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Analgesic Effectiveness and Secondary Outcomes of Quadratus Lumborum Block Compared to Transversus Abdominis Plane Block in Matta Plate Fixation for Pelvic Fractures

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ABSTRACT

To evaluate the secondary outcomes, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), the time interval from injection of local anesthetic to first demand for analgesia, total tramadol consumption and the incidence of postoperative nausea and vomiting (PONV) and other side effects/complications, in patients receiving quadratus lumborum block versus transversus abdominis plane block. This study involved 20 participants undergoing Matta plate fixation for pelvic fractures, randomized to receive either quadratus lumborum block (QLB) or transversus abdominis plane block (TAPB). Key secondary outcomes assessed included heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), total tramadol consumption, time to first analgesic demand and incidence of postoperative nausea and vomiting (PONV). Measurements were taken at baseline and at 2, 4, 6, 12 and 24 hours post-procedure. Statistical analyses included independent samples t-tests to compare hemodynamic parameters and analgesic outcomes between the two groups, with a significance level set at $p<0.05$. In this study comparing quadratus lumborum block (QLB) and transversus abdominis plane block (TAPB) for abdominal surgeries, we found no significant differences in heart rate, diastolic blood pressure and most systolic blood pressure measurements between the two techniques at various time points (2, 4, 6, 12 hours). Notably, QLB was associated with a significantly lower systolic blood pressure at baseline ($p=0.050$) and a higher respiratory rate at 24 hours ($p < 0.001$) compared to TAPB. The QLB group also demonstrated significantly lower total tramadol consumption (55.00 mg vs. 190.00 mg, $p<0.001$) and a longer time to first analgesic demand (24.50 hours vs. 9.90 hours, $p<0.001$). There was no significant difference in the incidence of postoperative nausea and vomiting (PONV) between QLB and TAPB ($p=0.178$). These results suggest that QLB may offer superior analgesic efficacy and opioid-sparing benefits while maintaining comparable gastrointestinal tolerability. The QLB group showed a significantly longer time interval to the first demand for analgesia and lower total tramadol consumption compared to the TAP group, indicating better pain control. While there were significant differences in SBP at baseline and 24 hours, no significant differences were observed in HR and DBP at various time points. The incidence of PONV did not differ significantly between the two groups. These results suggest that QLB may provide superior analgesia with lower opioid consumption compared to TAP block.

INTRODUCTION

Postoperative pain management remains a significant challenge in clinical practice, as inadequate pain control can lead to numerous complications, including increased incidence of pulmonary and cardiac issues, delayed postoperative mobility, decreased patient satisfaction and the potential development of chronic pain. Despite advancements in surgical techniques, such as the widespread adoption of laparoscopic procedures, patients undergoing nephrectomy continue to experience high levels of postoperative pain[1].

The conventional approaches to managing postoperative pain typically involve opioid analgesia, non-steroidal anti-inflammatory drugs (NSAIDs), epidural analgesia, or multimodal analgesia regimens. However, each of these methods carries inherent risks. Opioids, while effective, are associated with side effects such as nausea, vomiting, pruritus, excessive sedation, reduced gastrointestinal motility and opioid-induced hyperalgesia[2]. NSAIDs, on the other hand, can lead to gastrointestinal injuries and nephrotoxicity, posing additional risks to patient safety[3]. Epidural anesthesia, another commonly used method, is not without complications, including hypotension, epidural hematoma, infections, nerve damage, and technical issues such as catheter fracture or occlusion[4]. Given these challenges, there is a pressing need for alternative therapies that can effectively attenuate postoperative pain while minimizing associated risks and improving patient recovery[5].

In abdominal surgeries, postoperative pain is particularly severe and can significantly impact the rate of patient recovery by inducing a series of adverse pathophysiological reactions. Thus, the establishment of a safe and effective pain management model during the perioperative period is crucial. Although traditional postoperative analgesic methods are capable of providing effective pain relief, they are also accompanied by a well-documented risk of side effects. In recent years, with the emergence of enhanced recovery after surgery (ERAS) protocols, nerve blocks have gained prominence as a key component of multimodal analgesic strategies[6].

