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Clinico-Bacteriological Profile of Surgical Site Infections in a Tertiary Care Hospital - A Cross-sectional study

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Abstract

Background : SSI is a prevalent issue that raises healthcare expenditures by extending hospital stays and increasing morbidity and mortality. Based on Statistics from the National Nosocomial Infections Surveillance (NNIS) system, SSI ranks third accounting for 14–16% of all infections related to medical care among hospitalized patients. The current study is conducted with the aim to assess the prevalence of SSI and its associated risk factors among patients to provide a better understanding of microbial pathogens prevailing in our institute.

Materials and methods: A hospital based cross sectional study was conducted for a period of six months in the Department of Microbiology, SABVMCRI, Bengaluru. A total of 200 samples were collected from patients of Orthopedics and Surgery.

Results : The study included a total of 200 surgical procedures, of which 140 were from The Department of General Surgery and 60 from The Department of Orthopedics. 9 patients developed surgical site infections (SSI), giving an overall infection rate of 4.5%. The SSI rate was 4.3% in General Surgery and 5.0% in Orthopedic surgery. E. coli and Klebsiella pneumoniae were the most common organisms isolated from the cases. The rate of infection was higher in clean- contaminated wounds compared to clean wounds. Prolonged pre-operative stay and longer duration of surgery were found to be important risk factors.

Conclusion : The present study observed an overall surgical site infection (SSI) rate of 4.5% among 200 patients, which falls within the range reported by other Indian studies.

Keywords: Clean contaminated wound, Clean wound, Surgical site infections (SSI)

Introduction

Surgical site infections (SSIs) remain a major cause of preventable morbidity and mortality in postoperative patients. They significantly prolong hospital stay, increase treatment costs, and add to the burden on healthcare systems, particularly in developing countries [1,2]. According to the World Health Organization (WHO), SSIs account for a considerable proportion of healthcare- associated infections, with much higher rates reported in low- and middle-income nations compared to high-income regions [2]. Despite strict aseptic precautions and prophylactic antibiotic use, infection rates remain high in many tertiary hospitals. The Centre for Disease Control and Prevention (CDC) recommends evidence-based preventive strategies and continuous surveillance to control these infections effectively [1]. However, the pattern of infection and microbial causes may vary with surgical category, hospital environment, and local antibiotic practices, emphasizing the need for institutional data. The bacterial spectrum of SSIs has changed over time, with both Gram-positive and Gram- negative organisms now being important contributors. Staphylococcus aureus continues to be the most frequent isolate from clean wounds, while organisms such as Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter species are commonly detected in contaminated procedures (3,4). Increasing multidrug resistance among these pathogens has become a serious global concern, limiting the choice of effective antibiotics (4,6). Studies from India and other developing regions have documented diverse microbial profiles and resistance patterns, reflecting differences in infection control and antimicrobial use (3,5). In this context, the present study aims to analyse the clinico-microbiological pattern and antibiotic susceptibility profile of pathogens causing SSIs in a tertiary care hospital, to support better empirical therapy and strengthen infection-prevention measures.

Aims And Objectives:

1. To determine the proportion of Surgical Site Infections in a tertiary care hospital
2. To compare incidence of Surgical Site Infections in clean and clean contaminated surgery
3. To study the risk factors (Type II Diabetes Mellitus, Hypertension, duration of pre-operative stay, duration of surgery) associated with Surgical Site Infections
4. To study the microbial flora associated with Surgical Site Infections

Materials And Methodology

A Cross-sectional study was conducted in Microbiology Department of Shri Atal Bihari Vajpayee Medical College and Research Institute, Bangalore for a period of 5 months (April 2025 to August 2025)

Inclusion Criteria: Samples collected from patients who had undergone clean and clean contaminated surgeries from departments of Orthopedics and General Surgery were included for the study. The surgical wound was inspected, classified and diagnosed as SSI based on the Centre for Disease Control and Prevention (CDC) definition of nosocomial surgical site infections [1]

Clean surgeries (class I): A non-traumatic, elective procedure where respiratory, gastrointestinal, biliary or genitourinary tract were not entered was considered as a clean wound.

Clean-contaminated surgeries (class II): An elective opening of the respiratory, gastrointestinal, biliary or genitourinary tract was considered a Clean contaminated wound.

