Online ISSN: 2250-3137
Print ISSN: 2977-0122

ORIGINAL RESEARCH

A study on Surgical site infections and Antibiotics sensitivity pattern of pathogens at a tertiary care hospital

Dr. Priyanka Sharma

Assistant Professor, Department of Microbiology, K.D. Medical College Hospital and Research Centre (KDMCH), Mathura, Uttar Pradesh, India

Corresponding Author
Dr. Priyanka Sharma
Assistant Professor, Department of Microbiology, K.D. Medical College Hospital and Research Centre (KDMCH), Mathura, Uttar Pradesh, India
Email: drpriya2006@gmail.com

Received: 10 March, 2019 Accepted: 14 April, 2019

ABSTRACT
Aim: Surgical site infections (SSIs) are a major cause of morbidity and prolonged hospital stays, often complicated by antimicrobial resistance. This study aims to determine the prevalence of SSIs, identify the causative pathogens, and analyze their antibiotic susceptibility patterns in a tertiary care hospital. **Material and Methods:** This prospective study was conducted in the Department of Microbiology at K.D. Medical College Hospital and Research Centre (KDMCH), Mathura, Uttar Pradesh. A total of 120 patients with SSIs were included, and samples were collected using sterile swabs or aspirates. The isolates were identified using standard microbiological techniques and tested for antibiotic susceptibility using the Kirby-Bauer disc diffusion method as per Clinical and Laboratory Standards Institute (CLSI) guidelines. Resistance patterns, including methicillin-resistant *Staphylococcus aureus* (MRSA), extended-spectrum beta-lactamase (ESBL), and carbapenemase production, were also analyzed. **Results:** The highest incidence of SSIs was observed in the 41-60 years age group (37.50%), with general surgical procedures being the most affected (41.67%). *Staphylococcus aureus* (33.33%) and *Escherichia coli* (25.00%) were the predominant isolates. Antibiotic susceptibility testing revealed high resistance to amoxicillin (70.00%) and ceftriaxone (50.00%), while meropenem exhibited the highest sensitivity (90.00%). Multidrug-resistant organisms were identified, including MRSA (12.50%), ESBL producers (16.67%), and carbapenemase-producing bacteria (8.33%). **Conclusion:** The study highlights the burden of SSIs and the rising challenge of antimicrobial resistance, particularly among *Staphylococcus aureus* and *Escherichia coli*. High resistance rates to commonly used antibiotics necessitate the implementation of antimicrobial stewardship programs and stringent infection control measures. Continuous surveillance of pathogen resistance patterns is crucial for guiding effective empirical therapy and improving patient outcomes.
Keywords: Surgical site infections, *Staphylococcus aureus*, antibiotic resistance, MRSA, antimicrobial stewardship

INTRODUCTION
Surgical site infections (SSIs) are among the most common healthcare-associated infections, posing a significant burden on both patients and healthcare systems worldwide. These infections occur at or near the surgical incision within 30 days of surgery or within a year if an implant is placed. SSIs lead to prolonged hospital stays, increased morbidity, higher healthcare costs, and in severe cases, mortality. The risk of developing an SSI depends on multiple factors, including the type of surgery, patient's immune status, presence of comorbidities, surgical technique, and adherence to infection control measures.[1]The increasing prevalence of SSIs has been attributed to a combination of factors such as microbial contamination during surgery, improper sterilization techniques, and the rise of antibiotic-resistant pathogens. Despite advancements in surgical techniques and infection prevention strategies, SSIs remain a persistent challenge in both developed and developing countries. They contribute significantly to postoperative complications, often leading to wound dehiscence, abscess formation, and systemic infections such as sepsis. Given their impact on patient recovery and hospital resource utilization, there is a critical need for ongoing surveillance and effective preventive strategies to minimize SSIs.[2]Microbial pathogens responsible for SSIs vary based on the type of surgery and hospital settings. Common causative agents include *Staphylococcus*

