Bacteriological Profile of Surgical Site Infections (SSIs)- A Study in a Tertiary Care Hospital

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ABSTRACT

BACKGROUND

All postoperative surgical infections occurring in an operative site are termed Surgical Site Infections (SSIs). SSI is a common form of nosocomial infection and is a common complication associated with surgery. They are responsible for increasing cost, length of hospital stay, morbidity and mortality. Surgical site infection is a major public health problem worldwide. We wanted to determine the incidence of SSI rates, bacteriological profile, and the resistant pattern in a tertiary care centre.

METHODS

This prospective study was conducted in a tertiary care centre in Bangalore in the Department of Microbiology over a period of 6 months. 180 patients with surgical site infections were studied. Wound swabs and pus samples were collected and processed as per standard microbiological techniques. Antimicrobial testing was done using Vitek 2K automated method. MRSA, ESBL types of resistance among the isolates were detected and characterized as per CLSI guidelines.

RESULTS

Among 1734 patients, 180 (10.3%) patients developed surgical site infections (SSI). SSIs were more frequent in the age group of 36 - 45 years. Males were more likely to get SSIs. Diabetes mellitus was the commonest comorbid condition seen in SSI cases. Pre-operative waiting period beyond 7 days, not receiving prophylactic antibiotics, dirty and contaminated surgeries were the other contributory factors for SSIs. Gram negative bacilli were the predominant isolates in SSIs. *Klebsiella pneumoniae* was the most frequent isolate followed by *E. coli.* MRSA (Methicillin Resistant *Staphylococcus aureus*) was the predominant isolate in Gram positive bacteria. These strains demonstrated extensive antibiotic resistance to the drugs tested.

CONCLUSIONS

Minimizing postoperative wound infections relies on adequate asepsis, efforts to decrease the duration of surgery without compromising the patient's safety and beneficial outcome. Implementation of an effective infection control programme and judicious use of antibiotic prophylaxis reduces the incidence of SSIs in the hospital.

KEY WORDS

Surgical Site Infections, Vitek 2K Automated Method, Diabetes Mellitus, Prophylactic Antibiotics, *Klebsiella pneumoniae*, MRSA

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BACKGROUND

Infection of a wound after a surgery is called post-operative surgical wound infection. The rates of these infections vary from hospital to hospital and the site of the infection may be limited to the suture line or may extend into the operative site. Surgical wound infection is a type of nosocomial infection.[1]

Nosocomial infections are those infections that are acquired in hospitals or other healthcare facilities. For a person to have acquired a nosocomial infection he or she must be admitted to a hospital or healthcare facility for reasons other than the infection and no signs of active or incubating infection should be shown by the patient.[2]

Nosocomial infections can be urinary tract infections, respiratory infections, or surgical wound infections.[3] Surgical infections (SSI) are one of the most common causes of nosocomial infections and are a common complication associated with surgery.

They are responsible for increasing cost, length of hospital stay, morbidity and mortality. SSI accounts for 20 - 25% of all hospital acquired infections (HAI) worldwide. Globally SSI rates have been reported from 2.5% - 41.9%. The risk of acquiring hospital infection on hospitalized patients in relation to surgery is high, since majority of SSI are uncomplicated involving only skin and subcutaneous tissue but sometimes can progress to necrotizing infections.

75% of death of the patients with hospital acquired infections was reported to be related to postoperative infections. The number of surgical patients in developing countries is also increasing but surgical care given to the patients is poor.

Various factors affecting the infection rate include skin preparation, wound contamination, the length of pre - operative hospital stay, drainage of wounds, the age of the patient and duration of surgery.

Success in surgery depends on prevention and proper management of a wound. In order to adapt to the policies which decrease the incidence of SSIs, the most important requirement is to collect data, perform wound surveillance and surgical inspection.

HAI are further complicated by an increasing prevalence of multidrug resistance like Methicillin resistant *Staphylococcus aureus*, multidrug resistant Gram - negative bacilli, these bacteria worsen the condition and it has become a serious problem in the developing countries. Therefore identification of microorganism and their susceptibility pattern are beneficial to the patient and assist in selection of antibiotic to avoid emergence of multidrug resistant organisms in hospital.