Exclusion Criteria

1. Patients with incomplete history or incomplete surgeon's notes during intra operative period
2. Stitch abscess
3. Patients who are unwilling to give consent for the study
4. Antibiotic coated implants

Procedure [6,7]

Swabs were collected from 200 patients and processed by standard microbiological procedure if any one of the criteria were fulfilled

1. Serous or non-purulent discharge from wound
2. Pus discharge from wound
3. Signs of inflammation: edema, redness, increased local temperature, fever>38C, tenderness
4. Incision deliberately opened by surgeon

Specimen Collection [7]

Two sterile cotton swabs were used to collect the sample from the wound. Normal saline was used to wash the wound prior to collection of swabs to remove contaminating materials like debris, dried exudates and dressing residue. The suspected wound infections were cleaned with sterile normal saline, followed by 70% alcohol, and then the specimen was collected using a sterile swab. Two swabs were taken from the depth of the wound, and the aspirates were collected in a sterile disposable syringe and transported to the laboratory within two hours. If the wound is dry, then the swab tip was moistened with sterile saline. Care was taken that the swab only came into contact with the wound and not the surrounding skin. Tip of the swab was applied to the wound with gentle pressure and rotated between fingers while zig-zagging across the entire wound.

Processing Of Specimen

A smear was prepared from one swab which was stained by Gram stain and findings are to be recorded. Second swab taken was plated on 5% sheep Blood agar (BA) and MacConkey agar (MA). The plates would be incubated aerobically at 37˚C for 18 to 24 hours. Organisms were identified using Gram stain

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characteristics, colony characteristics and biochemical reactions as per standard guidelines.

Antimicrobial Susceptibility Testing

The organisms isolated was subjected to antimicrobial susceptibility using the Modified Kirby- Bauer disc diffusion method on Muller Hinton agar according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Statistical Analysis

The data obtained was entered in Microsoft Excel (Microsoft Corp., Redmond, WA), and the results were analyzed using SPSS (Statistical Package for the Social Sciences) version 30 (IBM Corp., Armonk, NY). The association between risk factors and the presence of SSI was assessed using the Chi-square test. With a 95% confidence interval, a p-value of less than 0.05 is considered statistically significant.

Results

Out of 200 patients included in the study, the maximum belonged to the age group of 21–30 years (38%) followed by 31–40 years (19%). There were 120 males (60%) and 80 females (40%). The study was conducted over a period of five months (April 2025 to August 2025). A total of 200 surgical procedures were included, of which 140 were from the General Surgery department and 60 from Orthopedics. Among the total surgeries, 75 (37.5%) were clean and 125 (62.5%) were clean-contaminated. Surgical site infection was noted in 3 (4%) of clean operative wounds and 6 (4.8%) of clean- contaminated wounds. (Table 1).

Of the total 200 patients, 9 developed surgical site infections (SSI), giving an overall infection rate of 4.5%. The SSI rate was 4.3% in General surgery and 5.0% in Orthopedic surgery (Table 2).

Table 1: Distribution of surgical site infections according to wound classification

	Total cases operated	SSI Detected
Clean Wounds	**75**	**3(4%)**
Clean Contaminated wounds	**125**	**6(4.8%)**

Table 2: Department wise distribution of cases

DEPARTMENT	No. of cases operated	No. of cases with SSI	SSI Rate
General Surgery	**140**	**6**	**4.3%**
Orthopedics	**60**	**3**	**5%**
Total	**200**	**9**	**4.5%**

Of the 9 infected cases, Escherichia coli and Klebsiella pneumoniae were the most common organisms isolated (33.3% each), followed by Staphylococcus aureus (22.2%) and Pseudomonas aeruginosa (11.1%) (Table 3).

Table 3: Organisms Isolated from infections

ORGANISM	NO. OF ISOLATES	PERCENTAGE
Escherichia Coli	**3**	**33.3%**
Klebsiella Pneumoniae	**3**	**33.3%**
Staphylococcus aureus	**2**	**22.2%**
Pseudomonas aeruginosa	**1**	**11.1%**

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Table 4: Risk factors associated with Surgical Site Infections

Risk factors	No. of Operated cases without SSI (N= 191)	No. Operated cases with SSI (N=9)
Diabetes	45 (23.5%)	2 (22.2%)
Hypertension	40 (20.9%)	1 (11.1%)
Pre-operative stay		
(a)0-2 days	70(36.6%)	1 (11.1%)
(b)3-5days	56 (29.3%)	2 (22.2%)
(c)6-8 days	45 (23.5%)	2 (22.2%)
(d)>8 days	20 (10.4%)	4 (44.4%)
Duration of Surgery		
(a) Less than 2 hours	120 (62.8%)	4 (44.4%)
(b) More than 2 hours	71 (37.1%)	5 (55.5%)

