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Original Article

Prevalence, Incidence and Risk Factors for Port Site Infection Following Laparoscopic Surgery: A Multicenter Study in Bangladesh

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Abstract

Introduction: Port site infection (PSI) is a significant postoperative complication of laparoscopic surgery, potentially leading to prolonged hospitalization, morbidity, and increased healthcare costs. Limited data exist regarding PSI incidence and risk factors in Bangladesh. This study aimed to determine the prevalence and incidence of PSI among patients undergoing laparoscopic surgery and to identify patient- and procedure-related risk factors, including instrument sterilization practices.

Methods: A prospective observational study was conducted on 93 patients undergoing elective laparoscopic procedures at Bangladesh Medical University and selected private hospitals (Popular General Hospital and East West Medical College Hospital) from January 2021 to December 2023. Postoperative PSI was assessed based on CDC criteria. Data collected included demographics, comorbidities, operative details, and instrument sterilization practices. Logistic regression was used to identify independent risk factors.

Results: The overall incidence of PSI was 14% (13/93). Significant risk factors included diabetes mellitus (OR 3.2, 95% CI 1.1–9.4, p=0.03), obesity (BMI >30) (OR 2.5, 95% CI 0.9–6.8, p=0.05), prolonged operative time (>90 minutes) (OR 2.8, 95% CI 1.0–7.6, p=0.04), and faulty sterilization of laparoscopic instruments (improper preparation of 3% glutaraldehyde solution, expired solution, inadequate contact time, faulty drying, tap water contamination, or instruments previously used for TVS TV patients not properly sterilized) (OR 4.5, 95% CI 1.4–14.0, p=0.01). All superficial infections resolved with conservative management, while deep infections required drainage. No mortality was reported.

Conclusion: PSI remains a significant complication in Bangladesh. Both patient factors (diabetes, obesity, prolonged operative time) and procedural factors, particularly improper instrument sterilization, are key contributors. Strict asepsis and quality control in sterilization can reduce PSI and improve outcomes.

Keywords: Port site infection, Laparoscopy, Risk factors, Bangladesh, Sterilization, Postoperative complication.

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Introduction

Laparoscopic surgery has transformed the practice of general surgery and is now considered the standard approach for many common abdominal procedures, including cholecystectomy, appendectomy, and hernia repair. Compared with conventional open surgery, the laparoscopic approach is associated with smaller incisions, reduced postoperative pain, earlier mobilization, shorter hospital stay, and improved cosmetic outcomes.[1-3] These advantages have contributed to its rapid adoption in both high-resource and low-resource settings. However, the benefits of minimally invasive surgery do not eliminate the risk of postoperative infectious complications. Among these, port site infection (PSI) remains an important cause of postoperative morbidity, delayed recovery,

unplanned outpatient visits, additional antibiotic use, and increased healthcare expenditure.[1,2] Although PSI is often less extensive than deep incisional or organ-space infection, it can substantially compromise patient satisfaction and surgical outcomes, particularly when diagnosis is delayed or infection progresses beyond the superficial tissue planes.

The reported incidence of PSI after laparoscopic procedures varies considerably across institutions and case series, with published estimates generally ranging from 1% to 15%.[4,5] This variation reflects differences in case mix, perioperative antibiotic practices, definitions of infection, duration of postoperative surveillance, and standards of instrument reprocessing. Clinically, PSI may present as a superficial infection confined to the skin and subcutaneous tissue, or as a deeper infection involving the fascia and muscle, with occasional localized abscess formation. In some settings, atypical infections caused by environmental organisms, including non-tuberculous mycobacteria, have been described after laparoscopic procedures, often in association with inadequate disinfection or contaminated instruments.[4] Because the laparoscopic port provides a direct conduit through the abdominal wall, even minor lapses in asepsis, specimen retrieval, or instrument handling may facilitate microbial inoculation of the wound. The umbilical port is often particularly vulnerable because of its natural bacterial colonization, frequent use for specimen extraction, and repeated instrumentation during surgery.

