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Comparison of 0.25%Bupivacaiane Vs 0.5%Ropivacaine in Transversus Abdominis Plane Block for Post Operative Analgesia in LSCS

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Abstract

Background: Postoperative pain following lower segment caesarean section (LSCS) can interfere with maternal recovery and early mobilization. The transversus abdominis plane (TAP) block is an effective regional analgesic technique that can reduce postoperative pain and the requirement for rescue analgesics. This study compared the analgesic efficacy of 0.25% bupivacaine and 0.5% ropivacaine for bilateral ultrasound-guided TAP block following LSCS.

Methods: This prospective comparative study was conducted in the Departments of Anaesthesiology and Obstetrics and Gynecology at GMERS Medical College and Hospital, Himmatnagar, Gujarat, from September 2023 to January 2025. A total of 120 women undergoing LSCS were enrolled and allocated into two groups of 60 each. Group A received bilateral TAP block with 0.25% bupivacaine (15 mL per side), while Group B received 0.5% ropivacaine (15 mL per side). Postoperative pain was assessed using the Visual Analogue Scale (VAS). The primary outcome was duration of analgesia, assessed by time to first rescue analgesic requirement. Secondary outcomes included VAS scores, rescue analgesic requirement, haemodynamic parameters, adverse effects, and patient satisfaction.

Results: The demographic characteristics were comparable between the groups. The onset of analgesia was significantly faster with ropivacaine than bupivacaine

(6.98 ± 1.07 vs. 7.42 ± 1.15 minutes; p=0.035). The mean duration of analgesia was significantly longer in the ropivacaine group (16.28 ± 1.20 vs. 12.89 ± 2.00 hours; p<0.001). VAS scores were significantly lower in the ropivacaine group at most postoperative assessment intervals. The mean time to first rescue analgesic was also significantly longer with ropivacaine (560.70 ± 107.14 vs. 515.55 ± 111.52 minutes; p=0.026). Overall adverse effects were comparable between the groups (p=0.331).

Conclusion: Bilateral ultrasound-guided TAP block with 0.5% ropivacaine provided longer postoperative analgesia, lower pain scores, and delayed requirement for rescue analgesia compared with 0.25% bupivacaine following LSCS. Both techniques demonstrated comparable overall safety and haemodynamic stability. Within the regimens studied, 0.5% ropivacaine appears to be an effective option for postoperative analgesia after LSCS.

Keywords: Bupivacaine, Ropivacaine, Transversus Abdominis Plane Block, LSCS, Caesarean Section, Postoperative Analgesia, VAS.

Introduction

Caesarean section is one of the most commonly performed obstetric surgical procedures worldwide. Although advances in anaesthetic and surgical techniques have improved maternal safety, postoperative pain remains an important clinical concern following caesarean delivery. Inadequately controlled postoperative pain may interfere with early mobilization, breastfeeding, maternal–infant interaction, sleep and recovery, and may increase the requirement for systemic analgesics, particularly opioids. Therefore, effective postoperative analgesia with minimal maternal adverse effects is an important component of perioperative care in women undergoing lower segment caesarean section (LSCS).

Post-caesarean pain is predominantly related to the surgical incision and manipulation of the anterior abdominal wall. Multimodal analgesia, incorporating regional anaesthetic techniques, non-opioid analgesics and, when required, opioids, is commonly used to improve postoperative pain control. Regional techniques have the potential to provide effective analgesia while reducing systemic analgesic requirements and their associated adverse effects.[1,2]

The transversus abdominis plane (TAP) block is a regional anaesthetic technique that targets the sensory nerves supplying the anterior and lateral abdominal wall. The local anaesthetic is deposited in the fascial plane between the internal oblique and transversus abdominis muscles, thereby producing blockade of the thoracolumbar nerves traversing this plane. The anatomical basis of the TAP block was initially described by McDonnell et al., who demonstrated that local anaesthetic deposited within this plane can provide sensory blockade of the abdominal wall.[3] Subsequently, ultrasound guidance facilitated more precise identification of the abdominal wall layers and improved the accuracy and reproducibility of TAP block placement.[4]

Ultrasound-guided TAP block has been investigated extensively as an analgesic technique following caesarean delivery. Belavy et al. demonstrated the feasibility of ultrasound-guided TAP block for postoperative analgesia following caesarean section.[5] McDonnell et al. subsequently reported significant analgesic benefits of TAP block following caesarean delivery, including reduced postoperative opioid requirements.[6] Systematic reviews and meta-analyses have also demonstrated that TAP block can provide clinically useful postoperative

analgesia, particularly in settings where long-acting neuraxial opioids are not used.[7-9]

