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ANTIBIOTIC STEWARDSHIP IN SURGICAL PROPHYLAXIS: A STUDY OF PRESCRIPTION TRENDS IN A TERTIARY CARE FACILITY

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Abstract:

Background: Wound infections are the commonest hospital acquired infections in surgical patients. They result in increased antibiotic usage, increased costs and prolonged hospitalization. Surgical prophylaxis means prevention of infection at the site of surgery that includes, infection at site of incision and infection of deeper tissues handled during surgery.

Prophylaxis may decrease hospital stays and expedite the return to regular activities on discharge. Therefore, the present study was undertaken to observe and analyse antimicrobial prescription pattern in patients that had undergone surgery at a tertiary care hospital. **Methods:** A prospective observational, noninterventional, descriptive study was conducted from January to August 2024. Patients who were more than 18 years of age admitted in general surgical wards receiving at least one dose of any class of antibiotics orally or intravenously were included in this study. During the study, 493 prescriptions were studied, and patient records were collected and analyzed.

Results: Among the patients, 62% were male, and 52.94% were aged 25-50 years. Prophylactic antibiotics were administered to 425 patients (86.2%), with cephalosporins (94.02%) and nitroimidazoles (73.33%) being the most commonly prescribed antibiotic groups. Of the 425 patients, 20.22% received monotherapy, while 79.77% received combination therapy. Ceftriaxone alone was used in 69.31%, and Ceftriaxone + Metronidazole in 48.7%. Surgical site infections (SSIs) developed in 51 patients (10.34%). A prior risk factor was identified in 252 patients. Patients with comorbidities were at higher risk of developing SSIs. SSIs were more frequent in contaminated (29.16%) and dirty wounds (26.31%), highlighting the importance of wound classification in SSI occurrence. Additionally, 349 patients (82.11%) received surgical antibiotic prophylaxis (SAP) within 1 hour before the incision. However, 19.35% of SSIs could be linked to receiving antibiotics more than 1hour before incision, and 12.92% of SSIs were associated with emergency surgeries.

Conclusions: Surgical antibiotic prophylaxis (SAP) is essential in preventing surgical site infections (SSIs) by targeting both exogenous and endogenous microorganisms. Administering

antibiotics within the critical window—30 to 60 minutes prior to surgery—has proven to be effective in reducing the risk of SSIs. Adhering to evidence-based guidelines for antibiotic selection, timing, and dosage is crucial for optimizing patient outcomes and minimizing infection-related complications.

Keywords: Surgical site infection, Antibiotics, Surgical prophylaxis.

Introduction:

Wound infections are the commonest hospital acquired infections in surgical patients.[1] They result in increased antibiotic usage, increased costs and prolonged hospitalization. Surgical site infection is defined as an infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissue (e.g. fascia, muscle) of the incision and/or the infection appears to be related to the operation and infection involves any part of the anatomy other than the incision that was opened or manipulated during an operation (e.g. organs and spaces). [2] Despite standard preoperative and antimicrobial measures, SSI rates vary widely, ranging from 2.5% to 41.9%, due to factors like surgery type, patient health, and hospital practices.[3]

Surgical site infections (SSIs) are caused by both exogenous microorganisms from the operating room or ward environment and endogenous microorganisms from the patient's skin or internal organs. Surgical prophylaxis aims to prevent infections at both the incision site and deeper tissues. The critical window for effective prophylaxis is within the first three hours after bacteria enter the tissues.[4] Administration of surgical antibiotic prophylaxis (SAP) before surgery is an evidence-based practice that reduces the risk of SSIs. Current guidelines recommend that antibiotics be administered at least 30 minutes, but no more than 60 minutes, prior to the surgical incision.[6]

Around 30-50% of hospital antibiotic use is for surgical prophylaxis, but 30-90% of this use is inappropriate. The most common issues are administering the antibiotic at the wrong time or continuing it for too long.[7] The goal of surgical prophylaxis is to prevent infection and disease from microorganisms. The regimen should target the most likely infecting organisms, without the need to eliminate every potential pathogen.The four guiding principles for antimicrobial prophylaxis in surgery are: ensuring safety, using a narrow spectrum to target relevant pathogens, avoiding reliance on the agent for treating active infections, and administering the antibiotic within one hour before surgery for a brief, defined period.[8]

