VASCULARIZED BILATERAL PECTORALIS MAJOR MUSCLE FLAPS AS A PRIMARY PROCEDURE IN PATIENTS WITH STERNAL NECROSIS AND INFECTION

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ABSTRACT

The current study was conducted to analyze our experience of vascularized bilateral pectoralis major muscle flaps as a primary procedure in patients with sternal necrosis and infection in terms of mortality, functional results and chest stabilization. It is a case - review analytical study conducted at Armed Forces Institute of Cardiology / National Institute of Heart Diseases, Rawalpindi from 1st Jan 1994 to 31st Dec 2001.

Patients developing sternal dehiscence subjected to primary repair with vascularized bilateral pectoralis major flaps were studied. Relevant information was retrieved from the medical records. The procedure entails generous excision of all visibly infected soft tissues and bone followed by covering with vascularized bilateral pectoralis major flaps, raised from medial to lateral side based on thoracoacromial vessels. Patients were followed for 01 year postoperatively for complications.

Twenty six patients suffered from deep mediastinal wound infection and sternal necrosis requiring bilateral pectoralis major flaps. One patient presented late after three months and all others were fresh cases. Mean age was 57.23 ± 8.92 and there were 24 males and 2 females. Twenty five patients had coronary artery bypass surgery and 01 had closure of ventricular septal defect (VSD) with aortic valve replacement and right ventricular outflow tract (RVOT) reconstruction. One (4%) patient had complete failure of the repair requiring omentoplasty, while 02 (8%) had partial wound dehiscence needing resuturing. Twenty two (84%) patients were discharged between 8 to 10 days while 01 (4%) patient died of septicemia and mutliorgan failure in the hospital. After one year, all were alive; none had chest instability, breathing difficulty or limitation of shoulder joint movement.

Primary repair with bilateral pectoralis major muscle flaps in sternal infection requiring extensive resection gives good results, with early discharge from the hospital good cosmetic results.

Keywords: Sternal dehiscence, pectoral major muscle flap

INTRODUCTION

The idea of using median sternotomy as an approach to thoracic organs was conceived in the late 1800s [1]. Nearly a century later, prevention and treatment of its infective complications remain a formidable challenge for cardiothoracic and plastic surgeons alike and deep mediastinal wound infection (DMWI) occurs in approximately 0.8 % to 8 % after such operations [2, 3, 4]. Mortality after DMWI has been reported to be up to 70% [5], although more recent reports showed significant improvement of the prognosis with mortality between 5% and 10 % [6].

Various risk factors for development of DMWI have been reported including diabetes mellitus, bilateral harvesting of internal mammary artery [8], obesity [9], corticosteroids or other

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immunosuppressive drugs [10] and prolonged procedural times [11]. Also, prolonged postoperative mechanical ventilation and pulmonary infections increase the risk of a mediastinal infection [12]. Multiple blood transfusion, faulty sternal splitting, excessive use of diathermy and bone wax are contributory factors as well [13].

Deep sternal infections leave physical, cosmetic and mental scars, and often prolonged and costly hospitalizations are necessary in these patients [14]. To treat this serious complication many therapeutic options have been applied such as; 1) open wound debridement and healing with secondary intention, 2) debridement followed by primary wound closure with closed irrigation, 3) debridement "clean" packing and delayed wound closure with pectoral muscle flaps, 4) early modified Robicsek closure and pectoralis major advancement flaps with or without irrigation, 5) use of vacum-assisted closure system and to primary repair with a muscle flaps with vascular pedicle (pectoralis major, rectus abdominis) or with omental transfer [15-21].

We adopted bilateral pectoralis major flap repair as a primary procedure for those patients who had osteomyelitis, required sternal resections with or without resection of costal cartilages or ribs, and in which rewiring was difficult to perform.

The following study investigates the outcome of patients suffering from deep sternal wound infections with sternal necrosis requiring resection and reconstruction of the resulting defect with bilateral pectoralis major flaps with particularly interest in the early outcome, complications and stay in the hospital.

METHODS

From 1st January 1994 to 30th December 2003, a colossal 8274 median sternotomies were performed at AFIC / NIHD. Patients having Sternal dehiscence with or without infection were identified and out of these 26 patients, requiring primary repair with vascularized bilateral pectoralis major flaps for infected and unstable sternum were studied. Patients in which sternal infections and dehiscence was managed by other procedures were not included. Relevant information was retrieved from the medical records. Patients who had infected sternum with or without involvement of costal cartilages or ribs, in which rewiring of the sternum to achieve sternal stability was not possible, were subjected to primary repair with vascularized bilateral pectoralis major flaps after resection of infected bone and tissue.

