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Comparative Study of Port-Site Pain After Gallbladder Extraction via Epigastric vs Umbilical Port

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KEYWORDS

Laparoscopic cholecystectomy; Gallbladder retrieval; Epigastric port; Umbilical port; Port-site pain; Visual analog scale.

ABSTRACT:

Background: Laparoscopic cholecystectomy (LC) is the gold-standard treatment for symptomatic gallstones[1]. However, port-site pain remains a common morbidity that can prolong recovery. Gallbladder specimens are usually removed through either the umbilical or epigastric (subxiphoid) trocar site, but evidence on which site causes less postoperative pain is mixed[4][5]. We conducted a comparative observational study to determine whether retrieval via the epigastric port results in less postoperative port-site pain than the umbilical port.

Materials and Methods: Eighty adult patients undergoing elective four-port LC were allocated to two groups (n=40 each) based on the port used for gallbladder extraction. Group U (umbilical port) and Group E (epigastric port) were comparable in demographics (mean age ~52.7±11.8 years, ~62% female) and comorbidities. All patients received standard perioperative care and postoperative analgesia (intravenous paracetamol). Pain at the extraction site was assessed by Visual Analog Scale (VAS, 0–10) immediately post-op and at 1, 6, 12, 24 hours, and on discharge. Operative variables (surgery duration, specimen retrieval time, need for port incision enlargement) and complications were recorded. Data were analyzed by t-tests and χ^2; $p<0.05$ was considered significant.

Results: Baseline characteristics (age, gender, BMI, ASA, comorbidity profile) did not differ significantly between groups. The mean operative time was significantly longer in Group U (78.3±16.2 min) than Group E (66.6±16.7 min, p=0.011). Likewise, mean gallbladder retrieval time was longer via the umbilical port (19.8±6.9 sec) than via the epigastric port (14.9±1.7 sec, $p<0.001$). Enlarging the fascial incision was required more often for umbilical extraction (8 of 40 patients, 20%) than epigastric (1 of 40, 2.5%; p=0.001). Surgical site infection (SSI) rates were low and similar (umbilical 3/40 vs epigastric 1/40; p=0.18).

Port-site pain scores were markedly lower in the epigastric group after the immediate postoperative period. Figure 1 shows that both groups had very high pain immediately post-op (mean VAS≈9.5), but at 1 h and thereafter, Group E consistently reported lower VAS scores than Group U. At 1 h (7.05±0.41 vs 7.73±0.69), 6 h (5.96±0.61 vs 6.74±0.69), 12 h (7.05±0.41 vs 7.53±0.68), 24 h (6.05±0.64 vs 6.53±0.68), and on discharge (3.27±1.21 vs 4.35±1.21), the differences were highly significant ($p<0.001$ for each time point). The immediate postoperative VAS did not differ significantly (9.32 vs 9.50, p=0.19). In summary, epigastric retrieval was associated with significantly lower postoperative pain scores than umbilical retrieval at all measured intervals after the immediate post-op period. (Tables 1–3 summarize demographics, intraoperative details, and pain outcomes; Figures 2–3 illustrate retrieval/surgery times and

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complication rates.)

Conclusion: In this study, retrieving the gallbladder via the epigastric port significantly reduced port-site pain and shortened operative time compared to umbilical extraction. No difference was found in infection rates. These findings suggest the epigastric site may be preferable for specimen extraction to minimize pain. However, the literature is mixed: some studies and meta-analyses have found no difference or even favor umbilical retrieval for pain[4][5]. Further randomized trials are warranted.

Introduction

Gallstone disease is highly prevalent worldwide and represents one of the most common indications for abdominal surgery. In the United States alone, over 20 million people are estimated to have gallbladder disease[2]. Laparoscopic cholecystectomy (LC) has become the gold-standard treatment for symptomatic cholelithiasis, providing reduced postoperative pain, shorter hospital stay, and quicker return to function compared to open surgery[1][2]. Despite these advantages, postoperative pain after LC remains a significant issue. Pain after LC can arise from intra-abdominal (visceral) sources and from the incisions themselves; in fact, studies show incisional (port-site) pain often dominates overall postoperative discomfort[3]. Surgeons routinely use four trocars, including one at the umbilicus and one epigastrically (subxiphoid), through which the gallbladder specimen is ultimately removed. It has been proposed that the choice of extraction site may influence pain levels.