The choice of antibiotic for surgical prophylaxis should be guided by the local antibiogram, ensuring effectiveness against prevalent pathogens in the specific hospital setting.[9] If the operation lasts four hours or less, one antibiotic dose is usually sufficient. In prolonged surgery of greater than four hours, further antibiotic doses may be required to maintain the concentration, particularly if the antibiotic has a short half-life. Post- operative administration of the AMA, especially after 4 hours of wound closure is recommended only in case of contaminated and dirty surgery, in which case it may be given for upto 5 days.[10,11]

Determining the prevalence of surgical site infections (SSI) in relation to surgical prophylaxis is crucial for evaluating the effectiveness of current antibiotic practices, identifying potential areas for improvement, and ensuring optimal infection prevention. This helps refine prophylactic strategies, minimize SSI rates, and reduce the emergence of antibiotic resistance.[12]

Therefore, this study was conducted to evaluate the prescription patterns of antibiotics for surgical prophylaxis in a tertiary care hospital, with the aim of assessing the appropriateness of antibiotic selection, timing, and duration, and to identify areas for improvement in adherence to guidelines to ensure effective infection prevention and reduce the risk of antibiotic resistance.

Aims and objective:

To determine the pattern of antimicrobial usage in the preoperative period to study its impact on the occurrence of SSI.

METHODS:

Study design: A prospective, observational, descriptive study was carried out at tertiary care teaching hospital, Navi Mumbai, after approval from institutional ethics committee of the institute IECBH reference no. "2023/076. We used the sample consisting 493 patients. Duration of study was from January- August 2024.

All the case sheets were examined and findings recorded for gender differences, diagnosis, ongoing treatment. Detailed information on antibiotic used including name of the antibiotic, dosage schedule ((route, dose and frequency), and duration of treatment was recorded from the patient's medical records. From daily data collection, the incidence and risk factors for SSI, including those related to specific procedures were computed.

The follow-up was done within 30 days, if the patient was having an infection. Antibiotics were administered according to the institutional policy. Where dirty and clean-contaminated surgical wounds operations were covered with proper antibiotics. We observed all the types of surgery performed as well as the length of hospital stay. The surgical sites were examined on the second postoperative day and then daily for pain, redness, warmth, and swelling and purulent drainage.

Data analysis: Then these data were entered, documented and analysed using Microsoft Excel 2010 and results were discussed. Different parameters were given as percentage.

RESULTS:

The age and sex distribution of the sample population of our study is as shown in the Table 1

The majority of patients were male (62%), with most falling within the 25-50 age group, representing 52.94% of the total.

Table 1: Age and Sex Wise Distribution

Characteristics	No. of patients	Percentage (%)
Male	306	62%
Female	187	38%
Age in years:		
Less than 25 years	107	21.70%
25-50 years	261	52.94%
More than 50 years	125	25.35%
Total	493	100%

Table 2: Morbidity Pattern with their mean duration of hospital stay

S.no	Type of surgery	Number of surgeries done (%)	Mean stay (days)
1.	Appendicectomy	187 (37.93)	8.93
2.	Hernias (Inguinal Hernia, Incisional, epigastric, umbilical)	61 (12.37)	11.10
3.	Hydrocele	53 (10.75)	11.21
4.	Breast lump/ Fibroadenoma	36 (7.30)	12.13
5.	Colorectal surgery	31(6.28)	13.11
6.	Gastroduodenal surgery	29 (5.88)	11.81
7.	Renal surgeries	24 (4.86)	11.96
8.	Fissurectomy	23 (4.66)	5.56
9.	Haemorrhoidectomy	17 (3.44)	5.59
10.	Incision and drainage	8 (1.62)	6.74
11.	Diabetic foot	7 (1.41)	15.23
12.	Circumcision	6 (1.21)	3.95
13.	Cellulites	6 (1.21)	12.76
14.	Amputation	5 (1.01)	30.82
	Total	493 (100%)	Mean = 11

Table 2 depicts the different types of surgeries included in our study along with their mean duration of postoperative stay in the ward. The most common surgical procedure performed was appendectomy (37.93%), followed by various types of hernia surgeries (12.37%). The mean duration of hospital stay for these patients was 11 days.

