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Deep sternal wound infection following cardiac surgery; Epidemiology and causative germs

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Abstract

Introduction: Deep sternal wound infection is a rare but serious complication after cardiac surgery that can increase mortality and morbidity. The aim of this study was to investigate the incidence and causative germs of deep sternal wound infection following cardiac surgery.

Methods: Data were collected retrospectively from patients who underwent different cardiac surgeries including coronary artery bypass gra ing and valvular heart surgeries between July 2010 and October 2012 at a teaching hospital in the north east of Iran. Patients with a deep sternal wound infection (DSWI) were defined based on clinical findings and culture results of the wound. The patients were tracked for the development of DSWI and causative germs and sensitivity were identified according to the microbiological studies.

Results: 4621 patients underwent different cardiac surgeries during the study period. There were 82 cases (1.77%) of DSWI with mean age of 53.93 years and male to female ra o of 47:35 with mortality rate of 10.9%. The most common germs in order of decreasing frequency included Klebsiella, Pseudomonas, Staphylococus Coagulase Negative, Acinetobacter, Staphylocciaureus, Escherichia coli, methicillin resistant Staphylocciaureus, Providenciarettgeri, and Obligatory anaerobe Streptococus.

Conclusions: We conclude that DSWI remains a rare but devastating complication and is associated with significant comorbidity, increased hospital mortality, and reduced long-term survival with gram negative rods as the most common pathogens.

Key Words: deep sternal wound infection; cardiac surgery; mortality

Introduction

Deep sternal wound infection (DSWI) is a rare but significant complication after median sternotomy. The reported incidence varies from 0.4%-5%, and Staphylococcus aureus (gram-positive organism) is the most common pathogen isolated from infected sternal wounds and even in blood cultures in these patients. It is associated with s ignificant mortality rates and morbidity up to 30% including prolonged hospitalization, additional surgical procedures together with expensive antibiotic therapy and even death(1- 4).

The incidence of DSWI after cardiac surgery according to the data entered in the JACVSD registry during the period from 2004 to 2009 was 1.8%, and more complicated procedures were followed by higher incidence and mortality. When re-exploration for bleeding was performed,

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mortality was significantly higher than when it was not performed alone (5).

It has been shown that age at surgery, body mass index (BMI), diabetes mellitus, chronic obstructive pulmonary disease (COPD)(6), hypertension and the female gender (7), preoperative dialysis, angina CCS class ≥3, use of ventricular assist device, cardiac transplantation and use of both ITA (8) emergent surgery, combined surgery, and postoperative intraaortic balloon pump (IABP) use (9) are independent risk factors for developing DSWI. In contrast, Shaikhrezai K et al did not find age, diabetes, chronic obstructive pulmonary disease (COPD), smoking, peripheral vascular disease (PVD), emergency operation, type of operation, re-opening or postoperative blood transfusion to be significant predictors of DSWI(10).

The aim of this study was to determine the overall incidence of DSWI after cardiac surgery, the incidence of DSWI according to each operative procedure, the overall 30-day mortality, the causative germs and their sensitivity to antibiotics. The primary outcome was the incidence of DSWI. The secondary outcomes included mortality rate, causative germs, hospital stay, and underlying diseases.

Methods

In a retrospective descriptivestudy, patients undergoing differentcardiac surgeries with open sternotomyat Emam Reza teaching Hospital, Mashhad, Iran from July 2010 to October 2012 were included in the study. The patients received prophylactic cephazolinor vancomycinfor prevention of postoperative infection. The patients' recordswere evaluated for development of deep sternal wound infection, in hospital mortality, and underlying diseases. The definition of deep sternal wound infection (DSWI) was established according to the Center for Disease Control and Prevention (CDC) guideline with at least one of the following: (1) an organism isolated from culture of mediastinal tissue or fluids(2) evidence of mediastinitis seen during the operation (3) one of the following conditions: chest pain, sternal instability, or fever (>38°C), in combination with either purulent discharge from the mediastinum or an organism isolated from the blood culture or culture of mediastinal drainage. Sternal wound infections included superficial infections involving the skin and subcutaneous tissue of the incision, as wellas deep infections. Infection data were obtained during hospitalization from the patients' medical records. After clinical suspicion for DSWI, the patients underwent wound irrigation, surgical wound debridement, rewiring, or pedicledomentoplasty for treatment of DSWI.

Results

A total of 4621 patients underwent different cardiac surgeries during the study period. Of these, 82 cases (1.77%) developed deep sternal wound infection. There were 63 coronary artery bypass graft and 19 valvular heart surgeries. The mean age of the patients withdeep sternal wound infection were 53.93±12.63 years with male to female ratio of 47:35. The mortality rates in patients with and without infection were 10.9% and 6.78%, respectively. The mean duration of patients' hospital stay was 22.59±5.92 days. There were 42 (51.21%) positive wound cultures with klebsiella as the most prevalent germ. The causative organisms in order of decreasing frequency included Klebsiella, Pseudomonas, Staphylococcus Coagulase Negative, Acinetobacter, Staphylocciaureus, Escherichia coli, methicillin resistant Staphylocciaureus, Providenciarettgeri, and Obligatory anaerobe Streptococus (table 1). Diabetes and renal insufficiency were seen in 27 (32.92%) and 23 (28.04%) patients, respectively.

Table 1. Frequency of causative germs

Germ	Prevalence
Klebsiella	12
Pseudomonas	6
Staph CoaguNeg	5
Acinetobacter	5
Staphylocciaureus	4
Escherichia coli	2
Enterbacter	2
MRSA	1
Providenciarettgeri	1
Obligatory anaerobeStreptococus	1

Data are shown as number of cases.

