Sirte University Scientific Journal Vol. 16, No. 1 (2026) 146-152
Sirte University Scientific Journal (SUSJ)
Journal home page: http://journal.su.edu.ly/index.php/susj

# Supra-Umbilical 10 mm Port Site Management in Laparoscopic Cholecystectomy: Closure versus Non-Closure

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**DOI**: https://doi.org/10.37375/susj.v16i1.4161

**ARTICLE INFO:**

Received 25 February 2026.
Accepted 10 April 2026.
*Available online 24 June 2026.*

***Keywords***
Laparoscopic cholecystectomy; Trocar; Fascial sheath closure; Port site hernia; Laparoscopic complications.

## ABSTRACT

**Background:** Port site complications, including port site hernia, bleeding, and infection, are uncommon but may depend on port size and location, trocar characteristics, patient-related factors, and surgeon experience. The necessity of routine fascial sheath closure for 10-mm supra-umbilical ports remains controversial. This study aimed to evaluate the outcomes of fascial sheath closure versus non-closure of the supra-umbilical 10-mm port site during laparoscopic cholecystectomy.
**Materials & Methods:** This prospective comparative study included 72 patients who underwent laparoscopic cholecystectomy at Sirt Oncology Center and Ibn Sina Hospital, Libya, between August 2024 and February 2025. Patients were alternately allocated into two groups: Group A (fascial sheath closure using 0 Prolene with skin closure using 3/0 Prolene) and Group B (no fascial sheath closure, skin closure only with 3/0 Prolene). A sharp 10-mm trocar was inserted through the linea alba at the supra-umbilical port site. Patients were followed for 1–4 months for port site complications.
**Results:** No cases of port site hernia, bleeding, or infection were recorded in either group during the follow-up period. The incidence of port site complications was 0% in both groups.
**Conclusion:** Fascial sheath closure of 10-mm supra-umbilical port sites increases operative time and procedural cost and may carry a risk of inadvertent visceral or omental injury. In experienced hands, routine fascial sheath closure of 10-mm supra-umbilical ports may not be necessary. Larger randomized studies with longer follow-up are recommended to confirm these findings.

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# مقارنة إغلاق اللفافة الجراحية وعدم إغلاقها في منفذ 10 ملم فوق السرة أثناء استئصال المرارة بالمنظار

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## المُخلص

**الخلفية**: تُعدّ مضاعفات منافذ الدخول في الجراحة التنظيرية، بما في ذلك فتق منفذ الدخول، والنزف، والعدوى، من المضاعفات غير الشائعة، إلا أنها قد تتأثر بعدة عوامل مثل حجم وموقع المنفذ، ونوع التروكار المستخدم، والعوامل المتعلقة بالمريض، وخبرة الجرّاح. ولا تزال ضرورة الإغلاق الروتيني للغمد اللفافي لمنافذ الدخول فوق السرة بقطر 10 مم موضع جدل في الأدبيات الجراحية. هدفت هذه الدراسة إلى تقييم نتائج إغلاق الغمد اللفافي مقارنة بعدم الإغلاق لمنفذ الدخول فوق السرة بقطر 10 مم أثناء استئصال المرارة بالمنظار.

**المواد والطرق**: أُجريت هذه الدراسة المستقبلية المقارنة على 72 مريضًا خضعوا لاستئصال المرارة بالمنظار في مركز سرت للأورام ومستشفى ابن سينا، ليبيا، خلال الفترة من أغسطس 2024 إلى فبراير 2025. تم توزيع المرضى بالتناوب إلى مجموعتين:

- المجموعة (A): تم فيها إغلاق الغمد اللفافي بخيط بروبلين رقم 0، مع إغلاق الجلد بخيط بروبلين 3/0
- المجموعة (B): لم يتم فيها إغلاق الغمد اللفافي، واقتصر الإغلاق على الجلد بخيط بروبلين 3/0

تم إدخال تروكار حاد بقطر 10 مم عبر الخط الأبيض في موقع المنفذ فوق السرة. وتمت متابعة المرضى لمدة تتراوح بين شهر وأربعة أشهر لرصد مضاعفات منافذ الدخول.