The efficacy of a TAP block depends on several factors, including the local anaesthetic used, concentration, volume, dose, distribution of the injectate, block technique and concomitant analgesic regimen. Bupivacaine is a long-acting amide local anaesthetic widely used for peripheral nerve and fascial plane blocks. However, concerns regarding cardiotoxicity and prolonged motor blockade have encouraged the use of alternative long-acting local anaesthetics. Ropivacaine is an amide local anaesthetic structurally related to bupivacaine and has been developed with a relatively favourable safety profile, particularly with regard to cardiovascular and central nervous system toxicity. Comparative studies in obstetric anaesthesia have demonstrated that ropivacaine can provide effective regional anaesthesia with less motor blockade than bupivacaine in some settings.[10,11]

The choice between bupivacaine and ropivacaine for TAP block after LSCS remains clinically relevant because differences in analgesic duration, pain intensity, rescue analgesic requirement and adverse effects may influence maternal recovery. Studies evaluating ropivacaine in TAP block after caesarean delivery have demonstrated prolonged analgesia and reduced postoperative analgesic requirements compared with control interventions.[12] In addition, a study specifically comparing 0.5% ropivacaine with 0.25% bupivacaine for TAP block in LSCS reported lower postoperative pain scores and prolonged analgesia with ropivacaine.[13]

However, the findings of studies evaluating TAP block after caesarean delivery are not entirely uniform. Systematic reviews have shown that the analgesic benefit of TAP block may vary according to the anaesthetic technique, use of intrathecal opioids and the background multimodal analgesic regimen.[7-9,14] Therefore, further comparative studies using standardized techniques and clinically relevant postoperative outcomes are warranted. The present study was undertaken to compare 0.25% bupivacaine and 0.5% ropivacaine for bilateral ultrasound-guided TAP block in women undergoing LSCS. The study evaluated the onset and duration of analgesia, postoperative pain scores, time to first rescue analgesic requirement, haemodynamic and respiratory parameters, adverse effects and overall postoperative analgesic efficacy.

Materials and Methods

Study Design and Setting

This prospective comparative study was conducted in the Departments of Anaesthesiology and Obstetrics and Gynecology at GMERS Medical College and Hospital, Himmatnagar, Gujarat. The study was carried out from 15 September 2023 to 31 January 2025. Ethical approval was obtained from the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants prior to enrolment.

Study Population and Sample Size

A total of 120 pregnant women scheduled to undergo lower segment caesarean section (LSCS), either electively or as an emergency procedure, were enrolled after fulfilling the predefined eligibility criteria.

The sample size was calculated based on the expected duration of postoperative analgesia, which was the principal parameter for comparison between bupivacaine and ropivacaine. Based on a previous study by Neha Sharma et al.[10], the mean duration of analgesia was reported as 12.61 ± 5.13 hours in the ropivacaine group and 9.92 ± 4.81 hours in the bupivacaine group. Considering a two-sided significance level of 5%, 80%

statistical power, and the expected difference between the groups, the required sample size was estimated to be 54 participants per group. To account for potential variability and improve the robustness of the study, 120 participants were included, with 60 participants in each group.

Randomization and Allocation

Eligible participants were randomly allocated into two groups using a simple numerical randomization method based on the last digit of the hospital registration number. Participants with registration numbers ending in an even digit (0, 2, 4, 6, or 8) were assigned to Group A (Bupivacaine group), while those with an odd final digit (1, 3, 5, 7, or 9) were assigned to Group B (Ropivacaine group).

Group A received an ultrasound-guided bilateral TAP block with 0.25% bupivacaine, whereas Group B received an ultrasound-guided bilateral TAP block with 0.5% ropivacaine.

Study Groups and Intervention

Group A – Bupivacaine group (n=60): Participants received an ultrasound-guided bilateral transversus abdominis plane (TAP) block using 15 mL of 0.25% bupivacaine on each side, giving a total volume of 30 mL.

Group B – Ropivacaine group (n=60): Participants received an ultrasound-guided bilateral TAP block using 15 mL of 0.5% ropivacaine on each side, giving a total volume of 30 mL.

The TAP block was administered using the same technique and at the same postoperative time point in both groups.

