Section: Miscellaneous

Original Research Article

POSTOPERATIVE SURGICAL SITE INFECTIONS AND ANTIMICROBIAL RESISTANCE PATTERN IN SURGICAL PATIENTS

Kiran Kumar[1], Deepthi Vadakattu[2], Anish Kumar Jain[3], Devasani Srinivasa[4], Deva Suman Sujith Kumar[5]

[1]Assistant Professor, Navodaya Medical College Hospital & Research Center, Raichur, Karnataka, India
[2]Laproscopic Surgeon, KIMS Hospitals Kondapur, Telangana, India
[3]Orthopedic Surgeon, Shantilal Navodaya Multispeciality Hospital, Hyderabad, Telangana, India
[4]Consultant, Shantilal Navodaya Multispeciality Hospital, Hyderabad, Telangana, India
[5]Assistant Professor, Department of Anaesthesiology, Chettinad Hospital and Research Institute, Chennai, Tamil Nadu, India

Received : 09/11/2024
Received in revised form : 28/12/2024
Accepted : 13/01/2025

Keywords:
Infections, antimicrobial resistance, ceftriaxone, antibiotics, E. Coli.

Corresponding Author:
Dr. Kiran Kumar,
Email: kiranyelkur@gmail.com

DOI: 10.47009/jamp.2025.7.1.20

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (1); 95-99

Abstract

Background: Surgical site infections (SSI) among postoperative patients accounted for the high morbidity, longer postoperative length of hospital stay and increased financial burden. Antibiotic resistance is increasing over past decade due to irrational use of antibiotics. Present study is conducted with aim to evaluate the incidence of postoperative surgical site infections and antimicrobial resistance pattern in surgical patients. **Materials and Methods:** Total 80 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. 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). Standard laboratory techniques were employed for culture and antibiotic susceptibility testing. **Result:** The mean age of the patients was 44.46 ± 15.36 years with a predominance of male patients (53%). Among majority of cases (73.8%), an elective surgery was performed. The most common pathogenic bacteria found at the surgical site infection was Klebsiella pneumoniae reported in 22.5% cases, followed by GPC in 15% cases, Escherichia coli in 13.8% cases. 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%). **Conclusion:** Multiple resistance to routinely prescribed antimicrobial drugs was seen in the majority of the Gram-negative isolates. The majority of gram-negative organisms were shown to be ineffective against ceftriaxone, a third-generation cephalosporin that is frequently used for antibiotic prophylaxis to avoid SSIs. This aligns with global observations emphasizing the need for updated antibiotic stewardship programs and the judicious use of prophylactic antibiotics.

INTRODUCTION

Infections contracted by patients in hospitals or healthcare facilities are known as health-care related infections, and they are the leading cause of morbidity among patients worldwide. After urinary tract infections, surgical site infections (SSI) are the second most frequent cause of health-care related infections.[1] According to the Centers for Disease Control and Prevention (CDC), SSIs are defined as any infection at or near the surgical site that happens within 30 days following an open or laparoscopic treatment, or within 90 days of a procedure requiring implants or a prosthesis. SSIs tends to impart high morbidity, a median 10-day increase in postoperative length of stay, and the financial strain on the patient and the hospital.[2] Additional expenses due to SSI have been documented ranging from £800 to £7000, depending on the type of operation and the extent of the infection.[3]

In the case of gastrointestinal surgery, the incidence of SSIs varies greatly over the world, ranging from 9.4% in wealthy countries to 14.0% in middle-income countries and 23.2% in low-income countries. According to a 2015 study, the combined prevalence of comprehensive SSIs in Southeast Asia was 9.0%, whereas the combined incidence of SSIs was 7.8%.[4,5] SSIs are the main causes of morbidity and mortality in India and the SSI rate varies greatly and can range from 1.6% to 38%, depending on the setting in which it occurs.[6]

SSIs continue to be an important challenge because of the growth of antimicrobial-resistant organisms, even with improvements in operating room ventilation, sterilization measures, and surgical methods.[7] The World Health Organization (WHO) has highlighted the global threat posed by antimicrobial resistance, urging better use of antibiotics and the development of new strategies to combat resistance.[8] Antibacterial drugs play a crucial role in preventing infections, but their excessive use has accelerated resistance, complicating the treatment of SSIs.[9] In particular, resistance patterns have been observed in bacteria like Escherichia coli, Staphylococcus aureus, and Klebsiella pneumoniae, complicating therapeutic management of these infections.[4]

SSIs, aiming to achieve effective tissue concentrations during surgery. However, the inappropriate use of antibiotics can lead to resistance, making it essential to balance their benefits and potential risks. Because SSIs result in a large burden of impairment and prolonged hospital stays, they ultimately fuel antimicrobial resistance by increasing the usage of antibiotics.[5] Due to the absence of standardized diagnostic and surveillance and notification systems in numerous developing nations, there is a dearth of information on the global epidemiology of SSI. Studying SSIs in India has been a relatively small endeavor. Therefore, present study is conducted with aim to evaluate the incidence of postoperative surgical site infections and antimicrobial resistance pattern.

