Section: Anaesthesia

Original Research Article

PROSPECTIVE RANDOMIZED CLINICAL STUDY TO COMPARE THE EFFICACY OF USG GUIDED QUADRATUS LUMBORUM BLOCK AND USG GUIDED TRANSVERSE ABDOMINIS PLANE BLOCK FOR POST-OPERATIVE ANALGESIA AND TO EVALUATE THE TOTAL POST-OPERATIVE ANALGESIC CONSUMPTION IN LOWER ABDOMINAL SURGERIES

K. Koushik[1], S. Chitra Devi[2], M.Muthuselvan[1]

[1]Assistant Professor, Department of Anaesthesiology, Government Vellore Medical College, Tamilnadu, India
[2]Associate Professor, Department of Emergency Medicine, Government Vellore Medical College, Tamilnadu, India

Received : *10/11/2025*
Received in revised form : *28/12/2025*
Accepted : *13/01/2026*

Keywords:
Analgesia; Hysterectomy; Nerve Block; Pain Management; Ultrasonography.

Corresponding Author:
Dr. K. Koushik,
Email: kkoushikmbbs92@gmail.com

DOI: 10.47009/jamp.2026.8.1.82

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

Int J Acad Med Pharm
2026; 8 (1); 432-437

ABSTRACT

Background: Effective postoperative analgesia is essential after total abdominal hysterectomy (TAH). The quadratus lumborum (QL) block may provide broader and longer analgesia than the transversus abdominis plane (TAP) block. This study aimed to compare the postoperative analgesic efficacy of ultrasound-guided TAP and QL blocks in women undergoing TAH under spinal anaesthesia. **Materials and Methods:** This prospective randomised study was conducted at a tertiary-care teaching hospital and included women aged 30–70 years with ASA physical status I–III undergoing elective TAH. Sixty patients were randomised to receive bilateral TAP (Group T) or QL (Group Q) blocks following surgery. Standardised spinal anaesthesia was administered to all participants. Postoperative pain scores (VAS), time to first rescue analgesia, tramadol consumption, hemodynamic parameters, and complications were recorded over 24 hours. Group differences were analysed using independent t-tests and chi-square tests. **Result:** Baseline age distribution was comparable between groups ($p = 0.212$). Group Q demonstrated a longer duration to first rescue analgesia (687.67 ± 109.8 vs 578.50 ± 115.8 minutes; $p < 0.001$) and reduced total tramadol requirement (140.00 ± 56.32 vs 220.00 ± 55.09 mg; $p < 0.001$). A single tramadol dose sufficed for 63.3% of Group Q, whereas most Group T patients required two or three doses ($p < 0.001$). VAS scores were significantly lower in Group Q at 2, 4, 8, and 24 hours ($p < 0.05$). Hemodynamic parameters (HR, SBP, DBP, SpO_2) and complication rates were comparable across groups ($p > 0.05$). **Conclusion:** The ultrasound-guided QL block provides superior postoperative analgesia compared with the TAP block in women undergoing TAH under spinal anaesthesia, offering prolonged pain relief, reduced opioid consumption, and comparable safety.

INTRODUCTION

Management of postoperative pain is important for the patients' recovery after lower abdominal surgeries such as total abdominal hysterectomy (TAH). The pain associated with these surgeries is often moderate to severe and may persist in some patients even with standard postoperative management.[1] Most women experience at least moderate pain after TAH, and it is estimated that about 45% patients report severe postoperative pain, and 21% report mild pain.[2] Poorly controlled pain delays mobilisation, increases opioid requirements, causes chronic postsurgical pain, increases the risk of venous thrombosis and results in patient dissatisfaction.[1] Enhanced Recovery After Surgery (ERAS) protocols involve opioid-sparing analgesia, combining systemic non-opioid drugs with regional techniques to improve analgesic effect and shorten hospital stay.[3] In gynaecologic surgery, ERAS and ACOG highlight the use of transversus abdominis plane (TAP) block and neuraxial techniques as components of multimodal analgesic regimens for abdominal hysterectomy.[4] The gold standard for perioperative pain control is epidural analgesia; their

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

use is limited as they have a risk of hypotension, motor block, and urinary retention, thus making clinicians choose a safer option like peripheral fascial plane blocks.[5]

The pain associated with lower abdominal surgeries primarily increases from the incision of the abdominal wall, which includes skin, muscle, and peritoneal layers. TAP block targets the anterior rami of T6–L1 within the fascial plane between the internal oblique and transversus abdominis, providing reliable somatic analgesia of the anterolateral abdominal wall.[6] TAP block has been reported to decrease postoperative opioid consumption and improve pain scores in hysterectomy patients.[7] However, its effect on visceral pain is limited, which might be a reason for the residual pain even after adequate blocks.[6,7]

