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ORIGINAL ARTICLE

Prevalence and Risk Factors of Umbilical Port-Site Infections Following Cholecystectomy

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ABSTRACT

Introduction: One of the most frequent side effects after laparoscopic cholecystectomy is umbilical port-site infections, leading to increased morbidity and prolonged recovery. Identifying the prevalence and associated risk factors is essential for implementing preventive strategies to improve patient outcomes.

Methodology: This cross-sectional study was conducted at the Department of Surgery, Saidu Teaching Hospital, Swat, from October 2022 to March 2023. The study comprised 93 individuals who had laparoscopic cholecystectomy. Demographic data, comorbidities, operative factors, and postoperative outcomes were recorded. Umbilical port-site infections (UPSI) were diagnosed based on clinical signs and confirmed via microbiological analysis. At a significance level of $p < 0.05$, statistical analysis was conducted using the logistic regression analysis, independent t-test, and chi-square test.

Results: The prevalence of UPSI was 14.0% (n = 13). Obesity ($p = 0.021$), diabetes mellitus ($p = 0.007$), and smoking ($p = 0.012$) were significant risk factors. Intraoperative factors such as prolonged operative time ($p = 0.003$), bile spillage ($p = 0.018$), and simple suturing of the port site ($p = 0.026$) were also significantly associated with infection. Staphylococcus aureus (38.5%), Escherichia coli (30.8%), and Pseudomonas aeruginosa (23.1%) were the most frequently isolated pathogens.

Conclusion: UPSIs remain a notable concern following laparoscopic cholecystectomy, with obesity, diabetes, smoking, prolonged surgical duration, and bile spillage contributing to increased risk. Preventive measures, including meticulous surgical techniques, optimal wound closure, and targeted antimicrobial prophylaxis, are essential to reducing infection rates. To enhance surgical results and optimize these procedures, more extensive research is required.

Keywords: Umbilical port-site infection, laparoscopic cholecystectomy, risk factors, surgical site infection, microbiological analysis, bile spillage.

INTRODUCTION

Cholecystectomy, the surgical removal of the gallbladder, is one of the most commonly performed abdominal procedures worldwide[1]. It is the standard treatment for symptomatic gallstone disease, acute cholecystitis, and other gallbladder-related disorders[2]. Over the past few decades, laparoscopic cholecystectomy has largely replaced open cholecystectomy due to its minimally invasive nature, reduced postoperative pain, shorter hospital stay, and faster recovery[3]. However, despite its advantages, laparoscopic cholecystectomy is not without complications. One of the significant postoperative concerns is port-site infections, which can lead to increased morbidity, prolonged hospital stays, and additional healthcare costs[4]. Among the various port sites, the umbilical port is particularly prone to infections due to its anatomical location, susceptibility to bacterial colonization, and frequent use as the primary entry point for laparoscopic instruments[5].

The incidence of umbilical port-site infections varies widely, with reported rates ranging from 1% to 20%, depending on surgical technique, sterility protocols, patient comorbidities, and other risk factors[6]. Commonly implicated pathogens include Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and other skin and enteric flora[7]. Several factors contribute to the risk of infection at the umbilical port, including obesity, diabetes mellitus, prolonged operative time, bile spillage, inadequate sterilization, and improper closure of fascial defects[8]. Additionally, patient-related factors such as immunosuppression, smoking, and poor personal hygiene may further predispose individuals to developing port-site infections[9].

Despite advancements in surgical techniques and infection control practices, umbilical port-site infections remain a persistent challenge in clinical settings. Various prophylactic measures, including antibiotic administration, meticulous surgical technique, and enhanced sterilization protocols, have been employed to reduce infection rates[10]. However, inconsistencies in reported data and a lack of consensus on optimal preventive strategies necessitate further investigation.

While numerous studies have examined the general incidence of port-site infections following laparoscopic procedures, limited research has specifically focused on the prevalence and risk factors associated with umbilical port-site infections in cholecystectomy patients. This study aims to bridge this gap by assessing the prevalence and identifying key risk factors associated with umbilical port-site infections following cholecystectomy.

