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Use of the Greater Omentum Flap for Reconstruction of Deep Sternotomy Wounds

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ABSTRACT

Deep sternal wound infection is a life threatening complication of a median sternotomy. This case series study was conducted in Zagazig University hospitals in the period from April 2006 to December 2008, to evaluate the utility of the greater omentum transposition flap in treatment of deep sternotomy wound infection. It included 8 patients, 7 males and 1 female. In all patients the pedicled greater omentum flap was transposed to the chest based on the right gastro-epiploic artery through a fascial defect in the abdominal wall and was immediately covered by split thickness skin graft. It was used as the primary reconstructive methods in 2 patients and as a salvage procedure in 6 patients. The follow-up period ranged from 3-18 months (mean: 6 months). All flaps survived completely, 1 patient had partial skin graft loss. No recurrent infection was reported during the follow-up period. The mean hospital stay was 27 days (17-50 days). One patient died before discharge from the hospital. The donor site complications were in the form of abdominal hernia in 1 patient and partial abdominal wound dehiscence in another 1 patient. The greater omentum flap is a useful tool in the management of deep sternal wound infections especially when other options have failed or are insufficient.

INTRODUCTION

The median sternotomy incision was introduced to the field of cardiac surgery by Julian and colleagues in 1957 **[1]**. Since then the approach to cardiac surgery was changed with excellent access to the mediastinal contents without the pain of rib retraction and muscle-splitting. Again cardiac surgeons were confronted with complications of post-sternotomy deep sternal wound infection and mediastinitis **[2]**. Mediastinitis complicates median sternotomy wound infection in 0.6% to 3% of cases undergoing CABG (Coronary Artery Bypass Grafting) or valve replacement **[3]**. It is a serious complication and carries a high mortality rate ranging between 5% and 50% **[2-4]**. Post-sternotomy wound infection and mediastinitis is associated with high morbidity, prolonged hospitalization and higher hospital expenses with some patients spending as long as 6 months in the hospital receiving treatment **[5]**. Many risk factors are associated with the development of post-sternotomy mediastinitis, among these are; obesity, diabetes mellitus, harvest of bilateral internal mammary arteries, significant history of smoking, prolonged mechanical ventilation support and the need for repeated blood transfusions **[6,7]**. Management of deep sternal wound infection has varied historically from open packing of the debrided wound to combination of wound debridement with antibiotic irrigation administrated through closed catheter systems, to the current practice of wound reconstruction by vascularized tissue transfer **[8,9]**. In the modern surgical practice, extensive wound debridement and coverage by muscle flap transfer has become a widely accepted procedure for primary reconstruction of sternal wounds and has been shown to reduce morbidity and mortality, however in some instances they are not sufficient to cover more extensive defects **[2,10]**. The omental flap is a versatile well-vascularized tissue that can be used for reconstruction of extra-peritoneal wounds and defects **[11]**.

The aim of this study was to evaluate the utility of the omental flap in reconstruction of post-sternotomy deep wound infections and defects.

PATIENTS AND METHODS

This study was conducted in Zagazig University Hospitals in the period from April 2006 to December 2008. It included 8 patients; 7 males and 1 female. The age of the patients at the time of surgery ranged between 58 and 70 years (mean: 66). Table (1) shows the risk factors found in those patients.

All patients underwent median sternotomy for CABG (Coronary Artery Bypass Grafting) and all

had deep sternotomy wound infection. Conduits used in these patients were left internal mammary artery in 5 patients, bilateral internal mammary arteries in 2 patients, saphenous vein grafts in 1 patient.

After examining the patient and evaluation of the defect (Fig. 1), the whole surgical procedure, possible need for multiple surgical interventions and all possible complications were explained and a written consent was obtained from all the patients.

