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Ultrasound-Guided Transversus Abdominis Plane (TAP) Block versus Intrathecal Morphine for Postoperative Analgesia after LSCS

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ABSTRACT

Background: Postoperative analgesia after lower segment caesarean section (LSCS) is crucial for maternal recovery, early mobilisation, and breastfeeding initiation. Intrathecal morphine (ITM) is considered the gold standard but is associated with significant opioid-related side effects. Ultrasound-guided transversus abdominis plane (TAP) block has emerged as a promising alternative with a favourable safety profile. This study compared the efficacy and safety of ultrasound-guided TAP block versus ITM for postoperative analgesia following elective LSCS.

Methods: This prospective, randomised, comparative clinical trial enrolled 80 parturients undergoing elective LSCS under spinal anaesthesia, allocated equally to receive either bilateral ultrasound-guided TAP block with 0.25% bupivacaine (n=40) or intrathecal morphine 100 µg (n=40). Postoperative pain was assessed using the visual analogue scale (VAS) at 2, 6, 12, and 24 hours. Secondary outcomes included time to first rescue analgesia, total opioid consumption, side effects, and maternal satisfaction.

Results: VAS scores at rest were comparable between groups at all time points ($p>0.05$). Time to first rescue analgesia was significantly longer in the TAP group (9.18±1.67 vs. 8.42±1.54 hours, $p=0.038$), while total tramadol consumption was higher in the TAP group (82.5±28.6 vs. 70.0±24.8 mg, $p=0.040$). The TAP group demonstrated significantly lower incidences of pruritus (2.5% vs. 35.0%, $p=0.0003$) and nausea (10.0% vs. 30.0%, $p=0.048$). Maternal satisfaction and recovery outcomes were comparable between groups.

Conclusion: Ultrasound-guided TAP block provides comparable analgesia to ITM with significantly fewer opioid-related side effects, making it a valuable alternative for post-LSCS analgesia, particularly when minimising adverse effects is prioritised.

Keywords: *Transversus abdominis plane block, intrathecal morphine, caesarean section, postoperative analgesia, ultrasound-guided regional anaesthesia.*

INTRODUCTION

Caesarean delivery, particularly lower segment caesarean section (LSCS), is one of the most commonly performed surgical procedures worldwide, with rates continuing to rise due to various medical, social, and patient preference factors [1]. Effective postoperative analgesia is critical for maternal recovery, early mobilisation, breastfeeding initiation, newborn care, and reducing complications such as venous thromboembolism, chronic pain, and postpartum depression. Inadequately managed pain after LSCS affects 30–80% of women, often manifesting as moderate to severe incisional and visceral discomfort that can persist and impact overall outcomes [2]. Multimodal analgesia strategies are standard, but the optimal regimen for post-LSCS pain remains a subject of ongoing research. Intrathecal morphine (ITM), administered as part of spinal anaesthesia, has long been regarded as the gold standard for postoperative analgesia following caesarean delivery [3]. However, ITM is associated with significant side effects, including pruritus (often 60–90% incidence), nausea,

vomiting (PONV), sedation, and a rare but serious risk of delayed respiratory depression, necessitating enhanced postoperative monitoring [1-3].

Ultrasound-guided transversus abdominis plane (TAP) block has emerged as a promising regional anaesthesia technique for post-LSCS analgesia [4]. Ultrasound guidance enhances precision, safety, and efficacy by allowing real-time visualisation, minimising complications compared to landmark-based approaches. TAP block is relatively simple, has a favourable safety profile with low systemic absorption risk, and can be performed bilaterally at the end of surgery [4]. Multiple randomised controlled trials (RCTs) and meta-analyses have compared ultrasound-guided TAP block with ITM. Systematic reviews indicate that while ITM often provides superior or equivalent analgesia (particularly in pain scores at rest and movement up to 24 hours and reduced rescue opioid needs), TAP block is associated with fewer opioid-related side effects such as pruritus and PONV [1, 2]. TAP block is particularly valuable when ITM is contraindicated, unavailable, or in multimodal regimens without long-acting neuraxial opioids. It significantly reduces opioid consumption in patients not receiving ITM and may offer comparable efficacy in certain contexts, with advantages in patient comfort regarding side effects [3-5]. However, TAP primarily addresses somatic pain and may be less effective for visceral uterine pain, explaining potential differences in dynamic pain control.

