

# Quadratus Lumborum Block versus Transversus Abdominis Plane Block for Postoperative Analgesia in Inguinal Hernia Surgery: A Comparative Study

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## ABSTRACT

**Background:** Postoperative pain following inguinal hernia surgery can affect early recovery and patient satisfaction. Ultrasound-guided quadratus lumborum (QL) block may provide broader and more prolonged analgesia than transversus abdominis plane (TAP) block. This study compared the postoperative analgesic efficacy of lateral QL block and TAP block in patients undergoing inguinal hernia surgery. **Methods:** This prospective, randomized, parallel-group, investigator-blinded study included 100 adult patients (ASA I–II) aged 25–60 years undergoing inguinal hernia repair under spinal anaesthesia. Patients were randomly allocated to receive either unilateral QL block or unilateral lateral TAP block, with 20 mL of 0.25% bupivacaine administered on each side. Postoperative pain was assessed using the Visual Analogue Scale (VAS) at predefined intervals for 24 hours. Duration of sensory blockade, time to first analgesic request, rescue analgesic requirement, patient satisfaction, haemodynamic parameters, and postoperative complications were also recorded. **Results:** Baseline demographic and clinical characteristics were comparable between the groups. The duration of sensory blockade was significantly longer in the QL group than in the TAP group ( $10.94 \pm 0.74$  vs  $6.26 \pm 1.24$  hours;  $p < 0.001$ ). The time to first analgesic request was also significantly longer with QL block ( $7.42 \pm 0.61$  vs  $4.21 \pm 0.60$  hours;  $p < 0.001$ ). The QL group required significantly fewer rescue analgesics ( $0.74 \pm 0.75$  vs  $1.98 \pm 0.86$ ;  $p < 0.0001$ ). From 6 hours onward, postoperative VAS scores were significantly lower in the QL group, with particularly marked differences at 8, 12, and 24 hours ( $p < 0.001$ ). Patient satisfaction was higher in the QL group (98% vs 68%;  $p < 0.001$ ). Postoperative complications were also less frequent in the QL group (4% vs 48%;  $p < 0.001$ ). Haemodynamic parameters remained relatively stable in both groups. **Conclusion:** Lateral QL block provided more prolonged postoperative analgesia than posterior TAP block in patients undergoing inguinal hernia surgery, with delayed rescue analgesic requirement, reduced analgesic consumption, lower late postoperative pain scores, and greater patient satisfaction.

**Keywords:** Quadratus lumborum block; transversus abdominis plane block; inguinal hernia; postoperative analgesia; Visual Analogue Scale; regional anaesthesia.

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## INTRODUCTION

Laparoscopic repair has become an established approach for the management of inguinal hernia and is associated with several perioperative benefits, including reduced postoperative discomfort and shorter hospital stay compared with conventional open techniques [1]. Among the laparoscopic approaches, transabdominal preperitoneal (TAPP) repair involves entry into the peritoneal cavity followed by placement of a mesh in the preperitoneal space. The procedure may produce both somatic and visceral components of postoperative pain, and immediate postoperative pain may be more prominent following TAPP than totally extraperitoneal repair [2]. Effective perioperative analgesia is therefore important, as inadequately controlled acute postoperative pain can

delay recovery and may contribute to the development of persistent postsurgical pain [3].

Regional anaesthetic techniques are an important component of multimodal analgesia for abdominal surgery. The transversus abdominis plane (TAP) block is widely used for postoperative analgesia and has been shown in clinical trials and systematic reviews to reduce postoperative pain and opioid requirements following inguinal hernia surgery [4,5]. However, conventional TAP block primarily provides somatic analgesia by depositing local anaesthetic within the fascial plane containing the thoracoabdominal nerves and has limited ability to address visceral pain [6].

Different approaches to TAP block have been described, with evidence suggesting that the lateral approach may provide more prolonged or extensive

analgesia [7]. The quadratus lumborum (QL) block has subsequently gained attention because of its potentially wider sensory distribution and ability to provide both somatic and visceral analgesia. Compared with TAP block, QL block has been reported to produce more extensive spread toward the thoracolumbar region, with proposed involvement of the paravertebral space [8,9].

