Patten of Antibiotics prophylaxis and incidence of surgical site infection

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ABSTRACT

Introduction: Surgical prophylaxis accounts for around 30-50% of antibiotic utilization in hospitals. However, a significant portion of this prophylactic usage, ranging from 30% to 70%, is deemed inappropriate. The primary reasons for inappropriateness include administering the antibiotic at the wrong timing or prolonging its use beyond the necessary duration. There is still ongoing debate regarding the optimal duration of prophylaxis as well as which specific surgical procedures warrant prophylactic treatment.
Material method: This study was conducted in Department of General Surgery in Heritage Institute of Medical Sciences Varanasi. The duration of study was over a period of Two years.A total of 68 patients were assessed for surgical site infection and surgical prophylaxis.
Result: This analysis of patient characteristics revealed that patients with older age (>68 yrs) had the highest percentage of infection among all age groups. Moreover, females had a higher percentage of infection than males. Also, patients who had a longer duration of the procedure, dirty wound, and postantibiotic administration of prophylaxis had a higher frequency of SSI compared to their category.
Conclusion: This study concludes a higher rate of surgical site infections (SSIs). Several factors were found to be statistically significant in relation to SSIs, including wound class, preexisting medical conditions, prolonged duration of surgery, absence of antibiotic prophylaxis, and the timing of antibiotic administration.
Keywords: Surgical site infections, Antibiotic prophylaxis, wound class

INTRODUCTION

Healthcare-Associated Infections (HAIs) continue to be a significant issue in public health. Among these, Surgical Site Infections (SSIs) contribute to a noteworthy mortality rate, substantial morbidity, prolonged hospital stays, and increased healthcare costs. [1] Among surgical patients, wound infections are the most frequent hospital-acquired infections. They lead to heightened antibiotic utilization, escalated expenses, and extended hospital stays. [2] While the use of suitable antibiotic prophylaxis can decrease the likelihood of postoperative wound infections, it's important to note that additional antibiotic usage can contribute to the selective pressure that promotes the development of antimicrobial resistance.[3] Surgical antibiotic prophylaxis refers to the administration of antibiotics to prevent infections specifically at the surgical site. It is important to differentiate it from the preemptive use of antibiotics to treat early infections, even if the infection is not clinically evident, such as in cases of perforated appendix or hernia. The original experiments on surgical antibiotic prophylaxis were conducted 40 years ago using pigs as subjects. The findings concluded that the most effective timeframe for prophylaxis is within three hours from the moment bacteria enters the tissues. Since then, numerous studies have been conducted in both animal models and human patients undergoing surgery. As a result, the principles of antibiotic prophylaxis have become an established and accepted component of surgical practice. [4] Currently, surgical prophylaxis accounts for around 30-50% of antibiotic utilization in hospitals. However, a significant portion of this prophylactic usage, ranging from 30% to 70%, is deemed inappropriate. The primary reasons for inappropriateness include administering the antibiotic at the wrong timing or prolonging its use beyond the necessary duration. There is still ongoing debate regarding the optimal duration of prophylaxis as well as which specific surgical procedures warrant prophylactic treatment. [5] Antibiotic prophylaxis is a crucial component among several measures implemented to lower the incidence of Surgical Site Infections (SSIs). The primary objective of antibiotic prophylaxis is to decrease the bacterial presence in the surgical wound and support the natural defense mechanisms of the body in preventing SSIs. When antibiotic prophylaxis is appropriately utilized during the perioperative period, it has the potential to reduce the rate of this complication by up to 50%.[6]