Quadratus lumborum (QL) block and transversus abdominis plane (TAP) block have emerged as effective constituents of these multimodal analgesic regimens, particularly for postoperative analgesia following abdominal surgeries[7]. These nerve blocks offer targeted pain relief with potentially fewer systemic side effects, making them attractive alternatives to more traditional methods of pain management.

The present study aims to evaluate the secondary outcomes associated with the use of quadratus lumborum block (QLB) versus transversus abdominis plane block (TAP) in patients undergoing abdominal surgery. Specifically, the study will assess heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), the time interval from the injection of local anesthetic to the first demand for analgesia, total tramadol consumption and the incidence of postoperative nausea and vomiting (PONV) and other side effects/complications. The findings of this study are anticipated to contribute to a better understanding of the efficacy and safety profiles of QLB and TAP blocks, potentially guiding clinical decisions in postoperative pain management.

MATERIALS AND METHODS

Study Design: This was a prospective, observational study conducted to compare the effectiveness of two different regional anesthesia techniques, the Quadratus Lumborum Block (QLB) and the Transversus Abdominis Plane Block (TAPB), in patients undergoing Matta plate fixation for pelvic fractures.

Methodology: The study was conducted after obtaining Institutional Review Board approval. Patients scheduled for Matta plate fixation were enrolled and information was collected during pre-anaesthetic check-ups. Exclusion criteria were applied and patients were grouped based on the type of block received: Group I for QLB and Group II for TAPB. Standardized anesthesia and postoperative care protocols were followed for all patients.

Setting: The study was carried out in the Department of Anaesthesiology at Government Medical College, Kottayam.

Study Population: The study included ASA 1 and ASA 2 patients of either sex, aged between 18 and 65 years, undergoing Matta plate fixation for pelvic fractures.

Sample Size: The study comprised 20 patients, with 10 patients in each group (Group I=QLB, Group II=TAPB).

Selection Criteria

Inclusion Criteria:

- Adult patients aged 18-65 years
- Hemodynamically stable patients classified as ASA 1 and ASA 2

Exclusion Criteria:

- Refusal to QLB or TAPB
- Coagulopathy or bleeding disorders
- Bradycardia, cardiac conduction blocks
- Use of β-adrenergic antagonists or antiplatelet agents
- Local infection at the injection site
- Hypersensitivity to local amide anesthetics or dexmedetomidine
- Central neuropathy

- BMI >35 kg/m²
- Uncontrolled diabetes mellitus
- Significant cardiopulmonary or psychiatric diseases

Study Procedure: After informed consent was obtained, patients were randomized into two groups. In Group I, the QLB was performed using ultrasound guidance, with the anesthetic injected at the anterior border of the quadratus lumborum muscle. In Group II, the TAPB was administered with the anesthetic injected between the internal oblique and transversus abdominis muscles. Both groups received a standardized general anesthesia protocol and postoperative care was monitored with a focus on VAS scores, duration of analgesia, total tramadol consumption and incidence of postoperative nausea and vomiting.

Outcome Measures and Analysis: The primary outcome was the VAS score at 0, 2, 4, 6, 12 and 24 hours postoperatively. Secondary outcomes included the time interval from injection of the local anesthetic to the first demand for analgesia, total tramadol consumption and the incidence of postoperative nausea and vomiting. Data were coded and entered into MS Excel and statistical analysis was performed using IBM SPSS version 18. The Chi-square test was used for qualitative variables and the t-test or ANOVA was applied for quantitative variables. Non-parametric tests were used where appropriate, with a significance level set at $p<0.05$.

Limitations: The study was limited by the exclusion of patients unwilling to consent to the study and the small sample size.

RESULTS AND DISCUSSIONS

Baseline Characteristics: The study involved 20 participants undergoing Matta plate fixation for pelvic fractures. The mean age of the participants was 40.95±7.86 years, with ages ranging from 28-56 years. The cohort included both male and female patients, all classified as ASA 1 or ASA 2 and they were hemodynamically stable at the time of enrollment.