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.

Statical 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 mean age of the patients was 44.46 ± 15.36 years. There was a predominance of male patients with 53% male and 27% female patients. Among majority of cases (73.8%), an elective surgery was performed while in rest of 26.3% cases emergency surgery was performed. The condition of post -surgical wound was cleaned in 32 (40%) cases while clean contaminated wound was observed in 4 (5%) cases, contaminated wound was recorded in 20 (25%) cases and wound was dirty in 24 (30%) cases [Figure 1].

The most common pathogenic bacteria found at the surgical site infection was Klebsiella pneumoniae reported in 18 (22.5%) cases, followed by GPC in 12 (15%) cases, Escherichia coli in 11 (13.8%) cases, 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].

Antibiotic resistance against gram positive bacteria revealed resistance against gentamycin in 25 (31.3%) cases, ceftriaxone in 41 (51.2%) cases, ciprofloxacin in 24 (30.0%) cases, ampicillin in 67 (83.8%) cases, amoxiclav in 57 (71.3%) cases, cotrimoxazole in 29 (36.3%) cases, chloramphenicol in 19 (23.8%) cases, and penicillin in 59 (73.8%) cases [Figure 3].

Antibiotic resistance against gram negative bacteria revealed resistance against gentamycin in 70 (87.5%) cases, ceftriaxone in 80 (100.0%) cases, ciprofloxacin in 45 (56.3%) cases, ampicillin in 80 (100.0%) cases, amoxiclav in 70 (87.5%) cases, cefotaxime in 80 (100.0%) cases, and ceftazidime in 80 (100.0%) cases [Figure 4].

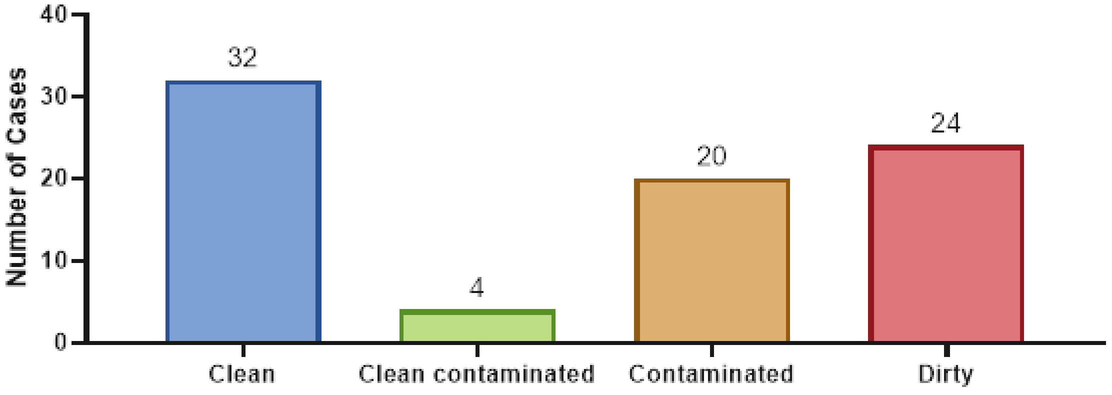

Figure 1: Condition of post -surgical wound.

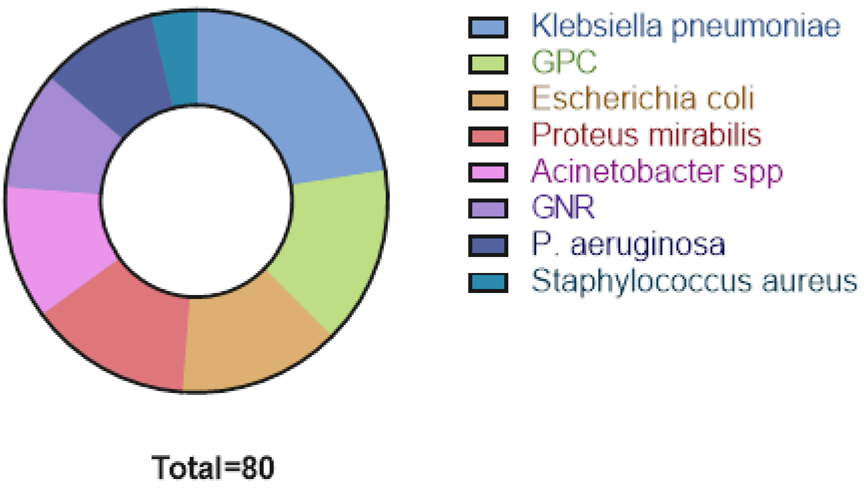

Figure 2: Pathogenic bacteria found at the surgical site infection.

