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PRE-OPERATIVEAND POST-OPERATIVE ANTIBIOTIC STRATEGIES FOR PREVENTION OF SURGICAL SITE INFECTION: A FOCUS ON INFECTION CONTROL PROTOCOL IN THE SURGERY WARD

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Abstract
Surgical site infections (SSIs) are among the most common healthcare-associated infections and remain a significant cause of postoperative morbidity, prolonged hospitalisation, and increased healthcare costs. This prospective observational study evaluated the effectiveness of pre-operative and post-operative antibiotic strategies in preventing SSIs among patients undergoing general surgical procedures. The study was conducted over six months in the Department of General Surgery at SVS Medical College and Hospital, Mahabubnagar, and included 100 patients. Data on patient demographics, comorbidities, type of surgery, antibiotic selection, timing of administration, dosage, duration of therapy, and postoperative outcomes were collected from medical records and clinical observations. Patients were monitored throughout their hospital stay for the development of SSIs. The mean age of the study population was approximately 44 years, with males constituting the majority of participants. The overall incidence of SSIs was 35%, including 31 cases of superficial SSI and 4 cases of deep SSI, while no organ/space infections were observed. Higher infection rates were identified among patients with diabetes mellitus and those undergoing major surgical procedures. Ceftriaxone-based regimens were the most commonly prescribed prophylactic antibiotics. Patients who developed SSIs had longer hospital stays than those without infections. The findings demonstrate that appropriate perioperative antibiotic prophylaxis, including correct antibiotic selection, timely administration, and adherence to recommended guidelines, plays a vital role in reducing the incidence of surgical site infections, improving postoperative recovery, and enhancing the quality of surgical care.

Keywords: Surgical Site Infections, Antibiotic Prophylaxis, Pre-operative Antibiotics, Post-operative Antibiotics, General Surgery, Infection Prevention.

INTRODUCTION

Surgical site infection refers to an infectious process that develops in tissues, organs, or anatomical spaces that were exposed during a surgical procedure. These infections may arise within thirty days of surgery, or within one year if prosthetic material or implants have been introduced, provided the infection is attributable to the surgical intervention [1,2].SSI remain one of the leading categories of healthcare-associated infections, accounting for a substantial proportion of postoperative morbidity worldwide [3]. The different types of surgical site infections includes:Superficial

incisional SSIs, Deep incisional SSIs, Organ/space SSIs [4].The etiology of Surgical Site Infection (SSI) is multifactorial and involves a complex interaction between microbial contamination, host-related vulnerabilities, surgical technique, and perioperative environmental factors. SSI does not occur solely because microorganisms are present at the surgical site; rather, it develops when the balance between microbial load and host defense mechanisms is disrupted [5]. The pathogenesis of Surgical Site Infection involves a complex interaction between microbial invasion and host immune response[6]. The progression from contamination to clinically apparent infection occurs through a series of biological and pathological events. Surgical Site Infection (SSI) represents a dynamic and multifactorial pathological process that begins at the moment of tissue injury and may progress through a sequence of microbial colonization, host immune activation, tissue destruction, and systemic inflammatory consequences. The development of SSI is not an isolated event but rather the result of a delicate imbalance between microbial burden and host defense mechanisms[7]. Surgical antibiotic prophylaxis (SAP) represents one of the most critical preventive strategies for reducing Surgical Site Infections (SSI) in general surgery patients. Evidence from systematic reviews and prospective cohort studies consistently demonstrates that appropriate perioperative antibiotic administration significantly lowers SSI incidence and shortens hospital stay when compared to inadequate or absent prophylaxis [8]. However, the effectiveness of antibiotic prophylaxis is highly dependent on meticulous pre-operative planning, proper patient assessment, and strict adherence to established guidelines [9].One of the most critical pre-operative considerations is the timing of antibiotic administration. Antibiotics must be administered during the "decisive period," defined as the time immediately before incision when bacterial contamination is most likely to occur [10].The primary objective of prophylactic antibiotic administration is to ensure bactericidal tissue concentrations at the moment of surgical incision. Bacterial contamination occurs predominantly at the time of incision and throughout the operative procedure. Therefore, antimicrobial levels must be optimal during this critical window, often referred to as the "decisive period" [11].The prevention of surgical site infections in the general surgery ward requires a structured, evidence-based, and multidisciplinary approach. Although antibiotic prophylaxis remains a cornerstone of prevention, its success depends on precise timing, appropriate drug selection, optimal dosing, intraoperative management, and rational postoperative continuation [12]. Meta-analytic and cohort evidence consistently demonstrate that adherence to standardized perioperative antibiotic protocols significantly reduces SSI incidence and hospital stay [13]. However, gaps in implementation and antimicrobial misuse necessitate continuous improvement strategies [14].