**النتائج**: لم تُسجَّل أي حالات فتق في منفذ الدخول أو نزف أو عدوى في أي من المجموعتين خلال فترة المتابعة. وبلغت نسبة حدوث مضاعفات منافذ الدخول 0% في كلا المجموعتين.

**الاستنتاج**: يؤدي إغلاق الغمد اللفافي لمنافذ الدخول فوق السرة بقطر 10 مم إلى زيادة زمن العملية والتكلفة الإجرائية، وقد يرتبط بخطر حدوث إصابة غير مقصودة للأحشاء أو الثرب. وعند إجرائه بواسطة جرّاحين ذوي خبرة، قد لا يكون الإغلاق الروتيني للغمد اللفافي لمنافذ الدخول بقطر 10 مم ضروريًا. ومع ذلك، تُوصى بإجراء دراسات عشوائية أكبر مع فترات متابعة أطول لتأكيد هذه النتائج.

***الكلمات المفتاحية:***

*استئصال المرارة بالمنظار؛ التروكار؛ إغلاق الغمد اللفافي؛ فتق منفذ الدخول؛ مضاعفات الجراحة التنظيرية*

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# 1 Introduction

Laparoscopic surgery has significantly advanced modern surgical practice due to its advantages, including reduced postoperative pain, faster recovery, shorter hospital stay, and fewer postoperative complications. It is a form of minimally invasive surgery in which procedures are performed through small incisions using specialized instruments, requiring the creation of pneumoperitoneum to improve visualization and operative space.

Pneumoperitoneum can be established using a Veress needle followed by trocar insertion or by direct trocar entry. The initial access to the peritoneal cavity represents the most critical step in laparoscopic surgery and carries the highest risk of major complications. A thorough understanding of abdominal wall anatomy and its relationship to underlying viscera and vascular structures is essential for safe trocar placement. The umbilicus is commonly selected for primary access because of its minimal intervening tissue and relatively avascular midline location. However, deviation from the midline may result in injury to the superior and inferior epigastric vessels, which course longitudinally within the rectus sheath (Wong & Merkur, 2016).

Small abdominal wall vessels may also be injured during trocar insertion, but many can be identified and avoided by transillumination. Anatomical variations in thin and obese patients increase the risk of vascular injury, as the distance between the abdominal wall and retroperitoneal vessels may be minimal. Adhesions between the abdominal wall and intra-abdominal organs are another important risk factor during laparoscopic entry, particularly in patients with previous abdominal surgery (Anaise, 2014; Vilos et al., 2007).

Although laparoscopic cholecystectomy is widely regarded as a safe procedure, it is associated with specific complications such as bile duct injury, bile leakage, bleeding, and bowel injury, which may be related to patient factors, surgeon experience, and technical limitations of the minimally invasive approach (Bhandarkar et al., 2009; Cuschieri et al., 1991; Hunter, 1992; Strasberg, 2005). Thermal injuries to the bile ducts are a recognized cause of biliary complications, and conversion to open surgery should be considered when safe dissection cannot be ensured (Strasberg & Brunt, 2005). Major vascular and bowel injuries during laparoscopic entry are uncommon but potentially life-threatening (Molloy et al., 2002).

Port site complications are an additional concern following laparoscopic surgery. The first port site hernia following laparoscopic cholecystectomy was reported in 1991 (Maio et al., 1991). The incidence of port site complications increases with trocar size and type (Helgstrand et al., 2011; Montz & Holschneider, 1994; Tonouchi et al., 2004). Port site hernia is a rare but clinically significant complication, with reported incidence ranging from 0.18% to 2.8%. Trocar diameter, patient age, body mass index, and fascial closure technique are key risk factors, and closure of the fascial defect has been suggested as an important preventive measure (Society of American Gastrointestinal and Endoscopic Surgeons [SAGES], 2019).

Major vascular injury during laparoscopic entry has been reported in 0.05–0.5% of cases and may involve retroperitoneal, intraperitoneal, or port site vessels (Ahmad et al., 2013). Port site infection remains another postoperative complication that may increase morbidity, hospital stay, and healthcare costs, despite advances in surgical techniques and sterilization methods (Losanoff et al., 2003). Surgical site infection following laparoscopic surgery has also been reported in colorectal and biliary procedures, with umbilical port sites being the most commonly affected (Ali et al., 2010; Francis et al., 2014; Min et al., 2012). Several studies have demonstrated that infection rates are lower in minimally invasive surgery compared with conventional open surgery (Banerjee & Chowdhury, 2015; Karthik et al., 2013).