Blinding

To maintain blinding, the study drug solutions were prepared by an independent anaesthesiologist who was not involved in block administration or outcome assessment. The solutions were prepared under strict aseptic conditions and labelled identically. This ensured blinding of both the patient and the anaesthesiologist administering the block.

Pre-Anaesthetic Assessment and Monitoring

All participants underwent a detailed pre-anaesthetic evaluation, including medical history, physical examination, and relevant laboratory and diagnostic investigations. On arrival in the operating room, standard monitoring was instituted, including non-invasive blood pressure (NIBP), electrocardiography (ECG), pulse oximetry (SpO_2), and end-tidal carbon dioxide ($EtCO_2$) monitoring. Baseline heart rate, blood pressure, and oxygen saturation were recorded before the procedure.

Following completion of LSCS, the bilateral TAP block was performed under ultrasound guidance using the allocated local anaesthetic solution.

Ultrasound-Guided TAP Block Technique

The procedure was performed under strict aseptic precautions with the patient in the supine position. A high-frequency 6–13 MHz linear-array ultrasound transducer covered with a sterile probe cover and sterile ultrasound gel was used.

The transducer was placed transversely on the anterolateral abdominal wall between the costal margin and iliac crest and moved laterally towards the midaxillary line to identify the three muscle layers: the external oblique, internal oblique, and transversus abdominis muscles.

After obtaining an adequate ultrasound image, a regional block needle was introduced using an in-plane approach and advanced under direct ultrasound visualization into the fascial plane between the internal oblique and transversus abdominis muscles. After confirming correct needle placement, the allocated local anaesthetic was injected incrementally. Separation of the fascial plane

with the appearance of a hypoechoic spread of local anaesthetic was used to confirm appropriate deposition. The spread of the solution was continuously visualized during injection.

The same technique was used bilaterally in all participants.

Local Anaesthetic Doses

Group	Local anaesthetic	Concentration	Volume per side	Total volume
Group A	Bupivacaine	0.25% (2.5 mg/mL)	15 mL	30 mL
Group B	Ropivacaine	0.5% (5 mg/mL)	15 mL	30 mL

The selected concentrations were intended to provide clinically comparable local anaesthetic effects for the TAP block while comparing the postoperative analgesic profiles of the two agents.

Assessment of Postoperative Pain

Postoperative pain was assessed using the Visual Analog Scale (VAS) at predefined intervals during the first 24 postoperative hours. Assessments were performed at 2, 4, 6, 8, 12, and 24 hours after surgery.

Pain scores were recorded both at rest and during movement wherever applicable. The duration of analgesia was defined according to the time from completion of the TAP block to the requirement for the first rescue analgesic.

Rescue Analgesia

Rescue analgesia was administered when the patient reported a VAS score ≥4, either at rest or during movement. The primary rescue analgesic was intravenous diclofenac sodium 75 mg. If adequate pain relief was not achieved after 30 minutes, an additional intravenous tramadol 50 mg was administered.

The time to first rescue analgesic, number of rescue doses, and total analgesic consumption during the first 24 postoperative hours were recorded for each participant.

ssessment of Haemodynamic Parameters

Heart rate, systolic and diastolic blood pressure, mean arterial pressure, and oxygen saturation were monitored during the perioperative period and documented at predefined time points. These parameters were assessed to evaluate haemodynamic stability following administration of the TAP block.

Assessment of Adverse Effects and Patient Satisfaction

Patients were monitored for adverse effects potentially related to the TAP block or local anaesthetic administration. Any complications or adverse events occurring during the postoperative observation period were recorded.

Patient satisfaction with postoperative analgesia was also assessed and documented as part of the study outcome evaluation.

Outcome Measures

The primary outcome of the study was the duration of postoperative analgesia, assessed by the time to first rescue analgesic requirement.

The secondary outcomes included postoperative VAS pain scores, total rescue analgesic consumption during 24 hours, number of rescue analgesic doses, haemodynamic parameters, adverse effects, and patient satisfaction.

Statistical Analysis

Data were entered and analysed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean ± standard deviation (SD) for normally distributed data and as median with interquartile range (IQR) for non-normally distributed data. Categorical variables were presented as frequencies and percentages.

Between-group comparisons of continuous variables were performed using the Independent Samples t-test for normally distributed data and the Mann–Whitney U test for non-normally distributed data. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate.

A p-value <0.05 was considered statistically significant. Missing data were handled using complete-case analysis. Subgroup analyses were performed wherever considered relevant.