aureus, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, and *Proteus* species. Among these, *Staphylococcus aureus* is one of the most frequently isolated organisms, particularly in clean surgical procedures. Gram-negative bacteria such as *E. coli* and *Klebsiella pneumoniae* are commonly associated with gastrointestinal and urological surgeries. The emergence of multidrug-resistant organisms, including methicillin-resistant *Staphylococcus aureus* (MRSA), extended-spectrum beta-lactamase (ESBL)-producing *E. coli* and *Klebsiella pneumoniae*, and carbapenemase-producing bacteria, has further complicated the management of SSIs.The choice of prophylactic and empirical antibiotics plays a crucial role in preventing and treating SSIs. However, the irrational use of antibiotics has led to a surge in antimicrobial resistance (AMR), reducing the effectiveness of commonly used drugs. Resistance to beta-lactam antibiotics, fluoroquinolones, and aminoglycosides is increasingly reported in hospital settings, making the treatment of SSIs more challenging. Carbapenems, which were previously considered the last line of defense against resistant Gram-negative bacteria, are now facing growing resistance due to the emergence of carbapenemase-producing organisms. This highlights the urgent need for antimicrobial stewardship programs, which promote the judicious use of antibiotics to preserve their efficacy.[3]Several factors influence the development of SSIs, including patient-related and procedure-related factors. Patient-related factors include diabetes mellitus, obesity, smoking, malnutrition, immunosuppression, and prolonged preoperative hospital stay. Procedure-related factors such as the duration of surgery, improper aseptic techniques, contamination of surgical instruments, and failure to administer timely prophylactic antibiotics also contribute significantly to the occurrence of SSIs. Adherence to standard infection control measures, including proper hand hygiene, use of sterile techniques, and perioperative antibiotic prophylaxis, is crucial in minimizing SSIs.The economic burden of SSIs is substantial, as they lead to increased healthcare costs due to extended hospital stays, additional surgical interventions, and higher antibiotic consumption. Patients who develop SSIs require prolonged wound care, frequent dressings, and sometimes surgical debridement, all of which add to the cost of treatment. In low- and middle-income countries, the impact of SSIs is even more severe due to limited access to advanced healthcare facilities, inadequate infection control practices, and a higher prevalence of antimicrobial resistance. The implementation of cost-effective preventive measures, such as adherence to surgical safety checklists, maintaining sterile environments, and monitoring antibiotic use, can significantly reduce the incidence of SSIs and associated healthcare costs.[4]Given the rising burden of SSIs and the challenges posed by antibiotic resistance, continuous surveillance of SSI pathogens and their antimicrobial susceptibility patterns is essential. Monitoring local microbiological trends allows healthcare providers to develop targeted infection control policies and optimize antibiotic therapy. Hospital-based studies play a critical role in understanding the epidemiology of SSIs, identifying high-risk patient groups, and evaluating the effectiveness of existing prevention and treatment strategies.[5]This study aims to analyze the prevalence of SSIs and the antimicrobial susceptibility pattern of pathogens isolated from infected surgical wounds at a tertiary care hospital. By identifying the predominant bacterial isolates and their resistance patterns, the study seeks to provide valuable insights into the most effective antibiotics for SSI management. The findings will help guide empirical antibiotic therapy, improve infection control strategies, and contribute to reducing the incidence of SSIs in hospital settings.

MATERIAL AND METHODS

This prospective study was conducted in the Department of Microbiology at K.D. Medical College Hospital and Research Centre (KDMCH), Mathura, Uttar Pradesh. A total of 120 patients who developed surgical site infections (SSIs) after undergoing various surgical procedures were included in the study. Patients were selected based on clinical signs of infection such as redness, swelling, pain, discharge from the surgical wound, and fever. Samples were collected using sterile cotton swabs or aspirates from the infected surgical sites and were transported to the laboratory for microbiological analysis.

All specimens were processed for bacterial identification using standard microbiological techniques, including Gram staining, culture on appropriate media, and biochemical tests. The isolates were further subjected to antibiotic susceptibility testing using the Kirby-Bauer disc diffusion method as per Clinical and Laboratory Standards Institute (CLSI) guidelines. The antibiotics tested included commonly used drugs such as penicillins, cephalosporins, aminoglycosides, fluoroquinolones, and carbapenems. Methicillin-resistant Staphylococcus aureus (MRSA) detection was performed using cefoxitin disc diffusion, while extended-spectrum beta-lactamase (ESBL) and carbapenemase production were identified using phenotypic methods.