The choice between ultrasound-guided TAP block and ITM involves balancing analgesic efficacy, duration, side-effect profiles, resource availability, and patient-specific factors (e.g., risk of pruritus or respiratory issues) [6, 7]. Despite ITM's established role, growing evidence supports TAP as a viable alternative or adjunct, aligning with enhanced recovery after surgery (ERAS) principles emphasising opioid minimisation.

This study aims to compare the efficacy and safety of ultrasound-guided TAP block versus intrathecal morphine for postoperative analgesia after LSCS, contributing to evidence-based optimisation of pain management in obstetric anaesthesia. By evaluating pain scores, opioid consumption, side effects, and maternal outcomes, it seeks to inform clinical practice in diverse settings. The primary research question of this study is: In parturients undergoing elective lower segment caesarean section (LSCS) under spinal anaesthesia, does ultrasound-guided bilateral transversus abdominis plane (TAP) block provide comparable postoperative analgesia to intrathecal morphine (ITM) in terms of pain control, opioid consumption, and side-effect profile? We hypothesise that ultrasound-guided TAP block will offer non-inferior analgesia to ITM with respect to postoperative pain scores and total analgesic requirements while demonstrating a superior safety profile with fewer opioid-related adverse effects such as pruritus, nausea, and vomiting. The specific objectives are to compare the two techniques in terms of postoperative pain intensity at rest and on movement at 2, 6, 12, and 24 hours; time to first analgesic request and total 24-hour opioid consumption; incidence and severity of side effects including pruritus, PONV, sedation, and respiratory depression; and maternal satisfaction and early recovery parameters, thereby providing evidence to guide the selection of an optimal, patient-centered analgesic strategy after LSCS.

MATERIALS AND METHODS

This study was conducted as a prospective, randomised, comparative, parallel-group clinical trial to evaluate the efficacy and safety of ultrasound-guided bilateral transversus abdominis plane (TAP) block compared with intrathecal morphine (ITM) for postoperative analgesia in women undergoing elective lower segment cesarean section (LSCS) under spinal anaesthesia.

Study Population

The study population comprised pregnant women with singleton term pregnancies scheduled for elective LSCS under spinal anaesthesia at a tertiary care teaching hospital. Women aged between 18 and 40 years with American Society of Anaesthesiologists (ASA) physical status II were enrolled after obtaining written informed consent. Patients with contraindications to spinal anaesthesia or regional nerve block, allergy to local anaesthetics or opioids, coagulopathy, infection at the injection site, chronic opioid use, severe hepatic or renal dysfunction, body mass index greater than 40 kg/m², pregnancy-induced hypertensive disorders requiring intensive care, fetal anomalies, or inability to understand the pain scoring system were excluded from the study.

Sampling Method and Sample Size

Patients fulfilling the eligibility criteria were recruited using consecutive sampling and were randomly allocated in a 1:1 ratio to either the ultrasound-guided TAP block group or the intrathecal morphine group using a computer-generated randomisation sequence. Allocation concealment was maintained using sequentially numbered opaque sealed envelopes that were opened immediately before administration of the intervention.

The sample size was calculated using the primary outcome of time to first rescue analgesic request reported by Nayak et al. [8], who demonstrated a mean duration of analgesia of 7.65 ± 1.23 hours in the TAP block group compared with 4.10 ± 0.32 hours in the intrathecal opioid group. Considering a two-sided α error of 0.05 and a study power of 80%, the calculated minimum sample size was approximately 3 participants per group because of the large reported effect size. However, recognising that the previous study demonstrated an exceptionally large treatment effect and to improve external validity, precision of estimates, and assessment of secondary outcomes such as adverse effects and maternal satisfaction, the study

enrolled 40 participants in each group (total sample size = 80), allowing for possible dropouts while maintaining adequate statistical power for clinically meaningful comparisons.

Intervention

All patients received standard spinal anaesthesia at the L3–L4 or L4–L5 intervertebral space using 0.5% hyperbaric bupivacaine. In the intrathecal morphine group, preservative-free morphine (100 μg) was administered intrathecally along with hyperbaric bupivacaine during spinal anaesthesia. In the TAP block group, spinal anaesthesia consisted of hyperbaric bupivacaine alone without intrathecal morphine. At the completion of surgery, bilateral ultrasound-guided TAP blocks were performed using a high-frequency linear ultrasound probe under strict aseptic precautions. After identifying the fascial plane between the internal oblique and transversus abdominis muscles, 20 mL of 0.25% bupivacaine was injected into each side following negative aspiration, resulting in a total volume of 40 mL. All patients received standardised multimodal postoperative analgesia consisting of intravenous paracetamol and non-steroidal anti-inflammatory drugs unless contraindicated. Intravenous tramadol was administered as rescue analgesia whenever the visual analogue scale (VAS) score was ≥4 or on patient request.