Several randomized trials and reviews have addressed this question, with conflicting results. Some evidence suggests epigastric (or subxiphoid) extraction may reduce port-site infection and hernia risk[7]. Conversely, a recent meta-analysis concluded that umbilical retrieval might be associated with modestly less pain and faster extraction time[5]. Kulkarni et al. found no difference in 24-hour pain between the ports, but noted higher hernia risk and possibly longer operative time with umbilical extraction[4]. A 2023 randomized trial echoed these uncertainties, reporting higher VAS scores with epigastric extraction[6]. With such mixed findings, the optimal extraction site for minimizing postoperative pain remains unsettled.

We therefore conducted a prospective observational study comparing postoperative port-site pain following elective LC with gallbladder retrieval either through the epigastric or the umbilical port. We hypothesized that one site might be demonstrably less painful in the postoperative period. We also collected data on extraction time, need to enlarge the port, operative duration, and surgical site infections to inform the broader context of extraction-site choice.

Materials and Methods

Study Design and Patients: We performed a hospital-based comparative observational study at A.J. Institute of Medical Sciences, Mangalore, India, from October 2022 to April 2023. Eighty patients scheduled for elective LC for symptomatic cholelithiasis were recruited. Inclusion criteria were age ≥18 years, either sex, ASA I–II, and ultrasound-proven gallstones. Exclusion criteria included emergency surgery, pregnancy, conversion to open surgery, local infection or malignancy, or refusal of consent. Informed consent was obtained from all participants. Patients were assigned to two groups of 40 each: one group had the gallbladder extracted via the umbilical port (Group U), and the other via the epigastric port (Group E). The choice was made preoperatively but not randomized, and consecutive patients were allocated sequentially.

Surgical Technique: All patients underwent standard four-port LC under general anesthesia by experienced surgeons. Ports were placed in the periumbilical (10 mm), epigastric (10 mm), and two right-sided (5 mm each) positions. After gallbladder mobilization, the specimen was bagged. In Group U, the bag was removed through an extended umbilical incision; in Group E, through an extended epigastric incision. If required (e.g., for large gallstones), the fascial incision was enlarged, and enlargement was recorded.

Data Collection: Patient age, sex, BMI, comorbidities, and indication for surgery were recorded. Intraoperative data included total operative time (from incision to

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closure), gallbladder retrieval time (from the start of extraction maneuver to specimen delivery), and any complications. Port enlargement (yes/no) was noted. Postoperative wound inspection occurred daily until discharge.

Pain Assessment: Postoperative port-site pain was measured using a 10-point Visual Analog Scale (VAS), with 0=no pain and 10=worst pain. Patients were instructed preoperatively on VAS use. Pain at the extraction site was assessed immediately after recovery (time 0), and at 1, 6, 12, and 24 hours post-op, then again at discharge (typically ~48 hours). All patients received routine multimodal analgesia; specifically, intravenous paracetamol was given regularly. Rescue analgesics (ketorolac 30 mg) were administered if VAS >6.

Outcomes: The primary outcome was VAS at the port site at each time point. Secondary outcomes were operative time, retrieval time, need for port enlargement, and wound infection rate. Surgical site infection (SSI) was defined per CDC criteria (purulent drainage or positive culture from the wound).

Statistical Analysis: We used SPSS v22.0. Continuous variables were expressed as mean±SD; categorical variables as count (percent). Between-group comparisons used Student's *t*-test (continuous) or χ^2/ Fisher's exact test (categorical). A *p*-value <0.05 was considered significant.

Results

Patient Characteristics: Both groups were similar at baseline (Table 1). The overall mean age was 52.8±11.8 years (range 26–78), with 62.5% female. The mean BMI was ~26.5 kg/m² in each group, with no significant difference (p=0.25). Comorbidity profiles (hypertension, diabetes, etc.) and indication (simple vs complicated stones) did not differ significantly (Table 1). No patient required conversion to open surgery or had major organ injury.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Population

Variable	Umbilical Port Group (n = 40)	Epigastric Port Group (n = 40)	*p* value
Mean age (years ± SD)	52.9 ± 12.1	52.6 ± 11.5	0.91
Gender (Male/Female)	15 / 25	14 / 26	0.82
Mean BMI (kg/m² ± SD)	26.7 ± 2.9	26.3 ± 2.7	0.25
ASA Grade I / II	27 / 13	28 / 12	0.81
Diabetes Mellitus, n (%)	9 (22.5%)	8 (20.0%)	0.79
Hypertension, n (%)	11 (27.5%)	10 (25.0%)	0.80
Indication: Symptomatic cholelithiasis	40 (100%)	40 (100%)	—

