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Original Research Article

Surgical Site Infections after Operations and the Associated Antimicrobial Resistance Trends in Surgical Patients in Tertiary Care Hospital

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Abstract

Background: Postoperative patients' high morbidity, longer length of hospital stay, and greater financial burden were all caused by surgical site infections (SSI). The overuse of antibiotics has led to an increase in antibiotic resistance over the past ten years. The purpose of the current study is to assess the prevalence of postoperative surgical site infections and the pattern of antibiotic resistance in surgical patients.

Materials and Methods: The study included 80 adult patients of either sex who were scheduled for elective or urgent surgery. For 30 days, the patient's wound was monitored for surgical site infections. The specimens were either two wound swabs on sterile cotton swab sticks (one for culture and one for direct smear staining microscopy) or aspirated pus from the surgical wounds in a syringe. Tests for antibiotic susceptibility and culture were conducted using standard laboratory procedures.

Result: T The patients' average age was 44.46 ± 15.36 years, and 53 percent of them were men. The majority of cases (73.8%) included elective surgery. Klebsiella pneumoniae was the most often detected pathogenic bacteria at the surgical site infection, occurring in 22.5% of cases, followed by GPC in 15% and Escherichia coli in 13.8%. It was discovered that gram negative bacteria were more resistant to antibiotics than gram positive bacteria. The highest levels of antibiotic resistance were observed in gram-positive bacteria against penicillin (73.8%) and in gram-negative bacteria against ampicillin, ceftriaxone, cefotaxime, and ceftazidime (100%).

Conclusion: Most of the Gram-negative isolates exhibited dual resistance to commonly used antimicrobial medications. Ceftriaxone, a third-generation cephalosporin commonly used for antibiotic prophylaxis to avoid SSIs, was found to be ineffective against most gram-negative pathogens. This is consistent with international observations that highlight the necessity of modern antibiotic stewardship initiatives and the prudent use of preventative antibiotics.

Introduction

Health-care-related infections are the most common cause of morbidity among patients globally and are acquired by patients when they are in hospitals or other healthcare facilities. Surgical site infections (SSI) are the second most common form of infections associated to healthcare, after urinary tract infections.[1] Any infection at or near the surgical site that occurs within 30 days after an open or laparoscopic procedure, or within 90 days after a procedure requiring implants or a prosthesis, is classified as an SSI by the Centers for Disease Control and Prevention (CDC). High morbidity, a median 10-day increase in postoperative length of stay, and financial pressure on the patient and the hospital are all common outcomes of SSIs.[2] A surgery and the infection's severity.[3] The incidence of surgical site infections (SSIs) in gastrointestinal surgery varies widely across the globe, with 9.4% occurring in wealthy countries, 14.0% in middle-income countries, and 23.2% in low-income countries. A 2015 study found that while the combined incidence of SSIs was 7.8%, the combined prevalence of comprehensive SSIs in Southeast Asia was 9.0%.In India, SSIs are the leading cause of morbidity and mortality [4,5]. The rate of SSIs varies widely, ranging from 1.6% to

38%, depending on the environment.[6] Despite advancements in surgical techniques, sterilizing protocols, and operating room ventilation, SSIs remain a significant concern due to the proliferation of antimicrobial-resistant pathogens.[7] The World Health Organization (WHO) has called attention to the threat that antimicrobial resistance poses to the entire world and has called for improved antibiotic use as well as the creation of new resistance-fighting tactics.[8] Although antibacterial medications are essential for avoiding infections, their overuse has accelerated resistance, making the treatment of SSIs more difficult.[9] Specifically, resistance patterns have been found in bacteria such as Klebsiella pneumoniae, Staphylococcus aureus, and Escherichia coli, making it more difficult to treat these illnesses therapeutically.[4]

SSIs, with the goal of achieving efficient tissue concentrations throughout the surgical procedure. It is crucial to weigh the advantages and possible hazards of antibiotics because improper use can result in resistance. SSIs increase the use of antibiotics, which in turn contributes to antimicrobial resistance since they impose a significant burden of disability and extended hospital admissions.[5] There is a lack of data on the global epidemiology of SSI because many poor countries lack standardized diagnostic, surveillance, and notification systems. In India, researching SSIs has been a minor undertaking. Thus, the purpose of the current study is to assess the prevalence of surgical site infections following surgery as well as the pattern of antibiotic resistance.

Materials and Methods

Study Design: Present study was a prospective and observational study that was conducted over the duration of six months. All ethical guidelines were followed and informed consent was obtained from the patients. Total 80 patients were enrolled in the study. Only adult patients of either sex who were planned for elective or emergency surgery was enrolled in the study. Patients wound were observed for the surgical site infection for 30 days.

