Section: General Surgery

Original Research Article

A COMPARATIVE STUDY OF THREE-PORT VERSUS CONVENTIONAL FOUR-PORT LAPAROSCOPIC CHOLECYSTECTOMY IN ELECTIVE GALLSTONE DISEASE

Juli[1], Sudhanshu Sharma[2]

[1-2]Department of General Surgery, Government Medical College, Jalaun (Orai), Uttar Pradesh, India.

Received : 20/11/2025
Received in revised form : 08/01/2026
Accepted : 25/01/2026

Keywords:
Laparoscopic cholecystectomy; Three-port technique; Four-port technique; Postoperative pain; Gallstone disease; Minimally invasive surgery.

Corresponding Author:
Dr. Juli
Email: drjuli2011@gmail.com

DOI: 10.47009/jamp.2026.8.1.135

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (1); 708-712

ABSTRACT

Background: Laparoscopic cholecystectomy is the standard surgical treatment for symptomatic gallstone disease. Efforts to further reduce surgical trauma have led to modifications such as three-port laparoscopic cholecystectomy; however, its advantages over the conventional four-port technique remain debated. **Objective:** To compare three-port and conventional four-port laparoscopic cholecystectomy with respect to operative parameters, postoperative pain, recovery, and patient satisfaction. **Materials and Methods:** This prospective comparative study was conducted in the Department of General Surgery, Government Medical College, Jalaun (Orai), from January to December 2025. Eighty-five patients undergoing elective laparoscopic cholecystectomy were included and divided into two groups: three-port (n = 42) and four-port (n = 43). Operative time, intra-operative outcomes, postoperative pain assessed using a visual analog scale (VAS), analgesic requirements, hospital stay, time to return to normal activity, and patient satisfaction were evaluated. Statistical analysis was performed using SPSS, with $p < 0.05$ considered significant. **Results:** The three-port group had a significantly shorter operative time compared with the four-port group (46.8 ± 10.1 vs 61.5 ± 12.6 minutes; $p = 0.001$). Port-site pain at 12 hours was significantly lower in the three-port group ($p = 0.02$), although pain scores at 24 hours were comparable. Analgesic requirements were significantly reduced in the three-port group ($p = 0.02$). No significant differences were observed in postoperative hospital stay, time to return to normal activity, operative success rate, or patient satisfaction. No major bile duct injuries occurred in either group. **Conclusion:** Three-port laparoscopic cholecystectomy is a safe and effective alternative to the conventional four-port technique, offering reduced operative time and early postoperative pain without compromising safety or patient satisfaction.

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for the treatment of symptomatic gallstone disease since its introduction in the late 1980s, owing to reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes compared with open surgery.[1-3] The conventional technique employs four ports, with the fourth port used primarily for fundal retraction of the gallbladder to facilitate exposure of Calot's triangle.[4] With increasing surgical experience and advances in minimally invasive techniques, efforts have been made to further reduce surgical trauma by decreasing the number and size of ports without compromising safety or efficacy.[5,6]

Three-port laparoscopic cholecystectomy has been proposed as a modification of the standard approach, eliminating the lateral retraction port while relying on coordinated instrument manipulation for adequate exposure.[7,8] Several studies have demonstrated the technical feasibility of the three-port technique, suggesting potential benefits such as reduced postoperative pain, lower analgesic requirements, and improved cosmetic satisfaction.[9-11] However, concerns persist regarding operative difficulty, prolonged operative time, and the potential risk of bile duct injury due to limited retraction and visualization.[12,13]

Postoperative pain remains a key determinant of patient recovery and satisfaction following laparoscopic surgery. Evidence suggests that pain intensity is related not only to the size but also to the

ISSN (O): 2687-5365; ISSN (P): 2753-6556

number of trocar incisions, particularly during the early postoperative period.[14,15] Reducing the number of ports may therefore translate into meaningful clinical benefits, especially in resource-limited settings where early ambulation and reduced analgesic use are desirable.[16] Despite these theoretical advantages, published data comparing three-port and four-port LC have yielded mixed results, with some studies demonstrating reduced pain and operative time, while others report comparable outcomes between techniques.[7,9,17]

The randomized controlled trial by Kumar et al. demonstrated that three-port laparoscopic cholecystectomy resulted in significantly reduced operative time and early port-site pain, with comparable overall pain, hospital stay, and patient satisfaction when compared with the conventional four-port approach.[7] Since then, further studies and systematic reviews have continued to evaluate reduced-port techniques, including mini-laparoscopic and single-incision approaches, with emphasis on balancing minimal invasiveness against operative safety.[18-20]

Given variations in patient population, surgeon experience, and healthcare infrastructure, it is important to evaluate the applicability of three-port laparoscopic cholecystectomy in different institutional settings. The present study was therefore undertaken to compare three-port and four-port laparoscopic cholecystectomy in terms of operative parameters, postoperative pain, recovery, and patient satisfaction in a tertiary care teaching hospital in India.

MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of General Surgery, Government Medical College, Jalaun (Orai), Uttar Pradesh, from January 2025 to December 2025. The study included patients aged 18 to 75 years with symptomatic gallstone disease who were scheduled for elective laparoscopic cholecystectomy. Patients with acute cholecystitis with empyema, suspected gallbladder malignancy, previous upper abdominal surgery, or those unfit for general anesthesia were excluded. Written informed consent was obtained from all participants prior to enrollment.

A total of 85 patients were included and allocated into two groups based on the surgical technique employed: 42 patients underwent three-port laparoscopic cholecystectomy and 43 patients underwent the conventional four-port technique. All procedures were performed under general anesthesia by experienced surgeons using standardized operative steps. In the three-port technique, the lateral right subcostal port was omitted, while the four-port group underwent the standard approach. The cystic duct and artery were identified, clipped, and divided in both groups, and the gallbladder was retrieved through the umbilical port. Placement of an additional port was permitted if adequate exposure could not be achieved.

Postoperative analgesia was standardized for all patients. Operative parameters, postoperative pain using a 10-cm visual analog scale at 12 and 24 hours, analgesic requirements, hospital stay, return to normal activity, and patient satisfaction scores were recorded by an independent observer. Data were analyzed using SPSS software, with a p value of <0.05 considered statistically significant.

RESULTS

A total of 85 patients undergoing elective laparoscopic cholecystectomy were included in this comparative study. The patients were divided into two groups: 42 patients in the three-port laparoscopic cholecystectomy group and 43 patients in the conventional four-port laparoscopic cholecystectomy group. The study was designed to evaluate and compare intra-operative parameters, postoperative pain, analgesic requirements, recovery profile, and patient satisfaction between the two techniques.

Table 1: Demographic & Clinical Profile

Variable	Three-port (n=42)	Four-port (n=43)	p value
Age (years), mean ± SD	39.8 ± 12.4	41.1 ± 13.0	0.63
Sex (Female:Male)	34 : 8	33 : 10	0.61
Diagnosis – Acute cholecystitis, n (%)	5 (11.9)	5 (11.6)	0.97
Diagnosis – Chronic cholecystitis, n (%)	37 (88.1)	38 (88.4)	0.97
ASA grade I–II, n (%)	40 (95.2)	41 (95.3)	0.98

ISSN (O): 2687-5365; ISSN (P): 2753-6556

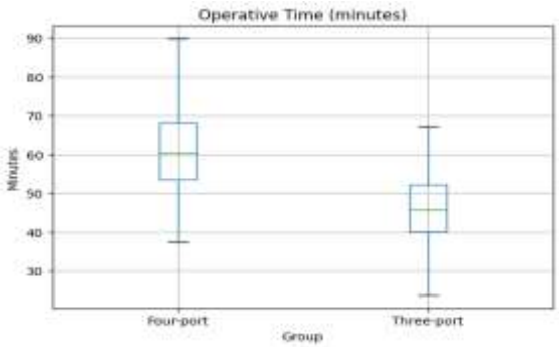

Figure 1: Comparison of operative time between three-port and four-port laparoscopic cholecystectomy

Box-and-whisker plot showing median, interquartile range, and range of operative time (minutes) in the two groups. The three-port technique demonstrates a shorter operative time with lower median values compared to the conventional four-port approach.

Eighty-five patients undergoing elective laparoscopic cholecystectomy were included, with 42 patients in the three-port group and 43 in the four-port group. The two groups were comparable with respect to age, sex distribution, clinical diagnosis, and ASA physical status (Table 1), with no statistically significant differences in baseline demographic or clinical characteristics, allowing meaningful comparison of perioperative outcomes.

