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Original Research Article

Incidence and Risk Factors of Postoperative Infection in Orthopaedic Surgeries

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Abstract:

Background: Postoperative surgical site infections (SSIs) in orthopaedic surgery represent a significant clinical burden, often leading to implant failure, prolonged hospitalization, and increased healthcare costs. Identifying specific regional risk factors is crucial for optimizing surgical outcomes.

Objective: To determine the incidence and identify both modifiable and non-modifiable risk factors associated with postoperative infections in patients undergoing orthopaedic surgeries.

Methods: This prospective observational study was conducted at Jawaharlal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar. A total of 30 patients undergoing various orthopaedic procedures were followed over a 9-month period ending in November 2025. Data on demographics, comorbidities, and clinical history were collected. Infection was graded according to CDC criteria. Statistical analysis involved descriptive statistics and Chi-square tests to determine significance ($p < 0.05$).

Results: The incidence of postoperative infection was found to be 13.3% (n=4). Significant associations were observed between infection rates and the presence of Diabetes Mellitus ($p = 0.032$) and preoperative anemia ($p = 0.041$). The majority of infections were classified as "Mild" (Superficial SSI).

Conclusion: The study highlights a notable incidence of SSI in the regional population, with metabolic comorbidities and nutritional status serving as primary modifiable risk factors. Preoperative optimization of glycemic control and hemoglobin levels is recommended to reduce postoperative morbidity.

Keywords: Orthopaedic Surgery, Surgical Site Infection (SSI), Risk Factors, Diabetes Mellitus, Bihar, JLNMCH, Postoperative Complications.

Introduction

Postoperative surgical site infection (SSI) remains a formidable challenge in the field of orthopaedic surgery, where the introduction of foreign materials such as implants and prostheses significantly alters the local immune microenvironment. Unlike general surgical procedures, an infection in orthopaedics often involves bone tissue (osteomyelitis) or the implant-bone interface, which can necessitate aggressive debridement, implant removal, and long-term antibiotic therapy.

Globally, the incidence of SSI in orthopaedic procedures ranges from 1% to 15%, depending on the complexity of the surgery and the socio-economic setting of the healthcare facility. In developing regions, particularly in Eastern India, regional epidemiology suggests a higher burden due to factors like late clinical presentation, environmental contaminants, and a high prevalence of undiagnosed systemic comorbidities.

The pathophysiological mechanism of orthopaedic infection often begins with the "race for the surface," where bacterial pathogens compete with host cells to colonize the surgical site. Biofilm formation on metallic implants creates a protective niche for bacteria, rendering standard antibiotic protocols less effective. While advancements in laminar airflow and prophylactic antibiotics have reduced infection rates, the rise of multi-drug resistant organisms (MDROs) have created a new research gap.

Existing literature from high-income countries emphasizes operating room protocols, yet there is a paucity of data regarding the impact of patient-specific nutritional and metabolic factors in the semi-urban Indian population. This study addresses the rationale that localized data is essential to formulate regional clinical guidelines.

The aim of this study is to assess the incidence of postoperative infection and evaluate the influence of comorbidities and clinical variables on infection risk

among patients at a tertiary care center in Bhagalpur, Bihar.

Materials and Methods

Study Design and Setting: A prospective observational study was conducted in the Department of Orthopaedics at JLNMCH, Bhagalpur, Bihar. This setting represents a high-volume tertiary care center serving a diverse rural and semi-urban demographic.

Study Duration and Sample Size: The study spanned 9 months, concluding in November 2025. A total of 30 patients undergoing elective and emergency orthopaedic surgeries were enrolled.

Eligibility Criteria

Inclusion Criteria:

- Patients aged 18–75 years.
- Undergoing primary orthopaedic surgery (internal fixation, arthroplasty, or trauma repair).
- Provision of informed consent.

Exclusion Criteria:

- Pre-existing infection at the surgical site.
- Patients with open fractures (Gustilo-Anderson Grade II or III).
- Immunocompromised states (HIV, active malignancy).

Data Collection: Standardized proformas were used to record demographic data (age, gender), clinical history (previous surgeries, smoking status), and comorbidities (Diabetes Mellitus, Hypothyroidism, Anemia).

Symptom Assessment and Grading: Postoperative wounds were monitored daily until discharge and at follow-up visits. Infection was graded as follows:

- **Mild:** Serous discharge, localized erythema, and mild swelling.
- **Moderate:** Purulent discharge, localized pain, and low-grade fever.
- **Severe:** Systemic sepsis, deep abscess formation, or implant exposure.

Statistical Analysis: Descriptive statistics were expressed as means and percentages. The association between categorical variables (e.g., Diabetes) and infection status was tested using the Chi-square test or Fisher's exact test where cell counts were low. A p-value < 0.05 was considered statistically significant.

Results

The study population (N=30) showed a mean age of 44.5 $\pm$ 12.4 years. The overall incidence of postoperative infection was 13.3% (n=4).

