

Patients Risk Factors as Predictors of Surgical Wound Infection Following Open Heart Surgery

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ABSTRACT

Background: Median sternotomy wound infections are infrequent yet potentially fatal complication following cardiac surgery. The reported incidence of sternal infections ranges from 0.9 to 20%, and the incidence of mediastinitis is 1–2% in most studies. Several studies have examined and identified possible causes and risk factors associated with sternal infections. They include patient-related risk factors, and procedure-related factors.

Aim of the study is the assessment of the patient's risk factors related to incidence of infection.

Patients and Methods: ninety-eight cardiac surgery patients operated via median sternotomy were included in the study and the role of patient related factors (age, gender, obesity and diabetes mellitus) in the incidence of postoperative superficial and deep sternal wound infection was accessed. **Results:** Sternal wound infection (SWI) developed in 18 patients (18.36%). 15 patients (15.3%) had superficial SWI while 3 patients (3.06%) had deep SWI. The most common causative organism in our study was staph. aureus especially MRSA.

Conclusion: Patient-related risk factors such as age, gender, obesity and diabetes mellitus are important risk factors in the development sternal wound infection.

Keywords: Patient Risk Factors, superficial sternal wound infection, Deep sternal wound infection, Open heart surgery, mediastinitis

INTRODUCTION

Median sternotomy wound infections are infrequent yet potentially fatal complication following cardiac surgery. This complication is associated with amplified cost of care, prolonged hospitalization, and increased morbidity and mortality⁽¹⁾.

For the benefit of consistency in comparing data from various reports, sternal wound infection (SWI) was subdivided into two groups: (A) superficial SWI: wound infection confined to the subcutaneous tissue and (B) deep SWI (bone and mediastinum): wound infection associated with sternal osteomyelitis with or without infected retrosternal space⁽²⁾.

Several studies have examined and identified possible causes and risk factors associated with sternal infections, although with conflicting results. They include patient-related risk factors such as age, gender, obesity and diabetes mellitus, and procedure-related factors such as prolonged preoperative stay, duration of surgery, use of bilateral mammary grafts, reoperation for control of bleeding and the need for repeated blood transfusions^(3,4).

AIM OF THE STUDY

Aim of this study is to access the role of patient related factors in the incidence of postoperative superficial and deep sternal wound infection following open heart surgery.

PATIENTS AND METHODS

This is a prospective study including 98 consecutive cardiac surgery patients operated via

median sternotomy in the Department of Cardiothoracic Surgery at Cairo University Hospital from the first of May 2015 till the end of December 2016.

43 patients underwent coronary artery bypass graft (CABG), 4 patients underwent CABG + valve surgery, 48 patients underwent valve surgery and 3 patients underwent graft repair of ascending aorta.

All patients were prepared by full history taking, full labs including glycated hemoglobin, radiological investigations, echocardiography, and coronary angiography for CABG patients and valve patients over 40 years, and preoperative prophylactic antibiotics were administered as usual.

Ethical considerations: All patients included in the study were consented and approval of the ethical committee was obtained.

All patients were operated via median sternotomy using standard cardiopulmonary bypass and closure was achieved using stainless steel sutures for the sternum and Vicryl sutures for the soft tissues and skin. Data such as operative time, CPB time, and cross clamp time were collected.

The postoperative course for all the patients was monitored and data such as length of mechanical ventilation, ICU stay, patient's hemodynamics and inotropic support were collected and analyzed. Patients showing signs of superficial wound infection had wound swab and blood culture and antibiotic therapy was changed accordingly.

Criteria for defining and reporting surgical site infections (SSIs) were published in evidence-

based guidelines by the Centers for Disease Control and Prevention (CDC) in 1999 ⁽⁵⁾.

Deep chest SSIs were defined as involving fascial and muscle layers or organ spaces, plus one of the following: (a) Purulent drainage from the deep incision or organ space. (b) Spontaneous dehiscence of the incision or open exploration by the surgeon in patients with fever (temperature >38°C), localized pain, or tenderness. (c) Abscess or other evidence of deep infection. (d) Diagnosis of deep incisional infection, osteomyelitis, or mediastinitis by a surgeon.

Superficial SSIs were defined as involving only skin and subcutaneous tissue of the incision, plus one of the following: (a) Purulent drainage from the superficial incision. (b) micro-organisms isolated

from a culture of fluid or tissue from the superficial incision. (c) Pain, tenderness, swelling, redness, or heat in a superficial incision (d) Diagnosis of superficial incisional infection by the surgeon ⁽⁵⁾.