Regarding the types of wounds, the majority of subjects, 332 (67.34%), had clean surgeries, followed by 118 (23.93%) with clean-contaminated wounds, 24 (4.86%) with contaminated wounds, and 19 (3.85%) with dirty wounds. Additionally, 147 (29.81%) patients underwent emergency surgeries, while the remaining patients had elective surgeries.

Fig: 1. **Surgical antibiotics usage:**

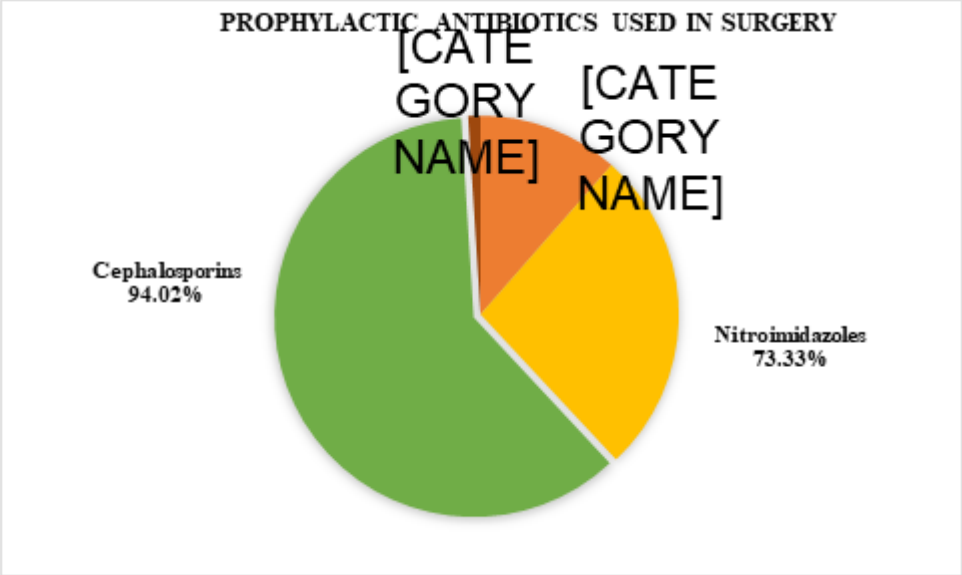

Fig:1 Illustrates Surgical antibiotics usage. 425 (86.20%) patients received prophylactic antibiotics. Commonly prescribed antibiotic groups are cephalosporins 94.02% and 73.33% Nitroimidazoles.

Table 3: Distribution Based on Surgical Antibiotic Prophylaxis among the Surgical Patients.

Type of Therapy	No. of Patient (%)	Total No. of Patient (%)
Monotherapy		
Cefotaxime	13 (14.77)	88 (20.22)
Ceftriaxone	61 (69.31)	
Cefoperazone +Sulbactam	14 (15.90)	
Combination Therapy		
Cefotaxime + Amikacin	18 (5.18)	347 (79.77)
Ceftriaxone + Amikacin	10 (2.88)	
Metronidazole + Amikacin	21 (6.05)	
Cefotaxime + Metronidazole	108 (31.12)	
Ceftriaxone + Metronidazole	169(48.70)	
Piperacillin +tazobactam +Metronidazole	5 (1.44)	
Cefoperazone +Sulbactam +Metronidazole	16 (4.61)	

Table:3 Illustrates the comparison between patients receiving monotherapy and combination therapy. 425 (86.20%) patients received prophylactic antibiotics. 20.22 % of patient received monotherapy and 79.77% of patients received combination therapy. About 69.31% of participants received Ceftriaxone as a single administration, while combination of Ceftriaxone and Metronidazole were used for 48.70% patients. Majority of prophylactic antibiotics (90%) were administered by intravenous route and only (10%) were given by oral route.

