A Prospective Study of Post-Operative, Surgical Site Infections (SSIS) from a Teaching Hospital of Western Uttar Pradesh

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ABSTRACT

By identifying the key determinants and patterns of SSIs, this research seeks to contribute to improved infection prevention and management protocols in the region of Western Uttar Pradesh. This study aimed to assess the prevalence, microbial profile and antibiotic susceptibility pattern of post-operative SSIs in a tertiary teaching hospital in the region. In a cohort of 282 patients presenting with post-operative wound infections, 196 exhibited bacterial growth. The majority (57%) of pus samples were collected from the surgical wards. The prevalence of Gram-negative bacteria was notably higher than that of Gram-positive bacteria at rates of 128 isolates (59.2%) versus 88 isolates (40.8%). The predominant pathogens identified included Staphylococcus species (86 isolates, 39.8%) and Escherichia coli (52 isolates, 24%). E. coli demonstrated the highest sensitivity to Tigecycline (100%), followed by Chloramphenicol (92.8%), Imipenem (85.5%), Amikacin (72.2%). Staphylococcus aureus displayed complete sensitivity (100%) to Vancomycin, Linezolid and Teicoplanin, underscoring their efficacy as first-line treatments for infections caused by this organism. Additionally, high susceptibility was observed to Mupirocin (95.3%), Rifampicin (95.3%) and Clindamycin (93.7%). The sensitivity data provides critical guidance for empiric antibiotic selection and underscores the importance of continued surveillance to monitor emerging resistance trends. Findings also emphasize the continued efficacy of key antibiotics against Gram-positive cocci while reinforcing the importance of ongoing monitoring to detect potential shifts in resistance patterns.

INTRODUCTION

A wound is defined as a disruption in the skin's integrity that exposes underlying tissues to potential microbial colonization and infection. Wound infections are recognized as one of the most prevalent sites for nosocomial infections and are associated with heightened morbidity and mortality rates[1,2]. Such infections can impede healing processes, lead to wound dehiscence, prolong hospitalization durations, and escalate healthcare costs[3]. The primary etiological factor for most wounds is trauma-either accidental or intentional-such as those resulting from surgical procedures or intravenous medical devices. Hospital-acquired wounds may also include pressure ulcers caused by localized ischemia when infected., these are often colonized by multiple bacterial species[4]. These infections are often polymicrobial, involving a diverse range of bacterial pathogens that complicate treatment outcomes. Surgical site infections (SSIs) are a significant public health concern and one of the most common nosocomial infections globally. SSIs develop within 30 days post-operation or within one year following the placement of a surgical implant[5]. Approximately 500,000 SSIs occur annually in the context of an estimated 27 million surgical procedures worldwide, contributing significantly to the overall burden of nosocomial infections[6,7]. Western Uttar Pradesh, like many other regions in India, faces significant challenges related to healthcare-associated infections, including SSIs. Limited resources, inadequate infection control practices and high patient loads exacerbate the risk. Despite being preventable, SSIs remain under-reported and inadequately studied in this region. This study aims to assess the prevalence, microbial profile and antibiotic susceptibility pattern of post-operative SSIs in a tertiary teaching hospital in Western Uttar Pradesh. By identifying the key determinants and patterns of SSIs, this research seeks to contribute to improved infection prevention and management protocols in the region.

MATERIALS AND METHODS

This cross-sectional descriptive study involved a total of 196 culture-positive patients from the Department of Microbiology at a tertiary care teaching institution located at western part of Uttar Pradesh. Inclusion criteria encompassed patients with surgical wounds exhibiting pus discharge or serous/seropurulent discharge alongside clinical signs of sepsis. Upon suspicion of infection, two sterile cotton swabs were obtained: one for Gram staining and another for inoculation on Nutrient Agar, MacConkey Agar and Tryptic Soy Broth media for bacterial culture identification according to standard protocols. Antibiotic susceptibility testing was performed utilizing the Kirby-Bauer disc diffusion method with antibiotic discs selected based on local prescribing practices aligned with hospital policy. All the isolates including Gram Positive and Gram negative were identified using standard identification protocols. The antibiotic sensitivity testing was done using Kirby Bauer Disc diffusion technique. The antibiotic discs used were according to local prescribing pattern as per the antibiotic policy of the hospital. For Gram positive cocci disks of Penicillin (10units), Erythromycin (15ug), Cloxacillin (5ug), Gentamycin (10ug), Ampicillin (10ug), Vancomycin (30ug), etc was used. For Pseudomonas isolate discs of Amikacin(30ug), Ceftriaxone (30ug), Cefotaxime (30ug), Gentamycin (10ug), Ciprofloxacin (5ug), Norfloxacin (10ug), etc. For Other Gram negative isolates discs of Cefotaxime (30ug), Gentamycin (10ug), Ciprofloxacin (5ug), Colistin (30ug), Polymyxin B(50ug), etc were used. The statistical analysis was done by standard methods. The study commenced solely after acquiring requisite approvals, including permission from the ethical committee of the medical college. The collected data were input into an MS Excel spreadsheet, suitably coded and subsequently cleansed for potential inaccuracies. The statistical analysis was conducted utilising IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp. Armonk, NY, USA). All data has been collected and analysed using suitable statistical procedures and tests.

