Original Research Article

Surgical site infection in a coastal tertiary care teaching hospital

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Abstract

Introduction: Surgical site infections are one among the commonly reported nosocomial infections. The present study was aimed at determining the possible risk factors involved in development of SSIs and the microorganisms responsible for SSIs with their antibiogram in a rural tertiary care teaching hospital.

Materials and methods: This was a prospective observational study conducted in the Department of Surgery in association with the Department of Microbiology at Vinayaka Missions Medical College and Hospital over a period of six months. Detailed history such as age, sex, operation category (elective/ emergency), history of diabetes were recorded. Swabs were collected from clinically suspected of surgical site infections. Specimens collected were subjected to standard microbiological procedures. Antimicrobial susceptibility of the isolates was determined by Kirby Bauer disk diffusion method on Muller Hinton agar plates according to Clinical and Laboratory Standard Institute (CLSI) guidelines.

Results: A total of 342 patients underwent surgery during the study period. 59 cases were clinically diagnosed of surgical site infection, out of which 55 patients' samples yielded growth and accounted for 16% infection rate. The incidence of infection was high in case of emergency surgeries (22%) compared to elective surgeries (13%). SSI rate was low in clean surgeries (7%) whereas contaminated and dirty wounds showed 43% and 75% respectively. Staphylococcus aureus (27.5%) was the predominant pathogen isolated. Linezolide was the most susceptible antibiotic against Gram positive cocci. Second predominant organism was Escherichia coli 14 (20.2%). and showed good susceptibility to imipenem, cefeperazone/ sulbactum and piperacillin/ tazobactum including ESBL producers.

Conclusion: In this study, surgical site infection rate was 16%. Staphylococcus aureus (27%) was the most frequently isolated bacteria followed by E.coli (20%). Good susceptibility observed towards linezolide against Gram positive cocci. Imipenem, cefeperazone/ sulbactum and piperacillin/ tazobactum were effective against Gram negative bacilli.

Key words

Surgical site infection, Stahylococcus aureus, Linezolide.

Introduction

Post-operative wound infection is defined as that infection presenting up to 30 days after a surgical procedure if no prosthetic is placed and up to 1 year if a prosthetic is implanted in the patient [1]. Centers for Disease Control (CDC) revised its definition of ‘wound infection’, by creating the definition, ‘surgical site infection’ (SSI) to prevent the confusion between the infection of a surgical incision and the infection of a traumatic wound [2]. Most of the SSIs are superficial, but even so, they contribute greatly to the morbidity and the mortality which are associated with the surgeries [3]. SSI's are the third most frequently reported nosocomial infections, accounting for 14-16% of all the infections. Worldwide estimates of SSI have varied from 0.5–15% [4-6]. Studies in India have consistently shown higher rates up to 38% [7, 8].

Various factors are responsible for developing SSIs. These include the degree of microbial contamination of the operation site indicated by wound class as clean, clean contaminated, contaminated and dirty, and also by patient age, length of surgery, pre-operative shaving of the operative site, hypothermia and comorbidities e.g. diabetes and obesity [9]. The probability of wound infection is determined largely by the interaction of the microbial burden, local wound conditions, and the patient's systemic host defenses. The conditions of antimicrobial therapy, both prophylactically and therapeutically, can only be defined when these other factors are under control [10].

Thus, the identification of factors that cause or predict these infections continues to be an important area of research. A wide variety of aerobic and anaerobic species of bacteria may be present, either singly or in combination [11]. Multi drug resistant bacteria (MDR) is one of the major threats due to widespread use of antimicrobial drugs. These bacteria exhibit resistance to two or more classes of antibiotics. In recent years, multi drug resistant bacteria such as, Methicillin resistant Staphylococcus aureus (MRSA), extended-spectrum-β-lactamases (ESBL) producing enterobacteria and vancomycin resistant enterococci (VRE) have become common particularly among hospitalized patients. Prevalence and antibacterial susceptibility patterns of MDR organisms are important for choosing appropriate empirical therapy especially to treat surgical site infections [12].

The present study was aimed at determining the possible risk factors involved in development of SSIs and the microorganisms responsible for SSIs with their antibiogram in a rural tertiary care teaching hospital.

Materials and methods

This was a prospective observational study conducted in the Department of Surgery in association with the Department of Microbiology at Vinayaka Missions Medical College and Hospital over a period of six months (January 2017 to June 2017) on all patients who underwent surgical procedures during study period. Verbal informed consent was obtained from all the patients. Detailed history such as age, sex, operation category (elective/ emergency), history of diabetes were recorded. The operations were classified, depending on the degree of contamination, as Clean, Clean-Contaminated, and Contaminated employing the

American College of Surgeons' Committee for Control of Surgical Infections guidelines [13].

