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ORIGINAL ARTICLE

Scalpels Shadow: Unveiling the Burden of Surgical Site Infection in a Tertiary Care Centre

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ABSTRACT

Background: Surgical Site Infections (SSIs) are the third most commonly reported nosocomial infection, which has an adverse impact on the hospital as well as on the patient. Approximately 0.5% to 3% of patients undergoing surgery will experience infection at or adjacent to the surgical incision site. Compared with patients undergoing surgery who do not have a surgical site infection, those with a surgical site infection are hospitalized approximately 7 to 11 days longer[1]. This study aims to evaluate the prevalence of SSIs, identify associated risk factors, characterize the microbial etiology, and assess antimicrobial resistance patterns in a tertiary care hospital in South India. **Materials and Methods:** A prospective, observational study was conducted over one year (January-December 2023) at a tertiary care centre, South India. A total of 87 post-operative patients with clinically suspected SSIs were enrolled. Wound swabs and pus samples were collected and cultured. Bacterial isolates were identified using standard microbiological techniques. Antimicrobial susceptibility testing was performed using the Kirby-Bauer disk diffusion method by CLSI guidelines. **Results:** Among the 87 patients, positive culture growth was obtained in 62.07% of cases. The highest incidence of SSIs was noted in the 41-50 year age group (32.6%). SSIs were more common in males (68.6%) than in females. The majority of infections were associated with procedures from general Surgery (49%). *Staphylococcus aureus* was the most prevalent isolate (25.6%), followed by *Escherichia coli* (14.0%) and *Pseudomonas aeruginosa* (10.5%). Gram-positive isolates were uniformly sensitive to Tetracycline and Linezolid. Gram-negative organisms exhibited multidrug resistance, with the highest sensitivity noted to Carbapenems and Aminoglycosides. The overall SSI rate at the institution was 2.2%. **Conclusion:** This study underscores the continued burden of SSIs, particularly among general surgical patients. Early detection and targeted antimicrobial therapy, guided by local antibiograms, are essential. Rational antibiotic use and stringent infection control measures can significantly reduce SSI rates and improve patient outcomes.

Keywords: Surgical site infections; Multi-drug resistant Enterobacteriaciae; MRSA

INTRODUCTION

Surgical site infections (SSIs) are among the most prevalent complications following surgical procedures, representing a major component of nosocomial infections[2]. Each year, a significant amount of morbidity and mortality is caused by infection at or around the surgical site, which occurs within 30–90 days of an operative procedure (or within one year of an implant used)[3].

Despite improvements in surgical techniques, sterilization of instruments, operation theatre practices, and the best efforts of infection prevention practices, SSIs remain a major cause of hospital-acquired infections[4].These are further complicated by an increasing prevalence of multidrug-resistant organisms. Most of the time, it is the patient's endogenous flora that is responsible for many SSIs, and the commonly isolated pathogens include *Staphylococcus aureus*, coagulase-negative staphylococci, *Enterococcus* sp., and *Escherichia coli*[1].

However, the identification of factors that cause or predict these SSIs remains an important area of research. We aim to investigate the risk factors for SSIs, together with the identification of the etiological bacterial agents and their antimicrobial susceptibility in a tertiary hospital.

MATERIALS AND METHODS

A prospective, cross-sectional study was conducted for one year from January 2023 to December 2023 at a tertiary care centre, Mangalore.

Inclusion Criteria

Patients of all age groups and genders who developed clinical features suggestive of SSI within 30 days post-surgery.

Exclusion Criteria

Patients who underwent a second surgery at the same site for any reason, patients on immunosuppressant therapy or any known immunodeficiency disease, patients on antibiotics already for any other infections, and patients with infection elsewhere in the body were also excluded from the study.

Ethical Clearance

The study was carried out after getting ethical approval from the Institutional Research Board and Institutional Ethics Committee (DCGI Reg. No. ECR/348/Inst/KA/2013/RR-16). Informed and written consent was obtained from every study subject.

Sample Size and Sampling Method

A total of 87 patients were selected based on convenience sampling, using data from previous prevalence estimates to determine adequate sample size. The study included patients who underwent elective surgeries falling under clean and clean-contaminated cases with at least 7 days of hospital stay post-operatively, and who experienced signs and symptoms such as redness, pain, swelling around the surgical site, tenderness over the site, fever, and delayed healing.