The quadratus lumborum (QL) block is a newly introduced posterior abdominal wall block in which local anaesthetic is deposited adjacent to the QL muscle and thoracolumbar fascia. This allows cranial spread toward the thoracic paravertebral space, thus blocking both somatic and visceral afferents from T4–L1.[8] QL block provides wider dermatomal coverage, longer duration of analgesia, and better visceral pain relief than TAP block, with reduced postoperative nausea and vomiting.[9] A meta-analysis comparing the QL and TAP blocks in abdominal surgery shows lower opioid consumption, lower pain scores, and prolonged time to first rescue analgesia with the QL block.[10] QL block has also been associated with earlier mobilisation and shorter hospital stay.[11]

Many studies involve heterogeneous abdominal procedures that are performed under general anaesthesia, or done with non-Indian populations, thereby limiting generalizability to women undergoing TAH under spinal anaesthesia in India. Hence, there is a lack of prospective randomised Indian studies directly comparing ultrasound-guided TAP and QL blocks for TAH with standardised dosing, outcome measures, and using an ERAS-oriented, opioid-sparing method. Therefore, this study aimed to compare the postoperative analgesic efficacy and analgesic consumption between USG-guided TAP block and USG-guided QL block in patients undergoing TAH under spinal anaesthesia. The objectives were to assess total analgesic consumption in the first 24 hours and the time to first analgesic request, and to evaluate postoperative pain intensity using Visual Analogue Scale (VAS) scores at 0, 2, 4, 6, 8, 12, and 24 hours.

MATERIALS AND METHODS

This prospective, randomised study was carried out in the Department of Anaesthesia at Thanjavur Medical College and Hospital, Thanjavur, from December 2022 to January 2024. Ethical clearance was granted by the Institutional Ethics Committee, and written informed consent was secured from every patient enrolled in the study.

Inclusion and exclusion criteria

Female patients aged 30–70 years with ASA physical status I–III scheduled for elective TAH were included.

Patients who refused participation, if surgery exceeded two hours, if they had severe cardiovascular, renal, respiratory or hepatic disease, coagulopathy, or if spinal anaesthesia was converted to general anaesthesia intraoperatively were excluded.

Sample size calculation: Sample size was calculated using the OpenEpi online sample size calculator, based on the study by Khanna et al., taking the mean VAS scores of the two groups at 16 hours post-surgery as reference.12 Using these values, the minimum required sample size was 44 patients. To account for probable dropouts and missing data, the sample size was increased by 20%, resulting in 52.8, and rounded off to a final target of 60 patients, with 30 patients in each group.

Methods: A total of 60 patients meeting the inclusion criteria were randomised equally into Group T and Group Q (n = 30 each) using a closed-cover allocation method. All patients received standard monitoring (NIBP, ECG, SpO_2), IV access, and spinal anaesthesia with 3 ml of 0.5% hyperbaric bupivacaine and 25 µg fentanyl at the L3–L4 interspace using a 25G Quincke needle. Surgery commenced after achieving a T6 sensory level, and hypotension (>20% fall in MAP) was treated with 6 mg ephedrine.

At the end of surgery, after regression to the T10 level, Group T received bilateral TAP blocks in the supine position under ultrasound guidance, with local anaesthetic deposited between the internal oblique and transversus abdominis muscles (20 ml of 0.25% bupivacaine with 2 mg dexamethasone per side).

Group Q received ultrasound-guided posterior Type-2 quadratus lumborum blocks in the lateral position. The probe was positioned along the mid-axillary line and advanced posteriorly to visualise the lumbar interfascial triangle and quadratus lumborum muscle. Local anaesthetic (20 ml of 0.25% bupivacaine with 2 mg dexamethasone) was injected into the thoracolumbar fascial plane on each side using an in-plane approach. The phrase “allowing free probe movement” was replaced with a clear description of probe placement and adjustment for optimal visualisation.

Postoperatively, patients were monitored for 30 minutes and then transferred to the ward, where HR, SBP, DBP, SpO_2, and VAS scores at 0, 1, 2, 4, 8, 12, and 24 hours were recorded. Patients reporting VAS ≥ 4 received intramuscular tramadol (2 mg/kg). Time to first rescue analgesia, total 24-hour analgesic use, and any complications (nausea, vomiting, headache) were documented. All data were entered into a secure electronic database for analysis.