Multiple patient-related and procedure-related factors have been implicated in the development of PSI. Important host factors include diabetes mellitus, obesity, poor nutritional status, advanced age, and other conditions that impair immune response or wound healing.[2,6] Hyperglycemia reduces leukocyte function and collagen synthesis, while obesity may increase tissue trauma, reduce local perfusion, and complicate wound care. Procedure-related determinants are also critical. Prolonged operative time increases exposure of wounds and instruments to potential contamination, and technical events such as bile spillage, specimen leakage, tissue trauma at the port site, or repeated trocar manipulation may further elevate infection risk.[6,7] Equally important is the quality of sterilization and high-level disinfection of laparoscopic instruments. Because many laparoscopic devices are heat-sensitive and require chemical disinfection or specialized reprocessing, improper preparation of disinfectant solutions, use of expired glutaraldehyde, inadequate contact time, incomplete drying, and post-disinfection rinsing with non-sterile water can all contribute to microbial persistence & subsequent wound contamination.[3,10-12] These factors are especially relevant in resource-constrained surgical environments, where high caseload, staff shortages, variable training, and inconsistent quality assurance may undermine adherence to standard operating procedures.

In Bangladesh, laparoscopic surgery has expanded rapidly in tertiary hospitals and private institutions, yet the local evidence base on PSI remains limited. Available reports suggest that PSI is not uncommon and may be influenced by both patient comorbidity and inconsistencies in infection prevention practices. Ahmed et al. documented a notable burden of postoperative infection after laparoscopic surgery in a tertiary center in Dhaka[8], while other regional and Bangladesh-based studies have similarly highlighted diabetes, obesity, and deficiencies in perioperative asepsis as important contributors.[5,8–10] Concerns regarding sterilization are particularly pertinent in the Bangladeshi context, where lapses in reprocessing protocols, maintenance of reusable instruments, and monitoring of disinfectant quality may persist across facilities.[10-12] Despite these concerns, multicenter prospective data evaluating PSI prevalence, incidence, and associated risk factors remain scarce. Furthermore, many prior studies have not examined sterilization practices in sufficient operational detail. A clearer understanding of the epidemiology of PSI and the relative contribution of modifiable procedural factors is necessary to inform targeted infection control interventions. Therefore, the present multicenter study was undertaken to determine the prevalence and incidence of PSI following laparoscopic surgery in Bangladesh and to identify patient-related and procedure-related risk factors, with particular emphasis on instrument sterilization practices. By addressing this evidence gap, the study seeks to support practical strategies to reduce postoperative infection and improve surgical quality in both public and private healthcare settings.

Methodology

This multicenter prospective observational study was conducted at Bangladesh Medical University, Popular

General Hospital, and East West Medical College Hospital in Dhaka, Bangladesh. The study was carried out over 36 months, from January 2021 to December 2023, and included patients who underwent laparoscopic surgical procedures and were subsequently assessed for postoperative port site wound infection. Eligible participants were adults aged 18 years or older undergoing elective laparoscopic cholecystectomy, appendectomy, or hernia repair. Patients were excluded if they underwent emergency surgery, were immunocompromised, or had a pre-existing wound infection. Data were collected on demographic characteristics, comorbidities (including diabetes, hypertension, and obesity), operative variables such as procedure type and operative duration, postoperative care, and instrument sterilization practices. Sterilization assessment focused on key aspects of reprocessing, including preparation of 3% glutaraldehyde solution, use of expired solution, adequacy of instrument contact time, faulty drying or rinsing of instruments, use of tap water, and reuse of instruments that had not been properly sterilized after previous procedures. Port site infection was defined according to CDC criteria. Superficial PSI was defined as infection involving the skin and subcutaneous tissue, whereas deep PSI involved the fascial or muscle layers. All patients were followed for 30 days postoperatively and monitored for clinical signs of infection, including redness, discharge, tenderness, and pus formation.