The collected data were statistically analyzed with the aid of computer program SPSS statistical package for social sciences version 17.0 on IBM compatible computer. Quantitative data were expressed as mean and standard deviation (X±SD), and qualitative data expressed as number and percentage (No. & %). Analysis was done by applying Pearson's Chi-Square test and Fisher's exact test. A P value of less than 0.05 was considered statistically significant, a P > 0.05 (non-significant).

RESULTS

Table (1): Procedure and incidence of superficial and deep SWI

Procedure	Patients (%)	Superficial SWI (%)	Deep SWI (%)
CABG	43 (43.8%)	7 (46.66%)	2 (66.7%)
Valve surgery	48 (48.9%)	6 (40%)	1 (33.3%)
CABG + valve	4 (4.08%)	1 (6.66%)	0
Repair of AA	3 (3.06%)	1 (6.66%)	0
Total	98 (100%)	15 (100%)	3 (100%)

Sternal wound infection (SWI) developed in 18 patients (18.36%); 15 patients (15.3%) had superficial SWI while 3 patients (3.06%) had deep SWI.

Table (2): Relation between age and wound infection

	Age <65 years 79	Age > 65 years 19	Significance
Not infected	71	9	
SWI	6	9	0.0002
DWI	2	1	0.3437

10 out of 19 patients over 65 years old had sternal wound infection (52.6%). 8 out of 79 patients under 65 years old had sternal wound infection (10.1%), which indicates that age is generally an important risk factor for sternal wound infection.

Table (3): Relation between gender and wound infection

	Male 55 (56.1%)	Female 43(43.9%)	Significance
Not infected	49 (89%)	31(72%)	
SWI	5 (9%)	10 (23%)	0.0376
DWI	1(1.8%)	2 (4.6%)	

Our study included 55 male patients (56.1%) and 43 female patients (43.9%). 10 out of 43 female patients had SWI (23%), 5 out of 55 male patients had SWI, which means that from 15 patients with SWI, 10 were females (66.6%) and 5 patients were males (33.3%). So, female patients are more likely to have SWI than male patients. Sex is statistically important risk factor in SWI (p < 0.05).

Table (4): Relation between obesity and wound infection

	Obese 13	Not obese 85	Significance
Not infected	4 (30.7%)	76 (89%)	
SWI	7 (53.8%)	8 (9.4%)	0.0003
DWI	2 (15.3%)	1(1.1%)	0.0169

In our study, 13 patients out of 98 (13.2%) has BMI > 30. From 13 obese patients, 9 patients (69.2%) had Surgical WI. 7 of them had superficial SWI and 2 patients had deep SWI.

Obesity is a very important risk factor for surgical wound infection ($p < 0.0001$) and is statistically significant for both superficial ($p < 0.001$) and deep ($p = 0.0169$) SWI.

Diabetes mellitus:

35 out of 98 patients (36.7%) were diabetic, 13 of them (33.3%) had SWI. From 18 patients with SWI, 12 patients (66.6%) were diabetic, which denotes that DM is an important risk factor in SWI and is statistically significant ($p = 0.0055$).

Table (5): Relation between DM and wound infection

	Diabetic 35	Non-Diabetic 63	Significance
Not infected	23 (65.7%)	57 (90.4%)	
SWI	9 (25.7%)	6 (9.6%)	0.0354
DWI	3 (8.6%)	0 (%)	0.0296

DISCUSSION

Sternal wound infection after cardiac surgery can be a serious complication. The reported incidence of sternal infections ranges from 0.9 to 20%, and the incidence of mediastinitis is 1–2% in most studies. The variation in incidence between studies is probably partly due to differences in classifications and partly to differences in surgical procedures and the mode of follow-up. Deep infections (mediastinitis and sternumosteitis) cause high morbidity, with a prolonged hospital stay and an increased cost of care. The reported mortality rate for patients with deep sternal infections ranges from 9.8 to 14% in different studies. The cost for patients with sternal wound complications has been estimated to be 2.8 times that for patients with uncomplicated postoperative courses⁽⁶⁾.