Table 5: Surgical Site Infection Rate reported by various authors

Author	Overall SSI rate	Clean	Clean Contaminated
Kochhal et al (7)	6%	4.65%	7.02%
Lilani SP et al. (9)	8.95%	3.03%	22.41%
Shahane V et al (10)	6%	4.6%	8%
Singh RR et al (11)	6%	6%	-
More SR et al. (12)	13.57%	7.73%	14.43%
Suchitra J B et al (13)	12%	-	-
Aniruddha S et al. (14)	32%	17.65%	39.39%
Kokate SB et al. (16)	5.44%	-	-
Shah KH et al. (17)	3.38%	2.25%	2.2%

Among patients with SSI, 22.2% were diabetic compared to 23.5% among those without SSI. 11.1% of SSI cases were hypertensive patients compared to 20.9% among non-SSI cases.

Pre-operative hospital stay showed a trend toward higher SSI occurrence with increasing duration of stay. Only 11.1% of patients with SSI had a pre-operative stay of 0–2 days, compared to 36.6% in the non-SSI group. higher proportion of SSI cases were seen in patients with prolonged pre-operative stay of more than 8 days (44.4%) compared to 10.4% among patients without SSI.

Analysis of duration of surgery as a risk factor showed, 55.5% of SSI cases underwent procedures lasting more than 2 hours, whereas only 37.1% of non-SSI patients had surgeries exceeding 2 hours. Conversely, surgeries lasting less than 2 hours were more common in patients without SSI (62.8%) compared to those with SSI (44.4%).

Overall, prolonged pre-operative hospital stay and longer duration of surgery were more frequently associated with surgical site infections (Table 4).

Discussion

The present study showed an overall surgical site infection (SSI) rate of 4.5% among 200 patients, which is relatively lower than those reported by other Indian studies. Similar rates have been noted by Kochhal et al [7] (6%), Shah KH et al. [17] (3.38%), Kokate SB et al. [16] (5.44%), and Shahane V et al [10] (6%), whereas higher rates were documented by More SR et al. [12] (13.57%) and Aniruddha S et al. [14] (32%). different study design, sample size, type of surgical procedure done and infection control practices of the hospital could be the reason for such variation

Based on the results of the present study, the prevalence of surgical site infection was 4.0% in clean wounds and 4.8% in clean-contaminated wounds. These findings are lower than those of Lilani SP et al. [9] (3.03% and 22.41%) and more than SR et al. [12] (7.73% and 14.43%) but closely align with the results of Shah KH et al. [17] (2.25% and 2.2%) and Kochhal et al [7] (4.65 and 7.02%). strict adherence to aseptic procedures, judicial use of prophylactic antibiotics, and effective postoperative wound care are likely the reason for lower values.

department-wise analysis showed that infection was slightly higher in orthopedic surgeries (5%) than in general surgeries (4.3%). The use of prosthetic implants and longer duration of surgery in orthopedic surgeries play a role in increasing the risk of infection.

Bacteriological analysis of infected wounds revealed Escherichia coli and Klebsiella pneumoniae as the most frequent isolates (33.3% each), followed by Staphylococcus aureus (22.2%) and Pseudomonas aeruginosa (11.1%). Several recent studies showed an increase in gram negative isolates, indicating a gradual shift in the microbial profile of surgical site infections. This change could be due to increased antibiotic exposure, change in endogenous flora, and the evolving antibiotic resistance among hospital pathogens.

Overall, both Klebsiella pneumoniae and Escherichia coli were 95% sensitive to Imipenem, 70% to Amikacin, 60% to Ciprofloxacin and Cotrimoxazole. Pseudomonas aeruginosa was more sensitive to Imipenem and Piperacillin- Tazobactam. Methicillin sensitive Staphylococcus aureus was sensitive to Gentamicin and vancomycin.

The certain patient based or hospital based risk factors may influence the occurrence of surgical site infections, which could not be confirmed due to a small sample size. A significant number of patients with type 2 diabetes mellitus developed surgical site infection, indicating a possible association related to altered host defense mechanisms and delayed wound healing. In contrast, hypertension showed no variation between infected and non-infected groups, implying no direct relationship with SSI risk in this sample.

