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POST CABG STERNAL AND MEDIASTINAL INFECTION: OUTCOME OF SECONDARY HEALING

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ABSTRACT:

Background: Sternal and mediastinal infection (SMI) is a serious complication of cardiac operations performed by median sternotomy. We attempted to describe the outcome of healing by secondary intention in cases were re-closure does not hold.
Methods: Retrospective review was performed of the data on 267 consecutive cardiac surgical patients in the year 2010. Chart review was performed on all patients in whom sternal and mediastinal infection (SMI) developed, and follow-up was obtained till late.
Results: Sternal and mediastinal infection developed in 13 patients. Multivariable predictors for development of SMI in all patients were (odds ratios and 95% confidence intervals in parentheses) (1) diabetes mellitus (2.6; 1.7 to 4.0) and (2) male sex (2.2; 1.3 to 3.9). In patients receiving coronary artery bypass grafting alone, independent predictors were (1) obesity (3.2; 1.1 to 8.9), (2) diabetes (2.7; 1.6 to 4.3), (3) male sex (1.8; 0.9 to 3.7), and (4) obstructive lung disease (2.4; 1.4 to 4.1). For all other patients, predictors were (1) male sex (3.0; 1.1 to 8.1), and (2) diabetes (2.3; 0.9 to 5.8). All patients initially received sternal debridement with primary closure. Healing by secondary intention was encouraged when rewiring failed.
Conclusions: Male sex and diabetes, obesity, and obstructive lung disease, longer duration of operation, re-exploration and prolong ventilation are predictors of SMI in all cardiac surgical patients. Healing with secondary intention is acceptable where sternal rewiring fails.

Key Word: Sternal wound infection, mediastinitis, post CABG infection.

INTRODUCTION

Sternal and mediastinal infection is a serious complication of cardiac surgical procedures performed by sternotomy. It results in increased mortality, morbidity, and prolonged hospital stay[1]. Several studies have examined risk factors for development of deep wound infection[2,3,4]. Commonly quoted risk factors include obesity, chronic obstructive pulmonary disease, elderly age, peripheral vascular disease, reoperation, use of bilateral internal mammary artery (IMA), operation time, low cardiac output, ventilation time, and re-exploration for bleeding. Several studies have also examined treatment options for SMI[5,6,7]. Therapeutic options include debridement with early or delayed closure, closed continuous irrigation, partial or complete sternectomy with flap reconstruction, or to let it heal by granulation. We have tried secondary wound closure by granulation in whom where sternal rewiring gave way. The purpose of this study was to determine the risk factors for SMI in a cohort of cardiac surgical patients in our local setting, and to analyze the outcomes of healing with secondary intension.

Definitions of infections[8]

Superficial wound infection(SWI) must involve only skin or subcutaneous tissue of the incision. In addition, superficial SWI must include at least one of the following: (1) purulent discharge is present; (2) an organism is isolated from the incision; (3) at least one of the following symptoms, tenderness, swelling, redness, or heat, is present and the

incision is opened by a surgeon. Infection was categorized as osteomyelitis when infection was limited to the sternal bone. Mediastinitis was defined to be infection involving tissues or spaces beneath the sternal tissue. In addition, mediastinitis must fit at least one of the following criteria: (1) an organism is isolated from culture of mediastinal tissue or fluid; (2) evidence of infection is seen during operation or by histopathologic examination; or (3) one of the following, fever (>38º C), chest pain, or sternal instability, is present and there is either purulent drainage from the mediastinum or an organism isolated from blood culture or culture of drainage of the mediastinal area.

PATIENTS AND METHODS

From January to December 2010, 267 consecutive cardiac surgical procedures through midline sternotomy were performed at our institution. Surgeries performed during the review period were screened for SMI. Case notes of patients who had sternal wound infection were retrieved. Patients who underwent operative therapy for wound infection (n=13) were the subject of follow-up and evaluation.

Perioperative management: Patients were shaved and showered a day before their operation. All patients received intravenous ceferoxim, or vancomycin if allergic to penicillins, preoperatively and for 48 hours postoperatively. The operative field was painted with povidone-iodine solution. The skin was incised with a scalpel and electrocautery was used to open the presternal layers and pericardium. Bone wax was not used. Left internal mammary artery was harvested as pedicled in situ graft when used for coronary bypass. Sump drains were placed in the mediastinum, and chest tubes were inserted into the pleural spaces if opened. The sternum was closed with stainless steel wires. The presternal space was obliterated with three layers of absorbable suture, and the skin was closed with a subcuticular absorbable suture. Patients were extubated when they were hemodynamically stable, normothermic, and ventilating spontaneously. All drains were removed the morning after operation or when drainage was less than 25 mL/h.