Various strategies have been proposed to reduce port site complications, including the use of blunt trocars, prophylactic antibiotics, and meticulous surgical technique (Chiu et al., 2006). The risk of port site hernia depends on trocar diameter, trocar design, pre-existing fascial defects, and direction of trocar insertion, and is higher in obese patients due to increased intra-abdominal pressure. Several techniques for fascial closure have been described, including standard closure through the skin incision, laparoscopic closure under direct vision, and closure using specialized suture-passing devices (Mudgal et al., 2018). Among port site complications, incisional port site hernia remains the most frequently reported (Krishnakumar & Tambe, 2009).

This study aimed to compare closure versus non-closure of the fascial sheath defect at the supra-umbilical 10-mm port site during laparoscopic cholecystectomy.

# 2 Materials and Methods

This prospective observational study with simple randomization was conducted in the Department of Surgery at Sirt Oncology Center and Ibn Sina Hospital from August 2024 to February 2025. During the study period, a total of 72 patients with symptomatic cholecystitis were enrolled and underwent laparoscopic cholecystectomy performed by experienced laparoscopic surgeons.

The diagnosis of cholecystitis (acute calculous or chronic calculous cholecystitis) was based on clinical evaluation and confirmed by abdominal ultrasonography. Patients were randomly and alternately allocated into two groups: Group A (n = 36), in which the supra-umbilical 10-mm port site fascial sheath defect was closed, and Group B (n = 36), in which the fascial sheath defect was left unclosed.

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Patients with a history of previous upper abdominal laparotomy, large umbilical or para-umbilical hernias, acute pancreatitis, choledocholithiasis, local skin infections, or those unfit for laparoscopic surgery were excluded.

The study was conducted after obtaining permission from the Research and Consultation Department, Faculty of Medicine, Sirte. Written informed consent was obtained from all participants or their legal guardians before enrollment. Patient confidentiality and data anonymity were strictly maintained throughout the study.

All patients underwent detailed clinical evaluation, including medical history, physical examination, and routine investigations. Laboratory investigations included complete blood count, fasting blood glucose, blood urea, serum creatinine, liver function tests, viral hepatitis screening, and coagulation profile. Additional assessments included chest X-ray, electrocardiography, and abdominal ultrasonography.

Body mass index (BMI) was calculated for all patients by measuring body weight (kg) using a calibrated weighing scale and height (m) using a measuring tape, according to the formula weight/height². Patients were categorized based on the World Health Organization (WHO) BMI classification as follows (WHO) BMI classification (World Health Organization, 2025):

- Underweight: BMI < 18.5 kg/m²
- Normal weight: BMI 18.5–24.9 kg/m²
- Overweight: BMI 25–29.9 kg/m²
- Obese: BMI ≥ 30 kg/m²

All patients received prophylactic third-generation cephalosporin (ceftriaxone 1 g every 12 hours for three doses), with the first dose administered at the induction of anesthesia.

All procedures were performed under general anesthesia. The abdominal skin was prepared using 10% povidone-iodine solution, starting from the nipple line down to the lower abdomen, followed by sterile draping. A 10-mm horizontal supra-umbilical incision was made and deepened through the subcutaneous tissue to the anterior rectus sheath. Pneumoperitoneum was established using a Veress needle, followed by insertion of a sharp trocar for laparoscopic access.

A 10-mm epigastric working port was placed just below the right costal margin. Two additional 5-mm ports were inserted at the right mid-clavicular and right anterior axillary lines below the costal margin. Standard laparoscopic cholecystectomy was then performed.

After completion of the procedure, all instruments were removed under direct vision, and carbon dioxide was evacuated. The supra-umbilical port was removed last. In Group A, the supra-umbilical fascial sheath defect was closed using 0 Prolene sutures with simple interrupted technique, ensuring separation of fascia from subcutaneous tissue before suturing. In Group B, the fascial sheath defect was not closed. Skin closure for all port sites was performed using 3/0 Prolene sutures.

