The Comparison between the conservative approach and pectoralis major flap transposition in the treatment of mediastinitis following median sternotomy

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Abstract

Background: Mediastinitis is a significant complication of open heart surgery and other thoracic operations. Deep sternal wound complications notably increase morbidity and mortality. The optimal treatment for deep sternal wounds following sternotomy remains a topic of discussion. Options such as repeated irrigation and debridement of the wound, closed chest catheter irrigation, and recent plastic surgery approaches like pectoralis major flap transposition all have their proponents.

Methods: Given the high prevalence of Deep Sternal Wound Infection (DSWI), we conducted this retrospective descriptive study. We used existing information to compare the conservative method of repeated irrigation and debridement with pectoralis major flap transposition. We presented the results using descriptive and analytic methods. We evaluated a total of 125 patient health records with deep sternal wound infection over a ten-year period (2003-2013).

Results: The results of this study showed that 83.2% of patients who developed DSWI after surgery suffered from underlying diseases such as diabetes, renal failure, etc. However, no relationship was found between the presence of an underlying disease and recovery. Furthermore, no significant relationship was observed between diabetes and recovery. Among the 125 assessed files, 50 patients received a pectoralis flap, among which 48 patients recovered with sternal stabilization and only 2 patients recovered without stabilization. Conversely, among cases without pectoralis flapping, records were available for only 67 patients, of whom only 35 patients recovered with sternal stabilization while 32 patients recovered without sternal stabilization. Recovery was significantly enhanced in the group receiving flapping.

Conclusions: The only factor that improved the outcome in our assessment was the use of pectoralis flapping. This is consistent with the results of studies published in recent years that used plastic surgery methods, i.e., pectorals muscle or omentum flapping, which are associated with a high success rate and reduced length of in-patient stay.

Keywords: Mediastinitis, Median Sternotomy, Pectoralis Flapping

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Introduction

Sternal wound complications following a median sternotomy incision are significant in cardiothoracic surgeries. The median sternotomy incision is the method of choice in most surgeries on the heart and great vessels, trauma surgeries, coronary artery bypass graft, valve replacement surgery, cardiac failure, and organ transplantation (heart) [1]. In addition, many surgical methods of pulmonary surgeries provide a wide surgical area for the surgeon. Postoperative pain is significantly lower in the median sternotomy

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incision method compared with open thoracic surgery with a thoracotomy incision [2]. Deep Sternal Wound Infection (DSWI) or mediastinitis is a severe, life-threatening complication with a reported prevalence of 1-5% in surgeries with a sternotomy incision [3], leading to a considerable mortality rate of 8.6-55% [4].

DSWI risk factors after a median sternotomy incision mainly include diabetes, obesity, Chronic Obstructive Pulmonary Disease (COPD), osteoporosis, smoking, reoperation, length of ICU stay, and the use of supporting appliances in operation [3]. These patients have a mean 20-day length of stay, which further increases costs, nosocomial infections, and the burden on health services [4].

The Center for Disease Control (CDC) of the United States defines DSWI by the presence of one of the following criteria: 1) Organism isolation in mediastinal fluid or tissue culture; 2) Evidence of mediastinitis seen during surgery; 3) Any of the following signs and symptoms: chest pain, unstable sternum, fever above 38°C, pus drainage, organism isolation in blood culture or mediastinal culture [5].

The Pairolero classification [6] divides infected median sternotomy wounds into three types: Type I infections occur within the first week after sternotomy and typically have serosanguineous drainage but no cellulitis, osteomyelitis, or costochondritis. The majority of cases are Type II infections, which occur during the second to fourth weeks after sternotomy and usually involve purulent drainage, cellulitis, and mediastinal suppuration. Costochondritis is rare, but osteomyelitis is frequent. Type III infections occur months to years after sternotomy and typically involve chronic draining sinus tracts and localized cellulitis. Although mediastinitis is rare in Type III, osteomyelitis and costochondritis are frequent findings.

DSWI is a clinical diagnosis, though a CT scan is highly sensitive and beneficial in diagnosing the depth of infection and involvement of mediastinal organs. The best approach in managing these patients is prevention through antibiotic prophylaxis before the operation [7]. When a DSWI diagnosis is confirmed, empirical antibiotic therapy should be initiated until the culture report is available. However, surgical treatment and debridement of infected tissue play a crucial role in the patient's therapeutic response. Additionally, flaps with omentum, pectoralis muscles, abdominal muscles, and free flaps are used in microsurgeries.

Materials and Methods

This is a descriptive retrospective study using existing data. Patients who underwent median sternotomy for open heart surgery or any other thoracic surgeries between 2003 and 2013 in Maish Daneshvari and Milad Hospitals, and who were referred for mediastinitis in the context of deep sternal wound infection, were evaluated.

Mediastinitis cases were diagnosed according to the CDC criteria for DSWI. Patients were treated with two therapeutic methods: 1) a conservative approach and 2) pectoralis major flap transposition. Personal information, including age, sex, underlying disease, type of operation leading to median sternotomy, postoperative complications, duration to develop mediastinitis, mediastinitis treatment method, length of hospital stay, mediastinitis symptoms, wound site isolated microorganism, duration of treatment, and follow-up, were extracted using a pre-designed questionnaire. This information was entered into the SPSS software, and groups were compared using the chi-square test.

Results

The information from 125 patient records was entered into the software and analyzed according to the study objectives.

Out of a total of 125 patients, 79 were men (63.2%) and 46 were women (36.8%), with a mean age of 59±18.9 years, ranging from 20 to 81. A total of 118 patients (94.4%) underwent CABG, and the remaining patients (5.6%) underwent other cardiac and mediastinum surgeries.