Statistical analysis: Data analysis using standard descriptive and inferential statistics. Continuous

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

variables were presented as mean ± standard deviation and compared using the independent samples t-test, while categorical variables were assessed with the chi-square test. Changes over time and intergroup were examined using repeated measures ANOVA in SPSS v26. A p-value < 0.05 was considered statistically significant.

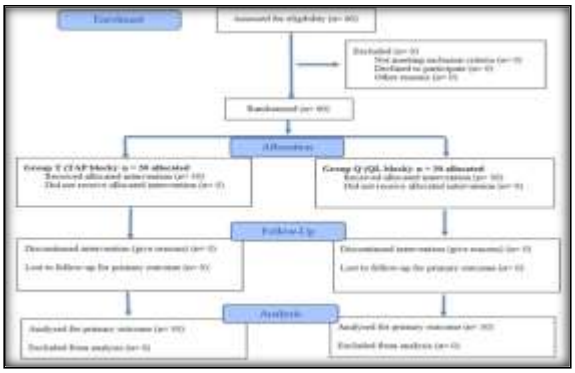

Figure 1: Consort flow diagram

RESULTS

A total of 60 met the eligibility criteria and were enrolled. All 60 participants were randomised equally into Group Q and Group T (n = 30 each), with no dropouts or protocol deviations. The age distribution between group Q and group T was comparable, with no significant difference (p = 0.212). [Table 1].

Group Q took significantly longer duration before requiring first rescue analgesia (687.67 ± 109.8 vs. 578.50 ± 115.8 minutes, p < 0.001). Total tramadol consumption was also lower in group Q (140.00 ± 56.32 vs. 220.00 ± 55.09 mg, p < 0.001). Regarding the number of tramadol doses, 63.3% of group Q required only one dose, while most of the group T required two doses (60%) and three doses (30%) (p < 0.001) [Table 2].

Table 1: Baseline demographic characteristics

Parameters		Group Q	Group T	p-value
Age group	31–40 years	3 (10%)	5 (16.7%)	0.212
	41–50 years	18 (60%)	22 (73.3%)	
	51–60 years	7 (23.3%)	3 (10%)	
	>60 years	2 (6.7%)	0	
Weight (kg)		54.40 ± 3.78	55.37 ± 4.22	0.306

Table 2: Postoperative analgesic requirements between groups

Parameters		Group Q	Group T	p-value
Mean duration for 1st rescue analgesia or tramadol (min)		687.67 ± 109.8	578.50 ± 115.8	< 0.001
Mean dose of tramadol (mg)		140.00 ± 56.32	220.00 ± 55.09	< 0.001
Number of tramadol doses	One dose (100 mg)	19 (63.3%)	3 (10.0%)	< 0.001
	Two doses (200 mg)	10 (33.3%)	18 (60.0%)	
	Three doses (300 mg)	1 (3.3%)	9 (30.0%)	

Post-operative VAS scores were significantly lower in group Q than in group T at all time points (p < 0.05) except for the 6th and 12th hours, where they were comparable (p > 0.05). Complication rates were comparable between Q and T groups, with headache occurring in 6.6 vs 3.3% (p = 0.555), vomiting in 6.6 vs 13.3% (p = 0.389), and nausea in 3.3 vs 0% (p = 0.312) [Table 3].

Table 3: Postoperative pain scores and complications

Parameters		Group Q	Group T	p-value
VAS scores	0 hrs	0 ± 0	0 ± 0	–
	2 hrs	0.9 ± 1.0	1.9 ± 0.5	<0.001
	4 hrs	1.8 ± 0.6	2.1 ± 0.3	0.031
	6 hrs	2.1 ± 0.3	2.2 ± 0.4	0.133
	8 hrs	2.1 ± 0.4	2.8 ± 0.9	0.001
	12 hrs	3.5 ± 0.8	3.0 ± 0.9	0.055
	24 hrs	3.4 ± 0.6	4.2 ± 0.9	0.001
Complications	Headache	2 (6.6%)	1 (3.3%)	0.555
	Vomiting	2 (6.6%)	4 (13.3%)	0.389
	Nausea	1 (3.3%)	0 (0%)	0.312

Heart rate remained comparable between the two groups at all time points, with no significant differences (p > 0.05). SBP and DBP showed no significant variation between group Q and group T across all measurements (p > 0.05). Median SpO2 remained consistently at 99% in both groups at all time intervals, with no significant differences (p > 0.05) [Table 4].

