Profile of Bacterial Pathogens in Surgical Site Infections and their Antibiogram in a Tertiary Care Hospital in Southern India.

ABSTRACT

Background: Surgical site infection (SSI) is a common complication following surgery, contributing significantly to post-operative morbidity and mortality. This study aims to identify the microorganisms responsible for SSIs and assess their antimicrobial susceptibility patterns.

Material and Methods:400 pus samples from suspected cases of surgical site infections were processed in accordance with Standard Microbiological Protocols. Utilising the Modified Kirby-Bauer disc diffusion method, the antibiotic susceptibility of the positive cultures was determined as per CLSI guidelines.

Results: Out of the 400 samples processed, 180 samples showed growth in culture. Male patients had greater culture positivity (57.5%). *Klebsiella pneumoniae* accounted for 58% of all Gram-negative isolates, followed by *E.coli* (32%). *Staphylococcus aureus* (10%) was the sole isolate that was Gram-positive. The majority of Gram-negative were susceptible to Imipenem, Meropenem, Piperacillin/Tazobactam. Linezolid and Clindamycin were effective against the majority of Gram-positive isolates.

Conclusion: Gram-negative bacilli were the most common pathogens in surgical site infections in our hospital area. To reduce the burden of SSI,a periodic examination of pathogenic organisms and their pattern of antibiotic susceptibility is required.

Keywords – Surgical site infection, Bacterial pathogens, Antibiotic sensitivity

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INTRODUCTION

Surgical site infections (SSIs) persist as a significant cause of postoperative mortality and morbidity worldwide, inspite of great advancements in antimicrobial prophylaxis, aseptic procedures, and surgical techniques. These infections are characterised as those that develop near or at the surgical site in 30 days after the surgery, or upto a year if a prosthetic material was implanted.[1] SSIs are the third most frequently reported healthcare-associated infections (HAIs) and they significantly worsen patient suffering, prolong hospital stays and increase healthcare expenses. [2]

The prevalence of SSIs varies greatly by different regions, healthcare settings, and surgical specialties, with rates ranging from 2.5% to over 30% in low- and middle-income countries. [3] The risk of SSI are influenced by a number of factors, including the patient's immunological status, cormorbidities, type and duration of surgery, operating room environment, and compliance to infection prevention protocols.[4]

There are two types of microbial contamination of the surgical wound: Exogenous, which is brought in by the surgical environment or staff, and Endogenous, which originates from patient's own flora. A wide variety of pathogens, such as *Staphylococcus aureus, E.coli, Klebsiella,* and other Gram-negative bacilli are linked to SSIs.[5,6] The management of SSIs has become more challenging due to rise of multidrug-resistant (MDR) bacteria, including those that produce carbapenemase and extended spectrum β-lactamase (ESBL).[7]

The growing prevalence of antibiotic resistance (AMR) is a significant obstacle for clinicians since empirical treatment may not be effective without the knowledge of local antibiogram.[8] To ensure effective treatment and improve antimicrobial stewardship, it is crucial to continuously monitor the bacteriological profile and antimicrobial susceptibility patterns of SSI infections.

The goal of this investigation was to identify the prevalent bacterial pathogens associated with SSIs and determining their antibiotic susceptibility pattern in a tertiary care facility. The findings aim to inform targeted treatment strategies and contribute to the development of effective infection control and prevention protocols.

AIMS AND OBJECTIVES

1. To detect organisms causing SSI.
2. To assess the antimicrobial sensitivity pattern of isolated organisms.

MATERIAL AND METHODS

Study design and setting

A prospective observational study was conducted for a period of two years from January 2022 to December 2024. A total of 400 pus samples were collected from operation sites from clinically suspected cases of surgical site infections.

Inclusion criteria

1. Samples from postoperative patients of different surgical departments developing surgical site infection within 30 days or surgery or within a year in case of implant surgery.
2. All gender and age groups of patients were included

Procedure

All patients with clinically diagnosed SSIs had their pus or wound swabs collected under aseptic conditions and promptly delivered to the Microbiology department for evaluation. Following standard laboratory procedures, the samples were processed for direct microscopy, aerobic culture, and antibiotic susceptibility testing. Gram staining was performed on smears prepared from the swabs to identify bacterial morphology.