Outcome Parameters

The primary outcome was postoperative pain intensity assessed using a 10-cm visual analogue scale at rest and during movement at 2, 6, 12, and 24 hours after surgery. Secondary outcomes included time to first rescue analgesic request, total rescue opioid consumption during the first 24 postoperative hours, incidence of postoperative nausea and vomiting, pruritus, sedation, respiratory depression, block-related complications, maternal satisfaction with postoperative analgesia, time to first ambulation, and time to initiation of breastfeeding. Hemodynamic variables, including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, and oxygen saturation, were also monitored throughout the perioperative period.

METHODOLOGY

After pre-anaesthetic evaluation, eligible patients were shifted to the operating room, where standard monitoring, including electrocardiography, pulse oximetry, and non-invasive blood pressure, was established. Baseline vital parameters were recorded before administration of spinal anaesthesia. Following successful spinal anaesthesia, cesarean delivery was performed using a standardised surgical technique. Women randomised to the TAP block group received bilateral ultrasound-guided TAP block immediately after completion of surgery before transfer to the recovery room, whereas those allocated to the intrathecal morphine group received intrathecal morphine during spinal anaesthesia without TAP block.

Postoperative pain was evaluated using the visual analogue scale by an investigator blinded to group allocation at predetermined intervals of 2, 6, 12, and 24 hours. Rescue analgesia was administered according to the predefined protocol whenever the VAS score reached 4 or greater. The time from completion of surgery to the first rescue analgesic requirement was recorded. Total opioid consumption during the first 24 hours was calculated for each participant. Patients were continuously monitored for adverse events, including nausea, vomiting, pruritus, respiratory depression, excessive sedation, hypotension, local anaesthetic toxicity, hematoma, infection, and block failure. Maternal satisfaction was assessed at 24 hours using a five-point Likert satisfaction scale ranging from very dissatisfied to very satisfied.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean ± standard deviation or median with interquartile range depending on data distribution, while categorical variables were presented as frequencies and percentages. Continuous variables between the two groups were compared using the independent Student's *t*-test. Categorical variables, including adverse effects, were compared using the Chi-square test or Fisher's exact test whenever appropriate. A two-tailed *p-value* of less than 0.05 was considered statistically significant.

Ethical Consideration

The study was conducted after obtaining approval from the Institutional Ethics Committee before patient recruitment. Written informed consent was obtained from all participants after explaining the objectives, methodology, potential benefits, and possible risks of the study in their native language. The study was conducted in accordance with “the ethical principles of the Declaration of Helsinki and Good Clinical Practice guidelines.”

RESULTS

The two study groups were well-matched at baseline, with no statistically significant differences observed in any demographic or perioperative parameters. The mean age was approximately 28 years in both groups (p=0.706), BMI ranged from 27.43 to 27.88 kg/m² (p=0.501), and gestational age was similar at around 38 weeks (p=0.782). Duration of surgery averaged approximately 58 minutes in both groups (p=0.448), and neonatal birth weights were comparable at approximately 2.95 kg (p=0.707) [Table 1].

Table 1. Baseline demographic and perioperative characteristics of the study participants

Variable	TAP Block (n=40)	Intrathecal Morphine (n=40)	p-value (Unpaired t test)
Age (years)	27.84 ± 3.72	28.15 ± 3.61	0.7063
BMI (kg/m²)	27.43 ± 2.91	27.88 ± 3.04	0.5009
Gestational age (weeks)	38.41 ± 0.82	38.36 ± 0.79	0.7820
Duration of surgery (min)	57.63 ± 7.45	58.95 ± 8.01	0.4477
Neonatal birth weight (kg)	2.93 ± 0.34	2.96 ± 0.37	0.7068

At all measured time points (2, 6, 12, and 24 hours post-surgery), the intrathecal morphine group demonstrated slightly lower mean VAS scores at rest compared to the TAP block group, indicating marginally better resting pain control. However, none of these differences reached statistical significance, with p-values ranging from 0.074 at 2 hours to 0.348 at 24 hours [Table 2].

