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Original Research Article

Bacteriology and Antimicrobial Resistance Patterns in Organisms in Surgical Site Infections in a Tertiary Care Hospital

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Abstract

Introduction: Surgical site infections (SSIs) are a major healthcare challenge, driven by diverse bacterial pathogens with complex resistance patterns. The rise of multidrug-resistant organisms, such as MRSA and resistant Gram-negative bacteria, necessitates ongoing surveillance and tailored antibiotic therapy. This study evaluates the bacteriology and antimicrobial resistance in SSIs to guide effective treatment and prevention strategies.

Methods: This cross-sectional study, conducted at Government Medical College, Anantapuram from January to December 2023, assessed SSIs in patients over 15 years old. Wound samples were cultured and tested for antimicrobial susceptibility using standard methods. Statistical analysis was performed using SPSS version 22.0, with significance set at $p<0.05$.

Results: The study included 200 patients, with 54% female. Culture positivity rates were 29% in males and 37% in females, with no significant difference. Diabetes mellitus (16%) and anemia (13.5%) were common risk factors. Among isolates, 43.18% were Gram-positive cocci (GPC) and 56.81% Gram-negative bacilli (GNB). GPC showed highest susceptibility to Vancomycin and GNB to Meropenem. A total of 132 multidrug-resistant strains were identified, with 43% being GNB and 31.8% GPC.

Conclusion: This study reveals a high prevalence of multidrug-resistant organisms in postoperative wound infections, notably MRSA and Gram-negative bacteria like Klebsiella pneumoniae. Vancomycin effectively treated all S. aureus isolates, while GNB showed high susceptibility to imipenem, amikacin, and piperacillin-tazobactam, despite some imipenem resistance. Continuous surveillance and tailored therapy are crucial.

Keywords: Multidrug-resistant, Postoperative wound infections, MRSA, Gram-negative bacteria, Antimicrobial susceptibility.

Introduction

Surgical site infections (SSIs) represent a significant healthcare burden, contributing to increased morbidity, extended hospital stays, and heightened healthcare costs. In tertiary care hospitals, these infections are primarily caused by a variety of bacterial pathogens, each exhibiting distinct antimicrobial resistance patterns. [1] The emergence of multidrug-resistant organisms has complicated the management and treatment of SSIs, necessitating continuous surveillance and updated antimicrobial stewardship programs. [2]

Recent studies have identified Staphylococcus aureus, particularly methicillin-resistant Staphylococcus aureus (MRSA), as one of the most prevalent pathogens in SSIs. Other common organisms include Escherichia coli, Klebsiella spp., and Pseudomonas aeruginosa, all of which exhibit varying degrees of resistance to commonly used antibiotics. The prevalence of these resistant strains underscores the need for effective infection control measures and the judicious use of antibiotics. [1, 3]

The resistance patterns of these pathogens are influenced by numerous factors, including hospital practices, patient demographics, and regional antimicrobial usage policies. Understanding these patterns is crucial for the development of targeted therapeutic strategies and for the implementation of effective preventive measures. Recent research highlights the importance of regular microbiological surveillance and tailored antibiotic therapy based on local antibiograms to combat the growing threat of antimicrobial resistance in SSIs. [4, 5] With this a study was conducted to assess the bacteriology and antimicrobial resistance patterns in organisms in SSIs.

Methods:

It was a cross sectional research conducted in the department of Microbiology, government Medical College, Anantapuram. Study was conducted between January to December 2023. Study protocol was approved by the institutional Ethics Committee. Those ≥ 15 years who have underwent surgery were included in the study. Non cooperative individuals, those with community acquired infections, stich abscess / surrounding inflammation without infection were not considered.

Sterile techniques were used to collect wound swabs or tissue samples from the infected sites. Samples were transported immediately to the microbiology laboratory for processing. Samples were cultured on appropriate media, including blood agar, MacConkey agar, and chocolate agar. Plates were incubated at 37°C for 24-48 hours. Bacterial growth was identified using standard biochemical tests. Identified bacterial isolates were subjected to antimicrobial susceptibility testing using the Kirby-Bauer disk diffusion method, adhering to the Clinical and Laboratory Standards Institute (CLSI) guidelines. Antibiotic disks included penicillin, ampicillin, ceftriaxone, ciprofloxacin, Vancomycin, and others relevant to the hospital's antibiogram. Quality control measures were implemented throughout the study to ensure the accuracy and reliability of results. This included the use of control strains for susceptibility testing and regular calibration of laboratory equipment. The methodology aimed to provide a comprehensive understanding of the bacterial profile and resistance trends in SSIs, facilitating the development of targeted infection control and treatment strategies.

The significance of the parameters found in this study was assessed using the t-test to analyse the mean difference between the continuous data, the paired t-test for follow-up data, and the Chi-square test for categorical data. Significant behaviour was defined as a P value 0.05. The statistical analysis was done on a Windows 10 computer running SPSS version 22.0 (IBM SPSS, US).

