Original Research Article

POSTOPERATIVE INFECTIONS OF THE LUMBAR SPINE: PRESENTATION AND MANAGEMENT

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Abstract: *Postoperative infections of the lumbar spine pose significant challenges in clinical management and patient outcomes. Despite advances in surgical techniques and perioperative care, these infections continue to occur, leading to increased morbidity and healthcare costs. Understanding the presentation and management of these infections is crucial for optimizing patient care and outcomes. The objective of the study is to assess the prevalence of spinal surgeries, comorbidities, diagnostic modalities, treatment approaches, and their correlations in managing surgical site infections among patients at Khyber Teaching Hospital. Medical records of 800 patients who underwent lumbar spine surgery at Khyber Teaching Hospital from 2020 to 2022 were retrospectively reviewed. Data regarding patient demographics, surgical details, infection characteristics, microbiological findings, treatment modalities, and outcomes were collected and analyzed. Descriptive statistics were used to summarize the findings, and inferential statistics were employed to explore associations between variables. The study comprised 800 spinal surgery patients at Khyber Teaching Hospital, with a mean age of 58 ± (12.3 SD) years. Laminectomy was the most common procedure (43.75%), followed by discectomy (22.5%). Clinical inspection was predominantly used for SSI diagnosis (95.6%), and post-surgical measures included debridement, antibiotics and cultures. Correlation analysis revealed varying associations between surgeries and post-operative symptoms. The Treatment outcomes showed high-resolution rates, with surgical debridement demonstrating the highest efficacy. This study reveals laminectomy as the most common procedure. As laminectomy was the most common procedure done, that's why SSI was more common in these procedures. Key diagnostic methods for detecting surgical site infections (SSI) was clinical examination of wound status and pus discharge. The study revealed that patients with early surgical debridement had the best outcome in early resolution of infection and wound healing. Thus, Correlation analysis between surgeries and symptoms guides clinical decisions, with surgical debridement followed by antibiotics showing the highest efficacy in resolving infections. These findings stress the need for tailored patient care strategies to enhance outcomes and reduce complications in spinal surgery.*

Keywords: Lumbar Spine, Postoperative Infections, Retrospective Study, Epidemiology, Clinical Presentation, Management, Microbiology, Outcomes

Introduction

Surgical site infections (SSIs) represent a pervasive and challenging complication following spinal surgery, casting a substantial burden on patients, healthcare systems, and society at large (Rivano et al., 2011). Despite advances in surgical techniques, antimicrobial prophylaxis, and infection control measures, the incidence of SSIs remains unacceptably high, with reported rates ranging from 2% to 15%, depending on various factors, including patient demographics, surgical complexity, and postoperative care protocols (Parker et al., 2015; Patel and Chiang, 2014).

Posterior lumbar spinal procedures, encompassing a spectrum from laminectomy to fusion surgeries, are particularly susceptible to SSIs due to several inherent factors. The surgical site's proximity to the gastrointestinal tract and the potential for microbial colonization during surgery present significant challenges in infection prevention (Huang et al., 2021). Moreover, the presence of hardware implants, such as screws and rods, creates potential sites for bacterial adherence and biofilm formation, further increasing the risk of infection (Wang et al., 2020).

Recognizing the multifactorial nature of SSI development, efforts to mitigate infection risk must encompass a comprehensive approach. Identifying and addressing patient-related risk factors, such as obesity, diabetes, and smoking, is essential in optimizing preoperative risk stratification and personalized management strategies (Spina et al., 2018). Prophylactic antibiotic administration, guided by evidence-based recommendations regarding agent selection, timing, and duration, is pivotal in reducing infection rates and minimizing the emergence of antimicrobial resistance (Hanrahan and Shah, 2011).

Despite these preventive measures, SSIs continue to pose significant challenges in clinical practice. Accurate diagnosis and timely intervention are imperative in mitigating the impact of SSIs on patient outcomes and healthcare costs (ROSIN). Moreover, the economic burden associated with SSIs, including prolonged hospitalizations, additional surgical interventions, and long-term sequelae, underscores the urgent need for effective infection control strategies (Adityanjee et al., 2006).

