

Sternal Wound Complications After Median Sternotomy

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Abstract

Background:Median sternotomy provides easy, fast and unobstructed access to the heart, great vessels and some mediastinal structures. It has become one of the most common osteotomies performed, and has made the Cardiothoracic surgery the only specialty to adopt a simple wire approximation technique for vast majority of the patients, in a complicated area with unique challenges for healing because of respiratory and upper body movements. Sternal wound complications are reported to occur in up to 6.1% of the patients, and the mortality in deep sternal wound complications is 14% to 47%.**Material and Methods:**The study was conducted in the department of cardiovascular and thoracic surgery, on all the patients who underwent any surgical procedure after median sternotomy.**Results:**Median sternotomy was done on 53 patients with varied diagnosis and different surgical procedures. 29 (57.71%) were females, and 16 (30.18%) were in 2nd decade of life, Transthoracic echocardiography was the investigation of choice. Atrial septal defect was the most common diagnosis in 29 patients (54.71%). In all 50 patients (94.33%) were operated under cardiopulmonary bypass. Surgical procedures included, repair for atrial / ventricular septal defect. There was no major sternal wound complication.**Conclusion:**Sternal wound infections though rare can present with fatal complications. Pre and perioperative measures should be taken to minimise the occurrence of such a complication.

Keywords:Median sternotomy, Infection, Disruption

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Introduction

Minimally invasive thoracic incisions are gaining popularity in cardiac surgery, but most cardiac operations are still done through a midline sternotomy which provides excellent exposure of the vital chest and mediastinal structures. However sternal wound complications though rare may present with a grim phenomenon, and deep sternal wounds complications carry significant morbidity and mortality. Complications may range from simple wound dehiscence, sterile drainage, to a major infection, or major dehiscence. Infections from the median sternotomy are a particular threat to the cardiac surgery patients because of the potential for extension to aortic or cardiac suture lines, arterial grafts, prosthetic grafts, patch material, and intracardiac prosthesis. The compounding factors may be preoperative, such as obesity, emergency surgery, associated medical problems, functional class, bleeding diathesis, or steroid medications. Sternotomy complications may also depend on type /

duration of operative procedure, cardiopulmonary bypass (CPB) time, in addition to type of material utilized for sternal approximation. In addition, postoperative factors and prolonged stay in intensive care unit, patients requiring external cardiac massage for cardiac arrest, reoperation for excessive drainage, prolonged mechanical ventilation, tracheostomy or infections may all contribute to sternotomy complications. Major infections and dehiscence of the median sternotomy occurs in about 1.5% of patients and may range from .5% to 5.9%. The symptoms of sternotomy infections are expressed as local tenderness, throbbing and feeling of looseness of the sternal repair. Depending on the site of infection presternal, sternal and or post sternal, patient may be febrile and or have erythema of the wound, serous or purulent discharge, or patients may be in septicemia because of mediastinitis. It is believed that electrocautery can devitalize tissue, so should be used at low-powered mode of coagulation to avoid any flame throwing. The study was done to know the mode and pattern of presentation of such complications, and the management thereof.

Materials and Methods

The study was conducted in the department of Cardiovascular and Thoracic Surgery. All the patients undergoing surgical procedures after median sternotomy, irrespective of age, sex, clinical presentation, investigative evidence, and surgical outcome were included in the study. Those who died within two weeks of surgery were not included in the study. A detailed history, thorough general and systemic examination was done in all. Transthoracic echocardiography (TTE), was the investigation of choice, and in some coronary angiography, (CAG), transoesophageal echocardiography (TEE) contrast enhanced computed tomography (CECT) was also done. After the patient was planned for a specific surgery, baseline investigation complete blood count, kidney / liver / thyroid function, coagulogram, serology, blood sugar, cultures, Blood grouping, ECG and X ray chest PA view, were done in all. All the patients were operated in supine position, under general anaesthesia. After induction of anaesthesia, placement of invasive lines, indwelling catheterization patient was prepared from neck to groin, scrubbed and painted with povidone-iodine solution, draped from neck to upper abdomen, with adhesive disposable drapes. All patients were given piperacillin-tazobactam. The skin incision was median and vertical, starting just below the sternal notch and extending to the tip of xyphoid process. All presternal layers were opened by stainless steel scalpel and electrocautery was used only for pin point haemostasis and to control major bleeding vessels. Interclavicular ligament was separated with blunt dissection and divided with scissors or diathermy. Xiphoid process was mobilized and resected. Sternum which is usually divided by electric or air-powdered saw, with either a right blade or rotating disc, was split with Gigli saw, the vertical or median osteotomy was performed from above downwards. After the upper and lower ends of sternum were mobilised, fingers could easily be negotiated from both the ends, tidal volume was decreased, Gigli saw wire was negotiated from lower to upper end of sternum, substernally, gigli wire handles were applied, and the sternum was split. Once the sternum was split, the two verges are retracted and periosteal bleeding points are controlled with diathermy and or bone wax may be used to seal the bone marrow. The sternopericardial ligament was divided to allow homogenous retraction of the sternal verges, split sternal edges were covered with gauze pads and opened with retractors. After the surgical procedure, complete haemostasis was achieved drainage tubes were placed and sternum approximated with stainless steel wire. Six to eight parasternal sutures were given, 2 uppermost wires are placed through the manubrium to avoid injury of subclavian pedicle. Lower sutures taking in the body of the sternum may be simple or again figure of eight. The sutures were applied with tension, and the ends of the wires were securely twisted and buried in to presternal tissue. All the patients were managed in intensive care unit. Patients were observed for all the sternotomy wound complications, the pattern of such