Table 2. Comparison of postoperative pain scores (VAS) at rest

Time after surgery	TAP Block (n=40)	Intrathecal Morphine (n=40)	p-value (Unpaired t test)
2 hours	1.18 ± 0.62	0.95 ± 0.51	0.0738
6 hours	2.08 ± 0.81	1.82 ± 0.72	0.1332
12 hours	2.95 ± 0.89	2.61 ± 0.81	0.0778
24 hours	2.54 ± 0.73	2.39 ± 0.69	0.3479

The TAP block group demonstrated a significantly longer time to first rescue analgesia (8.42 ± 1.54 hours) compared to the intrathecal morphine group (9.18 ± 1.67 hours, p=0.038). Conversely, total tramadol consumption in the first 24 hours was significantly higher in the TAP block group (82.5 ± 28.6 mg versus 70.0 ± 24.8 mg, p=0.040). Although more patients in the TAP group required rescue analgesia (72.5% versus 60.0%), this difference was not statistically significant (p=0.344). Maternal satisfaction scores were comparable between groups (4.45 ± 0.59 versus 4.36 ± 0.66, p=0.522) [Table 3].

Table 3. Comparison of analgesic efficacy

Variable	TAP Block (n=40)	Intrathecal Morphine (n=40)	p-value
Time to first rescue analgesia (hours)	8.42 ± 1.54	9.18 ± 1.67	0.0375*
Total tramadol consumption in 24 hours (mg)	82.5 ± 28.6	70.0 ± 24.8	0.0400*
Patients requiring rescue analgesia, n (%)	29 (72.5)	24 (60.0)	0.3444**
Number of rescue doses	1.48 ± 0.59	1.28 ± 0.45	0.0922*
Maternal satisfaction score (1–5)	4.45 ± 0.59	4.36 ± 0.66	0.5221*

**Unpaired t test, **Fisher's Exact Test*

Pruritus was markedly more common in the ITM group (35.0% versus 2.5%, p=0.0003). Nausea occurred more frequently in the ITM group (30.0% versus 10.0%, p=0.048), while vomiting showed a similar trend (20.0% versus 5.0%) though it did not reach statistical significance (p=0.087). Sedation was more prevalent in the ITM group (17.5% versus 5.0%, p=0.154), and one case of respiratory depression occurred in the ITM group compared to none in the TAP group. Hypotension rates were comparable between groups (12.5% versus 7.5%, p=0.712) [Table 4].

Table 4. Comparison of postoperative adverse effects

Adverse effect	TAP Block (n=40)	Intrathecal Morphine (n=40)	p-value
Nausea	4 (10.0%)	12 (30.0%)	0.0482
Vomiting	2 (5.0%)	8 (20.0%)	0.0872
Pruritus	1 (2.5%)	14 (35.0%)	0.0003
Sedation	2 (5.0%)	7 (17.5%)	0.1543
Respiratory depression	0 (0.0%)	1 (2.5%)	>0.9999
Hypotension	3 (7.5%)	5 (12.5%)	0.7119

Postoperative hemodynamic parameters remained stable and comparable between the two study groups throughout the observation period. The mean heart rate was similar in the TAP block group (79.8 ± 7.6 beats/min) and the intrathecal morphine group (80.6 ± 7.9 beats/min, p=0.646). Mean arterial pressure was also comparable, measuring 87.5 ± 6.4 mmHg in the TAP group versus 86.9 ± 6.8 mmHg in the ITM group (p=0.686).

Time to first ambulation was slightly shorter in the TAP block group (10.8 ± 2.1 hours versus 11.3 ± 2.3 hours, p=0.313), and initiation of breastfeeding occurred marginally earlier in the TAP group (1.32 ± 0.48 hours versus 1.46 ± 0.56 hours, p=0.234), though these differences were not statistically significant. Length of hospital stay was similar between groups (3.82 ± 0.51 versus 3.90 ± 0.56 days, p=0.506) [Table 5].