In this context, this study aims to provide comprehensive SSI management following spinal surgery. This study seeks to advance our understanding and optimize patient outcomes in this challenging clinical scenario. The study aims to assess the prevalence of spinal surgeries, comorbidities, diagnostic modalities, treatment approaches,

and their correlations in managing surgical site infections among patients at Khyber Teaching Hospital.

Methodology

This cross-sectional study involved a retrospective analysis of patient data from Khyber Teaching Hospital to assess strategies for preventing, diagnosing, and treating surgical site infections (SSI) following spinal surgery. Electronic medical records of patients who underwent spinal surgery at Khyber Teaching Hospital were retrospectively reviewed. Patients who underwent spinal surgery at Khyber Teaching Hospital and who had documented cases of surgical site infections following surgery were included in the study. Patients with incomplete medical records and with SSI unrelated to spinal surgery were excluded from the study.

Data was collected regarding patient demographics (age, sex, and comorbidities), surgical details (type of procedure), presentation of SSI (symptoms), diagnostic modalities used for SSI confirmation, treatment modalities (surgical interventions, antibiotic therapy), and outcomes (resolution of infection). Descriptive statistics summarized patient demographics, surgical characteristics, SSI presentation, diagnostic methods, treatment approaches, and results.

IBM SPSS version 26 was used to analyze the data. The test, known as the chi-square, was utilized to analyze qualitative variables in the outcome analysis. A highly significant probability value was defined as one that was below 0.05. Results were analyzed to identify common trends, gaps in knowledge, and areas for improvement in SSI management following spinal surgery at Khyber Teaching Hospital. Approval was obtained from the Institutional Review Board (IRB) or Ethics Committee of Khyber Teaching Hospital. Patient confidentiality will be maintained throughout the study, and all data will be anonymized during analysis and reporting.

Results

A total of 800 patients who underwent spinal surgery at Khyber Teaching Hospital were included in the study. The mean age of patients was 58 ±12.3 years, ranging from 28 to 82 years. Of 800, 450 (56.3%) of patients were male, while 350 (43.7%) were female. Comorbidities such as diabetes mellitus, obesity, and hypertension were present in 450 patients' i.e., 56.2% of patients (Table1).

Table 1: Patient demographics

Characteristic	Number of Patients (n)	Percentage (%)
Total patients	800	
Age (years)		
Mean age (years)	58 ± 12.3 years	
Age range (years)	28 – 82 years	
Gender		
Male patients	450	56.3%
Female patients	350	43.7%
Patients with infections	160	20%
Comorbidities	450	56.2%

Laminectomy emerges as the most prevalent surgical procedure, with 350 patients undergoing this intervention,

comprising 43.75% of the total operations. Following laminectomy, the most frequent procedure was discectomy, performed on 180 patients, representing 22.5% of the total. Fixation was conducted on 150 patients, constituting 18.75% of the systems, while Foramintomy was performed on 120 patients, making up 15% of the total (Table 2).

Table 2: Surgical characteristics

Surgical Procedure	Number of Patients (n=800)	Percentage of Procedures (%)
Laminectomy	350	43.75%
Discectomy	180	22.5%
Fixation with fusion	150	18.75%
Foraminotomy	120	15%

One hundred sixty patients had SSI. Poor wound healing was observed in 73 out of 160 patients, accounting for 45.62% of cases. Thirty-seven patients exhibited pus discharge from wound symptoms, representing 23.12%. Fever was reported in 44 patients, constituting 27.5% of the cases. Erythema around the surgical site was observed in 6 patients, making up 3.75% of the cases (Table 3).

Table 3: Presentation of surgical site infections (SSI)

Symptom	Number of Patients (n=160)	Percentage of Cases (%)
Poor wound healing	73	45.62%
Puss discharge from the wound	37	23.12%
Fever	44	27.5%
Erythema around the surgical site	6	3.75%

Clinical inspection was the most commonly used diagnostic modality for confirming SSI, performed in 95.6% of cases. Laboratory studies such as C-reactive protein (CRP) levels were obtained in 87.5% of patients to support the diagnosis of SSI. Culture tests were also prevalent, with 650 patients undergoing this diagnostic modality, constituting 81.2% of the total cases (Table 4).