Sample Collection: The specimens were either aspirated pus from the surgical wounds in a syringe or two wound swabs on sterile cotton swab sticks (one for culture and one for direct smear staining microscopy). These samples were labeled with the patient's name, age, sex, inpatient number, bed number, ward, date, time, and mode of collection. Tests for antibiotic susceptibility and culture were conducted using standard laboratory procedures.

Culture and identification: The samples were inoculated onto Mac Conkey Agar (MA) and Blood Agar (BA) plates, and they were then aerobically incubated for 24 hours at 37°C. Additionally, Robertson's Cooked Meat medium was used to inoculate aspirated pus. Initial bacterial identification was based on a series of common biochemical assays, colony features, including hemolysis on blood agar, changes in physical appearance on differential media, and enzyme activities of the organisms. Gram staining of initial culture colonies was used to ascertain the Gram-reaction.

Antimicrobial Susceptibility: Antimicrobial susceptibility pattern of isolated bacterial pathogens was performed according to the guidelines. A sterile wire loop was used to select portions of two or three identical colonies in order to create the inoculum. The organisms were allowed to reach their log phase of growth by suspending this in sterile peptone water (broth) and incubating it for up to two hours. In the proforma, the causal organisms of SSI were noted together with their patterns of antibiotic resistance.

Stastical Analysis: Data collected was entered into excel work sheet. Data was analyzed using the SPSS software. The data is presented in form of number and fraction of total. Total frequency is divided into various subgroups for certain variables, and number and percentage of cases belonging to each group was calculated. Appropriate tables and graphs are used to represent the data.

Results

The patients were 44.46 ± 15.36 years old on average. Male patients made up 53% of the total, while female patients made up 27%. While emergency surgery was performed in 26.3% of instances, elective surgery was conducted in the majority of cases (73.8%). 32 (40%) of the cases had a clean post-surgical wound, compared to 4 (5%) who had a clean contaminated wound, 20 (25%) who had a contaminated wound, and 24 (30%) who had a dirty wound [Figure 1]. Klebsiella pneumoniae was the most often detected pathogenic bacteria at the surgical site infection, occurring in 18 (22.5%) cases, followed by GPC in 12 (15%) cases and Escherichia coli in 11 (13.8%) instances. Proteus mirabilis 11 (13.8%) cases, Acinetobacter spp in 9 (11.3%) cases, GNR in 8 (10%) cases, P. aeruginosa in 8 (10%) cases, and Staphylococcus aureus in 3 (3.8%) cases [Figure 2]. Gram-positive bacterial antibiotic resistance showed that 25 (31.3%) of the cases were resistant to gentamycin, 41 (51.2%) to ceftriaxone, 24 (30.0%) to ciprofloxacin, 67 (83.8%) to ampicillin, 57 (71.3%) to amoxiclav, 29 (36.3%) to cotrimoxazole, 19 (23.8%) to chloramphenicol, and 59 (73.8%) to penicillin [Figure 3]. Gram-negative bacterial antibiotic resistance showed that 70 (87.5%) of the cases were resistant to gentamycin, 80 (100.0%) to ceftriaxone, 45 (56.3%) to ciprofloxacin, 80 (100.0%) to ampicillin, and 70 (87.5%) to amoxiclav.

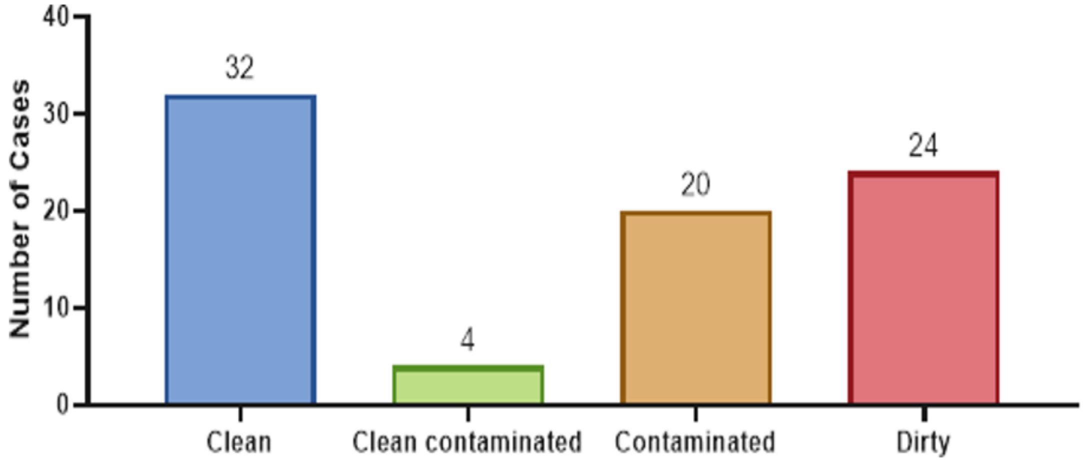

Figure 1: Condition of post -surgical wound.

