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Original Research Article

Antibiotic usage in surgical prophylaxis: a prospective observational study in the surgical wards of a tertiary care hospital

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ABSTRACT

Background: Surgical site infections (SSIs) are a leading cause of postoperative complications, particularly in resource-limited settings. Surgical antibiotic prophylaxis (SAP) is an effective measure for preventing SSIs when administered with appropriate antibiotic selection, timing, and duration. This study aimed to evaluate the SAP practices in elective surgeries and assess adherence to national and international guidelines.
Methods: A prospective observational study was conducted over six months at a tertiary care teaching hospital, including 293 patients undergoing elective surgical procedures in the departments of general surgery, orthopaedics, ENT, gynaecology, and obstetrics. Data on the choice of prophylactic antibiotics, timing relative to surgical incision, and duration of postoperative use were collected and compared with guidelines from the Indian council of medical research (ICMR), American society of health-system pharmacists (ASHP), and the world health organization (WHO).
Results: General surgery accounted for 51.9% of procedures, followed by orthopaedics (25%) and ENT (13.5%), with gynaecology and obstetrics together at 9.6%. Cefotaxime was the most frequently used antibiotic, particularly in obstetrics (100%) and general surgery (70.4%), whereas gynaecology predominantly used a cefotaxime-metronidazole combination (66.7%). SAP was administered within the recommended 60-minute window before incision in 80.7% of cases, with the highest adherence in obstetrics (100%). Discontinuation within 24 hours occurred in 77.8% of general surgery and 92.3% of orthopaedic cases, whereas extended use was common in obstetrics, ENT and gynaecology.
Conclusions: Although SAP timing was generally appropriate, the overuse of third-generation cephalosporin, the absence of cefazolin, and prolonged prophylaxis in some departments highlight the need for department-specific guideline adherence.

Keywords: Antibiotic timing, Antimicrobial stewardship, Elective surgery, Prophylactic duration, Surgical antibiotic prophylaxis

INTRODUCTION

Surgical site infections (SSIs) are among the most common healthcare-associated infections (HAIs) and significantly contribute to postoperative morbidity, prolonged hospital stays, increased treatment costs, and adverse patient outcomes. According to the world health organization (WHO), SSIs are the second most frequent hospital-acquired infections in low- and middle-income countries, with incidence rates reaching up to 20% of all surgical procedures.[1] In India, SSI rates range widely from 5% to 30%, depending on the type of surgical intervention, hospital infrastructure, and adherence to infection control measures.[2] These infections not only burden patients and healthcare systems but also highlight critical gaps in perioperative preventive strategies.

SAP is a well-established and cost-effective measure for preventing SSIs, particularly when administered with optimal selection, appropriate timing, and limited

duration. Proper SAP use has been associated with a significant reduction in postoperative infection rates and improved surgical outcomes.[3,4] Major healthcare organisations, including WHO, centers for disease control and prevention (CDC), ASHP, and ICMR, recommend administration of a single prophylactic dose of antibiotics within 60 min before surgical incision and discontinuation within 24 h after surgery.[5-8] These guidelines aim to ensure antibiotic efficacy, reduce adverse drug events and minimise antimicrobial resistance.

Despite the availability of these clearly defined and evidence-based guidelines, several studies have highlighted persistent deviations from them in real-world clinical practice. Common issues include inappropriate antibiotic selection (e.g. use of broad-spectrum agents where narrow-spectrum agents would suffice), timing errors (administration too early or too late), and prolonged postoperative use extending beyond 24 hours.[9-11] These deviations are particularly problematic in resource-constrained healthcare settings, where limited antimicrobial stewardship and inconsistent prescriber practices may contribute to irrational antibiotic use and rising resistance patterns.

SAP practices often vary significantly across surgical departments because of differences in procedural complexity, surgeon preferences, and departmental protocols. For example, major abdominal procedures may require broader antibiotic coverage than clean ENT or gynecologic surgeries. However, limited data are available from Indian tertiary care hospitals assessing adherence to SAP guidelines at the departmental level in India.

