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Original Research Article

Efficacy of Laparoscopic-Guided Transversus Abdominis Plane Block versus Standard Analgesia for Postoperative Pain Control in Laparoscopic Cholecystectomy

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Abstract: *The management of postoperative pain following laparoscopic cholecystectomy remains a clinical challenge. While systemic analgesics are routinely used, they may be associated with suboptimal relief and adverse effects. The laparoscopic-guided Transversus Abdominis Plane (TAP) block has emerged as a promising regional technique for effective postoperative analgesia.* ***Objectives:*** *To compare the efficacy of laparoscopic-guided TAP block versus standard systemic analgesia for postoperative pain control in patients undergoing laparoscopic cholecystectomy.* ***Methodology:*** *A prospective, randomized controlled trial conducted at the Department of Surgery Sheikh Zayed Hospital, Lahore, from March 2023 se April 2024. A total of 140 patients undergoing elective laparoscopic cholecystectomy were randomly divided into two equal groups: TAP block group (n=70) and standard analgesia group (n=70). The TAP block was administered under direct laparoscopic guidance at the end of surgery. Postoperative pain was assessed using the Visual Analogue Scale (VAS) at 2, 4, 8, 12, and 24 hours. Secondary outcomes included time to first analgesic request, total 24-hour tramadol consumption, frequency of rescue analgesia, and patient satisfaction.* ***Results:*** *VAS scores were significantly lower at all intervals in the TAP group ($p < 0.001$). The mean time to first analgesic request was longer (6.8 ± 2.5 vs 3.2 ± 1.7 hours), and tramadol consumption was lower (84.2 ± 21.4 mg vs 137.5 ± 30.8 mg) in the TAP group ($p < 0.001$). Patient satisfaction was also significantly higher ($p < 0.001$).* ***Conclusion:*** *Laparoscopic-guided TAP block provides superior postoperative analgesia, delays the need for rescue analgesics, reduces opioid use, and improves patient satisfaction compared to standard analgesia.*

Keywords: Analgesia, Cholecystectomy, Laparoscopic, Pain Management, Postoperative Pain, TAP Block, Tramadol

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Introduction

Laparoscopic cholecystectomy has become the gold standard for the treatment of symptomatic gallstone disease and other gallbladder pathologies due to its minimally invasive nature, shorter hospital stay, and faster recovery compared to open cholecystectomy. (1, 2) However, despite being less invasive, postoperative pain remains a significant concern, especially during the first 24 hours following surgery. (3) Pain after laparoscopic cholecystectomy arises from a combination of somatic and visceral sources, including incision sites, peritoneal irritation, and diaphragmatic stretching due to insufflation. (4) Effective management of this postoperative pain is essential for enhanced patient comfort, early mobilization, reduced hospital stay, and prevention of complications such as pulmonary dysfunction and deep vein thrombosis. (5)

Traditionally, standard postoperative analgesia relies heavily on systemic medications such as opioids and non-steroidal anti-inflammatory drugs (NSAIDs). While these medications can provide adequate pain relief, they are often associated with undesirable side effects, including nausea, vomiting, sedation, respiratory depression, and gastrointestinal irritation. (6, 7) These limitations have led to the increasing adoption of regional anesthesia techniques as part of a multimodal analgesic strategy to improve outcomes and minimize opioid use. (8)

One such technique is the transversus abdominis plane (TAP) block, which involves the injection of a local anesthetic into the fascial plane between the internal oblique and transversus abdominis muscles, thereby blocking the sensory nerves of the anterior abdominal wall. (9) The TAP block has gained popularity as a safe and effective method for providing postoperative analgesia in various lower abdominal surgeries, including laparoscopic cholecystectomy. It can be performed via ultrasound guidance or directly under laparoscopic visualization, offering a real-time, precise approach for anesthetic delivery. (10)

Laparoscopic-guided TAP block, in particular, has the advantage of being performed intraoperatively by the surgical team without the need for additional equipment or personnel. This approach has shown promising results in reducing pain scores, delaying the need for rescue analgesia, and decreasing overall opioid consumption in the postoperative period. (11, 12)

However, evidence comparing laparoscopic-guided TAP block with conventional systemic analgesia alone remains limited and somewhat inconsistent across different populations and healthcare settings. Therefore, this study aims to evaluate the efficacy of laparoscopic-guided TAP block in comparison with standard analgesia for postoperative pain control in patients undergoing laparoscopic cholecystectomy. By assessing pain scores, analgesic requirements, and patient satisfaction, we aim to determine whether this technique should be incorporated into routine clinical practice as a superior alternative or adjunct to standard postoperative analgesia.