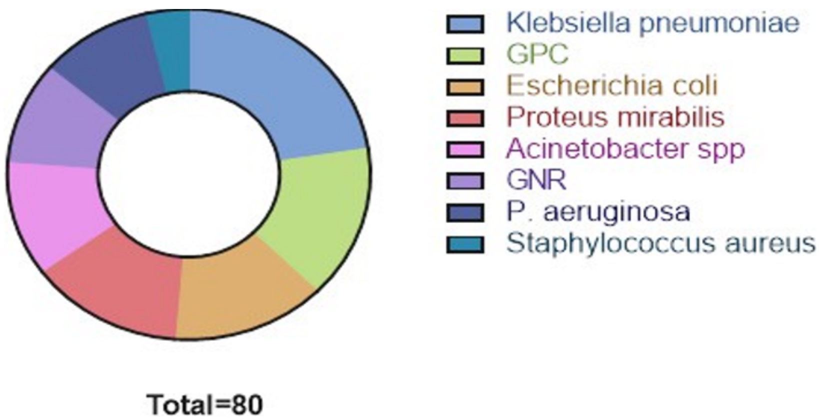

Figure 2: Pathogenic bacteria found at the surgical site infection.

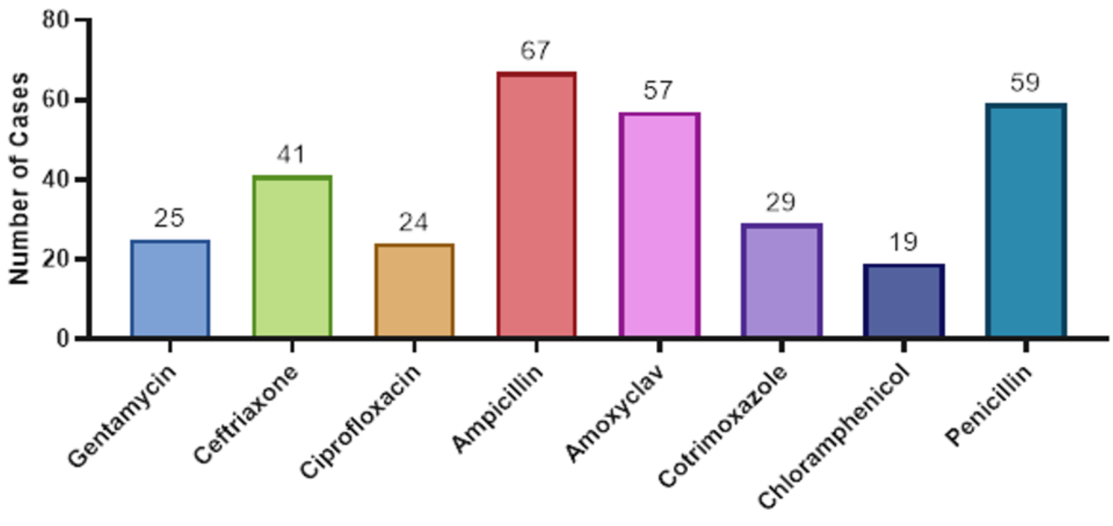

Figure 3: Antibiotic resistance against gram positive bacteria.

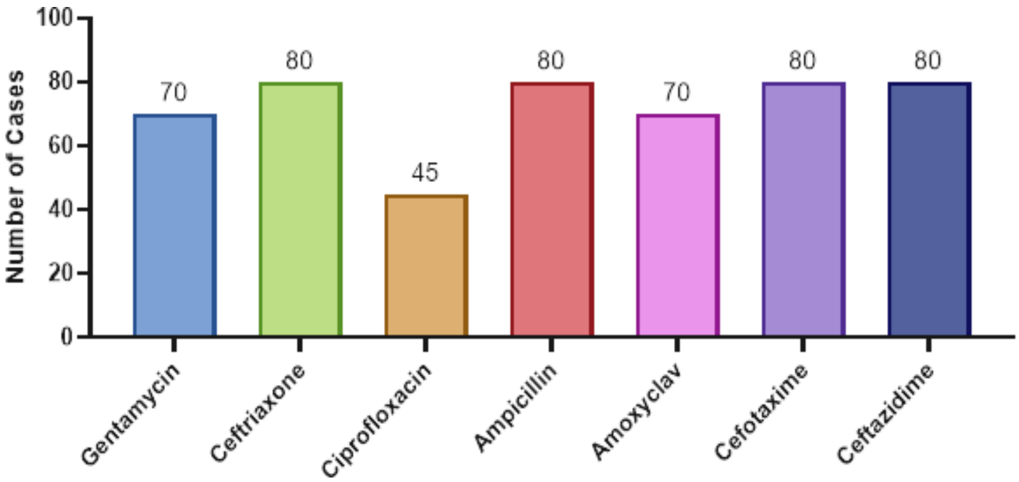

Figure 4: Antibiotic resistance against gram positive bacteria.