Table 2: Intra-operative Outcomes

Parameter	Three-port (n=42)	Four-port (n=43)	p value
Operative time (min)	**46.8 ± 10.1**	**61.5 ± 12.6**	**0.001**
Operative success rate (%)	97.6	97.7	0.99
Conversion to open surgery, n (%)	0	1 (2.3)	0.31
Need for additional port, n (%)	2 (4.8)	—	—
Major bile duct injury	0	0	—
Significant intra-op bleeding	0	1 (2.3)	0.31

As shown in Table 2, the mean operative time was significantly shorter in the three-port group compared with the four-port group (46.8 ± 10.1 vs 61.5 ± 12.6 minutes; p = 0.001). Operative success rates were comparable between the two groups (97.6% in the three-port group vs 97.7% in the four-port group). No patient in the three-port group required conversion to open surgery, whereas one patient (2.3%) in the four-port group was converted, a difference that was not statistically significant. Two patients (4.8%) in the three-port group required placement of an additional port to complete the procedure. No major bile duct injuries were observed in either group, and significant intra-operative bleeding occurred in only one patient in the four-port group. Overall, the three-port technique achieved similar operative safety and success as the conventional four-port approach while offering a significantly shorter operative duration.

Table 3: Post-operative Pain Scores

Pain Assessment	Three-port	Four-port	p value
Port-site pain (12 h)	**2.22 ± 1.05**	**2.94 ± 1.18**	**0.02**
Port-site pain (24 h)	2.26 ± 1.04	2.48 ± 1.10	0.41
Overall pain score (24 h)	3.15 ± 1.12	3.34 ± 1.21	0.48
Most painful port	Umbilical	Umbilical	—

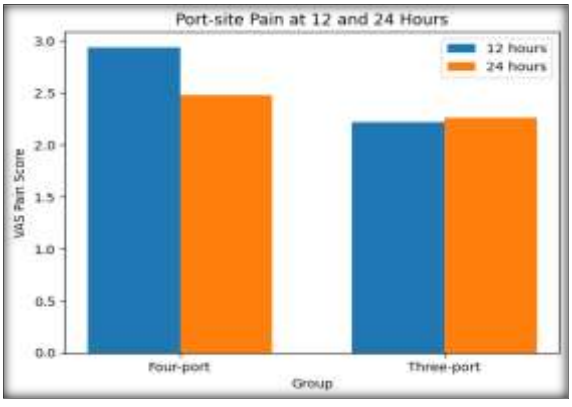

Figure 2: Port-site pain at 12 and 24 hours following three-port and four-port laparoscopic cholecystectomy

Bar graph depicting mean visual analog scale (VAS) pain scores at 12 hours and 24 hours postoperatively in both groups. Early port-site pain at 12 hours is lower in the three-port group, while pain scores at 24 hours are comparable between the two techniques.

Post-operative pain assessment revealed a significantly lower port-site pain score at 12 hours in the three-port group compared with the four-port group (2.22 ± 1.05 vs 2.94 ± 1.18; p = 0.02). However, by 24 hours post-surgery, port-site pain scores were comparable between the two groups (2.26 ± 1.04 vs 2.48 ± 1.10; p = 0.41). Similarly, the overall pain score at 24 hours did not differ significantly between the three-port and four-port techniques (3.15 ± 1.12 vs 3.34 ± 1.21; p = 0.48). In both groups, the umbilical port was identified as the most painful site. These findings indicate that three-port laparoscopic cholecystectomy offers a significant reduction in early postoperative port-site pain, while overall pain levels equalize within 24 hours.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 4: Analgesic Requirement & Recovery

Parameter	Three-port	Four-port	p value
Days of oral analgesic requirement	**3.7 ± 0.7**	**4.4 ± 1.1**	**0.02**
Post-operative hospital stay (days)	1.22 ± 0.41	1.46 ± 0.53	0.34
Days to return to normal activity	4.8 ± 0.9	5.9 ± 1.8	0.14

As summarized in Table 4, patients in the three-port group required a significantly shorter duration of oral analgesic therapy compared with those in the four-port group (3.7 ± 0.7 vs 4.4 ± 1.1 days; p = 0.02). Although the mean postoperative hospital stay was slightly shorter in the three-port group, the difference was not statistically significant (1.22 ± 0.41 vs 1.46 ± 0.53 days; p = 0.34). Similarly, patients undergoing three-port laparoscopic cholecystectomy tended to return to normal activity earlier than those in the four-port group (4.8 ± 0.9 vs 5.9 ± 1.8 days); however, this difference did not reach statistical significance (p = 0.14). Overall, the three-port technique was associated with reduced analgesic requirements, with comparable postoperative recovery parameters between the two groups.