Among the various QL block techniques, the lateral approach (LAT-QL) involves deposition of local anaesthetic between the quadratus lumborum and transversus abdominis muscle aponeurosis. This approach has been associated with extensive cranial spread of local anaesthetic and sensory blockade involving multiple thoracic and lumbar dermatomes [8-10]. Cadaveric investigations have demonstrated spread of injectate toward the thoracic paravertebral region, providing an anatomical basis for the broader analgesic effect attributed to LAT-QL block [9]. Volunteer studies have also demonstrated sensory blockade extending to higher thoracic dermatomes following LAT-QL block [10].

The proposed mechanism for the prolonged analgesic effect of LAT-QL block involves spread of local anaesthetic along the thoracolumbar fascia and potentially into the thoracic paravertebral region. This may result in blockade of both somatic and visceral afferent pathways and consequently provide more comprehensive analgesia than techniques limited predominantly to the abdominal wall [9]. LAT-QL block has been successfully incorporated into multimodal analgesic regimens for various abdominal and lower-limb procedures, with studies reporting reduced postoperative opioid consumption and prolonged time to first analgesic request [11,12].

In contrast, the analgesic effect of TAP block is predominantly directed toward the somatic component of abdominal wall pain, with relatively limited visceral analgesic coverage [6]. Given that TAPP repair involves manipulation of both the abdominal wall and peritoneal structures, a block capable of providing broader somatic and visceral analgesia may offer potential advantages.

Although both techniques are used for postoperative analgesia in laparoscopic inguinal hernia surgery, the relative efficacy of unilateral Lateral QL block compared with lateral TAP block remains an area of clinical interest. Therefore, the present study was undertaken to compare these two regional anaesthetic techniques in adults undergoing TAPP repair of inguinal hernia, with particular emphasis on postoperative pain, duration of analgesia, rescue analgesic requirement, haemodynamic parameters, complications and patient satisfaction.

## Materials and Methods

### Study design and participants

This prospective, randomized, parallel-group, investigator-blinded study was conducted at a tertiary care hospital in tertiary care institute of Maharashtra India between November 2023 and

April 2025. Approval was obtained from the Institutional Ethics Committee before commencement of the study (IEC no.). The study was conducted in accordance with the principles of the Declaration of Helsinki (2013).

A total of 100 adult patients classified as American Society of Anesthesiologists (ASA) physical status I or II, aged 20–60 years, were enrolled. Patients undergoing either unilateral inguinal hernia repair under spinal anaesthesia were eligible for participation. Patients were randomly allocated in a 1:1 ratio to either the quadratus lumborum (QL) block group or the transversus abdominis plane (TAP) block group using computer-generated random numbers [14]. Allocation concealment was achieved using sequentially prepared, opaque, sealed envelopes.

The primary investigator responsible for outcome assessment was blinded to group allocation. Due to the technical differences between the two regional anaesthetic procedures, blinding of the patients and the anaesthesiologists performing the blocks was not feasible.

Patients were excluded if they refused participation or were unable to provide informed consent because of mental disability, had a body mass index (BMI)  $\geq 35$  kg/m<sup>2</sup>, known allergy to local anaesthetic agents, bleeding or coagulation disorders, pre-existing neurological disease, chronic pain associated with a long-standing hernia, or an obstructed hernia.

Written informed consent was obtained from every participant before performing the block.

### Regional anaesthetic techniques

All patients received unilateral blocks after procedure is done but before regression of spinal anaesthesia. A total volume of 20 mL of 0.25% bupivacaine was administered, with the total dose maintained within a maximum of 3 mg/kg.

The blocks were performed by two experienced anaesthesiologists, each of whom had performed more than 100 ultrasound-guided regional blocks. A 10-cm echogenic needle (Pajunk Sonoplex, Geisingen, Germany) was used following local infiltration of the skin.

### Lateral quadratus lumborum block

For the LAT-QL block, the patient was positioned supine. A 2–5 MHz curvilinear ultrasound probe (Sonosite M-Turbo; Sonosite Inc., Bothell, WA, USA) The ultrasound probe was placed perpendicular to the long axis of the patient's body at the level of the iliac crest in the anterior axillary line to identify the three layers of the abdominal wall muscles (external oblique, internal oblique, and transversus abdominis), and then the probe was moved posteriorly to the midaxillary line to traced more posteriorly until the transversus aponeurosis appeared. Under ultrasound-guidance, a 10-cm 21-gauge block needle (PAJUNK, Geisingen, Germany) was penetrated the tendon of transversus

abdominis muscle using in-plane technique. After verifying the position of the needle tip with 2 mL normal saline, 20 mL of LA was injected into the junction of transversus abdominis muscle aponeurosis and quadratus lumborum.

