

# Incidence, risk factors and microbiological profile of Surgical Site Infections in cardiac surgery patients

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## Abstract

**Objective:** To find out the incidence of surgical site infections (SSI) in cardiac surgery patients, the organisms responsible and the risk factors associated with such infections. **Materials and methods:** The study is conducted in 1000 consecutive adult patients who underwent cardiac surgeries between January 2011 and August 2015 in a cardiac surgical department attached to a teaching hospital in Central Kerala, India. **Results:** SSIs were diagnosed in 1.8% of the patients (18 of 1,000). Of these, 15 were superficial wound infections and three were mediastinitis and all got cured with conservative management without any mortality. Culture was positive in 13 cases and the most commonly isolated pathogen was *Staphylococcus* spp. Though age > 60 years and male sex predisposed to SSIs, these were not statistically significant. 13 of our 18 SSI patients were diabetics. **Conclusion:** The incidence of surgical site infections in this centre is comparable with other studies from India as well as abroad which range from 0.53% to 18.7% [1, 2, 3, 4].

**Key words:** cardiac surgery - surgical site infections - risk factors - microbiology

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## INTRODUCTION

Surgical site infections (SSIs) such as sternal wound infections (SWI) and mediastinitis are serious complications following cardiac surgery, resulting in prolonged hospitalization, increased hospital costs, and also increased mortality. The reasons for these complications are multifactorial. There is a strong suggestion that an impairment of vascular supply of the sternum may be one of the most important factors influencing the incidence of deep sternal wound infection

(DSWI).<sup>5</sup> Several studies have assessed the risk factors for SSIs in cardiac surgery which include obesity, diabetes mellitus, chronic obstructive pulmonary disease (COPD), steroid use, smoking, peripheral vascular disease and renal insufficiency. In addition, intra operative factors; prolonged cardiopulmonary bypass duration and postoperative variables; prolonged mechanical ventilation, reoperation for bleeding, postoperative transfusions have been shown to be associated with DSWI.<sup>6,7,8</sup> Several studies from the USA and some European countries, show that *Staphylococcus aureus* is still the most common cause of SWI.<sup>9,10</sup> Recent studies from the Nordic countries show that coagulase negative staphylococcus (CoNS) is repeatedly the most commonly isolated bacteria in samples from SSI. Tegnell *et al.*<sup>11</sup> found that CoNS was present in 42–64% of various types of sternal infections. In the study of postoperative mediastinitis in cardiac surgery performed by Gårdlund *et al.*<sup>12</sup> next to CoNS, *Propionibacterium acne* was also found in some cases. The identification of risk factors that contribute to the SSI occurrence, can

provide information for planning and adoption of strategies in the prevention, control and monitoring of the infection in order to minimize their occurrence and maximize the principles of patient safety.

**MATERIALS AND METHODS**

The present study was conducted in 1000 consecutive patients who underwent cardiac surgery between January 2011 and August 2015 in an adult cardiac surgical department attached to a teaching hospital in Central, Kerala, India. Data were collected from medical records of patients undergoing cardiac surgery which include age and sex of the patients, weight, other co- morbidities like, diabetes, renal and liver dysfunction, history of previous admissions and cardiac procedures, diagnosis and type of surgery, preoperative left ventricular function duration of post operative ICU stay and history of reoperation for bleeding. From all cases who had signs of wound infection in the immediate post operative period or who got readmitted, wound swabs or aspirates were collected and send for culture. Cultures were done using standard microbiological methods. On getting growth in the culture, the organism identification and antibiotic sensitivity tests were done using automated system ( Vitek 2 – Biomerieux). Statistical analysis was done using chi square test with Fisher’s exact test and continuity correction. p value of < 0.05 was considered to be statistically significant.

**RESULTS**

Out of the 1000 cardiac surgery patients, most of them underwent open heart surgeries through longitudinal median sternotomy and some through mini thoracotomy in the case of minimally invasive procedures. Among the 1000 cardiac surgery patients,18 (1.8%) developed surgical site infections out of which 16 were post CABG cases and two MVR. Considering the risk factors, of the 18 infected cases, 13 were males and another 13 were diabetics. Most of the diabetics had uncontrolled blood sugar values in the immediate post operative period. One patient had undergone coronary stenting earlier and had poor LV function also. Except two, all patients had good LV function preoperatively. One had peripheral vascular disease and another one had nephropathy as risk factors for SSI. A patient who underwent MVR was a case of culture negative infective endocarditis and had a prolonged hospital stay before surgery. No one else had prolonged preoperative hospital stay or post operative ICU stay and no one was obese. None of our infected patients underwent reexploration.