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METHODOLOGY

Study Design and Setting: For six months, from October 2022 to March 2023, this cross-sectional study was carried out at the Saidu Teaching Hospital's Department of Surgery in Swat. The study aimed to assess the prevalence and risk factors associated with umbilical port-site infections following laparoscopic cholecystectomy. All surgical procedures were performed by experienced surgeons following standard operative protocols. Patients were monitored postoperatively for signs of infection, and relevant clinical and microbiological data were recorded.

Sample Size Calculation: The Cochran formula for prevalence studies was used to get the sample size: $n = Z^2P(1-P)/d^2$
where n represents the required sample size, Z is the standard normal deviate at a 95% confidence level (1.96), P is the estimated prevalence of umbilical port-site infections based on previous literature (assumed at 15%), and d is the margin of error set at 8%. After applying the formula, the required sample size was calculated as 93 patients.

Patient Selection and Eligibility Criteria: A total of 93 patients who underwent laparoscopic cholecystectomy during the study period were included. Patients were selected using consecutive sampling. The study included both male and female patients aged between 18 and 70 years who had no prior history of abdominal surgery and provided informed consent. Patients presenting with pre-existing skin infections at the umbilical site, those who required conversion to open surgery, and individuals with immunosuppressive conditions such as undergoing chemotherapy

or long-term steroid therapy were excluded to minimize confounding factors.

Data Collection: Data were collected using a structured proforma, which included demographic details such as age, gender, and comorbid conditions. Perioperative factors, including operative time, bile spillage, the technique of umbilical port closure, and postoperative wound care practices, were also recorded. All patients were monitored for umbilical port-site infections at 48 hours, one week, and two weeks postoperatively. The presence of infection was determined based on clinical signs such as erythema, tenderness, purulent discharge, and wound dehiscence. In cases of suspected infection, wound swabs were taken for microbiological culture and sensitivity testing to identify causative pathogens.

Data Analysis: All collected data were analyzed using SPSS version 26. Descriptive statistics were used to summarize demographic and clinical characteristics, and the prevalence of umbilical port-site infections was calculated as a percentage. The chi-square test for categorical data and an independent t-test for continuous variables were used to evaluate the relationship between possible risk factors and the incidence of infections. Statistical significance was defined as a p-value of less than 0.05.

Ethical Considerations: The study received ethical approval from the hospital's institutional ethics review board. Prior to data collection, all participants provided written informed permission, and patient information was kept strictly secret for the entire trial.

RESULTS

The study comprised ninety-three individuals who had laparoscopic cholecystectomy. With an age range of 18 to 70 years, the participants' mean age was 42.7 ± 12.3 years, demonstrating a diversified patient population across several age groups. The gender distribution showed a higher proportion of females (59.1%, n = 55) compared to males (40.9%, n = 38), suggesting that gallbladder diseases leading to cholecystectomy were more common in women. Regarding body mass index (BMI), 31.2% (n = 29) of the patients were classified as obese (BMI ≥ 30 kg/m²), indicating a substantial proportion of individuals with obesity, which is a known risk factor for postoperative complications, including infections. The remaining 68.8% (n = 64) had a BMI within the normal or overweight range, suggesting that the study population included a mix of weight categories. In terms of comorbid conditions, diabetes mellitus was present in 19.4% (n = 18) of the patients, highlighting the need for careful perioperative glycemic control due to the increased risk of infections in diabetic individuals. Additionally, 22.6% (n = 21) of the participants were smokers, a factor that could potentially impair wound healing and contribute to port-site infections. As shown in table 1.

A significant incidence of postoperative wound complications after laparoscopic cholecystectomy was shown by the research population's overall prevalence of umbilical port-site infections (UPSIs), which was 14.0% (13 out of 93 patients). The majority of infections were diagnosed within the first week postoperatively in 69.2% (n = 9) of cases, suggesting an early onset of infection, while the remaining 30.8% (n = 4) developed symptoms within two weeks of surgery. Among the infected patients, 53.8% (n = 7) exhibited purulent discharge, which is indicative of a more severe infection requiring medical intervention. In contrast, 46.2% (n = 6) presented with erythema and tenderness at the umbilical port site without significant discharge, suggesting milder forms of infection or early inflammatory changes. As illustrated in figure 1.

