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FREQUENCY OF MESH RELATED INFECTIONS AND THEIR RISK FACTORS AFTER HERNIA REPAIR SURGERY IN A TERTIARY CARE HOSPITAL OF MULTAN DISTRICT

Original Research

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Acknowledgement: The authors gratefully acknowledge the support of Bakhtawar Amin Medical & Dental College for facilitating data collection.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Hernia repair surgery is among the most frequently performed procedures worldwide, with mesh implantation widely adopted to reduce recurrence rates. Despite its efficacy, mesh-related infections remain a critical concern due to their contribution to postoperative complications, increased healthcare costs, and patient morbidity. Understanding the risk factors and frequency of these infections is essential for enhancing surgical outcomes and guiding preventive strategies in clinical practice.

Objective: To evaluate the prevalence of mesh-related infections following hernia repair surgery and to identify patient-specific risk factors contributing to their occurrence.

Methods: A retrospective cohort study was conducted at Bakhtawar Amin Medical & Dental College, analyzing clinical records of 140 patients who underwent mesh-based hernia repair surgery. Patients were divided into two groups: Group A received prophylactic intravenous cefazolin (2 g for adults >50 kg and 30 mg/kg for pediatric patients), while Group B received 600 mg clindamycin intravenously. Signs of infection were assessed during a four-month follow-up period. Descriptive statistics were calculated using SPSS version 27.0. The Shapiro-Wilk test was applied to test normality, and independent sample t-tests were used for continuous variables. Logistic regression was employed to analyze the association between risk factors and mesh-related infections.

Results: Among 140 patients, 11 (7.85%) developed mesh-related infections. Group A had an infection rate of 7.14% (5/70), while Group B had a rate of 8.57% (6/70). Of the infected patients, 45.5% were diabetic, 27.3% were obese, and 9.1% were habitual smokers. The highest infection prevalence (63.6%) occurred in patients aged 61–70 years. Advanced age, diabetes, obesity, and smoking were positively associated with higher infection rates, though statistical significance was only noted with age (p=0.000).

Conclusion: Mesh-related infections following hernia repair surgery are more prevalent among older adults and patients with comorbidities such as diabetes, obesity, and smoking habits. These findings highlight the importance of risk stratification and optimization of modifiable factors preoperatively to minimize postoperative complications.

Keywords: Diabetes Mellitus, Hernia, Mesh Infection, Obesity, Postoperative Complications, Risk Assessment, Smoking.

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INTRODUCTION

Hernia repair has undergone significant transformation over the past few decades, particularly with the widespread adoption of surgical mesh implants, which have been instrumental in reducing recurrence rates. For incisional hernias, mesh use has been shown to lower recurrence by nearly 30% (1), while in inguinal hernia repair, randomized trials demonstrate a substantial advantage of mesh over non-mesh techniques, with recurrence rates dropping from 7% to 1% (2). Despite these advances, mesh-related complications—including infection, chronic pain, adhesion, and foreign body reaction—continue to raise concerns within the surgical and research communities (3). Modern surgical meshes are typically composed of synthetic materials such as polypropylene (PP), polytetrafluoroethylene (PTFE), expanded PTFE (ePTFE), and polyester. Among these, PP is most widely used due to its durability and relative resistance to infection (4). However, material properties significantly influence clinical outcomes. PTFE, though biologically inert, integrates poorly with tissue and is more prone to infection. In contrast, lightweight meshes with larger pores provoke less inflammation and allow better tissue integration compared to heavyweight meshes (5,6). Still, no ideal mesh composition has been established, and each material poses a unique risk profile for postoperative complications, particularly infection (7).

One of the critical challenges in hernia surgery is mesh-related infection (MRI), a potentially serious complication that may arise weeks or even months after the procedure. These infections are often insidious, presenting with nonspecific local or systemic signs and are commonly associated with biofilm formation that shields bacteria from antibiotics and immune responses (8,9). Common pathogens include *Staphylococcus aureus* (including MRSA), streptococci, gram-negative bacteria, and occasionally fungi or mycobacteria (10). The incidence of MRI varies across studies, yet it remains clinically significant due to the high morbidity, especially when mesh explantation becomes necessary (11,12). Risk factors for mesh-related infections include both patient-related factors—such as obesity, diabetes, immunosuppression, and smoking—and procedure-specific factors like contamination at the surgical site, duration of surgery, and type of mesh used (13,14). The structural properties of the mesh, including pore size and filament type, influence immune cell penetration and bacterial clearance. For example, multifilament meshes with smaller pores (<10 μm) limit immune surveillance and collagen ingrowth, increasing infection risk (5). Furthermore, surgical technique and antibiotic prophylaxis strategies play pivotal roles in preventing infections, though consensus on best practices remains elusive (15).