**Table 1:** Types of surgery (n=1000) Table 2. Age distribution of patients (n=1000)

Type of surgery	No. (%)
Coronary artery bypass graft(CABG)	872(87.2)
Mitral valve replacement(MVR)	35(3.5)
Double valve replacement (DVR)	8(0.8)
Aortic valve replacement(AVR)	26(2.6)
Atrial septal defect correction	30(3)
CABG + MVR	5(0.5)
CABG + DVR	3(0.3)
CABG + AVR	6(0.6)
CABG + ventricular septal rupture repair	3(0.3)
Ventricular septal rupture repair	2(0.2)
CABG + aortic aneurysm	2(0.2)
MVR + embolectomy	1(0.1)
MVR+ tricuspid annuloplasty	1(0.1)
MVR + left ventricular rupture	1(0.1)
CABG+ aortobifemoral graft	1(0.1)
CABG + aortobifemoral and femoropopliteal graft	2(0.2)
Aortic root replacement	1(0.1)
Left atrial tumor resection	1(0.1)

**Table 2:** Age distribution of patients (n=1000)

Age group	No. (%)
5- 20	14 (1.4)
21-30	10 (1.0)
31 -40	39 (3.9)
41 -50	167(16.7)
51 -60	379 (37.9)
61 -70	321 (32.1)
71 -80	66 (6.6)
81 -90	4 (0.4)

**Table 3:** Sex distribution of patients

Gender	No. (%)
Male	769 (76.9%)
Female	231 (23.1%)
<b>Total</b>	<b>1000 (100%)</b>

**Table 4:** Aetiological agents of SSI (n=18)

Organism	No.
Staph. Aureus	2
Coagulase negative staphylococcus(CoNS)	4
Burkholderia cepacia	3
Klebsiella pneumonia	2
Atypical mycobacteria	1
Culture negative	6
<b>Total</b>	<b>18</b>

Twelve of the 18 infected cases showed culture positivity. Among the two *Staph. aureus* isolates, one was methicillin resistant *Staph. aureus* which was isolated twice from a post CABG case. One CoNS was also methicillin resistant. In the blood culture of a patient, *B.cepacia* has grown in the immediate post operative period who developed wound infection after one month of surgery but the pus culture was sterile. *B. cepacia* grew

from the pus of two other patients which got isolated twice from one of them. All *Klebsiella* isolates were multi drug resistant and ESBL positive and one was sensitive only to imipenem, meropenem and colistin. The atypical mycobacterium isolated from a patient who had a long hospital stay was treated with clarithromycin and ciprofloxacin.

## DISCUSSION

It is important to measure the rates of SSI, because they provide data that can lead to improvement of conditions observed and prevent this serious complication in patients undergoing cardiac surgery. In the present study, the incidence of SSI was lower than that identified in many studies in the literature, which is only 1.8%. Among the 18 SSI patients of our study, 15(83%) had only superficial wound infection and the rest developed mediastinitis requiring wound debridement and sternal rewiring under antibiotic cover. Rest of all got cured with conservative treatment including wound resuturing. In a study by Lepelletier D *et al*, SSIs were diagnosed in 3% of the patients. Of the 38 SSIs in their study, 20 were superficial incisional infections and 18 were mediastinitis. Cultures were positive in 28 cases and the most commonly isolated pathogen was *Staphylococcus*.<sup>3,4</sup> In our study also, coagulase negative staphylococcus is the prevalent microorganism, which was corroborated by other studies.<sup>11,12</sup> In contrast to a study from Brazil, where out of the 36 patients with SSI, 14 (38.9%) patients had died, no mortality has occurred in our patients out of the infection.<sup>13</sup> Though we found that patient demographics like male sex and age > 60 favored SSI, they are not statistically significant. Regarding the higher incidence of SSI in male patients, our result is close to the findings of other studies.<sup>14, 15</sup> The mechanisms by which men are more prone to develop this type of infection compared to women are not yet known. One hypothesis suggests that men, because they have more hair follicles in the chest area where sternotomy is made, they may be more susceptible to bacterial growth and infection, but further studies are needed to elucidate this hypothesis.<sup>16</sup> Risk factors such as DM and COPD are widely discussed in the literature as strong predictors for SSI.<sup>17</sup> In our study also 65% of SSI occurred in diabetics. The increased infection rate in diabetes has been attributed to the impairment of neutrophil chemotaxis, phagocytosis, adherence plus the glycosylation of collagen matrix proteins - all of which lead to weakened antibacterial defenses and delayed wound healing.<sup>18</sup> Several authors have identified obesity/overweight (BMI > 25) as a major risk factor.<sup>19,20</sup> Surprisingly, none of our infected patients were overweight. In all the operated cases excepting one, duration of hospital stay prior to surgery was minimal. As

per the CDC recommendations,<sup>21</sup> shaving should be done only when necessary and must be done before surgery, at a time equal to or less than two hours. Whole body shaving was done in all the patients, one hour before procedure followed by a wash with povidone iodine solution. The average duration of the procedure which is an important factor leading to SSI, was uniformly 3 to 3 ½ hours in our series which is comparable with the standard accepted one. And 96.8% of cardiac surgeries were performed off pump (OPCAB). These technical factors also could have contributed to the low incidence of SSI in our institution compared to other parts of the country.<sup>1,2</sup>

## CONCLUSION

We postulate that several factors do play a role in the acquisition of post CABG SSIs and possibly have an additive/ cumulative effect on the incidence of SSIs. The limitations in our study is that we could not investigate the role of other risk factors like blood transfusions, smoking and other co-morbidities like COPD and hypertension. The most important step in the management of wound infection is prevention, and this is best done by identifying the risk factors.

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