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Table 4: Hemodynamic parameters and oxygen saturation measurements

Parameters	Time	Group Q	Group T	p-value
HR (bpm)	Baseline	85.3 ± 10.0	87.8 ± 7.3	0.288
	5 min	86.5 ± 8.8	82.1 ± 21.3	0.306
	10 min	86.1 ± 8.6	85.7 ± 16.2	0.905
	15 min	84.7 ± 7.7	87.2 ± 5.3	0.142
	30 min	84.6 ± 6.9	86.9 ± 5.2	0.157
SBP (mm/Hg)	Baseline	124.5 ± 8.8	121.7 ± 9.2	0.233
	5 min	121.9 ± 7.1	120.7 ± 10.0	0.615
	10 min	121.4 ± 7.1	120.9 ± 8.5	0.793
	15 min	123.0 ± 7.0	121.8 ± 8.1	0.541
	30 min	122.9 ± 6.9	121.5 ± 8.1	0.485
DBP (mm/Hg)	Baseline	77.2 ± 7.4	74.5 ± 5.5	0.119
	5 min	74.9 ± 7.7	74.1 ± 6.0	0.684
	10 min	75.1 ± 7.4	75.4 ± 5.7	0.861
	15 min	76.1 ± 6.2	75.0 ± 6.8	0.527
	30 min	75.1 ± 6.8	75.5 ± 4.8	0.793
Median SpO2 (%)	Baseline	99	99	0.418
	5 min	99	99	0.492
	10 min	99	99	0.183
	15 min	99	99	0.979
	30 min	99	99	0.722

HR: heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; SpO_2: oxygen saturation; VAS: Visual Analogue Scale.

VAS scores showed a change over time ($F = 1056.3$, $p < 0.001$) and a lower VAS score in group Q ($F = 2694.1$, $p < 0.001$). HR showed no significant change over time ($F = 0.532$, $p = 0.713$), but Group Q showed stable HR values ($F = 6546.2$, $p < 0.001$). SBP varied over time ($F = 4.601$, $p = 0.003$), and the group Q had a stable SBP ($F = 4{,}466{,}420$, $p < 0.001$). DBP did not show changes over time ($F = 2.473$, $p = 0.055$), but the DBP was stable in group Q ($F = 10{,}080$, $p < 0.001$) [Table 5].

Table 5: Pain and hemodynamic variables by repeated measures ANOVA

Parameters	Repeated Measures ANOVA	Wilk's Lambda F-Value	df	p-value
VAS	Variability over time	1056.3	654	<0.001
	Difference between groups	2694.1	159	<0.001
HR	Variability over time	0.532	456	0.713
	Difference between groups	6546.2	159	<0.001
SBP	Variability over time	4.601	456	0.003
	Difference between groups	4466420	159	<0.001
DBP	Variability over time	2.473	456	0.055
	Difference between groups	10080	159	<0.001

HR: heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; SpO_2: oxygen saturation; VAS: Visual Analogue Scale.

DISCUSSION

Ultrasound-guided QL and TAP blocks are commonly used regional anaesthesia techniques to improve postoperative pain control after lower abdominal surgeries. This study compared the analgesic efficacy, opioid requirements, and safety profiles of QL and TAP blocks administered under spinal anaesthesia. Patients receiving QL block achieved more prolonged postoperative analgesia, required fewer rescue analgesics, and reported lower pain scores at most time intervals. Hemodynamic variables remained most stable in the QL group, and postoperative complications were minimal and comparable.

The age and the mean weight distribution between group Q and group T were comparable, with no significant difference. Similarly, Yousef observed a comparable distribution of age and weight between the groups with no significance (50.70 ± 6.8 years and 72.23 ± 6.37 kg vs. 56.5 ± 6.97 years and 71.23 ± 7.22 kg).[13] Vaghela et al. also analysed 64 patients and reported that the age and weight distribution of the patients were similar, with no significant difference ($p > 0.05$).[14] These findings indicate that most women undergoing TAH belong to the middle-aged category, thus they are at risk of such conditions.

Group Q took significantly longer duration before requiring first rescue analgesia (687.67 ± 109.8 vs. 578.50 ± 115.8 minutes, $p < 0.001$). Total tramadol consumption was also lower in group Q (140.00 ± 56.32 vs. 220.00 ± 55.09 mg, $p < 0.001$). Regarding the number of tramadol doses, 63.3% of group Q required only one dose, while most of the group T required two doses (60%) and three doses (30%) ($p < 0.001$). Yousef reported that the number of patients who required rescue analgesia was lower in the QL group compared to the TAP group ($p = 0.017$). Total amount of intraoperatively used fentanyl for the patients of the TAP group was significantly higher than the QL group ($p = 0.001$).[13] Further supporting our findings, a meta-analysis by Wang et al. reports that the duration of postoperative anaesthesia and the

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

patients requiring it are higher among the patients of the TAPB group.[15] Our findings are similar to the previous studies, and indicate that QL block showes better postoperative analgesic efficacy compared with the TAP block in patients undergoing TAH under spinal anaesthesia. QL block increases the time needed for rescue analgesics, and it reduces the required doses of postoperative analgesics.