Table 5: Patient Satisfaction

Satisfaction Score (VAS 0–10)	Three-port	Four-port	p value
Satisfaction with surgery (discharge)	7.9 ± 1.6	7.5 ± 1.9	0.29
Satisfaction with scar (Day-7)	8.4 ± 1.6	7.9 ± 1.7	0.24

Patient satisfaction scores were high in both groups, as shown in Table 5. Satisfaction with surgery at the time of discharge was comparable between the three-port and four-port groups (7.9 ± 1.6 vs 7.5 ± 1.9; p = 0.29). Similarly, satisfaction with the surgical scar assessed on postoperative day 7 did not differ significantly between the two techniques (8.4 ± 1.6 in the three-port group vs 7.9 ± 1.7 in the four-port group; p = 0.24). These findings indicate that both approaches yielded similar levels of patient-perceived satisfaction with surgical outcome and cosmetic appearance.

DISCUSSION

Laparoscopic cholecystectomy has undergone continuous refinement since its introduction, with reduction in port number representing one of the key strategies to minimize surgical trauma while preserving operative safety. The present study demonstrates that three-port laparoscopic cholecystectomy is a safe and effective alternative to the conventional four-port technique, offering specific advantages in terms of operative time and early postoperative pain without adversely affecting overall outcomes.

In the current study, operative time was significantly shorter in the three-port group compared with the four-port group. This finding is consistent with the randomized trial by Kumar et al,[7] and reports by Trichak,[9] and Leggett et al,[10] who attributed reduced operative duration to decreased time spent on placement and closure of an additional port. While some earlier studies reported longer operative times during the learning phase of reduced-port techniques,[12] increasing surgeon experience appears to mitigate this concern, as reflected in our results.

Postoperative pain remains a major determinant of patient recovery following laparoscopic surgery. In this study, port-site pain at 12 hours was significantly lower in the three-port group, although pain scores at 24 hours and overall pain were comparable between the groups. These findings align with earlier observations that pain intensity is closely related to the number of trocar incisions, particularly in the early postoperative period.[6,14] Similar trends have been reported in recent meta-analysis, which demonstrates reduced early pain with fewer ports but no sustained long-term difference.[20] The umbilical port was identified as the most painful site in both groups, a finding consistent with previous studies.[7,15]

Analgesic requirements were significantly reduced in the three-port group, supporting the clinical relevance of reduced early pain. However, postoperative hospital stay and time to return to normal activity were comparable between the two techniques. This may reflect standardized discharge protocols and socioeconomic factors influencing convalescence rather than surgical technique alone, as also noted in other studies from resource-limited settings.[16]

Importantly, operative safety was not compromised in the three-port group. There were no bile duct injuries in either group, and conversion rates were low and comparable. Concerns regarding increased biliary injury with reduced-port techniques have been raised previously,[12] however, adherence to the critical view of safety and allowance for additional port placement when required appear to mitigate this risk.[13] Patient satisfaction with surgery and cosmetic outcome was high in both groups, with no statistically significant difference. While fewer scars theoretically improve cosmesis, subjective satisfaction may be influenced by multiple factors, including pain control and overall recovery experience.[18,19]

Overall, the findings of the present study support three-port laparoscopic cholecystectomy as a feasible and safe technique with specific advantages in operative efficiency and early postoperative

ISSN (O): 2687-5365; ISSN (P): 2753-6556

comfort. Larger multicentric studies with longer follow-up may further clarify its role in routine surgical practice.

CONCLUSION

The present study demonstrates that three-port laparoscopic cholecystectomy is a safe, feasible, and effective alternative to the conventional four-port technique for elective management of symptomatic gallstone disease. In our series, the three-port approach was associated with a significantly shorter operative time and reduced early postoperative port-site pain, along with lower analgesic requirements, without compromising operative success or patient safety. Importantly, there were no major bile duct injuries or significant increases in intra-operative complications in the three-port group.

Postoperative recovery parameters, including hospital stay and time to return to normal activity, were comparable between the two techniques, indicating that reduction in port number does not adversely affect overall recovery. Patient satisfaction with both the surgical procedure and cosmetic outcome was high and similar in both groups, further supporting the acceptability of the three-port technique.

These findings corroborate existing evidence and reinforce that, when performed by experienced surgeons adhering to standard safety principles such as the critical view of safety, three-port laparoscopic cholecystectomy can be routinely adopted in appropriately selected patients. The technique offers the advantages of reduced surgical trauma and early postoperative discomfort while maintaining outcomes comparable to the conventional four-port approach, making it a valuable option in modern minimally invasive surgical practice.