Data analysis included descriptive statistics (mean, standard deviation, and frequency distribution), chi-square testing for categorical variables, and logistic regression to identify independent risk factors. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 93 patients who underwent laparoscopic surgery between January 2021 and December 2023 were included in the study. The mean age of the study population was 42 ± 15 years (range 18–78 years). There were 54 males (58.1%) and 39 females (41.9%), with a male-to-female ratio of 1.4:1. Among the participants, 21 patients (22.5%) had diabetes mellitus and 18 patients (19.3%) were obese (BMI >30 kg/m²). The most common procedure performed was laparoscopic cholecystectomy (56 cases, 60.2%), followed by laparoscopic appendectomy (22 cases, 23.7%) and laparoscopic hernia repair (15 cases, 16.1%). Among 93 patients studied, 13 patients developed port site infection (PSI), giving an overall incidence and prevalence of 14.0%. Among the infected patients, 10 patients (77%) developed superficial port site infection, and 3 patients (23%) developed deep port site infection, mentioned in Figure 1: Pie Chart. The majority of infections occurred within the first two postoperative weeks. The umbilical port was the most frequently affected site, accounting for approximately 61.5% of all infections. Management and outcome depend on the type of wound. Superficial infections are treated by antibiotics and local wound care, and deep infections require drainage; mortality is 0% . Patients with diabetes mellitus had a markedly higher rate of PSI compared with non-diabetic patients (38% vs. 8.3%). The odds ratio (OR) for PSI among diabetic patients was 3.2 (95% CI: 1.1–9.4, p = 0.03), indicating a statistically significant association. Obesity (BMI >30 kg/m²) was also associated with an increased infection rate (33% vs. 9.3%), with an OR of 2.5 (95% CI: 0.9–6.8, p = 0.05). Operative duration greater than 90 minutes significantly increased the likelihood of PSI. Patients with prolonged operative times had a PSI rate of 32%, compared with 8.5% among those with shorter procedures (OR 2.8, 95% CI: 1.0–7.6, p = 0.04). Intraoperative bile spillage during laparoscopic cholecystectomy was another significant predictor of infection. . The PSI rate among patients with faulty instrument sterilization was 40%, compared with 10% among those with standard instrument sterilization (OR 4.5, 95% CI: 1.4–14.0, p = 0.01) mentioned in Figure 2: Bar Graph.

Risk Factors for PSI include the major factors associated with an increased risk of port site infection in this study included diabetes mellitus, obesity, prolonged operative time, and faulty instrument sterilization. Among these, faulty instrument sterilization showed the strongest association with PSI, followed by diabetes mellitus and prolonged operative duration. Obesity also demonstrated an increased risk, although the strength of association was comparatively lower. The detailed distribution of infection rates, odds ratios, confidence intervals, and p-values for each factor is presented below.

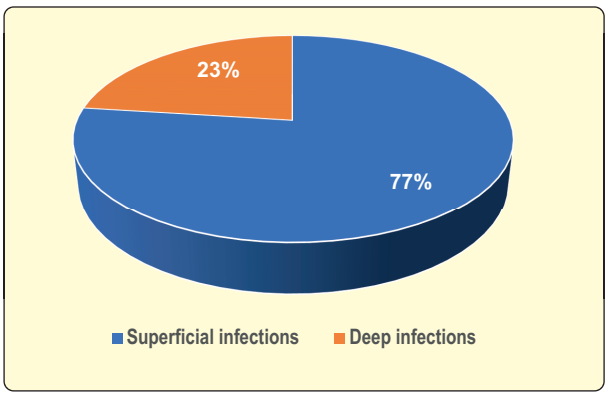

Figure 1: *Pie Chart – Distribution of PSI Type [Superficial: 77% and Deep: 23%]*