Methodology

This prospective, randomized controlled trial was conducted at the Department of General Surgery, Sheikh Zayed Hospital, Lahore, from March 2023 se April 2024 after approval from the Institutional Ethical Review Board. A total of 140 patients aged between 18 and 65 years, of either gender, undergoing elective laparoscopic cholecystectomy for symptomatic cholelithiasis were included in the study after obtaining informed written consent. Patients with a history of chronic pain, opioid use, previous abdominal surgery, known allergy to local anesthetics, or any contraindication to regional blocks were excluded.

The sample size of 140 patients (70 in each group) was calculated using OpenEpi software with a 95% confidence interval, 80% power, and an expected mean difference of 1.5 in postoperative pain scores (based on previous literature), assuming a standard deviation of 2.5. (13)

Patients were randomly allocated into two equal groups using a computer-generated random number table. Group A received a laparoscopic-guided transversus abdominis plane (TAP) block at the end of surgery, while Group B received standard postoperative analgesia alone. In Group A, after completion of the cholecystectomy and prior to port site closure, the TAP block was administered bilaterally under direct laparoscopic vision. In Group A, a 50:50 mixture of 0.25% bupivacaine and 2% lidocaine was used for the TAP block. The total volume administered bilaterally ranged from 20 to 60 ml, adjusted according to patient body weight and safety limits. Group B did not receive the block but was given the same standard postoperative analgesic regimen. All patients were given general anesthesia using a standardized protocol. Postoperatively, both groups received intravenous paracetamol 1 gram every 8 hours and intravenous ketorolac 30 mg every 12 hours. Rescue analgesia with intravenous tramadol 50 mg was administered if the pain score exceeded 4 on the Visual Analogue Scale (VAS). Pain assessment was performed using the VAS at 2, 4, 8, 12, and 24 hours postoperatively. The total dose of rescue analgesia and time to first analgesic request were also recorded. Patient satisfaction was evaluated at 24 hours using a 5-point Likert scale.

Data were entered and analyzed using SPSS version 25. Quantitative variables such as age, pain scores, and analgesic consumption were presented as mean ± standard deviation, and compared using the independent sample t-test. Categorical variables were analyzed using the chi-square test. A p-value <0.05 was considered statistically significant.

Results

The baseline demographic and clinical characteristics of the 140 patients enrolled in the study were comparable between the two groups. The mean age in the TAP block group was 39.8 ± 11.5 years, while in the standard analgesia group it was 38.9 ± 10.7 years. The gender distribution was similar, with 22 males and 48 females in the TAP group and 24 males and 46 females in the standard group. The mean BMI was 26.3 ± 3.1 kg/m² in the TAP group and 26.7 ± 3.4 kg/m² in the standard group. ASA Grade I/II distribution was 45/25 in the TAP group and 43/27 in the standard group. The mean duration of surgery was also comparable at 52.6 ± 8.3 minutes for the TAP group and 53.4 ± 9.1 minutes for the standard group. None of these differences were statistically significant ($p > 0.05$), indicating that the groups were well-matched at baseline as given in table 1.

Pain scores assessed by the Visual Analogue Scale (VAS) were consistently lower in the TAP block group at all postoperative time intervals. At 2 hours postoperatively, the mean VAS score was 2.9 ± 1.1 in the TAP group compared to 4.6 ± 1.3 in the standard group. At 4 hours, the scores were 3.1 ± 1.2 versus 4.9 ± 1.4; at 8 hours, 2.7 ± 1.0 versus 4.3 ± 1.2; at 12 hours, 2.2 ± 1.1 versus 3.6 ± 1.3; and at 24 hours, 1.4 ± 0.9 versus 2.8 ± 1.1, all favoring the TAP group. The differences were statistically significant at all time points ($p < 0.001$) as given in table 2.

The mean time to first analgesic request was significantly longer in the TAP group at 6.8 ± 2.5 hours compared to 3.2 ± 1.7 hours in the standard analgesia group ($p < 0.001$). Additionally, the total consumption of rescue tramadol in 24 hours was significantly lower in the TAP group (84.2 ± 21.4 mg) as compared to the standard group (137.5 ± 30.8 mg), with a p-value < 0.001 as given in table 3.

