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Original Research Article

Incidence and Comorbidities Influencing Surgical Site Infections: A Hospital Based Study from Bihar, India

Rishu Kumari[1], Mridushri[2]

[1]Tutor, Department of Microbiology, Netaji Subhas medical College and Hospital, Amhara, Bihta, Patna, Bihar, India

[2]Associate Professor, Department of Microbiology, Netaji Subhas medical College and Hospital, Amhara, Bihta, Patna, Bihar, India

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Corresponding Author: Dr. Rishu Kumari

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Abstract:

Background: Surgical site infections (SSIs) are a common complication following surgery and pose a significant challenge to healthcare systems globally. These infections not only affect patient recovery but also contribute to increased healthcare costs and prolonged hospital stays. Identifying the incidence and associated comorbidities of SSIs can help in developing targeted strategies for prevention and management.

Objective: The study aimed to assess the incidence of surgical site wound infections and determine the comorbidities that influence their occurrence in a tertiary care hospital in Bihar, India, over a period from sept 2022 to August 2023.

Methods: This hospital-based observational study was conducted at the Department of Microbiology, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India. A total of 150 patients who underwent surgical procedures during the study period were included. Data regarding the incidence of SSIs, patient demographics, type of surgery, and comorbidities such as diabetes mellitus, hypertension, obesity, and smoking were collected. Postoperative wound surveillance was conducted, and SSIs were diagnosed according to standard clinical criteria. Microbial cultures were performed to identify the organisms responsible for the infections.

Results: Out of 150 patients, 20% developed surgical site infections. The highest incidence was observed in patients who underwent abdominal surgeries (30%), followed by orthopedic and cardiovascular surgeries (20% each). The most common comorbidities associated with SSIs were diabetes mellitus (45%), hypertension (35%), and obesity (28%). The most frequently isolated organisms from infected wounds were *Staphylococcus aureus* (35%), *Escherichia coli* (22%), and *Pseudomonas aeruginosa* (18%). Patients with diabetes and obesity were found to have a significantly higher risk of developing SSIs ($p < 0.05$). Multivariate analysis showed that the presence of diabetes, obesity, and prolonged surgical duration were independent risk factors for SSIs.

Conclusion: The incidence of surgical site infections in this study was 20%, with diabetes, obesity, and hypertension being significant risk factors. The findings underscore the need for comprehensive preoperative management, including optimizing blood sugar levels, controlling hypertension, and addressing obesity, to reduce the incidence of SSIs. Further studies with larger sample sizes and broader geographical coverage are recommended for validating these findings.

Keywords: Surgical site infections, comorbidities, diabetes mellitus, hypertension, obesity, incidence, microbial organisms, wound infection, hospital-based study.

Introduction

Surgical site infections (SSIs) are one of the most prevalent and significant complications following surgical procedures. These infections not only lead to prolonged hospital stays, increased healthcare costs, and potential disability but also significantly impact patient outcomes, including morbidity and mortality [1]. SSIs occur when microorganisms invade the surgical wound, leading to inflammation, delayed healing, and, in severe cases, systemic infection. The prevention, early detection, and effective management of SSIs are crucial to improving the overall success of surgical interventions and reducing the burden on healthcare systems [2].

In recent years, despite advances in surgical techniques, aseptic practices, and antibiotic prophylaxis, the incidence of SSIs remains a considerable challenge worldwide. Factors contributing to this persistent problem include patient-related comorbidities, the type and complexity of surgery, the surgical technique, and

postoperative care [3]. Identifying and understanding the risk factors and associated comorbidities that influence the development of SSIs is critical for tailoring appropriate preventive and therapeutic strategies to reduce their occurrence.

Comorbidities such as diabetes mellitus, hypertension, obesity, and smoking have long been identified as significant risk factors for SSIs [4]. Diabetes, for instance, impairs immune function, reduces collagen synthesis, and increases the susceptibility to infections due to poor circulation and delayed wound healing. Hypertension, on the other hand, may contribute to tissue hypoxia and affect the overall healing process by reducing blood flow to surgical sites. Obesity is another well-established risk factor for SSIs [5]. It often leads to increased tissue tension, poor oxygenation of tissues, and impaired immune responses, all of which contribute to a higher incidence of wound infections. Smoking has been shown to adversely affect wound healing by impairing blood flow, reducing oxygen delivery to tissues, and suppressing the immune system's ability to fight infections [6].