The cumulative incidence of SSIs was expressed as infection rate – the number of patients with SSIs per 100 operated patients. Patients less than 14 years, Patients undergoing re-operations and those with open wounds for desloughing were excluded. Specimens were collected from the patients in the form of swabs from suspected surgical site infection (8-10 days and then 2-4 weeks after the surgery from the wounds having serous or purulent discharge, showing signs of inflammation). Two swabs were collected from each patient and subjected to standard microbiological procedures. Antimicrobial susceptibility of the isolates was determined by Kirby Bauer disk diffusion method on Muller Hinton agar plates according to Clinical and Laboratory Standard Institute (CLSI) guidelines [14].

Results

A total of 342 patients underwent surgery during the study period. 59 cases were clinically diagnosed of surgical site infection, out of which 55 patients' samples yielded growth and accounted for 16% infection rate. Surgical site infection was predominantly observed among patients above 65 years and accounted for 46.42% (**Table - 1**). The description of variables and its association with SSI is presented in **Table - 2**.

Table – 1: Age and sex wise distribution of surgical site infections.

Age in years	Male (n=230)	Female (n=112)	Total (n=342)	SSIs (%)
15-25	32	16	48	3(6.25%)
26-35	38	16	54	3(6.25%)
36-45	35	32	67	7(10.44%)
46-55	57	20	77	12(15.54%)
56-65	48	20	68	17(25%)
>65	20	8	28	13(46.42%)

Table – 2: Factors associated with surgical site infections.

Operation category	Number	SSIs (%)
Emergency	97	22(22.6%)
Elective	245	33(13.46%)
Type of operation		
Clean	189	15(7.9%)
Clean contaminated	105	14(13.3%)
Contaminated	32	14(43.7%)
Dirty	16	12(75.2%)
Co morbidities		
Diabetic	92	22(23.9%)
Non diabetic	250	33(13.2%)

Out of 59 specimens collected from patients clinically suspected of SSIs, 55 samples yielded growth. Monomicrobial growth was observed in 45 specimens and 10 specimens showed polymicrbial growth. Overall, 69 pathogens were identified and characterized. Staphylococcus aureus (27.5%) was the predominant pathogen isolated. Methicillin resistance was noticed in seven strains of Stahylococcus aureus. Second predominant organism was Escherichia coli 14 (20.2%). Among fungi, Candida species was isolated and accounted for 6 (8.6%) as per **Table – 3**.

Table – 3: Pathogens isolated from SSIs.

Isolate	Number (%)
Staphylococcus aureus MSSA MRSA	19(27.5%) 12(63.1%) 7(36.8%)
Escherichia coli	14(20.2%)
Klebsiella species	11(15.9%)
Pseudomonas aeruginosa	9(13%)
Proteus species	7(10.1%)
NFGNB	3(4.3%)
Candida species	6(8.6%)

(MSSA - Methicillin sensitive Staphylococcus aureus, MRSA - Methicillin resistant Sthaphylococcus aureus, NFGNB - Non fermenting gram negative bacilli)

All strains of Methicillin resistant staphylococcus aureus were susceptibility linezolide (100%) followed by co trimaxazole (71%) and cefeperazone/ sulbactum (71%). Methicillin sensitive staphylococcus aureus showed good susceptibility towards all antibiotics except cefotaxime (50%) and ofloxacin (50%). Seven strains of Klebsiella species were identified as extended spectrum of betalactamase (ESBL) producers. Among E.coli, six strains were found to be ESBL producers. Imipenem was the most active drug against ESBL strains followed by cefeperrazone/ sulbactum and piperacillin/ Tazobactum (**Table - 4**).

Table – 4: Antibiotic susceptibility pattern of bacterial isolates.

Antibiotics	**MRSA (7)**	**MSSA (12)**	**E.coli (14)**	**Klebsiella (11)**	**Pseudomonas (9)**	**Proteus (7)**	**NFGNB (3)**
Amoxyclav	3(42%)	12(100%)	12(85%)	9(81%)	8(88%)	7(100%)	3(100%)
Amikacin	3(42%)	11(91%)	10(71%)	8(72%)	9(100%)	7(100%)	1(33%)
Cefotaxime	1(14%)	6(50%)	6(42%)	5(45%)	7(77%)	3(42%)	0(0%)
Cotrimaxazole	5(71%)	11(91%)	7(50%)	5(45%)	3(33%)	5(71%)	0(0%)
Pipracillin/ Tazobactum	4(57%)	12(100%)	9(64%)	11(100%)	9(100%)	7(100%)	1(33%)
Cefeperazone/ sulbactum	5(71%)	12(100%)	12(85%)	11(100%)	9(100%)	7(100%)	3(100%)
Oflaxacin	4(57%)	6(50%)	6(42%)	7(63%)	2(22%)	4(57%)	1(33%)
Imipenem	NT	NT	13(92%)	9(81%)	9(100%)	7(100%)	2(66%)
Linezolide	7(100%)	12(100%)	NT	NT	NT	NT	NT