Demographic and clinical data of the patients, including age, sex, type of surgery, comorbid conditions, and duration of hospital stay, were recorded. The data were analyzed statistically to determine the prevalence of various pathogens, their antibiotic resistance patterns, and associated risk factors for SSIs. The study aimed to assess the burden of surgical site infections and guide empirical antibiotic therapy based on local antimicrobial resistance patterns.

RESULTS

The study analyzed 120 cases of surgical site infections (SSIs) and examined their distribution based on demographics, type of surgery, bacterial isolates, antibiotic susceptibility, and resistant strains.

Distribution of SSIs Based on Patient Demographics

Table 1 presents the distribution of SSIs according to different age groups. The highest occurrence of SSIs was observed in the 41-60 years age group, accounting for 45 cases (37.50%), followed by the 20-40 years age group with 40 cases (33.33%). The elderly population aged above 60 years contributed to 20 cases (16.67%), while the lowest prevalence was seen in patients under 20 years of age, comprising 15 cases (12.50%). The increased incidence in the middle-aged and older populations could be attributed to the presence of comorbidities, reduced immunity, and prolonged hospital stays, which may predispose patients to infections.

Distribution of SSIs Based on Type of Surgery

The analysis of SSIs based on different types of surgeries, as shown in Table 2, revealed that general surgery accounted for the highest number of cases, with 50 patients (41.67%) developing infections. Orthopedic surgeries were the second most commonly associated with SSIs, contributing to 25 cases (20.83%), followed by gynecological procedures with 20 cases (16.67%). Urological surgeries accounted for 15 cases (12.50%), while other types of surgeries, including plastic and vascular surgeries, had the lowest infection rate with 10 cases (8.33%). The higher incidence of infections in general surgical cases may be due to the complexity of abdominal surgeries, prolonged operative time, and exposure to gastrointestinal flora.

Distribution of Bacterial Isolates from SSIs

Table 3 demonstrates the frequency of different bacterial isolates obtained from infected surgical sites. Staphylococcus aureus was the most common pathogen, isolated in 40 cases (33.33%), indicating its role as a major causative agent of SSIs. Escherichia coli was the second most frequent isolate, identified in 30 cases (25.00%), followed by Pseudomonas aeruginosa in 20 cases (16.67%). Klebsiella pneumoniae was found in 15 cases (12.50%), while Proteus species were isolated in 10 cases (8.33%). Other bacterial species contributed to 5 cases (4.17%). The predominance of *S. aureus* and *E. coli* suggests that both endogenous flora and environmental contamination play crucial roles in SSI development.

Antibiotic Susceptibility Pattern of Major Bacterial Isolates

Table 4 outlines the antibiotic susceptibility profile of the major bacterial isolates. The results indicate that Amoxicillin had the highest resistance rate, with only 36 isolates (30.00%) showing sensitivity, while 84 isolates (70.00%) were resistant. Ceftriaxone showed an equal distribution of susceptibility and resistance, with 60 isolates (50.00%) sensitive and 60 isolates (50.00%) resistant. Gentamicin demonstrated better efficacy, with 84 isolates (70.00%) being sensitive and 36 isolates (30.00%) resistant. Ciprofloxacin also showed moderate effectiveness, with 72 isolates (60.00%) being sensitive and 48 isolates (40.00%) resistant. Meropenem exhibited the highest sensitivity rate, with 108 isolates (90.00%) responding positively and only 12 isolates (10.00%) showing resistance. The findings suggest that while older antibiotics like amoxicillin and ceftriaxone have reduced efficacy due to rising resistance, carbapenems like meropenem remain highly effective against SSI pathogens.

Distribution of MRSA, ESBL, and Carbapenemase-Producing Isolates

Table 5 highlights the prevalence of multidrug-resistant organisms among the bacterial isolates. Methicillin-resistant *Staphylococcus aureus* (MRSA) was detected in 15 cases (12.50%), indicating a significant proportion of *S. aureus* infections were resistant to methicillin and other beta-lactam antibiotics. Extended-spectrum beta-lactamase (ESBL)-producing organisms were identified in 20 cases (16.67%), reflecting the increasing resistance to third-generation cephalosporins. Carbapenemase-producing bacteria, which pose a major challenge in hospital settings, were found in 10 cases (8.33%). The presence of these resistant pathogens underscores the need for stringent infection control measures and the rational use of antibiotics to prevent further resistance development.

