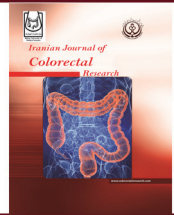


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Port-Related Complications in Laparoscopic Surgeries: A Prospective Observational Study of the Iranian Population

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Abstract

Background: Despite contradictory reports regarding complication rates associated with various laparoscopic techniques, data specific to the Iranian population remain limited. In this study, we prospectively investigated port-related complications in laparoscopic abdominal surgeries performed on individuals from the Iranian population.

Methods: This study was conducted as a prospective cohort at Imam Hossein Medical Center, Tehran, Iran, from 2021 to 2024. A total of 346 patients who were candidates for abdominal surgery using the laparoscopic technique and referred to the tertiary hospital were included in the study based on the inclusion criteria. Demographic information about the patients, including age, gender, and underlying conditions, as well as data related to the surgery and complications associated with the port, were examined and recorded by the surgeons for six months following the surgery.

Results: In this study, 346 patients were examined. The mean age of the patients was 44.34 ± 11.80 years, with ages ranging from 16 to 77 years. Among the patients, 206 (59.5%) were women, and 140 (40.5%) were men. Of the 346 patients who underwent surgery, 129 (37.3%) had a cholecystectomy, 117 (33.8%) underwent bariatric surgery, and 71 (20.5%) had herniorrhaphy. Port-related complications were observed in 11 patients (3.2%), with port site infections diagnosed in 10 patients (2.9%). An incisional hernia was diagnosed in one patient (0.3%). There were no port site bleeding, omental injury, or other possible port-related complications.

Conclusion: In this study, port-related complications among the Iranian population have been reported for comparison with other populations. The low complication rate of 3.2% aligns with global standards, underscoring the safety of laparoscopic procedures in well-equipped settings.

Keywords: Laparoscopy, Trocar, Operative complication

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Introduction

Efforts to minimize the trauma caused by surgery and facilitate and reduce the recovery period have led to the introduction of minimally invasive surgeries over the past few decades (1). The laparoscopic surgical approach is one of the least invasive methods and has been increasingly used in procedures such as cholecystectomy, appendectomy, colorectal surgery, and gynecological surgeries in recent years. Today, it has become the gold standard for many abdominal surgeries (2). Compared to other surgical methods, laparoscopic procedures offer several advantages, including a reduced inflammatory response, less pain, and satisfactory cosmetic results (3). Efforts to further minimize surgical trauma have led to the development of advanced laparoscopic techniques, such as mini-laparoscopic surgery, natural orifice transluminal endoscopic surgery (NOTES), and single-incision laparoscopic surgery (SILS) (4, 5). Initial evaluations have demonstrated the safety of these methods, along with improved surgical outcomes, and aesthetic benefits. However, surgeons express concerns regarding potential side effects associated with these techniques, such as incisional hernias (6).

In general, severe complications during or after laparoscopic surgery are reported to occur in less than 1% of cases, with the mortality rate estimated to be between 4 and 8 per 100,000 cases (7). More than 50% of the complications associated with laparoscopic surgery are related to the trocar insertion site (8, 9). There is still no optimal approach for determining the trocar insertion site or the number of trocars required for performing laparoscopic surgeries. The findings of previous studies regarding the rate of complications following surgery using different laparoscopic techniques are contradictory. For example, while the SILS method seems to offer greater aesthetic benefits, the need for a larger incision in the abdominal wall may be associated with a higher incidence of incisional hernias. Previous studies have reported the incidence of incisional hernia in various methods to be between 1.5% and 33%. Some studies have associated the incidence of this complication with factors such as age, gender, body mass index (BMI), trocar insertion site, and a previous history of hernia (1-4). Cultural, demographic, and healthcare infrastructure differences in Iran necessitate region-specific evaluations of surgical outcomes. This study prospectively evaluates port-related complications in laparoscopic abdominal surgeries within the Iranian population to address existing discrepancies in reported rates.