Discussion

Sternal wound infection following cardiac procedures represents a serious problem involving prolonged hospitalization, increased hospital costs, and increased morbidity and mortality. Our study revealed a 1.7% incidence of DSWI that is in accordance with most reported studies in the literature.

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There is still debate over appropriate prophylactic antibiotic for cardiothoracic surgeries. Although Staphylococcus aureus (gram-positive organism) and either cephazolin or vancomycin have been postulated as the most prevalent pathogen and prophylactic antibiotics, respectively, our study demonstrated klebsiella as the most common isolated pathogen. This can be attributed to lack of routine prophylactic antibiotics forgram negative coverage in high risk patients in our institution. However, the overall incidence of our infection was similar to other institutions.

We found a relatively high prevalence of underlyingrenal diseases and diabetes in affected patients. Nevertheless, as we did not evaluated the prevalence of these comorbidities in non-infected patients, we cannot consider these comorbiditiesas independentrisk factors for development of DSWI.

Kubota et al reviewed 73,700 cases registered in the Japan Adult Cardiovascular Surgery Database (JACVSD) during the period from 2004 to 2009. The overall incidence of postoperative DSWI was 1.8%. The incidence of postoperative DSWI was 1.8% after isolated CABG, 1.3% after valve surgery, 2.8% after valve surgery plus CABG, 1.9% after thoracic aortic surgery, and3.4% after thoracic aortic surgery plus CABG. The 30-day and operative mortality in patients with DSWI was higher after more complicated operative procedures (11).

Early retrospective studies identified a significant number of factors that might be involved in the etiology of the condition. Preoperative risk factors included diabetes, renal failure, smoking, sex, age, reoperation, morbid obesity, breast size, steroid use and chronic obstructive pulmonary disease. Intraoperatively, length of surgery and the use of internal mammary arteries—both single and bilateral—were implicated(12). Several measures have been proposed for prevention of infection following cardiothoracic surgeries including appropriate prophylactic antibiotics and strict perioperative glucose control.

A positive blood culture in patients who have undergone coronary artery bypass grafting should prompt a careful evaluation of the sternal wound for possible infection (13). Multiple blood cultures are recommended in postoperative coronary bypass patients with pronounced fever. If no source of infection can be identified, sternal wound aspirate may be revealing.

A wide variety of treatment modalities for DSWI have been developed in the recent years including simple surgical revision, the suction-irrigation drainage (4), pedicledomentoplasty (14), Negative-pressure wound therapy (15), vacuum-assisted closure (16). It has been reported that extensive reconstructive plastic surgery, and application of bone wax is safe and does not increased rate of DSWI (17).

In a case series of 36 patients, Schols et al recommend vacuum-assisted closure (VAC) therapy plus delayed sternal plating and additional bilateral pectoralis major flap advancement as first repair option in case of DSWI (13). In another study, it was suggested that VAC therapy was a safe and reliable option in the treatment of sternal wound infection in cardiac surgery. VAC therapy should be considered an effective adjunct to conventional treatment modalities for the treatment of extensive and life-threatening wound infections following cardiac surgery, particularly in the presence of risk factors (16). Negative-pressure wound therapy (NPWT) has been used for the treatment of deep sternal wound infection (DSWI) with promising results. However, surgical experience is recommended when debriding sternal wounds with the use of a wound dressing, such as paraffin gauze, in order to protect the RV from direct contact with the polyurethane foam (15).

DSWI may also be reduced by using nine or more paired fixation points when closing with standard peri-sternal stainless steel wires (10).

Daptomycin has been found to be efficacious in the treatment of patients with DSWI after cardiac surgery (2).

In addition to the criteria stated by CDC, computed tomography, indium-111 leukocyte scanning and epicardial pacer wire cultures may be useful in the diagnosis of poststernotomy deep wound infection (18).

Bilal H et al sought to assess the external validity of the STS-estimated risk of DSWI in a United Kingdom (UK) population They found a total of 135 (0.95%) patients developed DSWI. The STS risk calculator lacks adequate discriminatory power for estimating the isolated risk of developing deep sterna wound infection in a UK population (19).

A prospective randomized multicentre trial on 2539 patients (age 67±11years, 45% female)was performed to analyze the efficacy of a vest (Posthorax support vest®) to prevent sternal

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wound infection after cardiac surgery, and to identify risk factors. The frequency of deep wound complications (dWC: mediastinitis and sternal dehiscence) was significantly lower in vest (n=14; 1.04%) vs non-vest(n=27; 2.27%) patients (ITT, P<0.01), but superficial complications did not differ between groups. Subanalysis of vest patients revealedthat only 933 (Group A) wore the vest according to the protocol, while 202 (Group BR) refused to wear the vest (non-compliance) and 216 (Group BN) did not use the vest for other reasons. All dWC occurred in Groups BR (n=7) and BN (n=7), although these groups had the same preoperative risk profile as Group A. Postoperatively, Group BN had a prolonged intubation time, a longer stay in the intensive care unit, greater use of intra-aortic balloon pump, higher frequency of COPD and a larger percentage of patients who required prolonged surgery. The investigator demonstrated that Consistent use of the Posthorax® vest prevented deep sternal wounds (20).

Conclusions

In conclusion, we found a low incidence of DSWI following cardiac surgeries in our institution with klebsiella as the most common pathogen. Adherence to strict clean technics, appropriate prophylactic antibiotics, early diagnosis and intervention might decrease the incidence and mortality and morbidity attributed to DSWI.

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