#### **Transversus abdominis plane block**

The patients in the TAP group were placed in the supine position, and after sterilizing the operation area, the linear (6-13 MHz) ultrasound probe was placed vertically in the mid-axillary line between the upper edge of the iliac crest and the 12th rib, and the probe was adjusted from shallow to deep to visualize the external oblique, internal oblique, and transversus abdominis. A 10-cm 21-gauge block needle (PAJUNK, Geisingen, Germany) was inserted in the fascial planes between internal oblique (IO) and transversus abdominis (TA) muscles, after confirming the correct position of the needle tip with 2 mL normal saline, 20mL of LA was injected.

#### **Postoperative analgesia**

Postoperative analgesia was provided according to the institutional protocol. Tramadol was used as the primary analgesic and administered intravenously at a dose of 100 mg every 6–8 hours, with a maximum allowable dose of 400 mg during 24 hours.

For breakthrough or severe postoperative pain, defined as a VAS score >6, intravenous paracetamol 1 g was administered as rescue analgesia, with a maximum dose of 4 g in 24 hours.

#### **Assessment of sensory block**

Sensory dermatomal coverage was assessed with the patient in the supine position immediately after block placement and subsequently at 5, 10, 15, 20, and 30 minutes. Cold sensation was tested using a spirit swab, while tactile sensation was assessed using the blunt tip of a needle over the T5–L1 dermatomes.

The extent of sensory loss was graded using a three-point scale:

- **0:** Loss of both cold and touch sensations.
- **1:** Loss of cold sensation with preservation of touch sensation.
- **2:** Loss of both cold and touch sensations.

#### **Block-related parameters**

Block onset time was defined as the interval between completion of the block and the first detectable loss of sensation, corresponding to a sensory score of 1 or 2 in any assessed dermatome.

The duration of analgesia was defined as the time from completion of block placement until the patient's first request for analgesia.

#### **Assessment of postoperative pain and other outcomes**

Postoperative pain intensity was assessed using the Visual Analogue Scale (VAS), both at rest and during movement, at predetermined intervals of 0, 1, 2, 4, 6, 12, and 24 hours after surgery.

Patient satisfaction with postoperative analgesia was assessed during the 24-hour postoperative observation period.

Adverse events were recorded throughout the observation period. These included postoperative nausea and vomiting (PONV), motor weakness, and pain at the injection site..

#### **Sample size calculation**

At the time of study initiation, adequate prospective randomized evidence specific to the present surgical population was limited. Therefore, the sample size was estimated using the findings of a previous study by Çaparlar et al. [13], which compared posterior QL block with posterior TAP block in patients undergoing unilateral inguinal hernia surgery.

The calculation was based on the expected difference in mean VAS scores at 6 hours between the QL and TAP groups. The anticipated mean difference was 0.62. Sample size estimation was performed using OpenEpi software, version 3, for comparison of two independent means, with a two-sided confidence level of 95% and statistical power of 80%. Assuming an allocation ratio of 1:1, the minimum calculated sample size was 19 patients per group.

To provide a larger study population and improve the robustness of the analysis, 50 patients were recruited into each group. Thus, the final sample consisted of 100 participants, with 50 patients in the QL group and 50 patients in the TAP group.

#### **Statistical analysis**

Data were entered into a Microsoft Excel spreadsheet and subsequently analysed using Stata version 14. Continuous variables were summarized as mean  $\pm$  standard deviation (SD).

Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. Normally distributed continuous variables were compared between groups using the independent-samples *t* test, whereas non-normally distributed continuous variables were analysed using the Mann–Whitney U test (Wilcoxon rank-sum test). For within-group comparisons of paired continuous observations, the paired *t* test or Wilcoxon signed-rank test was applied, as appropriate. Variables expressed as proportions were compared using the two-proportion *Z* test. A two-sided *P* value <0.05 was considered statistically significant.

