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Spectrum of surgical site infections with special reference to methicillin resistant *Staphylococcus aureus* (MRSA)

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Abstract
Introduction: Surgical site infections (SSIs) remains one of the most critical health-related infections causing discomfort, extended hospital stay with elevated costs, cosmetically inappropriate wounds, resulting in patients' miserable state. The present study was to determine the bacterial spectrum of surgical site infections with special reference to methicillin resistance *Stahylococcus aureus*.
Materials and Methods: A prospective cross sectional study was conducted at Vinayaka missions Medical College and Hospital by Department of General Surgery in association with the Department of Microbiology for a period of three months from October 2019 to December 2019. Data were collected using a structured questionnaire for a time period of three month. Samples were collected from suspected SSIs and sent to clinical microbiology for bacterial identification. Methicillin resistance *Stahylococcus aureus* (MRSA) was identified by disc diffusion technique.
Results: A total of 762 surgeries were conducted during the study period. Out of 762 surgeries, 137 patients developed signs of surgical site infection and accounted for 17.98% surgical site infection rate. Specimens were collected from all suspected cases of surgical site infection. A total of 109 specimens yielded growth of 133 bacteria. *Stahylococcus aureus* was the most common bacteria isolated from surgical site infections which accounted for 33%. Overall MRSA was accounted for 14%. All MRSA isolates were found to be susceptible to Vancomycin (100%).
Conclusion: In the present study, overall surgical site infection rate was 17.98%. *Staphylococcus aureus* was found to be the most common bacterial pathogen isolated from SSIs. MRSA is a key problem, since there are limited treatment options for such resistant strains.

Keywords: Surgical site infection, MRSA, infection control

Introduction
Nosocomial infections are contracted by patients when seeking treatment in healthcare facilities and constitute the most common adverse outcomes impacting patients' protection worldwide. For every 100 hospitalized patients at any given time, seven in developed and 15 in developing countries will acquire at least one hospital acquired infection. In low- and middle-income countries, the endemic rate of HAI is also significantly (at least 2-3 times) higher than in high-income countries, especially in patients admitted to ICUs and newborns [1].
Surgical site infection (SSI) are defined as infections occurring within 30 days after a surgical operation (or within one year if an implant is left in place after the procedure) and affecting either the incision or deep tissue at the operation site, contributes substantially to surgical morbidity and mortality each year. SSI accounts for 15% of all nosocomial infections and, among surgical patients, represents the most common nosocomial infection [2].
SSI remains one of the most critical health-related infections causing discomfort, extended hospital stay with elevated costs, cosmetically inappropriate wounds, resulting in patients' miserable state. This whole sequel could be prevented by systemic antibiotic prophylaxis, since the bacteria involved in SSIs include those granted by the patients themselves (endogous flora) or those that could be instigated in the operating room (exogenous flora). Infection caused by microorganisms following surgery from an external source is less frequent than endogenous [3].
Staphylococcus aureus remains the most common pathogen causing SSI. In general hospitals it accounts for 20 per cent of SSI. A combination of nasal colonization and *S. aureus*' immuno-evasive strategies prompted it to become a major pathogen responsible for infection associated

with healthcare [4]. The SSIs proportion due to *S. aureus* increased from 16.6% to 30.9% in the period 1992-2002, when the number of MRSA isolates also increased from 9.2% to 49.3%. The 90 days postoperative mortality has been reported as 6.7% and 20.7% for SSI patients with methicillin susceptible *S. aureus* (MSSA) and MRSA, respectively [5].

Antibiotic selection should cover the organisms expected to be found in SSI, which could be guided by available previous data. On this basis the research was conducted to determine the prevalence of MRSA in SSI and also to determine the trend of antibiotic resistance of MRSA strains which will eventually help the infection management team prepare the preoperative antibiotic program.

Materials and methods: A prospective cross sectional study was conducted at Vinayaka missions Medical College and Hospital by Department of General Surgery in association with Department of Microbiology for a period of three months from October 2019 to December 2019. Data were collected using a structured questionnaire for a time period of three month. SSIs were assessed by:1. Pus or purulent discharge from the wound along with pain. 2. Any two cardinal signs of inflammation, and 3. Diagnosis of SSI by the surgeon.