Samples were inoculated onto appropriate culture media, including Blood agar (BA), MacConkey agar (MAC), and Nutrient agar (NA). These plates are incubated aerobically at 37°C for 18 to 24 hours. After incubation, culture isolates were identified by biochemical reactions as per standard protocol. Antibiotic susceptibility testing was conducted on Mueller Hinton Agar using appropriate antibiotic discs, following Clinical and Laboratory Standards Institute (CLSI) guidelines.

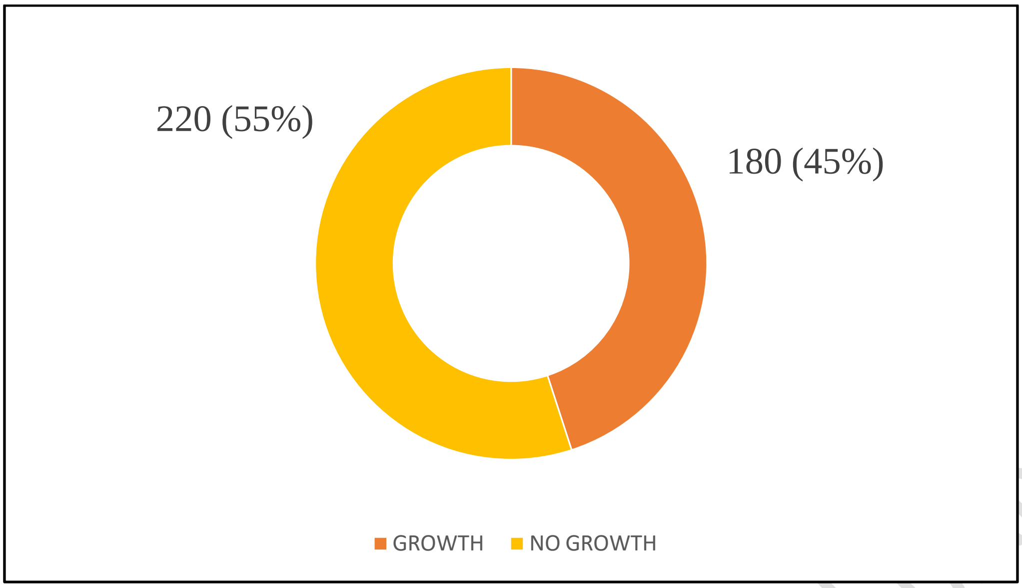
Statistical Analysis

The recorded observations were entered into Microsoft Excel spreadsheet and analyzed using suitable statistical methods. The results were expressed in terms of numbers and percentages.

RESULTS

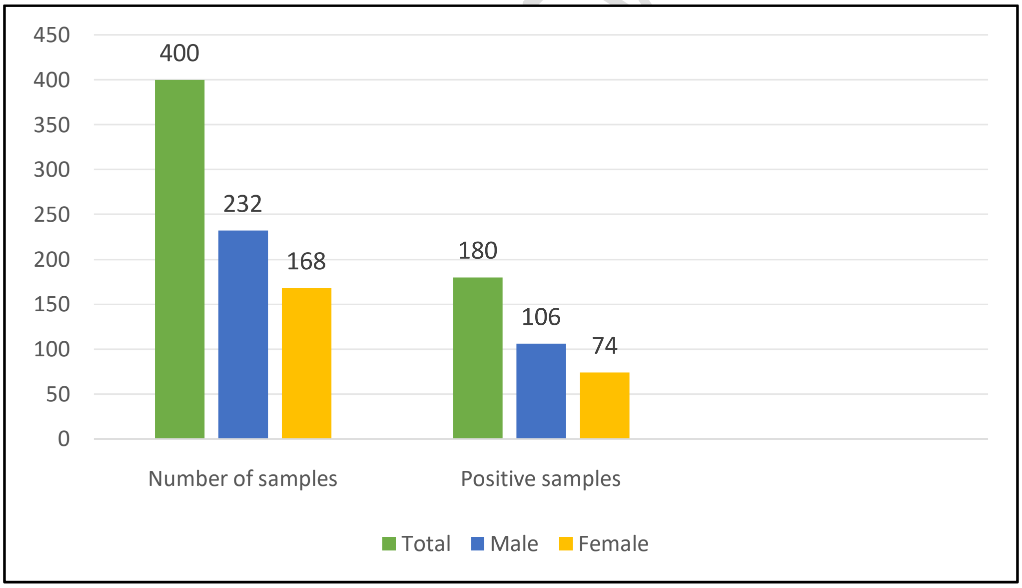
The study included a total of 400 patients with surgical site infections, comprising of 230 males (57.5%) and 170 females (42.5%). Out of the 400 samples collected, 180 (45%) demonstrated aerobic bacterial growth, whereas 220 (55%) showed no growth, as illustrated in Figure 1.