Management of infection: Thirteen patients (7.8%) were diagnosed with sternal wound infection; eight on the same admission as their cardiac surgical procedure. Discharged patients with delayed wound infection (n=5) were also readmitted. Twelve further patients had superficial wound infection or some degree of osteomyelitis, but they settled with parenteral antibiotics, and will not be considered hence forth in this report. Pus samples were taken for culture in all patients, and where indicated blood culture was drawn. Patients were started on a combination of antibiotics where Amikacin was a usual inclusion. All patients with DSWI underwent surgical therapy; wounds were laid open, steel wires were removed, thorough and repeated cleansing with hydrogen per oxide(H2O2) and Sodium Hypochloride solution (EUSOL) were carried out.. If the sternal rewiring did not hold; no second attempt for any other surgical procedure was made. Wound was reopened and allowed to granulate, shrink and close by secondary intention.

RESULTS:

During the study period of Jan-Dec 2010, 13 of the 267 patients (4.86%) undergoing cardiac surgery developed sternal and mediastinal infection, needing operative intervention. There were further 12 patients who acquired wound infection; they received antibiotics with resolution of the infection and are not included here. This study pertains only to those patients undergoing operative therapy for SMI.

Incidence of deep wound infection in isolated aortocoronary artery bypass grafting (CABG) was 9/203 (76%), valvular procedures with or without CABG was in 3/46 (17.2%), and in adult congenital procedures was1/18(6.7%). Patients who acquired SMI had longer intensive care unit stays (7.7 ± 11.1 versus 2.5 ± 3.6 days, $p < 0.001$) and hospital stays (32 ± 21 versus 10 ± 9 days, $p < 0.001$) than patients who did not have SMI. There was no post-operative death due to SMI in this study period. A univariate analysis of potential risk factors for development of SMI was performed using the variables listed in (Table I). Significant preoperative predictors of SMI were male sex, body mass index, diabetes, smoking status, and chronic obstructive pulmonary disease. Intraoperative predictors were cardiopulmonary bypass time, operation time. Postoperative predictors were low cardiac output syndrome, ventilation time, and postoperative resternotomy for bleeding.

Table II shows the results of cultures obtained at the time of operative therapy for the 13 patients with SMI. Clinical signs of SMI included purulent discharge in 80.4% of patients, and sternal click or gross instability in 19.6%. All patients received operative procedure for their wound infection i.e. sternal debridement with primary closure. It failed in all but only two cases. These patients were ex-smokers and non diabetics. Where the wiring failed, sternum was reduced to multiple small fragments. Wound was laid wide open and cleansed with EUSOL regularly till granulation took effect. The median length of time from date of initial cardiac operation to diagnosis of SMI was 12 days. The median length of time from diagnosis of SmI to date of operative therapy for SMI was 3 days. The median time of wound healing with secondary intention was 7 weeks.

DISCUSSION

Mediastinal wound infection is a well-described complication of operations performed through a median sternotomy[1]. Our study identified three independent predictors; diabetes and male sex and relation to smoking. Diabetes is known to impair wound healing and cellular and humoral immunity, which may increase the risk of infection [9]. Male sex is cited as a risk factor for DSWI in at least two other studies [6,9,]. Smoking recernt or past causes chronic changes in the respiratory tract; whereby sputum retention and persistent cough are nidus to infection[10]. The reason for male sex as an independent predictor is unclear, particularly in view of the fact that female sex is traditionally associated with increased morbidity and mortality in cardiac surgical patients. It may be that males tend to have increased tension on their sternal incision, which in turn leads to increased risk of sternal instability. Akyut and collegues [2] have identified obesity and reoperation as risk factors for SMI. The prolonged use of inotropic agents was another risk factor for SMI. Prolonged mechanical ventilation, or prolonged stay in the ICU, have previously been identified as risk factors for SMI [3,11,]. The use of inotropic agents may reflect a prolonged stay in ICU and exposure of the mediastinal area to remote site infections. For unstable hemodynamic condition by itself to be a risk factor for SMI is biologically plausible, because it decreases wound perfusion and alters local immune reactions. Gram-negative micro-organisms isolated in SMI usually originate from a remote source in the postoperative period, whereas gram-positive cocci are likely to be inoculated from the patient's

