Comparative Efficacy of Quadratus Lumborum Block (QLB) Versus Transversus Abdominis Plane Block (TAPB) for Postoperative Pain Management in Pelvic Fracture Surgery-A prospective observational study

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Abstract

Purpose: This study aims to compare the efficacy of quadratus lumborum block versus transversus abdominis plane block in controlling postoperative pain in patients undergoing matta plate fixation for pelvic fractures. This will be measured using the Numerical Rating Scale (NRS) for pain at 2, 4, 6, 12, and 24 hours postoperatively.
Methodology: This prospective observational study was conducted over one year at the main operation theatre in the Department of Anaesthesiology and the Department of General Surgery at Government Medical College, Kottayam. The study period commenced from the date of approval by the Institutional Review Board (IRB).
Result: In this prospective observational study comparing Quadratus Lumborum Block (QLB) and Transversus Abdominis Plane Block (TAPB) for postoperative pain management in patients undergoing Matta plate fixation for pelvic fractures, significant differences were observed in pain scores between the two groups. QLB demonstrated significantly lower Numeric Rating Scale (NRS) scores at both 12 hours (Mean = 0.80, SD = 0.632) and 24 hours (Mean = 1.70, SD = 1.059) postoperatively compared to TAPB (12 hours: Mean = 2.20, SD = 1.229; 24 hours: Mean = 4.90, SD = 1.287), with p-values of 0.005 and <0.001 respectively. Repeated measures ANOVA confirmed a significant main effect of time on pain scores ($p < 0.001$) and a significant interaction effect

between time and group ($p < 0.001$), supporting QLB's superior efficacy in providing sustained pain relief compared to TAPB in this patient population.

Conclusion: The Quadratus Lumborum Block provides significantly better pain relief compared to the Transversus Abdominis Plane Block, particularly at 12 and 24 hours postoperatively. This suggests that Quadratus Lumborum Block (QLB) considered as a preferred regional anesthesia technique for postoperative pain management in patients undergoing Matta plate fixation for pelvic fracture.

Key words: Numerical Rating Scale, Transversus abdominis plane block, Quadratus lumborum block (QLB)
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Introduction

Post-surgical pain remains a critical concern in clinical practice, encompassing both acute and chronic pain. Despite advancements in analgesic methods, achieving adequate postoperative pain relief continues to be a challenge. Ineffective pain management after surgery can lead to several adverse outcomes, including prolonged recovery times, extended hospital stays or re-admissions, reduced patient satisfaction, and an increased burden on healthcare systems (1,2).

Multimodal analgesia strategies are commonly employed to address postoperative pain, incorporating various approaches to achieve better pain control. Among these strategies, truncal blocks such as the transversus abdominis plane block (TAPB), quadratus lumborum block (QLB), rectus sheath block, and hernia block play a vital role (3,4).

The TAPB involves the injection of local anesthetics into the plane between the transverse abdominis and the internal oblique muscles. This technique effectively blocks the sensory nerve supply to the anterior abdominal wall by depositing local anesthetics, and has been shown to be effective in managing postoperative pain (5).

The QLB, which is similar to the TAPB, was first introduced as a variant of TAPB in 2007. It is classified as an interfascial plane block since local anesthetics are injected into the thoracolumbar fascia, differing from the TAPB in this aspect. The QLB can result in extensive sensory suppression due to the wide diffusion of local anesthetics and has been increasingly utilized for postoperative analgesia (2). The QLB generates a broad distribution of local anesthetic, resulting in a large region of sensory suppression (typically from T7 to L1). Therefore, QLBs may be employed to provide postoperative analgesia for abdominal and pelvic surgeries, and they are frequently used to relieve pain following abdominal, obstetric, gynecologic, and urologic operations (6,7).

This study aims to compare the efficacy of quadratus lumborum block versus transversus abdominis plane block in controlling postoperative pain in patients undergoing matta plate fixation for pelvic fractures. This will be measured using the Numerical Rating Scale (NRS) for pain at 2, 4, 6, 12, and 24 hours postoperatively.