Table 1: Age and gender distribution of patients along with the type of surgery performed.

Variable	Domain	Number	Percentage
Mean age		44.46 ± 15.36 Yrs	
Gender	Male	Male	53
	Female	Female	27
Type of surgery	Elective	59	73.8
	Emergency	21	26.3

Discussion

The average age of the patients in this study was 44.46 ± 15.36 years, and 53 percent of the patients were men. The average age of the patients in the Dahal et al. study was 36.16±1.27 years, with 38.8% of them being men and 61.3% being women.[5] Similar to the current study, Oberoi et al.'s investigation found a male prevalence of 51%.[4] In our analysis, emergency surgery was done in 26.3% of instances, but elective surgery was done in the majority of cases (73.8%). The majority of patients (77%) in the Oberoi et al. study had emergency procedures, which runs counter to the results of this investigation. The differences between this study's varied findings and those of other studies could

According to our study's findings, 25% of post-surgical wounds were contaminated, and 30% were filthy. The proportion was higher when comparing this conclusion to the findings of Pathak et al. (5%) and Shrestha et al. (2.6%).[10,11] Nevertheless, the estimate was much lower than previous studies by Chaudhary et al. (77.6%) and Amatya et al. (60.6%).[12,13] The percentage of surgical wound infections with culture confirmation was 22.71% in the Dahal et al. study, which is comparable to the current study.[5] Differences in nosocomial pathogen distribution and infection prevention and control practices among different countries and healthcare facilities may be the cause of the discrepancy in the percentage of culture-confirmed SSI.

According to the current study, Klebsiella pneumoniae was the most often detected pathogenic bacterium at the surgical site infection, occurring in 18 (22.5%) cases, followed by GPC in 12 (15%) and Escherichia coli in 11 (13.8%) instances. Escherichia coli was the most common isolate in the Dahal et al. study (39.8%), followed by coagulase negative staphylococci (16.7%) and Staphylococcus aureus (12.0%).[5] Variability in these studies may be due to a number of reasons, including differences in the populations studied, the types of surgeries performed on research participants, and the timing of specimen collections.

Antibiotic resistance against gram negative bacteria was found to higher as compared to gram positive bacteria. In gram positive bacteria, highest antibiotic resistance was found against penicillin (73.8%) whereas in gram negative bacteria, highest antibiotic resistance was found against ceftriaxone, ampicillin, cefotaxime and ceftazidime (100%). The high percentage of infections caused by Gram-negative organisms in this study could have been caused by a number of variables. Gram-positive isolates in the Dahal et al. investigation were completely resistant to ampicillin, amoxicillin, and ampicillin/sulbactam. Ceftriaxone was completely ineffective against gram-negative bacteria, following amoxycillin- clavulanic acid (94%), amoxicillin (94.0%), cefixime (90.7%), and cefepime (89.8%).[5]

This aligns with global observations emphasizing the need for updated antibiotic stewardship programs and the judicious use of prophylactic antibiotics. Implementing more precise infection control protocols could help to mitigate the spread of these resistant organisms in clinical settings. Additionally, the role of hospital hygiene practices and patient education in reducing SSIs cannot be underestimated, as the transmission of resistant pathogens often involves lapses in infection control measures. Our findings underscore the importance of tailoring antibiotic prophylaxis based on local resistance data to enhance patient outcomes and minimize the risk of resistant infections.

This approach could lead to more targeted therapies, ultimately reducing the incidence of SSIs and improving recovery times for patients. Present study has some limitations which need to be discussed so that the further studies could be planned more efficiently. The first limitations of the study are the small sample size. Due to small sample size, the results of this study could not be generalized. Moreover, since all the case in present study was taken from a single hospital, the findings may exhibit variation when applied on wider demographics. Further multicentric studies by taking the ample sample size needed to be conducted to validate the findings of this study.

Conclusion

Gram negative bacteria were shown to be more resistant to antibiotics than their gram positive counterparts. Most of the Gram-negative isolates exhibited dual resistance to commonly used antimicrobial medications. Ceftriaxone, a third-generation cephalosporin commonly used for antibiotic prophylaxis to avoid SSIs, was found to be ineffective against most gram-negative pathogens. This is in line with international observations that highlight the necessity of modernized antibiotic stewardship initiatives and the prudent application of preventative antibiotics. The spread of these resistant pathogens in healthcare settings may be minimized by putting in place more exact infection control procedures. Additional multicentric research using the sufficient sample size required to confirm the results of this investigation.

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