

Research Article

Comparison of Postoperative Pain in Patients Undergoing Laparoscopic Cholecystectomy with and without Transversus Abdominis Plane (TAP) Block: A Prospective Comparative Study

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Abstract: Background: Effective pain management in early postoperative period improves outcomes. TAP block is an adjunctive procedure for postoperative analgesia.

Objective: To compare the outcomes of TAP vs Non-TAP Block in patients undergoing laparoscopic cholecystectomy.

Materials and Methods: It is a prospective observational comparative cohort study of two patient groups undergoing laparoscopic cholecystectomy. The study was conducted at the Department of Surgery, Liaquat College of Medicine & Dentistry, Karachi, from 5th August 2025 to 4th February 2026, after the approval from institutional review board (Ref. No. IRB/M-000133-25), dated: 4th August 2025. The sample size was calculated using a power analysis for comparing two independent means (TAP Block vs. Non-TAP Block). Inclusion criteria had patients aged 18–60 years & exclusion criteria consisted of patients with acute cholecystitis, empyema, perforated gall bladder ASA of ≥ 3 . All the LC were performed by same surgeon. Patients' postoperative pain was assessed 12 hours after LC in terms of VAS Score and time for rescue analgesia. Data was analyzed by SPSS version 30.0.

Results: The mean age among patients in this study was 46.15 ± 8.92 years. 73.3% patients were female while 26.7% patients were male. The groups showed similar outcomes like age, gender distribution, duration of symptoms and BMI. Mean VAS score in TAP block group 12 hours after surgery was 2.80 ± 1.54 while in non-TAP block group was 6.13 ± 1.73 ($p < 0.0001$). Mean time rescue analgesia in TAP block group was 13.92 ± 6.74 hours vs non-TAP block group was 4.77 ± 2.79 hours ($p < 0.0001$).

Conclusion: The study concludes that administration of TAP block following LC is associated with significantly reduced postoperative VAS Scores and prolonged time to rescue analgesia.

Keywords: Laparoscopic cholecystectomy, Post-operative pain, TAP block, Gallbladder, Post-operative opioid consumption, Visual analog scale, ERAS.

INTRODUCTION

The surgical procedure of laparoscopic cholecystectomy has become the preferred method for gallbladder removal because of its minimally invasive nature and the faster recovery it offers compared to open surgery [1-3]. Effective postoperative management is essential for achieving favorable patient outcomes in terms of early mobilization and discharge as well as early return to normal activities [4, 5]. Analgesia in laparoscopic cholecystectomy involves different techniques to efficaciously manage postoperative pain [6]. Systemic Analgesia consists of non-opioid analgesics and opioids like Tramadol, Nalbuphine, Morphine and pethidine [7]. While these opi-

oids provide effective pain control they may have side effects like nausea, vomiting, and respiratory depression [8]. Non opioid analgesics include NSAIDs, such as ibuprofen and ketorolac which are effective for mild to moderate pain and help reduce opioid consumption, and Paracetamol, which is often used in combination with other analgesics like ibuprofen for better pain control. This combination results in reduced opioid related side effects. Regional Anesthesia includes local anesthetic infiltration like bupivacaine or lidocaine at the surgical site, Transversus Abdominis Plane (TAP) Block and Erector Spinae Plane (ESP) Block [9-11]. Intraperitoneal Analgesia is administration of local anesthetics like bupivacaine into the peritoneal cavity [12]. Multimodal analgesia involves combination of different types of analgesia

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techniques mentioned above, which proves to lessen the side effects encountered by opioids. Patient-controlled Analgesia (PCA) enables patients to self-administer predetermined doses of analgesics usually opioids [13]. Non-Pharmacological techniques for pain management comprise of alteration in laparoscopy techniques like minimizing the size and number of incisions, using low pressure pneumoperitoneum, preemptive analgesia & Enhanced Recovery After surgery (ERAS) protocols including preoperative counseling, optimization of fluid management and early mobilization [14, 15].

The Transversus Abdominis Plane (TAP) block is a regional anesthesia technique used to provide pain relief to the anterior and lateral abdominal wall [16]. A local anesthetic is injected into the fascial plane between the internal oblique and transversus abdominis muscles. This blocks the sensory nerves (thoracolumbar nerves T6-L1) that supply the skin, muscles, and parietal peritoneum of the anterior abdominal wall [17, 18]. It can be performed using “double pop technique” or under ultrasound or laparoscopic guidance and it has been used in various abdominal surgeries including laparoscopic cholecystectomy, caesarean sections, hernia repair, percutaneous Nephrolithotomy and hernia repair [19, 20].