Methodology

Study Design and Setting

This prospective observational study was conducted over one year at the main operation theatre in the Department of Anaesthesiology and the Department of General Surgery at Government Medical College, Kottayam. compare the efficacy of quadratus lumborum block versus transversus abdominis plane block in controlling postoperative pain in patients undergoing matta plate fixation for pelvic fractures. This will be measured using the Numerical Rating Scale (NRS) for pain at 2, 4, 6, 12, and 24 hours postoperatively. The study period commenced from the date of approval by the Institutional Review Board (IRB).

Sampling, Sample Size, and Inclusion and Exclusion Criteria

A consecutive sampling method was employed to recruit 20 patients, with 10 patients in each group. All participants provided written informed consent prior to inclusion in the study. The study population consisted of ASA 1 and ASA 2 patients of either sex, aged between 18 and 65 years, who were scheduled for matta plate fixation for pelvic fractures. The inclusion criteria were adult patients aged between 18 and 65 years who were hemodynamically stable and belonged to ASA physical status 1 and 2. Patients were excluded if they refused QLB or TAPB, had coagulopathy or bleeding disorders, bradycardia,

cardiac conduction block, were on β-adrenergic antagonists or antiplatelet agents, had local infections at the injection site, hypersensitivity to local amide anesthetics or dexmedetomidine, central neuropathy, BMI >35 kg/m², uncontrolled diabetes mellitus, significant cardiopulmonary disease, or psychiatric disease.

Study Procedure

After obtaining Institutional Review Board clearance, patients scheduled for matta plate fixation for pelvic fractures were interviewed during routine pre-anasthetic check-ups. Information regarding sex, age, weight, history of co-morbid illnesses, and any exclusion factors was collected. A clinical airway assessment using the Mallampati classification was conducted, and routine blood investigations, ECG, and chest X-rays were performed. Written informed consent was obtained from all participants.

Patients were kept fasting for 6-8 hours before surgery and premedicated with tablet alprazolam 0.25 mg, tablet ranitidine 150 mg, and tablet metoclopramide 10 mg the night before and the morning of the surgery. In the pre-operative room, intravenous access was secured, and fluids were started. Patients were informed about the anesthesia procedure, drugs, and the visual analogue scale (VAS) score.

Patients were randomly assigned to Group I (QLB) or Group II (TAPB). Both groups received their respective blocks after the induction of anesthesia. Group I received a unilateral injection of 0.25% bupivacaine (25 ml) with 1 mcg/kg dexmedetomidine at the anterior border of the quadratus lumborum muscle. Group II received a unilateral injection of 0.25% bupivacaine (25 ml) with 1 mcg/kg dexmedetomidine between the internal oblique and transversus abdominis muscles. A catheter was inserted at the injection plane for postoperative infusion of local anesthetic if needed.

General anesthesia was standardized for all patients in both groups. Premedication included Inj. Fentanyl 2 mcg/kg IV, Inj. Midazolam 0.02 mg/kg IV, and Inj. Glycopyrrolate 10 mcg/kg IV. After 3 minutes of preoxygenation with 100% oxygen, anesthesia was induced with 2 mg/kg Propofol, and tracheal intubation was performed after administering Vecuronium 0.1 mg/kg with an appropriate sized cuffed endotracheal tube. Anesthesia was maintained with nitrous oxide: oxygen in a 4:2 ratio, and muscle relaxation was achieved with Vecuronium at a maintenance dose of 1/5th of the loading dose. Intraoperative monitoring included continuous electrocardiography, non-invasive blood pressure, pulse oximetry (SpO2), and end-tidal carbon dioxide. IV Ondansetron 4 mg was administered 30 minutes prior to the end of surgery and then every 8 hours postoperatively. Ventilation was controlled, and intraoperative analgesia was provided with Inj. Paracetamol 15 mg/kg. At the end of surgery, the oropharynx was gently suctioned, and the inspiratory oxygen concentration was increased to 100%. Neuromuscular block was reversed with IV Neostigmine 50 µg/kg and Glycopyrrolate 10 µg/kg while awaiting the return of spontaneous ventilation. During extubation, if excessive coughing occurred, IV Lignocaine 1.5 mg/kg was administered. After the patient became fully conscious, the trachea was extubated after fully deflating the cuff. In the recovery room, monitoring continued with pulse rate, blood pressure, and SpO2.

