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Research Article

AN OBSERVATIONAL STUDY OF POSTOPERATIVE PORT SITE INFECTION IN LAPAROSCOPIC SURGERY (A CLINICAL STUDY OF 60 CASES)

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ABSTRACT

Background: Laparoscopic surgery has become the preferred surgical approach for many abdominal procedures because of its advantages such as reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes. However, port site infection (PSI) remains an important postoperative complication that may increase morbidity, prolong treatment, and adversely affect patient outcomes. The present study was conducted to evaluate the incidence, risk factors, clinical presentation, microbiological profile, and outcomes of postoperative port site infections following laparoscopic surgery.

Methods: A prospective observational study was conducted in the Department of General Surgery at a tertiary care center over a period of 18 months. A total of 60 patients who underwent laparoscopic surgery and developed port site infection were evaluated. Demographic characteristics, comorbidities, surgical details, clinical presentation, microbiological findings, treatment modalities, complications, and follow-up outcomes were recorded and analyzed. Statistical analysis was performed using SPSS version 23, and a p-value <0.05 was considered statistically significant.

Results: The majority of patients belonged to the 20–40 years age group (41.7%), and males and females were equally represented (50% each). Diabetes mellitus (33.3%) and obesity (20.0%) were the most common comorbidities. Cholecystectomy was the most frequently performed laparoscopic procedure (41.7%). The incidence of port site infection was 20%. Among infected patients, 50% developed symptoms within the first seven postoperative days. Wound discharge was the most common clinical presentation (58.3%). *Staphylococcus aureus* was the predominant pathogen isolated (33.3%), followed by *Escherichia coli* and *Klebsiella pneumoniae* (25% each). All patients received antibiotic therapy, while 66.7% required drainage and debridement. Delayed wound healing was the most common complication (58.3%). Complete recovery was achieved in 66.7% of patients. Diabetes mellitus and obesity showed a statistically significant association with the development of port site infection (p<0.05).

Conclusion: Port site infection remains a significant complication of laparoscopic surgery despite advances in minimally invasive techniques. Diabetes mellitus and obesity were important risk factors, while *Staphylococcus aureus* was the most common causative organism. Early diagnosis, appropriate microbiological evaluation, timely antibiotic therapy, and strict adherence to aseptic surgical practices are essential for reducing the incidence and morbidity associated with port site infections.

Keywords*: Port site infection; Laparoscopic surgery; Surgical site infection; Cholecystectomy; Risk factors; Diabetes mellitus; Obesity; Microbiological profile; Wound infection; Postoperative complications.*

INTRODUCTION

Laparoscopic surgery has transformed the field of general surgery and is now considered the standard approach for many abdominal and pelvic procedures. Compared with conventional open surgery, laparoscopic procedures are associated with reduced postoperative pain, shorter hospital stay, faster recovery, earlier return to routine activities, and superior cosmetic outcomes. These advantages have resulted in a substantial increase in the utilization of minimally invasive

surgical techniques worldwide [1,2]. Despite these benefits, postoperative complications continue to occur, among which port site infection (PSI) remains an important cause of morbidity following laparoscopic surgery [3].

Port site infection is defined as an infection occurring at the trocar insertion site following laparoscopic procedures and may present with erythema, tenderness, swelling, wound discharge, abscess formation, delayed wound healing, or chronic sinus formation [4]. The reported incidence of port site infections varies widely in the literature, ranging from approximately 1% to 8% depending upon the type of surgery performed, patient characteristics, operative environment, and infection-control practices [1,4]. Although the incidence is lower than that observed following open surgical procedures, PSIs can lead to prolonged treatment, increased healthcare expenditure, delayed recovery, poor cosmetic outcomes, and decreased patient satisfaction [5].

Several patient-related and procedure-related factors have been implicated in the development of PSIs. Patient-related risk factors include advanced age, diabetes mellitus, obesity, malnutrition, hypoalbuminemia, immunosuppression, and poor personal hygiene. Procedure-related factors include prolonged operative duration, specimen extraction through contaminated ports, inadequate sterilization of laparoscopic instruments, breach in aseptic techniques, and wound contamination during surgery [6,7]. Studies have also demonstrated that bacterial contamination and inadequate perioperative infection-control measures significantly increase the risk of postoperative wound infections [8,9].