Regarding the frequency of rescue analgesia, 20.0% of patients in the TAP group required no additional doses compared to only 2.9% in the standard group. One dose was required by 50.0% of TAP patients versus 14.3% in the standard group. In contrast, ≥3 doses were required by only 7.1% in the TAP group, while 45.7% in the standard group required three or more doses. These differences were statistically significant ($p < 0.001$) as given in table 4.

Patient satisfaction measured at 24 hours postoperatively showed higher satisfaction in the TAP group. Very satisfied responses were reported by 54.3% in the TAP group compared to 17.1% in the standard group. A satisfied rating was reported by 34.3% versus 40.0%, neutral by 8.6% versus 22.9%, and dissatisfied by 2.9% versus 14.3%, respectively. The overall difference in satisfaction was statistically significant ($p < 0.001$), with higher satisfaction in the TAP group as given in table 5.

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n = 140)

Variable	TAP Block Group (n = 70)	Standard Analgesia Group (n = 70)	p-value
Mean Age (years)	39.8 ± 11.5	38.9 ± 10.7	0.62
Gender			
Male	22 (31.42%)	24 (34.28%)	0.71
Female	48 (68.57%)	46 (65.7%)	
BMI (kg/m²)	26.3 ± 3.1	26.7 ± 3.4	0.48
ASA Grade I/II			
Grade I	45 (64.28%)	43 (61.42%)	0.69
Grade II	25 (35.71%)	27 (38.57%)	
Duration of Surgery (mins)	52.6 ± 8.3	53.4 ± 9.1	0.52

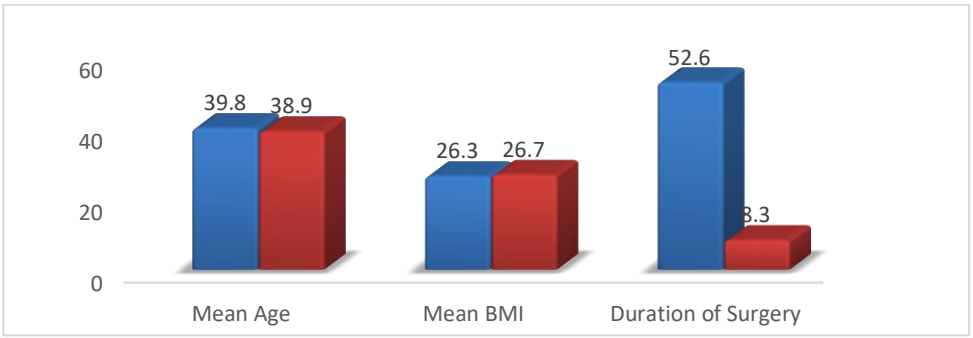

Figure 1: Baseline Demographic and Clinical Characteristics mean age, BMI & duration of surgery of Study Participants

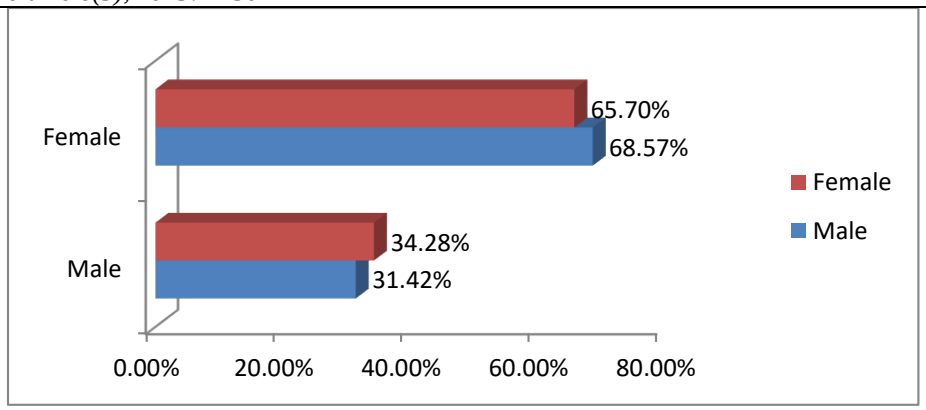

Figure 2: Baseline Demographic and Clinical Characteristics of age & gender Study Participants

Table 2: Mean Visual Analogue Scale (VAS) Scores at Various Postoperative Time Points