It is also important to take appropriate steps to control the spread of infection with in the unit. Furthermore, the information gathered helps in planning antibiotic usage policy for SSI. With this background this study was undertaken to determine the SSI rates, bacteriological profile and their resistant pattern in a tertiary care centre.[4,5]

METHODS

This prospective study was conducted in a tertiary care centre in Bangalore in the department of Microbiology over a period of 6 months. Wound swabs and pus samples were taken from consented surgical site infected patients for microbiological analysis before wound dressing, taking care to avoid skin contamination. The clinical samples were subjected to direct microscopy by Gram stain and were further inoculated onto MacConkey and blood agar plates with in 1 hour of collection. The agar plates were incubated at 37 ºC aerobically and examined after 24 hrs of incubation. Those plates showing no growth was further incubated for another 24 hrs, identification and susceptibility of the implicating pathogen was done using Vitek 2K automated method as per CLSI guidelines. MRSA, ESBL type of resistance among the isolates were detected and characterized as per CLSI guidelines.[6,7,8]

CDC criteria were used to define the type of surgical wound i.e. Class I - Clean, Class II Clean contaminated, Class III - Contaminated, Class IV - Dirty.[9]

RESULTS

A total of 1734 surgeries were done during the study period of which 180 (10.3%) patients developed surgical site infections.

Age	Total Number	Number of SSIs
1 - 15	29	4
16 - 25	236	24
26 - 35	300	30
36 - 45	408	44
46 - 55	353	36
56 - 65	231	24
66 - 75	177	18
Total	**1734**	**180**

Table 1. Frequency of SSIs in Different Age Groups

The rate of SSIs was more in patients in the age group of 36 - 45 years followed by 46 - 55 years. (Table: 1). Of the 180 cases 108/1040 (60%) were males and 72/694 (40%) were females.

Sl. No.	Comorbid Conditions	No. of SSIs
1	Anaemia	18 (10%)
2	Diabetes mellitus	77 (43%)
3	Hypertension	49 (27%)
4	Obesity	13(7%)
5	>1 co morbidity	14 (8%)
6	No co morbidity	9 (5%)
Total		**180**

Table 2. Associated Comorbid Conditions in SSI Patients

Anaemia, diabetes mellitus, hypertension and obesity were the co morbid conditions studied. 43% of the patients with diabetes mellitus went on to develop SSIs, among them 12 % had uncontrolled condition. 27% of the patients with hypertension developed SSIs. 10% and 7% of patients with anaemia and obesity developed the infection respectively, about 8 % of the patients had more than one co morbid condition. However no associated co morbid condition was seen in 8 % of the patients. (Table: 2)

Factor		% of SSIs
Pre - operative waiting period	< 2 days	11%
	2 - 7 days	36%
	>7 days	53%
Prophylactic antibiotics	Received	38%
	Not received	62%

Table 3. Contributory Factors for SSI's

Pre-operative waiting period beyond 7 days and not receiving prophylactic antibiotics were the other contributory factors for SSIs accounting up to 53% and 62% respectively. (Table: 3)

Type of surgery	% of SSIs
Clean	3%
Clean contaminated	22%
Contaminated	31%
Dirty	44%
Total	**100%**

Table 4. Type of Surgeries in SSI's

Dirty and contaminated surgeries accounted maximum for the development of SSIs accounting up to 44% and 31 % respectively. (Table: 4.)

Sl. No.	Isolate	Number	%
1	MRSA	24	15
2	MSSA	15	10
3	CONS	06	4
4	*Enterococci*	09	6
5	*E. coli*	35	22
6	*Klebsiella pneumoniae*	46	29
7	*Proteus vulgaris*	04	3
8	*Proteus mirabilis*	02	1
9	*Pseudomonas aeruginosa*	16	10
Total		**157**	**100**

Table. 5 Bacterial Flora in SSI's

Of the 180 samples collected 157 (87%) were culture positive and 23 (13%) did not show any significant growth. Of the 157 isolates 54 (34%) were Gram positive organisms and 103 (66%) were Gram negative organisms. Of the Gram - positive organisms MRSA (Methicillin resistant *Staphylococcus aureus*) was the predominant isolate followed by MSSA (Methicillin sensitive *Staphylococcus aureus*). Gram negative bacilli were the predominant isolates in SSIs. *Klebsiella pneumoniae* was the most frequent isolate followed by *E. coli*, the rate of isolation being 29% and 22% respectively. (Table 5)

Among the gram - negative isolates 46 (45%) exhibited resistance like ESBL (extended spectrum β lactamases), MBL (metallo β lactamases) and Amp C. ESBL was the commonest resistance exhibited by the Gram - negative bacteria mounting up to 44% of the total SSIs followed by MBL 35% and Amp C 21% respectively.