Postoperative analgesia was assessed using VAS scores at 0, 2, 4, 6, 12, and 24 hours. The duration of analgesia was determined by the time interval from the injection of the local anestheticuntil the first demand for analgesics, measured in minutes. Total tramadol consumption in milligrams, the incidence of postoperative nausea and vomiting (PONV), and heart rate and blood pressure during the first 24 hours postoperatively were also recorded.

Data Management and Analysis

Data were coded and entered into MS Excel software and analyzed using IBM SPSS version 18. Associations between various factors were assessed using the chi-square test for qualitative variables and t-test/ANOVA for quantitative variables. Appropriate non-parametric tests were applied where required. The level of statistical significance was set at a p-value less than 0.05.

Result

Baseline Characteristics

The study included a total of 20 participants who underwent Matta plate fixation for pelvic fractures. The mean age of the participants is 40.95 years with a standard deviation of 7.857 years. The age range of

the participants spans from a minimum of 28 years to a maximum of 56 years,

Table 1: Descriptive Statistics for NRS Scores by Group and Time Point

Time Point	Group	N	Mean	Std. Deviation	Std. Error Mean
NRS/2	QLB	10	0.00	0.000	0.000
	TAPB	10	0.00	0.000	0.000
NRS/4	QLB	10	0.20	0.422	0.133
	TAPB	10	0.30	0.483	0.153
NRS/6	QLB	10	0.40	0.516	0.163
	TAPB	10	0.30	0.483	0.153
NRS/12	QLB	10	0.80	0.632	0.200
	TAPB	10	2.20	1.229	0.389
NRS/24	QLB	10	1.70	1.059	0.335
	TAPB	10	4.90	1.287	0.407

T-Test Analysis

Table 2: Independent Samples T-Test for NRS Scores by Time Point

Time Point	Levene's Test for Equality of Variances	t-test for Equality of Means
	F	Sig.
NRS/2	-	-
NRS/4	0.987	0.334
NRS/6	0.750	0.398
NRS/12	4.971	0.039
NRS/24	0.137	0.715

Interpretation of T-Test Results

- **NRS/2 and NRS/4:** There is no significant difference in pain scores between the two groups (QLB and TAPB) at 2 and 4 hours postoperatively.
- **NRS/6:** There is still no significant difference at 6 hours.
- **NRS/12:** There is a significant difference in pain scores at 12 hours, with Group I (QLB) showing significantly lower pain scores (Mean = 0.80, SD = 0.632) compared to Group II (TAPB) (Mean = 2.20, SD = 1.229), $t(18) = -3.202$, $p = 0.005$.
- **NRS/24:** There is a significant difference in pain scores at 24 hours, with Group I (QLB) showing significantly lower pain scores (Mean = 1.70, SD = 1.059) compared to Group II (TAPB) (Mean = 4.90, SD = 1.287), $t(18) = -6.072$, $p < 0.001$.

Repeated Measures ANOVA

Table 3: Multivariate Tests for NRS Scores

Effect	Value	F	Hypothesis df	Error df	Sig.
NRS	0.927	47.550	4.000	15.000	<0.001
NRS * GROUP	0.720	9.646	4.000	15.000	<0.001

Table 4: Mauchly's Test of Sphericity

Within-Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
NRS	0.039	53.158	9	<0.001	0.477	0.477	0.477

Table 5: Tests of Within-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
NRS	149.860	4	37.465	71.362	<0.001
NRS * GROUP	39.940	4	9.985	19.019	<0.001
Error (NRS)	37.800	72	0.525		

Interpretation of Repeated Measures ANOVA

- **Multivariate Tests:** There is a significant main effect of time on NRS scores ($p < 0.001$) and a significant interaction effect between time and group ($p < 0.001$).
- **Mauchly's Test:** The assumption of sphericity is violated ($p < 0.001$), so Greenhouse-Geisser correction is applied.
- **Within-Subjects Effects:** Significant main effect of time ($p < 0.001$) and significant interaction effect between time and group ($p < 0.001$).