Sample Collection and Processing

Wound swabs and pus aspirates were collected under sterile conditions and transported promptly to the microbiology laboratory. Samples were inoculated on Blood Agar, MacConkey Agar, and Nutrient Agar and incubated aerobically at 37°C for 18-24 hours.

Identification and Sensitivity Testing

Interpretation of the cultures and identification of the organisms was done as per standard protocol[5], and antibiotic sensitivity was done using Kirby–Bauer disc diffusion method. Sensitivity patterns of the isolates are recorded as per Clinical and Laboratory Standards Institute (CLSI) guidelines[6].

RESULTS

In the present study, 87 clinically diagnosed cases of SSIs were studied for one year (January 2023 to December 2023) in all age groups and sexes. Based on age-wise and gender wise distribution out of 87 samples (Table 2), 59 (68.6%) were males and 28 (31.4%) were females. Among 87 cases, 32.6% were of the age group 41-50 Years, of which 16 (18.6%) were males and 12 (14.0%) females. The age group of 51-60 was showing 17 cases, of which 11 (12.8%) were males and 6 (7.0%) were females. On the other hand, the age group 31-40 years showed 13 cases. 0f which 10 (11.6%) were males and 3 (2.3%) were females. According to this data, the age group of 41-50 years showed a higher percentage (32.6%) of SSIs, and the incidence was higher in male than female patients (Figure 1).

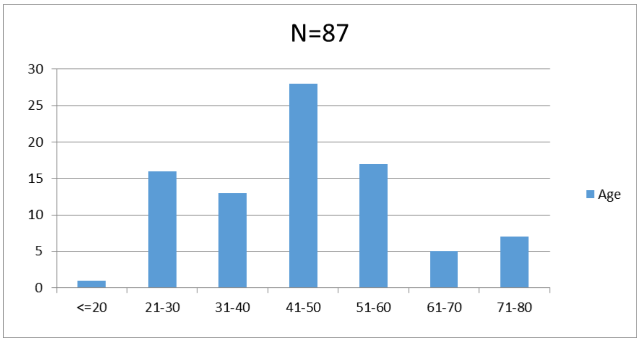

Fig. 1: Graph representing age wise distribution of the study participants

Out of 87 cases of Bacterial isolates, culture-positive cases were 54 (62.07%) and culture-negative cases were 33 (37.93%) (Figure 2).

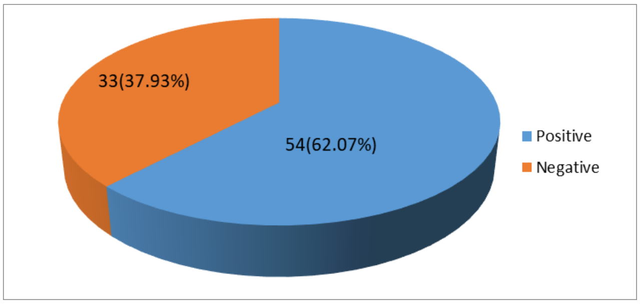

Fig. 2: Pie chart representing the gender wise distribution of the study participants

Staphylococcus aureus was the most predominant microorganism isolated (25.6%) followed by *E. coli* (14.0%) and *Pseudomonas* sp. (10.5%). Very few cases of *Enterobacter* (4.7%), *Klebsiella*, CoNS, and *Proteus* (2.3%) were reported. All microorganism isolates were tested for antimicrobial sensitivity testing and the results were interpreted according to standard value by CLSI6 (Table 1).

Table 1: Distribution based onthe microorganisms isolated

Microorganisms Isolated	Frequency	Percentage (%)
No growth	33	38.4
Staphylococcus aureus	23	25.6
E. coli	12	14
Pseudomonas	9	10.5
Enterobacter	4	4.7
Klebsiella	2	2.3
CoNS	2	2.3
Proteus	2	2.3
Total	87	100

Table 2: Types of surgical procedures with SSI

Type of Procedure	Number	Percentage
General surgery	40	49%
Plastic surgery	13	14%
Orthopaedics	10	11%
Obstetrics & Gynecology	10	11%
Cardiovascular	8	9%
Pediatrics	6	6%
Total	87	100%

The majority of the SSI patients (49%) were from General surgery (40 cases), most of which were abdominal surgeries. Plastic surgery was 13 cases (14%), Orthopedics and gynecology with each of 10 cases (11%), and cardiovascular with 9% cases. The minority of the surgeries (6%) were from Pediatrics (6 cases) (Table 2). Certain underlying conditions like anaemia, smoking with a history of tobacco chewing, with chronic cough, diabetes with obesity, and hypertension may alter or decrease the immune status, thus significantly increasing the risk of SSI. They are also an important cause of increasing the pre-operative stay of the patient, which steeply increases the risk of SSI in such patients. In our study, 7.6% of patients with SSI had some underlying conditions, anaemia and diabetes mellitus being the commonest.

