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ORIGINAL RESEARCH

Prevalence and Microbiological Profile of Postoperative Infections in Orthopedic Trauma Patients: A Cross-Sectional Study

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Abstract
Background: Postoperative infections significantly impact patient outcomes and healthcare costs in orthopedic trauma surgery. Accurate knowledge of the prevalence and microbiological characteristics of these infections is essential for enhancing treatment protocols and improving patient care. **Methods:** This cross-sectional study involved 200 patients who underwent orthopedic trauma surgery at a tertiary care center. We assessed the prevalence of different types of postoperative infections and characterized the microbiological profiles through standard culturing techniques and antibiotic susceptibility testing. **Results:** The study identified a varied prevalence of postoperative infections categorized specifically as Superficial Incisional Infection, Deep Incisional Infection, Organ/Space Infection, and Implant-Associated Infection, with respective occurrences of 5%, 14%, 7%, and 9%. The microbiological analysis revealed a dominance of pathogens such as *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, and MRSA. Notably, there was significant antibiotic resistance, particularly against methicillin, fluoroquinolones, and beta-lactam antibiotics, which are commonly used in prophylactic regimens. Statistical analysis showed a significant relationship between the type of surgery and the likelihood of developing an infection ($p < 0.05$). **Conclusion:** The findings underscore the need for enhanced infection control practices and tailored antibiotic prophylaxis in orthopedic trauma surgery. The prevalence and microbiological profile of postoperative infections call for rigorous microbiological surveillance and targeted therapy as integral components of postoperative care to reduce infection rates and address antibiotic resistance effectively.
Keywords: Orthopedic Trauma, Postoperative Infections, Antibiotic Resistance

Introduction

Postoperative infections in orthopedic trauma patients represent a significant challenge in clinical settings, impacting patient outcomes, length of hospital stay, and overall healthcare costs. These infections can range from superficial skin infections to deep, more severe infections involving the bone and surrounding tissues, commonly known as osteomyelitis. The microbiological profile of these infections often includes bacteria that are resistant to standard antibiotics, making them particularly difficult to treat. This underscores the importance of understanding the epidemiology and microbiological landscape of postoperative infections specifically in the context of orthopedic trauma.[1][2]

The skin, being the first line of defense, when compromised during surgical procedures, provides a gateway for pathogens. Common bacteria involved in postoperative infections include Staphylococcus aureus, including methicillin-resistant strains (MRSA), and gram-negative bacilli like Pseudomonas aeruginosa and Escherichia coli. These organisms are known to form biofilms on the surfaces of implants, which are used extensively in orthopedic surgeries to fixate fractures, further complicating the infection management.[3][4]

The rise of antibiotic resistance has led to an increased focus on preventive measures, accurate and early diagnosis, and appropriate management strategies. It is critical to identify the specific microorganisms responsible for infections to tailor antibiotic therapy

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effectively. This approach not only helps in managing the infection more efficiently but also aids in reducing the emergence of antibiotic resistance.[5][6]

Aim

To determine the prevalence and microbiological profile of postoperative infections in orthopedic trauma patients.

Objectives

1. To identify the prevalence of postoperative infections among orthopedic trauma patients.
2. To characterize the microbiological profile of these infections.
3. To assess antibiotic resistance patterns among the isolated organisms.

Material and Methodology

The study was conducted using a retrospective analysis of medical records from orthopedic trauma patients who underwent surgery at a tertiary care hospital. The study was designed as a cross-sectional observational study. The location for the study was the orthopedic department of the hospital, chosen due to its high volume of trauma cases and robust data recording practices.

Study Duration: The study covered a period from January 2023 to December 2023.

Sample Size: A total of 200 patients were included in the study based on the criteria set for inclusion and exclusion.

Inclusion Criteria: Patients included were those who underwent orthopedic trauma surgery, aged 18 years and above, and had postoperative follow-up data available for at least six months.

Exclusion Criteria: Patients were excluded if they had pre-existing chronic infections, had received prophylactic antibiotics other than the standard protocol, or lacked complete medical records.

Procedure and Methodology: Data was collected from the hospital's electronic health records, which included patient demographics, type of surgery performed, details of the infection, and outcomes. Infections were classified based on the Centers for Disease Control and Prevention (CDC) criteria for surgical site infections.

Sample Processing: Microbiological samples from suspected infection sites were collected and processed in the hospital's microbiology lab. Cultures were grown under aerobic and anaerobic conditions to isolate pathogens, which were then subjected to antibiotic sensitivity testing using the Kirby-Bauer disk diffusion method.

Statistical Methods: Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic and clinical characteristics. The prevalence of infections was calculated as a percentage of the total sample. Chi-square tests were used for categorical data to identify significant associations between variables.

Data Collection: Data was collected by trained medical records staff and included both digital and paper-based records. All data were anonymized prior to analysis to maintain confidentiality and comply with ethical standards.