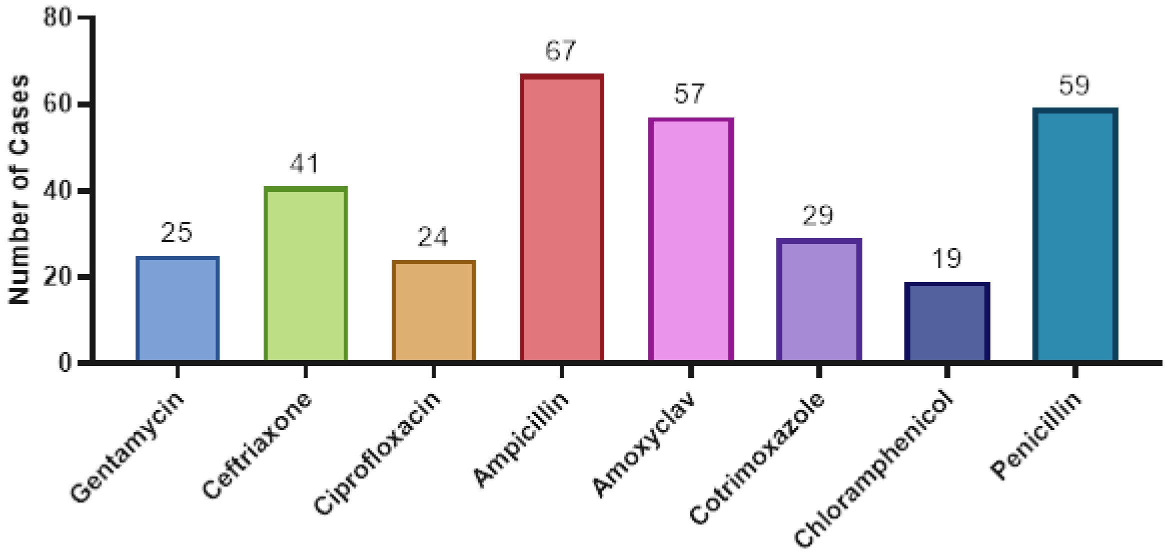

Figure 3: Antibiotic resistance against gram positive bacteria.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

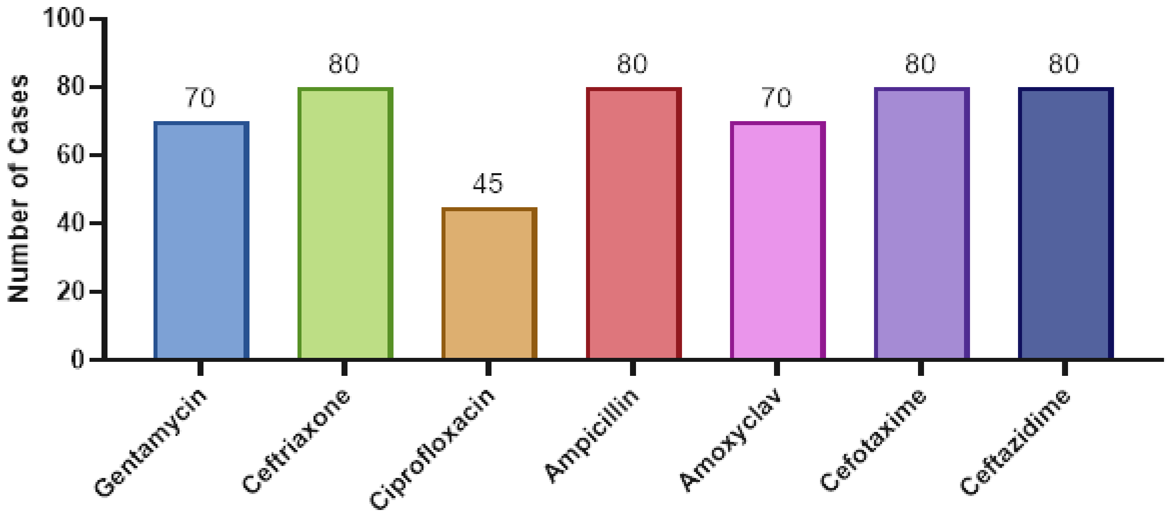

Figure 4: Antibiotic resistance against gram positive bacteria.

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

In the present study, the mean age of the patients was 44.46 ± 15.36 years with a predominance of male patients (53%). In the study by Dahal et al., mean age of the patient was 36.16±1.27 years and among them 61.3% were females and 38.8% were males.[5] In the study by Oberoi et al., a male predominance (51%) was reported which is similar to present study.[4] In our study, an elective surgery was performed in majority of cases (73.8%) while emergency surgery was performed in 26.3% cases. In the study by Oberoi et al., most of patients had undergone emergency procedures (77%) which is contrary to the findings of this study. The variation in the various findings to this study with respect to other studies could be resulted from the demographics and healthcare facilities available in the local regions.