Table: 4 Presence of risk factors associated with infection

Risk Factors	No. of Patients n (%)	No. of SSI n (%)
Anaemia	7 (1.41)	2 (28.57)
DM	94 (19.06)	19 (20.21)
HTN	45(9.12)	7 (15.55)
DM + HTN	81 (16.43)	16 (19.75)
Obesity	15 (3.04)	2 (13.33)
Smoking	10 (2.02)	1 (10)
None	241(48.08)	3 (1.24)
Total	493	51 (10.34)

Table 4: Elucidates a prior risk factor was present in 252 patients (51.11%). Of 493 patients who underwent surgery, 51 patients developed SSIs. 51 patients with SSI have undergone culture tests. The organisms isolated were Staphylococcus aureus in 32 cases, Klebsiella in 7 cases, Pseudomonas aeruginosa in 5 cases and Enterococci in 2 cases. In 5 patients, no specific organism was isolated.

Table 5: Factors Associated with Surgical Site Infections Occurrence Among Surgical Patients

Variables	**No. of Patients (%)**	**SSI Present (%)**	**NO SSI (%)**
Age in Years			
Less than 25 years	107 (21.70)	8 (7.47)	99 (92.52)
25-50 years	261 (52.94)	21 (8.05)	240 (91.95)
More than 50 years	125 (25.35)	14 (11.2)	111 (88.8)
Sex			
Males	306 (62.06)	31(10.13)	275 (89.86)
Females	187 (37.93)	12(6.41)	175 (93.58)
Pre-operative Antimicrobial prophylaxis			
Received	425 (86.20)	14 (3.29)	411 (96.70)
Not Received	68 (13.79)	59 (86.76)	9 (13.23)
Timing of Antimicrobial prophylaxis administration (h)			
30 minutes before surgery	45 (10.58)	4 (8.88)	41 (91.11)
30 minutes to 1 hour before incision	349 (82.11)	41 (11.74)	308 (88.25)
1 to 2 hours before incision	31(7.29)	6(19.35)	25(80.64)
Type of Surgery			
Elective	346 (70.18)	24 (6.93)	322 (93.06)
Emergency	147 (29.81)	19 (12.92)	128 (87.07)
Comorbidities			
Yes	252 (51.11)	40 (15.87)	212 (84.12)
NO	241(48.08)	3 (1.24)	238(98.75)
Wound Class			
Clean	332 (67.34)	22 (6.62)	310 (62.88)
Clean contaminated	118 (23.93)	9 (7.62)	109 (7.62)
Contaminated	24(4.86)	7 (29.16)	17 (70.83)
Dirty	19 (3.85)	5 (26.31)	14 (73.68)

DISCUSSION:

The use of prophylactic antibacterial agents has significantly reduced post-operative patient mortality and morbidity. Standard antibiotic prophylaxis guidelines recommend administering these medications before surgery to minimize the risk of infection. Today, the use of these agents is essential to lower the chances of infection following surgical procedures.[13] In this study, antibiotics

were administered preoperatively, and the incidence of surgical site infections (SSIs) was subsequently assessed.

The majority of patients in this study were male (306, 62%), which aligns with findings from other studies, including Patel DJ et al. (62.5%)[14] and Kumar et al. (61.77%).[15] This is in contrast to the study by Joshi et al[16].,which reported a female predominance.