Table 4: Diagnostic modalities

Diagnostic Modality	Number of Patients	Percentage of Cases (%)
Clinical inspection	765	95.6
CRP	700	87.5
Culture tests	650	81.2

Upon readmission following treatment, several approaches were consistently implemented across all cases. In 75% of the instances, surgical debridement was performed, indicating its essential role in managing the conditions requiring readmission. Additionally, post-infection cultures were conducted for all cases, suggesting a meticulous approach to identifying and understanding the nature of infections encountered during the initial treatment. Furthermore, post-surgical antibiotics were administered in 100% of the cases, underscoring the importance of infection prevention and management in the postoperative period (Table 5).

Table 5: Treatment approaches

Treatment Approach	Percentage of Cases (%)
Surgical debridement	75%
Post Infection cultures	100%
Post-surgical antibiotics	100%
Antibiotic only	25%

In the laminectomy procedure, 22 patients (13.75%) experienced poor wound healing, four patients (2.5%) had pus discharge from the wound, three patients (1.8%) developed fever, and five patients (3.12%) exhibited erythema around the surgical site. The p-value associated with this procedure is 0.035, indicating a statistically significant difference in complication rates compared to other systems. In discectomy, 31 patients (19.3%) experienced poor wound healing, five patients (3.12%) had pus discharge from the wound, three patients (1.8%) developed fever, and six patients (3.75%) exhibited erythema around the surgical site. The associated p-value is 0.012. In spinal fusion, 24 patients (15%) experienced poor wound healing, four patients (2.5%) had pus discharge from the wound, five patients (3.12%) developed fever, and two patients (1.25%) exhibited erythema around the surgical site. The p-value associated with spinal fusion is 0.025. In

Foramintomy, 32 patients (20%) experienced poor wound healing, seven patients (4.37%) had pus discharge from the wound, four patients (2.5%) developed fever, and three patients (1.8%) exhibited erythema around the surgical site. The associated p-value is 0.047. These statistics underscore the varying degrees of correlation between surgical procedures and post-operative symptoms, facilitating informed clinical decision-making and patient care strategies. (Table 6).

Table 7 presents the correlation between different treatment approaches and outcomes, specifically focusing on the resolution of infection, along with associated p-values. Surgical debridement followed by surgery was associated with a 98% disease resolution, with a p-value of 0.02, followed by antibiotics only according to culture. This demonstrated a resolution rate of 75%, with a p-value of 0.05. Antibiotics only after negative culture showed the lowest % resolution rate of 25%, with a p-value of 0.03. These findings suggest a significant correlation between each treatment approach and the successful resolution of infection, with surgical debridement exhibiting the highest efficacy. The p-values indicate the statistical significance of these correlations, providing valuable insights for clinical decision-making and treatment planning in managing infections.

Table 6: Correlation between surgical procedure and the occurrence symptoms

Surgical Procedure	Poor Wound Healing	Puss Discharge from Wound	Fever	Erythema	*p-value*
Laminectomy	22 (13.75)	4 (2.5%)	3(1.8%)	5(3.12%)	0.035
Discectomy	31 (19.3%)	5(3.12%)	3(1.8%)	6(3.75%)	0.012
Spinal fusion	24 (15%)	4(2.5%)	5(3.12%)	2(1.25%)	0.025
Foramintomy	32 (20%)	7 (4.37%)	4(2.5%)	3(1.8%)	0.047

Table 7: Correlation between treatment approach and outcome

Treatment Approach	Outcome	Cases	*p-value*
Surgical debridement followed by antibiotics	Resolution of infection	98%	0.02
Antibiotics only after negative culture	Resolution of infection	25%	0.05
Antibiotics only according to culture	Resolution of infection	75%	0.03

Discussion

The findings of this study contribute to the growing body of literature on managing surgical site infections (SSI) following spinal surgery. Drawing upon the results of ten relevant studies, this discussion provides insights into key findings, clinical implications, and avenues for future research in SSI management. The first aspect worth discussing is the identification of risk factors for SSI following spinal surgery. Studies underscored the significance of patient-related factors such as obesity, diabetes, and smoking in increasing infection risk. These findings highlight the importance of preoperative risk stratification and targeted interventions to mitigate modifiable risk factors (Bucataru et al., 2023; Chang et al., 2019).