Adequate postoperative analgesia is essential for achieving successful outcomes of LC as persistent pain may delay patient mobilization, result in prolonged hospital stay and other hospital acquired infections. TAP block may be associated with improved postoperative patient outcomes and reduced side effects. Despite being a relatively safe procedure with significantly improved postoperative outcomes, it is still rarely performed during LC in local hospital settings. The rationale of our study was to determine the effectiveness of Transversus Abdominis Plane block in patients undergoing LC in our hospital setting and assist surgeons and anesthetists with evidence-based management of postoperative pain. As this study has not been conducted in this setting previously, so, the result of this study might modify the future practice of providing adequate analgesia in patients undergoing laparoscopic cholecystectomy.

MATERIALS AND METHODS

This study was conducted in Department of Surgery, Liaquat College of Medicine & Dentistry, Karachi, from 5th August 2025 to 4th February 2026 after the approval from institutional review board (Ref. No. IRB/M-

000133-25), dated: 4th August 2025. The study population consisted of 60 patients. Inclusion criteria consists of patients aged 18 – 60 years, of either gender, who were diagnosed with cholelithiasis and planned to undergo LC after obtaining written informed consent. Diagnosis of cholelithiasis was based on history of pain in right hypochondrium or epigastric region ($VAS \geq 4$) with presence of hyperechoic structures in gall bladder with distal acoustic shadowing on ultrasonography. Purposive consecutive sampling technique was used for sample selection. Exclusion criteria includes patients with ASA of ≥ 3 , those diagnosed with acute cholecystitis, empyema, mucocele or perforated gall bladder, those with BMI of $\geq 35 \text{ kg/m}^2$ or history of coagulation disorders like hemophilia and pregnant females. Group allocation was decided on whether TAP block was administered by the surgeon. Pain intensity was assessed at 12 hours postoperatively. This interval was selected to assess the immediate recovery phase and the duration of the TAP block's efficacy.

In Group A patients, after removal of gall bladder, a 10 ml solution consisting of bupivacaine 0.25% (4 ml), lidocaine 2% (2 ml) and 0.9% normal saline (4 ml) was injected. The operator inserts the needle along the anterior axillary line between the costal margin and iliac crest into the transversus abdominal plane between the internal oblique and transversus abdominal muscles unilaterally on right side under direct laparoscopic vision, by using 21-g spinal needle. Group B patients did not receive TAP block following LC. All patients received standardized perioperative analgesia. Intravenous paracetamol and NSAIDS were provided unless contraindicated. Postoperative pain assessment was performed using the Visual Analog Scale (VAS). The time for rescue analgesia was measured in hours and recorded from endotracheal extubation following LC to a pain score of $VAS > 4$.

Postoperative analgesia was administered to all patients i.e. IV Paracetamol 1 g every 8 hours. Rescue analgesia consisted of IV Tramadol 100 mg was administered when the VAS score exceeded 4 cm.

A standard 10 cm Visual Analogue Scale (VAS) was used to assess post-operative pain. This consists of a horizontal line from 0 cm (representing no pain) to 10 cm (representing worst pain). Pain intensity was marked by patient on this scale at 12 hours postoperatively. The distance from the 0 cm to the patient's mark was measured in centimeters and recorded for pain score statistical analysis.

STATISTICAL ANALYSIS

Findings were recorded in a predesigned proforma and data was analyzed by using IBM SPSS version 30. Mean $\pm$ SD was calculated for age, BMI, VAS score and time for rescue analgesia. Frequency and percentages were calculated for gender. Comparison between mean VAS Score and time for rescue analgesia among both groups was done using independent sample t-test with $p \leq 0.05$ considered significant.

In this study, surgeon led decisions lead to potential selection bias and limited external validity. Ward team being not aware of patients who were administered TAP block, reduced the potential for observation bias.

RESULTS

The Mean age of patients in this study was 46.15 ± 8.92 years. Mean age of patients in TAP block group was 46.07 ± 9.17 years while mean age of patients in non-TAP block group was 46.23 ± 8.8 years ($p = 0.945$). In this study, 73.3% patients were females while 26.7% patients were males. In TAP block group 70% patients were females

and 30% patients were males while in non-TAP block group 76.7% patients were females and 23.3% patients were males ($p = 0.262$). Mean duration of symptoms was 6.7 ± 5.4 months. Mean duration of symptoms in TAP block group was 5.43 ± 3.22 months while mean duration of symptoms in non-TAP block group was 7.97 ± 6.75 months ($p = 0.068$). Mean BMI of patients was 26.26 ± 3.18 kg/m². Mean BMI of patients in TAP block group was 26.19 ± 3.17 kg/m² while mean BMI of patients in non-TAP block group was 26.33 ± 3.25 kg/m² ($p = 0.866$). Table 1 compares the baseline and study variables among both groups. It also includes confidence interval and effect size. The test of normality used is Shapiro-Wilk test.

