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SURGICAL SITE INFECTIONS IN PATIENTS FOLLOWING OPEN HEART SURGERY: A STUDY ON INCIDENCE, RISK FACTORS AND MICROBIOLOGICAL PROFILE

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ABSTRACT

Purpose: Surgical site infection (SSI) is an important cause of morbidity and occasional mortality following open heart surgery. The aim of this study is to find out the incidence of surgical site infections in patients undergoing open heart surgery, the organisms responsible and the risk factors associated with such infections. **Patients and Methods**: Consecutive patients undergoing open heart surgery between June2014 and December2015 have been included for study. The exclusion criteria being age less than 30 years, penicillin/ cephalosporin allergy and any other associated systemic infections the parameters studied were age, sex, obesity, hypertension, diabetes, and myocardial infarction, length of pre and postoperative hospital stay and duration of surgery. Suspected sites of infection were cultured. Postoperative follow up was done every month for six months. **Results**: One hundred thirty five patients who had median sternotomy for open heart surgery have been studied. Seventeen patients (12.59%) developed surgical site infection (SSI) infection (superficial sternal wound infection and leg wound infections) and all got cured with conservative management Organisms isolated at SSI were *Staphylococcus aureus*-7(41.17%), *Escherichia coli*- 3 (17.6%),Coagulase negative *Staphylococcus* - 2(11.76%), *Klebsiella pneumoniae* 2 (11.76%) , *Pseudomonas aeruginosa* -2 (11.76%) and *Proteus species* -1 (5.8%) . Surgical site infection has increased the postoperative hospital stay and the total treatment cost. **Conclusions**: The incidence of surgical site infections in this centre was comparable with other studies from India as well as abroad. Surgical site infection may occur due to non *Staphylococcus aureus* organisms. Uncontrolled diabetes mellitus and male sex are associated with higher infection rates.

KEYWORDS: Diabetes Mellitus, Median Sternotomy, Open Heart Surgery, *Staphylococcus Aureus,* Surgical Site Infections (SSI)

INTRODUCTION

Despite improved understanding of the path physiology and improved methods of prevention and prophylaxis, infections remains the most common cause of postoperative morbidity and mortality [1]. Sternal wound infection is a serious infection after cardiac surgery [2]. It is of two types. Superficial sternal wound infection and deep sternal wound infection. The incidence of sternal wound infection ranges from 0.43%–2.3% [3, 4, and 5]. The bacteriological pattern for surgical site infection is both Gram positive and Gram negative organisms. It has also been noted that early detection and aggressive treatment were responsible for the reduction in the high mortality of surgical site infections previously reported [6,7].

Therefore, this study aims to determine the incidence of wound infections following open heart surgeries and identify the risk factors that may be associated with SSIs in our center.

Patients and Methods

The present prospective study was conducted in 135 patients who underwent open cardiac surgery by medial sternotomy between June 2014 and December 2015 in cardiac surgical department (Dept. of Cardio thoracic surgery), Manipal Super speciality Hospital, Visakhapatnam, India. The following data were from medical records of patients who underwent cardiac surgery were noted like age and sex of the patients, weight, other co- morbidities like, diabetes, hypertension, myocardial infarction , length of pre and postoperative hospital stay and duration of surgery . From all cases who had signs of wound infection (superficial sternal wound infection and leg wound infection) in the immediate post operative period, samples were collected under aseptic conditions with the help of two sterile disposable cotton swabs. One swab was used to make smear for detection of pus cells and micro-organisms. Other swab was used to inoculate onto blood agar and Mac Conkey agar and other special media that were necessary for identification and incubated at 37°C for 24 hours. The same swab was sub-cultured in nutrient broth and sub-cultured again after 24 hours where no growths were observed. After incubation, identification of bacteria from positive cultures was performed using standard microbiological techniques [8].

RESULTS

In the present study, the incidence of SSI following open heart surgery was 12.59%. Out of 135 patients, 31-50 years age group comprised of 40.73% and >50 years age group comprised of 59.25%. Males (90) were more than female (45) patients and the male female ratio was 2:1. The indications for open heart surgery were coronary artery bypass grafting (CABG) in 91 patients (67.4%) and aortic and mitral valve replacements in 44 patients (32.6%). Out of the 135 cardiac surgery patients who underwent open heart surgeries through longitudinal procedure, 17 (12.59%) developed surgical site infections out of which 9 were post CABG cases and 8 were valve replacement cases. Considering the risk factors, of the 9 infected cases among CABG, 6(66%) were males and 8(88%) were diabetics ,above 50 years age group comprised of 8 (88%). Five (55%) were hypertensive , 4 (44%) had myocardial infarction, poor LV function was seen in 5 (55%) and more than 1 graft was used in 8 (88%) patients. Of the 8 infected cases among valve replacements, 3 (37.5%) were males, above 50 years age group comprised of 2 (25%) ,poor LV function was seen in 2(25%) and none of them were diabetic, hypertensive or had myocardial infarction. Prolonged hospital stay before surgery was present in one patient who underwent mitral valve replacement. No one else had prolonged post operative ICU stay and no one was obese. All the 17 infected cases showed culture positivity and no patient had multiple infections. The infective aerobic microbial flora was shown in table 6. The commonest organism was *Staphylococcus aureus* (41.17%) followed by *Escherichia coli* (17.64%), Coagulase negative *Staphylococcus* (11.76%), *Klebsiella* species (11.76%), *Pseudomonas aeruginosa* (11.76%) and *Proteus* species (5.88%).

