ORIGINAL RESEARCH

To evaluate the utilization of antimicrobial prophylaxis in surgical patients at a tertiary care hospital

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ABSTRACT

Background: Surgical site infection is one of the most common causes of the morbidity and mortality in postoperative patients. Surgical antibiotic prophylaxis (SAP) has been a boon in the prevention of surgical site infections (SSIs). **Aim:** To evaluate the utilization of antimicrobial prophylaxis in surgical patients at a tertiary care hospital. **Materials and methods:** The study included a cohort of 100 patients. This study included individuals of all genders and ages who had undergone a surgical procedure, as well as patients who were willing to provide informed consent. The data were collected in accordance with a standardized format, developed based on the criteria established by the World Health Organization (WHO). This format encompassed various aspects, such as the demographic characteristics of the patients, the antimicrobial prescriptions given from the time of admission to discharge, and the examination of operative notes to identify instances of antimicrobial administration during surgery. **Results:** Almost, all the patients (96%) receive intravenous preoperative antimicrobial dose on the day of surgery. Most commonly prescribed 80(80%) antimicrobials were third-generation cephalosporins, followed by aminoglycosides 38 (38%). Ceftriaxone was the most frequently prescribed antimicrobial in 76(76%) patients. Among these, the most commonly prescribed group was the third-generation cephalosporin (75%). While individually amikacin (60%) was the most commonly prescribed individual AMA followed by ceftriaxone (45%) and metronidazole (53%). Fixed-dose combinations were also frequently used; among them piperacillin-tazobactam (22%) was the most common combination used followed by the ceftriaxone-sulbactam (21%) and amoxy-clavulanic acid (14%). **Conclusion:** The findings of the current investigation indicate a notable lack of adherence to SAP-stranded guidelines, particularly with regards to the extended utilization of antimicrobial agents following surgery.

Keywords: Surgical Site Infections, Antimicrobial, Prophylaxis

INTRODUCTION

Surgical Site Infections (SSI) are a frequently encountered complication linked to surgical procedures, with documented occurrence rates ranging from 2% to 20%. Additionally, it is noteworthy that this condition ranks as the second most prevalent etiology of nosocomial infections [1]. Surgical antimicrobial prophylaxis entails the administration of a short-term regimen of antimicrobial medication immediately prior to a surgical procedure, with the aim of preventing infections at the site of surgery [2]. Surgery is regarded as one of the most widely accepted practices in the medical field. Nevertheless, despite the available evidence supporting the efficacy and the existence of published guidelines for antimicrobial prophylaxis, its utilization is frequently observed to be less than ideal [3]. Surgical prophylaxis accounts for an estimated 30-50% of antimicrobial utilization within hospital settings. Nevertheless, studies have indicated that a significant proportion, ranging from 30% to 90%, of the administration of this prophylactic treatment is deemed inappropriate [4]. The achievement of optimal prophylaxis necessitates the careful selection of antimicrobials that are both safe and effective. It also involves administering the initial dose at an appropriate time and considering redosing if necessary. This is done to ensure that adequate levels of the antimicrobial are maintained in the patient's serum and tissues throughout the surgical procedure. Finally, discontinuation of prophylaxis should occur when the patient no longer derives any

therapeutic benefit. [3] The utilization of inappropriate doses and prolonged administration after surgery does not yield any additional advantages and may potentially elevate the occurrence of drug-resistant pathogens in subsequent hospital-acquired infections [5]. Section After the emergence of antimicrobial resistance, its consequences can profoundly affect the morbidity and mortality rates of patients, consequently leading to an escalation in healthcare expenditures [6]. The existing body of research provides evidence of the prevalent concern regarding the improper utilization of antimicrobial agents. The results of this study provide compelling evidence supporting the necessity of conducting studies on the utilization of antimicrobial drugs as a means of establishing quality control or conducting audits of antimicrobial therapy [7]. Given the prevalence of medication errors in hospitals, it is important to address the issue of errors in antimicrobial prophylaxis for surgical patients. In India, there is a lack of sufficient information and standardized treatment guidelines for surgical antimicrobial prophylaxis. Therefore, it is necessary to gather baseline data on the current utilization of prophylactic antimicrobials in order to inform any potential modifications that may be recommended. Multiple studies have reported inadequate compliance with the established guidelines, particularly in relation to the selection, timing, and duration of antimicrobial prophylaxis [10,11]. The current study was undertaken to investigate and evaluate the prescription patterns of antimicrobial drugs among patients undergoing surgical procedures at a tertiary care hospital in India.