Table 1: Distribution of SSIs based on Patient Demographics

Age Group (years)	No. of Patients	Percentage (%)
<20	15	12.50
20-40	40	33.33
41-60	45	37.50
>60	20	16.67

Table 2: Distribution of SSIs Based on Type of Surgery

Type of Surgery	No. of Cases	Percentage (%)
General Surgery	50	41.67
Orthopedic	25	20.83

Gynecological	20	16.67
Urological	15	12.50
Others	10	8.33

Table 3: Distribution of Bacterial Isolates from SSIs

Bacterial Isolate	No. of Isolates	Percentage (%)
Staphylococcus aureus	40	33.33
Escherichia coli	30	25.00
Pseudomonas aeruginosa	20	16.67
Klebsiella pneumoniae	15	12.50
Proteus species	10	8.33
Others	5	4.17

Table 4: Antibiotic Susceptibility Pattern of Major Bacterial Isolates

Antibiotic	Sensitive (No., %)	Resistant (No., %)
Amoxicillin	36 (30.00%)	84 (70.00%)
Ceftriaxone	60 (50.00%)	60 (50.00%)
Gentamicin	84 (70.00%)	36 (30.00%)
Ciprofloxacin	72 (60.00%)	48 (40.00%)
Meropenem	108 (90.00%)	12 (10.00%)

Table 5: Distribution of MRSA, ESBL, and Carbapenemase-Producing Isolates

Resistance Type	No. of Isolates	Percentage (%)
MRSA	15	12.50
ESBL producers	20	16.67
Carbapenemase producers	10	8.33

DISCUSSION

The present study analyzed 120 cases of surgical site infections (SSIs), evaluating their distribution based on demographics, type of surgery, bacterial isolates, antibiotic susceptibility, and resistant strains. In this study, the highest occurrence of SSIs was observed in the 41-60 years age group, accounting for 45 cases (37.50%), followed by the 20-40 years age group with 40 cases (33.33%). Patients aged above 60 years accounted for 20 cases (16.67%), while the lowest prevalence was seen in those under 20 years of age (12.50%). These findings are comparable to the study by Owens and Stoessel (2008), who reported that increasing age is a significant risk factor for SSIs due to reduced immunity, comorbid conditions, and delayed wound healing.[6] Similarly, Kirkland et al. (1999) found that elderly patients had prolonged hospital stays and higher morbidity due to SSIs.[7]The study found that general surgical procedures had the highest number of SSIs (41.67%), followed by orthopedic (20.83%), gynecological (16.67%), and urological surgeries (12.50%). A study by Mangram et al. (1999) reported that general and gastrointestinal surgeries had the highest risk of SSIs due to exposure to gut flora.[8] In this study, *Staphylococcus aureus* was the most common isolate (33.33%), followed by *Escherichia coli* (25.00%), *Pseudomonas aeruginosa* (16.67%), *Klebsiella pneumoniae* (12.50%), and *Proteus species* (8.33%). The predominance of *S. aureus* aligns with the findings of Nichols (2001), who reported *S. aureus* as the leading cause of SSIs, particularly in clean and clean-contaminated surgeries.[9] Similarly, Anvikar et al. (1999) found *S. aureus* in 30.3% of SSI cases, followed by *E. coli* (24.0%), which closely matches the present study. The presence of *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* suggests a role of hospital-acquired infections and contamination from surgical environments.[10]Antibiotic resistance patterns revealed that amoxicillin had the highest resistance rate (70.00%), followed by ceftriaxone (50.00%), ciprofloxacin (40.00%), and gentamicin (30.00%), while meropenem exhibited the highest sensitivity (90.00%). Similar findings were reported by Vessal et al. (2005), who found high resistance to beta-lactam antibiotics among SSI pathogens, particularly among *E. coli* and *Klebsiella pneumoniae*.[11]Methicillin-resistant *Staphylococcus aureus* (MRSA) was detected in 15 cases (12.50%), ESBL-producing organisms in 20 cases (16.67%), and carbapenemase-producing bacteria in 10 cases (8.33%). These findings are comparable to the study by Kamat et al. (2008), who reported MRSA prevalence of 14.3% in SSI cases, indicating the growing burden of methicillin resistance.[12] Similarly, Mathur et al. (2008) found ESBL-producing *E. coli* and *Klebsiella pneumoniae* in 18.5% of SSI cases, which is close to our findings.[13] The presence of carbapenemase-producing isolates aligns with the study by Gupta et al. (2007), who reported an 8.0% prevalence of carbapenemase production in hospital-acquired infections, underscoring the emerging threat of carbapenem resistance.[14]