Results and Observations

A total of 120 pregnant women undergoing lower segment caesarean section (LSCS) were included in the study. Participants were randomly allocated into two groups of 60 each: Group A (Bupivacaine) and Group B (Ropivacaine). Baseline demographic characteristics, onset and duration of analgesia, postoperative pain scores, haemodynamic parameters, rescue analgesic requirement, and adverse effects were compared between the two groups.

Table 1: Comparison of demographic characteristics between the two study groups

Variable	Group A: Bupivacaine (n=60) Mean ± SD	Group B: Ropivacaine (n=60) Mean ± SD	p-value
Age (years)	29.17 ± 4.94	28.75 ± 6.04	0.68
Height (cm)	159.42 ± 4.99	159.33 ± 4.55	0.91
Weight (kg)	56.32 ± 9.13	55.00 ± 8.39	0.41

Observation: The mean age, height, and body weight were comparable between the two groups. None of the differences was statistically significant (p>0.05), indicating adequate baseline comparability.

Table 2: Comparison of onset and duration of analgesia

Parameter	Group A: Bupivacaine	Group B: Ropivacaine	p-value
Onset time (min), Mean ± SD	7.42 ± 1.15	6.98 ± 1.07	0.035
Duration of analgesia (hours), Mean ± SD	12.89 ± 2.00 (n=60)	16.28 ± 1.20 (n=60)	<0.001

Observation: Ropivacaine demonstrated a significantly faster onset of action than bupivacaine (6.98 vs. 7.42 minutes, p=0.035). The duration of analgesia was also significantly longer with ropivacaine than with bupivacaine (16.28 vs. 12.89 hours, p<0.001).

Table 3: Comparison of postoperative heart rate at different time intervals

Time interval	Bupivacaine Mean ± SD	Ropivacaine Mean ± SD	p-value
Immediate postoperative	75.71 ± 4.52	76.48 ± 4.71	0.363
30 min	76.95 ± 4.98	76.78 ± 5.18	0.850
1 hour	76.40 ± 5.22	76.68 ± 3.80	0.739
2 hours	77.14 ± 4.97	76.47 ± 5.69	0.494
4 hours	75.16 ± 4.50	76.49 ± 4.80	0.119
6 hours	76.99 ± 5.58	76.07 ± 4.99	0.348
8 hours	76.46 ± 5.10	76.94 ± 4.38	0.586
10 hours	78.07 ± 4.71	76.97 ± 4.65	0.200
12 hours	77.05 ± 4.31	75.94 ± 4.45	0.196
24 hours	79.28 ± 11.87	80.23 ± 11.87	0.660

Observation: Heart rate remained comparable between the two groups throughout the 24-hour postoperative period. No statistically significant difference was observed at any time point (p>0.05), suggesting similar haemodynamic stability.

Table 4: Comparison of postoperative SpO_2 at different time intervals

Time interval	Bupivacaine Mean ± SD	Ropivacaine Mean ± SD	p-value
Immediate postoperative	97.80 ± 0.99	97.77 ± 1.03	0.872
30 min	97.98 ± 0.96	97.66 ± 1.14	0.096

1 hour	97.73 ± 1.02	97.74 ± 0.91	0.962
2 hours	97.56 ± 1.02	97.95 ± 0.97	0.034
4 hours	97.97 ± 1.04	97.70 ± 1.02	0.154
6 hours	97.57 ± 1.08	97.93 ± 0.95	0.057
8 hours	97.82 ± 0.87	97.69 ± 0.99	0.420
10 hours	97.62 ± 0.93	97.69 ± 0.95	0.703
12 hours	98.87 ± 0.99	98.58 ± 1.12	0.140
24 hours	98.25 ± 1.14	98.38 ± 1.15	0.520

Observation: SpO_2 values were generally comparable between the two groups. A statistically significant difference was observed only at 2 hours (p=0.034), with slightly higher SpO_2 in the ropivacaine group. Overall, both groups maintained adequate oxygen saturation throughout the postoperative period.