Patients and Methods

This prospective cohort study examines potential port-related complications in patients who underwent abdominal surgery using the laparoscopy technique at

Imam Hossein Medical Center in Tehran, Iran, from 2021 to 2024. Ethical approval was obtained from the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.MSP.REC.1402.028). Written informed consent was obtained from all patients participating in the study. Patients with a history of any prior abdominal surgery were excluded. Hand-assisted laparoscopy surgeries (HALS) and those utilizing a wound retractor were also excluded. For all trocar insertion sites greater than 5 mm, the fascia was repaired with Vicryl sutures. All resected specimens, including the gallbladder, were removed through the abdominal wall using an EndoBag. Surgeons documented demographic information, the urgency of the surgery, the type of surgery performed, and the number of trocars utilized. Postoperatively, all patients were clinically examined for complications related to the port during their hospital admission and after discharge, up to six months. All potential complications associated with the port, including port site infection, port site bleeding, incisional hernia, and metastasis at the port site, were thoroughly investigated in the patients. A sample size of 346 was calculated using a 95% confidence interval and a 5% margin of error, based on an anticipated 5% complication rate. The study is reported in accordance with the STROBE guideline (10).

Statistical Analysis

All statistical analyses were performed using SPSS (IBM, USA) version 27. Quantitative data are presented as means with standard deviations or medians with interquartile ranges, depending on the normality of the data distribution. The normality of the data was assessed using the Shapiro-Wilk test. Qualitative data are presented as frequencies and percentages. Comparisons of quantitative data were conducted using the Independent Samples t-test and the Wilcoxon Rank-Sum test, while comparisons of qualitative data were made using Pearson's Chi-Square test and Fisher's Exact Test. A significance level of less than 0.05 was considered statistically significant for all tests.

Results

In this study, 346 patients were examined. The mean age of the patients was 44.34 ± 11.80 years, with ages ranging from 16 to 77 years. Among the participants, 206 (59.5%) were women, and 140 (40.5%) were men. Seventy-seven patients (22.3%) had an underlying condition in addition to requiring surgical intervention, with the most common underlying diseases being diabetes ($n=39$, 11.3%), hypertension ($n=32$, 9.2%), and heart disease ($n=21$, 6.1%). A total of 334 patients (96.5%) underwent elective surgery. Among the 346 operated patients, 129 (37.3%) underwent cholecystectomy, 117 (33.8%) underwent bariatric surgery, and 71 (20.5%) underwent herniorrhaphy (Table 1).

Table 1: Type of surgery and frequency of complications

Surgery types	N (%)	Compilations N (%)
Cholecystectomy	129 (37.3%)	9 (7%)
Bariatric surgery	117 (33.8%)	1 (0.9%)
Herniorrhaphy	71 (20.5%)	1 (1.4%)
Diagnostic	18 (5.2%)	0 (0%)
Appendectomy	11 (3.2%)	0 (0%)
Total	346 (100%)	11 (3.2%)

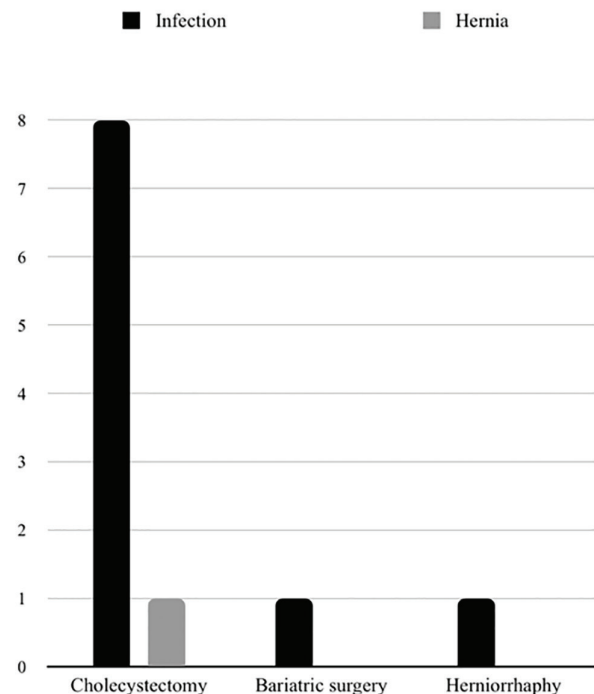
A mean of 3.80 ± 0.93 trocars was used, with a range of 2 to 5 trocars employed. For the majority of patients, 151 (43.6%) underwent procedures using three trocars, 109 patients (31.5%) used five trocars, 73 patients (21.1%) utilized four trocars, and only 13 patients (3.8%) had procedures with two trocars.

Out of 346 patients examined, port-related complications were observed in 11 patients (3.2%). Port site infections were diagnosed in 10 patients (2.9%). Among these 10 patients with port site infections, eight patients (80.0%) underwent cholecystectomy, one patient (10.0%) underwent bariatric surgery, and one patient (10.0%) underwent herniorrhaphy. The port site infection was superficial in nine patients and ultimately recovered without the need for oral antibiotics. An incisional hernia was diagnosed in one patient (0.3%) following cholecystectomy (Figure 1). There were no instances of port site bleeding, omental injury, or other possible port-related complications. The number of trocars used was compared in relation to complications associated with the port, and no significant differences were found (3.79 ± 0.93 for patients without complications vs. 4.09 ± 0.83 for patients with complications, $P=0.279$).