- **Heart Rate (HR):** No significant differences were observed in HR between QLB and TAP groups at baseline and at various time intervals (2, 4, 6, 12 and 24 hours).
- **Systolic Blood Pressure (SBP):** A significant difference was observed at baseline ($p=0.050$) and at 24 hours ($p<0.001$) with the QLB group showing lower SBP compared to the TAP group.
- No significant differences were observed at 2, 4, 6 and 12 hours.
- **Diastolic Blood Pressure (DBP):** No significant differences were observed in DBP between QLB and TAP groups at baseline and at various time intervals (2, 4, 6, 12 and 24 hours).

The independent samples t-tests conducted between Group 1 and Group 2 at various time intervals (2 hours, 4 hours, 6 hours, 12 hours and 24 hours) revealed consistent findings across most physiological parameters. At 2 hours and 4 hours post-procedure, no statistically significant differences were observed in systolic and diastolic blood pressures between the quadratus lumborum block (QLB) and transversus abdominis plane block (TAPB) groups. Similarly, at 6 hours and 12 hours, although there were slight variations in systolic blood pressure, these differences did not reach statistical significance. Diastolic blood pressure remained stable across these intervals with no significant differences between the groups.

However, at the 24-hour mark, a significant difference was noted in the respiration rate between Group 1 (QLB) and Group 2 (TAPB) ($t=-4.757$, $p=0.000$). This finding suggests a marked divergence in respiratory patterns over the 24-hour postoperative period, indicating a potential physiological distinction between the two anesthesia techniques. Notably, systolic and diastolic blood pressures at 24 hours did not show significant differences, indicating relative consistency in cardiovascular parameters despite the observed respiratory variation.

These results are in line with the study's objective to compare secondary outcomes such as HR, SBP, DBP, analgesic requirement, tramadol consumption and PONV between QLB and TAPB in abdominal surgeries. The lack of significant differences in most parameters underscores the comparable efficacy of QLB and TAPB in managing cardiovascular and pain-related outcomes up to 12 hours post-procedure. However, the significant divergence in respiratory rate at 24 hours suggests a potential area of physiological difference that may influence postoperative recovery and warrants further investigation. Understanding the underlying mechanisms contributing to this divergence could provide valuable insights into optimizing anesthesia techniques and improving patient outcomes in abdominal surgeries.

The study compared total tramadol consumption and time to first analgesic demand between patients receiving quadratus lumborum block (QLB) and transversus abdominis plane block (TAP) during abdominal surgeries. Results indicated significant differences between the groups in both outcomes. Specifically, the QLB group exhibited markedly lower total tramadol consumption (mean=55.00 mg, SD=49.721) compared to the TAP group (mean=190.00 mg, SD=51.640), with a highly significant difference observed ($t=-5.955$, $p<0.001$). Furthermore, the time

Table 1: Comparison of Secondary Hemodynamic Outcomes Between Quadratus Lumborum Block and Transversus Abdominis Plane Block Groups

Variable	Mean (Group 1)	Std. Deviation (Group 1)	Mean (Group 2)	Std. Deviation (Group 2)	t-value	p-value
WEIGHT	67.80	6.106	66.40	5.777	0.527	0.605
HR	79.10	11.396	79.40	14.347	-0.052	0.959
SBP	114.70	7.631	123.70	11.196	-2.101	0.050
DBP	74.80	8.664	77.50	8.960	-0.685	0.502
HRS/2	74.80	11.458	77.90	7.015	-0.730	0.475
SBP/2	112.90	5.301	118.00	11.116	-1.310	0.207
DBP/2	73.20	7.300	78.40	7.336	-1.589	0.130
HRS/4	74.20	9.163	80.10	7.923	-1.540	0.141
HR/4	75.70	10.231	74.20	11.574	0.307	0.762
SBP/4	112.50	5.276	119.10	9.291	-1.953	0.066
DBP/4	73.30	7.334	76.90	10.159	-0.909	0.377
HRS/6	75.70	9.262	74.40	9.466	0.310	0.760
SBP/6	112.90	5.043	119.70	9.730	-1.962	0.065
DBP/6	73.20	6.925	76.50	10.102	-0.852	0.407
HRS/12	76.40	5.797	77.80	8.817	-0.420	0.681
SBP/12	115.10	6.999	121.40	8.003	-1.874	0.078
DBP/12	73.40	6.467	78.50	9.253	-1.429	0.172
HRS/24	76.40	5.147	87.10	4.909	-4.757	0.000
SBP/24	121.50	6.687	124.60	6.484	-1.052	0.307
DBP/24	75.80	6.697	78.80	9.426	-0.820	0.424