All Patients underwent chest radiography and electrocardiography (ECG) along with routine blood tests for hematology and biochemical profile. Blood cultures and cultures from the wound were done. Cultures were also done on tissues removed during operation to find out the culprit organism.

Operative Technique

The procedure was performed with the patient under general anaesthesia under intravenous antibiotic cover. Soft tissues and sternum were cut back to the bleeding edges with an effort to remove all of the infected tissue and salvage as much of the sternal bone as possible. Skin, subcutaneous tissue, mediastinal fluid, and sternal bones were sent for culture. Pectoralis muscle advancement flaps were raised from medial to lateral in the relatively avascular plane beneath the pectoralis major muscles. Diathermy was used minimally to avoid leaving necrotic tissues as nidus for infection. Superiorly the dissection was stopped at the level of the clavicles. Laterally the pectoralis muscle advancement flaps were raised as far as the anterior axillary line. The humeral insertion of the pectoralis major, the thoracoacromial vessels and the pectoral nerves were all left intact. The pectoralis minor muscle was also left undisturbed. Inferiorly the dissection passed below the superior fibers of the anterior rectus sheath but stayed superficial to the actual rectus abdominis muscle. After, these myocutaneous flaps had been raised bilaterally, the wound was irrigated with 1 to 2 L of normal saline mixed with povidone iodine. A closed suction drain (Redovac) was placed under each flap, and a third drain was inserted in the mediastinum. The flaps were then easily advanced to the midline without tension. Polydioxanon monofilament, absorbable sutures were used to approximate the pectoralis major muscles and their overlying fascia. Inferiorly the superior portion of the anterior rectus sheath was included in this deep layer of the closure. Skin and subcutaneous tissues were closed with interrupted nylon suture. Culture results determined the choice of antibiotic therapy.

Post operatively patients were monitored closely for fever, wound discharge, total leukocyte count, changes in ECG, cardiac enzymes and other biochemical parameters. Invasive blood pressure and central venous pressure monitoring was done in all patients along with measurements of hourly urine output. Patients were weaned from the ventilator as soon as judged appropriate by the anesthesiologist. The Redovac drains placed behind the muscle flaps were removed after five days minimum. Oral antibiotic treatment was prescribed for a total of 6 weeks.

RESULTS

A total of 8274 median sternotomies were performed during the study period at AFIC/NIHD and sternal dehiscence with or without infection occurred in 132 (1.59%) patients. Twenty six (19.9%) patients out of these constituting 0.2% of the total mediasternotomies were subjected to primary repair with vascularized bilateral pectoralis major flaps. Mean age was 57.23 ± 8.92 ranging from 19 years to 71 years. There were 24 (92%) Males and 04 (8%) females. Twenty five patients underwent coronary artery bypass grafting while 01 patient had closure of VSD with aortic valve replacement and right ventricular outflow tract reconstruction. As for risk factors, Diabetes mellitus was present in 12 (46%) patients and obesity in 9 (34.5%) patients while 11(42%) patients had reopening for excessive bleeding.

Twenty five (96%) patients presented with fever, serous or purulent discharge and wound dehiscence within 3-7 days after the first operation. X-ray of chest showed linear radiolucent shadow in the midline between two parts of sternum and malalignment of sternal wires in all these cases. One patient presented with late osteomyelitis of sternum after three month. Three (11.5%) had failure of treatment with open dressing and attempt at healing by secondary intentions while 01(3.8%) patient had failure after closed irrigation. The organisms grown from cultures are shown in table.

Fifteen patients had partial portion of the sternum left while 11 patients who had extensive involvement of the sternum, needed removal of major portion of sternum and costal cartilages and involved ribs twenty two (84%) patients had successful repair and these patients were discharged 8-10 days after the repair. 01 (4%) patient had complete failure requiring Omentoplasty later on and 02 (8%) had partial wound dehiscence requiring resuturing. Four (16%) had retro pectoral seroma formation requiring aspiration and 03(11.5%) had sinus formation needing dressings, both the above complications were treated in the out patients department. One (04%) patient died of septicemia and multiorgan failure. Seven (27%) patients complained of stretch and pain at the humeral attachment of pectoralis major muscle while walking at initial follow-ups but this gradually became better by the end of first year and at 01 year follow up, all were alive with stable chest and no breathing difficulty, or limitation of movement at the shoulder joint.