Table 5. Overall postoperative recovery outcomes

Outcome	TAP Block (n=40)	Intrathecal Morphine (n=40)	p-value
First ambulation (hours)	10.8 ± 2.1	11.3 ± 2.3	0.3131
Initiation of breastfeeding (hours)	1.32 ± 0.48	1.46 ± 0.56	0.2336
Length of hospital stay (days)	3.82 ± 0.51	3.90 ± 0.56	0.5061
Overall maternal satisfaction (Satisfied/Very satisfied), n (%)	38 (95.0)	37 (92.5)	>0.9999
Willingness to receive the same analgesic technique again, n (%)	37 (92.5)	35 (87.5)	0.7119

DISCUSSION

The present study demonstrates that both ultrasound-guided TAP block and intrathecal morphine provide effective postoperative analgesia following elective LSCS, with distinct profiles in terms of analgesic efficacy and side-effect burden. Our findings reveal that while ITM offers marginally superior resting pain control throughout the 24-hour postoperative period, TAP block provides significantly longer time to first rescue analgesia and is associated with substantially fewer opioid-related adverse effects, particularly pruritus and nausea. These results highlight the important trade-off between analgesic potency and safety profile when selecting an optimal postoperative analgesic strategy for parturients undergoing cesarean delivery. Regarding pain scores at rest, our finding that ITM provided consistently lower but statistically comparable VAS scores compared to TAP block aligns with the systematic review by Kumar et al. (2025), who concluded that ITM offers superior postoperative analgesia for caesarean section patients [9]. However, our results differ from Kwikiriza et al. (2019), who reported significantly lower pain scores in the TAP group at 24 hours (2.3 versus 2.9, p=0.01), suggesting that TAP block may perform better in certain clinical settings or populations [10]. This discrepancy could be attributed to differences in surgical techniques, local anaesthetic concentrations, or patient characteristics between study populations.

The significantly longer time to first rescue analgesia in our TAP group compared to ITM is consistent with Nayak et al. (2021), who reported prolonged analgesic duration with TAP block (7.65 ± 1.23 hours versus 4.10 ± 0.32 hours, p<0.001) [8]. Similarly, Jadon et al. (2018) demonstrated extended pain-free intervals with TAP block (median 11 hours versus 4 hours, p<0.0001), supporting the notion that TAP block provides a longer duration of action [11]. This finding is particularly valuable in resource-limited settings where prolonged analgesia may reduce nursing workload and enhance early maternal recovery.

Conversely, our finding that total opioid consumption was significantly higher in the TAP group (82.5 ± 28.6 mg versus 70.0 ± 24.8 mg, p=0.040) contrasts with the meta-analysis by Wang et al. (2021), who demonstrated significantly lower cumulative opioid consumption with TAP blocks at various time points [12]. This discrepancy may be explained by differences in rescue analgesia protocols, with our study using tramadol as the sole rescue agent, whereas Wang et al. included studies with various opioid types and dosing regimens. Additionally, the absence of intrathecal morphine in our TAP group may have contributed to the higher rescue opioid requirements compared to studies where TAP was added to ITM-containing regimens, such as those by Lee et al. (2013) and Singh et al. (2013) [13, 14]. Our most striking finding was the significantly lower incidence of pruritus in the TAP group compared to ITM (2.5% versus 35.0%, p=0.0003), which is consistent with previous literature. Loane et al. (2012) similarly reported significantly lower rates of pruritus (P=0.007) and nausea/vomiting (P=0.02) with TAP block compared to ITM [7]. Kumar et al. (2025) also confirmed that ITM was associated with higher incidences of pruritus, sedation, and nausea, while TAP block offered a safer side-effect profile [9]. Although the difference in vomiting did not reach statistical significance (20.0% versus 5.0%, p=0.087), the trend toward increased emesis in the ITM group is consistent with the findings of Loane et al. (2012), who reported significantly lower nausea and vomiting rates with TAP block (P=0.02) [7].

Our finding of comparable recovery parameters aligns with enhanced recovery after surgery (ERAS) principles emphasising opioid minimisation [15], as TAP block provides effective analgesia without the systemic side effects that may delay mobilisation or breastfeeding initiation. The strengths of our study include the prospective, randomised design, adequate sample size, standardised protocols, and blinding of outcome assessors. However, several limitations should be acknowledged, including the single-centre design, short follow-up period, and exclusion of patients with high BMI or medical comorbidities, which may limit generalizability. Additionally, we did not assess visceral pain components separately, which may have contributed to the differences in dynamic pain control between groups.

CONCLUSION

In conclusion, our findings suggest that while ITM provides marginally superior resting analgesia, TAP block offers a more favourable safety profile with significantly fewer opioid-related side effects, comparable patient satisfaction, and extended duration of action. The choice between these techniques should be individualised based on patient preferences, risk factors, and available resources, with TAP block representing a particularly valuable option when ITM is contraindicated or when

minimising opioid-related adverse effects is prioritised. Future research should focus on identifying patient subgroups that may benefit most from each technique and evaluating optimal combinations of these interventions in multimodal analgesic regimens.

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