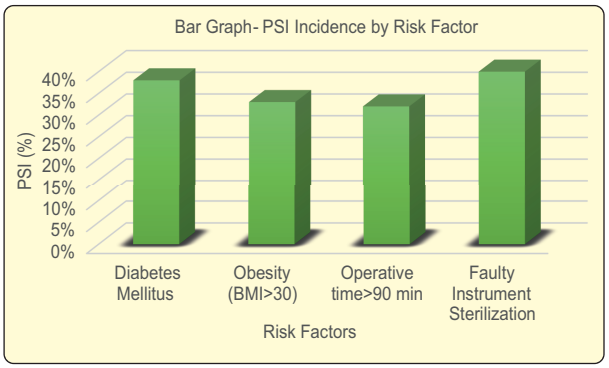

Figure 2: *Bar Graph – PSI Incidence by Risk Factor [X-axis: Risk factors (Diabetes, Obesity, Operative Time >90 min, Faulty Instrument Sterilization) , Y-axis: PSI rate (%).*

Discussion

In this multicenter prospective study, the overall incidence of port site infection (PSI) following laparoscopic surgery was 14.0%, indicating that postoperative wound infection remains a clinically relevant problem even in the setting of minimally invasive procedures. This incidence falls within the range reported in South Asian and other low- to middle-income settings, where rates of PSI after laparoscopic surgery have commonly varied according to patient profile, procedure type, perioperative infection control practices, and methods of postoperative surveillance [2,5,8,9]. The predominance of superficial over deep infection in our cohort is also consistent with prior reports and reflects the fact that most laparoscopic wound infections are confined to the skin and subcutaneous tissue. Nevertheless, the occurrence of deep infections in nearly one quarter of infected cases is important because these infections require more intensive management, may prolong convalescence, and can increase health-service use. The observation that most infections developed within the first two postoperative weeks further supports the importance of close early postoperative follow-up and patient education regarding warning signs such as pain, erythema, discharge, and swelling.

Among patient-related determinants, diabetes mellitus emerged as a significant predictor of PSI. This finding is biologically plausible and agrees with previous studies showing that perioperative hyperglycemia impairs neutrophil function, compromises microvascular circulation, and delays collagen deposition and wound healing [2,8,9]. In practical terms, diabetic patients may be more vulnerable to bacterial inoculation from even minor contamination at the trocar site. Obesity was also associated with a higher risk of infection, with borderline statistical significance. This pattern has been documented elsewhere and may be explained by thicker subcutaneous tissue, reduced tissue perfusion, increased technical difficulty during trocar insertion and extraction, and greater challenge in maintaining a clean, dry wound environment after surgery [2,6]. Although obesity did not show as strong an association as diabetes in our sample, the direction of effect suggests that high body mass index remains clinically relevant when assessing risk before laparoscopic procedures. Together, these findings indicate that host vulnerability contributes meaningfully to PSI and support careful perioperative optimization, particularly glycemic control and individualized wound care advice, in high-risk patients.

Procedure-related exposures were also strongly associated with infection. Operations lasting more than 90 minutes carried a significantly greater probability of PSI, a relationship that has been repeatedly described in the surgical infection literature [1,2,6]. Longer procedures increase the duration of port manipulation, instrument exchange, tissue handling, and environmental exposure, all of which may raise the opportunity for microbial contamination. Prolonged operating time may also act as a marker of technically difficult surgery, intraoperative adhesions, bleeding, or other events that increase tissue trauma. In addition, bile spillage during laparoscopic cholecystectomy was associated with a substantially higher infection rate in the present study. This is clinically credible because spilled bile may contain bacteria or inflammatory debris and may contaminate the extraction site, especially when the gallbladder is removed through

the umbilical port. The frequent involvement of the umbilical port in our series is consistent with this explanation and also with its known susceptibility to colonization and repeated instrument passage. These observations highlight the importance of meticulous operative technique, specimen retrieval precautions, and thorough irrigation when contamination occurs.