RESULTS AND DISCUSSIONS

Out of the total cohort of 282 pus samples analyzed for post-operative wound infection, 196 demonstrated aerobic bacterial growth. The demographic profile indicated that males constituted the majority at 108 cases (55.1%) compared to females at 88 cases (44.9%). The age distribution revealed that patients over the age of 50 years represented the largest group at 23.4%, followed by those aged between 21-30 years at 22.4%. The distribution of pus samples indicated that the surgical ward contributed the highest number of cases at 112 samples (57%). Of the culture-positive cases analyzed, monomicrobial growth was observed in 176 samples while polymicrobial growth occurred in 20 samples. The prevalence of Gram-negative bacteria was notably higher than that of Gram-positive bacteria at rates of 128 isolates (59.2%) versus 88 isolates (40.8%). The predominant pathogens identified included: Staphylococcus species: 86 isolates (39.8%), Escherichia coli: 52 isolates (24%), Pseudomonas species: 30 isolates (13.8%), Enterobacter species: 20 isolates (9.2%), Klebsiella species: 12 isolates (5.5%), Proteus species: 8 isolates (3.7%), Acinetobacter species: 6 isolates (2.7%), Enterococcus spp.: 2 isolates (0.9%). The sensitivity pattern of Gram-negative bacilli, as presented in (Table 1), highlights the antimicrobial

susceptibility profiles of various organisms, providing valuable insights into effective treatment options. E. coli demonstrated the highest sensitivity to Tigecycline (100%), followed by Chloramphenicol (92.8%), Imipenem (85.5%), Amikacin (72.2%), Gentamycin (61%), and Tetracycline (60%). This pattern underscores the utility of Tigecycline as a robust therapeutic agent against E. coli infections. Klebsiella spp. exhibited complete sensitivity to Imipenem (100%), with substantial susceptibility observed for Colistin (84.4%), Amikacin (81.3%) and Ampicillin-Sulbactam 81.3%). These findings suggest that Imipenem remains a first-line treatment option for Klebsiella-related infections. Proteus spp. demonstrated remarkable sensitivity, with a 100% susceptibility rate to Amikacin, Piperacillin/Tazobactam, Imipenem, Meropenem and Tobramycin. This uniform sensitivity profile indicates a broad range of effective therapeutic options for treating Proteus infections. Enterobacter spp. was highly sensitive to Tigecycline (100%), with moderate sensitivity observed for Imipenem (72.5%) and Amikacin (71.5%). These results highlight Tigecycline as a preferred agent, while other antibiotics may serve as secondary options based on clinical scenarios.(Table 1)

Table 1: Sensitivity Pattern of Gram-Negative Bacilli

Name of the organisms	Sensitivity pattern
1. E. coli	Tigecycline (100%) followed by Chloramphenicol (92.8%), Imepenam (85.5%), Amikacin (72.2%), Gentamycin (61%) and Tetracycline (60%)
2. Klebsiella spp.	Imepenem (100%), Colistin (84.4%), Amikacin (81.3%) and Ampicillin-Sulbactum (81.3%)
3. Proteus spp.	Amikacin (100%), Piperacilin /Tazobactum (100%), Imipenem (100%), Meropenem and Tobramycin (100%)
4. Enterobacter spp.	Tigecycline (100%) and Imepenem (72.5%), Amikacin (71.5%), etc.