Results

Total 200 members were included, 108 (54%) were female. Among the male, 29% (58) were culture positive (CP) and 17% (34) were culture negative (CN). Whereas in female, it was 37% and 17%, respectively; statistically there was no significant difference (Table 1). Diabetes mellitus (DM) was found to be the leading (16%) risk factor followed by anemia (13.5%). Among the isolates, 75 (43.18%) were gram positive cocci (GPC) and 56.81% were gram negative bacilli (GNB). Among the GPC, Staph. aureus was the leading (36) followed by Spah. Epidermis (21) and Enter. Fecalis (18). Among the GNB, Klebsiella pneumoniae (KP) was the leading (18), *Pseudomonas aeruginosa* (14). GPC showed highest susceptibility to Vancomycin (100%) and least to Erythromycin (30%). Whereas GNB showed highest susceptibility to Meropenem (94%) and least to Ceftriaxone (11%). Total 132 multi drug resistance (MDR) strains were detected; in this 43% (57) were GNB and 31.8% (42) were GPC.

Table 1: Gender wise culture results; n (%)

Gender	CP	CN	Total
Female	74 (37)	34 (17)	108 (54)
Male	58 (29)	34 (17)	92 (46)
Total	132 (66)	68 (34)	200 (100)
Statistical analysis	Ψ^2 value = 0.6636; P = 0.415277		
	Not significant		

Discussion

Infection of postoperative wounds is a prevalent healthcare issue that involves complex biological interactions at the molecular level. These infections are a significant cause of morbidity and mortality. In the current study, 200 patients meeting the inclusion criteria were included, with a mean age of 42.56 years. Among them, 28.5% were aged 21-30 years, 54% were female, and 46% were male. Various risk factors were identified: 13.5% had anemia, 16% had diabetes mellitus, and 0.5% had chronic kidney disease (CKD). The distribution of swabs received from different wards was as follows: 59.5% from general surgery, 35% from obstetrics and gynecology, and 5.5% from orthopedics. [6]

In a related study by Misha G et al. [7] involving 251 research participants, 126 (50.2%) were female. The overall rate of postoperative surgical site infections was reported to be 21.1%, with 71.7% (38 out of 53) being CP. This highlights the significant burden of postoperative wound infections and underscores the need for effective infection control measures.

The study's findings indicate that postoperative wound infections remain a critical issue in healthcare settings, affecting a considerable proportion of patients, particularly those with

underlying conditions such as diabetes and anemia. The high rate of culture-positive infections among swabs from general surgery and obstetrics and gynecology wards further emphasizes the importance of stringent infection prevention protocols and the need for ongoing surveillance and targeted interventions to reduce the incidence and impact of these infections.

In this study gram-positive cocci seen in 56.81 patients and 43.18% with GNB. Among the GPC, *Staphylococcus aureus* is common (27.27%) followed with *Staphylococcus epidermidis* (15.9%) and *Enterococcus faecalis* (13.6%). Among the GNB, *Klebsiella pneumoniae* (13.63%) was common. Negi V et al. [8] documented the most common isolate was *Staphylococcus aureus* (50.4%), followed by Escherichia coli (23.02%), Pseudomonas aeruginosa (7.9%), and Citrobacter species (7.9%). Chaudhary R et al. [10] results showed 194 (77.6%) of the 250 samples were positive for bacterial growth. *Staphylococcus aureus* accounted for 47.4% of the total, with Escherichia coli 20.6%. 39.2% of the 194 isolates tested positive for multiple drugs.

In this study, majority of the isolates (80.8%) were determined to be MDR. The majority of these pathogens were determined to be MDR. As a result, regular monitoring of bacterial isolate types and antibiotic resistance patterns should be considered. [10] Yehouenou CL et al. [11] reported that 5.24% of GNB showed resistance to at least one carbapenem, with no isolates displaying a wild-type susceptible phenotype. Their research highlights the alarming incidence of multidrug-resistant organisms in surgical site infections in Benin hospitals, emphasizing the need for periodic surveillance and strict hand-hygiene practices. In this study, multidrug resistance was documented in 75% of cases. Staphylococcus aureus showed high sensitivity to moxifloxacin (91.7%), doxycycline (80.6%), vancomycin (88.9%), and clindamycin (75%). KP was 100% sensitive to moxifloxacin, 94.4% to meropenem, and *Escherichia coli* showed similar sensitivity patterns.

The study found that Staphylococcus aureus was the most prevalent organism (49/54), with MRSA isolated in 65.3% of cases. Vancomycin was effective against all S. aureus isolates. Gram-negative bacteria constituted 42.6% of all isolates, with Escherichia coli being the most prevalent. Most Gram-negative isolates were sensitive to amikacin, imipenem, and piperacillin-tazobactam, though some resistance to imipenem was noted in E. coli, Pseudomonas, and Acinetobacter. No vancomycin-resistant S. aureus was found. Khan AS et al. [12] reported vancomycin and teicoplanin as most sensitive, with high MDR levels in E. coli, Klebsiella spp., Proteus spp., and S. aureus.

In summary, this study highlights the significant prevalence of MDR organisms in postoperative wound infections, with MRSA and GNB such as KP being prominent pathogens. Vancomycin was effective against all S. aureus isolates, while high susceptibility to imipenem, amikacin, and piperacillin-tazobactam was observed among GNB, though some resistance to imipenem was present. The findings underscore the critical need for continuous surveillance, effective infection control measures, and tailored antibiotic therapy to manage and reduce the impact of multidrug-resistant organisms in SSIs.

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