Discussion

This prospective study investigated the frequency and types of port-related complications in laparoscopic surgeries. Previous findings have demonstrated that laparoscopic surgery offers numerous advantages over open surgery (11-13). However, various complications may arise in relation to laparoscopic ports. The incidence of these complications may depend on factors such as port size, type of surgery, and the surgeon's expertise. Although complications are not common, port-related complications occur more frequently than other types. Conversely, complications during surgery, such as injury to large vessels and intestinal perforation, if they occur, usually lead to open surgery and can be life-threatening (14).

Complications following surgery, are usually more common than complications during surgery, such as hernia, infection, metastasis at the port entry site, and tuberculosis of the port site (15, 16). The present study identified port-related complications in 11 patients (3.2%). Port site infection was diagnosed in 10 patients (2.9%). Among the 10 patients with port site infection, eight underwent cholecystectomy,

**Figure 1:** Distribution of port-related complications (n=11)

one underwent bariatric surgery, and one underwent herniorrhaphy. The Incidence of port-related complications following laparoscopy has been reported to range from 2.5% to 10% in various studies (17, 18). The most common complication associated with the port was port site infection (19-21), which aligns with the findings of the present study. In this study, port site infections were superficial in 9 patients (90%), all of whom ultimately recovered without the need for oral antibiotics. In the study conducted by Verma et al. involving 656 patients who underwent abdominal surgery for various reasons, 21 patients (3.2%) experienced port site infection. Notably, 16 of these reported infections were superficial (19). Additionally, the research by Colizza et al. indicated that less than 2% of patients developed port infections, all of which were superficial and affected the skin and subcutaneous tissue (22). Therefore, proper skin preparation appears to be crucial for patients.

The other complication is herniation at the port entry site. In the study by Dugg et al., no hernias were observed in the port entry area among these patients after surgery (23). However, studies conducted by Kabir et al. and Panigrahi et al. reported hernia incidences of 2.8% and 3.8%, respectively (24, 25).

In our study, we diagnosed an incisional hernia in one patient (0.3%) following cholecystectomy. Our low rate of incisional hernias (0.3%) may reflect the proactive measures implemented in this study, which were informed by prior evidence suggesting that fascial closure for trocars >5mm reduces the risk of hernia (24, 25). We presumed that meticulous fascia repair using Vicryl sutures, along with the use of bevel-tip trocars designed to minimize tissue trauma, would reduce complication rates compared to techniques that neglect these steps. This aligns with the findings of Kabir et al. (24), which indicated that hernia rates were correlated with unclosed fascial defects. However, our presumption that the number of trocars might influence complications was not supported, as no significant association was observed ($P=0.279$). These outcomes underscore the importance of standardized closure protocols rather than focusing solely on the quantity of trocars used.

This study has several limitations. First, its single-center design may restrict the generalizability of the findings to broader populations with varying surgical practices. Second, the six-month follow-up period may overlook late-onset complications, such as hernias that develop beyond this timeframe. Lastly, the exclusion of immunocompromised patients and individuals with a history of abdominal surgery limits insights into higher-risk cohorts. Future multi-center studies with extended follow-up periods and standardized documentation of techniques are warranted.

Conclusion

In this prospective study involving 346 patients,

port-related complications were observed in 3.2% of cases, primarily consisting of superficial infections (2.9%) and one incisional hernia (0.3%). These rates are consistent with global benchmarks (2.5–10%) for laparoscopic surgeries, underscoring the safety of this technique within the Iranian population. The high incidence of infections following cholecystectomy (80% of cases) necessitates the implementation of targeted prophylactic measures, while the low occurrence of hernias suggests the potential effectiveness of systematic fascial closure for trocars >5mm. Further research is needed to optimize port-site management across diverse surgical contexts.

Authors' Contribution

H.K, M.S, M.A.Z, and B.N participated in conceptualization and writing the original draft; T.J, B.N, H.T, A.H.T, and M.A participated in methodology and writing, reviewing, and editing the manuscript; S.P.K.H, F.P, H.K, A.H.T participated in data curation, analysis, and writing the original draft; B.N, and A.H.T participated in project administration. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Conflicts of Interest: None declared.

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