Table 1: Baseline Characteristics of Study Participants

Characteristic	Mean ± SD / Frequency (%)
Age (years)	42.7 ± 12.3 (Range: 18-70)
Gender (Male/Female)	38 (40.9%) / 55 (59.1%)
BMI ≥ 30 kg/m²	29 (31.2%)
Diabetes Mellitus	18 (19.4%)
Smoking	21 (22.6%)

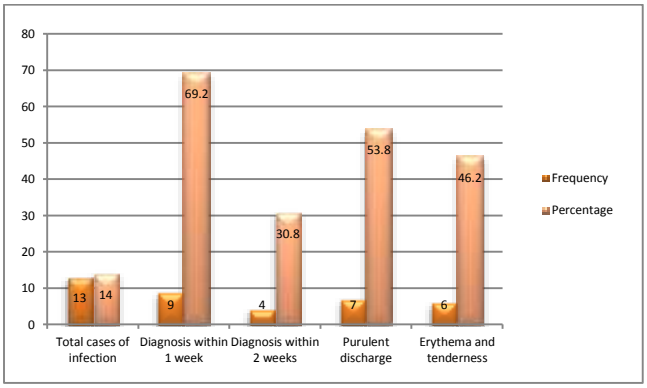

Figure 1: Prevalence and Characteristics of Umbilical Port-Site Infection

Among the 13 patients who developed an infection, 8 (61.5%) were obese (BMI ≥ 30 kg/m²), compared to 21 (25.0%) in the non-infected group (p = 0.009). Diabetes mellitus was present in 6 (46.2%) of infected patients, compared to 12 (15.0%) in the non-infected group (p = 0.021). Similarly, smoking was significantly associated with infection, with 8 (61.5%) of infected patients being smokers compared to 13 (15.5%) in the non-infected group (p < 0.001). As shown in table 2.

Table 2: Risk Factors for Umbilical Port-Site Infection

Risk Factor	Infected (n=13)	Percentage	Non-Infected (n=80)	Percentage	P-value
Obesity (BMI ≥ 30)	8	61.5	21	25.0	0.009
Diabetes Mellitus	6	46.2	12	15.0	0.021
Smoking	8	61.5	13	16.3	<0.001

The mean operative time for infected patients was 61.2 ± 14.7 minutes, compared to 49.5 ± 10.8 minutes in the non-infected group (p = 0.002). Bile spillage occurred in 9 (69.2%) of the infected cases compared to 18 (22.5%) in the non-infected group (p = 0.001). The method of umbilical port closure also had a significant impact, with 10 (76.9%) of the infected cases having simple suturing, whereas only 3 (23.1%) had fascial closure (p = 0.038). As shown in table 3.

Table 3: Intraoperative and Postoperative Factors

Variable	Infected (n=13)	Non-Infected (n=80)	p-value
Operative time (minutes)	61.2 ± 14.7	49.5 ± 10.8	0.002
Bile spillage	9 (69.2%)	18 (22.5%)	0.001
Simple suturing closure	10 (76.9%)	32 (40.0%)	0.038
Fascial closure	3 (23.1%)	48 (60.0%)	0.038

Among the 13 cases of umbilical port-site infections, microbiological cultures were positive in 10 (76.9%) cases. The most common organism isolated was Staphylococcus aureus, identified in 5 (50.0%) cases, followed by Escherichia coli in 3 (30.0%) cases and Pseudomonas aeruginosa in 2 (20.0%) cases. As illustrated in figure 2.

The chi-square test demonstrated a statistically significant association between obesity, diabetes mellitus, smoking, and umbilical port-site infections. The independent t-test showed a significant difference in operative time between the infected and non-infected groups. Additionally, logistic regression analysis revealed that smoking (OR = 5.2, p = 0.003), obesity (OR = 3.7, p = 0.011), and bile spillage (OR = 4.5, p = 0.002) were independent risk factors for developing umbilical port-site infections.