The umbilical port is particularly vulnerable to infection because of its natural bacterial colonization and its frequent use for specimen retrieval. Previous studies have reported that contamination during extraction of infected gallbladders, appendices, or other pathological specimens may contribute significantly to the occurrence of PSIs [2,7]. Furthermore, the increasing use of reusable laparoscopic instruments has raised concerns regarding sterilization practices and the possibility of atypical mycobacterial infections, which may present as delayed non-healing sinuses several weeks after surgery [1].

Appropriate antibiotic prophylaxis and strict adherence to aseptic surgical techniques have been shown to reduce the incidence of postoperative wound infections. Studies evaluating prophylactic antibiotic regimens have demonstrated lower rates of surgical site infections when evidence-based infection prevention measures are implemented [5,10]. Early recognition of symptoms and microbiological evaluation through wound culture and sensitivity testing remain essential for accurate diagnosis and effective management of PSIs.

Despite the growing number of laparoscopic procedures performed in tertiary care centers, prospective data regarding the incidence, risk factors, microbiological profile, clinical presentation, and outcomes of port site infections remain limited, particularly in the Indian population. Understanding these factors is important for developing effective preventive strategies and optimizing patient care. Therefore, the present study was undertaken to evaluate postoperative port site infections following laparoscopic surgery, identify associated demographic and procedural risk factors, analyze microbiological findings, and assess treatment outcomes among affected patients.

Laparoscopic surgery has become the preferred surgical approach for many abdominal procedures because of its advantages, including reduced postoperative pain, shorter hospital stay, faster recovery, and better cosmetic outcomes. However, postoperative port site infection (PSI) remains an important complication that can lead to increased morbidity, prolonged treatment, delayed wound healing, chronic sinus formation, additional healthcare costs, and decreased patient satisfaction. The present study aims to investigate postoperative port site infections in patients undergoing laparoscopic surgery and to evaluate the influence of various demographic, clinical, and procedural factors on their occurrence. The study will also assess the clinical presentation, microbiological profile, treatment modalities, and outcomes of patients who develop PSIs. Understanding the incidence, causative organisms, associated risk factors, and treatment responses will help in identifying preventive measures, improving sterilization and infection-control practices, reducing postoperative complications, and enhancing overall surgical outcomes. The findings of this study are expected to contribute valuable institution-specific data that can aid in developing evidence-based guidelines for the prevention, early diagnosis, and effective management of port site infections in laparoscopic surgery, ultimately improving patient safety and quality of surgical care.

METHODOLOGY

This prospective observational study was conducted in the Department of General Surgery at a tertiary care teaching hospital in Surat over a period of 18 months after obtaining approval from the Institutional Ethics Committee (IEC No. SMIMER/IEC/OUTNO.34). The study population consisted of patients undergoing laparoscopic surgery who subsequently developed port site infection during the study period. The sample size was calculated based on a reported incidence of port site infection of 5.7% in laparoscopic surgeries, with a confidence level of 95% and an allowable error of 6%, resulting in a minimum sample size of 57 patients. Considering possible dropouts and incomplete follow-up, a total of 60 patients were included in the study.

Patients of all age groups and both genders who developed port site infection following laparoscopic surgery and provided written informed consent were enrolled in the study. Patients whose laparoscopic procedures were converted to open surgery and those who did not provide consent were excluded. All eligible patients were evaluated clinically for

signs and symptoms of port site infection, including pain, erythema, swelling, tenderness, wound discharge, abscess formation, delayed wound healing, and sinus tract formation.

After obtaining informed consent, detailed demographic information such as age, gender, socio-economic status, and relevant clinical history was recorded. Clinical variables including comorbid conditions such as diabetes mellitus, hypertension, tuberculosis, immunosuppressive disorders, nutritional status, and serum albumin levels were documented. Operative details such as indication for surgery, type of laparoscopic procedure performed, duration of surgery, number and size of ports used, wound classification, specimen retrieval technique, use of prophylactic antibiotics, and postoperative wound care practices were also recorded.