This study aimed to evaluate SAP practices among patients undergoing elective surgical procedures across various departments in a tertiary care teaching hospital. Therefore, evaluating SAP practices is essential for informing antimicrobial stewardship efforts and reducing the development of antimicrobial resistance. This prospective observational study aimed to assess the gaps in SAP selection, timing, and duration to support the development of a standardised protocol in tertiary care settings.

Objectives

Objectives were to evaluate the current practices of prophylactic antibiotic administration, including the selection, timing, and duration of use, among patients undergoing elective surgical procedures in a tertiary care hospital over six months, with the intent to provide evidence-based recommendations for the development of standardised SAP protocols.

METHODS

Study design

This prospective observational study was conducted from April 2024 to September 2024 at the department of microbiology, Annapoorna medical college and hospitals, Salem, Tamil Nadu, India. The study included 293 patients who underwent various elective surgical procedures across departments, such as orthopaedics, obstetrics and gynaecology, paediatric surgery, and ENT surgery.

Inclusion criteria

Only those who received SAP and had wounds classified as clean, clean-contaminated, or contaminated were included.

Exclusion criteria

Patients who underwent emergency surgical procedures, those with dirty or infected wounds who received antibiotics before surgery, individuals on non-SAP, and those receiving oral antibiotics were excluded.

Methodology used

The appropriateness of antibiotic selection, timing of administration (particularly whether administered within 60 min before incision), and duration of use, especially regarding compliance with the recommended discontinuation within 24 h post-surgery, were evaluated.

Data were collected prospectively through direct observation and a review of medical and surgical records. The information included demographic details, type of surgery, surgical wound classification, antibiotic agent(s) used, timing of administration relative to surgical incision, duration of intraoperative and postoperative prophylaxis, and any documented postoperative infections on days 3 and 5. The distribution of data is presented as frequencies and percentages.

RESULTS

The median age was 45 years, with an interquartile range (IQR) of 28 years. In terms of gender, 57.2% (n=163) of the patients were female, while 42.8% (n=130) were male.

More surgeries were performed in the general surgery department, accounting for 51.9% (n=27) of the cases. This was followed by orthopaedics (25%, n=13) and ENT (13.5%, n=7). The gynaecology and obstetrics departments contributed 9.6% of the total procedures, with 3 and 2 surgeries performed, respectively (Table 1).

Cefotaxime, administered as a single agent, was the most commonly used prophylactic antibiotic, with usage highest in obstetrics (100%) and general surgery (70.4%), followed by gynaecology (33.3%), orthopaedics (15.4%), and ENT (14.3%). Combination of cefotaxime and metrogyl was predominantly used in gynaecology (66.7%) and to a lesser extent in general surgery (7.4%), with no reported use in other departments, cefoperazone sulbactam utilised in orthopaedics (15.4%), general surgery (3.7%), ENT (14.3%) but not in gynaecology and obstetrics.

Ciprofloxacin was used only in orthopaedics (15.4%) and ENT (14.3%). Ceftriaxone was primarily used in orthopaedics (38.5%) and to a limited extent in general surgery (3.7%), with no usage in ENT, gynaecology, or obstetrics. Augmentin was exclusively used in the ENT department (57.1%). Other antibiotics were recorded in 15.4% of orthopaedic cases, and 14.8% of general surgery cases, with no use noted in gynaecology, ENT or obstetrics (Table 2).

Within the general surgery department, 85.2% of patients received prophylactic antibiotics <1 h before the surgical incision, whereas 14.8% received them >1 h before. In orthopaedics, 76.9% received antibiotics <1 h and 23.1% >1 h before incision. In the ENT department, 71.4% of patients received antibiotics within <1 h and 28.6% received antibiotics within >1 h. Similarly, in gynaecology, 66.7% received antibiotics <1 h and 33.3% >1 h. In obstetrics, all of the patients received antibiotics <1 h.