The condition of post -surgical wound in our study indicate contaminated wound in 25% cases and dirty wound in 30% cases. Comparing this conclusion to the reports from Pathak et al. (5%) and Shrestha et al. (2.6%), the proportion was greater.[10,11] However, compared to earlier research by Chaudhary et al. (77.6%) and Amatya et al. (60.6%), the estimate was significantly lower.[12,13] However, in the Dahal et al. study, the proportion of culture confirmed surgical wound infection was 22.71% which is similar to present study.[5] The disparity in the percentage of culture-confirmed SSI may result from variations in nosocomial pathogen distribution and infection prevention and control strategies across various nations and healthcare facilities.

In present study, the most common pathogenic bacteria found at the surgical site infection was Klebsiella pneumoniae reported in 18 (22.5%) cases, followed by GPC in 12 (15%) cases, and Escherichia coli in 11 (13.8%) cases. The most frequent isolate in the Dahal et al. investigation was Escherichia coli (39.8%), which was followed by Staphylococcus aureus (12.0%) and coagulase negative staphylococci (16.7%).[5] Differences in the populations examined, the variety of surgical operations done on research participants, and the timing of specimen collections could all be contributing factors to the variation observed in these studies.

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

It was discovered that gram negative bacteria were more resistant to antibiotics than gram positive bacteria. Multiple resistance to routinely prescribed antimicrobial drugs was seen in the majority of the Gram-negative isolates. The majority of gram-negative organisms were shown to be ineffective against ceftriaxone, a third-generation cephalosporin that is frequently used for antibiotic prophylaxis to avoid SSIs. 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. Further multicentric studies by taking the ample sample size needed to be conducted to validate the findings of this study.

REFERENCES

1. Puro V, Coppola N, Frasca A, Gentile I, Luzzaro F, Peghetti A, et al. Pillars for prevention and control of healthcare-associated infections: an Italian expert opinion statement. Antimicrobial Resistance & Infection Control. 2022;11(1):87.
2. Jenks P, Laurent M, McQuarry S, Watkins R. Clinical and economic burden of surgical site infection (SSI) and predicted financial consequences of elimination of SSI from an English hospital. J Hosp Infect. 2014;86(1):24-33.
3. Misha G, Chelkeba L, Melaku T. Bacterial profile and antimicrobial susceptibility patterns of isolates among patients diagnosed with surgical site infection at a tertiary teaching hospital in Ethiopia: a prospective cohort study. Ann Clin Microbiol Antimicrob. 2021;20:1-10.
4. Oberoi A, Pansuriya J, Fatah HA, Goenka A, Medhi D, Bapat A, et al. A Retrospective Cohort to Study the Postoperative Infections and Antimicrobial Therapy in Surgical patients. International Journal of Pharmaceutical and Clinical Research. 2024;16(11):383-7.
5. Dahal K, Rawal L, Shah S, Pokharel S, Dahal M, Shrestha S, et al. Pattern of antibiotic resistance in surgical site infections in a tertiary care hospital of Nepal. IJS Global Health. 2024;7(2):e0403.
6. Borle FR. Determinants of superficial surgical site infections in abdominal surgeries at a Rural Teaching Hospital in Central India: A prospective study. Journal of family medicine and primary care. 2019;8(7):2258-63.
7. Allegranzi B, Pittet D. Role of hand hygiene in healthcare-associated infection prevention. J Hosp Infect. 2009;73(4):305-15.
8. Cassini A, Högberg LD, Plachouras D, Quattrocchi A, Hoxha A, Simonsen GS, et al. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. The Lancet infectious diseases. 2019;19(1):56-66.
9. Burdon DW. Principles of antimicrobial prophylaxis. World J Surg. 1982;6:262-7.
10. Shrestha S, Wenju P, Shrestha R, Karmacharya R. Incidence and risk factors of surgical site infections in Kathmandu university hospital, Kavre, Nepal. Kathmandu University Medical Journal. 2016;14(54):107-11.
11. Pathak A, Saliba EA, Sharma S, Mahadik VK, Shah H, Lundborg CS. Incidence and factors associated with surgical site infections in a teaching hospital in Ujjain, India. Am J Infect Control. 2014;42(1):e11-e5.
12. Amatya J, Rijal M, Baidya R. Bacteriological study of the postoperative wound samples and antibiotic susceptibility pattern of the isolates in BB hospital. JSM Microbiol. 2015;3(1):1019.
13. Chaudhary R, Thapa SK, Rana JC, Shah PK. Surgical site infections and antimicrobial resistance pattern. J Nepal Health Res Counc. 2017;15:2015-18.