#### **RESULTS**

A total of 100 patients were enrolled in the study and randomized equally into two groups, with 50 patients in the TAP group and 50 patients in the QL group. All patients completed the study and were included in the final analysis. The two groups were comparable with respect to baseline demographic and clinical characteristics. There was no statistically significant difference between the groups in terms of age, sex, weight, height, BMI, ASA physical status, or duration of surgery (all *p* >

0.05), indicating adequate baseline comparability between the study groups (Table 1).

**Table 1: Comparison of Baseline Demographic and Clinical Characteristics Between TAP and QL Groups**

| Parameters                               | Group TAP (n=50)   | Group QL (n=50)    | P value     |
|------------------------------------------|--------------------|--------------------|-------------|
| Age(years) Mean $\pm$ SD                 | 39.54 $\pm$ 7.39   | 40.98 $\pm$ 10.14  | <b>0.42</b> |
| Sex<br>Male:<br>Female                   | 50(100%):<br>0(0%) | 50(100%):<br>0(0%) | <b>1.00</b> |
| Weight(kg) Mean $\pm$ SD                 | 59.68 $\pm$ 2.89   | 59.66 $\pm$ 2.99   | <b>0.97</b> |
| Height (in cms) Mean $\pm$ SD            | 160.74 $\pm$ 3.42  | 160.30 $\pm$ 3.25  | <b>0.51</b> |
| BMI(kg/m <sup>2</sup> ) Mean $\pm$ SD    | 23.86 $\pm$ 1.70   | 24.00 $\pm$ 1.97   | <b>0.70</b> |
| ASA I:<br>ASA II<br>n(%)                 | 25(50%):25(50%)    | 25(50%):25(50%)    | <b>1.00</b> |
| Surgery duration (minutes) Mean $\pm$ SD | 111.80 $\pm$ 13.98 | 113.50 $\pm$ 12.29 | <b>0.52</b> |

Values are expressed as Mean  $\pm$  SD for continuous variables and n (%) for categorical variables. NS = Not statistically significant. A p value < 0.05 was considered statistically significant.

#### Postoperative VAS scores

Intergroup comparison demonstrated statistically significant differences in mean VAS scores at baseline, immediately after block administration, 5 minutes, 6 hours, 8 hours, 12 hours, and 24 hours ( $p < 0.05$ ). No statistically significant differences were observed at 10, 15, 30, or 45 minutes and at 1, 2, and 4 hours ( $p > 0.05$ ).

During the early postoperative period, mean VAS scores were slightly higher in the QL group. However, from 6 hours onward, the TAP group demonstrated progressively higher pain scores. The difference became particularly pronounced at 8, 12, and 24 hours, when the mean VAS scores were 2.04  $\pm$  0.73, 3.26  $\pm$  0.66, and 4.30  $\pm$  0.68, respectively, in the TAP group, compared with 0.06  $\pm$  0.31, 0.02  $\pm$  0.14, and 0.00  $\pm$  0.00 in the QL group (all  $p < 0.001$ ).

**Table 2: Intergroup Comparison of Mean VAS Scores at Various Time Intervals After Administration of Block**

| Time interval                      | TAP Group (Mean $\pm$ SD) | QL Group (Mean $\pm$ SD) | P value        |
|------------------------------------|---------------------------|--------------------------|----------------|
| Baseline (immediate postoperative) | 0.22 $\pm$ 0.56           | 0.90 $\pm$ 0.76          | <b>P value</b> |
| Immediately after block            | 0.22 $\pm$ 0.56           | 0.71 $\pm$ 0.74          | <0.001         |
| 5 min                              | 0.22 $\pm$ 0.56           | 0.56 $\pm$ 0.73          | <0.001         |
| 10 min                             | 0.22 $\pm$ 0.56           | 0.36 $\pm$ 0.48          | 0.011          |
| 15 min                             | 0.22 $\pm$ 0.56           | 0.14 $\pm$ 0.35          | 0.183          |
| 30 min                             | 0.220 $\pm$ 0.545         | 0.120 $\pm$ 0.328        | 0.394          |
| 45 min                             | 0.275 $\pm$ 0.599         | 0.100 $\pm$ 0.300        | 0.270          |
| 1 hour                             | 0.100 $\pm$ 0.303         | 0.080 $\pm$ 0.274        | 0.069          |
| 2 hours                            | 0.080 $\pm$ 0.274         | 0.040 $\pm$ 0.197        | 0.730          |
| 4 hours                            | 0.042 $\pm$ 0.000         | 0.020 $\pm$ 0.141        | 0.404          |
| 6 hours                            | 1.140 $\pm$ 0.728         | 0.020 $\pm$ 0.141        | 0.793          |
| 8 hours                            | 2.040 $\pm$ 0.727         | 0.060 $\pm$ 0.313        | <0.001         |
| 12 hours                           | 3.260 $\pm$ 0.664         | 0.020 $\pm$ 0.141        | <0.001         |
| 24 hours                           | 4.300 $\pm$ 0.677         | 0.000 $\pm$ 0.000        | <0.001         |