Table 3: Antibiogram of Gram positive bacteria

Antibiotics	*Staphylococcus Aureus* (23)		CoNS (2)	
	Sensitive (%)	Resistant (%)	Sensitive (%)	Resistant (%)
Tetracycline	23(100%)	0(0%)	2(100%)	0(0%)
Linezolid	23(100%)	0(0%)	2(100%)	0(0%)
Clindamycin	19(82.60%)	4(17.39%)	2(100%)	0(0%0
Cefoxitin	18(78%)	5(22%)	2(100%)	0(0%)
Cotrimozazole	18(78%)	5(22%)	2(100%)	0(0%)
Erythromycin	17(73.90%)	6(26.09%)	0(0%)	2(100%)
Penicillin	0(0%)	23(100%)	0(0%)	2(100%)

Isolates of *Staphylococcus aureus* were found to be 100% sensitive towards Tetracycline and Linezolid, 23 (100%) and 5 isolates (22%) were reported as MRSA. CoNS were sensitive to most of the antibiotics, and no Methicillin-resistant strains were detected. CoNS was reported based on clinical correlation and discussion with the clinician (Table 3).

Among *E. coli*, 4 isolates (33%) were found to be ESBL producers and were sensitive towards Amikacin, Gentamicin, and Meropenem, and most of them were resistant to Ciprofloxacin and Tetracycline. Most of the Isolates of *Pseudomonas* (77.7%) were found to be maximally sensitive towards Imipenem, Meropenem, Ciprofloxacin, and other antibiotics but resistant (66.7%) to Cephalosporins (Table 4).

DISCUSSION

SSIs are the most common hospital-acquired infection and could be superficial, involving skin and subcutaneous tissue, or a serious infection involving deeper tissues, organs, or the implant itself[7]. In developing countries, the incidence rates of SSIs range from 1.2 to 23.6 per 100 surgical procedures[8]. Several studies across India have reported SSI rates ranging from 0.04–22.00%[9,10]. Our study reported 2.2% of SSIs, similar to a study by Trrisha et al[1]. A study by Sathyanarayan et al[11] showed a rate of 13.7% SSIs, which was much higher than our study.

The current study confirms that SSIs were predominantly seen in male patients, those in the 41-50 year age group. The finding obtained in the study of Nidhi Pal et al[12] found that the model age group was 31- 60 years with a frequency of 102 (49.5%) out of 206, which is similar to findings in our study. Male predominance could be attributed to occupational exposure, comorbidities, or lifestyle-related risk factors. The study conducted by Rama Bastola et al in New Delhi, India, also showed that out of 206 samples 65.04% were from males and 34.90% were from female patients[13].

In our study, the highest number of surgical site infection was from general surgery 40 (49%), followed by plastic surgery 13 (14%), 10 from orthopedics, obstetrics and gynecology (11%), 8 (9%) from cardiovascular surgery and 6 (6%) from pediatric surgery. A similar result was obtained in a study carried out by Chenna Krishna Reddy Chada et al[14] in Andhra Pradesh, who reported SSI of 41.18% from the general surgical ward, 32.6% from orthopedics & 26.4% from the gynecology ward. SSIs were common in abdominal surgeries from the general surgery and gynecology ward, which is similar to a study done by Allegranzi et al[15] who also reported that abdominal surgeries have high rates of SSIs due to contamination with endogenous flora.