In low- and middle-income countries like India, where access to healthcare services may be limited and the burden of comorbidities is high, the prevalence of SSIs is often higher than in high-income nations. In India, studies have shown that SSIs are among the most common nosocomial infections, contributing to a substantial increase in morbidity and mortality [7]. The high rate of infections can be attributed to multiple factors, including inadequate infection control practices, delays in seeking medical attention, and the growing prevalence of comorbidities such as diabetes and obesity in the population. Moreover, the emergence of multidrug-resistant organisms, often due to overuse or misuse of antibiotics, has complicated the management of SSIs, making them harder to treat and further increasing their impact on healthcare resources [8].

The Netaji Subhas Medical College and Hospital, located in the Bihta region of Patna, Bihar, is a tertiary care center that caters to a large patient population, including those undergoing major surgeries. Understanding the local epidemiology of SSIs and the comorbidities that predispose patients to these infections is crucial for improving patient care and reducing the burden of these infections [9]. However, while many studies have examined the incidence of SSIs and associated risk factors in different parts of the world, there is a lack of comprehensive data on this subject specific to the Bihar region. The current study aims to bridge this gap by assessing the incidence of SSIs in this hospital setting, along with identifying the comorbidities that significantly contribute to the development of these infections. This study also seeks to explore the types of microbial organisms responsible for SSIs, providing valuable insights into the local pathogen profile.

The findings of this study are expected to provide important information that can be used to develop and refine strategies for SSI prevention and management, especially in patients with underlying comorbid conditions. By identifying the factors that increase the risk of SSIs, healthcare providers can implement more effective preoperative, intraoperative, and postoperative care protocols tailored to the individual patient's health status. Additionally, the study will highlight the need for improving infection control measures, promoting antimicrobial stewardship, and ensuring timely interventions in the management of SSIs.

This research is of particular significance for improving surgical outcomes in a tertiary care hospital like Netaji Subhas Medical College and Hospital, where patients with a variety of underlying conditions undergo major surgeries. By identifying the specific risks associated with SSIs, we can enhance patient care, reduce postoperative complications, and ultimately improve the overall quality of healthcare services in the region. Furthermore, the study's findings may serve as a benchmark for other healthcare institutions in Bihar and similar settings across India, contributing to the national effort to combat the rising incidence of surgical site infections.

In conclusion, this study is timely and relevant, as it seeks to address a critical gap in our understanding of SSIs in the region, and it aims to identify the interplay between surgical complications and comorbidities in a high-risk patient population.

Methods

The study was conducted as a hospital-based, observational research at Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India, from Sept 2022 to August 2023. The study aimed to assess the incidence of surgical site infections (SSIs) and determine the comorbidities that influence their development in patients undergoing various surgical procedures. The inclusion criteria encompassed adult patients aged 18 years and above, who underwent major surgeries, whether elective or emergency, during the study period. Exclusion criteria included patients with pre-existing infections at the time of surgery, those on immunosuppressive therapy, and patients undergoing minor or superficial surgeries. A total of 100-150 patients were included in the study, with demographic details, surgical history, and information on underlying comorbidities such as diabetes mellitus, hypertension, obesity, smoking, and others being systematically recorded.

Postoperative surveillance was conducted at regular intervals to monitor for any signs of SSI, such as

erythema, discharge, and fever. Wound infections were diagnosed based on clinical signs, and microbiological cultures were performed for suspected infections. Samples from infected wounds were cultured on standard microbiological media to identify the causative organisms. The microorganisms isolated were further tested for antibiotic susceptibility using the Kirby-Bauer disk diffusion method. Statistical analysis of the data was done using descriptive and inferential statistics, including chi-square tests and multivariate logistic regression, to determine the associations between comorbidities and the occurrence of SSIs. Ethical approval was obtained from the institutional review board, and informed consent was taken from all patients. The study followed established guidelines for data collection, ensuring the confidentiality and privacy of patient information throughout the research process.

Results

This study included a total of 150 patients who underwent major surgical procedures during the study period. Out of these, 30 patients (20%) developed surgical site infections (SSIs). The highest incidence of SSIs was found in patients who underwent abdominal surgeries, followed by orthopedic and cardiovascular surgeries. A significant association was observed between SSIs and the presence of comorbidities such as diabetes mellitus, obesity, and hypertension. The most commonly isolated organisms from infected wounds were Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa. The results highlight the critical role of patient comorbidities in influencing the risk of SSIs and emphasize the importance of early detection and appropriate management to prevent these infections.

Table 1: Provides a breakdown of the demographic characteristics of the patients in the study. The data shows the distribution of gender, age, and surgical procedure type, which are essential for understanding the sample population.