DISCUSSION

Infection of wounds after surgical operations is a real risk associated with any surgical procedure and represents a significant burden in terms of patient morbidity and mortality. The present study was conducted to assess the frequency of SSIs, its association with the type of surgery, risk factors, implicated bacterial flora and its resistance pattern in a tertiary care centre which spanned over a period of six months.

The rate of SSIs varies worldwide from hospital to hospital. The rate ranging from 2.5% - 41%, which largely depends on hospital policies and guidelines, other contributory factors being sample size, study design and study period. In the present study 1734 surgeries were conducted, of which 180 cases developed surgical site infections with an infection rate of 10.3% which is in concurrence with the various studies.[10 - 13]

The rate of SSIs increases with age. In the present study patients in the age group of 36 - 45 years were more likely to get SSIs followed by 46 - 55 years, such a trend has been seen other studies.[13,14]

This has been described by different studies in that age is one of non - modifiable risk factor that influence wound healing process and increases the likelihood of a positive surgical outcome,[15] also in comparison to the younger population, these patients are usually characterized by an impaired immune response to infectious agents, inferior nutritional status, and possibly more comorbidities.[16]

The present study showed a male preponderance in developing SSIs when compared to the female patients, such a finding has been documented by Naveen et al and Varsha et al.[13,17] However sex, marital status, educational status and occupation are not a pre - determinant of the risk of SSI and not statistically significant.[18]

Diabetes mellitus, hypertension, anaemia and obesity were the important risk factors for developing SSIs in our study. Diabetes mellitus was the most frequent co morbid condition. These co morbidities alter or decrease the immune status there by significantly increasing the risk of SSIs.[19, 20]

Prolonged preoperative hospital stay leads to colonization with antimicrobial resistant micro - organisms and directly affects patient's susceptibility to infection either by lowering host resistance or by providing increased opportunity for ultimate bacterial colonization.[21]

Such an effect was also noticed in the present study wherein of the 180 SSIs cases 53% of the patients were in housed in the hospital for more than 7 days. Prophylactic antibiotic usage decreases the incidence of SSIs, 62% of the patients who had not received prophylaxis, went on to develop SSIs as compared to the ones who were instituted prophylactic antibiotics.

The frequency of SSIs was high in dirty (44%) and contaminated (31%) type of wounds as compared with the clean wounds. This is an expected outcome was also seen in various studies.[10,14] Of the 180 SSIs cases 157 (87%) yielded growth of bacteria, however 23 (13%) showed no growth and contributory no organisms on direct microscopy. Lilani et al,[10] and Varsha et al[17] reported 22 % and 17.6% culture negative SSI cases in their research.

Gram negative bacilli (GNB) have dominated the trend in our set up accounting up to 65% of the total isolates, followed by Gram positive cocci (GPC) which were isolated from 35% of the cases. Among GNB *Klebsiella pneumoniae* and *E. coli* belonging to Enterobacteriaceae were the commonest isolates accounting to 29% and 22% respectively. Other important implicating GNB was *Pseudomonas aeruginosa* isolated from 10% of the cases. Similar trend has been documented by several

authors.[17,21,22] GNB inherently being part of normal endogenous microbial flora are becoming the most important pathogens in causing SSIs.

Staphylococcus aureus was the most important pathogen among GPC and sizeable number were methicillin resistant (MRSA). *Staphylococcus aureus* is a major pathogen responsible for various nosocomial infections, including bacteraemia, pneumonia, skin and soft tissue infections, and osteomyelitis. MRSA are implicated in serious infections and nosocomial outbreaks. Drug resistance poses a therapeutic problem in the hospital settings, as most of the bacteria have acquired resistance to multiple antibiotics. Antimicrobial drug resistance is emerging world - wide as a major public health problem. Selective pressure of misuse and overuse of antibiotics in the hospitals has resulted in the emergence and dissemination resistant bacteria in many areas of hospitals. The various mechanisms of drug resistance in Gram negative bacteria in the present study included extended spectrum b - lactamases (ESBL) production, Amp C lactamase production, metallo b - lactamases (MBL), efflux mechanism and porin deficiency.[23]

CONCLUSIONS

The incidence of surgical site infection was 10.3 % in this study. Pre-operative stay, type of surgery, and diabetes mellitus were the major risk factors responsible for causing surgical site infections. Minimizing the postoperative wound infections relies on adequate asepsis, efforts to decrease the duration of surgery without compromising the patient's safety and beneficial outcome. Periodic surveillance of SSI will guide the infection control committee in laying down strict guidelines to further decrease SSI incidence in our set up, which is an indicator of health care in a given system. Antimicrobial stewardship programmes are important to address excessive or inappropriate antimicrobial usage.

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