Swabs were collected from the infected site as per standard guidelines, and collected before dressing was done. Swabs were transported immediately to the Central Microbiology Laboratory and processed immediately as per standard CLSI guidelines. The pathogens were isolated and identified by a battery of biochemical tests and antimicrobial susceptibility of the pathogen was performed as per CLSI Guidelines. Methicillin resistant *Staphylococcus aureus* was (MRSA) identified by disc diffusion technique [6].

Result: A total of 762 surgeries were conducted during the study period. Out of 762 surgeries, 137 patients developed signs of surgical site infection and accounted for 17.98% surgical site infection rate. Specimens were collected from all suspected cases of surgical site infection. A total of 109 specimens yielded growth of 133 bacteria. Out of 109 specimens, 12 specimens were yielded the growth of more than one organism. All specimens yielded polymicrobial growth was from clean contaminated and dirty surgeries. Male was found to be the predominant compared to females in developing SSIs. A total of 79 males patients were suspected of SSIs, Out of 79 patients specimens, 63 yielded the growth. In the present stud, 80 patients who undergone elective surgery were suspected to have SSIs. Out of 80 specimens, 60 yielded the growth. (Table.1)

Table 1: Distribution of surgical site infections

Varaibles	Suspected SSI(N=137)	Bacterial growth (N=109)	Percentage
Gender			
Male	79	63	57.80%
Female	58	46	42.20%
Nature of surgery			
Elective	80	60	55.05
Emergency	57	49	44.95
Class of surgical wound			
Clean	57	44	40.37
Clean-contaminated	37	30	27.52
Contaminated	30	26	23.85
Dirty	9	9	8.26
Diabetes			
Diabetic	77	73	66.97
Non diabetic	60	36	33.02

Staphylococcus aureus was found to be the common bacteria isolated from the wounds of surgical site infections and accounted for 45(33.83%). Overall the prevalence of Methicillin resistant *Staphylococcus aureus* was found to be 14.28%. Second common isolate was *E. coli* which accounted for 27(18.05%) followed by *Pseudomonas aeruginosa* 21(15.79%). Proteus and Non fermenting gram negative bacilli were found to be the least common isolates from surgical infections. (Table.2)

Table 2: Bacteria isolated from surgical site infections (SSIs)

Bacteria (n=133)	Number (%)
Staphylococcus aureus MRSA	19(14.28%)
MSSA	26(19.54%)
E. coli	27(18.05%)
Pseudomonas aeruginosa	21(15.79%)
Klebsiella species	16(12.03%)
CONS	12(9.02%)
Proteus	6(4.5%)
NFGNB	6(4.5%)

Methicillin resistant *Staphylococcus aureus* (MRSA) was found to be the most resistant bacterial pathogen. Least susceptibility was observed against Ceftazidime (15.79%). Ceftriaxone and Gentamicin exhibited same susceptibility pattern and accounted for 26.32%. All MRSA isolates were found to be susceptible to Vancomycin (100%). Greater degree of susceptibility was noticed with Augmentin (84.21%) followed by Piperacillin/tazobactum (78.95%). Among isolated Gram negative bacteria, Non fermenting Gram negative bacilli (NFGNB) was found to be the multi drug resistant bacteria and least susceptible to the antibiotics. All strains of NFGNB were found to be resistant to Gentamicin. (Table.3)

Table 3: Antibiotic susceptibility pattern of bacteria isolated from SSI s

Antibiotic	Caz	Ctr	Va	Ak	Gen	Ipm	Pit	Of	Aug
MRSA(n=19)	15.79	26.32	100.00	52.63	26.32	NT	78.95	47.37	84.21
MSSA(n=26)	65.38	73.08	100.00	100.00	50.00	NT	100.00	65.38	88.46
E.coli(n=27)	80.77	76.92	NT	76.92	80.77	103.85	96.15	69.23	80.77
Psedomonas aeruginosa (n=21)	73.08	38.46	NT	69.23	65.38	76.92	76.92	57.69	73.08
Klebsiella (n=16)	57.69	38.46	NT	50.00	42.31	61.54	50.00	30.77	42.31
CONS(n=12)	34.62	19.23	100.00	46.15	26.92	NT	46.15	34.62	46.15
Proteus (n=6)	23.08	19.23	NT	23.08	19.23	23.08	23.08	11.54	23.08
NFGNB(n=6)	11.54	7.69	NT	3.85	0.00	11.54	3.85	3.85	11.54