All general surgery procedures were completed in <4 h. In orthopaedics, 92.3% of surgeries lasted <4 h, whereas 7.7% exceeded >4 h. In ENT, gynaecology and obstetrics, 100% of surgeries were completed in <4 h, with none exceeding that duration.

In general surgery, 77.8% of patients received antibiotics for <24 h and 22.2% for >24 h. In orthopaedics, 92.3% of patients received antibiotics for <24 h and 7.7% for >24 h. In the ENT department, 57.1% received antibiotics for <24 h and 42.9% for >24 h. In gynaecology, 66.7% received antibiotics for <24 h and 33.3% for >24 h. In obstetrics, 50% of patients received antibiotics for <24 h, whereas 50% received antibiotics for >24 h (Table 3).

Table 1: Department-wise distribution of elective surgeries.

Name of the department	No. of surgeries performed	Percentage (%)
General surgery	27	51.9
Orthopedics	13	25
ENT	7	13.5
Gynaecology	3	5.8
Obstetrics	2	3.8
Total	52	100

Table 2: Distribution of prophylactic antibiotics across surgical departments.

Name of the antibiotic	General surgery	Orthopaedics	ENT	Gynaecology	Obstetrics
Cefotaxime only	19 (70.4%)	2 (15.4%)	1 (14.3%)	1 (33.3%)	2 (100%)
Cefotaxime+metrogyl	2 (7.4%)	0	0	2 (66.7%)	0
Cefoperazone sulbactam only	1 (3.7%)	2 (15.4%)	1 (14.3%)	0	0
Ciprofloxacin	0	2 (15.4%)	1 (14.3%)	0	0
Ceftriaxone only	1 (3.7%)	5 (38.5%)	0 (0%)	0	0
Augmentin	0	0	4 (57.1%)	0	0
Others	4 (14.8%)	2 (15.4%)	0 (0%)	0	0

Table 3: Department-wise surgery antibiotic prophylaxis and surgery duration profile.

Parameters		General surgery	Orthopedics	ENT	Gynaecology	Obstetrics
The time gap between antibiotic administration and the start of surgery	<1 hour	23 (85.2%)	10 (76.9%)	5 (71.4%)	2 (66.7%)	2 (100%)
	>1 hour	4 (14.8%)	3 (23.1%)	2 (28.6%)	1 (33.3%)	0
Duration of surgery	<4 hours	27 (100%)	12 (92.3%)	7 (100%)	3 (100%)	2 (100%)
	>4 hours	0	1 (7.7%)	0	0	0
Duration of antibiotic administration	<24 hours	21 (77.8%)	12 (92.3%)	4 (57.1%)	2 (66.7%)	1 (50%)
	>24 hours	6 (22.2%)	1 (7.7%)	3 (42.9%)	1 (33.3%)	1 (50%)

DISCUSSION

Antibiotic prophylaxis is essential for preventing SSIs, particularly in resource-limited settings. This study identified significant interdepartmental variations in SAP practices despite the existence of established guidelines. Evidence supports that single-dose prophylaxis for clean and clean-contaminated surgeries is equally effective as extended regimens and helps reduce hospital stay and resource utilisation.

In our study, general surgery constituted the majority of procedures (51.9%), followed by orthopaedics (25%) and ENT (13.5%), while gynaecology and obstetrics contributed to 9.6%. Similarly, a study done by Bhandarkar et al reported that among the total surgical

procedures performed, general surgery accounted for 18.3% annually, while obstetric and gynaecologic surgeries together comprised 14.1%.[12]

In our study, cefotaxime emerged as the most frequently used prophylactic antibiotic, with distinct departmental preferences, reflecting considerable variability in antibiotic selection across surgical specialities. Similarly, Basant et al carried out a prospective study over 1 year involving 102 patients who all received cefotaxime as a single agent.[13] Gurunthalingam et al found that the most commonly used antibiotic was ceftriaxone (pre-operative 58.12% (n=229) and post-operative 43.14% (n=170).[14] Vigneswaran et al found cephalosporin to be the most prescribed antibiotic class (86%).[15] In a study of 103 gynecologic and obstetric cases, done by Sae-Tia and Chongsomchai found that a single preoperative 1 g dose of cefotaxime resulted in 0% postoperative infections, demonstrating its effectiveness in clean surgical procedures.[16]