Radical wound debridement was done in the operative theatre under general anesthesia and was repeated after 48 hours, when needed, till the wound was ready for definitive reconstruction (Fig. 2). Wound swabs were taken and sent for culture and sensitivity tests. Omental flap was then transposed to cover the defect (Fig. 3-a,b). The flap was harvested through limited extension of the median sternotomy incision as upper midline laparotomy incision. In all patients the pedicled greater omental flap was transposed to the chest through a fascial defect in the abdominal wall, based on the right gastro-epiploic artery and covered with split-thickness skin graft in the same setting (Fig. 4). Following surgery all patients were transferred to the ICU (Intensive Care Unit). Evaluation of the outcome included flap survival, donor and recipient site complications, length of hospital stay after sternal wound reconstruction, and long-term follow-up.

RESULTS

All patients underwent radical wound debridement before definitive wound closure; 5 patients underwent radical sternectomy for deep and extensive sternal wounds and 3 had significant defects involving the lower third of the sternum. Definitive flap coverage was performed after an average of 1.9 debridements (range: 1-3). In 2 patients debridement was done and followed by immediate flap reconstruction.

The pathogens isolated from sterile cultures taken from the wounds prior to reconstruction were mostly gram positive (Table 2).

The omental flap was used as the primary reconstructive method in 2 patients. It was used a salvage procedure after failure of muscle flap reconstruction in 6 patients. The failed muscle flaps were bilateral pectoralis major in 2 patients, unilateral pectoralis major in 4 patients.

The duration of stay in the ICU ranged from 10 to 40 days (mean: 15 days). The hospital stay following omental flap reconstruction ranged from 17 to 50 days (mean: 27 days).

Patients were followed-up for 3 to 18 months post-operatively (mean: 6 months). One patient died before discharge from the hospital, he was 69 years old, had omental flap transfer after failure of unilateral pectoralis major muscle flap reconstruction of the sternotomy wound. We had no cases of total or partial flap loss. Partial loss of the skin graft occurred in 1 patient and was treated conservatively. We had no cases of recurrent infection during the follow-up period (Fig. 5).

Donor site complications occurred in 2 patients; one had abdominal hernia and the other one had partial abdominal wound dehiscence that required secondary suturing. Table (3) shows the overall morbidity and mortality among patients included in the study.

Table (1): Risk factors among patients.

Risk Factor	No.
Age (years) (mean, range)	66 (58-70)
Male gender	7
Obesity	3
Diabetes mellitus	4
Smoking	4
Chronic obstructive pulmonary disease	1
Hypertension	6
Use of bilateral internal mammary artery	2

Table (2): Organisms isolated from sternal wounds prior to reconstruction.

Organism	No.
Staphylococcus epidermidis	8
Staphylococcus aureus	5
Enterobacter cloacae	2
Escherichia coli	1
Klebsiela pneumoniae	1
Proteus mirabilis	1
Pseudomonas aeruginosa	1

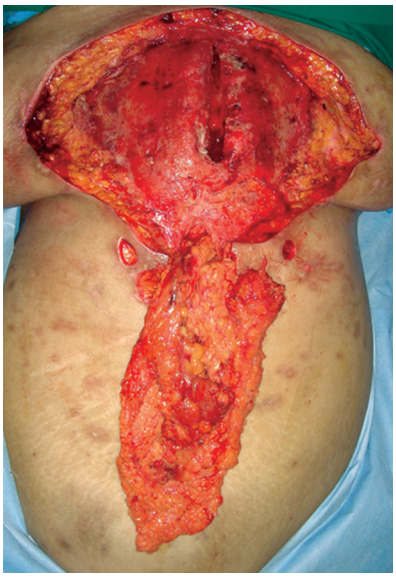
Table (3): Morbidity and mortality among patients.

Item	No. (%)
Mortality	1 (12.5)
Partial skin graft loss	1 (12.5)
Partial or total flap loss	0 (0)
Recurrence of sternal wound infection	0 (0)
Donor site morbidity	2 (25)
Abdominal wall hernia	1 (12.5)
Partial abdominal wound dehiscence	1 (12.5)

Fig. (1): Open sternal wound in a 60 year old female patient following debridement of failed bilateral pectoralis major muscle flap.