The administration of surgical antibiotic prophylaxis (SAP) prior to surgery is a practice supported by evidence to prevent the occurrence of Surgical Site Infections (SSIs). According to the literature, it is recommended that antibiotics be given within a timeframe of at least 30 minutes but no more than 60 minutes before making the incision. However, it is important to consider factors such as the characteristics of the specific pathogen, pharmacokinetics and pharmacodynamics of the antibiotics, proper timing, dosage, and route of administration.[7] These factors play a significant role in the effectiveness of SSI prevention and the appropriate use of prophylactic antibiotics.[8] As per the guidelines set by the World Health Organization (WHO), the recommended maximum duration for post-operative prophylaxis administration is within 24 hours of the initial incision. Additionally, antibiotic prophylaxis is typically recommended in cases involving contaminated wounds, penetrating wounds, abdominal trauma, compound fractures, and wounds with devitalized tissue. These types of wounds carry a higher risk of infection, making antibiotic prophylaxis an important preventive measure. [9-10] Despite the recommended guidelines, various studies have found that surgical antibiotic prophylaxis (SAP) is frequently administered inappropriately. The irrational use of prophylactic antibiotics is often observed in terms of inappropriate choice, timing, and duration of SAP. Several studies have reported that a significant proportion of surgical patients, ranging from 30% to 50%, are prescribed prophylactic antibiotics, with a high percentage (30% to 90%) of these prescriptions being deemed inappropriate.[14-15] The irrational use of prophylactic antibiotics in surgical settings has led to various adverse effects, which have been commonly reported. These include increased healthcare costs, extended hospital stays, superinfections, the development of antibiotic resistance, and adverse drug reactions. These consequences are often attributed to the inappropriate choice, timing, and duration of prophylactic antibiotics, highlighting the importance of ensuring rational and evidence-based practices in antibiotic prophylaxis to mitigate these adverse effects.[7,12] Hence, the objective of this study is to evaluate the practice of surgical antibiotic prophylaxis and the prevalence of surgical site infections among surgical patients. The findings from this study will provide valuable insights that can contribute to the enhancement of surgical site infection control measures and promote the rational utilization of antibiotic prophylaxis. By identifying areas of improvement and addressing any existing gaps, this research aims to improve patient outcomes and optimize the use of antibiotics in surgical settings.

MATERIAL & METHODS

Study Area: This study was conducted in Department of General Surgery in Heritage Institute of Medical Sciences Varanasi.

Study Duration: The duration of study was over a period of Two years.

Study population: A total of 68 patients were assessed for surgical site infection and surgical prophylaxis

Data collection: Data collection format containing the variables to be measured was developed and used for the collection of data on sociodemographic characteristics, surgery-related parameters (preoperative, intraoperative, and postoperative data), and potential risk factors. Wound classification and diagnosis of SSI were done by the attending physician. Information about SSI was obtained through a medical chart review. Each patient was assessed from the time of admission until the time of discharge. Details that were recorded include the type of surgery, wound class, type and duration of operation, antimicrobial prophylaxis, preoperative hospital stay, and total hospital stay. The data quality was controlled before collection through pretesting and during and after collection through direct observation.

Data analysis: Data were analysed by using Microsoft Excel.

RESULTS

A total 136 cases were included for SSTI and surgical prophylaxis. Among all 70 were male rest were female. Out of 136 cases 52 were belonged to 21-30 age group followed by >50 (30),31-40(24),41-50(18) & <20(12). Among the total patients, 24 were with the comorbid condition, and 32 had developed SSI.

Moreover, 76 were emergency operations, and gastrointestinal (GI) was the most frequent, 42, surgical procedure. Of the total procedures, 50 were clean, and the rest accounts for clean-contaminated, contaminated, and dirty wounds. Antibiotic prophylaxis was administered in 118 operations and most, 52 , of the drugs were given preoperatively, of which 110 were given in IV. Besides, prophylaxis was extended over one day in 86 patients. Among all patients given antibiotic prophylaxis, 36 patients used single prophylactic agents, and the rest took a combination of drugs. The most frequently administered prophylactic antibiotics were a combination of ceftriaxone and metronidazole (56). Concerning the surgical site infection rate, 32 patients had developed infection.

This analysis of patient characteristics revealed that patients with older age (>68 yrs) had the highest percentage of infection among all age groups. Moreover, females had a higher percentage of infection than males. Also, patients who had a longer duration of the procedure, dirty wound, and postantibiotic administration of prophylaxis had a higher frequency of SSI compared to their category.

