although the standard treatment of pulmonary hydatid cyst is surgery, some other interventional treatments have been reported. One of these treatments is the evacuation of the cyst with the help of a transthoracic catheter and then injection of a scolocidal substance inside. However, this treatment modality may be preferred only in patients who cannot tolerate surgery and in patients with accompanying infective clinical picture (obstructive pneumonia, empyema, etc.) in spite of the medical treatment [11].

Complications such as spontaneous pneumothorax, empyema, pleural thickening, hepatopleural fistula, pericarditis, and hepatobronchial fistula may develop after rupture of the pulmonary hydatid cyst into pleura [12].The ruptured cysts may lead to a misdiagnosis with the complications caused. They can be confused with other lung diseases such as pneumonia, tuberculosis, tumor, pleurisy, and pneumothorax [13].

In our study, 5 cases (12.5%) with perforated cysts presented to the emergency department with clinical findings of pneumothorax, hydropneumothorax. These patients had symptoms of sudden-onset chest pain, dyspnea and cough. It should not be overlooked that perforated pulmonary hydatid cyst cases may present to hospital with clinical findings of pneumothorax/hydro-pneumothorax, and the diagnosis of pulmonary hydatid cyst should be kept in mind.

CONCLUSION

Surgery is the primary treament of lung hydatid cyst with low morbidity and mortality. Cystotomy and capitonnage is safe and effective for surgical management of pulmonary hydatid cyst without recurrence in 12 months follow up. That procedure decrease risk of air leak and bleeding, so decrease cost and hospital stay.

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Pentalogy of Cantrell: Case report

Case Report

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Ectopia cordis is a rare clinical condition that means exteriorization of the heart outside the thoracic cavity. It is classified into partial and complete forms. Pentalogy of Cantrell is a partial form of ectopia cordis and comprises an association of anomalies that includes : deficiency of the anterior diaphragm, defect of anterior diaphragmatic pericardium, defect of the lower sternum, defect in midline supra umbilical abdominal wall and congenital cardiac abnormalities. We present here a two years old female infant with pentalogy of Cantrell presented with symptoms of heart failure in addition to a characteristic pulsating swelling in the upper abdomen.

KEY WORDS: **Cantrell pentalogy, Ectopia cordis, pediatric**

Ectopia cordis is a rare clinical condition that means exteriorization of whole or part of the heart outside the thoracic cavity It is classified into partial and complete forms according to the extent of midline defect, also it is varied between thoracic, abdominal, cervical and combined varients (1). Pentalogy of Cantrell is a partial form of ectopia cordis and comprises an association of anomalies that includes : deficiency of the anterior diaphragm, defect of anterior diaphragmatic pericardium, defect of the lower sternum, defect in midline supra umbilical abdominal wall and congenital cardiac abnormalities (2). So, it is considered as a partial form, thoraco abdominal variant of ectopia cordis but itself is varied between three classes, Class 1: Exact diagnosis, with the 5 present defects**,** Class 2: Probable diagnosis, with 4 defects (including intracardiac and abdominal wall defects)**,** Class 3: Incomplete diagnosis, with combination of the defects (always accompanied by sternal defects) (3). The exteriorized part is usually a ventricular diverticulum and cardiac defects varies between simple lesions like atrial septal defect (ASD) and complex lesions as fallot tetralogy (2) . Diagnosis and management should be tailored for each patient and depend on; age at presentation, severity of cardiac defects and severity of associated extracardiac malformations (2,4).

Case report:

We present here a two years old female infant with class 1 pentalogy of Cantrell presented with symptoms of heart failure in addition to a characteristic pulsating swelling in the upper abdomen coincident with the heart beats. Echocardiography revealed left ventricular (LV) apical diverticulum, abnormal ventricular relationship with LV is more anterior and midline apex, large apical ventricular septal defect (VSD), marked biventricular enlargement, Severe pulmonary hypertension, impaired myocardial functions (LVEF= 35%) and Moderate mitral and tricusbid incompetence. Computed tomography (CT) also was done and revealed the apical diverticulum protruded into the upper abdomen and the lower sternal defect (figure, 1). The surgical strategy consisted of; single stage repair, full hypothermic cardiopulmonary bypass (CPB) and cold blood cardioplegia (CP), resection of LV diverticulum (figure, 2), trans diverticulectomy synthetic patch closure of the apical VSD using interrupted teflon pledgetted 5 0 prolene sutures (figure, 3) , direct closure of the apical ventricular defect between two Teflon stripes (figure, 4) and direct repair of the diaphragmatic, abdominal wall and sternal defects.

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Codex : o5/01/1301

Results

The operative and early post operative data regarding; X clamp time, CPB time, mechanical ventilation time, ICU and Hospital stay are grouped in (table 1). The pre discharge and early follow up (two month) echocardiography was nearly the same with EF is 40 %, Cardiomegally, Mild MR, moderate TR. Clinically, the pulsating abdomial Swelling disappeared completely with only Mild symptomatic improvement ,so; the patient is still on maximized medical treatment.