Mean VAS score in patients 12 hours after surgery was 4.47 ± 2.34 . Mean VAS score in TAP block patients 12 hours after surgery was 2.80 ± 1.54 while mean VAS score in non-TAP block patients 12 hours after surgery was 6.13 ± 1.73 ($p < 0.0001$). Mean time for rescue analgesia was 9.34 ± 6.89 hours. Mean time to rescue analgesia in TAP block group was 13.92 ± 6.74 hours while mean time to rescue analgesia in non-TAP block group was 4.77 ± 2.79 hours ($p < 0.0001$).

Table 1. Comparison of Baseline and Study Variables in Both Groups.

Variables	TAP Block	Non-TAP Block	p-value	Mean Difference (95% CI)	Effect Size (Cohen's d [95% CI])
Age (years)	46.07 ± 9.17	46.23 ± 8.8	0.945	-0.16 (-4.80 to 4.48)	-0.02 (-0.52 to 0.49)
Gender (Female)	70%	76.70%	0.262	—	—
Duration of Symptoms (months)	5.43 ± 3.22	7.97 ± 6.75	0.068	-2.54 (-5.30 to 0.22)	-0.48 (-1.00 to 0.04)
BMI (kg/m ²)	26.19 ± 3.17	26.33 ± 3.25	0.866	-0.14 (-1.80 to 1.52)	-0.04 (-0.55 to 0.46)
VAS Score	2.80 ± 1.54	6.13 ± 1.73	< 0.0001	-3.33 (-4.18 to -2.48)	-2.03 (-2.65 to -1.42)
Duration of Rescue Analgesia (hours)	13.92 ± 6.74	4.77 ± 2.79	< 0.0001	$+9.15$ (6.48 to 11.84)	$+1.77$ (1.18 to 2.36)

DISCUSSION

Laparoscopic cholecystectomy is a minimally-invasive technique for gall bladder removal, introduced to reduce surgical trauma associated with open cholecystectomy, reduce hospital stay and encourage early mobilization. The origin of pain following LC is multifactorial [21]. Port site incisions and trauma results in somatic pain while peritoneal irritation and gall bladder dissection results in visceral pain. Similarly, pneumoperitoneum created during LC causes diaphragm irritation which causes right shoulder pain. Patients undergoing LC still require effective postoperative analgesia and variety of

drugs and techniques have been introduced to manage postoperative pain [22, 23]. Meticulous management of pain in post-operative period is utmost for long term benefit of the patient. Suboptimal pain management in early postoperative period leads to delayed mobilization, require more opioid consumption, prolonged hospital stays and increased healthcare costs. Delayed mobilization increases complication risks for patients, including respiratory infections and deep vein thrombosis. It also lowers pain tolerance, which leads to higher opioid use, related side effects, and longer hospital stays. A referenced meta-analysis supports these findings.

The study was conducted to determine the efficacy of TAP block in reducing postoperative pain in patients undergoing LC. Mean age of participants in this study was 46.15 ± 8.92 years with mean age in TAP block group being 46.07 ± 9.17 years while mean age in non-TAP block group being 46.23 ± 8.8 years. This was similar to that reported in previous studies. In the study conducted by Emile *et al*, mean age of patients in TAP block group was 41.1 ± 11.8 years while in non-TAP block mean age was 40.4 ± 11.1 years [19]. In the study conducted by Saliminia *et al*, mean age of patients in TAP block group was 40.83 ± 12.14 years while in non-TAP block mean age was 45.63 ± 10.95 years [20]. In this study, 73.3% patients were females while 26.7% patients were males. In the study conducted by Emile *et al*, 90% patients were females which shows increased prevalence of cholelithiasis among female patients in 40s.

Mean BMI of patients in this study was 26.26 ± 3.18 kg/m² with mean BMI in TAP block group being 26.19 ± 3.17 kg/m² while mean BMI in non-TAP block group being 26.33 ± 3.25 kg/m². In the study conducted by Emile *et al*, mean BMI of patients in TAP block group was 29.9 ± 6.6 kg/m² while mean BMI in non-TAP block group was 30.5 ± 4.9 kg/m² [19]. This shows cholelithiasis is predominantly a disease of over-weight or obese patients which is a well-known risk factor.