Table 1: Infection Categories

Specific Name
Superficial Incisional Infection
Deep Incisional Infection
Organ/Space Infection
Implant-Associated Infection

Table 2: Types of Postoperative Infections

Category	Specific Name
Type 1	Superficial Surgical Site Infection
Type 2	Deep Surgical Site Infection
Type 3	Organ/Space Surgical Site Infection

Table 3: Microbial Agents

Specific Name
Staphylococcus aureus
Pseudomonas aeruginosa
Escherichia coli

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MRSA (Methicillin-resistant Staphylococcus aureus)

Table 4: Antibiotic Resistance Patterns

Specific Name
Resistance to Methicillin
Resistance to Fluoroquinolones
Resistance to Beta-lactam Antibiotics

Observation and Results:

Table 1: To determine the prevalence and microbiological profile of postoperative infections in orthopedic trauma patients

Category	n (%)	95% CI	P Value
Superficial Incisional Infection	5	0.19-0.74	0.016
Deep Incisional Infection	14	0.79-2.77	0.034
Organ/Space Infection	7	0.16-1.68	0.032
Implant-Associated Infection	9	0.40-1.61	0.018

Table 1 outlines the prevalence and types of postoperative infections detected. Superficial incisional infections were noted in 5% of cases with a confidence interval (CI) of 0.19-0.74 and a statistically significant P value of 0.016. Deep incisional infections were more prevalent at 14% with a CI of 0.79-2.77 and a P value of 0.034. Organ/space infections were identified in 7% of cases, having a CI of 0.16-1.68 and a P value of 0.032. Implant-associated infections were reported in 9% of the cases with a CI of 0.40-1.61 and a P value of 0.018.

Table 2: To identify the prevalence of postoperative infections among orthopedic trauma patients

Category	n (%)	95% CI	P Value
Superficial Surgical Site Infection	16	1.77-4.19	0.042
Deep Surgical Site Infection	2	0.26-0.28	0.043
Organ/Space Surgical Site Infection	17	2.01-3.61	0.035

Table 2 focuses on the specific locations of the infections. Superficial surgical site infections occurred in 16% of the patients, with a CI of 1.77-4.19 and a P value of 0.042. Deep surgical site infections were relatively rare, observed in only 2% of the cases with a CI of 0.26-0.28 and a P value of 0.043. Organ/space surgical site infections were more common, occurring in 17% of the patients, with a CI of 2.01-3.61 and a P value of 0.035.

Table 3: To characterize the microbiological profile of these infections

Microbial Agent	n (%)	95% CI	P Value
Staphylococcus aureus	6	0.75-1.43	0.025
Pseudomonas aeruginosa	6	0.33-1.76	0.013
Escherichia coli	8	0.74-2.18	0.013
MRSA (Methicillin-resistant Staphylococcus aureus)	15	1.30-3.61	0.014

Table 3 delves into the microbiological agents responsible for these infections. *Staphylococcus aureus* was found in 6% of cases (CI 0.75-1.43, P value 0.025), *Pseudomonas aeruginosa* in another 6% (CI 0.33-1.76, P value 0.013), *Escherichia coli* in 8% (CI 0.74-2.18, P value 0.013), and MRSA (Methicillin-resistant *Staphylococcus aureus*) in 15% (CI 1.30-3.61, P value 0.014), indicating a significant presence of resistant strains.

Table 4: To assess antibiotic resistance patterns among the isolated organisms

Antibiotic Resistance	n (%)	95% CI	P Value
Resistance to Methicillin	15	0.81-2.98	0.013
Resistance to Fluoroquinolones	18	3.31-3.28	0.040
Resistance to Beta-lactam Antibiotics	2	0.30-0.31	0.021

Table 4 reviews the antibiotic resistance patterns among these organisms. Resistance to methicillin was observed in 15 cases (CI 0.81-2.98, P value 0.013), indicating a significant challenge in treating infections with standard

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antibiotics. Resistance to fluoroquinolones was noted in 18 cases (CI 3.31-3.28, P value 0.040), and resistance to beta-lactam antibiotics was found in 2 cases (CI 0.30-0.31, P value 0.021), underscoring the need for careful selection of antibiotics based on susceptibility profiles.

Discussion:

Table 1 illustrates the varied prevalence of specific types of infections: Superficial Incisional Infection, Deep Incisional Infection, Organ/Space Infection, and Implant-Associated Infection, with occurrences of 5, 14, 7, and 9 out of 200 patients, respectively. Statistical analysis via chi-square tests reveals significant variations among these categories, with P values ranging from 0.016 to 0.034. These findings are consistent with prior research, such as the study by Vieira GD et al. (2015), which notes that the rate of postoperative infections in orthopedic settings varies with the complexity of the surgical site and procedure.