X clamp time	72 minutes
CPB time	100 minutes
Support	dobutamine; 10 mug/kg / minute, milrinone : 0.5 mug/kg/ minute
Mechanical v	24 hours
ICU stay	5 days
Hospital stay	13 dayes

Table (1). The operative and early post operative data

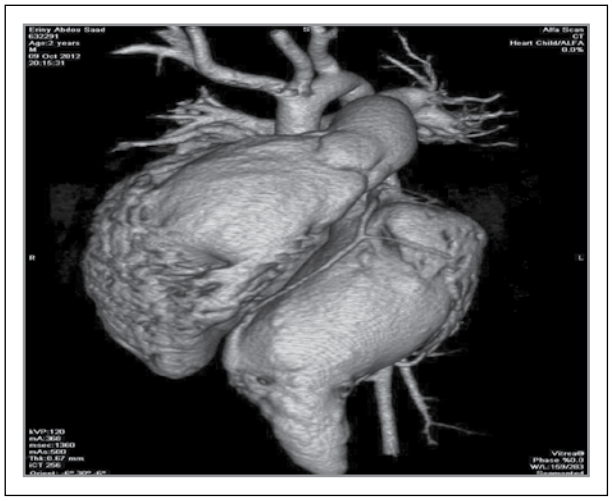

Fig 1. CT Pentalogy of Cantrell

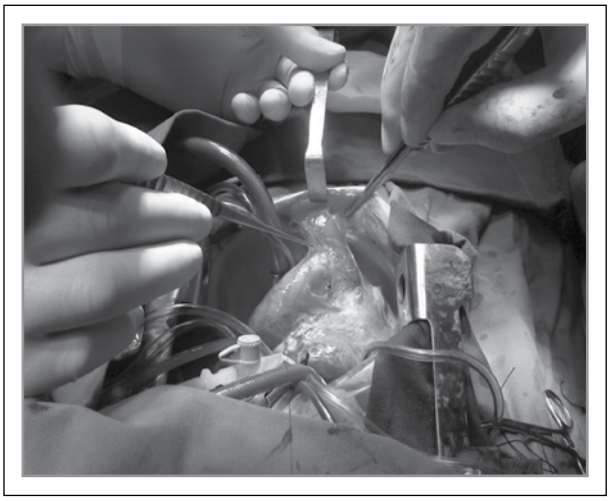

Fig 2. Operative view: apical diverticulum protruding into upper abdomen.

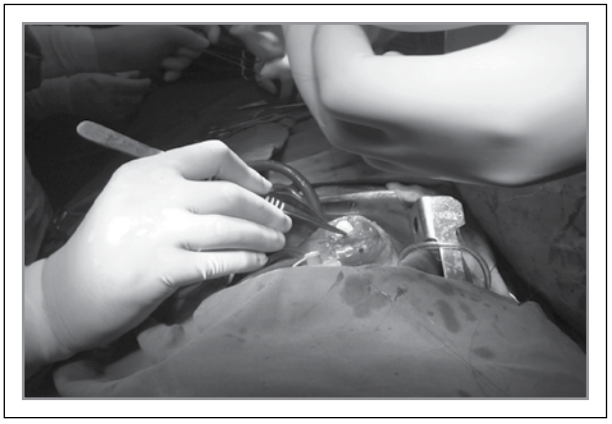

Fig 3. Operative view: VSD closure.

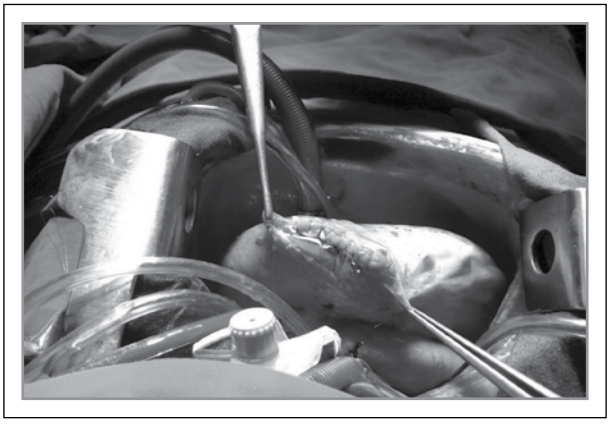

Fig 4. Operative view: closure after diverticulectomy

Conclusion

There are several reports about repair of pentalogy of Cantrell and the outcome of repair varies and depends mainly on severity of cardiac defects, size of the exteriorised part and the associated extracardiac anomalies ,so; the surgical strategy should be tailored for each patient but the main issues remain concerning ; single versus staged repair, reduction versus resection of the exteriorized part and direct closure versus augmenting the wall defect

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