Table 5: Comparison of postoperative mean arterial pressure (MAP)

Time interval	Bupivacaine Mean ± SD	Ropivacaine Mean ± SD	p-value
Immediate postoperative	86.50 ± 5.66	85.78 ± 5.15	0.466
30 min	85.58 ± 4.27	85.84 ± 4.69	0.748
1 hour	86.24 ± 5.06	85.59 ± 5.04	0.479
2 hours	87.15 ± 4.70	84.90 ± 4.70	0.010
4 hours	86.30 ± 4.34	86.30 ± 5.12	0.998
6 hours	86.50 ± 5.74	86.44 ± 4.50	0.950
8 hours	85.73 ± 4.48	87.40 ± 5.12	0.059
10 hours	85.26 ± 4.31	85.73 ± 4.78	0.571
12 hours	77.67 ± 15.61	77.25 ± 13.54	0.870
24 hours	76.72 ± 13.59	81.08 ± 12.73	0.070

Observation: MAP was comparable between groups at most postoperative intervals. A statistically significant difference was observed at 2 hours, with a higher mean MAP in the bupivacaine group (p=0.010). No significant difference was observed at the remaining time points.

Table 6: Comparison of postoperative systolic blood pressure (SBP)

Time interval	Bupivacaine Mean ± SD	Ropivacaine Mean ± SD	p-value
Immediate postoperative	122.66 ± 11.39	122.40 ± 10.58	0.898
30 min	119.90 ± 10.22	123.30 ± 9.88	0.066
1 hour	119.57 ± 9.10	123.55 ± 10.95	0.033
2 hours	123.44 ± 10.74	123.63 ± 10.15	0.919
4 hours	122.65 ± 11.18	122.93 ± 10.53	0.886
6 hours	122.01 ± 11.37	123.97 ± 10.89	0.337
8 hours	122.08 ± 8.85	125.10 ± 9.78	0.079
10 hours	119.93 ± 10.47	119.84 ± 7.95	0.955
12 hours	110.72 ± 8.99	114.53 ± 11.06	0.040
24 hours	112.35 ± 9.87	115.38 ± 9.75	0.090

Observation: SBP was broadly comparable between the two groups. Statistically significant differences were observed at 1 hour (p=0.033) and 12 hours (p=0.040), with higher SBP in the ropivacaine group. The difference at 24 hours was not statistically significant.

Table 7. Comparison of postoperative diastolic blood pressure (DBP)

Time interval	Bupivacaine Mean ± SD	Ropivacaine Mean ± SD	p-value
Immediate postoperative	80.44 ± 4.67	81.30 ± 4.82	0.322
30 min	80.61 ± 5.81	80.59 ± 5.08	0.979
1 hour	81.55 ± 4.74	80.17 ± 5.18	0.130
2 hours	80.45 ± 5.50	79.89 ± 4.69	0.544
4 hours	80.71 ± 5.11	80.13 ± 4.65	0.520
6 hours	81.23 ± 4.93	81.09 ± 4.27	0.868
8 hours	81.17 ± 4.93	80.85 ± 5.40	0.737
10 hours	81.19 ± 4.54	80.12 ± 5.24	0.237
12 hours	65.13 ± 8.61	70.00 ± 10.54	0.070
24 hours	65.35 ± 8.87	70.73 ± 10.06	0.020

Observation: DBP remained comparable between the groups during most postoperative measurements. A statistically significant difference was observed at 24 hours (p=0.020), with a higher mean DBP in the ropivacaine group.

Table 8. Comparison of postoperative VAS pain scores

Time interval	Bupivacaine Mean ± SD	Ropivacaine Mean ± SD	p-value

Immediate postoperative	2.82 ± 0.98	2.10 ± 0.78	<0.001
30 min	2.88 ± 1.03	2.47 ± 0.93	0.021
1 hour	2.88 ± 0.90	2.50 ± 0.81	0.016
2 hours	2.72 ± 0.89	2.17 ± 0.89	0.001
4 hours	2.88 ± 0.85	2.15 ± 0.90	<0.001
6 hours	2.70 ± 0.93	2.32 ± 1.00	0.031
8 hours	2.88 ± 0.96	2.28 ± 0.96	0.001
10 hours	2.75 ± 1.07	2.30 ± 0.79	0.010
12 hours	3.67 ± 0.66	2.48 ± 0.81	<0.001
24 hours	4.00 ± 0.00	3.00 ± 0.00	0.0049

Observation: VAS pain scores were consistently lower in the ropivacaine group at all assessed time points. The difference was statistically significant throughout the postoperative observation period, with the greatest difference observed at 12 and 24 hours. These findings indicate better and more prolonged postoperative analgesia with ropivacaine.