Values are expressed as Mean  $\pm$  SD. VAS = Visual Analogue Scale; TAP = Transversus Abdominis Plane block; QL = Quadratus Lumborum block. A p value < 0.05 was considered statistically significant

#### Postoperative analgesic outcomes

The duration of sensory blockade was significantly longer in the QL group than in the TAP group (10.94  $\pm$  0.74 vs. 6.26  $\pm$  1.24 hours;  $p < 0.001$ ). Similarly, the time to first analgesic request was significantly prolonged in the QL group (7.42  $\pm$  0.61 vs. 4.21  $\pm$  0.60 hours;  $p < 0.001$ ).

The mean number of rescue analgesic doses was significantly lower in the QL group than in the TAP group (0.74  $\pm$  0.75 vs. 1.98  $\pm$  0.86;  $p < 0.0001$ ). Patient satisfaction was also significantly higher in the QL group (98% vs. 68%;  $p < 0.001$ ).

Postoperative complications were reported in 4% of patients in the QL group compared with 48% in the TAP group, representing a statistically significant difference ( $p < 0.001$ ).

**Table 3: Comparison of Postoperative Analgesic Outcomes Between TAP and QL Groups**

| Parameters                                         | Group TAP (n=50) | Group QL (n=50)  | P value |
|----------------------------------------------------|------------------|------------------|---------|
| Duration of sensory blockade(hours)(Mean $\pm$ SD) | 6.26 $\pm$ 1.24  | 10.94 $\pm$ 0.74 | <0.001  |
| Time to first analgesia (hours) (Mean $\pm$ SD)    | 4.21 $\pm$ 0.60  | 7.42 $\pm$ 0.61  | <0.001  |
| Number of rescue analgesics                        | 1.98 $\pm$ 0.86  | 0.74 $\pm$ 0.75  | <0.001  |
| Patient satisfaction n(%)                          | 34(68%)          | 49(98%)          | <0.001  |
| Postop complications:                              | 24(48%)          | 2(4%)            | <0.001  |

Values are expressed as Mean  $\pm$  SD for continuous variables and n (%) for categorical variables. TAP = Transversus Abdominis Plane block; QL = Quadratus Lumborum block. A p value  $< 0.05$  was considered statistically significant.

#### Haemodynamic parameters

The mean SBP remained relatively stable in both groups throughout the postoperative observation period. Although the QL group demonstrated higher mean SBP values at several later postoperative time points, the absolute differences were modest and there were no major clinically important haemodynamic fluctuations.(fig 1)

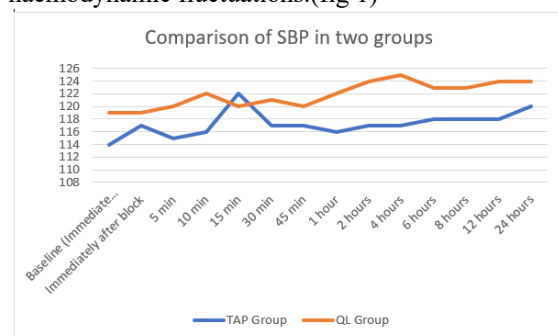


**Figure 1: Comparison of SBP in two groups**

Similarly, mean DBP remained relatively stable in both groups. Values ranged from approximately 74–80 mmHg in the TAP group and 75–86 mmHg in the QL group during the observation period. The QL group showed higher mean DBP at several later time points, particularly at 4, 8, 12, and 24 hours. At 6 hours, the mean DBP was marginally higher in the TAP group. Overall, there was no evidence of major postoperative haemodynamic instability in either group.(fig2)