A particularly important finding of this study was the significant association between faulty instrument sterilization and PSI. Compared with several conventional patient-related factors, this procedural exposure is especially relevant because it is potentially modifiable at the institutional level. The sterilization-related lapses documented in our centers—including incorrect preparation of 3% glutaraldehyde solution, use of expired disinfectant, inadequate contact time, improper drying, rinsing with tap water, and reuse of inadequately reprocessed instruments—provide plausible pathways for microbial survival and reintroduction into subsequent surgical cases. These mechanisms are well supported by previous reports showing that laparoscopic instruments, because of their lumens, hinges, insulation, and heat-sensitive components, are vulnerable to incomplete decontamination when reprocessing protocols are inconsistently followed [3,7,10–12]. Chemical disinfection is highly dependent on solution concentration, exposure time, and post-disinfection handling. Even when an effective disinfectant is used, contamination can recur if instruments are rinsed in non-sterile water or stored while still wet. In resource-constrained settings, where reusable equipment is common and reprocessing capacity may be limited, such lapses can have a disproportionate effect on surgical outcomes. Our findings therefore reinforce the view that infection prevention in laparoscopic surgery depends not only on surgeon technique but also on the reliability of the entire instrument reprocessing pathway.

The present findings are broadly in agreement with Bangladesh-based and regional studies reporting that PSI after laparoscopic surgery is influenced by both host factors and shortcomings in perioperative infection control [5,8–12]. Ahmed et al. and Rahman et al. reported comparable infection burdens in tertiary hospitals, while Saha et al. and Khan et al. identified diabetes, obesity, and technical contamination as recurring contributors [5,8,9]. Our study extends this literature by examining sterilization failures in more operational detail across multiple centers rather than treating asepsis as a single composite variable. This has practical importance because it moves the discussion from general recommendations toward specific quality-improvement targets. For example, routine validation of disinfectant concentration, documentation of immersion times, use of sterile water for rinsing, drying before storage, and segregation of instruments requiring reprocessing after contaminated procedures are all feasible interventions. Training of theatre personnel, written standard operating procedures, periodic audit, and microbiological surveillance of reprocessing systems may be especially valuable in institutions where equipment is reused frequently and staff turnover is high. Because all superficial infections in our study resolved with conservative treatment and no mortality occurred, the immediate prognosis of PSI may appear favorable; however, the broader consequences—including pain, anxiety, treatment cost, prolonged wound care, and possible interruption of return to work—remain important from both patient and health-system perspectives.

This study has several limitations that should be considered when interpreting the results. First, the sample size was modest, which may have reduced precision for some effect estimates and limited the ability to explore interactions among risk factors. Second, the study was conducted in three hospitals in Dhaka, and the findings may not be fully generalizable to all public and private surgical centers in Bangladesh, particularly those with different case complexity or reprocessing infrastructure. Third, as an observational study, the analysis identifies associations but cannot definitively establish causality. Some sterilization-related variables were also based partly on reported practice rather than direct continuous observation, which may have introduced reporting bias. Despite these limitations, the study has important strengths, including its prospective design, multicenter setting, use of standardized definitions of PSI, and explicit assessment of modifiable sterilization practices. Overall, the data suggest that PSI after laparoscopic surgery in Bangladesh is driven by a combination of patient susceptibility and preventable procedural lapses. Reducing the burden of infection will likely require a dual strategy: improved perioperative management of high-risk patients, particularly those with diabetes and obesity, and rigorous quality assurance for instrument

reprocessing. Future larger multicenter studies should incorporate microbiological characterization of wound isolates and direct audit of sterilization workflows to better define causal pathways and guide targeted prevention strategies.

Conclusion

PSI remains a significant postoperative complication following laparoscopic surgery in Bangladesh. Patient factors (diabetes, obesity, prolonged operative time) and procedural factors, particularly faulty instrument sterilization, are major contributors. Strict adherence to sterilization protocols and identification of high-risk patients are crucial to reducing PSI and improving surgical outcomes. Multicentre large cohort study could help better gaining an inference regarding this type of wound infection, management guidelines recommendations.

Conflict of interest

The authors have none to declare. This study was not funded.

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