TABLE I

VARIABLES ASSESSED AS UNIVARIATE PREDICTORS OF STERNAL AND MEDIASTINAL INFECTION

Variable	Incidence in Patients Without SMI (%) (n = 267)	Incidence in Patients With SMI (%) (n = 13)	p Value
Age in years			
<65	59.2	53.3	
65-74	32.2	37.0	0.516
Male sex	72.1	84.8	0.007
Diabetes	59.3	78.0	0.005
Hypertension	43.8	42.2	0.107
Smoking status			
Never	32.5	18.5	
Former	57.0	68.5	0.017
Active	10.5	13.0	
COPD	10.4	21.8	0.004
Renal failure	4.9	4.4	0.814
LV ejection fraction in %			
20-39	20.1	27.2	0.488
40-59	41.7	34.8	
> 60	33.5	32.6	
Procedure			
Isolated CABG	65.6	72.8	
Valve ± CABG	20.8	17.4	0.325
Adult Congenital	13.7	9.8	
Timing			
Elective	58.4	56.5	
Urgent	36.3	39.1	0.820
Emergent	5.3	4.4	
Body mass index (mean ± SD)	27.1 ± 4.5	29.0 ± 4.2	0.001
CPB time (mean ± SD)	94 ± 39	102 ± 41	0.049
Cross-clamp time (mean ± SD)	66 ± 30	71 ± 31	0.140
Operation time (mean ± SD)	181 ± 58	198 ± 65	0.005
LIMA	58.4	72.8	0.041
Postoperative resternotomy	4.2	22.8	0.001

CABG = coronary artery bypass grafting; COPD = chronic obstructive pulmonary disease; SMI = sternal and mediastinal infection; CBP = cardiopulmonary bypass; LIMA = left internal mammary artery; LV = left ventricle; SD = standard deviation.

endogenous flora or the environment during the operation[9]. We assume that impaired host defenses in hemodynamically unstable patients cannot eliminate the perioperative inoculum, leading to subsequent SMI.

Left IMA grafting to the left anterior descending coronary artery increases bypass graft patency rates and decreases late cardiac events. Extra arterial grafts may result in further improvements in patency rates and cardiac events. The use of bilateral IMA grafts, however, may lead to increased risk of SMI by decreasing sternal blood flow [12]. The risk of SMI in patients receiving bilateral ITA grafts is controversial, with some studies suggesting no increased risk in selected patients [12] and others finding a consistent increase in risk in all patient groups [13]. In our institution use of bilateral internal mammary is very sporadic; fortunately none developed infection. This observation in our setting is meaning less.

TABLE II

BACTERIOLOGY

Organism	No. of Patients
Coagulase-negative staphylococci	2
Enterobacter species	2
Enterococcus	5
Pseudomonas aeruginosa	3
Multiple organisms	1

In all other cardiac surgical patients independent predictors of SMI were age more than 74 years, male sex, and diabetes, in decreasing order. Elderly age has been associated with sternal wound infection in other studies [14,15,]

The results of wound culture are presented in Table II. As in several previous studies, the most common organisms were gram-negative cocci [7,8,14,]. followed by gram-positive cocci. (60% versus 15%, p = 0.002). Whereas gram-negative-organism infections may be caused by hematogenous spread or by contamination from distant sites; staphylococcal infections may be caused by wound contamination from local skin flora,

Healing of the wound by granulation is very satisfactory, where an attempt to re-wire the sternum had failed. Admittedly the hospital stay is longer but use of parenteral antibiotic therapy is gets reduced substantially. Patient is saved from another surgical procedure, which has a potential to failure. More over the dressings at a stage after substantial wound contraction can be easily managed at home. All our patients returned back to full economic potential, which to us was a relief.

CONCLUSION:

In conclusion, SMI is a devastating complication of operations performed through a median sternotomy. Although the incidence of this complication is low (0.75% in our study population), high-risk patients can be identified. Male sex and diabetes are predictors of SMI in all cardiac surgical patients. Most risk factors are not amenable to intervention. Incidence could, however, be reduced by careful assessment of indications for surgical procedures, and by monitoring operative procedures in units where duration of operation is found to be a risk factor.

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