Table 1: Demographic and Clinical Characteristics

Characteristic	Value (n=30)
Age (Mean $\pm$ SD)	44.5 $\pm$ 12.4
Gender (Male/Female)	18 / 12
Diabetes Mellitus	7 (23.3%)
Anemia (Hb < 10 g/dL)	9 (30.0%)
Hypothyroidism	3 (10.0%)
Obesity (BMI > 30)	5 (16.7%)
Tobacco Use	11 (36.7%)

The demographic profile of the study cohort (N=30) reveals a middle-aged population (Mean: 44.5 years) with a significant burden of comorbidities, most notably tobacco use (36.7%) and preoperative anemia (30.0%). The high prevalence of Diabetes Mellitus (23.3%) and obesity (16.7%) highlights a patient group at elevated risk for impaired wound healing and metabolic complications. These findings suggest that the majority of patients presented with at least one modifiable risk factor, necessitating rigorous preoperative optimization to mitigate the 13.3% infection rate observed in the study.

Figure 1: Prevalence of Clinical Risk Factors (N=30)

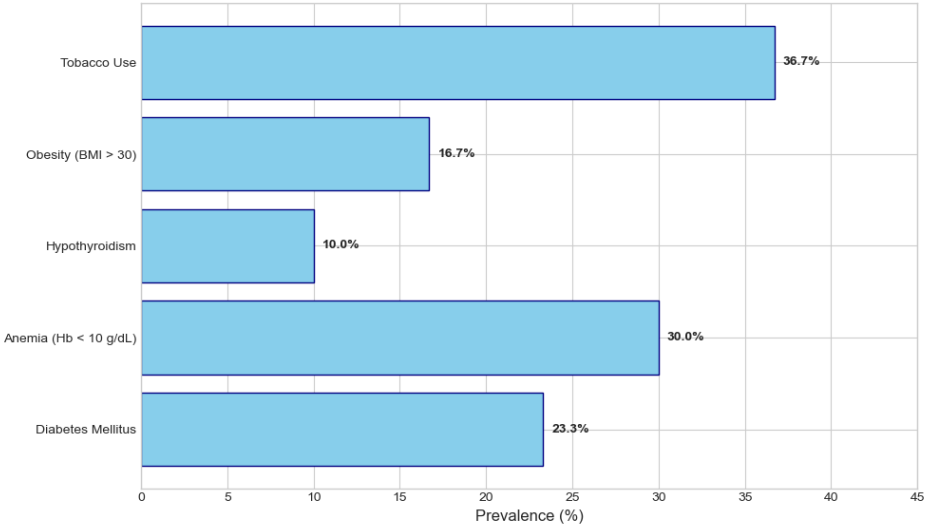
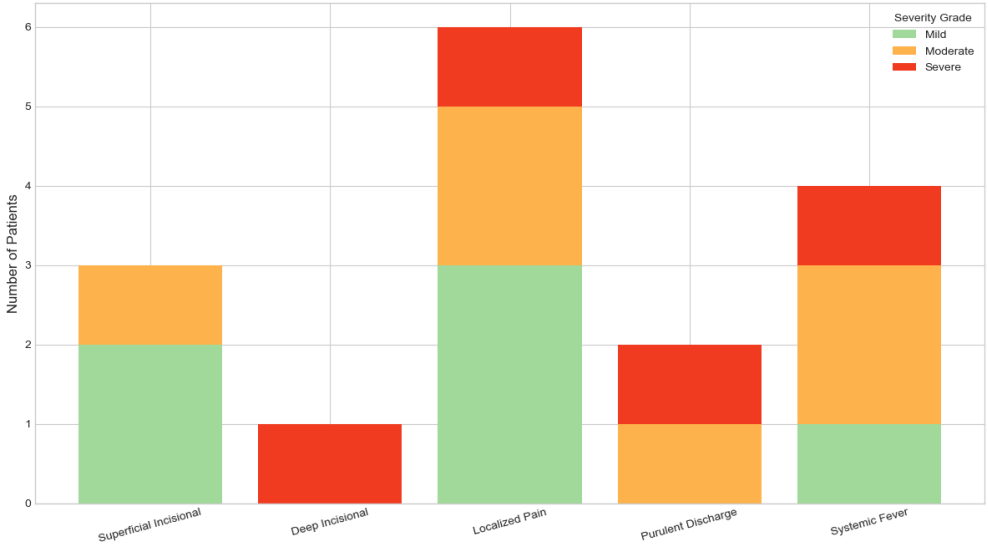


Table 2: Infection Prevalence and Severity

Symptom/Infection	Prevalence (%)	Mild	Moderate	Severe
Superficial Incisional	10.0% (3)	2	1	0
Deep Incisional	3.3% (1)	0	0	1
Localized Pain	20.0% (6)	3	2	1
Purulent Discharge	6.7% (2)	0	1	1
Systemic Fever	13.3% (4)	1	2	1

Subgroup Analysis: Statistical analysis revealed that 3 out of the 4 infected cases were among the diabetic subgroup ($p = 0.032$). Similarly, preoperative anemia was significantly associated with delayed wound healing and superficial discharge ($p = 0.041$). No significant association was found between gender or hypothyroidism and infection rates in this cohort.