DISCUSSIONS

Cardiothoracic surgery associated postoperative infection increases the length of hospital stay by 57% and cost of treatment by 42% [9]. It is therefore imperative to implement adequate measures to reduce the incidence of post-operative infection. To this end, it is necessary to identify the risk factors of postoperative infections. Surgical site infections are manifestations of an imbalance between microbial growth and host's defenses. The surgical stress response imposes an

impairment of these defenses [10]. 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. The reported incidence of SSI has ranged between 2% to 20%, the acceptable range being 11%-15% [11]. The overall rate of surgical site infection in this study was 12.59% which is within the acceptable range. SSI incidence in our study is closely related to Ahmed Abdulaziz Abuzaid et al [12] (17%) and Bhatia et al [13] showing incidence of 18.86%. The incidence of SSI in this centre was comparable with other studies from India as well as abroad which range from 0.53% to 18.7% [14,15,16,17]. All patients got cured with conservative treatment.

We found that patient demographics like male sex and age > 60 favoured SSI. Regarding the higher incidence of SSI in male patients, our result is close to the findings of other studies [18, 19]. 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 [20]. Risk factor such as diabetes is widely discussed in the literature as strong predictors for SSI [21]. In our study also 65% of SSI occurred in diabetics. The increased infection rate in diabetes has been attributed to the impairment of neutrophil chemo taxis, phagocytosis, adherence plus the glycosylation of collagen matrix proteins - all of which lead to weakened antibacterial defenses and delayed wound healing [22]. Raised blood glucose levels impairs wound healing and the continuous use of intravenous insulin has been reported to significantly reduce the incidence of deep sternal wound infection in diabetic patients [23]. Several authors have identified obesity/overweight (Body mass index > 25) as a major risk factor [24, 25]. None of our infected patients were overweight. In all the operated cases excepting one, duration of hospital stay prior to surgery was minimal. 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. Loop *et al*., [26] described several risk factors for sternal wound complications in cardiac surgery. Bilateral internal mammary harvesting, diabetes, obesity, blood transfusion and operative time were considered significant risk factors for sternal wound complications. Preoperative hospital admission duration, antibiotic prophylaxis use, surgical urgency, reoperation, surgical time, CPB duration, amount of blood transfused, postoperative blood loss, chest re-exploration, rewiring of a sterile sternal dehiscence, duration of mechanical ventilation and days of treatment in the intensive care unit were described as other peri-operative factors contributing to the development of SSIs [27]. The microbial aetiology of sternal wound infections were bacterial, both Gram-negative and Gram-positive bacteria. *Staphylococcal* species continue to be the most common offending organisms. Coagulase negative *staphylococci* have been reported to be one of the significant pathogens in postoperative wound infections following cardiac operations [28,29] .Reports on causal organisms involved in postoperative infections have shown a shift from gram negative to gram positive bacteria [30] .

CONCLUSIONS

Surgical site infections, though an infrequent occurrence following open heart surgeries has a deep impact on the cost and may contribute to mortality. The most important step in the management of wound infection is prevention and this is best done by identifying the risk factors. We have maintained an acceptable range of wound infection by adopting good aseptic technique, judicious use of antibiotics, diathermy and application of good surgical techniques. Of all the preoperative co morbidities diabetes mellitus still seems to influence the rate of surgical wound infection and also hypertension as a risk factor should be considered too and thus should be managed expeditiously. Early and aggressive

treatment resulted in good treatment outcome and zero mortality. The search for non *Staphylococcus* organisms should be looked into and treated aggressively.

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APPENDICES

Table 1: Age Wise Distribution of Patients

Age Group	Number (N=135)	%
31-40	26	19.25
41-50	29	21.48
51-60	44	32.59
61-70	32	23.70
>71	4	2.96

Table 2: Sex Distribution of Patients

Gender	Number (N=135)	%
Male	90	66.67
Female	45	33.34

Table 3: Indications for Open Heart Surgery

Indication	Number (N=135)	%
Coronary artery bypass grafting	91	67.40
Aortic and Mitral valve replacements	44	32.6

Table 4: Patient and Disease Characteristics

Variable	CABG (N=91) (%)	Valve Replacements (N=44) (%)
Male	68 (74)	22 (50)
Female	23(25)	22 (50)
Diabetes mellitus	48(52)	1(2.7)
Hypertension	58 (63)	3 (6.8)
Myocardial Infarction	33(36)	1 (2.7)

Table 5: Incidence of Surgical Site Infections after Open Heart Surgery

Procedure	Number of Patients	Infected Patients	
		Number	(%)
Coronary artery bypass grafting	91	9	9.8
Valve replacements	44	8	18.18
Total	**135**	**17**	**12.59**

Table 6: Pathogens Detected in Surgical Site Infections

Pathogen Detected	Number (N=17)	%
Staphylococcus aureus	6	35.29
Coagulase negative Staphylococcus	2	11.76
Escherichia coli	4	23.52
Klebsiella species	2	11.76
Pseudomonas species	2	11.76
Proteus species	1	5.88

Table 7: Analysis of Risk Factors

Variable	CABG (N=9) (%)	Valve Replacement (N=8) (%)
Male	6 (66)	3 (37.5)
Age >50 years	8 (88)	2 (25)
Diabetes mellitus	6 (66)	0
Hypertension	5 (55)	0
Myocardial Infarction	4 (44)	0
LV Function (<45%)	5 (55)	2 (25)
Graft number (>1)	8 (88)	_