Figure 1. Ring diagram showing positive bacterial culture in study participants.



Out of the 180 culture positive samples, 106 (58.9%) were from male patients, while 74 (41.1%) were from female patients as seen in Figure 2.

Figure 2. Bar chart depicting the distribution of samples according to Gender.



The highest number of isolates was observed in patients aged above 60 years account for 65 isolates (36.2%), followed by 45 isolates (25%) in the 41-60 year age group, as shown in Figure 3.

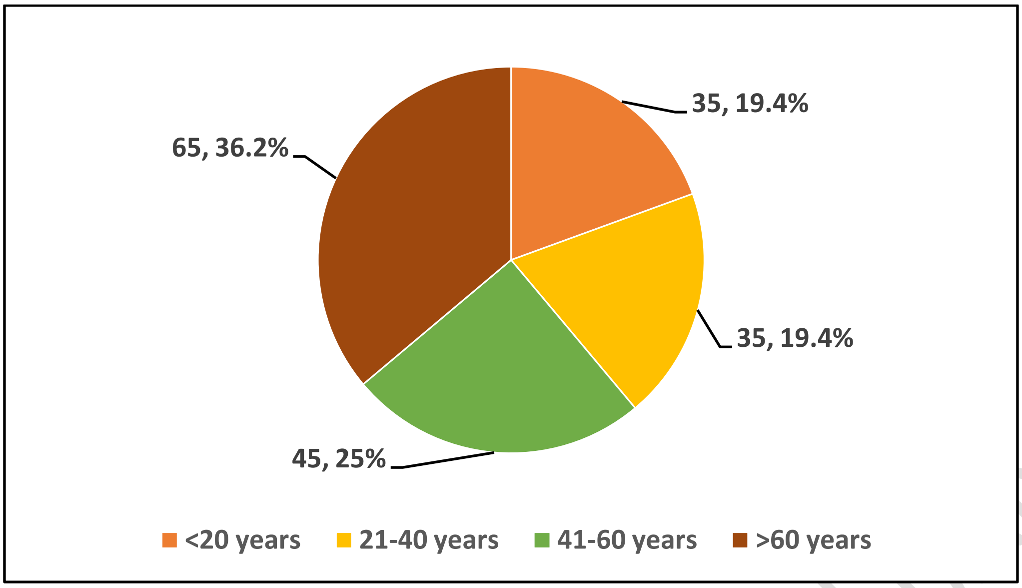


Table 1 shows the distribution of isolated organisms from the samples. It demonstrated that *Klebsiella* was the predominant isolate, with a total of 104 isolates, representing 57.8% of all the isolates analyzed. This was followed by *E.coli*, which accounted for 52 (28.9%) isolates. Additionally, *Staphylococcus* were identified in 24 isolates making upto 13.3% of the isolates.

Table 1. Distribution of isolated organism included in this study

Organism	Number	Percentage
Klebsiella	104	57.8%
E.coli	52	28.9%
Staphylococcus	24	13.3%

Linezolid showed maximum antibiotic sensitivity to Gram-positive isolates 15 (62.5%), followed by Clindamycin 13 (54.17%) and Amikacin 11 (45.83%). Cotrimoxazole and Erythromycin demonstrated sensitivities of 10 (41.67%) and 8 (33.3%) respectively. (Table 2)

Table 2. Antibiotic sensitivity pattern of Gram-positive isolates in SSI

Antibiotics	Gram-positive (N=24)
Vancomycin	3 (12.5%)
Erythromycin	8 (33.3%)

Clindamycin	13 (54.17%)
Amikacin	11 (45.83%)
Linezolid	15 (62.5%)
Cotrimoxazole	10 (41.67%)

When the antibiotic sensitivity of 156 Gram-negative isolates was analyzed, Imipenem showed the highest sensitivity with 143 (91.67%) isolates sensitive, followed by Meropenem with 138 (88.46%) sensitive isolates.