MRSA: Methicillin resistant *Staphylococcus aureus*; MSSA: Methicillin sensitive *Staphylococcus aureus* NFGNB: Non fermenting gram negative bacilli; Caz: Ceftazidime; Ctr: Ceftriaxone; Va: Vancomycin; Ak: Amikacin; Gen: Gentamicin; Ipm: Imipenem; Pit: Pipiracillin/Tazobactum; Of: Oflaxacin; Aug: Augmentin NT: Not Tested

Discussion

In our study, surgical site infection rate was 17.98%. Overall, rates of surgical site infection ranged from 2.5 per cent to 41,9 per cent [7]. However, the onset of SSI is influenced by various factors related to surgery (type of operation performed, nature of operation, type of anesthesia, etc.), individual conditions (patient age, patient sex, co-morbidity, etc.). Among male patients the SSI rate was higher compared to females. This observation is parallel to the study conducted by Chada *et al*. [8]

In our study, the incidence of SSIs rate was found to be predominant between the age group of 40-60 years. In the study carried out by S Sahu *et al*. [9] maximum infections were reported in the age group of 61-80 years (10.7%) and the lowest number was found in the 21-40 years of age group (4.1%).

Preponderance of SSIs among diabetic patients was found to be more. Previous research found that patients with pre morbid disorders, such as diabetes mellitus, are at high risk of acquiring SSI because of their poor immunity. Diabetes causes vasoconstriction and affects circulation of tissue leading to local tissue hypoxia [10]. Incidence of SSIs was found to be high among smokers compared to non smokers. Tobacco chewing was also found to be one of the predisposing factors. Several studies have shown association of tobacco consumption and increased risk of SSI [11].

In our study, the incidence of SSIs were higher among patients undergone elective than emergency surgeries. In elective cases, the higher statistics may be attributed to the longer operating duration associated with major surgeries. This result conflicts with the findings taken from the bulk of studies contrasting general elective and emergency procedures, suggesting that the frequency of emergency surgery is higher [12, 13] Just a few studies have seen a greater SSIs rate among patients undergone elective surgery [14, 15].

In the present study, *Staphylococcus aureus* was found to be the common bacteria isolated from the wounds of surgical site infections and accounted for 45(33.83%). Our study results are similar to the previous studies [16]. As per CDC, [17] *S. aureus*, CoNS, and *E. coli* were the most prevalent organisms associated with surgical wound infections. The disparity in the pattern of dissemination of bacterial isolates in various settings may be due to the research population variability and local antimicrobial usage trend resulting in the proliferation of pathogens that actually have the ability to withstand antibiotics.

The overall average bacterial spectrum (*S. aureus*, *E. coli*, *Klebsiella* species, *P. aeruginosa* and *Proteus* species in the present study is similar to the studies conducted by previous researchers [18]. Methicillin resistant *Staphylococcus aureus* strains was isolated and accounted for 44.22% among *S. aureus* strains. Previous study from the same institution reported 23.47% of MRSA from wound infections [19]. Incidence of MRSA isolation was broadly ranged from 15.7% - 63.5% as per previous data [20].

A big difference in the occurrence of MRSA will rely on the pre- and post-operative antibiotic policies and surveillance systems that exist in various settings. The incidence of MRSA in male patients with SSI was found to be greater than that of female patients. Majority of MRSA strains were isolated from diabetic patients. Reducing immunity, low curing power, enhanced catabolism and the present state of co-morbid diseases make the elderly population more susceptible to SSI [21].

In the present study, no vancomycin resistant strains were reported. This is similar previous study conducted by Nazeer *et al*. [19] In a study from Northern India, six (0.76%) VISA strains and two (0.25%) VRSA strains were reported.21 Next to Vancomycin, majority of MRSA strains were susceptible to Augmentin (84.21%) and Piperacillin tazobactum (78.95%).

Conclusion

In the present study, overall surgical site infection rate was 17.98%. *Staphylococcus aureus* was found to be the most common bacterial pathogen isolated from SSIs. MRSA is a key problem, since there are limited treatment options for such resistant strains. The aggregation of regional SSI data and reviews are crucial issues about the development of a suitable guideline for peri-operative antibiotic prophylaxis to reduce the hospital SSI rate

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