

COMPARISON OF THE EFFICACY OF BUPIVACAINE PLUS DEXMEDETOMIDINE VERSUS BUPIVACAINE PLUS DEXAMETHASONE IN ULTRASOUND-GUIDED TRANSVERSUS ABDOMINIS PLANE BLOCK FOR POSTOPERATIVE ANALGESIA FOLLOWING CESAREAN SECTION: A PROSPECTIVE RANDOMIZED COMPARATIVE STUDY

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ABSTRACT

Background: Efficient postoperative analgesia after cesarean section promotes early ambulation, breastfeeding, maternal-infant bonding, and overall patient satisfaction. The ultrasound-guided transversus abdominis plane (TAP) block has emerged as a crucial element of multimodal analgesia. Dexmedetomidine and dexamethasone are frequently employed adjuvants to extend the duration of local anesthetic efficacy. Therefore, the study is designed to evaluate the analgesic effectiveness of dexmedetomidine and dexamethasone as adjuncts to bupivacaine in transversus abdominis plane block post-cesarean section. **Materials and Methods:** A prospective randomized comparative study was performed over six months involving 60 patients undergoing elective cesarean sections with spinal anesthesia. Patients were randomly assigned to two groups of 30 individuals each. Group A was administered bupivacaine combined with dexmedetomidine, whereas Group B received bupivacaine in conjunction with dexamethasone. The duration of analgesia, time to first rescue analgesia, postoperative pain scores, total analgesic consumption, maternal satisfaction, and adverse effects were evaluated. **Result:** The analgesia duration was markedly prolonged in Group A relative to Group B (712 ± 86 vs 548 ± 79 min; $p < 0.001$). The duration until the initial rescue analgesia was markedly extended in Group A (11.9 ± 1.4 hours vs 9.1 ± 1.3 hours; $p < 0.001$). VAS scores were markedly reduced in Group A starting from the fourth postoperative hour. The total tramadol consumption in the initial 24 hours was markedly reduced in Group A (78 ± 32 mg compared to 126 ± 38 mg; $p < 0.001$). Maternal satisfaction scores were markedly elevated in Group A (8.9 ± 0.8 compared to 7.8 ± 0.9 ; $p < 0.001$). **Conclusion:** Dexmedetomidine seems to offer enhanced postoperative analgesia relative to dexamethasone when utilized as an adjunct to bupivacaine in TAP block after cesarean section.

INTRODUCTION

Caesarean section is among the most frequently executed surgical procedures globally, with rising incidence observed in both developed and developing nations. Effective postoperative pain management is crucial for prompt ambulation, maternal comfort, successful breastfeeding, prevention of thromboembolic complications, and improvement of maternal-infant bonding. Insufficient pain

management after caesarean delivery can result in delayed recovery, extended hospital stays, and diminished patient satisfaction.^[1,2] Multimodal analgesia has emerged as the fundamental approach for postoperative pain management following cesarean section. Diverse analgesic methods, such as neuraxial opioids, nonsteroidal anti-inflammatory drugs, paracetamol, and regional anaesthesia techniques, have been integrated into multimodal

protocols to enhance postoperative results while reducing opioid-related side effects.^[3]

The transversus abdominis plane (TAP) block, initially described by Rafi in 2001, is a regional anesthetic method that delivers analgesia to the anterior abdominal wall by obstructing the thoracolumbar nerves (T6–L1) situated within the neurofascial plane between the internal oblique and transversus abdominis muscles. The ultrasound-guided transversus abdominis plane (TAP) block has achieved broad acceptance owing to its safety, simplicity, and effectiveness in alleviating postoperative pain after lower abdominal surgeries, including cesarean sections.^[4,5]

Bupivacaine is one of the most commonly utilized local anesthetics for TAP block due to its extended duration of action and advantageous safety profile. The analgesic duration of bupivacaine alone may be inadequate for effective postoperative pain management, prompting researchers to investigate the incorporation of various adjuvants.^[6,7]

Dexmedetomidine is a highly selective agonist of the α_2 -adrenergic receptor, exhibiting sedative, anxiolytic, and analgesic effects. Dexmedetomidine, when utilized as an adjuvant to local anesthetics, has demonstrated the ability to extend sensory blockade, postpone the necessity for rescue analgesia, and enhance the quality of postoperative analgesia via both peripheral and central mechanisms.^[8]

Dexamethasone, a powerful corticosteroid with anti-inflammatory effects, has been extensively studied as an adjunct in peripheral nerve blocks. The analgesic effect is thought to arise from the inhibition of inflammatory mediators, alleviation of neural edema, and modulation of nociceptive transmission. Numerous studies have shown extended analgesic duration and diminished postoperative analgesic needs with the incorporation of dexamethasone into local anesthetics.^[9,10]

While both Dexmedetomidine and Dexamethasone have shown effectiveness as adjuvants in TAP block, direct comparative evidence in cesarean section patients is scarce.^[11] The identification of the optimal adjuvant may enhance postoperative pain management and increase maternal satisfaction.^[12,13]

This study aimed to compare the efficacy of Bupivacaine combined with dexmedetomidine against Bupivacaine combined with Dexamethasone in ultrasound-guided TAP block for postoperative analgesia after cesarean section.

MATERIALS AND METHODS

Study Design: Prospective randomized comparative study.