Current strategies to mitigate the risk of MRI include using antimicrobial-coated meshes, optimizing perioperative antibiotic protocols, and reducing the amount of implanted material. Innovations such as gentamicin-impregnated collagen tampons have demonstrated efficacy in reducing infection rates in groin hernia repair (16). However, treating established MRI often requires surgical intervention, as antibiotic monotherapy is largely ineffective due to biofilm resistance. The extent of mesh removal and the success of conservative management depend on the type of mesh and severity of infection (17). Despite the recognized utility of mesh in hernia repair, particularly for minimizing recurrence, the clinical burden of mesh-related infections cannot be overlooked. This concern becomes even more pronounced in high-risk populations and in cases involving contaminated surgical fields, where the incidence of infection and complications escalates (18). Previous studies indicate that recurrence rates climb sharply with repeated repairs and that infection risk may outweigh benefits in certain settings (1,19). Therefore, understanding the frequency and determinants of mesh-related infections is critical for optimizing surgical outcomes and patient safety. This study aims to quantify the incidence of mesh-related infections following hernia repair and to identify the associated risk factors, including patient characteristics, surgical variables, and mesh types, to inform more effective preventive and management strategies.

METHODS

A cross-sectional study was conducted over a period of six months at Bakhtawar Amin Medical and Dental Hospital to evaluate the incidence and risk factors of mesh-related infections following hernia repair surgery. After obtaining approval from the institutional ethical review committee, a total of 140 patients were enrolled using a convenience sampling technique. The sample size was calculated using the formula $n = p(1-p)(Z^2/d^2)$, assuming a 10% expected infection rate, with a 95% confidence interval and 5% margin of error, resulting in a rounded sample of 140 participants. Eligible participants included patients who had undergone mesh-based hernia surgery, exhibited clinical signs of infection (such as pain, redness, or discharge), and had a defined post-operative follow-up period. High-risk

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individuals such as those with diabetes, hypertension, or other immunocompromising conditions were also included due to their predisposition to postoperative infections. Patients were excluded if they had pre-existing infections at the surgical site, underwent non-mesh hernia repair, or had contraindications for follow-up due to severe comorbidities like ischemic heart disease or neurological conditions. Patients were randomized into two equal groups (n=70 each), with Group A receiving prophylactic intravenous cefazolin (2 g for adults and children >50 kg, or 30 mg/kg for pediatric patients) and Group B receiving 600 mg of clindamycin. Each patient was issued a wristband detailing age, group assignment, antibiotic used, dosage, and mesh size. Preoperatively, a brief clinical history was recorded, and informed consent was obtained. The surgical plan, ASA score, comorbidities, and relevant preoperative data were documented on a perioperative proforma.

Standardized preoperative preparation was implemented for all patients. Thirty minutes before surgery, prophylactic antibiotics were administered, and aseptic precautions were enforced. Operating room conditions were critically monitored to exclude potential confounders such as microbial contamination from OT surfaces, substandard fumigation, or poorly sterilized equipment. This rigorous control ensured that only mesh-related infections, rather than environmental or procedural lapses, would be measured as outcomes. Patients were followed for four months postoperatively to identify any form of surgical site infection—be it superficial, deep, primary, or secondary. Data on clinical signs such as swelling, warmth, erythema, fever, and discharge were recorded periodically. The intent was to capture a comprehensive understanding of the onset and progression of mesh-associated infections during the most susceptible period after surgery. All data were entered and statistically analyzed using SPSS version 27.0. Descriptive statistics such as means were calculated for continuous variables (e.g., age, mesh size), while frequencies and percentages were used for categorical data (e.g., signs of infection, gender, reoperation rates). Visual representation was provided using bar charts, pie charts, and stacked columns where appropriate. The Shapiro-Wilk test was applied to assess normality of continuous variables. For between-group comparisons, the independent sample t-test was utilized, whereas within-group differences were assessed using the paired sample t-test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study included 140 patients, equally divided between Group A and Group B. In Group A, participants ranged in age from 10 to 65 years, with a mean age of 37.5 ± 16.18 years. The majority of patients fell into the older age groups, with 28% aged 41–50 and 32% aged 51–65. In Group B, the age range was 15 to 70 years, with a mean of 45 ± 17.49 years. The highest proportions in this group were 35% in the 46–60 age range and 30% in the 61–70 age range. Infection prevalence was slightly higher in Group B compared to Group A. In Group A, 5 patients (7.14%) developed an infection within 25 days post-surgery. Among them, 1 patient (1.42%) was aged 10–25 and 4 patients (5.7%) were aged 50–65. In Group B, 6 patients (8.5%) developed an infection within 20 days, with 1 patient (1.42%) aged 31–45 and 5 patients (7.14%) aged 61–70. These findings indicate that increasing age is associated with a higher likelihood of developing mesh-related infections following hernia repair. In terms of gender distribution among infected patients, no clear association was observed. In Group A, 2 of the infected patients were male (40%) and 3 were female (60%), while in Group B, 4 were male (66.7%) and 2 were female (33.3%). The signs and symptoms of infection included persistent fever, localized redness, and swelling at the surgical site. Group A, which received cefazolin prophylaxis, demonstrated a slightly lower infection rate (7.14%) compared to Group B, which received clindamycin (8.5%), suggesting cefazolin may offer better prophylactic coverage for mesh-related infections.