Patients diagnosed with port site infection underwent appropriate investigations including complete blood count, blood glucose estimation, serum albumin levels, wound swab culture and sensitivity testing, and additional investigations such as CBNAAT, sputum AFB examination, ultrasonography, computed tomography, or magnetic resonance imaging whenever clinically indicated. Microbiological analysis of wound specimens was performed to identify causative organisms and determine their antimicrobial susceptibility patterns.

The treatment modalities employed for management of port site infection, including antibiotic therapy, wound dressing, drainage procedures, debridement, and other surgical interventions, were documented. All patients were followed up regularly until complete resolution of infection or completion of treatment. Outcome measures such as clinical presentation, microbiological profile, treatment response, healing time, recurrence rate, complications, duration of hospital stay, recovery period, and overall patient outcomes were assessed and recorded.

The collected data were entered into Microsoft Excel and analyzed using SPSS software version 23. Descriptive statistics were used to summarize demographic, clinical, microbiological, and outcome variables. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Associations between various demographic, clinical, and procedural risk factors and the occurrence of port site infection were assessed using appropriate statistical tests such as Chi-square test, Fisher's exact test, and Student's t-test. A p-value of less than 0.05 was considered statistically significant. The results were presented in the form of tables, charts, and graphs for better interpretation and analysis.

RESULT

A total of 60 patients undergoing laparoscopic surgery were included in the study. The majority of patients belonged to the 20–40 years age group (41.7%), followed by 41–60 years (33.3%), while 16.7% were above 60 years and 8.3% were below 20 years of age. The gender distribution was equal, with males and females each constituting 50% of the study population. Most patients belonged to the middle socioeconomic class (58.3%), followed by the low (25.0%) and high (16.7%) socioeconomic groups.

Regarding comorbidities, diabetes mellitus was the most common condition observed in 33.3% of patients, followed by hypertension (25.0%), obesity (20.0%), and COPD (8.3%), whereas 13.4% of patients had no associated comorbidities. Cholecystectomy was the most frequently performed laparoscopic procedure (41.7%), followed by appendectomy (25.0%), hernia repair (16.7%), hysterectomy (8.3%), and other procedures (8.3%).

Out of the 60 patients, 12 patients developed port site infection, resulting in an incidence of 20%, while 80% of patients did not develop infection. Among infected patients, 50.0% developed symptoms within the first 7 postoperative days, 33.3% between 7 and 14 days, and 16.7% after 14 days. Wound discharge was the most common clinical presentation, observed in 58.3% of infected cases, followed by sinus formation (25.0%) and combined wound discharge with sinus formation (16.7%).

Microbiological evaluation revealed that *Staphylococcus aureus* was the most commonly isolated organism (33.3%), followed by *Escherichia coli* (25.0%), *Klebsiella pneumoniae* (25.0%), and *Pseudomonas aeruginosa* (16.7%). All infected patients received antibiotic therapy, while 66.7% additionally underwent drainage and debridement procedures.

Regarding hospital stay among infected patients, 50.0% required less than 5 days of treatment, 33.3% required 5–10 days, and 16.7% required more than 10 days. Delayed wound healing was the most common complication (58.3%), followed by chronic pain (33.3%), abscess formation (25.0%), chronic discharging sinus (8.3%), and sepsis (66.7%).

Follow-up assessment demonstrated that complete recovery was achieved in 66.7% of patients, while 25.0% experienced partial recovery and only 8.3% had persistent infection. Patient satisfaction was generally high, with 66.7% reporting high satisfaction, 25.0% reporting satisfaction, and 8.3% remaining neutral. Statistical analysis showed that diabetes mellitus and obesity were significantly associated with the occurrence of port site infection ($p<0.05$), whereas age, gender, hypertension, and type of surgery did not demonstrate statistically significant associations.