The majority of patients were in the 25-50 years age group (52.94%). This could be attributed to their active lifestyle and long working hours, which may increase their susceptibility to conditions that require surgical intervention. This finding is consistent with other studies.[15]

While Bhansali et al.[17] reported that 57.08% of patients were in the 40 to 60 years age group our study found the majority of patients were between 25-50 years of age. Regarding prophylactic antibiotic use, 425 (86.20%) of surgical patients received surgical antibiotic prophylaxis, which is consistent with the findings of the study by Kefale et al.[18] (88.6%) and which is higher than the 72.1% reported by Alamrew et al.[19] and lower than the 92.0% reported by Lijaemiro et al.[20]

In the present study, 10.34% of patients developed surgical site infections (SSIs), which is consistent with findings from previous studies by Mukagendaneza et al. (10.9%)[21]and Alamrew et al.[19](11.1%).[19] The incidence is higher compared to studies by Ghali et al.[22] (8.6%) and Fisha et al.[23] (9.9%). Conversely, the prevalence in our study is lower than that observed in studies by Tekie et al.[24](18%) and Sievert et al.(19.1%).[25]

The disparity in SSI incidence may be due to differences in patient profiles, surgical procedures, and hospital practices, including antibiotic stewardship and infection control measures. Variations in the timing, choice, and duration of antibiotic prophylaxis also likely contribute.

Family Physicians recommendations, prophylactic antibiotics should be initiated within 1 hour before surgical incision.[26] This supports our study finding as most of our study participants 349 (82.11%) received SAP within 1 hour before surgical incision. This is comparable to a study conducted by Ayele (208, 83.5%)[27] and Afzal khan et.al.[28] 19.35% of SSIs may be linked to receiving antibiotic prophylaxis 1-2 hours before incision.

Additionally, a higher proportion of surgical procedures were classified as clean (67.34%, 38.1% of surgeries), which is lower compared to the study by Aragaw et al.[29] where 54% of surgical wounds were clean and 80% of patients received preoperative prophylaxis. In our study, 332 (67.34%) surgeries were clean, followed by 118 (23.93%) with clean-contaminated wounds, and only 24 (4.86%) had contaminated wounds. This finding aligns with the study by Ayele et al.[27] SSIs were more frequent in contaminated (29.16%) and dirty wounds(26.31%), suggesting that wound classification plays a critical role in SSI occurrence, with lower infection rates in clean and clean-contaminated surgeries. This is consistent with the findings of Weldu et al.[30] and Mezemir et al.[31]These wound types are more conducive to the colonization and proliferation of various pathogens.

A higher percentage of surgical procedures were general (69.57%). In contrast, Laloto et al.[32] and Awoke et al.[33] found that head and neck procedures (29.5%) and abdominal surgeries (42.9%) were the most common surgical procedures, respectively. Furthermore, most procedures in our study were elective (70.18%), which is consistent with the findings of Awoke et al.[33] (69.28%). 12.92% of SSIs could be linked to emergency surgeries.

A single antibiotic was used in 88 (20.22%) of the surgical patients, with ceftriaxone being the most commonly administered, consistent with the findings of Ayele et al.[27] The combination of ceftriaxone and metronidazole (48.70%) was the most frequently used combination therapy, administered to 347 (79.77%) patients, consistent with the findings of Misganaw et al.[34] and Alamrew et al.studies.[35]

Our study identified several risk factors contributing to surgical site infections (SSIs), with patients having comorbidities being at a higher risk of developing SSIs compared to those without comorbidities. This finding aligns with the study by Allaf Navirian et al.,[36] which suggests that the presence of comorbidities may increase the susceptibility to infections due to compromised immunity.

A total of 51 patients (10.34%) developed surgical site infections (SSI), with Staphylococcus aureus being the most commonly isolated organism. This aligns with the findings of the study by Neigi et al.,[37] but contrasts with the study by Khairy et al.,[38] where Escherichia coli was the predominant organism identified.
The study's limitations include the lack of patient-specific data, such as comorbidities, and the absence of postoperative infection assessment, restricting evaluation of the clinical impact of inappropriate antibiotic use. Thus, implementing an antibiotic stewardship program is necessary.

Conclusions: In conclusion, 86% of surgical procedures received antimicrobial prophylaxis, either as single agents or in combination. However, the antibiotic selection was often inappropriate, with the frequent and unjustified use of Ceftriaxone and its combination with Metronidazole. This highlights the need for better adherence to guidelines to prevent misuse and reduce the risk of antimicrobial resistance.

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