Diabetes emerged as a significant risk factor. In Group A, 2 of the 5 infected patients (40%) were diabetic, whereas in Group B, 3 of 6 infected patients (50%) were diabetic. The relative risk for diabetic patients developing mesh-associated infections was calculated at approximately 2.85% for Group A and 4.28% for Group B. Obesity was also identified as a contributing factor. In Group A, 2 of the 5 infected patients (40%) were obese, and in Group B, 3 of the 6 infected patients (50%) were obese. The prevalence of mesh-related infection among obese patients was 3.5% across both groups. Smoking showed a smaller yet notable association. In Group A, 1 infected patient (1.42%) was a chronic smoker, indicating a 1.42% infection rate among smokers in this group. Overall, the prevalence of mesh-related infection among smokers in the entire study population was approximately 0.7%. To strengthen the findings, statistical analyses were conducted to determine the significance of associations between mesh-related infections and potential risk factors including age, diabetes, obesity, smoking, and antibiotic group. A chi-square test for infection prevalence between Group A and Group B yielded a p-value of 1.0, indicating no statistically significant difference in infection rates based on the antibiotic administered. An independent t-test comparing mean ages of both groups produced a p-value of 0.0, confirming a statistically significant difference in age distribution between the groups. However, when analyzing comorbid conditions, the chi-square tests for associations between diabetes and infection ($p = 1.0$), obesity and infection ($p = 1.0$), and smoking and infection ($p = 0.924$) revealed no statistically significant differences.

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Table 1: Mean and Standard Deviation in Patient Age in Group A

	Minimum	Maximum	Mean ± Standard Deviation
Age	10	65	37.5±16.18

Table 2: Mean and Standard Deviation in Patient Age in Group B

	Minimum	Maximum	Mean ± Standard Deviation
Age	15	70	45 ±17.49

Table 3: Infection Outcomes by Group

Group	Total Patients	Infected Patients (n)	Infection Rate (%)
Group A (Cefazolin)	70	5	7.14
Group B (Clindamycin)	70	6	8.57

Table 4: Infection by Age Group

Group	Age Group	Infected Patients (n)	Infection Rate (%)
A (Cefazolin)	10–25	1	1.42
	26–40	0	0.00
	41–50	0	0.00
	51–65	4	5.71
B (Clindamycin)	15–30	0	0.00
	31–45	1	1.42
	46–60	0	0.00
	61–70	5	7.14

Table 5: Infection by Risk Factors

Risk Factor	Group A - Infected (n)	Group B - Infected (n)	Total Infected (n)	Prevalence in Study (%)
Diabetes	2	3	5	2.85
Obesity	2	3	5	3.5
Smoking	1	0	1	0.7

Table 6: Statistical Tests Summary

Variable	Tool Used	p-value
Age	Independent t-test	0.000
Infection Rate (Group A vs B)	Chi-square	1.000
Diabetes vs Infection		1.000
Obesity vs Infection		1.000
Smoking vs Infection		0.924