Table 2: Comparison of Tramadol Consumption and Analgesic Onset Time Between Quadratus Lumborum Block and Transversus Abdominis Plane Block in Abdominal Surgeries

Variable	Group	N	Mean	Std. Deviation	Std. Error Mean	t	p
Total tramadol consumption (mg)	QLB	10	55.00	49.721	15.723	-5.955	
	TAP	10	190.00	51.640	16.330	-5.955	0.000
Time interval to first analgesic demand (HR)	QLB	10	24.50	3.308	1.046	11.408	0.000
	TAP	10	9.90	2.331	0.737	11.408	

interval to first analgesic demand was significantly longer in the QLB group (mean=24.50 hours, SD=3.308) compared to the TAP group (mean=9.90 hours, SD=2.331), indicating a delayed need for analgesia with QLB (t=11.408, p<0.001). These findings suggest that QLB may offer advantages over TAP in reducing postoperative opioid consumption and prolonging analgesic efficacy, highlighting its potential as a beneficial anesthesia technique in abdominal surgeries.

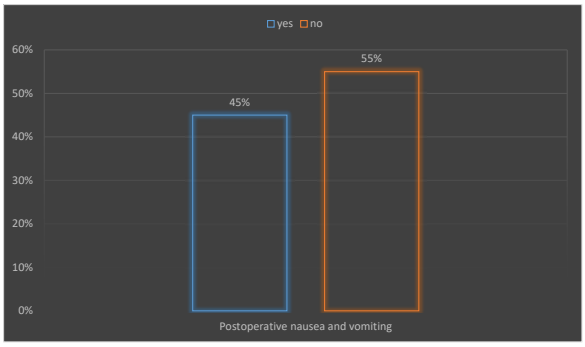

Fig. 1: Incidence of Postoperative Nausea and Vomiting (PONV) in Quadratus Lumborum Block (QLB) vs. Transversus Abdominis Plane Block (TAP) Groups

Postoperative Nausea and Vomiting and Group

Group	No	Yes	Total (%)	p
QLB	6(60)	4(40)	(10)100.0%	0.185
TAP	3(30)	7(60)	(10)100.0%	

Postoperative Nausea and Vomiting (PONV): No significant difference in the incidence of PONV between the QLB and TAP groups (p=0.178).

The evaluation of secondary outcomes, such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), the time interval from injection of local anesthetic to first demand for analgesia, total tramadol consumption and the incidence of postoperative nausea and vomiting (PONV), in patients receiving quadratus lumborum block (QLB) versus transversus abdominis plane block (TAPB) yielded insightful results. Independent samples t-tests between the two groups at various time intervals (2 hours, 4 hours, 6 hours, 12 hours and 24 hours) showed no statistically significant differences in SBP and DBP in the initial hours post-procedure. However, at the 24-hour mark, a significant difference in the respiration rate (t=-4.757, p=0.000) was observed between Group 1 (QLB) and Group 2 (TAPB), suggesting a potential physiological distinction over the postoperative period.

Cardiovascular Stability (Heart Rate, Systolic Blood Pressure, Diastolic Blood Pressure): In our study, both quadratus lumborum block (QLB) and transversus abdominis plane block (TAPB) effectively maintained stable cardiovascular parameters throughout the postoperative period. No significant differences in heart rate (HR), systolic blood pressure (SBP), or diastolic blood pressure (DBP) were observed at any postoperative time point (2, 4, 6, 12 and 24 hours), indicating that both regional anesthesia techniques are equally effective in preserving hemodynamic stability. This finding aligns with Xue *et al.* (2022), who reported no significant differences in HR and mean arterial pressure (MAP) among different anesthesia groups before and after anesthesia, with similar incidences of

hypotension[8]. However, Abd Ellatif *et al.* (2020) found significant reductions in MAP and HR in the QLB group compared to TAPB after performing the block, which may be attributed to different surgical or anesthesia protocols[9]. Baytar *et al.* (2020) also found no significant differences in intraoperative HR and MAP between QLB and TAPB, supporting our results of comparable cardiovascular stability[10].