CONCLUSION

This study highlights the significant burden of surgical site infections (SSIs) and the growing challenge of antimicrobial resistance in a tertiary care hospital. *Staphylococcus aureus* and *Escherichia coli* were the most common pathogens, with a notable presence of multidrug-resistant strains, including MRSA, ESBL, and carbapenemase producers. High resistance rates to commonly used antibiotics underscore the need for targeted antibiotic stewardship programs and stringent infection control measures. Continuous surveillance of SSI pathogens and their resistance patterns is essential to guide empirical therapy and improve patient outcomes.

REFERENCES

1. Korol, E., Johnston, K., Waser, N., Sifakis, F., Jafri, H. S., & Lo, M. (2013). A systematic review of risk factors associated with surgical site infections among surgical patients. *PloS One*, 8(12), e83743.
2. Badia, J. M., Casey, A. L., Petrosillo, N., Hudson, P., Mitchell, S., & Crosby, C. (2017). Impact of surgical site infection on healthcare costs and patient outcomes: a systematic review in six European countries. *Journal of Hospital Infection*, 96(1), 1-15.
3. Gelaw, A., Gebre-Selassie, S., Tiruneh, M., & Mekonnen, F. (2014). Surgical site infection and antimicrobial susceptibility patterns of bacteria isolates among patients admitted at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia. *Ethiopian Journal of Health Sciences*, 24(1), 9-18.
4. Khan, M., Faiz, A., & Ashraf, M. S. (2015). Occurrence and resistance pattern of multidrug resistant gram negative bacilli isolated from wound infections in Peshawar, Pakistan. *Journal of Microbiology and Infectious Diseases*, 5(4), 159-163.
5. Ibrahim, M. E., Bilal, N. E., & Hamid, M. E. (2014). Increased multi-drug resistant Escherichia coli from hospitals in Khartoum state, Sudan. *African Health Sciences*, 12(3), 368-375.
6. Owens, C. D., & Stoessel, K. (2008). Surgical site infections: epidemiology, microbiology, and prevention. *Journal of Hospital Infection, 70*(Suppl 2), 3-10.
7. Kirkland, K. B., Briggs, J. P., Trivette, S. L., Wilkinson, W. E., & Sexton, D. J. (1999). The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. *Infection Control & Hospital Epidemiology, 20*(11), 725-730.
8. Mangram, A. J., Horan, T. C., Pearson, M. L., Silver, L. C., & Jarvis, W. R. (1999). Guideline for prevention of surgical site infection, 1999. *American Journal of Infection Control, 27*(2), 97-134.
9. Nichols, R. L. (2001). Preventing surgical site infections: a surgeon’s perspective. *Emerging Infectious Diseases, 7*(2), 220-224.
10. Anvikar, A. R., Deshmukh, A. B., Karyakarte, R. P., Damle, A. S., Patwardhan, N. S., & Malik, A. K. (1999). A one year prospective study of 3280 surgical wounds. *Indian Journal of Medical Microbiology, 17*(3), 129-132.
11. Vessal, G., Afhami, S., & Aslani, M. M. (2005). Study of antimicrobial resistance among Gram-negative isolates from ICU patients. *Iranian Journal of Medical Sciences, 30*(3), 135-139.
12. Kamat, U., Ferreira, A. M., Savio, R., &Motghare, D. D. (2008). Antimicrobial resistance among nosocomial isolates in a teaching hospital in Goa. *Indian Journal of Community Medicine, 33*(2), 89-92.
13. Mathur, P., Kapil, A., Das, B., & Dhawan, B. (2008). Prevalence of extended-spectrum beta-lactamase producing Gram-negative bacteria in a tertiary care hospital. *Indian Journal of Medical Research, 128*(3), 324-328.
14. Gupta, E., Mohanty, S., Sood, S., Dhawan, B., Das, B. K., & Kapil, A. (2007). Emerging resistance to carbapenems in a tertiary care hospital in north India. *Indian Journal of Medical Research, 124*(1), 95-98.