The antimicrobial sensitivity pattern of Gram-positive cocci, detailed in (Table 2), reveals the susceptibility profiles of Staphylococcus aureus and Enterococcus spp., offering critical insights for optimal therapeutic decision-making. Staphylococcus aureus displayed complete sensitivity (100%) to Vancomycin, Linezolid, and Teicoplanin, underscoring their efficacy as first-line treatments for infections caused by this organism. Additionally, high susceptibility was observed to Mupirocin (95.3%), Rifampicin (95.3%) and Clindamycin (93.7%), highlighting their potential as effective alternatives in specific clinical scenarios. Enterococcus spp. exhibited complete sensitivity to Colistin and Tigecycline (100%), indicating their utility as potent therapeutic agents. Moderate susceptibility was observed for Imipenem (72.5%), suggesting it may be considered in combination therapies or tailored treatment regimens based on susceptibility results. (Table 2).

Table 2: Sensitivity Pattern of Gram Positive Cocci

Name of the organisms	Sensitivity pattern
1. Staphylococcus aureus	Vancomycin (100%), Linezolid (100%), Teicoplanin (100%) followed by Mupirocin (95.3%), Rifampicin (95.3%), Clindamycin (93.7%),
2. Enterococcus spp.	Colistin (100%), Tigecycline (100%), Imepenem (72.5%)

Among the isolated strains of Staphylococcus aureus, methicillin-resistant strains accounted for a significant proportion at 62 cases. Antibiotic susceptibility testing revealed that Gram-positive cocci were highly sensitive to Vancomycin and Linezolid while exhibiting complete resistance to several antibiotics including Penicillin and Levofloxacin.

The findings of this study underscore the persistent challenge posed by post-operative surgical site infections (SSIs) in a tertiary care setting, particularly in Western Uttar Pradesh. Despite the implementation of stringent aseptic protocols during surgical procedures, the prevalence of SSIs remains alarmingly high, reflecting a multifactorial etiology that includes both patient-related and procedural factors. The observed infection rates, which align with existing literature indicating a range from 10%-76%, highlight the critical need for enhanced infection control measures tailored to the specific challenges faced in this region. The demographic analysis revealed a predominance of male patients and those over the age of 50, suggesting that age and gender may play significant roles in susceptibility to SSIs. This demographic trend is consistent with previous studies that have identified older age as a risk factor for infection due to potential comorbidities and decreased physiological resilience[8]. Furthermore, the high incidence of infections in surgical wards emphasizes the need for continuous monitoring and evaluation of infection control practices within these high-risk environments. The microbial profile identified in this study is particularly noteworthy. The predominance of Gram-negative bacteria, specifically Escherichia coli and Pseudomonas species, reflects the evolving landscape of pathogens associated with SSIs. The high rates of isolation of Staphylococcus aureus, including methicillin-resistant strains (MRSA), further complicate treatment strategies and necessitate vigilant antibiotic stewardship[9,10]. The resistance patterns observed, particularly the complete resistance to Penicillin and Levofloxacin among Gram-positive cocci, highlight an urgent need for ongoing surveillance to inform empirical antibiotic therapy effectively. Antibiotic susceptibility testing revealed that while Gram-positive pathogens exhibited high sensitivity to Vancomycin and Linezolid, Gram-negative organisms displayed varied susceptibility profiles. Notably, E. coli demonstrated remarkable sensitivity to Tigecycline and

Imipenem, reinforcing these agents' roles as first-line therapies for managing infections caused by resistant strains. The findings suggest that while some antibiotics retain efficacy against specific pathogens, there is an alarming trend towards increasing resistance that must be addressed through prudent prescribing practices and patient education[11,12]. The implications of these findings extend beyond individual patient care., they underscore the necessity for institutional policies that prioritize infection prevention strategies, including preoperative prophylaxis tailored to local resistance patterns[13]. Moreover, the establishment of robust surveillance systems can facilitate timely interventions aimed at curbing the emergence of resistant strains. Post-operative wound infections represent a significant clinical challenge due to their association with increased morbidity and mortality rates as well as elevated healthcare costs. The sensitivity data provides critical guidance for empiric antibiotic selection and underscores the importance of continued surveillance to monitor emerging resistance trends[14]. Findings also emphasize the continued efficacy of key antibiotics against Gram-positive cocci while reinforcing the importance of ongoing monitoring to detect potential shifts in resistance patterns.

CONCLUSION

In conclusion, this study highlights the pressing need for enhanced infection control protocols and continuous monitoring of microbial resistance trends within surgical settings. Addressing these challenges will require a multifaceted approach involving healthcare providers, microbiologists and policymakers to develop effective strategies aimed at reducing the burden of SSIs in our healthcare institutions. Future research should focus on longitudinal studies to track changes in microbial profiles and resistance patterns over time, thereby providing critical insights into effective management strategies for post-operative infections.

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