MATERIALS AND METHODS

A prospective observational study was carried out in Acharya Shri Chander College of Medical Sciences and Hospital Jammu, India after obtaining prior approval from the Ethical Committee. The study included a cohort of 100 patients. This study included individuals of all genders and ages who had undergone a surgical procedure, as well as patients who were willing to provide informed consent. The study excluded patients with contaminated wounds, patients with severe illnesses, and patients who either died or were transferred to higher-level medical facilities. Participants were provided with written informed consent after receiving a comprehensive explanation of the study's purpose and nature in a language that they understood.

The study encompassed the entire duration of patients' hospitalization, from admission to discharge. The data were collected in accordance with a standardized format, developed based on the criteria established by the World Health Organization (WHO). This format encompassed various aspects, such as the demographic characteristics of the patients, the antimicrobial prescriptions given from the time of admission to discharge, and the examination of operative notes to identify instances of antimicrobial administration during surgery. In order to examine the prescription pattern, the study utilized several prescribing indicators, including the selection and mean quantity of antimicrobial agents, the proportion of drugs administered via injections, the dosage, timing, and overall duration of the prophylactic treatment. The investigator refrained from intervening in the patient's care in any manner.

STATISTICAL ANALYSIS

Data were entered into Microsoft excel sheet. It was analyzed and presented as percentage, mean, and standard deviation. Statistical analysis was done using SPSS version 25.0 .

RESULTS

A cohort of 100 individuals (43 females and 57 males) was examined throughout their period of hospitalization until their release. The average age of the patients was 46.14 ± 5.83 years. The mean duration of hospitalization was 12.11 ± 2.98 days, ranging from a minimum of 4 days to a maximum of 30 days. During the duration of the study, patients underwent a range of surgical procedures. Based on the classification of surgical wounds, the majority of patients (53) had clean-contaminated surgical wounds, while a small number of patients (7) had contaminated surgical wounds [Table 1].

Table 1 Basic profile of the patients

	Number	Percentage
Gender		
Male	57	57
Female	43	43
Mean age	46.14 ± 5.83	
Average stay in the hospital	12.11 ± 2.98	
Surgical wound classification		
Clean	40	40
Clean-contaminated	53	53
Contaminated	7	7

Almost, all the patients(96%) receive intravenous preoperative antimicrobial dose on the day of surgery. No intraoperative antimicrobial was administered to any patient. Majority of the patients (53%) were prescribed single antimicrobial drug, out of which 15 (15) patients were given the fixed-dose combination

of antimicrobial. While 15(15%) patients were prescribed three antimicrobial drugs [Table 2]. Most commonly prescribed 80(80%) antimicrobials were third-generation cephalosporins, followed by aminoglycosides 38 (38%). Ceftriaxone was the most frequently prescribed antimicrobial in 76(76%) patients [Table 3]. Out of which 14 patients were prescribed ceftriaxone as fixed-dose combination of ceftriaxone-sulbactam. Postoperatively, various other antibiotics like amikacin and metronidazole were added. All the patients were prescribed intravenous postoperative antimicrobials and variations were seen in the number as well type of antimicrobials being prescribed to the patients. Majority of the patients (52%) were prescribed three antimicrobial drugs [Table 4]. Among these, the most commonly prescribed group was the third-generation cephalosporin (75%). While individually amikacin (60%) was the most commonly prescribed individual AMA followed by ceftriaxone (45%) and metronidazole (53%). Fixed-dose combinations were also frequently used; among them piperacillin-tazobactam (22%) was the most common combination used followed by the ceftriaxone-sulbactam (21%) and amoxy-clavulanic acid (14%). [Table 5]. Cephalosporin plus an aminoglycoside plus an anti-anaerobic agent was the preferred prescribed postoperative antimicrobial combination. The duration of postoperative prophylaxis typically spans a minimum of 24 hours, or longer, for all patients throughout their hospitalization period. During their hospitalization, the patients received AMAs, and the average length of time for administering postoperative prophylactic antimicrobials was 9.11 days. The surgeons conducted an evaluation of the surgical site in a sample of 100 patients, revealing that 10 individuals (10%) experienced surgical site infections (SSIs).