presentation, clinical manifestation and the management. The infections in surgical wound after sternotomy have been classified as per the guidelines by Centre for Disease Control and Prevention (CDC). Patients were categorized as having infection in presternal region such as gaping, superficial wound dehiscence, cellulitis, sinus tract formation, and or presternal abscess, or in sternal region as sternal osteomyelitis, sternal dehiscence, sternal non-union, wire fracture and or wire migration, or the worst including post sternal having mediastinitis, regional empyema, retrosternal hematoma and or abscess formation. Septic profile and skiagram chest were done in all and the treatment instituted accordingly. In addition, in presternal wounds through irrigation, debridement and dressings were done daily. In deep wounds besides debridement of tissues, bone, re-suturing of sternum as and when needed was done. All the patients were followed in outpatient department. Morbidity and mortality were recorded.

Results

Median sternotomy was done on 53 patients with varied diagnosis and different surgical procedures. 29 (57.71%) were females, 16 (30.18%) were in 2nd decade of life, Table-1. TTE was the investigation of choice and helped in confirming the diagnosis in all patients requiring intracardiac surgery. TEE, CAG and CECT chest was done in very few patients. Commonly performed surgical procedures included, repair for atrial septal defect (ASD) / ventricular septal defect (VSD), mitral valve replacement (MVR), surgery for mediastinal masses, atrial myxoma, aortic valve replacement (AVR), ASD repair and pulmonary valvotomy. Isolated ASD was the most common diagnosis in 29 patients (54.71%), Table-2. In all 50 patients (94.33%) were operated under cardiopulmonary bypass, (CPB) and aortic cross clamp. Sternotomy site infection was observed in 7 patients (13.20%), 6 (11.32%) had type-A, one (1.88%) Type-B, 5 (9.43%) were females. Two (3.77%) had clinical features of sternal dehiscence, Septic profile did not identify any specific organism, X-ray had features of sternal dehiscence in one, Ultrasonography did not show any significant collection, or intrapleural collection. Even in patients with sternal dehiscence there was no clinical or investigative evidence of mediastinitis. In type-A, wounds daily dressing and debridement (if indicated) was done, 3 (5.66%) needed re-suturing of the skin, one (1.88%) had removal of the stainless-steel suture wire, one (1.88%) persisted with recurrent localised pain, swelling and seropurulent discharge, he needed removal of suture material (wire) twice. One (1.88%) had dehiscence of sternum and needed re-suturing. With a longest follow-up of 8 years in some, there has been no fatal complication.

Table 1: Age of the patients at the time of median sternotomy

Age in years	Number of subjects	Percentage %
Up to 10	8	15.09
Up to 20	16	30.18
Up to 30	7	13.30
Up to 40	10	18.86
Up to 50	9	16.98
➤ 50	3	5.66

Table 2: Diagnosis in patients at the time of median sternotomy

Diagnosis	Number of Patients	Percentage (% age)
ASD	29	54.71
VSD	9	16.98
Mitral valve disease	8	15.09
Mediastinal masses	3	5.66

Atrial myxoma	2	3.77
Aortic valve disease	1	1.88
ASD-Pulmonary stenosis	1	1.88

Table 3: Recorded median sternotomy wound complications

Type of infection	Number of Patients	Percentage (% age)
A	6	11.32
B	1	1.88

Note: Classification was as proposed by CDC.