DISCUSSION

Sternal wound infection is a devastating complication after open heart operations carrying high morbidity and mortality [5, 6]. Patients with high risk factors, [7-13] definitely contribute towards sternal infection but, careful attention to surgical techniques, like avoiding paramedian sternotomy, excessive use of diathermy and bone wax, a good hemostasis and minimizing operating time [13] can reduce the morbidity and mortality.

The commonly reported organism in sternal infection are Gram-positive bacteria staphylococcus aureus or S. epidermidis, followed by mixed infections, Gram-negative organism and fungal infections [13] and in a number of patients no organisms are grown [18]. In our series gram-negative organisms were more prevalent.

The appropriate treatment of sternal wound infections and dehiscence, has, however remained a source of controversy since the introduction of closed-chest catheter irrigation and muscle flap techniques, but, both have been proved to be better than open treatment with healing by secondary intentions in terms of morbidity, mortality cost, hospital stay and mental stress [15,16]. Closure over irrigation catheters has become a standard procedure for mediastinitis following open heart surgery. However, need for reoperation due to persistent infection ranged from 13% to 66% [5, 10] especially if sternum osteitis is present. In sternal necrosis extensive debridement of necrotic tissue combined with open wound treatment and delayed closure, a longer stay in the hospital have been reported [3] and mortality rates were as high as 46% [10].

In sternal wound infection where it was not possible to rewire, bilateral pectoralis flap closure has been done as a primary repair after thorough debridement and curettage and removing all the infected sternum till healthy bleeding area is reached and have shown encouraging results [20, 22]. In children as well as those patients who had chest wall irradiation, primary repair done with bilateral pectoralis major showed successful outcome [23, 24].

The mortality in primary closure with bilateral pectoralis major flap repair has been reported from 0% to 25% [22, 20] which is in acceptable limits as compared to other modalities of treatment [5, 17, 25, 26].

Satisfactory cosmetic results, shoulder movements except adduction of arm, and pulmonary function have been reported after surgery [17,20]. The hospital stay has been also shorter as compared to other modalities of treatment in patients with deep sternal wound infection and dehiscence [22].

In other plastic procedures, omentoplasty has been done, but the patients require opening of abdomen which can be infected and in patients where gastroepiploic artery has been used as a conduit its use is to be avoided [13,20]. In rectus abdominis muscle flap technique, again, if internal mammary artery is used, it is not recommended to use the muscle [13]. In techniques where rewiring is combined with bilateral pectoralis major muscle flaps, Robicsek weave and figure of 8 pericostal sutures in fragile sternum or sternums with multiple fractures can disrupt the collateral blood supply by producing a constricting weave around the vessels and it is not as effective in approximating the top and bottom of a gaping sternum [18].

Our strategy is that, if there is only sternal dehiscence with no infection then Robiscek repair [2] is carried out; when sternum is minimally infected and can be easily preserved and rewired, we do Robiscek with bilateral pectoralis major muscle flap repair. In patients who require significant sternal resection or beyond and with rewiring sternal stability is not possible, primary repair with bilateral pectoralis major muscle flap is the procedure of choice. Use of rectus abdominis muscle and omentum is reserved only for those where the above methods fail and is done by the plastic surgeon. In conclusion, we have found primary closure as an acceptable procedure in the patients with deep sternal wound infections and dehiscence, and its outcome is comparable to other techniques. The advantages are early covering of the wound, early mobilization and less hospital stay. Also, it has psychological and cost benefits and cosmetic results have been satisfactory.

Table: Microbiology of culture-positive cases of mediastinits

ORGANISMS	CASES
No growth	6 (23.07%)
Serratia marcescens	7 (26.9%)
Psuedomonas aeruginosa	4 (15.38%)
Staphylococcus aureus	3 (11.5%)
Enterobacter cloaca	2 (7.6%)
Escherichia coli	1 (3.8%)
Kleibsella pneumoniae	1 (3.8%)
Staphylococcus aureus + Serratia marcescens	1 (3.8%)

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