In our study, among 54 culture-positive samples, 25 (29%) were Gram-positive and 29 (33.4%) were Gram-negative bacteria. A similar result was obtained by Akther MS et al, conducted in Mumbai, where *Staphylococcus*

Table 4: Antibiogram of Gram negative bacteria

Antibiotics	*E. coli* (n=12)		*Pseudomonas* (n=9)		*Klebsiella* (n=2)		*Proteus* (n=2)	
	S(S%)	R(R%)	S(S%)	R(R%)	S(S%)	R(R%)	S(S%)	R(R%)
Ceftazidime	8(67%)	4 (33%)	3(33.4%)	6(66.7%)	0	2(100%)	0	2(100%)
Ciprofloxacin	4(33.4%)	8(66.7%)	7(77.8%)	2(22.2%)	0	2(100%)	0	2(100%)
Gentamicin	12(100%)	0	5(55.6%)	4(44.5%)	0	2(100%)	0	2(100%)
Cefepime	10(50%)	2(50%)	6(66.7%)	3(33.4%)	0	2(100%)	0	2(100%)
Cefotaxime	8(67%)	4(33%)	7(77.8%)	2(22.2%)	0	2(100%)	0	2(100%)
Pip+Tazo	10(83.4%)	2(16.7%)	7(77.8%)	2(22.2%)	2(100%)	0	-	-
Imipenem	10(83.4%)	2(16.7%)	7(77.8%)	2(22.2%)	2(100%)	0	-	-
Meropenem	12(100%)	0	7(77.8%)	2(22.2%)	2(100%)	0	0	2(100%)
Co-trimozazole	10(83.4%)	2(16.7%)	-	-	2(100%)	0	0	2(100%)
Amikacin	12(100%)	0	7(77.8%)	2(22.2%)	2(100%)	0	0	2(100%)
Tetracycline	5(41.7%)	7(41.7%)	-	-	2(100%)	0	0	2(100%)
Ampicillin	4(33.4%)	8(66.7%)	-	-	0	2(100%)	0	2(100%)

Table 5: SSI rate in our hospital

Month	No .of SSI	Major+Minor Surgery	Total	Number of SSI/Total Surgery X 100	SSI Rate
JAN-MAR	21	583+357	940	21/940 x100	2.3%
APR-JUNE	19	663+206	869	19/869 x100	2.2%
JLY-SEP	23	724+101	825	23/825 x100	2.7%
OCT-DEC	24	998+84	1082	24/1082 x100	2.2%

aureus, Escherichia coli, and Klebsiella sp. were the most common organisms[16]. In the present study, the most common pathogen was Staphylococcus aureus (25.6%), followed by *E. coli* (14%), *Pseudomonas species* (10.5%), *Enterobacter* (4.7%), *Klebsiella*, CoNS, and *Proteus* each of (2.3%). *Staphylococcus aureus* has been the most common organism isolated from SSI over the decades and across the continent. In a study carried out by T. Gridhar et al[17] in Kadapa, *Staphylococcus aureus* was the commonest organism, accounting for 22% of all isolates.

Our study showed *Staphylococci* 100% sensitive to Tetracycline and Linezolid, and all isolates were resistant to Penicillin. This is similar to the study findings by Mundhada and Tenpe[18]. Out of 23 isolates, 5 (22%) were reported as MRSA, similar to a study by Bhattacharya.S et al in West Bengal[18].

Gram-negative bacteria are multidrug-resistant Enterobacteriaceae, which display a high magnitude of resistance to multiple antibiotics. In our study *E. coli* showed 33% resistance to β-lactam antibiotics (ESBL producers), and both the isolates of *Klebsiella* species showed 100% resistance to β-lactam antibiotics (ESBL producers). Among them, *E. coli* and *Klebsiella* species were 100% sensitive to Carbepenems and Aminoglycosides, but *Proteus* species were resistant to Carbepenem and Aminoglycosides. This was similar to the study of Shahane V et al, where the Enterobacteriaceae showed very low sensitivity to cephalosporins and fluoroquinolones (10% and 58%, respectively). This could be due to the overuse of these drugs and the high prevalence of extended-spectrum beta-lactamases (ESBLs) among these organisms[19]. Multi-drug resistant *Klebsiella* and carbapenem-resistant *Klebsiella* are important hospital pathogens causing SSI.

CONCLUSION

This study highlights that surgical site infections, though relatively controlled in incidence (2.2%), continue to pose a challenge due to evolving microbial profiles and resistance patterns. The predominance of *S. aureus*, followed by *E. coli* and *Pseudomonas aeruginosa*, necessitates targeted prophylactic and therapeutic interventions.

Key recommendations include:

- Implementation of strict pre- and post-operative asepsis.
- Use of tailored, evidence-based antibiotic prophylaxis.
- Routine microbiological screening and antibiogram generation.
- Continuous staff training on infection prevention practices.

Reducing the burden of SSIs through these interventions will significantly improve surgical outcomes and optimize healthcare resources.

DISCLOSURE

Competing Interest

None.

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None.

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