Table 1: Demographic and Baseline Characteristics of Study Participants (n=60)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (Years)	<20	5	8.3

	20–40	25	41.7
	41–60	20	33.3
	>60	10	16.7
Gender	Male	30	50.0
	Female	30	50.0
Socioeconomic Status	Low	15	25.0
	Middle	35	58.3
	High	10	16.7
Comorbidities	Diabetes Mellitus	20	33.3
	Hypertension	15	25.0
	Obesity	12	20.0
	COPD	5	8.3
	No Comorbidity	8	13.4

Table 2: Clinical and Surgical Characteristics of Patients (n=60)

Variable	Category	Frequency (n)	Percentage (%)
Type of Laparoscopic Surgery	Cholecystectomy	25	41.7
	Appendectomy	15	25.0
	Hernia Repair	10	16.7
	Hysterectomy	5	8.3
	Others	5	8.3
Port Site Infection	Developed PSI	12	20.0
	No PSI	48	80.0

Table 3: Clinical Outcomes and Microbiological Profile of Port Site Infection Cases (n=12)

Variable	Category	Frequency (n)	Percentage (%)
Time of Onset of PSI	<7 days	6	50.0
	7–14 days	4	33.3
	>14 days	2	16.7
Clinical Presentation	Wound Discharge	7	58.3
	Sinus Formation	3	25.0
	Both	2	16.7
Microbiological Findings	Staphylococcus aureus	4	33.3
	E. coli	3	25.0
	Klebsiella pneumoniae	3	25.0
	Pseudomonas aeruginosa	2	16.7
Treatment Given	Antibiotics	12	100.0
	Drainage & Debridement	8	66.7
Hospital Stay	<5 days	6	50.0
	5–10 days	4	33.3
	>10 days	2	16.7
Follow-up Outcome	Complete Recovery	8	66.7
	Partial Recovery	3	25.0
	Persistent Infection	1	8.3
Patient Satisfaction	Highly Satisfied	8	66.7
	Satisfied	3	25.0
	Neutral	1	8.3

Table 4: Association of Selected Risk Factors with Development of Port Site Infection

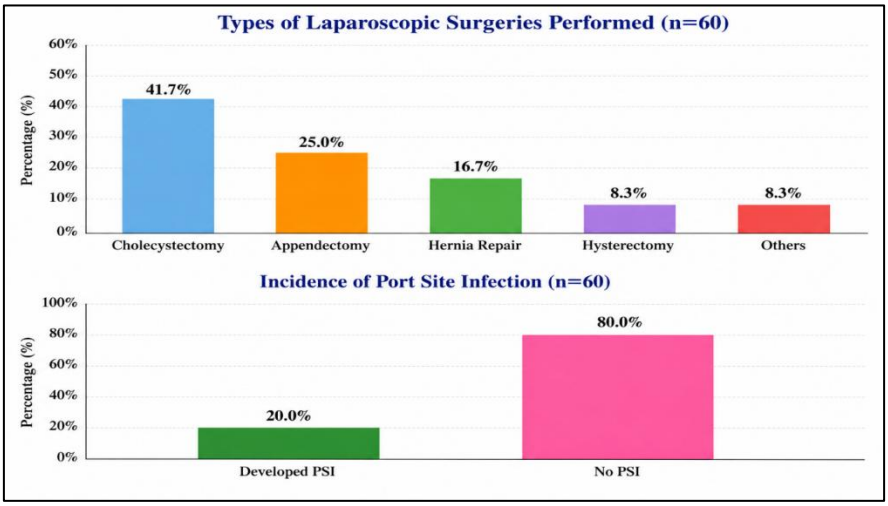
Variable	PSI Present (n=12)	PSI Absent (n=48)	Chi-square (χ^2)	p-value
Diabetes Mellitus	7	13	4.52	0.033*
Hypertension	4	11	0.48	0.489
Obesity	5	7	4.86	0.027*
Age >40 years	8	22	1.67	0.196

Male Gender	7	23	0.21	0.643
Cholecystectomy	7	18	0.79	0.374

*Statistically significant ($p < 0.05$)

Interpretation

Diabetes mellitus and obesity demonstrated a statistically significant association with the development of port site infection ($p<0.05$). Age, gender, hypertension, and type of laparoscopic surgery did not show statistically significant associations with PSI occurrence in the present study.