MATERIALS AND METHODS

Study Design and Duration

A prospective, observational, non-interventional study was conducted over a period of six months in the Department of General Surgery, SVS Medical College and Hospital, Mahabubnagar, India. The study evaluated the effectiveness of pre-operative and post-operative antibiotic strategies in preventing surgical site infections (SSIs) among patients undergoing elective surgical procedures. Patient demographics, surgical characteristics, antibiotic prophylaxis, and postoperative outcomes were recorded using a structured data collection form.

Study Setting

The study was carried out in the General Surgery wards of SVS Medical College and Hospital, Mahabubnagar. Data were collected from patient case records, operative notes, nursing charts, medication administration records, laboratory reports, and postoperative follow-up records.

Study Population and Sample Size

A total of 100 patients undergoing elective surgical procedures were included in the study. The sample size was determined based on the availability of eligible patients during the study period.

Eligibility Criteria

Inclusion Criteria

- Patients admitted for elective surgical procedures.
- Patients receiving pre-operative and/or post-operative antibiotic prophylaxis.
- Patients willing to provide written informed consent.
- Adult patients undergoing general surgical procedures.

Exclusion Criteria

- Patients receiving antibiotics for pre-existing infections unrelated to surgery.
- Patients with chronic immunosuppressive conditions, including HIV/AIDS or those receiving chemotherapy.
- Patients with incomplete medical records or those lost to follow-up.
- Pregnant and lactating women.

Data Collection and Study Procedure

After obtaining written informed consent, eligible patients were enrolled consecutively. Baseline demographic and clinical information, including age, sex, body mass index (BMI), comorbidities, type of surgery, and duration of surgery, was recorded. Details of perioperative antibiotic prophylaxis, including antibiotic prescribed, dose, route of administration, timing of the first dose before incision, intraoperative redosing (when indicated), and duration of postoperative therapy, were documented. Information regarding infection control practices, including hand hygiene,

sterile dressing techniques, skin preparation, wound care, and glycaemic control, was also collected. Patients were monitored throughout their hospital stay and followed for up to 30 days after surgery to identify the occurrence of surgical site infections based on clinical signs such as wound discharge, erythema, pain, swelling, and fever.

Outcome Measures

The primary outcome was the occurrence of surgical site infection during the postoperative follow-up period. Secondary outcomes included the relationship between antibiotic prophylaxis practices and SSI occurrence, duration of hospital stay, and factors associated with postoperative infection.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 23 and GraphPad Prism version 9. Continuous variables were expressed as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test. Logistic regression and correlation analyses were performed where appropriate to identify factors associated with SSIs. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of SVS Medical College and Hospital before initiation of the study (Reference No. IEC DHR-03/ (04-7)/2025). Written informed consent was obtained from all participants before enrolment, and patient confidentiality was maintained throughout the study. No additional investigations or interventions beyond routine clinical care were performed.

RESULTS AND DISCUSSION

A total of 100 patients undergoing elective surgical procedures were included in the study. Demographic characteristics, perioperative antibiotic utilization, surgical site infection (SSI) rates, associated risk factors, and treatment approaches were evaluated. The findings are presented in the following tables and figures.

Age Distribution

The present study demonstrated that patients aged >50 years constituted the largest proportion of the study population (42%), with a mean age of 44.64 ± 12.04 years (Table 1). Advanced age is a well-recognised risk factor for surgical site infections because of impaired immune function, delayed wound healing, and the higher prevalence of comorbidities. The predominance of middle-aged and elderly patients in the present study is comparable with previous reports evaluating postoperative infections in general surgical patients.

Table 01: Distribution of patients according to age (n = 100).

Age Group (Years)	Number of Patients	Percentage (%)
<20	3	3
21–30	13	13
31–40	14	14
41–50	28	28
>50	42	42
Total	**100**	**100**

Mean ± SD: 44.64 ± 12.04 years

Gender Distribution

Male patients accounted for 63% of the study population, while females represented 37% (Table 2). The higher proportion of males undergoing surgery may be attributed to differences in healthcare utilisation and disease prevalence. Although gender itself is not considered an independent predictor of SSI, the higher number of male surgical admissions contributed to the greater number of infections observed among men in the present study.

Table 02: Distribution of patients according to gender (n = 100).