Fourteen patients required reoperation after the primary surgery due to bleeding or other complications, and 111 patients (88.8%) developed mediastinitis after the primary surgery. Out of 125 patients, 104 had at least one underlying disease, and 21 patients did not have any underlying disease. According to the Pairolero classification, 34 patients belonged to Type I, 53 patients to Type II, and 38 patients to Type III. No significant relationship was found between the type of infection and the recovery rate.

The wound culture of patients was positive in 67.2% of cases and negative in 20.4%, while the results of 12.4% of cultures were not accessible. Of the positive culture reports, 69% belonged to Staphylococcus, 9.5% to Acinetobacter, and 7.1% to Pseudomonas.

Among the 56 patients for whom the stability and instability of the sternum were reported in their medical records, the sternum was stable in only 9 cases and unstable in 47 cases at the time of reference.

Out of the 125 patients, 50 received pectoralis major flap transposition. These patients received a mean of 28.4 days of antibiotic therapy, compared with the conservative group, which received 33.6

Table 1: Patient and methods

Patient and methods		
Deep Sternal wound infection	125	100%
Age(years) average and range	59(20-)18	
Male/Female Ratio	79/46	83.2%
Underlying disease	104	59%
Diabetes mellitus	70	67.2%
Positive culture	84	
Staphylococcus	58	
Acintobacter	8	
Pseudomonas aeruginosa	6	
E. coli	2	
Enterococcus	2	
Type infection (pairolero classification)	-	
i	34	
ii	53	
iii	38	
Sternum stability	-	
Yes	9	
No	47	
Unknown	69	
Primary surgery	-	
CABG	118	
Others	7	
Reoperation	-	
Yes	14	
No	111	

Table 2: Wound recovery and sternum stability (pectoralis major flap transposition vs conservative treatment)

Flapping	**Wound recovery**	**Wound recovery and sternum stability**
No	32 (42.6%)	35 (46.6%)
Yes	2 (4%)	48 (96%)
	X^2=26.59, df=1, P<0.0001	

Table 3: Recovery (pectoralis major flap transposition vs conservative treatment)

Flapping	**Complete recovery**	**Partial recovery**
No	33 (44.3%)	16 (21.3%)
Yes	48 (96%)	2 (4%)
	F=19.93 , P<0.001	

days of antibiotic therapy. This difference was not statistically significant (P-value=0.87).

Patient records were assessed to extract information such as wound recovery, sternum stability after treatment, and complete or partial recovery of patients.

Table 2 shows that sternum stability is significantly more associated with pectoralis major flap transposition compared with conservative treatment. Specifically, 96% of patients who received pectoralis major flap transposition experienced wound recovery and sternum stability. On the other hand, only 46.6% of patients who received conservative treatment achieved wound recovery with sternum stability, while 42.6% of wounds recovered without sternum stability.

Table 3 demonstrates that complete recovery was achieved in 96% of patients in the Pectoralis major flap transposition group, and 4% of them achieved partial recovery. Conversely, complete and partial recovery was achieved in 44% and 21.3% of patients who did not receive flapping, respectively. In 6 cases, the patient died during the follow-up, and 20 patient records had missing data, making it impossible to assess recovery.

Discussion

Deep wound opening and subsequent instability in thorax healing is undoubtedly one of the most frightening complications of sternotomy, initiating tissue infection and mediastinitis. This leads to long-term hospital stays, increased morbidity and mortality, and decreased long-term survival. Consequently, the prevention of deep wound infection remains a significant challenge for cardiothoracic surgeons and hospital personnel [8]. The mortality rate of deep sternal wound infection remains high, with rates reported between 4.8% to 10% in recent decades for patients treated with plastic repair or closed wound irrigation [9-11]. Hence, none of these methods have reduced the mortality rate to below 4%. Since Shumaker proposed the method of closed chest catheter irrigation, it has become a chosen treatment for deep sternal wound infection [12]. However, in recent years, a high success rate and reduced length of stay have been reported for plastic surgery methods, i.e., omentum or pectoralis major flap transposition [9, 13-15]. In our center, repeated irrigation and debridement are used instead of this method, which is associated with an 8% mortality rate. Some authors have reported the use of granulated sugar to clean the wound bed in a sensible time and prepare the environment for plastic surgery repair. Sugar granules do not stick to the wound and facilitate painless wound redressing. No complications associated with this method have been reported. However, it does increase insulin dosage in diabetic patients, reduces water activity in the wound, and disturbs bacterial growth [16].

This study revealed that 83.2% of patients who developed DSWI had an underlying disease. Among these, 59.2% of patients were diabetic. However, as this is a retrospective study, further assessments are required to investigate the percentage of diabetic patients who developed DSWL after a median sternotomy.

Another assessment in this study was the classification of sternal infections according to the Pairolero classification [6]. This assessment revealed that the type of infection did not significantly affect recovery. Nevertheless, there are a limited number of studies available in this field.

Six deaths occurred in this study, accounting for 4.8% of patients. All of these belonged to the irrigation and debridement group (8.8%), and no deaths were reported in the pectoralis flapping group. This difference may be due to the fact that patients with better general health status were selected for pectoralis flapping, and severe patients were allocated to the irrigation and debridement group. Among the six deaths, five diabetic patients and four patients with renal failure were under hemodialysis. However, there are still discussions about the best therapeutic method. As mentioned before, no method has decreased mortality to below 4% in long series [9, 10, 11]. In our investigation, complete recovery was significantly higher in the pectoralis flapping group compared with the conservative treatment. This is consistent with the results of previous studies. It can be concluded that pectoralis flapping significantly reduced recovery and hospitalization costs, and it is introduced as a choice method for deep sternal wound infection.

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