DISCUSSION

The present prospective observational study was conducted to evaluate the incidence, risk factors, microbiological profile, clinical presentation, and outcomes of postoperative port site infections (PSIs) following laparoscopic surgery. Laparoscopic surgery has become the preferred approach for many surgical procedures because of its advantages, including reduced postoperative pain, shorter hospital stay, faster recovery, and lower wound-related complications compared with conventional open surgery [1,2]. Despite these benefits, port site infection remains a significant postoperative complication that can increase morbidity, prolong treatment, and adversely affect patient satisfaction [3,4].

In the present study, the majority of patients belonged to the 20–40 years age group (41.7%), followed by the 41–60 years age group (33.3%). Similar observations have been reported by Karthik et al. [3] and Shah et al. [38], who found that laparoscopic procedures are most commonly performed in young and middle-aged adults. The equal gender distribution observed in our study suggests that the occurrence of port site infection is more closely related to surgical and patient-related risk factors rather than gender alone.

The incidence of port site infection in the present study was 20%. Previous studies have reported lower incidences ranging from 1% to 8% following laparoscopic procedures [1,4]. Richards et al. [2] demonstrated that laparoscopic surgery is associated with a lower risk of surgical site infection compared to open surgery. The higher incidence observed in the present study may be attributed to variations in patient characteristics, prevalence of comorbidities, local infection-control practices, and differences in operative procedures. Studies by Taj et al. [4] and Shindholimath et al. [7] have similarly highlighted that inadequate sterilization practices, specimen contamination, and patient comorbidities significantly influence infection rates.

Among the comorbid conditions identified, diabetes mellitus was the most common (33.3%), followed by hypertension (25.0%) and obesity (20.0%). Statistical analysis revealed that diabetes mellitus and obesity were significantly associated with the occurrence of port site infection. These findings are consistent with those of Latham et al. [11], who demonstrated a strong association between diabetes and postoperative wound infections due to impaired immune function and poor wound healing. Similarly, studies by Nakamura et al. [12,13] and Chuang et al. [14] identified obesity and metabolic disorders as important risk factors for surgical site infections.

Cholecystectomy was the most frequently performed laparoscopic procedure (41.7%), followed by appendectomy and hernia repair. This observation is consistent with previous literature, where laparoscopic cholecystectomy remains the most commonly performed minimally invasive procedure worldwide [2,5]. MacFadyen et al. [15] reported that contamination during gallbladder extraction may increase the risk of wound infection. Furthermore, Liang et al. [16] and Macano et al. [17] emphasized the importance of appropriate antibiotic prophylaxis in reducing postoperative infectious complications following laparoscopic cholecystectomy.

In the present study, 50% of infected patients developed symptoms within the first seven postoperative days, while 33.3% developed symptoms between 7 and 14 days. Similar findings were reported by Sasmal et al. [1], who observed that most

bacterial port site infections present during the early postoperative period. Early diagnosis and intervention are therefore essential to prevent progression to more severe complications.

Wound discharge was the most common clinical presentation (58.3%), followed by sinus formation (25%) and combined presentation (16.7%). Similar findings were reported by Taj et al. [4] and Karthik et al. [3], who identified wound discharge as the predominant manifestation of port site infection. Chronic sinus formation has been associated with delayed infections, particularly those caused by atypical organisms and inadequate wound management [1].

Microbiological analysis demonstrated that *Staphylococcus aureus* was the most frequently isolated pathogen (33.3%), followed by *Escherichia coli* and *Klebsiella pneumoniae* (25% each), while *Pseudomonas aeruginosa* accounted for 16.7% of infections. These findings are in agreement with previous studies that identified *Staphylococcus aureus* as the leading cause of postoperative wound infections [5,7,14]. The isolation of gram-negative organisms may reflect contamination during specimen retrieval, bowel manipulation, or exposure to contaminated instruments during surgery [8,9].