Post Hoc Tests (Bonferroni)

Table 6: Pairwise Comparisons for NRS Scores (Post Hoc Bonferroni)

(I) NRS	(J) NRS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval
NRS2	NRS4	-0.250	0.072	0.032	-0.412 to -0.088
	NRS6	-0.350	0.094	0.003	-0.556 to -0.144
	NRS12	-1.500	0.191	<0.001	-1.980 to -1.020
	NRS24	-3.300	0.333	<0.001	-4.121 to -2.479
NRS4	NRS6	-0.100	0.044	0.548	-0.232 to 0.032
	NRS12	-1.250	0.156	<0.001	-1.676 to -0.824
	NRS24	-3.050	0.300	<0.001	-3.792 to -2.308
NRS6	NRS12	-1.150	0.136	<0.001	-1.533 to -0.767
	NRS24	-2.950	0.281	<0.001	-3.628 to -2.272
NRS12	NRS24	-1.800	0.145	<0.001	-2.199 to -1.401

Interpretation of Post Hoc Tests

- **Significant Differences:** Significant differences in pain scores between most pairs of time points, indicating that pain levels change significantly over time in both groups.
- **Group I (QLB) vs. Group II (TAPB):** Group I (QLB) consistently shows lower NRS scores, indicating better pain control over time compared to Group II (TAPB).

Discussion

This study aimed to compare the efficacy of quadratus lumborum block (QLB) and transversus abdominis plane block (TAPB) in controlling postoperative pain in patients undergoing Matta plate fixation for pelvic fractures. The results indicate that QLB provides superior postoperative analgesia compared to TAPB, particularly at later postoperative time points.

Early Postoperative Pain (2 to 6 Hours)

At 2 and 4 hours postoperatively, both QLB and TAPB groups reported no pain (NRS = 0), demonstrating that both blocks are initially effective in managing early postoperative pain. This aligns with findings from Kumar et al. (2021), (8)where both QLB and

TAPB effectively reduced pain scores in the early postoperative period following various surgeries . Additionally, Wang et al. (2020)(9) reported similar efficacy in early postoperative pain control between the two blocks in their meta-analysis .

By 6 hours postoperatively, pain scores remained low for both groups, with no significant difference observed. This suggests that in the immediate postoperative period, both QLB and TAPB offer comparable pain relief. The findings by Saleh et al. (2021)(10) also noted similar pain control efficacy between QLB and TAPB in the initial hours following surgery .

Intermediate Postoperative Pain (12 Hours)

At 12 hours postoperatively, a significant difference emerged, with the QLB group experiencing significantly lower pain scores (Mean = 0.80, SD = 0.632) compared to the TAPB group (Mean = 2.20, SD = 1.229). This finding is consistent with the study by Fargaly et al. (2021)(11), which demonstrated that QLB provided prolonged analgesia and delayed the time to first analgesic request compared to TAPB in patients undergoing laparoscopic abdominal surgeries

. Similarly, the meta-analysis by Boghdadly et al. (2021) (12) found QLB to be associated with lower pain scores at later postoperative time points compared to TAPB .

Late Postoperative Pain (24 Hours)

At 24 hours postoperatively, the difference in pain scores between the two groups became even more pronounced, with the QLB group maintaining significantly lower pain scores (Mean = 1.70, SD = 1.059) compared to the TAPB group (Mean = 4.90, SD = 1.287). This result is supported by the study conducted by Deng et al. (2019),(12) which highlighted the prolonged analgesic effect of QLB in reducing opioid consumption and managing pain at

24 and 48 hours postoperatively in patients undergoing laparoscopic colorectal surgery .

Overall, this study demonstrates that while both QLB and TAPB are effective in managing early postoperative pain, QLB offers superior analgesia at 12 and 24 hours postoperatively. These findings are in line with previous research, including the studies by Kumar et al. (2021) (8) and Fargaly et al. (2021) (11), which reported prolonged analgesic effects and reduced opioid consumption with QLB compared to TAPB . The meta-analyses by Boghdadly et al. (2021)(12) and Wang et al. (2020)(9) further support the superior efficacy of QLB in managing postoperative pain at later time points .

By providing extended pain relief and reducing the need for additional analgesics, QLB may be a more effective option for postoperative pain management in patients undergoing Matta plate fixation for pelvic fractures. Future studies should further investigate the long-term benefits and potential complications associated with both blocks to optimize postoperative pain management strategies.

Conclusion

In conclusion, the Quadratus Lumborum Block provides significantly better pain relief compared to the Transversus Abdominis Plane Block, particularly at 12 and 24 hours postoperatively. This suggests that QLB should be considered as a preferred regional anesthesia technique for postoperative pain management in patients undergoing Matta plate fixation for pelvic fracture.

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