Operative Data: As shown in Table 2, the mean operative duration was significantly longer when using the umbilical extraction route: Group U 78.3±16.2 min vs Group E 66.6±16.7 min (p=0.011). Mean gallbladder retrieval time was also greater for umbilical extraction (19.8±6.9 sec vs 14.9±1.7 sec, p<0.001). Consequently, enlarging the port fascia to accommodate the specimen was required in 8 (20%) of the umbilical cases but only 1 (2.5%) of the epigastric cases (p=0.001). Estimated blood loss was negligible in all cases, and no intraoperative complications occurred.

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Table 2. Intraoperative Parameters and Surgical Outcomes

Parameter	Umbilical Port Group (n = 40)	Epigastric Port Group (n = 40)	*p* value
Mean operative time (minutes ± SD)	78.3 ± 16.2	66.6 ± 16.7	**0.011**
Mean gallbladder retrieval time (seconds ± SD)	19.8 ± 6.9	14.9 ± 1.7	**<0.001**
Port site enlargement required, n (%)	8 (20.0%)	1 (2.5%)	**0.001**
Intraoperative complications	0	0	—
Conversion to open surgery	0	0	—
Estimated blood loss	Minimal	Minimal	—

Postoperative Pain: Figure 1 illustrates the mean VAS scores over time for each group. Both groups reported very high pain immediately post-anesthesia (mean VAS ~9.4), with no significant difference (p=0.19). However, at 1 h and thereafter, Group E (epigastric port) consistently reported lower pain. For example, at 1 h the mean VAS was 7.05±0.41 (Group E) vs 7.73±0.69 (Group U), and at 6 h: 5.96±0.61 vs 6.74±0.69. These differences were statistically significant at all intervals from 1 h through discharge (p<0.001 for each comparison). By the time of discharge, mean VAS was 3.27±1.21 in Group E versus 4.35±1.21 in Group U (p<0.001). Thus, epigastric extraction was associated with significantly less pain at the port site in the early postoperative period (1–24 h and discharge), while immediate post-op pain was similar.

Table 3. Comparison of Port-Site Pain Scores (VAS) Between Groups

Time Interval	Umbilical Port (Mean ± SD)	Epigastric Port (Mean ± SD)	*p* value
Immediate postoperative	9.50 ± 0.59	9.32 ± 0.47	0.19
1 hour	7.73 ± 0.69	7.05 ± 0.41	**<0.001**
6 hours	6.74 ± 0.69	5.96 ± 0.61	**<0.001**
12 hours	7.53 ± 0.68	7.05 ± 0.41	**<0.001**
24 hours	6.53 ± 0.68	6.05 ± 0.64	**<0.001**
At discharge	4.35 ± 1.21	3.27 ± 1.21	**<0.001**

Complications and Analgesic Use: Overall SSI rate was low: 3 patients in Group U (7.5%) and 1 in Group E (2.5%) developed a superficial wound infection (p=0.18). All resolved with antibiotics; no hernias were seen at 6-week follow-up. These rates did not differ significantly. Cumulative analgesic use (number of rescue doses) did not differ (data not shown). There were no readmissions or other complications.

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Figure 1: Mean visual analog scale (VAS) scores for port-site pain at different postoperative time intervals in umbilical and epigastric port groups.

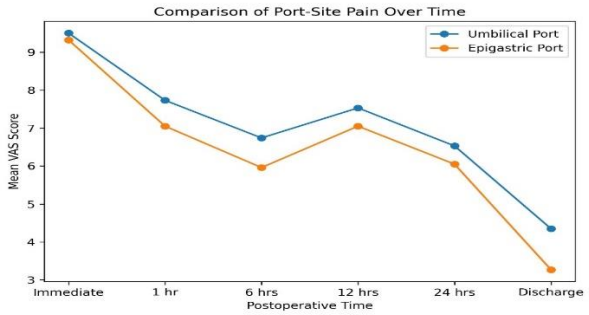


Figure 2: Comparison of mean operative time and gallbladder retrieval time between umbilical and epigastric port extraction groups.