SSI incidence was higher in patients with longer pre-operative hospital stay (more than eight days prior to surgery). Prolonged hospital stay may cause exposure to nosocomial pathogens, increasing the risk of colonization by drug resistant organisms. Reduced patient immunity adds to increased risk of infection. Additionally, surgeries with more than two hours time span were associated with a higher proportion of SSI, potentially due to prolonged tissue exposure, reducing prophylactic antibiotic saturation and higher risk of breach in aseptic technique. These trends emphasize the importance of pre-operatively patient preparation, avoiding unnecessary hospital stay, and reducing duration of operation to lower the risk of surgical site infections.The present findings reaffirm that the class of wound remains an important determinant of infection risk, with a higher tendency for SSIs in clean-contaminated wounds compared to clean wounds. Regular monitoring of infection rates, active surveillance of microbial patterns, and stringent enforcement of infection prevention measures are essential to maintain low SSI rates and improve surgical outcomes.

Conclusions

The results of the present study indicate a lower percentage of surgical site infections compared to other similar studies which is indicative of effective infection control practices of the hospital. The study is however, limited by its cross-sectional design,

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variation of infection rates or information bias. E. coli and Klebsiella pneumoniae were the most common organisms isolated from the cases. Prolonged pre-operative stay and longer duration of surgery were found to be important risk factors. A significant association was noticed with type 2 diabetes mellitus but none with hypertension.

References

1. Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. JAMA Surg. 2017;152(8):784-91.
2. World Health Organization. Global Guidelines for the Prevention of Surgical Site Infection. 2nd ed. Geneva: World Health Organization; 2018.
3. Narula H, Singh V, Gupta A, Sharma M et al. A prospective study on bacteriological profile and antibiogram of surgical site infections in a tertiary care hospital. Int J Res Med Sci. 2020;8(5): 1746-1751
4. Worku S, Derbie A, Teshager L, et al. Bacterial profile of surgical site infection and antimicrobial resistance patterns in a tertiary hospital. Ann Clin Microbiol Antimicrob. 2023; 22:32.
5. Abiodun AA, Akingbade OA, Ogiogwa JI, et al. Microbial profile of surgical site infections and antibiotic susceptibility in a tertiary hospital. BMC Infect Dis. 2023; 23:457.
6. Collee JG, Mackie TJ, McCartney JE, Fraser AG, Marmion BP, Simmons A, editors. *Mackie & McCartney Practical Medical Microbiology.* 14th ed. Elsevier; 1996. ISBN: 9788131203934.
7. Kochhal N, Dangre Mudey G, Choudhari SZ. A study of clinico-microbiological profile of surgical site infections in a tertiary care hospital. International Journal of Advances in Medicine, 2019; April 6(2):324-329.
8. Palikhey A, Sharma S, Acharya A, et al. Multidrug resistance among patients with surgical site infections in a tertiary care centre. PLoS One. 2023;18(6): e0287654.
9. Lilani SP, Jangale N, Chowdhary A. Surgical site infection in clean and clean-contaminated cases. Ind J Med Microbiol. 2005;23(4):249-52.
10. Shahane V, Bhawal S. Surgical site infections: A one-year prospective study in a tertiary; care center. Int J Health Sciences (Qassim University). 2012;6(1):79-84.
11. Singh RR, Bansal DB, Deb KS, Aggarwal A, Puar GS. Bacteriological profile and antimicrobial susceptibility in Surgical Site Infections in elective abdominal surgeries. Int J Res Health Sci. 2014;2(1):331-334.
12. More SR, Kale CD, Shrikhande SN, Rathod VS. Bacteriological Profile of surgical site infection among postoperative patients at a tertiary care centre in Nanded. Int J Adv Res. 2015;3(11):1060-1066.
13. Suchitra JB, Lakshmidevi N. Surgical site infections: Assessing risk factors, outcomes and antimicrobial sensitivity patterns. African J Microbiol Res. 2009;3(4):175-179.
14. Aniruddha S. Mundhada, Tenpe S. A study of organisms causing surgical site infections and their antimicrobial susceptibility in a tertiary care Government Hospital. Ind J Patho Microbiol. 2015;58(2):195-200.
15. Negi V, Pal S. Bacteriological Profile of Surgical Site Infections and Their Antibiogram: A Study from Resource Constrained Rural Setting of Uttarakhand State, India. J Clin Diagn Res. 2015;9(10): DC17-20.
16. Kokate SB, Rahangdale V, Katkar VJ. Study of Bacteriological Profile of Post Operative Wound Infections in Surgical Wards of a Tertiary Care Hospital. Int J Contemp Med Res. 2017;4(1):77-83.
17. Shah KH, Singh SP, Rathod J. Surgical site infections: incidence, bacteriological profiles and risk factors in a tertiary care teaching hospital, Western India. Int J Med Sci Public Health. 2017;6(1):173-176

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