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ORIGINAL ARTICLE

Is the trocar through which the gallbladder is removed during cholecystectomy important for potential complications?

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Abstract

Objective: Laparoscopic cholecystectomy is considered the gold standard for the treatment of gallstone disease and complications can develop at trocar sites following laparoscopic cholecystectomy. This study aims to evaluate the impact of extracting the gallbladder through either the umbilical or epigastric ports during laparoscopic cholecystectomy on the complications observed after gallbladder extraction.

Methods: Symptomatic cholelithiasis patients who had four port laparoscopic cholecystectomy included to the study. Individuals were divided into two groups based on gallbladder removal site: umbilical or epigastric. Medical records were reviewed for post-surgical complications within 30 days and incisional hernias within one year. The age, gender, operation duration, BMI, blood parameters and the largest stone sizes of the patients were also noted.

Results: A total of 112 patients were included in the study, with 45 patients in the umbilical group and 67 patients in the epigastric group. No significant differences were observed in age, gender, body mass index and stone sizes between groups. Port site hernia and port site infection developed more frequently but not significantly in umblical group. When examined the stone size and BMI based on the presence of a port site hernia and port site infection, BMI and stone size were significantly higher in port site infection and hernia patients.

Conclusions: Using umbilical port for removing gallbladder, carried a higher risk of infection and hernia development. Additionally, regardless of which trocar is used, patients with a high BMI and large stone size have a higher risk of port site infection and hernia. Patients should be informed about these risks during the preoperative period.

Keywords: Gallstone; laparoscopic cholecystectomy; port-site hernia; port-site infection

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Introduction

Laparoscopic cholecystectomy (LC) has revolutionized the field of minimally invasive surgery and is considered the gold standard for the treatment of gallstone disease [1]. Laparoscopic cholecystectomy offers advantages in terms of postoperative pain, hospital stay duration, and cosmetic outcomes, and it is widely performed worldwide. The popularity of LC is based on its quicker postoperative recovery, allowing patients to return to daily activities sooner, and its overall cost-effectiveness [2,3].

Removing the gallbladder constitutes the final step of LC, usually performed through either the epigastric or umbilical port [4]. Previous studies have indicated that both ports are recommended for extraction and are typically chosen based on the surgeon's preference [2-5]. Like any surgical method, LC has its own specific complications. Among the common ones are wound infections and port-site hernias (PSH) [4,5]. Each port used for gallbladder extraction has its advantages and disadvantages. The epigastric port may be advantageous for ease of access and shorter procedure time, while some studies have found the umbilical port to be more suitable [6,7]. However, the number of studies clearly delineating the performance differences between these two ports is limited.

Complications such as postoperative pain and port-site infections (PSI) may become more pronounced when the port site needs to be enlarged. Enlarging the port site can increase the risk of bleeding, infection, and PSH. It has been noted that the umbilical port is the most common site for port-site hernia, leading some authors to prefer extracting the gallbladder through the epigastric port [2-4]. Therefore, the choice of port site and extraction technique should be carefully considered to minimize postoperative complications.

This study aims to evaluate the impact of extracting the gallbladder through either the umbilical or epigastric ports during LC on the complications observed after gallbladder extraction.

Methods

This retrospective study enrolled 151 individuals who underwent LC for gallstones from January 2021 to January 2023 at the general surgery department, following local ethical committee approval (Date: 19.08.2024, No: 57). Participants were selected based on being 18-80 years old with confirmed gallstones. Reasons for exclusion included: postoperative gallbladder cancer diagnosis, any malignancy, acute gallbladder inflammation, gallbladder perforation, thickened gallbladder wall, pregnancy, severe obesity (BMI $\geq$ 40), compromised immune system, use of specimen retrieval bag during surgery, or antibiotic treatment within 30 days after surgery for any cause. Considering all exclusion criteria, the number of patients included in the study was determined as 121.

All subjects received 1 gram of Cefazolin Sodium before surgery. The laparoscopic procedure utilized four entry points: two 10 mm ports (umbilical and epigastric) and two 5 mm ports in the right upper abdomen. Umbilical port sites of all participants were closed with no 0 polypropylene suture. Individuals were divided into two groups based on gallbladder removal site: umbilical or epigastric. Medical records were reviewed for post-surgical complications within 30 days and incisional hernias within one year. The age, gender, operation duration, body mass index (BMI), hematocrit, leukocyte, sodium, potassium and the largest stone size of the patients were also noted. In addition, patients were grouped separately in terms of the development of port site infection and the factors affecting the development of port site infection were compared.