Fig. (2): The sternal wound after excision, sternal debridement and irrigation.

(A)



(B)

Fig. (3): A- The omental flap is raised on the right gastro-epiploic artery through extension of the sternotomy wound as a median laparotomy incision. B- The omental flap is transposed to fill and cover the wound.

Fig. (4): The omental flap is immediately covered by split-thickness skin graft.

Fig. (5): Stable wound 18 months following omental flap reconstruction.

DISCUSSION

Post-sternotomy mediastinitis, commonly called deep sternal wound infection, is one of the most serious complications following cardiac surgery. Although its incidence is relatively low, ranging from 0.6% to 3%, it is feared because it carries significant morbidity and a high mortality rate up to 50% **[2-4]**.

The pathogenesis of post-sternotomy mediastinitis is complex and multifactorial. Many risk factors have been identified and found to be associated with increased incidence of developing post-sternotomy mediastinitis such as obesity, heart failure, chronic obstructive lung disease and diabetes mellitus **[6,7,12]**. Due to the improvement of the health care system and increased life span of people, patients undergoing cardiac surgery continuously grow older. In this study, the mean age was 66 years. At time of surgery many of these patients suffered one or more of these risk factors (Table 1). The contribution of each factor to the development of post-sternotomy wound infection is still unclear. We agree with Milano et al. **[13]** that in obese patients, antibiotics may be poorly distributed in the adipose tissues, also preoperative skin preparation and sterilization may be inadequate in those patients due to deep skin folds. Elevated blood sugar level in diabetic patients impairs wound healing and is commonly reported as a risk factor for post-sternotomy mediastinitis **[14]**. The use of bilateral internal mammary arteries for cardiac revascularization has been commonly reported to be a risk factor for development of post-sternotomy mediastinitis; it is referred to poor wound healing following devascularization of the wound edges **[15]**.

The microbial etiology is variable; many pathogens have been shown to be responsible for sternal wound infections including gram-negative and gram-positive bacteria as well as fungi **[7,16]**. Gardlund et al. **[17]** reported that the most common pathogens involved in sternal wound infections were staphylococcus epidermidis and staphylococcus aureus which both form the normal flora of the skin. In our study, staphylococcus epidermidis was isolated from all wounds (Table 2). Sjögren et al. **[16]** stated that staphylococcus epidermidis is now considered as one of the most important causative organisms of wound infections especially when foreign material is implanted, such as prosthetic cardiac valves, prosthetic joints, cerebrospinal fluid shunts and steel wires used in almost all cardiac surgery procedures to close the sternotomy. Following colonization of the wound with staphylococcus epidermidis, a protective polysaccharide biofilm is formed around the colony which necessitates removal of the infected foreign body to treat infections caused by staphylococcus epidermidis **[18]**.

In this series, treatment always started by early wound excision under general anesthesia, debridement of all necrotic and devitalized tissues. All wires were removed, wound cultures were taken and sternal edges or even the whole sternum was debrided until healthy bone with nicely bleeding edges were found. This approach agrees with many authors **[2,7,19]**. Then, when debridement is complete and the wound is clean, transposition of the greater omentum to cover the defect created after debridement was done followed immediately by split thickness skin grafts. We agree with Ghazi et al. **[2]** that it is better to bury the omental flap underneath the skin wherever possible to achieve sternal stability. However, in those patients the chest had been open and the skin was retracted, skin graft was required to achieve tension-free closure of the wound. In our patients, skin and muscles were approximated wherever possible and sternal instability was not a major problem.