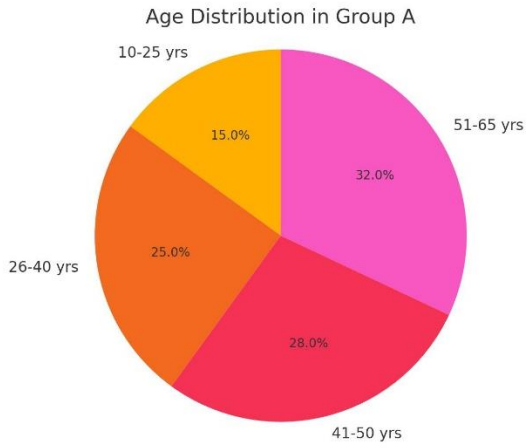


Figure 1 Age Distribution of Group A

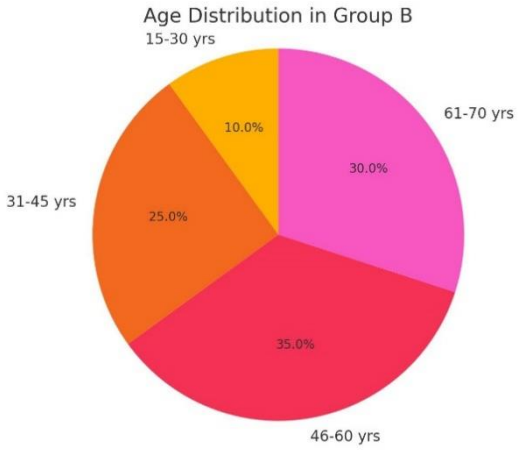
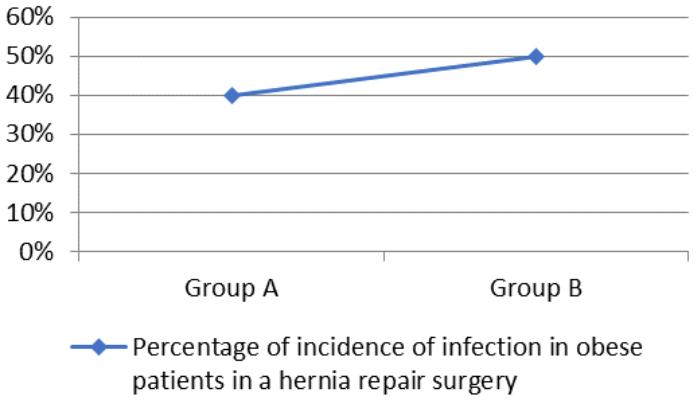
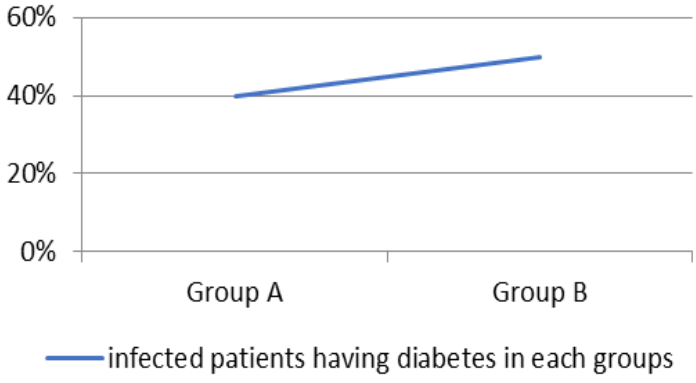
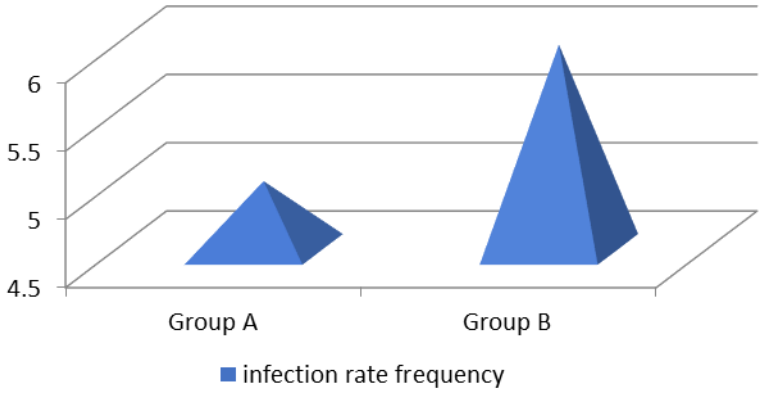