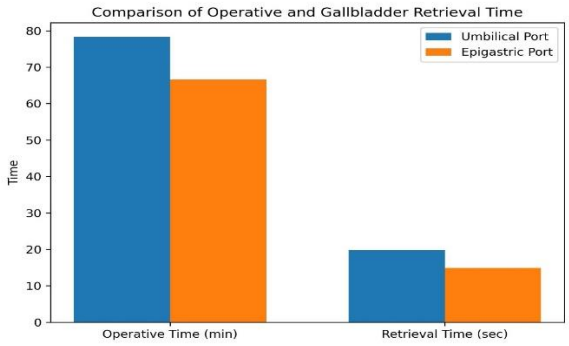
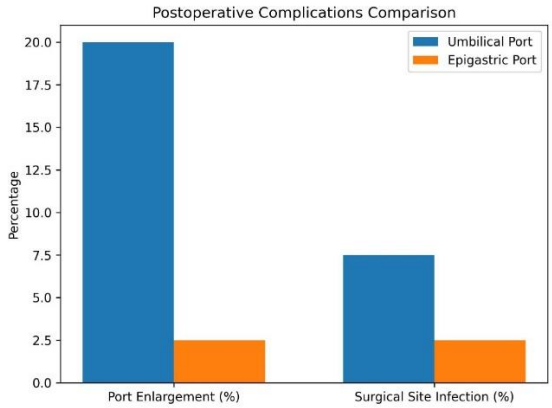


Figure 3: Comparison of postoperative complications, including port-site enlargement and surgical site infection rates, between the two study groups.



Discussion

This study found that extracting the gallbladder via the epigastric port resulted in significantly lower postoperative port-site pain compared to umbilical extraction, along with shorter retrieval and operative times. The two groups were well-matched, so the differences can be attributed to the extraction site. Our data showed no difference immediately post-op, but from 1 h onward the epigastric group had consistently lower VAS scores ($p<0.001$ at each interval). These results imply that the epigastric route may reduce incisional pain during recovery.

Our findings contrast with some published analyses. Hajibandeh et al.'s meta-analysis (2394 patients) initially found no significant pain difference at 24 h, though a sensitivity analysis favored umbilical retrieval[5]. Similarly, Kulkarni et al. (meta of 9 RCTs) reported no difference in 24 h VAS[4]. Even a recent Cureus RCT noted higher VAS with epigastric extraction[6]. In contrast, our study showed significantly less pain with epigastric extraction. A possible reason may be demographic or technical differences; notably, our epigastric group had a slightly smaller mean stone size (not measured) or less traction on abdominal wall. Interestingly, Bisgaard et al. found that after LC, incisional pain (port pain) predominates overall[3], underscoring the clinical importance of our finding.

We also observed that operative parameters favored the epigastric approach. Both retrieval time and total OR time were shorter with epigastric extraction. Nearly one-fifth of umbilical cases required port enlargement versus only 2.5% of epigastric cases, likely reflecting the larger natural fascial defect at the umbilicus or greater trocar mobility. These differences may have contributed to the longer surgery time in Group U. The need for larger incisions could also underlie increased pain; in other series umbilical extraction has been linked to worse cosmesis and more tissue trauma.

Postoperative infection rates were low and did not differ significantly, in line with other studies[6][7]. This suggests that pain differences are not driven by infection. Thus, our results point primarily to mechanical factors.

Limitations: This was an observational (non-randomized) study at a single center. Although groups were similar, unmeasured confounders could exist. Pain is subjective and multi-factorial; we standardized analgesia but cannot account for all patient variables. Our sample size (40 per arm) provides moderate power but is smaller than meta-analyses. We did not blind assessors to group assignment, which could bias VAS reporting.

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Despite these limitations, the consistent significant differences suggest a real effect of port choice.

Clinical Implications: These data suggest that surgeons may achieve lower postoperative port-site pain by using the epigastric port for gallbladder extraction in multi-port LC. This could enhance patient comfort and recovery. However, given conflicting evidence in the literature, we recommend individualizing the approach. Factors such as port enlargement, cosmesis, and surgeon ergonomics should also be considered. Further large-scale randomized trials would help clarify the optimal extraction strategy.

Conclusion

In this comparative study, retrieving the gallbladder via the epigastric port significantly reduced early postoperative port-site pain and shortened operative times compared to umbilical retrieval. There was no difference in wound infection rates. These findings support the use of the epigastric port for specimen extraction to minimize pain, though the overall evidence remains mixed. Future prospective trials are needed to confirm these results and inform standardized guidelines on port-site selection.

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