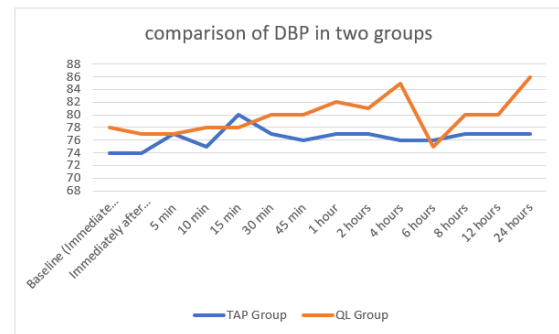


**Figure 2: Comparison of DBP in two groups**

#### DISCUSSION

The present study compared the postoperative analgesic efficacy of ultrasound-guided transversus abdominis plane (TAP) block and quadratus lumborum (QL) block in patients undergoing inguinal hernia surgery. The two groups were comparable with respect to baseline demographic and clinical characteristics.

The principal finding of the present study was that QL block provided a longer duration of sensory blockade and prolonged analgesia compared with TAP block. The mean duration of sensory blockade was 10.94  $\pm$  0.74 hours in the QL group compared with 6.26  $\pm$  1.24 hours in the TAP group, while the mean time to first analgesic request was 7.42  $\pm$  0.61 hours and 4.21  $\pm$  0.60 hours, respectively. Thus, patients receiving QL block experienced a considerably longer period of effective postoperative analgesia. This may be explained by the wider spread of local anaesthetic associated with QL block and potential involvement of the thoracolumbar nerves and paravertebral structures. These findings are consistent with the randomized controlled trial conducted by Roy et al., who compared QL block with TAP block in patients undergoing laparoscopic TAPP repair of inguinal hernia. They reported significantly lower 24-hour fentanyl consumption in the QL group compared with the TAP group (552  $\pm$  229.56  $\mu$ g vs. 735.5  $\pm$  264  $\mu$ g;  $p = 0.01$ ). They also reported a significantly longer duration of analgesia with QL block (354.8  $\pm$  107 min vs. 282.5  $\pm$  89.9 min;  $p = 0.03$ ). Greater dermatomal spread was also observed in the QL group<sup>[1]</sup>. These findings closely support the present observation of prolonged sensory blockade and delayed requirement for rescue analgesia with QL block.<sup>[14]</sup>

The present study also demonstrated a significantly lower requirement for rescue analgesics in the QL group. The mean number of rescue analgesic doses was 0.74  $\pm$  0.75 in the QL group compared with 1.98  $\pm$  0.86 in the TAP group ( $p < 0.0001$ ). This indicates that the longer-lasting analgesic effect of QL block translated into a clinically meaningful reduction in additional analgesic requirements. Similar findings were reported by Roy et al., who observed significantly lower total fentanyl consumption

during the first 24 postoperative hours in patients receiving QL block <sup>[14]</sup>.

The findings of Rai et al. are also in agreement with the present study. In their study of patients undergoing unilateral inguinal hernia surgery, the QL group demonstrated significantly lower pain scores at 2, 4, 6 and 8 hours. Total opioid consumption and time to first analgesic administration also favoured QL block ( $p < 0.001$ ). They further reported that haemodynamic and respiratory parameters remained stable in both groups and that adverse effects were minimal and comparable <sup>[15]</sup>.

The postoperative VAS findings in the present study further demonstrate a difference in the analgesic profile of the two blocks. Significant intergroup differences were observed at baseline, immediately after administration of the block, at 5 minutes, and subsequently at 6, 8, 12 and 24 hours. From 6 hours onwards, VAS scores increased progressively in the TAP group, reaching  $4.30 \pm 0.68$  at 24 hours, whereas the QL group maintained very low VAS scores, with a value of 0 at 24 hours. The marked difference at 8, 12 and 24 hours suggests that the analgesic effect of QL block was more sustained. These findings are consistent with the lower pain scores at later postoperative intervals reported by Rai et al. <sup>[15]</sup>.