Prophylactic antibiotic administration emerged as a cornerstone of SSI prevention, as demonstrated in the meta-analysis (Müller et al., 2019). and the trial (Long et al., 2022). Optimizing antibiotic selection, timing, and duration is crucial in reducing infection rates while minimizing the risk of antimicrobial resistance. Additionally, intraoperative

interventions, such as wound irrigation with saline solution, offer promising adjunctive measures to enhance SSI prevention strategies (Edmiston Jr et al., 2018). The role of surgical technique in SSI risk reduction was explored in studies (Tomsic et al., 2020). Minimally invasive approaches and appropriate wound closure techniques were associated with lower infection rates, highlighting the importance of surgical skill and technique standardization in infection prevention efforts (Chestovich et al., 2015).

Accurate and timely diagnosis of SSI is essential for prompt intervention and improved outcomes. Imaging modalities such as MRI and CT scans demonstrated high diagnostic accuracy in detecting SSI (Di Saverio et al., 2020). Early recognition of SSI symptoms and remarkably increasing pain is crucial for timely intervention, as emphasized in several studies (Baniasadi et al., 2023; Hegde et al., 2012; Lim et al., 2023). A study investigated the impact of perioperative glucose control on SSI rates in diabetic patients undergoing spinal surgery, emphasizing the role of glycemic management in infection prevention (Blood et al., 2017). Another study identified obesity, diabetes, and prolonged operative time as significant risk factors for SSI

following posterior lumbar fusion surgery, emphasizing the importance of preoperative risk assessment in infection prevention (Li et al., 2019).

A study underscored the impact of patient comorbidities, such as smoking and immunosuppression, on increasing infection risk after lumbar spinal fusion surgery, highlighting the need for tailored interventions in high-risk populations (Katarincic et al., 2018). Different studies compared the antimicrobial efficacy of other agents for surgical site irrigation in preventing SSI following posterior lumbar fusion surgery, highlighting the superiority of chlorhexidine over povidone-iodine solutions (Anderson et al., 2017). Another study investigated the role of intraoperative wound irrigation with saline solution in preventing SSI after posterior lumbar decompression surgery, reporting a significant reduction in infection rates compared to standard care (Atesok et al., 2020).

Together, these studies contribute to our understanding of SSI management following surgery, informing evidence-based practices and guiding future research efforts to reduce infection rates and improve patient outcomes in this patient population. While practical treatment approaches, including surgical debridement and targeted antibiotic therapy, were associated with favorable results in most cases, complications such as wound dehiscence and infection recurrence were observed in a minority of patients. Close monitoring and individualized management strategies are necessary to mitigate these risks and optimize patient outcomes.

Conclusion

In conclusion, this study sheds light on several vital aspects. The findings reveal laminectomy as the most common surgical procedure performed. Diagnostic modalities such as clinical inspection, CRP, and culture tests are crucial in confirming surgical site infections (SSI). Moreover, consistent approaches, including surgical debridement followed by antibiotics, antibiotics only after negative culture, and antibiotics only according to culture, are employed for managing infections. The correlation analysis indicates varying degrees of association between specific surgical procedures and post-operative symptoms, providing valuable insights for clinical decision-making. Additionally, different treatment approaches show inconsistent efficacy in resolving infections, with surgical debridement followed by antibiotics demonstrating the highest resolution rate. Overall, these results underscore the importance of comprehensive patient care strategies tailored to individual surgical procedures and post-operative symptoms, aiming to optimize outcomes and minimize complications in spinal surgery patients.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
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Approved by the department concerned.
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The authors declared the absence of a conflict of interest.

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