Chart: 1 Gender distribution

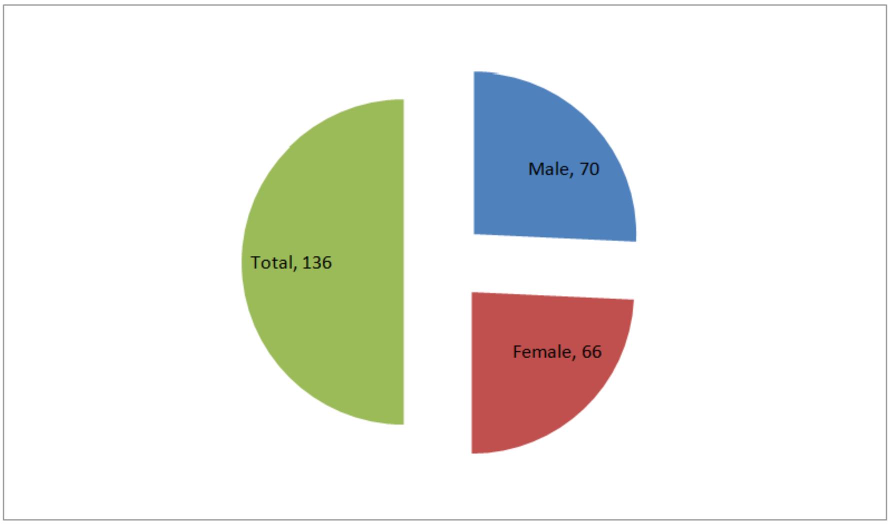

Chart 2 Age distribution

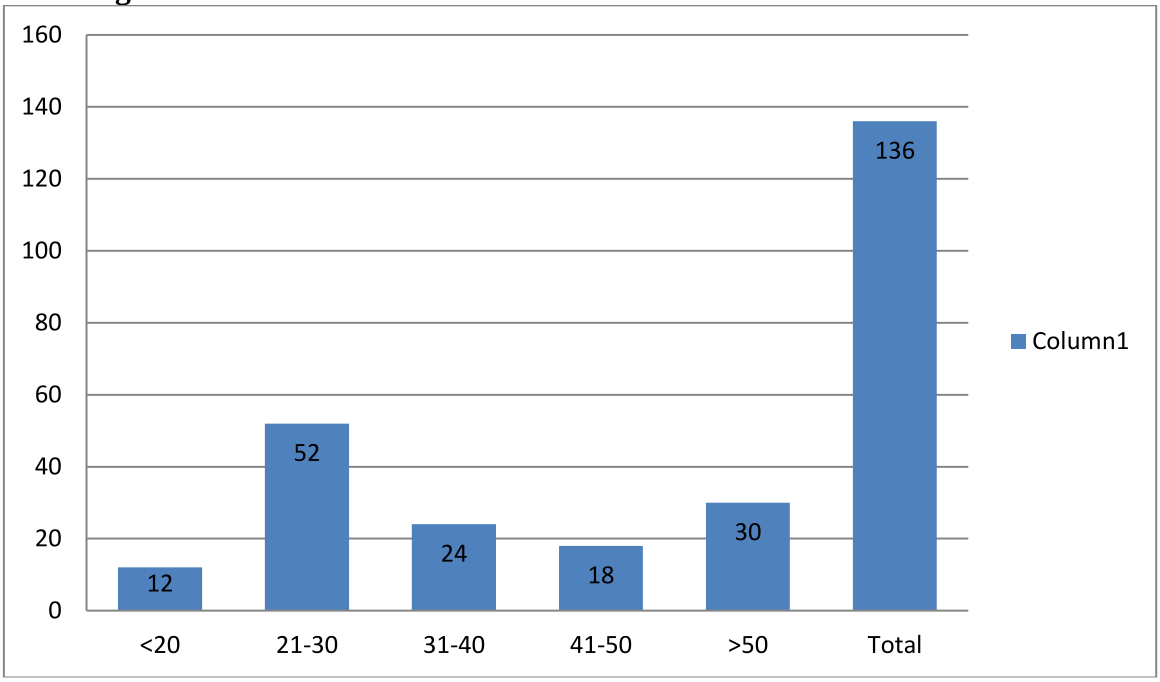

Table 1 Table Showing patient operation characteristics

Variables		Frequency
Patients comorbidity	Yes	24
	No	112
Nature of operation	Elective	60
	Emergency	76
Surgical Procedure	GI surgery	42
	Urosurgery	22
	Neck surgery	22
	Gynecologic surgery	20
	Orthopedic surgery	14
	Other surgery	16
Wound Class	Clean	50
	Clean-contaminated	44
	Contaminated	34
	Dirty	8
Duration of procedure	≤1 hr	86
	>1 hr	50
SSI	YES	32
	NO	52
Preoperative duration of hospitalization	≤1 day	60
	>1 day	76
Postoperative duration of hospitalization	≤3 day	74
	>3 days	62

Table 2 Characteristics of antibiotic prophylaxis administration

Variables		Frequency
Prophylaxis	Yes	118
	No	18

Timing of prophylaxis administration	Early	14
	Preoperative	52
	Perioperative	10
	Postoperative	42
Duration of SAP administration	>1	32
	>1	86
Route	IV	110
	IV and PO	8

Table 3 Prophylactic drugs used in surgical patients.

Prophylaxis drug	**Frequency**
Ceftriaxone	20
Cloxacillin	16
Ceftriaxone+metronidazole	56
Ceftriaxone+ampicillin	10
Ceftriaxone+gentamicin+metronidazole	8
Ceftriaxone+metronidazole+amoxicillin	8