Patients were followed up for 1–4 months postoperatively to assess port site complications, including port site hernia (PSH), port site bleeding (PSB), and port site infection (PSI). Clinical examination and ultrasonographic evaluation were performed for all patients to detect these complications.

Data were analyzed using SPSS software version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize patient demographics and clinical characteristics, including age, sex, cholecystitis status, and BMI. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages.

## 3 Results

A total of 72 patients who underwent laparoscopic cholecystectomy were included in this study. The patients' ages ranged from 19 to 64 years, with a mean ± standard deviation of 39.5 ± 10.8 years. Females were predominant, accounting for 51 patients, whereas males constituted 21 patients. The highest frequency of male patients was observed in the 30–39 years age group (7 patients).

Regarding the type of cholecystitis, chronic calculous cholecystitis was the most common diagnosis, affecting 58 patients. The highest frequency of chronic calculous cholecystitis was observed in the 40–49 years age group, while the lowest frequency was observed in the 60–69 years age group.

Analysis of body mass index (BMI) revealed that overweight and obese patients were most prevalent in the 40–49 years age group, with 9 overweight patients (BMI 25–29.9 kg/m²) and 16 obese patients (BMI ≥30 kg/m²). Underweight and normal-weight patients were less frequent across all age groups (Table 1).

During the follow-up period, no port site hernia, port site infection, or port site bleeding was detected in either Group A (fascial sheath closure) or Group B (non-closure). Furthermore, no intraoperative or postoperative complications related to the laparoscopic cholecystectomy procedure were observed throughout the study period (Table 2).

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**Table 1:** Baseline Demographic and Clinical Characteristics of the Study Population (N = 72)

| Variables | <29 | 30–39 | 40–49 | 50–59 | 60–69 | Total |
|---|---|---|---|---|---|---|
| **Sex** | | | | | | |
| Male | 2 | 7 | 6 | 4 | 2 | 21 |
| Female | 6 | 16 | 20 | 6 | 3 | 51 |
| Total | 8 | 23 | 26 | 10 | 5 | 72 |
| **Cholecystitis status** | | | | | | |
| Acute calculous cholecystitis | 3 | 3 | 4 | 2 | 2 | 14 |
| Chronic calculous cholecystitis | 7 | 16 | 22 | 9 | 4 | 58 |
| Total | 10 | 19 | 26 | 11 | 6 | 72 |
| **BMI (kg/m²)** | | | | | | |
| <18.5 | 1 | 0 | 0 | 0 | 1 | 2 |
| 18.5–24.9 | 1 | 2 | 2 | 1 | 0 | 6 |
| 25–29.9 | 5 | 8 | 9 | 3 | 1 | 26 |
| ≥30 | 1 | 12 | 16 | 6 | 3 | 38 |
| Total | 8 | 22 | 27 | 10 | 5 | 72 |

**Table 2**: Incidence of Port-Site Complications in Groups A and B During Follow-Up (N = 72)

| Complication | Group A (Closure) (n=36) | Group B (Non-Closure) (n=36) | Total (N=72) | P-value |
|---|---|---|---|---|
| Port Site Hernia (PSH) | 0 (0%) | 0 (0%) | 0 (0%) | NA |
| Port Site Bleeding (PSB) | 0 (0%) | 0 (0%) | 0 (0%) | NA |
| Port Site Infection (PSI) | 0 (0%) | 0 (0%) | 0 (0%) | NA |

NA = Not applicable because no events occurred in either group; statistical comparison was not performed.

## Discussion

This study included 72 patients who underwent laparoscopic cholecystectomy, aged between 19 and 64 years (mean ± SD: 39.5 ± 10.8 years). The main outcomes assessed were port site complications, including Port Site Hernia (PSH), Port Site Bleeding (PSB), and Port Site Infection (PSI) in two study groups: Group A, in which the supra-umbilical port site fascial defect was closed, and Group B, in which the fascial defect was left unclosed.