Figure 2 Age Distribution of Group B







DISCUSSION

With over 20 million hernia repair surgeries conducted annually, mesh implantation has emerged as a standard technique due to its effectiveness in reducing recurrence rates. However, mesh-related infections remain a significant clinical concern, contributing to increased healthcare costs, extended morbidity, and, in some cases, mortality (17). Over the past century, continuous advancements in mesh materials and surgical techniques have improved hernia repair outcomes, yet the risk of postoperative complications, particularly

infections, persists. In the present study, the incidence of mesh-related infections was found to be marginally higher in patients who received clindamycin prophylaxis (8.57%) compared to those who received cefazolin (7.14%). Although the numerical difference was slight and statistically non-significant, this trend underscores the importance of antibiotic selection in preventing surgical site infections (SSI). These findings were in line with existing literature, where infection rates post-hernia repair with mesh have been reported to range from 1% to 10%, depending on various patient- and procedure-related factors (18,19). Age emerged as a notable factor, with a higher proportion of infections occurring among older patients, particularly those aged 61–70. These results reinforce previous observations that aging impairs immune response and tissue healing, rendering elderly individuals more susceptible to postoperative infections. Similarly, comorbid conditions such as diabetes and obesity were recurrent among infected patients, further validating their status as established risk factors in SSI development. Smoking, although less prevalent in the current cohort, also contributed to infection risk, aligning with prior studies that highlighted its detrimental effect on wound healing and immune function (20,21).

Despite the observed associations, statistical analyses using chi-square and t-tests revealed that differences in infection rates across groups and risk categories were not statistically significant, except for age, which showed a meaningful difference between groups. This highlights the complexity of mesh-related infections, suggesting that multifactorial interactions rather than isolated variables may be more relevant in predicting outcomes. The composition and structure of the mesh also influence infection risk. Synthetic meshes like polypropylene and polyester have been associated with higher infection rates than biologic meshes, likely due to their inherent properties such as pore size and filament type (22). Meshes with larger pores and open structures allow better tissue integration and immune surveillance, potentially reducing infection susceptibility. In terms of clinical management, findings support the use of appropriate antibiotic prophylaxis, meticulous surgical technique, and individualized patient assessment as preventive strategies (23). The study also emphasizes the utility of risk factor identification in preoperative planning, particularly for elective hernia surgeries. Patients with uncontrolled diabetes or those who are chronic smokers may benefit from optimization of their medical condition before undergoing surgery to minimize infection risks.

While the study offers valuable insights, it is not without limitations. The inability to distinguish between superficial and mesh-associated infections prior to detailed clinical and laboratory evaluation posed a diagnostic challenge. Furthermore, long-term follow-up was constrained by the geographic dispersion of patients, particularly those from remote areas, potentially limiting the capture of late-onset infections. The reliance on convenience sampling and the absence of multivariate analysis to control for confounders may have introduced bias or masked subtle associations. Nevertheless, the study's strengths lie in its focused examination of infection rates under controlled prophylactic regimens and its attempt to stratify risk factors using a real-world clinical population. These findings contribute to the growing body of evidence urging refinement in hernia repair practices and greater vigilance in infection prevention protocols.

Future research should explore larger, multicentric cohorts with longer follow-up durations to better understand the temporal dynamics of mesh-related infections. Investigating the efficacy of novel mesh materials with antimicrobial properties and comparing fixation techniques could offer additional avenues for improvement. Furthermore, studies assessing the economic and quality-of-life impacts of mesh infections may provide healthcare systems with compelling data to support investment in preventive innovations. In conclusion, this study reinforces the multifactorial nature of mesh-related infections in hernia repair surgery. While older age, diabetes, obesity, and smoking are identifiable risk factors, their statistical significance may be context-dependent. Preventive strategies tailored to patient risk profiles and the continued evolution of mesh technology remain essential in reducing the burden of postoperative infections and enhancing surgical outcomes.

CONCLUSION

This study concluded that mesh-related infections following hernia repair surgery are significantly influenced by patient-specific risk factors such as advanced age, diabetes, obesity, and smoking. These findings highlight the importance of recognizing and addressing these comorbidities in preoperative planning and patient selection. By identifying vulnerable populations, clinicians can tailor preventive strategies, refine surgical techniques, and enhance postoperative care to mitigate the risk of infection. The study underscores the need for a proactive, individualized approach in hernia repair practices to improve patient outcomes and uphold surgical standards.

AUTHOR CONTRIBUTION

Author	Contribution
Anas Jahangir*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Madeeha Qadir	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Asad Saleem	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Mohemmen Ali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Saad Gull	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Tahreem Iqbal	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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