Time Post-Surgery	TAP Block Group	Standard Analgesia Group	p-value
2 hours	2.9 ± 1.1	4.6 ± 1.3	<0.001
4 hours	3.1 ± 1.2	4.9 ± 1.4	<0.001
8 hours	2.7 ± 1.0	4.3 ± 1.2	<0.001
12 hours	2.2 ± 1.1	3.6 ± 1.3	<0.001
24 hours	1.4 ± 0.9	2.8 ± 1.1	<0.001

Table 3: Time to First Analgesic Request and Total Tramadol Consumption

Variable	TAP Block Group (n = 70)	Standard Analgesia Group (n = 70)	p-value
Time to First Analgesic (hours)	6.8 ± 2.5	3.2 ± 1.7	<0.001
Total Tramadol Used (mg/24 hrs)	84.2 ± 21.4	137.5 ± 30.8	<0.001

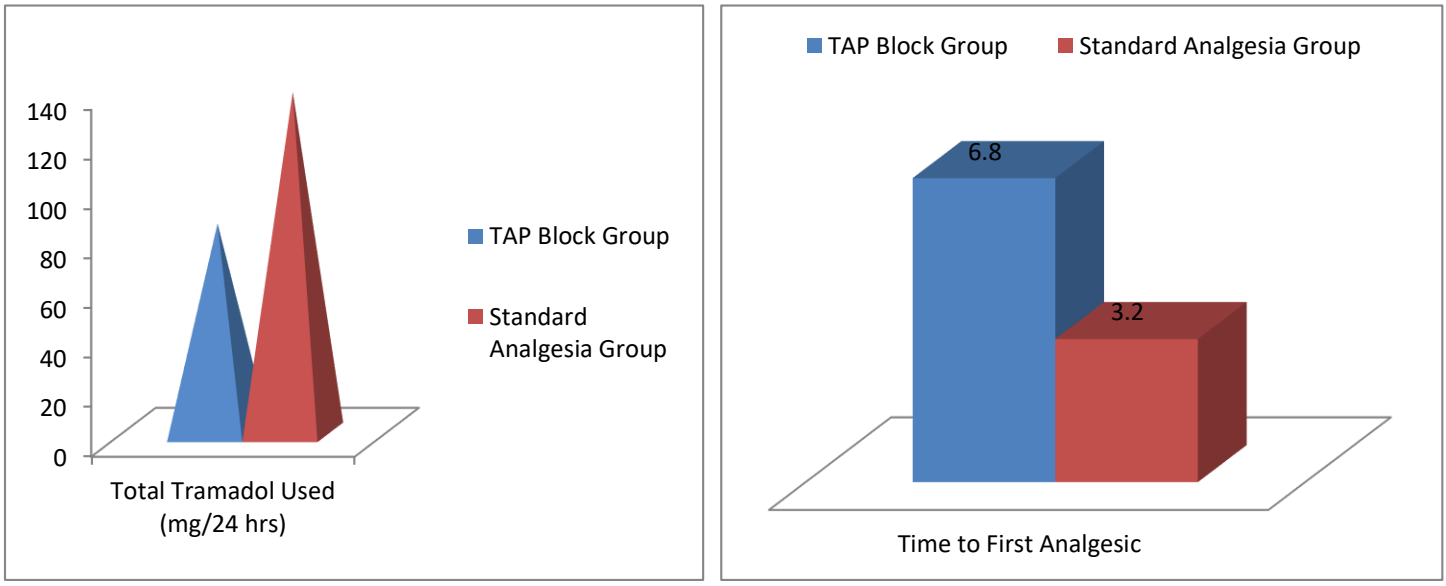

Figure 3: Mean Time to First Analgesic Request and Total Tramadol Consumption

Table 4: Frequency of Rescue Analgesia Use in 24 Hours

Number of Doses Required	TAP Block Group (n = 70)	Standard Analgesia Group (n = 70)	p-value
0 doses	14 (20.0%)	2 (2.9%)	<0.001
1 dose	35 (50.0%)	10 (14.3%)	
2 doses	16 (22.9%)	26 (37.1%)	
≥3 doses	5 (7.1%)	32 (45.7%)	

Table 5: Patient Satisfaction at 24 Hours Postoperatively (Likert Scale)

Satisfaction Level	TAP Block Group (n = 70)	Standard Analgesia Group (n = 70)	p-value
Very Satisfied	38 (54.3%)	12 (17.1%)	<0.001
Satisfied	24 (34.3%)	28 (40.0%)	
Neutral	6 (8.6%)	16 (22.9%)	
Dissatisfied	2 (2.9%)	10 (14.3%)	

Discussion

Laparoscopic cholecystectomy is the gold standard for managing symptomatic gallstones but is often associated with moderate postoperative pain. Effective pain control enhances recovery and reduces hospital stay. (14) Standard systemic analgesia may be inadequate or associated with opioid-related side effects. The Transversus Abdominis Plane (TAP) block targets nerves supplying the anterior abdominal wall. Laparoscopic-guided TAP block provides a precise and minimally invasive approach. (15) This study evaluates its efficacy compared to standard analgesia for postoperative pain relief.