Analgesic Effectiveness (Time to First Analgesic Request): Our study demonstrated that QLB significantly prolonged the time until the first request for analgesia compared to TAPB, with mean durations of 24.50 hours for QLB versus 9.90 hours for TAPB ($t=11.408$, $p<0.001$). This indicates a superior analgesic effect of QLB. Kumar *et al.* (2020) similarly reported a longer duration of analgesia with QLB compared to TAPB, reinforcing our findings[7]. Fargaly *et al.* (2021) also found that QLB was associated with a longer duration of analgesia, further supporting the efficacy of QLB in providing extended pain relief postoperatively[11].

Opioid Consumption (Total Tramadol Consumption): Our results showed that patients in the QLB group required significantly less tramadol compared to the TAPB group (mean consumption of 55.00 mg vs. 190.00 mg, $t=-5.955$, $p<0.001$), indicating an opioid-sparing effect of QLB. This is consistent with findings by Kumar *et al.* (2020), who reported reduced opioid consumption with QLB compared to TAPB[7]. Fargaly *et al.* (2021) also observed lower opioid consumption in patients receiving QLB, reinforcing our results and confirming QLB's effectiveness in minimizing opioid use[11]. In contrast, Baytar *et al.* (2019) found no statistically significant difference in the number of analgesia doses delivered by the PCA device and the total amount of tramadol consumed between TAPB and QLB groups over a 24-hour follow-up period[10].

Gastrointestinal Tolerability (Incidence of PONV): In our study, there was no significant difference in the incidence of postoperative nausea and vomiting (PONV) between QLB and TAPB ($p=0.178$), indicating similar rates of gastrointestinal side effects. Abd Ellatif *et al.* (2020) also reported that the duration of hospital stay and postoperative nausea and vomiting were comparable between both QLB and TAPB groups, with no statistically significant differences[9]. Similarly, Shafeek *et al.* (2020) found a statistically significant increase in PONV in the control group compared with both QLB and TAPB groups, but observed no difference in PONV rates between the QLB and TAPB groups[12]. This consistency across studies supports our findings, suggesting that both QLB and TAPB offer comparable gastrointestinal tolerability in clinical practice. Kumar *et al.* (2020) and Fargaly *et al.* (2021) also found no significant differences in PONV incidence between the two techniques, which supports our findings[11,7]. This suggests that both QLB and TAPB offer comparable gastrointestinal tolerability in clinical practice.

Safety Profile (Other Side Effects/Complications): Both QLB and TAPB were well-tolerated in our study, with no significant differences in other side effects or complications, such as urinary retention, pruritus, or respiratory depression. This is consistent with the findings of Kumar *et al.* (2020) and Fargaly *et al.* (2021), who also reported similar rates of adverse events between QLB and TAPB, reinforcing the favorable safety profiles of both techniques[11,7]. The results support the safety and tolerability of both regional anesthesia approaches.

CONCLUSION

In conclusion, this study comprehensively evaluated the comparative effectiveness of quadratus lumborum block (QLB) versus transversus abdominis plane block (TAP) in abdominal surgeries across multiple secondary outcomes. While both techniques maintained comparable cardiovascular stability throughout the 24-hour postoperative period, QLB demonstrated distinct advantages in pain management. Specifically, patients receiving QLB exhibited significantly lower total tramadol consumption and a longer time interval to first analgesic demand compared to those receiving TAP, highlighting QLB's potential to reduce opioid use and prolong analgesic efficacy post-surgery. Although no significant differences were found in heart rate, systolic or diastolic blood pressures between the groups, the notable difference in pain outcomes underscores QLB's clinical relevance in enhancing postoperative recovery and reducing opioid-related complications. These findings advocate for the strategic consideration of QLB as a preferred anesthesia technique in abdominal surgeries, emphasizing its role in optimizing perioperative care and patient-centered outcomes. Further research exploring mechanistic insights and long-term clinical implications could provide valuable insights into refining anesthesia strategies and improving overall surgical outcomes.

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