All patients in the present study received antibiotic therapy, while 66.7% additionally required drainage and debridement. Similar treatment approaches have been recommended by Sasmal et al. [1], who emphasized that successful management of port site infections often requires a combination of antimicrobial therapy and appropriate surgical intervention. The role of antibiotic prophylaxis and targeted antimicrobial therapy has also been highlighted by Colizza et al. [5], Liang et al. [16], and Macano et al. [17].

Delayed wound healing was the most common complication (58.3%), followed by chronic pain (33.3%), abscess formation (25%), and chronic discharging sinus (8.3%). These findings are comparable to those reported in studies evaluating postoperative wound infections, where delayed healing and abscess formation were among the most frequent adverse outcomes [8,9,10]. Such complications may increase hospital stay, treatment costs, and patient discomfort.

The prognosis of patients in the present study was generally favorable. Complete recovery was achieved in 66.7% of patients, while 25% experienced partial recovery and only one patient had persistent infection. Furthermore, the majority of patients reported high satisfaction with treatment. These findings suggest that early diagnosis, microbiological evaluation, timely initiation of antibiotics, and appropriate wound management can effectively control port site infections and improve patient outcomes.

Overall, the present study highlights that port site infection remains an important complication of laparoscopic surgery despite advances in minimally invasive techniques. Diabetes mellitus and obesity emerged as significant risk factors, while *Staphylococcus aureus* was the most commonly isolated organism. Early postoperative wound discharge was the predominant clinical manifestation, and most patients responded well to antibiotic therapy and wound care. Strengthening infection-control practices, optimizing perioperative antibiotic prophylaxis, ensuring proper instrument sterilization, and careful management of high-risk patients may further reduce the incidence and morbidity associated with port site infections following laparoscopic surgery.

CONCLUSION

The present study concluded that port site infection remains a significant postoperative complication following laparoscopic surgery, with an incidence of 20% among the studied patients. The majority of infections occurred within the first week after surgery and commonly presented as wound discharge. Diabetes mellitus and obesity were identified as important risk factors associated with the development of port site infections. *Staphylococcus aureus* was the most frequently isolated microorganism, followed by *Escherichia coli* and *Klebsiella pneumoniae*. Most patients responded favorably to appropriate antibiotic therapy and wound management, resulting in complete recovery in the majority of cases. Early diagnosis, prompt microbiological evaluation, meticulous surgical technique, effective sterilization practices, and optimal perioperative care play crucial roles in minimizing the occurrence and consequences of port site infections.

LIMITATIONS

- The study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other healthcare settings.
- The sample size was relatively small, particularly for patients who developed port site infections.
- Long-term follow-up was limited; therefore, late recurrences and delayed complications may not have been fully assessed.
- Advanced microbiological investigations for atypical mycobacterial infections and molecular characterization of pathogens were not performed in all cases.
- Variations in operative techniques and surgeon experience could not be completely controlled.
- The study primarily focused on clinically diagnosed port site infections and may not have captured subclinical infections.

RECOMMENDATIONS

- Strict adherence to aseptic surgical techniques and sterilization protocols should be ensured during all laparoscopic procedures.

- Appropriate perioperative antibiotic prophylaxis should be administered according to established guidelines.
- Patients with diabetes mellitus, obesity, and other high-risk comorbidities should undergo careful preoperative optimization and postoperative monitoring.
- Routine microbiological culture and sensitivity testing should be performed in suspected cases to facilitate targeted antimicrobial therapy.
- Early recognition and prompt treatment of wound discharge and other signs of infection should be encouraged to prevent progression to severe complications.
- Regular surveillance and audit of port site infections should be undertaken to monitor infection rates and identify areas for quality improvement.
- Larger multicentric studies with longer follow-up periods should be conducted to better understand the epidemiology, microbiological spectrum, and long-term outcomes of port site infections.
- Continuous training of surgical teams regarding infection prevention practices and safe laparoscopic techniques should be promoted to further reduce postoperative infectious complications.

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