Gender	Number of Patients	Percentage (%)
Male	63	63
Female	37	37
Total	**100**	**100**

Incidence of Surgical Site Infection

The overall incidence of surgical site infection was 35%, with 65% of patients remaining free of infection (Table 3). This incidence reflects the continued burden of postoperative wound infections despite routine perioperative antibiotic prophylaxis. The findings emphasize the importance of strict adherence to infection prevention strategies, including appropriate antibiotic administration, aseptic surgical techniques, and postoperative wound care.

Table 03: Distribution of patients according to surgical site infection.

SSI Status	Number of Patients	Percentage (%)
SSI Present	35	35
No SSI	65	65
Total	**100**	**100**

Type of Surgery and Surgical Site Infection

Major surgical procedures were associated with a significantly higher incidence of SSI than minor procedures (Table 4). Patients undergoing major surgery exhibited substantially greater infection rates, and the association was statistically significant ($p < 0.001$). Longer operative duration, greater tissue manipulation, increased blood loss, and prolonged exposure to hospital microorganisms likely contributed to the higher infection risk observed in major surgeries.

Table 04: Association between type of surgery and surgical site infection.

Type of Surgery	Total Patients	SSI	No SSI
Major	54	30	24
Minor	46	5	41
Total	**100**	**35**	**65**

Statistical significance: $p = 0.001$

Pre-operative Antibiotic Prophylaxis

Ceftriaxone combined with metronidazole was the most frequently prescribed pre-operative prophylactic regimen, followed by ceftriaxone alone (Table 5; Figure 1). These antibiotics provide broad-spectrum coverage against both aerobic and anaerobic organisms commonly encountered during abdominal and general surgical procedures. Appropriate timing of antibiotic administration before surgical incision remains an essential component of effective SSI prevention.

Table 05: Distribution of patients according to pre-operative antibiotic prophylaxis.

Antibiotic Regimen	Number of Patients	Percentage (%)
Ceftriaxone	32	32
Ceftriaxone + Metronidazole	41	41
Cefoperazone + Sulbactam + Metronidazole	10	10
Cefuroxime + Sulbactam	13	13
Cefazolin	4	4
Total	**100**	**100**

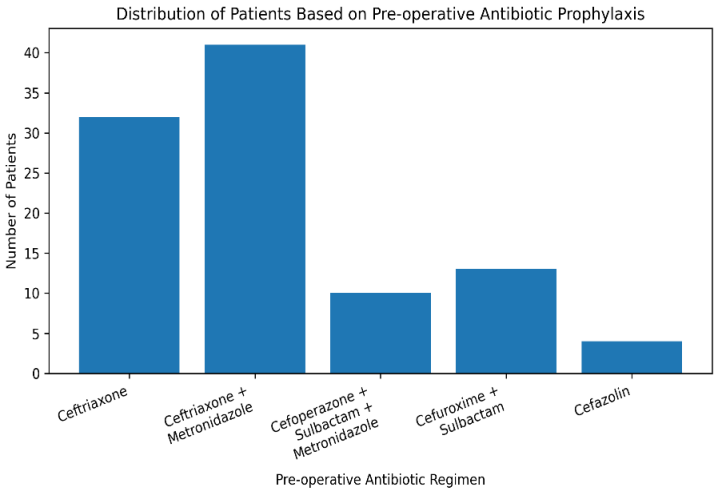

Figure 01: Pattern of pre-operative antibiotic prophylaxis.

Post-operative Antibiotic Therapy

Post-operative antibiotic therapy predominantly consisted of ceftriaxone either alone or in combination with metronidazole (Table 6; Figure 2). The prescribing pattern reflected the need for continued antimicrobial coverage during the immediate postoperative period. Rational postoperative antibiotic use, together with appropriate wound management, likely contributed to limiting the severity of postoperative infections.

Table 06: Distribution of patients according to post-operative antibiotic therapy**.**

Antibiotic Regimen	Number of Patients	Percentage (%)
Ceftriaxone	53	53
Ceftriaxone + Metronidazole	20	20
Cefoperazone + Sulbactam	10	10
Meropenem + Metronidazole	7	7
Amoxicillin + Metronidazole	4	4
Linezolid + Metronidazole	4	4
Cefuroxime + Sulbactam	2	2
Total	**100**	**100**

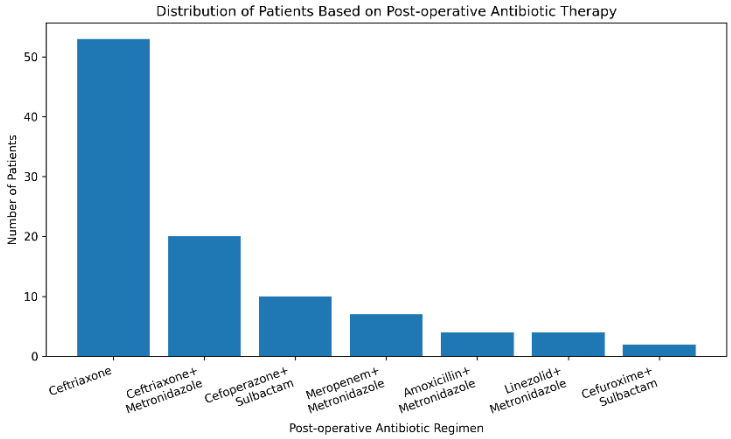

Figure 02: Distribution of post-operative antibiotic therapy.