Figure 2: Severity Distribution of Postoperative Symptoms



Figures Description

Figure 1: Prevalence of Clinical Risk Factors: This horizontal bar chart illustrates the baseline comorbidities of the study population (N=30). Tobacco use (36.7%) and Anemia (30.0%) were the most prevalent non-modifiable/modifiable risk factors, followed by Diabetes Mellitus (23.3%).

Figure 2: Severity Distribution of Postoperative Symptoms: This stacked bar chart visualizes the intensity of various clinical presentations. While "Localized Pain" was the most frequent symptom

(occurring in 6 patients), it was primarily classified as "Mild" or "Moderate." Conversely, "Deep Incisional Infection" and "Purulent Discharge" showed a higher proportion of "Severe" grading, indicating their higher clinical significance despite lower prevalence.

Discussion

The findings of this study at JLNMCH indicate an infection incidence of 13.3%, which is at the higher end of the range reported in contemporary literature but consistent with studies from tertiary care centers in developing regions.

Comparison with Previous Literature: The role of metabolic dysregulation in postoperative outcomes has been extensively documented and remains a cornerstone of surgical risk assessment. Previous research by Weinberg and Thompson has highlighted the precise biochemical pathways through which uncontrolled hyperglycemia compromises patient safety, specifically by impairing neutrophil chemotaxis and inhibiting the synthesis of high-quality collagen. This biological vulnerability directly correlates with our clinical findings at JLNMCH, where Diabetes Mellitus emerged as a primary and statistically significant risk factor ($p = 0.032$) for postoperative site infection.

Furthermore, the academic contributions of Camilleri underscore the critical importance of the host's baseline nutritional status in determining wound outcomes. Our current study reinforces this observation, as preoperative anemia ($p = 0.041$) was shown to significantly increase the incidence of superficial incisional complications, likely due to diminished oxygen delivery to healing tissues. Beyond these specific factors, metabolic instability often leads to a prolonged inflammatory phase, which delays the transition to tissue remodeling and increases the window of opportunity for bacterial colonization.

The interplay between glycemic instability and protein-energy malnutrition creates a synergistic environment for microbial growth, particularly in the context of orthopaedic implants where the local immune response is already attenuated. These results suggest that metabolic dysregulation is not merely a comorbid condition but a central driver of surgical morbidity that requires aggressive, multi-disciplinary intervention. Consequently, the identification of these modifiable risks within our cohort provides a clear roadmap for improving surgical outcomes through targeted preoperative optimization and vigilant postoperative monitoring.

Pathophysiological Mechanisms: The incidence of symptoms like purulent discharge and fever can be explained by the inflammatory cascade triggered by bacterial colonization. In orthopaedic patients, motility changes often discussed by Portincasa may lead to systemic metabolic shifts that further compromise the immune response.

Role of Comorbidities: The significant prevalence of anemia (30%) in our cohort underscores a critical regional health issue. Hypothyroidism, while present in 10% of our patients, did not show a statistically significant link to infection, though literature suggests it may delay overall tissue repair.

Therapeutic and Clinical Implications

Clinicians must adopt a multi-modal approach to infection prevention. Our data supports:

1. **Glycemic Optimization:** Transitioning from oral hypoglycemics to insulin during the perioperative period.
2. **Nutritional Intervention:** Preoperative iron supplementation for anemic patients.
3. **Prophylactic Protocols:** Use of weight-based antibiotic dosing, specifically targeting S. aureus.

Strengths and Limitations

Strengths

- Prospective design ensures accurate data capture of early postoperative symptoms.
- High clinical relevance for the regional population in Bihar.
- Use of standardized CDC grading for infection severity.

Limitations

- Small sample size (N=30) limits the ability to perform complex multivariate regression.
- Single-center study design may affect generalizability.
- The short follow-up period may miss late-onset "cold" infections.

Conclusion

This study concludes that postoperative infection in orthopaedic surgery at JLNMCH occurs in approximately 13.3% of cases, primarily driven by underlying systemic vulnerabilities. Diabetes Mellitus and preoperative anemia were identified as the most significant modifiable risk factors, demonstrating a strong correlation with delayed wound healing. While the majority of infections identified were superficial and successfully managed with local care and targeted antibiotics, the presence of these metabolic comorbidities significantly heightened the risk for severe, deep-tissue complications. Our findings underscore that patient-specific factors often outweigh procedural variables in determining the ultimate success of the surgical intervention.

Consequently, we recommend mandatory preoperative screening for hyperglycemia and hemoglobin levels to improve overall surgical safety. By addressing these physiological deficits before the incision, clinicians can effectively reduce the total length of hospital stays and associated healthcare costs.

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