Table 2: Number of antibiotics prescribed preoperatively

Number of antibiotics	Number of patients	Percentage	As FDC (%)	Percentage
None	4	4	-	
1	53	53	14	14
2	28	28	10	10
3	15	15	-	

Table 3: Groups and types of antibiotics prescribed preoperatively

Antibiotics groups	Antibiotics	Number of patients	Percentage	As FDC	Percentage
Cephalosporins	Ceftriaxone	76	76	14	14
	Cefixime	4	4		
Nitroimidazoles	Metronidazole	20	20		
Aminoglycosides	Amikacin	35	35		
	Gentamycin	3	3		

Table 4: Number of antibiotics prescribed postoperatively

Number of antibiotics	Number of patients	Percentage	As FDC	Percentage
1	12	12	5	5
2	24	24	10	10
3	52	52	25	25
4	12	12	1	1

Table 5: Antibiotics prescribed postoperatively

Antibiotic group	Antibiotics	Number	Percentage	As FDC
Cephalosporins	Ceftriaxone	45	45	21
	Cefotaxime	1	1	4
	Cefixime	3	3	
	Cefuroxime	1	1	
Penicillins	Piperacillin	1	1	22
	Amoxicillin	-	-	14
Aminoglycosides	Amikacin	60	60	-
	Gentamycin	4	4	
	Netilmycin	2	2	
Nitroimidazoles	Metronidazole	53	53	
Fluoroquinolones	Ofloxacin	1	1	
	Levofloxacin	1	1	
	Ciprofloxacin	1	1	
Imipenem	Meropenem	3	3	

DISCUSSION

The primary aim of this study was to investigate the utilization patterns of antimicrobial agents within our healthcare facility. The majority of patients in our study exhibited clean-contaminated surgical wounds, which aligns with the findings of a study conducted in Dutch hospitals. Clean-contaminated wounds have a higher likelihood of becoming infected in comparison to clean wounds, while contaminated wounds exhibit the highest rate of infection [12,13] The implementation of a universal SAP guideline cannot be solely based on the type of surgical wound, as the occurrence of surgical site infections (SSIs) is also influenced by additional factors including the site and duration of the procedure, as well as the overall health of the patient, such as glucose levels and weight.[14] In our investigation, a significant proportion of the patients (96%) were administered preoperative prophylactic antimicrobials, a finding consistent with a study conducted in Greece [15]. However, this contrasts with the results of studies conducted in Ahmedabad and Kerala[11,16], where all patients received preoperative prophylactic antimicrobials. In the present study, a limited number of patients with uninfected wounds did not receive SAP in accordance with the guidelines. In accordance with the guidelines set forth by the Society of Antibiotic Pharmacology, the preoperative antibiotic dose was administered intravenously to all patients. The majority of patients (53%) were prescribed a single preoperative antimicrobial drug, which aligns with the guidelines set by the SAP. These guidelines state that a single intravenous dose of a single antimicrobial is adequate for preventing surgical site infections (SSIs). [13]According to the study, the AMA group that was most frequently prescribed was cephalosporins, which was followed by the aminoglycosides and the anti-anaerobic agent known as metronidazole [13]. These findings align with the results reported in other studies, which similarly identified cephalosporins as the antimicrobials most frequently prescribed.[11,12,17] In our study, it was observed that ceftriaxone was the predominant cephalosporin prescribed, which contrasts with the findings of a study conducted in Delhi where cefotaxime was reported as the most frequently utilized cephalosporin.[17] Similarly, a study conducted in Czech Republic revealed that cefazolin was the most commonly prescribed cephalosporin.[18] According to recent guidelines, it is recommended to utilize first-generation cephalosporins, such as Cefazolin, as SAP. However, the selection of antimicrobial agents may be influenced by the local resistance patterns and the surgeon's personal experience within the hospital setting. The utilization of two antimicrobial agents and three antimicrobial substances exhibits a substantial prevalence within our research investigation. They were primarily employed as a form of prophylactic treatment to mitigate the risk of infection. The most frequently utilized AMA combinations in clinical practice consist of cephalosporin, amikacin, and metronidazole. However, there is a limited amount of data available that demonstrates any additional advantages resulting from the inclusion of an aminoglycoside. The timing of administration in SAP is a crucial factor, ideally occurring within one hour of the incision in order to attain a plasma concentration of sufficient minimum inhibitory concentration. Antimicrobial agents were administered to all patients on the day of surgery; however, there was incomplete documentation pertaining to the specific timings of antimicrobial administration. One possible explanation for this phenomenon could be the consistent timing of antimicrobial administration in hospital wards, regardless of the timing of surgeries. This issue could potentially be addressed by having anesthetists administer antimicrobial drugs in the operating room.