Table 3. Antibiotic sensitivity pattern of Gram-negative isolates in SSI

Antibiotics	Gram-negative (N=156)
Gentamicin	95 (60.90%)
Ceftazidime	90 (57.69%)
Ciprofloxacin	78 (50%)
Ofloxacin	78 (50%)
Tobramycin	78 (50%)
Meropenem	138 (88.46%)
Imipenem	143(91.67%)
Piperacillin/Tazobactam	113 (72.44%)
Cefaperazone/Sulbactam	107 (68.59%)
Ampicillin	28 (17.95%)

DISCUSSION

In the present study, aerobic bacterial growth was observed in 180 out of 400 SSI cases, yielding a culture positivity rate of 45%. This is comparable to a study by Patel P et al, which reported a culture positivity of 38% in SSI cases.[9]

A higher incidence of SSIs was noted among male patients (58.9%) compared to females (41.1%), a trend also reported by SJS Aghdassi et al., who found that male patients had a higher risk of developing SSIs across various surgical procedures. [10] Additionally, Boyle et al., reported gender-related differences in SSI pathogens, with gram-positive organisms more commonly isolates in males and gram-negative in females.[11]

Age-wise, the majority of infections were observed in patients aged above 60 years (36.2%), followed by those aged 41-60 years (25%). Age has been well established as a risk factor for SSI, with P Bischoff et al., reporting higher SSI rates in patients aged above 82 years undergoing hip and knee replacement surgeries.[12]

Microbiological analysis revealed that *Klebsiella* species as the predominant pathogen (57.8%), followed by *E.coli* (28.9%) and *Staphylococcus* species (13.3%). These findings are not in accordance with other studies.The studies of Negi V[13] and Khan AS[14]reveal *Staphylococcus aureus* as the most common pathogen in SSIs. However, in our study Gram-negative bacteria like *Klebsiella* and *E.coli* were the most common isolates. *Staphylococcus aureus* and *Pseudomonas* in SSIs suggest airborne contamination of the surgical wound, whereas gram-negative pathogens like *Klebsiella* and *E.coli* predominantly enter the surgical wound by fecal contamination. This emphasizes the need for proper skin preparation, exacting sterile technique, and suitable antibiotic prophylaxis, to stop gram-negative gut bacteria from infiltrating surgical wounds.

Among Gram-positive isolates, Linezolid showed the highest sensitivity (62.5%), followed by Clindamycin (54.17%) and Amikacin (45.83%). These results are consistent with previous studies that identified Linezolid as highly effective against resistant Gram-positive bacteria, including MRSA.[15]

For Gram-negative isolates, Imipenem demonstrated highest sensitivity (91.67%), followed by Meropenem (88.46%). Shah et al., similarly reported Carbapenems as the most effective agents against Gram-negative bacilli, with only 6% of isolates being resistant.[16]

In the present study of pathogens causing SSIs, majority of the gram-negative bacteria are resistant to all drugs including third-generation cephalosporins necessitating the need for combination drugs and carbapenems for the treatment of SSIs in our hospital area. This could be probably due to the irrational use of third generation cephalosprins for surgical antimicrobial prophylaxis. Strict adherence to surgical antimicrobial prophylaxis policy of the hospital which includes administering Cefazolin or Cefuroxime could prevent the resistance to third generation cephalosporins, thereby preventing multidrug-resistance in SSIs.

CONCLUSION

Proper skinpreparation, exacting sterile technique, and suitable antibiotic prophylaxis remain the key principles in preventing gram-negative gut bacteria from infiltrating surgical wounds. Irrational use of third generation cephalosporins for surgical antimicrobial prophylaxis could be the main factor contributing to drug resistance in treatment of SSIs. Surgical antimicrobial prophylaxis with first or second generation cephalosporins would help in combating multidrug-resistance in the treatment of SSIs.

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