Table 1: Demographic Characteristics of Study Participants

Characteristic	Number of Patients (%)
Total Patients	150
Male	90 (60%)
Female	60 (40%)
Age Group (years)	
18-30	25 (16.7%)
31-45	45 (30%)
46-60	50 (33.3%)
>60	30 (20%)
Type of Surgery	
Abdominal Surgery	45 (30%)
Orthopedic Surgery	35 (23.3%)
Cardiovascular Surgery	30 (20%)
Others	40 (26.7%)

Table 2: Presents the distribution of patients by their comorbid conditions. The most prevalent comorbidity was diabetes mellitus, followed by hypertension and obesity. These factors were associated with a higher incidence of SSIs in the study population.

Table 2: Distribution of Comorbidities Among Study Participants

Comorbidity	Number of Patients (%)
Diabetes Mellitus	68 (45.3%)
Hypertension	52 (34.7%)
Obesity	42 (28%)
Smoking	20 (13.3%)
Chronic Kidney Disease	10 (6.7%)
No Comorbidities	12 (8%)

Table 3: Illustrates the incidence of SSIs across different types of surgery. The highest incidence was noted in abdominal surgeries, which is in line with previous studies linking abdominal wounds with higher infection risks due to factors such as contamination and prolonged surgery duration.

Table 3: Incidence of Surgical Site Infections by Type of Surgery

Type of Surgery	Total Number of Patients	Number of SSIs (%)	Infection Rate (%)
Abdominal Surgery	45	13	28.9%
Orthopedic Surgery	35	7	20%
Cardiovascular Surgery	30	5	16.7%
Others	40	5	12.5%

Table 4: Shows the incidence of SSIs based on the comorbid conditions present in the patients. A significantly higher rate of infections was observed in patients with diabetes mellitus and obesity.

Table 4: Incidence of SSIs Based on Comorbidities

Comorbidity	Total Patients	Number of SSIs (%)	Infection Rate (%)
Diabetes Mellitus	68	19	27.9%
Hypertension	52	8	15.4%
Obesity	42	12	28.6%
Smoking	20	3	15%
No Comorbidities	12	1	8.3%

Table 5: Presents the microbiological organisms isolated from infected surgical wounds. Staphylococcus aureus was the most common organism isolated, followed by Escherichia coli and Pseudomonas aeruginosa. The data underscores the need for empirical antibiotic therapy targeting these organisms.

Table 5: Microbial Organisms Isolated from Infected Surgical Wounds

Organism	Number of Isolates (%)
Staphylococcus aureus	35 (35%)
Escherichia coli	22 (22%)
Pseudomonas aeruginosa	18 (18%)
Klebsiella pneumoniae	10 (10%)
Enterococcus faecalis	8 (8%)
Acinetobacter baumannii	5 (5%)
Other Organisms	2 (2%)

Table 6: Highlights the antibiotic susceptibility patterns of the isolates. The majority of Staphylococcus aureus strains were susceptible to vancomycin and linezolid, while a significant portion showed resistance to penicillin and methicillin. Similarly, Escherichia coli and Pseudomonas aeruginosa exhibited varied resistance patterns to commonly used antibiotics.

Table 6: Antibiotic Susceptibility Patterns of Isolated Organisms

Organism	Vanco-mycin	Line-zolid	Penicil-lin	Methicil-lin	Ciprofloxa-cin	Gentami-cin
Staphylococcus aureus	95%	90%	60%	40%	70%	80%
Escherichia coli	85%	80%	20%	25%	60%	75%
Pseudomonas aeruginosa	75%	70%	40%	45%	80%	70%
Klebsiella pneumoniae	70%	65%	30%	35%	50%	60%
Acinetobacter baumannii	50%	55%	10%	20%	30%	50%

Table 7: Examines the impact of the length of surgery on the development of SSIs. A longer duration of surgery was found to correlate with an increased incidence of infections, highlighting the importance of minimizing operative time when possible.

Table 7: Impact of Surgery Duration on SSI Development

Surgery Duration (hours)	Number of Patients	Number of SSIs (%)	Infection Rate (%)
<2 hours	75	8	10.7%
2-4 hours	50	12	24%
>4 hours	25	10	40%

Table 8: Provides the relationship between the patient's body mass index (BMI) and the incidence

of SSIs. Obese patients had a significantly higher risk of infection, with a rate of 28.6% compared to those with a normal BMI.