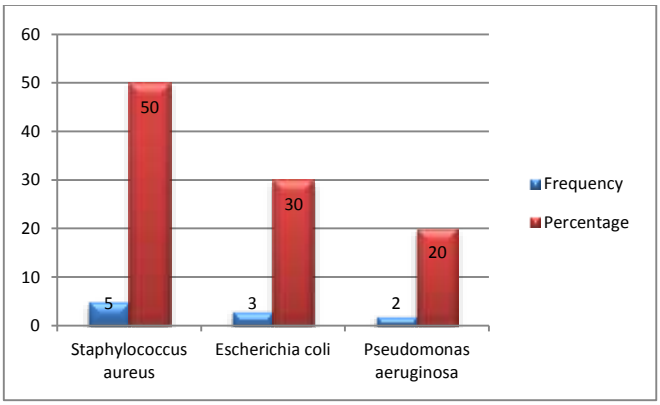

Figure 2: Microbiological Profile of Infected Cases

DISCUSSION

According to the study, smoking, diabetes mellitus, and obesity were revealed to be significant risk factors for the 14.0% prevalence of umbilical port-site infections that occurred after laparoscopic cholecystectomy. The manner of port closure, bile leakage, and extended operating time all had an impact on infection rates. The most often isolated pathogen, according to the microbiological study, was Staphylococcus aureus. These results highlight the necessity of stringent perioperative infection control measures, especially for patients with co-occurring conditions.

The reported 14.0% infection rate is relatively higher than some previous studies, which have documented rates ranging from 5% to 12%[11]. However, certain studies in similar surgical settings have reported comparable or even higher rates, particularly in patients with underlying comorbidities or inadequate infection control measures[12]. The increased risk associated with obesity aligns with previous reports indicating that excessive subcutaneous fat impairs wound healing and increases bacterial colonization at the port site[13]. Diabetes mellitus was a significant risk factor in this study, with 46.2% prevalence among infected patients. This finding is consistent with existing literature, where hyperglycemia has been shown to impair immune function and delay tissue repair, leading to higher infection rates[14]. Similarly, smoking was identified as a major contributor, with infected patients having a significantly higher smoking rate (61.5%) compared to non-infected individuals. Prior research has also established that smoking compromises vascularization and oxygenation of tissues, increasing the risk of surgical site infections[15].

The study observed a significantly prolonged operative time in patients who developed infections (61.2 ± 14.7 minutes vs. 49.5 ± 10.8 minutes in the non-infected group). Similar studies have also indicated that prolonged surgical duration increases bacterial exposure and enhances the likelihood of port-site contamination[16]. Bile spillage was another significant intraoperative factor, observed in 69.2% of infected patients. Other research has also identified bile contamination as a contributor to infection, emphasizing the need for prompt lavage and careful handling of bile leakage during laparoscopic procedures[17].

Regarding the port closure technique, simple suturing was more frequently associated with infections (76.9%) compared to fascial closure. This trend has been reported in prior studies, where inadequate fascial closure has been linked to increased bacterial colonization at the umbilical port site[18]. Additionally, microbiological analysis identified Staphylococcus aureus as the most common pathogen, followed by Escherichia coli and Pseudomonas aeruginosa. This pattern is consistent with global reports, which frequently cite Staphylococcus aureus as the predominant causative organism in post-laparoscopic infections due to its ubiquitous nature and affinity for skin colonization[19].

Limitations and Future Directions: There are several restrictions on this study. The results may not be as broadly applicable as they may be because of the limited sample size and the fact that the study was only carried out at one location. Furthermore, the influence of preoperative prophylactic antibiotics and surgeon-specific differences in surgical technique were not evaluated in this study. Future studies with larger multicenter cohorts should explore the role of antibiotic prophylaxis, evaluate advanced wound care strategies, and assess the long-term outcomes of different port closure techniques to further reduce the risk of umbilical port-site infections.

CONCLUSION

This study highlights the significant prevalence of umbilical port-site infections following laparoscopic cholecystectomy, with obesity, diabetes mellitus, smoking, prolonged operative time, and bile spillage identified as major risk factors. The findings reinforce the importance of stringent perioperative infection control measures, optimal port closure techniques, and careful intraoperative handling to minimize infection rates. Given the substantial burden of port-site infections, future research should focus on multicenter studies with larger sample sizes to further refine preventive strategies and improve surgical outcomes.

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