The findings of our study demonstrated that laparoscopic-guided TAP block was significantly superior to standard analgesia for postoperative pain control in patients undergoing laparoscopic cholecystectomy. Visual Analogue Scale (VAS) scores at 2, 4, 8, 12, and 24 hours postoperatively were significantly lower in the TAP block group ($p < 0.001$). The mean time to first analgesic requirement was longer (6.8 ± 2.5 hours vs 3.2 ± 1.7 hours), and total 24-hour tramadol consumption was substantially reduced (84.2 ± 21.4 mg vs 137.5 ± 30.8 mg, $p < 0.001$), aligning with previously reported literature. Rajanbabu et al. (2019) similarly found significantly lower pain scores up to 24 hours ($p < 0.001$) and reduced rescue analgesic usage in TAP block recipients, reinforcing the efficacy of TAP block in providing extended analgesia. (16) Our findings also mirrored those of Tihan et al. (2016), who reported a 24-hour median VAS score of 2 (±1–3) in the TAP block group versus 3 (±2–5) in the control group, with a significant difference ($p = 0.001$). (13) Notably, like in our study, Tihan et al. emphasized the procedural safety and reduced risk of visceral injury with laparoscopic guidance. (13)

Khoja et al. (2021) also documented a consistent pattern of lower VAS scores in the TAP group at all postoperative intervals, with $p < 0.0001$, corroborating our results across all measured time points. Hasnain et al. (2025) compared ESP and TAP blocks, showing longer analgesia duration in ESP (238.5 ± 5.1 min) versus TAP (174.1 ± 6.0 min, $p = 0.0001$); however, TAP still showed significant analgesic benefits compared to conventional methods, supporting its clinical value, though ESP might offer a marginally longer duration. (17, 18) Our results also resonated with Ismail et al. (2023), who reported lower rescue tramadol use in TAP (median 15 mg) compared to control (30 mg, $p = 0.035$), and lower percentage of patients with NRS >4 in TAP (46.5%) vs control (72%, $p = 0.034$), closely matching our findings of reduced analgesic demand and improved patient comfort. (19) Chauhdry et al. (2025) demonstrated mean NRS of 2.4 ± 0.9 in the TAP group versus 3.8 ± 0.8 in the diclofenac group at 2 hours ($p < 0.001$), and 20% versus 60% rescue analgesia requirement ($p = 0.003$), again supporting the significant early analgesic benefit of TAP block. (20)

Hassan et al. (2022) observed a lower mean VAS of 3.69 ± 1.21 in the TAP group compared to 4.26 ± 1.29 in the periportal local anesthesia group ($p = 0.033$), further validating TAP block's superiority in postoperative pain mitigation. (21) Thus, our findings are consistent with multiple randomized trials and controlled comparisons, confirming the superior pain relief profile, delayed rescue analgesia requirement, and reduced opioid use associated with laparoscopic-guided TAP block in patients undergoing laparoscopic cholecystectomy.

The study had a randomized design and equal group sizes, enhancing comparability. Standardized surgical and anesthetic protocols minimized procedural variability. Objective pain scoring at multiple intervals strengthened result reliability. However, the study was single-centered, limiting generalizability. Blinding of patients and assessors was not feasible, introducing potential bias. Long-term pain and recovery outcomes were not assessed.

Conclusion

Laparoscopic-guided TAP block was significantly more effective than standard analgesia in controlling postoperative pain. It delayed the need for rescue analgesia, reduced opioid consumption, and improved patient satisfaction. TAP block should be considered a valuable component of multimodal analgesia in laparoscopic cholecystectomy.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-MMS-033-24)
Consent for publication
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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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ZJ (Trainee Registrar)
Conception of Study, Development of Research Methodology Design,
SG (Trainee Registrar)
Study Design, manuscript review, critical input.
MK (House Officer),
Manuscript drafting, Study Design,
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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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