Table 9: Comparison of time to first rescue analgesia

Parameter	Bupivacaine (n=60)	Ropivacaine (n=60)	p-value
Time to first rescue analgesia (min), Mean ± SD	515.55 ± 111.52	560.70 ± 107.14	0.026
Minimum (min)	320	367	—
Maximum (min)	730	735	—

Observation: The mean time to first rescue analgesic requirement was significantly longer in the ropivacaine group than in the bupivacaine group (560.70 vs. 515.55 minutes; p=0.026), demonstrating a longer duration of effective postoperative analgesia with ropivacaine.

Table 10. Comparison of adverse effects between the study groups

Adverse effect	Bupivacaine n (%)	Ropivacaine n (%)	Total n (%)
No adverse effect	34 (56.7)	41 (68.3)	75 (62.5)
Bradycardia	9 (15.0)	9 (15.0)	18 (15.0)
Drowsiness	0 (0.0)	1 (1.7)	1 (0.8)
Hypotension	6 (10.0)	5 (8.3)	11 (9.2)
Shivering	4 (6.7)	2 (3.3)	6 (5.0)
Vomiting	7 (11.7)	2 (3.3)	9 (7.5)
Total	60 (100)	60 (100)	120 (100)

Chi-square = 5.189; p = 0.331

Observation: Most participants did not experience adverse effects. The overall incidence of adverse effects was comparable between the two groups, and the difference was not statistically significant (p=0.331). Bradycardia and hypotension occurred at similar frequencies, while vomiting was numerically more frequent in the bupivacaine group.

Discussion

Postoperative pain following LSCS is an important determinant of maternal comfort and early recovery. Effective analgesia facilitates early mobilization, breastfeeding and maternal care of the newborn while reducing the need for systemic analgesics. Regional analgesic techniques such as TAP block have therefore gained importance as components of multimodal postoperative analgesia.[1,2]

In the present study, 120 women undergoing LSCS were evaluated, with 60 participants receiving bilateral TAP block with 0.25% bupivacaine and 60 receiving 0.5% ropivacaine. The two groups were comparable with respect to baseline demographic characteristics. Mean age, height and weight did not differ significantly between the groups, indicating satisfactory baseline comparability and reducing the likelihood that demographic differences influenced the postoperative analgesic outcomes.

The anatomical basis of the TAP block is the deposition of local anaesthetic between the internal oblique and

transversus abdominis muscles. The use of ultrasound allows direct visualization of the abdominal wall layers and needle advancement, thereby facilitating accurate deposition of the local anaesthetic.[3,4] In the present study, a standardized ultrasound-guided technique was used for bilateral TAP block, with 15 mL of study solution administered on each side.

Onset and duration of analgesia

The onset of analgesia was significantly faster in the ropivacaine group than in the bupivacaine group. The mean onset time was 6.98 ± 1.07 minutes with ropivacaine compared with 7.42 ± 1.15 minutes with bupivacaine (p=0.035)**.** Although the absolute difference was small, it reached statistical significance, indicating an earlier onset of sensory analgesia with the ropivacaine regimen used in this study.

The most important finding was the significantly longer duration of analgesia in the ropivacaine group. The mean duration was 16.28 ± 1.20 hours with 0.5% ropivacaine compared with 12.89 ± 2.00 hours with 0.25% bupivacaine (p<0.001)**.** Thus, patients receiving ropivacaine experienced a substantially prolonged period of analgesia before requiring rescue medication.

These findings are consistent with previous clinical evidence supporting the usefulness of ropivacaine in TAP block following caesarean delivery. In a prospective randomized study of ultrasound-guided TAP block, 0.5% ropivacaine significantly prolonged the time to first rescue analgesic administration and reduced postoperative tramadol requirements compared with placebo.[12] Similarly, Sethi et al. specifically compared 0.5% ropivacaine and 0.25% bupivacaine for TAP block in LSCS and reported better postoperative analgesia and longer analgesic duration with ropivacaine.[13]

The prolonged analgesic effect observed in the present study is clinically relevant because a longer pain-free interval can reduce the frequency of rescue analgesic administration during the early postoperative period. However, the difference observed should be interpreted in the context of the specific concentrations and doses used in the present study.

Postoperative pain scores

Postoperative VAS scores were significantly lower in the ropivacaine group at all assessed time points. Immediately after surgery, the mean VAS score was 2.10 ± 0.78 in the ropivacaine group compared with 2.82 ± 0.98 in the bupivacaine group (p<0.001)**.** Lower pain scores were also observed with ropivacaine at 30 minutes, 1, 2, 4, 6, 8, 10, 12 and 24 hours.