NT-Not tested

Discussion

In our study, surgical site infection rate was fond to 16%. This is similar to the study conducted by Brown, et al. (16.7%) [15] in republic of Georgia. In our study, Surgical site infection rate is very low compared to the studies conducted by Ganguly, et al. (38.8%) and Subramanian, et al. (24.8%) [7, 8]. But few studies from various parts of India showed low incidence of surgical site infection. Recent study by Chada, et al. showed very low incidence of surgical site infection rate (3.83%) [16]. Murthy R, et al. also reported 4.2% as incidence of SSI in their study [17].

Emergency surgeries were more likely to be associated with higher incidence of SSI in various studies done worldwide. The incidence of SSIs in our study was more in emergency surgeries 22/97 (22%) as compared to routine/ elective surgeries 33/245 (13%). Mahesh CB, et al. [18] also observed a similar SSI rate of 21.05% in emergency surgeries as compared to 7.61% of cases in elective surgeries. This can be due to the reasons like emergency surgeries which lack regular pre-operative preparation and involve mostly abdominal and intestinal surgeries which are contaminated surgeries.

In the present study, SSIs predominantly observed in age group above 65 years (46.42%) followed by 56-65 years (25%). This is similar to the study conducted by Astagneau, et al. [19]. In our study, when operation categorized by traditional wound classification, infections occurred in 7.9% of the clean wounds, 13.3% of the clean-contaminated wounds, 43.7% of the contaminated wounds and in 75.2% of the dirty or the infected wounds. These findings are similar to the study conducted by of Rosentha, et al. in his study [20]. A study which was conducted at the Mayo Hospital, Lahore, reported an infection rate of 5.05% among the clean and a rate of 8.39% amongst the clean-contaminated cases [21].

Certain underlying conditions like anemia, diabetes, and smoking may alter or decrease the immune status thus significantly increasing the risk of SSI. They play the role in increasing the pre operative stay of the patient which steeply increases the risk of SSI in such patients. In our study, among diabetic patients SSI was found to be 23.9% and in non-diabetic patients 13.2%.

In the present study, Staphylococcus aureus was the predominant bacteria isolated and accounted for 27.5%. Staphylococcus aureus, is a major pathogen and a predominant cause of SSIs worldwide with a prevalence rate ranging from 4.6% to 54.4% [22]. Infection with S. aureus is most likely associated with endogenous source as it is a member of the skin and nasal flora and also with contamination from environment, surgical instruments or from hands of health care workers [23]. In the present study MRSA was accounted for 36.8%. This is low as compared to other studies conducted by Eagye, et al. (45%) and Kaye, et al. (58.2%) [24, 25]. All strains were found to be susceptible to linezolide (100%) followed by cotrimaxazole (71%).

Among Gram negative bacteria, E.coli (20.2%) and Klebsiella species (15.9%) were found to common pathogens followed by Pseudomonas aeruginosa (13.0%) Few studies have reported P.aeruginosa as the most frequent isolate in SSI [26]. All Gram negative bacilli showed good susceptibility to Imipenem, cefeperazone/ sulbactum and piperacillin/ tazobactum including ESBL producers. Candida species (spp) have emerged as the seventh most common health care - associated pathogen in the critically ill with an associated mortality rate of 19- 50% [27]. In the present study, 6(8.6%) of Candida species isolated.

In this study limitations are, only few factors which are associated with SSIs were taken into the study, no anerobic culture was done and only antibiotic susceptibility testing was performed. No antifungal susceptibility was done with Candida species isolated from SSIs.

Conclusion

In this study, surgical site infection rate was found to 16%.Association of various risk factors showed impact on developing SSIs. The rate of infection in diabetics and those who underwent emergency operations was significantly higher than others. Staphylococcus aureus (27%) was the most frequently isolated bacteria from SSIs. All MRSA strains were found to be susceptible to linezolide. Among Gram negative bacteria, E.coli (20%) was the predominant bacteria and showed good susceptibility to imipenem, cefeperazone/ sulbactum and piperacillin/ tazobactum including ESBL producers.

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