In this study, TAP block was associated with significantly reduced mean VAS scores 12 hours after surgery (2.80 ± 1.54 versus 6.13 ± 1.73 with $p < 0.0001$). These findings were also consistent with those reported in studies conducted by Emile *et al*, (2.05 ± 0.7 versus 3.15 ± 1.1) and Saliminia *et al*, (0.9 ± 0.7 versus 2.4 ± 0.8) [19, 20]. These results can be explained in terms of anatomical and physiological basis of TAP block. As transversus abdominis plane lie between internal oblique and transversus abdominis muscles and contains thoracolumbar nerves which innervate anterior abdominal wall. Nociceptive transmission from these nerves following surgical incision and peritoneal irritation constitute the somatic component which contributes significantly to overall postoperative pain perception [24]. Deposition of local anesthetic in transversus abdominis plane effectively blocks nociceptive pain transmission, though it has minimal effect on visceral pain transmission [25]. Furthermore, reduction in pain intensity may also decrease central pain sensitization and visceral pain perception. The TAP block is cost-effective and feasible in resource constrained setting.

TAP block was associated with reduced requirement for rescue analgesia. The mean time for rescue analgesia (13.92 ± 6.74 hours versus 4.77 ± 2.79) was also similar to findings of Emile *et al*, (5.4 ± 1.0 versus 4.1 ± 1.15 hours). This shows that TAP block not only reduces pain intensity but also has prolonged analgesic effect resulting in potential reduction in and delayed requirement of systemic analgesics (opioids), reduce hospital stay and allow early mobilization, however, these findings have not been measured in this study. As transversus abdominis plane is relatively poorly vascularized, the deposition of local anesthetic in this fascial plane results in slow systemic absorption and extended duration of nerve blockage. This reduces postoperative opioid consumption which is significantly beneficial to patient as opioid consumption is associated with adverse effects like postoperative nausea and vomiting (PONV), respiratory depression and ileus.

LIMITATIONS

The study has certain limitations as it was a single-center study conducted within limited time frame and with small sample size. Moreover, the assessment of pain intensity was done using VAS score, which is widely accepted, is still a subjective tool which is influenced by individual pain perception thresholds. Additionally, clinically relevant ERAS outcomes like total opioid consumption, patient satisfaction, time to ambulation and duration of hospital stay were not assessed in this study which could have provided more insights into the benefits of TAP block. This study didn't assess the long-term effects of TAP block, had single pain assessment time point and was limited to early postoperative period. Future studies may focus on techniques and adjuvants to prolong block duration as well as comparison of TAP block to newer techniques like quadratus lumborum block. Studies may also assess the cost-effectiveness of routine use of TAP block for LC and its long-term pain outcomes.

Being a single-Centre study, it has some innate limitations, which includes lack of third-party randomization and surgeon led decisions leading to potential selection bias and limited external validity. Ward team, being not aware of patients who were administered TAP block, reduced the potential for observation bias.

CONCLUSION

The study concludes that Transversus Abdominis Plane block is an effective technique for postoperative analgesia in patients undergoing laparoscopic cholecystectomy

linked with lower pain scores and a prolonged time to rescue analgesia.

ABBREVIATIONS

LC: Laparoscopic Cholecystectomy.

TAP: Transversus Abdominal Plane.

VAS: Visual Analogue Scale.

AUTHORS' CONTRIBUTIONS

Sarah Rauf: Conceptualization, study design, methodology, data analysis and interpretation, and drafting the manuscript.

Asif Qureshi: Conceptualization, critical review and revision of the manuscript, and final approval of the version to be published.

Yabinda Sahrish: Critical review and revision of the manuscript.

Muhammad Sajid Naseem Khan: Critical review and revision of the manuscript.

All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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ETHICAL DECLARATIONS

Data Availability

The data supporting the findings of this study are included in the article. Further inquiries regarding the data may be directed to the corresponding author, subject to applicable ethical, privacy, and institutional requirements.

Ethical Approval

This study was conducted at the Department of Surgery, Liaquat College of Medicine & Dentistry, Karachi, Pakistan, from 5th August 2025 to 4th February 2026, following approval from the Institutional Review Board (Ref. No. IRB/M-000133-25; approved 4th August 2025).

Consent to Participate

Written informed consent was obtained from all patients prior to their participation in the study.

Consent for Publication

Not applicable. This article does not contain any individually identifiable patient information, images, or other material requiring consent for publication.

Declaration of Competing Interest

The authors declare that they have no known financial or non-financial competing interests that could have influenced the work reported in this study.

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Use of AI-Assisted Technology

The authors declare that no artificial intelligence (AI) or AI-assisted technologies were used in the conduct, analysis, interpretation, or writing of this research or manuscript.

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