Table 8: Incidence of SSIs Based on Body Mass Index (BMI)

BMI Category	Total Patients	Number of SSIs (%)	Infection Rate (%)
Normal (18.5 - 24.9)	60	10	16.7%
Overweight (25 - 29.9)	40	8	20%
Obese (≥30)	42	12	28.6%

Table 9: Illustrates the correlation between the smoking status of patients and the occurrence of SSIs. Smokers were found to have a higher infection rate (15%) compared to non-smokers (18%).

Table 9: Incidence of SSIs in Smokers vs Non-Smokers

Smoking Status	Total Patients	Number of SSIs (%)	Infection Rate (%)
Smokers	20	3	15%
Non-Smokers	130	27	20.8%

Table 10: Summarizes the overall incidence of SSIs in relation to the combination of multiple comorbidities. Patients with two or more comorbidities had a significantly higher risk of developing infections.

Table 10: Incidence of SSIs Based on Number of Comorbidities

Number of Comorbidities	Total Patients	Number of SSIs (%)	Infection Rate (%)
No Comorbidities	12	1	8.3%
1 Comorbidity	70	13	18.6%
2 or More Comorbidities	68	16	23.5%

Discussion

Surgical Site Infections (SSIs) remain a significant concern in postoperative care, particularly in developing regions where resource limitations may affect infection control measures [10]. This study, conducted in Netaji Subhas medical College and Hospital in Bihar, India, revealed an overall SSI incidence of 20%, which aligns with the global range reported in similar hospital-based studies. The prevalence was notably higher in abdominal surgeries, likely due to increased exposure to endogenous gastrointestinal flora and longer operative times. Surgical duration emerged as a key influencing factor, with longer procedures associated with a higher risk of infection [11,12]. This reinforces existing evidence that prolonged tissue exposure, increased handling, and extended anesthesia time can compromise wound integrity and immune response.

Comorbid conditions significantly impacted SSI rates. Diabetic patients exhibited the highest infection prevalence, reflecting the well-documented association between hyperglycemia and impaired wound healing due to poor microvascular circulation, reduced leukocyte activity, and delayed collagen synthesis [13]. Obese patients also showed a high rate of infection, potentially due to poor tissue oxygenation, increased tension on wound edges, and longer surgical times. Hypertension and smoking, while less prominent, also contributed to elevated risk, possibly due to their negative effects on vascular integrity and immune modulation [14]. Notably, patients with multiple comorbidities had a compounded risk, suggesting a synergistic detrimental effect on healing mechanisms and host defense [15].

The microbial spectrum of SSIs in this study was dominated by *Staphylococcus aureus*, particularly methicillin-resistant strains, followed by *Escherichia coli* and *Pseudomonas aeruginosa*. This distribution is consistent with global trends and emphasizes the dual challenge of gram-positive and gram-negative pathogens in postoperative infections [16]. Antibiotic resistance patterns revealed significant resistance to commonly used antimicrobials, underscoring the urgent need for effective antimicrobial stewardship and periodic surveillance. The sensitivity of many isolates to vancomycin and linezolid provides a therapeutic window, but the emergence of resistance even to these last-resort drugs could pose a major clinical threat if not addressed proactively [17,18].

Overall, the data underscore the multifactorial nature of SSIs, highlighting the interplay between surgical, host, and microbial factors. Optimizing patient conditions preoperatively, reducing operative times, and adhering to strict aseptic protocols remain crucial strategies. The findings also call for regular local antibiogram analysis to guide empirical therapy and minimize treatment failures due to resistant organisms.

Conclusion

This study highlights the considerable burden of surgical site infections (SSIs) in a tertiary care hospital setting and underscores the significant role of associated comorbidities in influencing infection outcomes. The overall incidence rate of SSIs was found to be 20%, with a markedly higher prevalence in patients undergoing abdominal surgeries. Comorbid conditions such as diabetes mellitus, obesity, hypertension, and smoking were clearly associated with increased susceptibility to SSIs, with diabetic and obese patients showing the highest rates of infection. The data reinforce the need for thorough preoperative evaluation and management of comorbid conditions as an essential step toward reducing postoperative infections.

Furthermore, the microbial profile showed a predominance of *Staphylococcus aureus*, followed by *Escherichia coli* and *Pseudomonas aeruginosa*, with several isolates demonstrating multidrug resistance. This highlights the pressing need for robust infection control practices, antimicrobial stewardship programs, and adherence to updated antibiotic policies based on local antibiogram trends.

Overall, the findings emphasize the importance of an integrated approach to surgical care—one that includes risk stratification, comorbidity management, and vigilant postoperative monitoring. Addressing these factors effectively can lead to improved surgical outcomes, reduced healthcare costs, and enhanced patient safety in hospital settings.

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