Patient related factors such as age, sex, BMI and Diabetes mellitus are very important risk factors contributing to the incidence of median sternotomy wound infection and mediastinitis and are therefore directly related to morbidity and mortality. In our study 10 out of 19 patients over 65 years old had sternal wound infection (52.6%), while 8 out of 79 patients under 65 years old had sternal wound infection (10.1%), which indicates that age is generally an important risk factor for sternal wound infection.

Ridderstolpe et al. stated that patients with severe infections needing surgical revisions were older and showed signs of more advanced atherosclerotic disease as indicated by more peripheral vascular disease and a higher NYHA score⁽⁶⁾.

Our study included 55 male patients (56.1%) and 43 female patients (43.9%). 10 out of 43 female patients had SWI (23%), 5 out of 55 male patients had SWI, which means that from 15 patients with SWI, 10 were females (66.6%) and 5 patients were males (33.3%). So, female patients are more likely to have SWI than male patients. Sex is statistically important risk factor in SWI ($p < 0.05$). **Ridderstolpe et al.** considered female sex as an independent risk factor for morbidity and mortality following CABG surgery⁽⁶⁾.

In our study, 13 patients out of 98 (13.2%) has BMI > 30. From 13 obese patients, 9 patients (69.2%) had Surgical WI. 7 of them had superficial SWI and 2 patients had deep SWI. Obesity is to be considered with body mass index (BMI) more than 30^(6,7).

Many other studies found that obesity is an important risk factor for SWI. **Blanchard et al.** showed that 32.7% of patients with SWI were obese⁽⁸⁾. Another study done by **Diez et al.** on mediastinitis showed that the risk for mediastinitis increases by three percent per additional kilogram body mass per square meter body surface⁽⁹⁾.

35 out of 98 patients (36.7%) were diabetic, 13 of them (33.3%) had SWI. From 18 patients with SWI, 12 patients (66.6%) were diabetic, which denotes that DM is an important risk factor in SWI and is statistically significant ($p=0.0055$). A study done by Okonta et al. showed that DM was the commonest risk factor for SWI. He found that DM was present in 76.9% of patients with SWI⁽¹⁰⁾.

REFERENCES

1. **Toumpoulis IK, Anagnostopoulos CE, DeRose JJ (2005):** The impact of deep sternal wound infection on long-term survival after coronary artery bypass grafting. *Chest*, 127:464-471.
2. **El Oakley RM, Wright JE (1996):** Postoperative mediastinitis: classification and management. *Ann Thorac Surg.*, 61:1030-1036.
3. **Ulicny Jr. KS, Hiratzka LF (1991):** The risk factors of median sternotomy infection: a current review. *J Card Surg.*, 6:338-351.
4. **Vuorisalo S, Haukipuro K, Pokela R, Syrja'la' H(1998):** Risk features for surgical-site infections in coronary artery bypass surgery. *Infect Control Hosp Epidemiol.*, 19:240-247.
5. **Olsen MA, Lock-Buckley P, Hopkins D, Polish LB, Sundt TM, Fraser VJ (2002):** The risk factors for deep and superficial chest surgical-site infections after coronary artery bypass graft surgery are different. *J Thorac Cardiovasc Surg.*, 124:136-145.
6. **Ridderstolpe L, Gill H, Granfeldt H, Åhlfeldt , Rutberg H (2001):** Superficial and deep sternal wound complications: incidence, risk factors and mortality. *Eur J Cardiothorac Surg.*, 20:1168-1175.
7. **Lepelletier D, Perron S, Bizouarn P (2005):** Surgical-site infection after cardiac surgery: incidence, microbiology, and risk factors. *Infect Control Hosp Epidemiol.*, 26: 466-472.
8. **Blanchard A, Hurni M, Ruchat P, Stumpe F, Fischer A, Sadeghi H (1995):** Incidence of deep and superficial sternal infection after open heart surgery. A ten years retrospective study from 1981 to 1991. *Eur J Cardiothorac Surg.*, 9:153-7.
9. **Diez C, Koch D, Kuss O et al. (2007):** Risk factors for mediastinitis after cardiac surgery: a retrospective analysis of 1700 patients. *J Cardiothorac Surg.*, 2: 23.
10. **Okonta KE, Anbarasu M, Agarwal V, Jamesraj J, Kurian VM, Rajan S (2011):** Sternal wound infection following open heart surgery: appraisal of incidence, risk factors, changing bacteriologic pattern and treatment outcome. *Indian Journal of Thoracic and Cardiovascular Surgery*, 27(1), 28-32.