In our study, post-operative VAS scores were significantly lower in group Q than in group T at all time, but were comparable for the 6th and 12th hours. Complications such as headache, vomiting and nausea were low and were comparable between Q and T groups. Similarly, Wang et al. analysed 13 studies and reported that the postoperative VAS score at the 24th hour was significantly higher in the TAPB group compared to the QLB group ($p = 0.008$). A total of 5 studies that postoperative dizziness was higher in the TAPB group, while there was no significant difference in complications between the groups.[15] Kumar et al. observed that the group receiving QL blocks had significantly lower VAS scores at the 1st-16th postoperative hours compared to the group receiving TAP block.[16] Though complications are less reported in these studies, QL block and TAP block may be comparable in postoperative complications like dizziness, nausea and vomiting. However, the VAS scores reported by the patients receiving QL block are low at most time points compared TAP block.

In our study, HR, SBP, DBP, and SpO2 showed no significant differences at any time point ($p > 0.05$). VAS scores and SBP changed significantly over time; all these parameters, along with HR and DBP, remained significantly stable in group Q ($p < 0.05$). Vaghela et al. observed that the VAS scores, mean blood pressure, and the HR were comparable initially, but they became significantly higher in the TAP group during the 12th, 18th, and 24th hours postoperatively.[14] Ghandhi et al. concluded that QL block provided better analgesic effect with opioid consumption compared to the TAP block, but with similar stable hemodynamic parameters observed in the TAP block group.[17] The hemodynamic parameters observed across the studies comparing QL and TAP block are not comparable; however, all those previous studies and ours indicate that both block techniques are equally safe, but the QL block has a better analgesic effect.

Differences observed between our findings and earlier studies may show variations in block technique, local anaesthetic spread, operator experience, and postoperative analgesic protocols. The posterior QL approach permits wider cranial spread into the thoracic paravertebral space, potentially explaining its more consistent visceral and somatic analgesia compared with the more restricted distribution of TAP block. These anatomical and methodological differences likely contribute to the superior analgesic duration observed with QL block. Therefore, QL block as an effective regional analgesic technique for patients undergoing TAH under spinal anaesthesia. The QL block provided longer-lasting pain relief, reduced analgesic consumption, and lower pain scores compared with the TAP block, while maintaining stable haemodynamics. We recommend using the QL block as a dependable and opioid-sparing multimodal postoperative analgesia for lower abdominal surgeries.

A major strength of this study is its prospective randomised design with standardised anaesthetic protocols and outcome measurements. The use of uniform VAS-based analgesic criteria, consistent postoperative monitoring, and ultrasound-guided techniques enhances internal validity. The exclusive inclusion of TAH patients under spinal anaesthesia also reduces clinical heterogeneity.

Limitations

The study was conducted at a single institution, which may affect the generalizability of the findings to settings with different patient profiles or clinical practices. Outcomes were assessed only within the initial 24-hour postoperative period, leaving longer-term pain patterns and recovery outcomes unexplored. Minor variations in block administration could have affect the analgesic effectiveness. Pain evaluation depends on subjective VAS scoring, which can be affected by individual tolerance, expectations, and psychological factors. Certain patient groups, such obesity, severe cardiovascular disease, or chronic pain, were excluded, which limiting the applicability to broader populations. Unmeasured variables, including preoperative anxiety, prior analgesic use, or intraoperative factors, may have affect the results. Future studies should examine long-term outcomes, include multicentre cohorts, and evaluate different QL block variants.

CONCLUSION

The ultrasound-guided QL block showed significantly better postoperative analgesia compared with the TAP block in patients undergoing TAH under spinal anaesthesia. The QL block provided a longer duration of first rescue analgesia, lower total tramadol consumption, and lower pain scores across most postoperative time points. Both techniques were safe, with stable hemodynamic parameters and minimal, comparable complication rates. The findings support the QL block as a more effective and opioid-sparing regional anaesthesia technique for lower abdominal surgeries, with enhanced pain control and improved postoperative recovery. Including the QL block into multimodal analgesic protocols may contribute to better pain control, reduced opioid requirements, and increased patient satisfaction.

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