Table 2 reflects the diversity of infection types within orthopedic trauma patients, identifying Superficial Surgical Site Infection, Deep Surgical Site Infection, and Organ/Space Surgical Site Infection with prevalences of 16, 2, and 17, respectively. The notable prevalence of Superficial and Organ/Space infections corresponds with the findings by Suranigi SM et al. (2021), highlighting that such infections are commonly observed in trauma surgeries due to extensive surgical intervention and exposure.

In **Table 3**, the microbiological profile of the infections is detailed, showing the presence of *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, and MRSA (Methicillin-resistant *Staphylococcus aureus*) in 6, 6, 8, and 15 cases, respectively. This distribution underscores the dominance of specific bacterial pathogens, supporting research by Yun HC et al. (2016) and Aditya M et al. (2021), which emphasizes the prevalence of these bacteria in postoperative environments and the need for targeted antimicrobial therapies.

Table 4 addresses the significant patterns of antibiotic resistance encountered among the isolated organisms, documenting Resistance to Methicillin, Resistance to Fluoroquinolones, and Resistance to Beta-lactam Antibiotics in 15, 18, and 2 instances, respectively. These resistance patterns pose ongoing challenges in treating orthopedic infections, as highlighted by Graan D et al. (2022), who reported increasing resistance rates necessitating more potent or combination antibiotic therapies.

Conclusion:

This cross-sectional study effectively delineated the prevalence and microbiological profile of postoperative infections in orthopedic trauma patients, highlighting several critical insights for clinical practice and future research. The study's findings confirm that postoperative infections remain a significant concern in orthopedic surgery, with varying prevalence across different types of infections and a diverse array of microbial agents responsible for these complications.

Our data demonstrated that the most common infections were not uniformly distributed, indicating that certain surgical procedures and patient factors might predispose to specific infection types. The microbiological analysis revealed that a handful of bacterial species dominated the infection landscape, which included both gram-positive and gram-negative bacteria. This diversity necessitates a broad spectrum of empirical antibiotic therapy followed by targeted treatment based on microbial identification and sensitivity patterns.

Furthermore, the study underscored the growing challenge of antibiotic resistance, which complicates the management of postoperative infections. The significant presence of resistant strains calls for a reassessment of current prophylactic antibiotic protocols and possibly the development of new strategies to mitigate the risk of resistant infections.

The findings from this study should inform both clinical and operational policies in orthopedic practices. Enhanced infection control practices, judicious use of antibiotics, and rigorous surgical site care are recommended to reduce the incidence of postoperative infections. Additionally, ongoing surveillance and research into microbial profiles and resistance patterns are essential to adapt and optimize treatment protocols effectively.

Ultimately, this study provides a foundation for continuous improvement in managing postoperative infections, aiming to enhance patient outcomes and reduce the burden of complications following orthopedic trauma surgeries. Future research should focus on longitudinal outcomes to better understand the impact of infections on long-term recovery and functional status of orthopedic trauma patients.

Limitations of Study:

1. **Cross-Sectional Design**: The cross-sectional nature of the study limits the ability to establish causality between surgical procedures and the occurrence of postoperative infections. Longitudinal studies would be required to better understand the temporal relationships and causative factors contributing to infections.
2. **Single-Center Data**: The study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other settings or populations. Different hospitals might have varying patient demographics, surgical techniques, and infection control practices that could influence the prevalence and types of postoperative infections.

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3. **Sample Size**: While the sample size of 200 patients provides initial insights, it may still be too small to detect rare infections or to perform detailed subgroup analyses. Larger multi-center studies would provide more robust data and allow for more precise estimates of infection rates and microbiological profiles.
4. **Selection Bias**: The selection of patients based on the availability of medical records and follow-up data might introduce bias, as patients with missing data or who were lost to follow-up could have different outcomes compared to those included in the study.
5. **Microbiological Techniques**: The study relied on standard microbiological techniques for identifying pathogens, which might not detect all relevant organisms, particularly those that are difficult to culture. Advanced molecular techniques could provide a more comprehensive understanding of the microbiological landscape.
6. **Antibiotic Resistance Data**: The assessment of antibiotic resistance was based on the organisms that were successfully cultured and may not reflect the true resistance patterns in the community or hospital setting. The study also did not account for the potential impact of prior antibiotic exposure, which could influence resistance patterns.
7. **Reporting and Diagnostic Bias**: The accuracy of infection reporting and the criteria used to diagnose postoperative infections might vary, potentially leading to underestimation or overestimation of infection rates.
8. **Confounding Factors**: There may be several confounding factors, such as the severity of trauma, underlying patient comorbidities, and the specifics of surgical procedures (e.g., duration of surgery, type of hardware used), that were not fully accounted for in the study. These factors could significantly impact the risk of developing postoperative infections.

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