In the present cohort, no cases of PSH were observed in either group during the follow-up period of 1–4 months. These findings are consistent with previous studies reporting low incidence rates of PSH. For example, Hussain et al. (2009) and Jamil et al. (2016) reported PSH incidences of 0.1% and 1.1%, respectively, among patients undergoing fascial closure. Hussain et al. (2009) concluded that classical closure methods are associated with acceptable rates of port-site hernias, while Aziz (2013) emphasized that fascial closure should be simple, safe, cost-effective, and efficient. Similarly, Yi et al. (2012) reported a PSH incidence of 0.5% using non-closure techniques in a series of 400 patients, attributing the low complication rate to surgical expertise.

Other studies also support these findings. Soroush et al. (2013) observed a PSH rate of 2.3% in 220 patients, noting that hernias were more common in 10 mm ports without fascial closure, and therefore recommended closure until further evidence is available. Jamil et al. (2016), in a cohort of 450 patients, reported a PSH incidence of 1.1% with fascial closure. Singal et al. (2016) demonstrated no PSH among 200 patients in whom blunt trocars were used to separate muscle fibers rather than cutting them sharply, highlighting the importance of surgical technique. Al-Dhahiry et al. (2017) reported a PSH rate of 0.35% in 570 patients using non-closure methods, suggesting that closure may not be necessary for 5–10 mm ports. Shamkhi and Muzhir (2021), in a study of 50 patients, reported no PSH, bleeding, or infection during 4–16 weeks follow-up, indicating that experienced surgeons may safely omit fascial closure in small ports while reducing operative time and material costs.

Regarding PSB, no bleeding events were observed in either group during follow-up. Previous reports show variable incidence rates depending on technique and experience. Vagenas et al. (2006) observed PSB in 1.55% of 220 patients using non-closure techniques, whereas Marakis et al. (2007) reported a rate of 1.22% among 1225 patients. Tuveri and Tuveri (2007) reported 0.63% PSB with fascial closure, noting the risk to branches of the iliac arteries during trocar insertion. Khan and Aziz (2010) observed 0.04% PSB in 4957 patients, emphasizing the importance of surgical skill, early recognition, and prompt management. Yi et al. (2012) reported 4.5% PSB in 400 patients using non-closure methods, underscoring that experience can prevent severe complications. Karthik et al. (2013) reported 0.7% PSB among 579 patients, suggesting that careful surgical technique minimizes port-site bleeding, even in high-risk patients.

For PSI, no infections occurred in either group during follow-up. This is consistent with the literature, although higher infection rates have been reported in other studies. Taj et al. (2012) observed 5.48% PSI among 492 patients, emphasizing the benefits of using a surgical glove during gallbladder extraction. Yi et al. (2012) reported 2.75% PSI in 400 patients, and Karthik et al. (2013) reported 1.8% PSI in 570 patients. Mir et al. (2013) noted 6.7% PSI in 675 patients, with Pseudomonas as the most common pathogen, highlighting the need for appropriate empirical antibiotic prophylaxis. Yanni et al. (2013) reported 4% PSI in 100 patients, concluding that selective prophylaxis for high-risk patients does not increase infection rates while reducing costs and antibiotic resistance.

Overall, the absence of PSH, PSB, and PSI in this study may be attributed to the expertise of the surgical teams, strict adherence to aseptic techniques, and high standards of operative care. Nevertheless, the study recommends future research with larger sample sizes and longer postoperative follow-up, including both clinical and ultrasonographic assessment, to further validate these findings.

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## Conclusion

The present study indicates that closure of the supra-umbilical 10 mm port site fascial sheath defect during laparoscopic cholecystectomy did not confer a reduction in port-site complications, as no cases of hernia, bleeding, or infection were observed in either the closure or non-closure groups. Fascial sheath closure was associated with longer operative time, higher procedural costs, and potential risks, including inadvertent injury to omentum or bowel loops. These findings suggest that non-closure of 10 mm port sites may be safely performed by experienced surgical teams. Nevertheless, larger-scale studies with extended follow-up are warranted to validate these results and provide stronger evidence for clinical practice.

## Acknowledgements

The authors would like to thank all patients who participated in this study and the medical staff involved in their care.

**Conflict of interest**: The authors declare that there are no conflicts of interest

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