Comorbidities and Surgical Site Infection

Patients with diabetes mellitus, either alone or combined with hypertension, demonstrated markedly higher SSI rates than patients without comorbidities (Table 07). Diabetes impairs leukocyte function, collagen synthesis, and tissue perfusion, thereby delaying wound healing and increasing susceptibility to infection. These findings highlight the importance of optimal glycaemic control and careful perioperative management in reducing SSI risk.

Table 07: Association between comorbidities and surgical site infection.

Comorbidity	Total	SSI	No SSI	SSI Rate (%)
No Comorbidity	62	6	56	9.7
Diabetes Mellitus	26	20	6	76.9
Diabetes + Hypertension	11	9	2	81.8
Chronic Kidney Disease	1	0	1	0
Total	**100**	**35**	**65**	**35.0**

Length of Hospital Stay and SSI

A significant association was observed between prolonged hospital stay and the occurrence of SSI (Table 8). Patients with infections required extended hospitalization because of delayed wound healing, repeated dressings, additional antibiotic therapy, and closer clinical monitoring. Therefore, prevention of SSI not only improves patient outcomes but also reduces healthcare resource utilization.

Table 08**:** Association between length of hospital stay and surgical site infection.

Length of Stay	SSI	No SSI	Total
<5 days	3	37	40
6–10 days	15	20	35
>10 days	17	8	25
Total	**35**	**65**	**100**

CDC/NHSN Classification of Surgical Site Infection

According to the CDC/NHSN criteria, superficial incisional SSI was the most common category, whereas deep incisional SSI accounted for only a small proportion of infections, and no organ/space SSI was identified (Table 9; Figure 3). The predominance of superficial infections suggests that most cases were detected early and managed before progression to more severe postoperative infections.

Table 09: Classification of surgical site infection according to CDC/NHSN criteria.

SSI Category	Number of Patients	Percentage (%)
No SSI	65	65
Superficial Incisional SSI	31	31
Deep Incisional SSI	4	4
Organ/Space SSI	0	0
Total	**100**	**100**

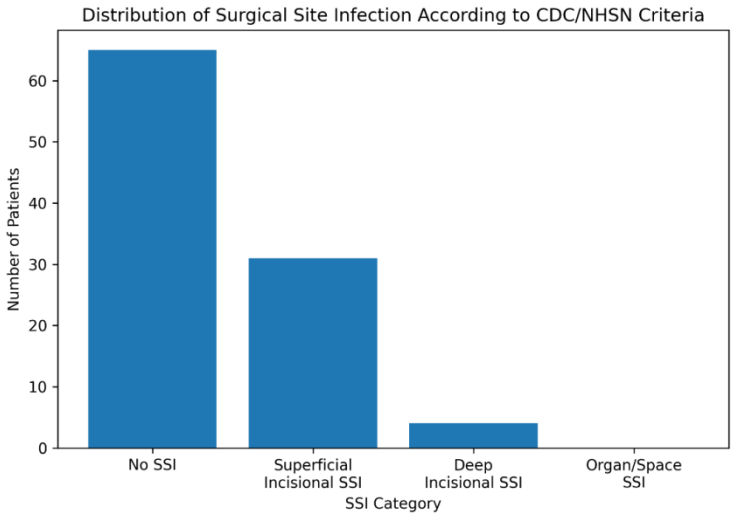

Figure 03: Distribution of surgical site infections according to CDC/NHSN classification.

Antibiotic Treatment Approach

Third-generation cephalosporins, particularly ceftriaxone with or without metronidazole, formed the cornerstone of both prophylactic and therapeutic antibiotic regimens (Table 10; Figure 4). Broader-spectrum antibiotics such as meropenem and linezolid were reserved for selected high-risk patients. The overall prescribing pattern was consistent with current perioperative antimicrobial recommendations and supported effective management of surgical patients.

Table 10. Antibiotic treatment approach used in the study.