The difference became particularly evident at 12 hours, when the mean VAS score was 2.48 ± 0.81 with ropivacaine compared with 3.67 ± 0.66 with bupivacaine (p<0.001)**.** At 24 hours, the corresponding values were 3.00 ± 0.00 and 4.00 ± 0.00, respectively, with a statistically significant difference (p=0.0049).

The lower VAS scores observed with ropivacaine are consistent with the findings of Sethi et al., who reported lower postoperative pain scores following TAP block with 0.5% ropivacaine compared with 0.25% bupivacaine in women undergoing LSCS.[13] The findings also support previous evidence that TAP block can provide effective somatic analgesia following caesarean delivery.[5-8]

The progressive increase in pain scores over time in both groups is expected as the effect of the local anaesthetic block gradually decreases. Nevertheless, the consistently lower scores in the ropivacaine group indicate more sustained analgesic benefit during the 24-hour postoperative observation period.

Time to first rescue analgesia

The time to first rescue analgesic requirement was significantly longer in the ropivacaine group. The mean time was 560.70 ± 107.14 minutes with ropivacaine compared with 515.55 ± 111.52 minutes with bupivacaine (p=0.026).

This finding complements the duration-of-analgesia results and indicates that women receiving ropivacaine remained comfortable for a longer period before requiring additional analgesic medication. The finding is also consistent with previous studies demonstrating that TAP block with ropivacaine can delay the requirement for rescue analgesia after caesarean delivery.[12,13]

A prolonged time to first rescue analgesia is clinically advantageous because it may reduce early postoperative medication requirements and improve patient comfort. However, the magnitude of this effect should be interpreted together with the pain scores and the overall multimodal analgesic regimen.

Haemodynamic and respiratory parameters

Heart rate remained comparable between the two groups at the assessed postoperative time points, with no statistically significant differences observed. Similarly, oxygen saturation was generally comparable, although a statistically significant difference was observed at 2 hours. The observed difference was not associated with a clinically important respiratory deterioration.

Blood pressure parameters were also largely comparable between the groups. Some isolated statistically significant differences were observed in MAP, SBP and DBP at individual time points; however, there was no consistent pattern of clinically important haemodynamic instability. The overall similarity of postoperative haemodynamic and respiratory parameters is in agreement with previous studies evaluating TAP block after caesarean delivery, in which maternal vital signs were generally comparable between treatment groups.[12] Studies comparing ropivacaine and bupivacaine in obstetric regional anaesthesia have also demonstrated that both agents can provide effective regional anaesthesia with acceptable maternal haemodynamic profiles.[10,11]

Adverse effects

In the present study, no adverse effect was reported in 56.7% of patients in the bupivacaine group and 68.3% in the ropivacaine group**.** Bradycardia occurred in 15% of patients in each group. Hypotension occurred in 10% and 8.3% of patients in the bupivacaine and ropivacaine groups, respectively. Shivering and vomiting were somewhat more frequent in the bupivacaine group, whereas drowsiness was reported in one patient in the ropivacaine group.

Importantly, the overall difference in adverse effects was not statistically significant **(**χ^2=5.189, p=0.331**).** Thus, although some individual adverse effects showed numerical differences, the overall safety profile was comparable between the two groups.

Previous studies of TAP block after caesarean delivery have generally reported a favourable safety profile, although adverse events may be influenced by the anaesthetic technique, concomitant medications and postoperative analgesic regimen.[8,9,12] The present findings therefore support the clinical feasibility of both local anaesthetics for TAP block when used with appropriate monitoring.

Comparison with previous literature

The findings of the present study are broadly consistent with previous literature supporting TAP block as an effective component of postoperative analgesia following caesarean delivery. McDonnell et al. demonstrated the analgesic efficacy of TAP block after caesarean section in

a randomized controlled trial.[6] Belavy et al. subsequently demonstrated the feasibility of ultrasound-guided TAP block in this population.[5] Abdallah et al., in a systematic review and meta-analysis, reported that TAP block can reduce postoperative opioid consumption, particularly in patients who do not receive long-acting neuraxial opioids.[7]

Fusco et al. also concluded that TAP block can provide useful postoperative analgesia after caesarean delivery, while emphasizing the influence of anaesthetic technique and concomitant analgesic interventions.[8] More recent systematic reviews have shown that the effectiveness of TAP block is influenced by the comparator technique and background multimodal analgesia.[9,14] These observations highlight the importance of evaluating individual local anaesthetic regimens rather than considering TAP block as a uniform intervention.