However, the present findings should also be interpreted in the context of recent evidence showing that the superiority of QL block is not universal. Dwivedi et al. conducted a randomized non-inferiority study in patients undergoing unilateral open inguinal hernia repair and found that QL block was non-inferior to TAP block for time to first rescue analgesic and total tramadol consumption. They also found no significant difference in postoperative VAS scores or haemodynamic parameters between the groups <sup>[16]</sup>. This contrasts with the present study, where QL block demonstrated clear advantages in duration of analgesia, later postoperative VAS scores and rescue analgesic requirement.

The differences between the present study and that of Dwivedi et al. may be explained by differences in surgical technique, block approach, local anaesthetic regimen, postoperative analgesic protocol, sample size and residual effects of spinal anaesthesia. Dwivedi et al. specifically noted the potential influence of residual spinal anaesthesia and variability in their findings <sup>[16]</sup>.

Patient satisfaction was another important outcome in the present study. Ninety-eight percent of patients in the QL group were satisfied compared with 68% in the TAP group, suggesting that the improved analgesic profile of QL block translated into a better patient experience. This finding is also in agreement with previous comparative studies reporting improved postoperative analgesic outcomes and patient satisfaction following QL block <sup>[15]</sup>.

Postoperative complications including pain at injection site and nausea were less frequent in the QL group in the present study, occurring in 4% compared with 48% in the TAP group. This finding should be interpreted cautiously, particularly because the type and severity of individual complications are important when assessing clinical significance. Nevertheless, the result suggests a favourable postoperative profile for QL block. Rai et al. similarly reported that adverse effects were minimal and comparable between the QL and TAP groups <sup>[15]</sup>.

Regarding haemodynamic variables, the present study showed statistically significant differences in systolic and diastolic blood pressure at several postoperative time points. However, the absolute differences were relatively modest, and no major haemodynamic instability was observed. This is consistent with the findings of Dwivedi et al., who reported no significant difference in haemodynamic parameters between QL and TAP groups <sup>[16]</sup>. Rai et al. also reported stable haemodynamic and respiratory parameters in both groups <sup>[15]</sup>. Thus, the statistically significant differences observed in the present study should be distinguished from clinically important haemodynamic instability.

The superior analgesic efficacy of QL block observed in the present study may be explained by its ability to produce a wider dermatomal spread, particularly toward the higher thoracic dermatomes (T8–T10), which is relevant for analgesia following inguinal hernia surgery. This proposed mechanism is supported by cadaveric studies demonstrating spread of local anaesthetic beyond the immediate injection site <sup>[9]</sup>. In healthy volunteers, QL block has been shown to produce local anaesthetic spread as high as **T6 and T7 dermatomes**, with blockade extending to the L2 and L4 levels, respectively <sup>[10]</sup>. However, in the clinical study from which these observations were reported, T6 and T7 dermatomal involvement was observed in only one patient, indicating that the extent of cephalad spread may be variable. Similarly, although TAP block primarily produces blockade of the anterior abdominal wall, higher dermatomal coverage has also been reported with TAP block, with spread reaching as high as T6–T9 in some patients <sup>[7]</sup>. Therefore, the broader and potentially more cephalad spread associated with QL block may contribute to its prolonged analgesic effect and lower postoperative analgesic requirements observed in the present study. Roy et al. similarly demonstrated greater dermatomal spread in the QL group, supporting the possibility that wider neural coverage contributes to improved analgesia <sup>[14]</sup>.

Overall, the findings of the present study are largely consistent with Roy et al. <sup>[14]</sup> and Rai et al. <sup>[15]</sup>, both of whom reported better analgesic outcomes with QL block. However, they differ from the findings of Dwivedi et al. <sup>[16]</sup>, who demonstrated non-inferiority

rather than superiority of QL block over TAP block. These differences highlight the influence of block technique, surgical approach, anaesthetic regimen and postoperative analgesic protocols on clinical outcomes.

Our study had few limitations. This was a single-centre study with a relatively small sample size, and complete blinding was not feasible because of the different techniques used for QL and TAP blocks. The follow-up was limited to 24 hours, precluding assessment of long-term analgesic outcomes and chronic postoperative pain.

## CONCLUSION

The present study demonstrates that QL block provided longer sensory blockade, delayed the first request for rescue analgesia, reduced rescue analgesic requirements, resulted in lower pain scores during the later postoperative period and was associated with greater patient satisfaction compared with TAP block. These findings support QL block as an effective regional analgesic technique for postoperative pain management following inguinal hernia surgery.

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