Garcia-Rodriguez et al found in a randomized trial of 1,451 patients, cefotaxime showed a lower wound infection rate (3.3%) compared to cefoxitin (7.6%), with the lowest rate (0.63%) when administered within one hour before surgery.[17] Esposito et al did a meta-analysis study that showed that ceftriaxone was superior for preventing SSIs, UTIs, and RTIs, with 87.8% of 163 orthopaedic patients in a hospital receiving ceftriaxone prophylaxis.[18] Luchsheva et al found that Augmentin (cefotaxime) administered post-ENT surgery reduced wound secretion and oedema, and promoted faster healing after maxillary sinus and tonsil procedures.[19]

In our study, timely administration of prophylactic antibiotics was achieved in most departments, with the highest compliance in obstetrics and general surgery, while delayed administration was notably prevalent in ENT and gynaecology. Similarly, in Gurunthalingam et al the duration of SAP was appropriate only in 6.53% (n=24) and the timing of SAP administration was appropriate only in 50.76% (n=204).[14] A study conducted by Polla et al reported that only 60.1% of SAP administrations occurred within the optimal 60-minute window before surgical incision, while 39% were administered at inappropriate times, exceeding the recommended interval.[20] Misganaw et al observed that nearly half of their patients received SAP at inappropriate times, contributing to a higher incidence of SSIs (23.5%), and Ratnesh et al found prolonged postoperative use up to 48 hours.[21,22]

In our study, nearly all surgeries across departments were completed within four hours, with full compliance in general surgery, ENT, gynaecology, and obstetrics, and minimal extensions observed in orthopaedics (7.7%). Similarly, Costa A da found that orthopaedics accounted for 16.6% of procedures with a mean surgical duration of 151.95±92.45 min, followed by general surgery at 15.9% and 150.95±98.27 min. Gynaecological surgeries had a significantly shorter duration of 79.32±79.43 min and comprised 13.4% of all surgeries. ENT accounted for 8.6% with an intermediate average duration of 129.23±86.64 minutes.[23] Alemkere found in a study where 84% received ceftriaxone, 75.8% had prophylaxis >24 hours, but patients in gynaecology and obstetrics were significantly less likely to receive prolonged prophylaxis (AOR=0.07, 95% CI: 0.01-0.81).[24]

In our study, over 77.8% of patients in the general surgery department received antibiotic prophylaxis for ≤24 hours post-surgery, whereas 22.2% continued for >24 hours. Similarly, Hassan et al over 78% of patients received antibiotic prophylaxis for ≤24 hours post-surgery, whereas 21.5% continued for >24 hours.[25]

Our study highlights significant gaps in adherence to the ICMR and ASHP guidelines, particularly in terms of antibiotic selection, timing, and duration. The absence of cefazolin highlights potential formulary or resistance-related issues. These findings highlight the urgent need for antimicrobial stewardship, regular formulary reviews, and prescriber education to align clinical practices with evidence-based standards.

Limitations

The study was limited by its small sample size and short duration, which may have affected the generalisability of the findings. It was conducted in a single centre without postoperative infection outcome assessment, and microbial resistance patterns were not evaluated.

CONCLUSION

Most patients received antibiotics within the recommended 60-minute window before incision. In general surgery and obstetrics, significant variations were observed in antibiotic selection and duration, with third-generation cephalosporins commonly used and cefazolin absent. Prolonged prophylactic use beyond 24 hours was particularly evident in ENT and gynaecology. These findings highlight the need for department-specific standardisation of prophylactic protocols to align with national and international guidelines, ensuring rational antibiotic use and mitigating the risk of antimicrobial resistance.

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