Data analysis was performed using SPSS 21.0 software, with a 95% confidence interval and $p < 0.05$ considered significant. Normality distribution of the data was performed using the Kolmogorov Smirnov test. Continuous variables with normal distribution were expressed as mean ± standard deviation and variables with non-normally distribution were expressed as median-IQR. Categorical variables were assessed using the Chi-square test, while the Mann-Whitney test was employed for qualitative variable comparisons. Cox Regression analysis used to determide the risk factors og PSH and PSI.

Results

A total of 112 patients were included in the study due to exclusion criteria, with 45 patients in the umbilical group and 67 patients in the epigastric group. The average age of the participants was 50.19±14.19 years, with a F/M ratio of 69/43. The distribution of demographic and operational characteristics by groups is provided in Table 1.

Table 1: Characteristics of patients by groups (BMI: Body mass index, IQR: Interquartile range).

		Umblical group (n:45)	Epigastric group (n:67)	P value
Age (year) (mean±SD)		51.58±13.03	49.27±14.91	0.400
Gender	**Female (n-%)**	29 (64.4%)	40 (59.7%)	0.613
BMI (median-IQR)		29.00-5.00	28.00-6.00	0.263
Operation duration (min) (median-IQR)		55.00-25.00	55.00-25.00	0.096
Stone size (mm) (median-IQR)		15.00-12.00	14.00-9.00	0.301
Hematocrit (%) (mean±SD)		34.88±4.24	33.12±6.80	0.124
Leukocyte (10^9/L) (median-IQR)		9.21-5.36	8.80-5.65	0.910
Sodium (mmol/L) (median-IQR)		139.00-4.50	137.00-6.00	0.109
Potassium (mmol/L) (median-IQR)		4.00-0.70	4.29-0.97	0.130

When comparing surgery times between the groups, it was observed that the surgery time was shorter, though not statistically significant, in the group where the gallbladder was extracted through the umbilicus (p:0.096). No significant differences were observed in the other evaluated parameters (Table 1). Additionally, when evaluating the frequency of port site infection and hernia, although no significant differences were observed between the groups for either parameter, there was a noticeable decrease in both parameters in the group using the epigastric port (p:0.095 and p:0.300, respectively) (Table 2).

It was noted that all patients who developed a PSH also experienced a PSI within the first 30 postoperative days. When examining the stone size and BMI based on the presence of a PSH, the average stone size and BMI were 13.95±5.73 mm and 28.21±3.48, respectively, in the group without hernia, and 26.25±2.06 mm and 34.50±2.64 in the group with hernia, with the differences being statistically significant (p:0.000 and p:0.001, respectively).

Additionally, when grouping patients based on the presence of PSI, those who developed PSI had significantly higher BMI and stone sizes (p:0.000 and 0.000, respectively) (Table 3). According to the Cox regression analysis, no risk factor was found for the development of PSH, while both BMI and stone size were determined as risk factors for the development of PSI (p: 0.043, Hazard Ratio: 1.388 and p: 0.044, Hazard Ratio: 1.121, respectively).

Discussion

Laparoscopic cholecystectomy as the preferred treatment for benign gallbladder disease according to current guidelines. However, there is still debate about

Table 2: Distribution of port site infection and port site hernia by groups.

		Umblical group (n:45)	Epigastric group (n:67)	P value
Port- Site Infection	**Yes (n-%)**	8 (17.8%)	5 (7.5%)	0.095
	No (n-%)	37 (82.2%)	61 (92.5%)	
Port-Site Hernia	**Yes (n-%)**	3 (6.7%)	1 (1.5%)	0.300
	No (n-%)	42 (93.3%)	66 (98.5%)	

Table 3: Evaluation of parameters based on the presence of port site infection (BMI: Body mass index, IQR: Interquartile range).

		Port site infection (-) (n:99)	Port site infection (+) (n:13)	P value
Age (year) (mean±SD)		49.91±14.14	52.38±14.76	0.556
Gender	**Female (n-%)**	61 (61.6%)	8 (61.5%)	0.996
BMI (median-IQR)		28.00-5.00	33.00-4.00	0.000
Operation duration (min) (median-IQR)		55.00-20.00	55.00-33.00	0.312
Stone size (mm) (median-IQR)		13.00-9.00	23.00-7.00	0.000
Hematocrit (%) (mean±SD)		34.12±6.11	31.63±4.06	0.157
Leukocyte (10^9/L) (median-IQR)		8.80-5.07	9.51-7.69	0.210
Sodium (mmol/L) (median-IQR)		139.00-4.00	136.00-4.00	0.093
Potassium (mmol/L) (median-IQR)		4.13-0.83	3.80-0.95	0.131

which port is best for gallbladder removal. In our study, it was determined that the use of an umbilical port to remove the gallbladder from the abdomen in patients who underwent laparoscopic cholecystectomy caused higher rates of PSI and PSH, although not significantly, and when the causes of PSI were examined, it was determined that high BMI and large stone size were risk factors for PSI development.