REFERENCES

1. Mouret P. How I developed laparoscopic cholecystectomy. Annals of the Academy of Medicine, Singapore. 1996 Sep;25(5):744-7.
2. Dubois F, Icard PB, Berthelot GA, Levard H. Coelioscopic cholecystectomy: preliminary report of 36 cases. Annals of surgery. 1990 Jan 1;211(1):60-2.
3. Litynski GS. Profiles in laparoscopy: Mouret, Dubois, and Perissat: the laparoscopic breakthrough in Europe (1987-1988). JSLS. 1999 Apr-Jun;3(2):163-7.
4. Strasberg SM. Acute calculous cholecystitis. New England Journal of Medicine. 2008 Jun 26;358(26):2804-11.
5. Sarli L, Iusco D, Gobbi S, Porrini C, Ferro M, Roncoroni L. Randomized clinical trial of laparoscopic cholecystectomy performed with mini-instruments. Journal of British Surgery. 2003 Nov;90(11):1345-8.
6. Bisgaard T, Klarskov B, Trap R, Kehlet H, Rosenberg J. Pain after microlaparoscopic cholecystectomy: a randomized double-blind controlled study. Surgical endoscopy. 2000 Apr;14(4):340-4.
7. Kumar M, Agrawal CS, Gupta RK. Three-port versus standard four-port laparoscopic cholecystectomy: a randomized controlled clinical trial in a community-based teaching hospital in eastern Nepal. JSLS: Journal of the Society of Laparoendoscopic Surgeons. 2007 Jul;11(3):358.
8. Slim K, Pezet D, Stencl Jr J, Lechner C, Le Roux S, Lointier P, Chipponi J. Laparoscopic cholecystectomy: an original three-trocar technique. World journal of surgery. 1995 May;19(3):394-7.
9. Trichak S. Three-port vs standard four-port laparoscopic cholecystectomy. Surgical Endoscopy and Other Interventional Techniques. 2003 Sep;17(9):1434-6.
10. Leggett PL, Bissell CD, Churchman-Winn R, Ahn C. Three-port microlaparoscopic cholecystectomy in 159 patients. Surgical endoscopy. 2001 May;15(3):293-6.
11. Tagaya N, Kita J, Takagi K, Imada T, Ishikawa K, Kogure H, Ohyama O. Experience with three-port laparoscopic cholecystectomy. Journal of Hepato-Biliary-Pancreatic Surgery. 1998 Nov;5(3):309-11.
12. Ng WT. Three-trocar laparoscopic cholecystectomy: a cautionary note. Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 1998 Apr 1;8(2):159.
13. Strasberg SM, Brunt ML. Rationale and use of the critical view of safety in laparoscopic cholecystectomy. Journal of the American College of Surgeons. 2010 Jul 1;211(1):132-8.
14. Bisgaard T, Kehlet H, Rosenberg J. Pain and convalescence after laparoscopic cholecystectomy. The European journal of surgery. 2001 Feb 1;167(2):84-96.
15. Kehlet H, Dahl JB. Anaesthesia, surgery, and challenges in postoperative recovery. The Lancet. 2003 Dec 6;362(9399):1921-8.
16. Gupta N, Ranjan G, Arora MP, Goswami B, Chaudhary P, Kapur A, Kumar R, Chand T. Validation of a scoring system to predict difficult laparoscopic cholecystectomy. International Journal of Surgery. 2013 Nov 1;11(9):1002-6.
17. Poon CM, Chan KW, Lee DW, Chan KC, Ko CW, Cheung HY, Lee KW. Two-port versus four-port laparoscopic cholecystectomy. Surgical Endoscopy and Other Interventional Techniques. 2003 Oct;17(10):1624-7.
18. Pisanu A, Reccia I, Porceddu G, Uccheddu A. Meta-analysis of prospective randomized studies comparing single-incision laparoscopic cholecystectomy (SILC) and conventional multiport laparoscopic cholecystectomy (CMLC). J Gastrointest Surg. 2012 Sep;16(9):1790-801.
19. Marks JM, Phillips MS, Tacchino R, Roberts K, Onders R, DeNoto G, Gecelter G, Rubach E, Rivas H, Islam A, Soper N. Single-incision laparoscopic cholecystectomy is associated with improved cosmesis scoring at the cost of significantly higher hernia rates: 1-year results of a prospective randomized, multicenter, single-blinded trial of traditional multiport laparoscopic cholecystectomy vs single-incision laparoscopic cholecystectomy. Journal of the American College of Surgeons. 2013 Jun 1;216(6):1037-47.
20. Nip L, Tong KS, Borg CM. Three-port versus four-port technique for laparoscopic cholecystectomy: systematic review and meta-analysis. BJS Open. 2022 Mar 8;6(2):zrac013.

ISSN (O): 2687-5365; ISSN (P): 2753-6556