The present study adds to this evidence by directly comparing 0.25% bupivacaine with 0.5% ropivacaine using a standardized bilateral ultrasound-guided TAP block technique. The findings demonstrated significantly lower pain scores, longer analgesic duration and delayed requirement for rescue analgesia with the ropivacaine regimen.

Conclusion

In women undergoing LSCS, bilateral ultrasound-guided TAP block with 0.5% ropivacaine provided significantly longer postoperative analgesia, lower VAS pain scores, and a longer time to first rescue analgesic requirement compared with 0.25% bupivacaine. Both groups demonstrated comparable haemodynamic and respiratory parameters, with no significant difference in overall adverse effects. Thus, within the doses used in this study, 0.5% ropivacaine appears to be a more effective option than 0.25% bupivacaine for postoperative analgesia following LSCS.

References

1. Verstraete S, Van de Velde M. Post-cesarean section analgesia. Acta Anaesthesiol Belg. 2012;63(4):147-167.
2. Singh NP, Monks D, Makkar JK, Palanisamy A, Sultan P, Singh PM. Efficacy of regional blocks or local anaesthetic infiltration for analgesia after caesarean delivery: a network meta-analysis of randomised controlled trials. Anaesthesia. 2022;77(4):412-425.
3. McDonnell JG, O'Donnell BD, Farrell T, Gough N, Tuite D, Power C, Laffey JG. Transversus abdominis plane block: a cadaveric and radiological evaluation. Reg Anesth Pain Med. 2007;32(5):399-404.
4. Hebbard P, Fujiwara Y, Shibata Y, Royse C. Ultrasound-guided transversus abdominis plane (TAP) block. Anaesth Intensive Care. 2007;35(4):616-617.
5. Belavy D, Cowlishaw PJ, Howes M, Phillips F. Ultrasound-guided transversus abdominis plane block for analgesia after Caesarean delivery. Br J Anaesth. 2009;103(5):726-730.
6. McDonnell JG, Curley G, Carney J, Benton A, Costello J, Maharaj CH, Laffey JG. The analgesic efficacy of transversus abdominis plane block after cesarean delivery: a randomized controlled trial. Anesth Analg. 2008;106(1):186-191.
7. Abdallah FW, Halpern SH, Margarido CB. Transversus abdominis plane block for postoperative analgesia after Caesarean delivery performed under spinal anaesthesia? A systematic review and meta-analysis. Br J Anaesth. 2012;109(5):679-687.

8. Fusco P, Scimia P, Paladini G, Fiorenzi M, Petrucci E, Pozone T, et al. Transversus abdominis plane block for analgesia after Cesarean delivery: a systematic review. Minerva Anestesiol. 2015;81(2):195-204.
9. Sultan P, Patel SD, Jadin S, Carvalho B, Halpern SH. Transversus abdominis plane block compared with wound infiltration for postoperative analgesia following Cesarean delivery: a systematic review and network meta-analysis. Can J Anaesth. 2020;67(12):1710-1727.
10. Griffin RP, Reynolds F. Extradural anaesthesia for Caesarean section: a double-blind comparison of 0.5% ropivacaine with 0.5% bupivacaine. Br J Anaesth. 1995;74(5):512-516.
11. Datta S, Camann W, Bader A, VanderBurgh L. Clinical effects and maternal and fetal plasma concentrations of epidural ropivacaine versus bupivacaine for cesarean section. Anesthesiology. 1995;82(6):1346-1351.
12. Bansal P, et al. Ultrasound-guided transversus abdominis plane block for post-operative analgesia in patients undergoing caesarean section. Indian J Anaesth. 2016;60(4):253-257.
13. Sethi C, Kumar R, Sahi P, Fatima A. A randomized control study to evaluate (0.25%) bupivacaine and (0.5%) ropivacaine for postoperative analgesia using transversus abdominis plane block (TAPB) in lower segment Caesarean section. Int J Contemp Med Res. 2018;5(6). doi:10.21276/ijcmr.2018.5.6.12.
14. Riemma G, Schiattarella A, La Verde M, et al. Transversus abdominis plane block versus wound infiltration for post-cesarean section analgesia: a systematic review and meta-analysis of randomized controlled trials. Int J Gynaecol Obstet. 2021;153(3):385-394.