The overall incidence of PSI of our study was 11.6%, which is a little bit high to the previously reported rates of 1.3-6.7% [8]. Port site infections are typically caused by endogenous flora, often resulting from contamination with infected bile [9]. Laparoscopic cholecystectomy has higher rates of bile spillage and contamination due to gallbladder perforation, which can be as high as 25-36% [10,11]. Despite their widespread use, extraction bags have not been shown to reduce infection rates in uncomplicated elective cholecystectomy [12]. Research indicates that extraction through the epigastric port is easier and associated with fewer surgical site infections, while the umbilical port results in less postoperative pain but has a higher risk of incisional hernia and wound infection [3]. Although PSI rates in laparoscopic surgeries are generally low, they can still cause significant complications. Some studies reported PSI rates ranging from 5.07% to 6.3% [13-15]. Certain authors identified the epigastric port as the most common site for PSI [13,15,16], whereas others found that PSI was more frequent at the umbilical port [17,18]. In our study, a noticeably higher, though not statistically significant, PSI rate was observed in patients using the umbilical port. The higher PSI rate at the umbilical port site might be due to a potentially higher microbial load persisting even after antiseptic cleaning. Additionally, patients who developed PSI had significantly higher BMI and stone sizes compared to those who did not, regardless of the extraction port used. This suggests that the stretching and incisions made to enlarge the trocar site, which result in microhematomas, may predispose patients to developing PSI.

Some studies suggest that removing the gallbladder through the umbilical port takes longer and can extend the overall surgery time [3,19]. However, in our study, there was no significant difference in total surgery time between the two groups. Extracting the gallbladder through the epigastric port can sometimes be time-consuming, particularly in obese patients, due to the slanted path and its close association with or traversal of

the falciform ligament fat. Additionally, umbilical port removal requires repositioning the camera and does not offer direct access to the gallbladder.

Current evidence on causative risk factors is weak; however, age over 70, BMI greater than 30, longer surgery duration, diabetes mellitus, incision enlargement, using trocars larger than 10 mm, and wound infection appear to be the main risk factors for PSH [20]. The umbilical and para-umbilical region is naturally a weak area in the abdominal wall. Additionally, intra-abdominal contents such as the small intestine and omentum are closer to the umbilical port compared to the epigastric port, making herniation more likely [21]. Hernia formation can also be influenced by repeated stretching, fascial dilation, and enlargement of the incision at the umbilical site to remove large stones or a thick-walled, swollen gallbladder [22]. Memon et al. reported a PSH rate of 3.66% in the umbilical port extraction group, compared to 0.11% in the epigastric port extraction group in a large comparative study [23]. Nofal et al. found that two-thirds of the PSH in their series of 2930 patients who underwent LC occurred at the umbilical port extraction site [24]. In our study, the overall incidence of PSH was 3.5%. The incidence was 6.7% in the umbilical extraction group and 1.5% in the epigastric group. Although not statistically significant, the incidence was noticeably higher when the umbilical port was used for gallbladder extraction. In patients who developed trocar site hernias, the average stone size was significantly larger, suggesting that fascia dilation and excessive stretching of the fascia are important factors in the development of trocar site hernias, regardless of the extraction site.

The limitations of our study include the limited number of cases and the exclusion of patients with acute cholecystitis and those using endobags.

Conclusion

It should be kept in mind that complications can develop at trocar sites following LC, which is considered the gold standard for patients with symptomatic cholelithiasis. Our study found that the use of the umbilical port, although not significantly, carried a higher risk of infection and hernia development. Additionally, regardless of which trocar is used, patients with a high BMI and large stone size have a higher risk of PSI and PSH. Patients should be informed about these risks during the preoperative period.

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Ethical Declaration: Ethics approval for the study was obtained from the Non-Interventional Clinical Research Ethics Committee of S.B.Ü İstanbul Training and Research Hospital with decision number 09/08/2024 - 57

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