In our series all patients had extensive defects involving the lower part of the sternotomy wound and were successfully filled by omental flap. The lower part of the sternum, in the region of the xiphisternum, represents the most common site for sternotomy wound dehiscence **[7,19,20]**. This area is usually closed under tension after undermining of the skin to facilitate closure, this undermining may devascularize the skin flaps. Skin in this area is supplied by relatively fewer perforators coming from the internal mammary vessels as they pass beneath the costal margin to supply the rectus abdominus muscle **[21]**. We agree with Weinzweig and Yetman **[19]** and Ghazi et al. **[2]** that the pectoralis muscle flap, even if used bilaterally, would not be enough alone to cover such extensive and lower sternal defects and will need to be combined with omental flap.

We agree with Jones et al. **[7]** that the omentum is a very useful tissue for reconstruction of such deep and complex defects as it fills the deep portions of the wound obliterating dead spaces. Hultman et al. **[22]** added that its immunologic and angiogenic properties help to supply such defects with a highly vascularized tissue that improves blood supply to the wound increasing delivery of antibiotics and improving leucocytes function which help to combat infection. In our series we reported no cases of recurrent infection, This is

comparable to Ghazi et al. **[2]** who reviewed 52 patients underwent omental flap reconstruction of post-sternotomy wound infection over 15 years and reported that although these patients had more aggressive and resistant infection, the incidence of recurrent infection was as low as 1%. This highlights the clinical utility of the omental flap in reconstruction of infected wounds.

Many authors prefer to keep the omental flap to be used as a "back up" flap for salvage of a failed muscle flap or wherever the muscle flap is insufficient for extensive and lower sternal defects to avoid the added morbidity of a laparotomy **[7,20]**. Hultman et al. **[22]** reported donor site complications in 21 of the 64 patients underwent pedicled omentum transfer (33%). Donor site complications in their patient population, which included 135 patients, were usually limited to abdominal wall infection (6.7%), wound dehiscence (5.9%) and abdominal hernia (5.9%). In our study, donor site complications occurred in 2 patients (25%), we reported 1 case (12.5%) of abdominal wall hernia and 1 case (12.5%) of partial abdominal wound dehiscence. Our results are considered also comparable with Weinzweig and Yetman **[19]** who reported an incidence of abdominal hernia in 25 patients underwent greater omentum flap transposition to be as 21%. Yuen et al. **[23]** reported the incidence of hernia following omental flap reconstruction of the chest to be as low as 2.3% in 42 patients. This difference in the results with our work may be attributed to the difference in the number of patients. Meanwhile, Lopez-Monjardin et al. **[24]** did not report any donor site complications following transposition of the greater omentum to the chest.

In this series we reported a single case of death (12.5%) before discharge from the hospital. He was 69 years old who had the omental flap reconstruction of the sternum after failure of unilateral pectoralis major muscle flap. He was obese, developed post-operative atrial fibrillation, deep venous thrombosis and pulmonary embolism. He died on the 28th post-operative day. Death of this patient was not referred to the procedure of omental flap transfer but to the many co-morbid factors this patient had and the complexity of his case. Hultman et al. **[22]** noticed that omental flap transfer to the chest following sternal wound infection or tumor resection had the highest general complication rate including death among their patient population. They referred this to the old age of these patients and associated co-morbidities. We agree also with Ghazi et al. **[2]** and Shrager et al. **[25]** who did not attribute the increased mortality in such patients to the procedure of omental flap transfer but to the complex situation requiring its usage as a salvage procedure following failure of muscle flap, patient risk factors and advanced disease.

In this series the average hospital stay following omental flap transposition was 27 days which is comparable with other series reporting the same technique for management. Weinzweig and Yetman **[19]** reported an average hospitalization of 28.5 days, and Ghazi et al. **[2]** reported an average hospital stay of 20 days following transposition of the greater omentum for treatment of post-sternotomy wound infections.

Conclusion: Based on the results of this study, we can conclude that omental flap transposition is a good option for reconstruction of complex sternal defects especially after failure of muscle flaps or when the defects are extensive and low to the extent that muscle flaps alone will not be sufficient for coverage of the defects.

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