Antibiotic Class	Regimen	Pre-operative n (%)	Post-operative n (%)
1st Generation Cephalosporin	Cefazolin	4 (4)	—
2nd Generation Cephalosporin	Cefuroxime + Sulbactam	13 (13)	2 (2)
3rd Generation Cephalosporin	Ceftriaxone	32 (32)	53 (53)
3rd Generation Cephalosporin	Ceftriaxone + Metronidazole	41 (41)	20 (20)
Cephalosporin + β-lactamase inhibitor	Cefoperazone + Sulbactam	—	10 (10)
Cephalosporin + β-lactamase inhibitor	Cefoperazone + Sulbactam + Metronidazole	10 (10)	—
Carbapenem	Meropenem + Metronidazole	—	7 (7)
Oxazolidinone	Linezolid + Metronidazole	—	4 (4)
Penicillin	Amoxicillin + Metronidazole	—	4 (4)

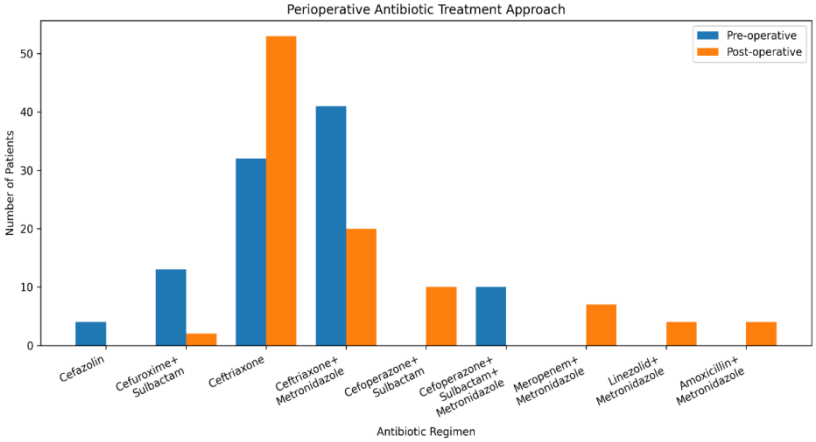

Figure 10. Pattern of preoperative antibiotic utilization.

CONCLUSION

This prospective observational study evaluated the effectiveness of perioperative antibiotic strategies in preventing surgical site infections (SSIs) among 100 patients undergoing elective surgical procedures over a six-month period. The overall incidence of SSI was 35%, with superficial incisional SSI representing the most common type of infection. Advanced age, diabetes mellitus, major surgical procedures, and prolonged hospital stay were identified as significant factors associated with increased SSI risk. Ceftriaxone-based regimens were the most frequently prescribed antibiotics for both pre-operative prophylaxis and post-operative therapy. The findings highlight the importance of appropriate antibiotic selection, timely administration, perioperative glycaemic control, and adherence to evidence-based antimicrobial stewardship guidelines to reduce postoperative infections and improve surgical outcomes.

LIMITATIONS

The study has several limitations. It was conducted at a single tertiary care hospital with a relatively small sample size of 100 patients, limiting the generalizability of the findings. The six-month study duration may not reflect seasonal variations in SSI incidence. As an observational study, causal relationships between antibiotic practices and surgical site infections could not be established. In addition, variations in surgical procedures, patient comorbidities, and postoperative care may have influenced the study outcomes.

RECOMMENDATIONS

Implementation of guideline-based perioperative antibiotic prophylaxis should be encouraged, with cefazolin considered the preferred agent for appropriate clean surgical procedures and broader-spectrum antibiotics reserved for specific clinical indications. Strict perioperative glycaemic control, optimisation of patient comorbidities, standardised timing and duration of antibiotic administration, and comprehensive patient education regarding wound care should be incorporated into routine surgical practice. Future multicentre studies with larger sample sizes and longer follow-up periods are recommended to validate these findings and further optimise SSI prevention strategies.

FUNDING

The authors received no financial support for the conduct of this study.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest related to this study.

ACKNOWLEDGMENTS

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AUTHOR CONTRIBUTIONS

Dr. T. Mangilal conceived and designed the study, supervised the research work, and critically reviewed the manuscript. Rahela Tarannum, M. Mercy, and Amena Mumtaz contributed to patient recruitment, data collection, statistical analysis, interpretation of results, and manuscript preparation. All authors reviewed, revised, and approved the final manuscript.

ETHICAL APPROVAL

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of SVS Medical College and Hospital, Mahabubnagar, before commencement of the study (Reference No. **IEC DHR-03/(04-7)/2025**). Written informed consent was obtained from all participants prior to enrolment.

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