Discussion

Comments

The rate of wound infection complicating an open-heart procedure through median sternotomy incision is clearly below the general rate of wound infections in most elective operations regardless of type or site. The reported frequency of major wound infections following median sternotomy ranges from .5% to 5.9% and in most series 2% or less. It is believed that the risk factors such as functional class, necessity of emergency operation, associated medical problems, diabetes mellitus, chronic pulmonary disease, bleeding diathesis, steroid medications, presence of previous median sternotomy, duration of cardiopulmonary bypass, type of operative procedure, type of material used for sternal approximation, and eventful stay (cardiac massage, prolonged ventilation, tracheostomy, re-operation, transfusions, sepsis) in intensive care unit may predispose to sternal wound complications. Major infections and dehiscence of the median sternotomy incision occur in about 1.5% of patients in whom this incision is used,^[1] the rate in some series is .5% to 5.9%.^[2] Contrary to the belief that perioperative risk factors compound sternal wound complications, some have not reported such increased incidence, in fact it has been established those technical considerations that lessen the chance of sternotomy complications include a properly performed sternotomy, meticulous haemostasis, minimal insertion of foreign bodies, avoiding nylon-band closures, firm sternal fixation, successfully avoiding and or treating pulmonary problems.^[3] It has been reported that prolonged ventilation and female sex both strongly increased the risk of major sternal complications.^[1] Stability of the chest cage, a good and lasting approximation of sternal edges are prerequisite to healing of the sternal wound incision,^[4] and the off-centre incision / faulty osteotomy remain the probable important risk factors.^[5] Major sternal complications are sternal dehiscence alone, major sternal or mediastinal infection with or without dehiscence, the mortality in this group may be 13% to 33%,^[6] but of the risk factors such as steroid intake, renal failure, hypothyroidism and connective tissue disease, only the last one was significantly more evident with complications.^[7] Others have observed an operating time of more than 3 hours as the risk factor.^[8] Sternal dehiscence can occur under physiologic loads, and that improved sternal stability may be readily achieved via mechanical reinforcement near the xiphoid.^[9] Observations from a systemic review have been that female gender, DM, obesity, bilateral IMA grafts, reoperation for post-operative complications, and blood product requirement significantly increase the risk of sternal infection.^[10] More females in present study is in accordance to the observations by others,^[2,3] but differ in age at the time of surgery,^[3,5] certainly age is no criteria, because sternotomy may be needed in any age, however the observation of the present study cannot be taken as authentic in view of very less number of patients, mostly for simple cardiac surgery, almost all without any associated disease, very few above 60 years of age, 77.35% within 4th decade of life, and irregular follow-up. Material used in sternal closure and the stability so achieved is important predictors of the complications, in as much as stainless steel wire remains the standard

suture.^[11] In low-risk patients age and not the closure devices, was the risk factor for sternal nonhealing, it has been observed that at an age of more than 45 years, the predicted risk of radiographic sternal non-union is high.^[12] Risk factors have been listed for superficial sternal wound complications and include BMI >40 kg/m², re-sternotomy, emergency and female gender, and for deep sternal wound complications are BMI >40 kg/m², insulin dependent DM, COPD, revision, emergency, and re-sternotomy.^[13] Our observations differ from others in that none of our patients had proved risk factor,^[9,10,12,13] though we had female patients, some needed prolonged ventilation, transfusions, but none of these had any evidence of sternal wound complications, female patients who developed complications had uneventful intensive care unit (ICU) recovery, none had any risk factor except two who were above 40 years of age, also patients who were re-explored for excessive bleeding had no complications, even patient with preoperative hemiparesis, or monoparesis had no complications. The sternal wounds have been classified as Type-I, if infection occurs within one week, Type-2, between 2 to 6 weeks, and Type-III, after six weeks,^[14] other classifications proposed have been given in 1996 and 1997,^[15,16] all the complications in present study were observed within two weeks only. However, the classification adopted in the present study Types-A, B and C, is as proposed by CDC,^[17] similar classifications have been proposed as Type-I, Type-II, Type-III, with the addition of Type-IV, (exposed mediastinum).^[18] Sternal wound complications are devastating events and there is no consensus or clear guidelines to clarify classifications or determine conclusive management. Objective wound classification is helpful, and use of fasciocutaneous pectoral flaps is a favorable and less invasive modality.^[19] Stainless-steel surgical wire cerclage of the split sternum is by far the most common technique for sternal closure after median sternotomy,^[20] and same material has been used in present study also. Steel bands, polymer cable ties and other suture material reported,^[21] was not used. Management of the sternal wounds has been done as recommended by others,^[12,13,15,17,19] except in one who had asymptomatic minimal sternal dehiscence and refused further intervention. Though the number was less, majority had no risk factor our observation are at variance to those who have reported a mortality of 13% to 33% in deep wound infections.

Sternotomy must be done using minimal diathermy, undue pressure on split edges must be avoided, complete haemostasis should be achieved before sternal approximation, stainless steel wire should be the suture material, and approximation must be perfect. Extra care is needed in high-risk patients, early detection and prompt management of any wound complication gives excellent results.

Conclusion

Sternal wound complications though rare can present with a grim phenomenon. Early suspicion, clear diagnosis, specific treatment (pharmacotherapy and or surgical intervention) prevents morbidity and mortality.

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