DISCUSSION

Surgical Site Infections (SSIs) are recognized as one of the prevailing causes of healthcare-associated infections worldwide. They continue to pose significant health challenges, leading to heightened antibiotic consumption, escalated costs, prolonged hospital stays, and increased morbidity and mortality rates among patients [16]. The incidence of SSIs varies considerably, ranging from 2.5% to 41.9% based on diverse studies conducted globally and among different hospitals [17]. In this study, the rate of surgical site infections was determined to be 23.5%, which was found to be higher than the rate reported in a similar study conducted at Tikur Anbessa Specialized Hospital. [18] The rate of infection reported in this study, which was 23.5%, exceeded the rates found in similar studies conducted at Tikur Anbessa Specialized Hospital (17.9%) and in other countries such as India (16%), Muhimbili (20%), and Brazil (15%). This higher infection rate observed in the current study could be attributed to several factors, including the absence of an effective infection control system, suboptimal practices, and the indiscriminate use of antibiotics. These factors may have contributed to an increased risk of surgical site infections in the study population.[19] The study findings revealed that a prolonged duration of surgical procedures was identified as a significant risk factor for Surgical Site Infections (SSIs). Specifically, surgical procedures lasting longer than one hour were associated with approximately twice the risk of SSIs compared to procedures completed within one hour. This finding aligns with a similar study conducted in Thailand (RR = 3.26, 95%CI = 1.44-7.52) and is further supported by a study conducted in a Peruvian hospital. These consistent results highlight the importance of considering the duration of surgery as a contributing factor in the development of SSIs and emphasize the need for appropriate infection control measures during lengthy surgical procedures [20]. Additionally, the study identified wound class as another significant risk factor for the development of Surgical Site Infections (SSIs). The results indicated that wounds classified as "dirty" had the highest odds (7.33) of becoming infected, followed by contaminated wounds and clean-contaminated wounds. This higher infection rate among the former wound types can be attributed to the substantial influence of endogenous contamination during the surgical procedure, which is consistent with findings from other studies. These results underscore the importance of recognizing and appropriately managing different wound classes to mitigate the risk of SSIs[21]. Furthermore, the study highlighted that comorbid conditions were a significant and statistically significant risk factor (OR = 5, p = 0.00) for the development of Surgical Site Infections (SSIs). This finding is consistent with various studies in the literature, which have demonstrated that the prevalence of SSIs tends to be higher among individuals with comorbidities such as HIV/AIDS and other immunosuppressive conditions like malignancy and diabetes mellitus. These underlying health conditions can compromise the immune system and increase the vulnerability to infections, including SSIs [22- 23]. Furthermore, the study findings emphasized the importance of the timing of antibiotic administration and the presence of antibiotic prophylaxis in preventing surgical wound infections. It was observed that the administration of antibiotics postoperatively was associated with a 9.94 times higher risk of SSI compared to preoperative administration. Additionally, 13.24% of patients did not receive surgical antibiotic prophylaxis and had a 2.00 times higher risk of SSI compared to patients who received prophylaxis. The use of antibiotics for prophylaxis in surgical patients is a justified practice. However, it is crucial to consider factors such as the appropriate route of administration, timing, and