In the present investigation, it was observed that none of the subjects were administered antimicrobial doses during the intraoperative period. This was attributed to the fact that the surgical procedures lasted less than 4 hours and did not involve substantial blood loss. Current guidelines advocate for the administration of a solitary dose of antimicrobial medication with a plasma half-life of adequate duration as SAP, while emphasizing that its administration should not exceed a duration of 24 hours.[13] In our research, there was a significant increase in the quantity of antimicrobials prescribed following surgical procedures in comparison to the preoperative period. Following the surgical procedure, a significant proportion of patients (88%) were prescribed a combination of two or more antimicrobial medications. Notably, the majority of patients (52%) were administered a regimen consisting of three antimicrobials. In contrast to the preferred preoperative antimicrobial agents, aminoglycosides were frequently administered in conjunction with cephalosporins. Amikacin was administered to 60% of the patient population, typically in conjunction with other antimicrobial agents, while ceftriaxone was prescribed to 45% of the patients. The majority of patients received antimicrobial treatment via both parenteral and oral administration routes, with an average duration of 9.11 days. This duration exceeds the recommended guidelines. Numerous additional studies have also reported the extended utilization of antimicrobial prophylaxis following surgical procedures.[12,17] Furthermore, it was observed that newer antimicrobial agents (AMAs) such as meropenem, imipenem, and linezolid were also utilized in the postoperative period. These findings align with previous studies that have reported excessive antibiotic usage.[11,17] Out of the total sample size, 10 patients, accounting for 10% of the population, experienced surgical site infections (SSI). Several studies conducted in India have demonstrated a range of incidence rates, ranging from 8.95% to 17.8%. These findings indicate that providing blanket prophylaxis alone is insufficient for

effective prevention.[19,20] This study demonstrates that the utilization of antimicrobials for prophylactic purposes, particularly in the postoperative period, is deemed inappropriate for the majority of patients. The significance of minimizing postoperative infections cannot be overstated; however, the extended use of antimicrobial agents not only contributes to the development of resistant microbial strains but also escalates the occurrence of adverse effects associated with these agents, as well as the financial burden of treatment.[21]

CONCLUSION

The findings of the present study indicate a notable lack of adherence to SAP-stranded guidelines, particularly with regards to the extended utilization of antimicrobial agents following surgery. Further research is required to ascertain the extent of antibiotic utilization in various surgical disciplines, including orthopedics, obstetrics, and gynecology. This study highlights the urgent necessity for the development and widespread distribution of local guidelines for the appropriate use of SAP among healthcare professionals, given the global issue of antibiotic resistance.

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