duration of prophylactic antibiotics. These factors help ensure that high levels of antibiotics are present in the plasma and tissues during and shortly after the surgical procedure when the risk of bacterial contamination is at its peak. Making informed decisions regarding antibiotic prophylaxis can significantly contribute to reducing the incidence of surgical site infections. [24-25]. In this study, the majority of antibiotics were administered intravenously (IV) at a rate of 93.2%. This finding aligns with existing evidence [24], which also supports the preference for IV administration of antibiotics in surgical prophylaxis. However, it is noteworthy that despite the recommendations of using first-generation cephalosporins, such as cefazolin, for surgical site infections (SSIs), the most commonly administered antibiotics were ceftriaxone and metronidazole, accounting for 47.1% of cases. This deviation from the recommended guidelines highlights the need for ensuring adherence to appropriate antibiotic selection in surgical prophylaxis to optimize effectiveness and minimize the risk of antimicrobial resistance [24, 26]. Contrary to the findings of this study, previous research has indicated that first-generation cephalosporins, such as cefazolin, are commonly used in surgical prophylaxis [27, 28]. The frequent utilization of the combination of ceftriaxone and metronidazole in this study can be partially attributed to the limited availability of first-generation cephalosporins in the hospital setting. The study also revealed that the incidence of Surgical Site Infections (SSIs) increased with age, particularly among patients over the age of 68, although this association was not statistically significant. Similarly, there was no significant relationship observed between SSI development and the gender of the patients , which is consistent with findings from other studies. These findings align with other studies, as increasing age is typically associated with a higher likelihood of certain chronic conditions and decreased immunity, leading to delayed healing [23]. Additionally, the higher rate of Surgical Site Infections (SSIs) observed during emergency surgery may be attributed to inadequate preparation and planning before the surgical procedure. Therefore, the appropriate timing of antibiotic prophylaxis plays a crucial role in reducing the incidence of SSIs. Furthermore, considering factors such as the type of wound, duration of surgery, and presence of comorbid conditions also plays a vital role in minimizing the rate of SSIs. By taking these factors into account and implementing effective antibiotic prophylaxis protocols, healthcare providers can significantly contribute to the reduction of SSIs and improve patient outcomes.

CONCLUSION

This study highlighted a higher rate of surgical site infections (SSIs). Several factors were found to be statistically significant in relation to SSIs, including wound class, preexisting medical conditions, prolonged duration of surgery, absence of antibiotic prophylaxis, and the timing of antibiotic administration. In terms of antibiotic administration, the majority of antibiotics were administered intravenously (IV), which is consistent with common practice. The most frequently administered antibiotics in this study were ceftriaxone and metronidazole. However, it is worth noting that the choice of antibiotics may not align with recommended guidelines, as first-generation cephalosporins (such as cefazolin) are usually preferred for surgical prophylaxis. These findings emphasize the importance of adhering to appropriate antibiotic prophylaxis protocols, including the selection of the right antibiotics and the correct timing of administration, to reduce the risk of surgical site infections. By addressing these factors effectively, healthcare providers can contribute to improving patient outcomes and reducing the incidence of SSIs.

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