Study setting: Department of Anaesthesia in collaboration with Department of Obstetrics & Gynaecology, Shri Atal Bihari Vajpayee Medical College & Research Institute.

Study Duration: 5th August 2025 to 5th February 2026 (Six months)

Study Population: Patients undergoing elective caesarean section under spinal anaesthesia.

Sample Size: 60 patients.

Group Allocation: Participants in the study were randomly assigned to two equal groups, each consisting of 30 individuals. Group A (n = 30) underwent an ultrasound-guided transversus abdominis plane (TAP) block utilizing 0.25% Bupivacaine supplemented with Dexmedetomidine at a dosage of 1 μ g/kg as an adjunct. Group B (n = 30) underwent an ultrasound-guided transversus abdominis plane block utilizing 0.25% Bupivacaine supplemented with 4 mg of Dexamethasone as an adjunct. The TAP block was administered bilaterally at the end of the surgery under sterile conditions. The postoperative analgesic efficacy, duration of analgesia, pain scores, time to first rescue analgesic requirement, total analgesic consumption, maternal satisfaction, and adverse effects were evaluated and compared between the two groups.

Inclusion Criteria

Eligible participants for the study were pregnant women aged 18 to 40 years with American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective cesarean section under spinal anaesthesia. Only women with a singleton pregnancy were included to ensure homogeneity of the study population and to reduce confounding variables that could affect postoperative analgesic results.

Exclusion Criteria

Patients were excluded from the study if they had a documented allergy or hypersensitivity to any of the investigational medications, including Bupivacaine, Dexmedetomidine, or Dexamethasone. Women with coagulopathy or bleeding disorders, infection at the designated injection site, or a history of chronic opioid use were excluded as well. Moreover, patients with substantial systemic illnesses, including severe cardiovascular, respiratory, hepatic, renal, or neurological disorders that could influence perioperative management or postoperative pain evaluation, were deemed ineligible for participation in the study.

Outcome Measures: The principal outcome measure of the study was the duration of postoperative analgesia, defined as the time elapsed between the administration of the TAP block and the initial request for rescue analgesia. The secondary outcome measures encompassed the duration until the initial requirement for rescue analgesia, postoperative pain intensity evaluated via the Visual Analog Scale (VAS) at specified intervals, total analgesic consumption within the first 24 hours post-surgery, and maternal satisfaction ratings concerning pain relief. Furthermore, the occurrence of adverse effects, including nausea, vomiting, sedation, hypotension, bradycardia, and complications associated with the TAP block, was documented and compared across the study groups.

Statistical Analysis: Data were analyzed utilizing SPSS software version 23. Continuous variables were presented as mean $\pm$ standard deviation. The

independent t-test was employed for the comparison of continuous variables, whereas the Chi-square test was utilized for categorical variables. A p-value less than 0.05 was deemed statistically significant.

RESULTS

Sixty patients were enrolled in the study, evenly divided between Group A (Bupivacaine + Dexmedetomidine) and Group B (Bupivacaine + Dexamethasone), with 30 participants in each group. The fundamental demographic traits and surgical variables were analyzed to evaluate the uniformity of the study population.

The average age of patients in Group A was 27.4 ± 3.6 years, whereas in Group B it was 26.9 ± 3.9 years, with no statistically significant difference observed between the groups ($p = 0.61$). The average body

weight was 68.2 ± 6.8 kg in Group A and 67.5 ± 7.1 kg in Group B ($p = 0.69$). The average body mass index (BMI) was 27.1 ± 2.5 kg/m² in Group A, while it was 26.8 ± 2.7 kg/m² in Group B; the difference was not statistically significant ($p = 0.72$).

The average surgical duration was similar in both groups, measuring 52.6 ± 8.4 minutes in Group A and 51.9 ± 7.8 minutes in Group B ($p = 0.78$). As all p-values exceeded 0.05, no statistically significant differences were detected between the groups concerning demographic or operative characteristics. The findings demonstrate that both groups were adequately matched at baseline, thereby reducing the impact of potential confounding variables and ensuring that any observed differences in postoperative analgesic outcomes can be primarily ascribed to the study interventions rather than variations in patient characteristics or surgical duration.

Table 1: Demographic Characteristics

Variable	Group A	Group B	P value
Age (years)	27.4 ± 3.6	26.9 ± 3.9	0.61
Weight (kg)	68.2 ± 6.8	67.5 ± 7.1	0.69
BMI (kg/m ²)	27.1 ± 2.5	26.8 ± 2.7	0.72
Duration of surgery (min)	52.6 ± 8.4	51.9 ± 7.8	0.78

Table 2: Comparison of Duration of Analgesia and Time to First Rescue Analgesia Between the Study Groups

Parameter	Group A (n=30)	Group B (n=30)	p-value
Duration of Analgesia (min)	712 ± 86	548 ± 79	<0.001
Time to First Rescue Analgesia (hours)	11.9 ± 1.4	9.1 ± 1.3	<0.001

[Table 2] contrasts the duration of postoperative analgesia with the time to the initial requirement for rescue analgesics between the two study groups. The average duration of analgesia was markedly prolonged in Group A, which received bupivacaine with Dexmedetomidine, in comparison to Group B, which received bupivacaine with Dexamethasone (712 ± 86 minutes vs 548 ± 79 minutes; $p < 0.001$). This discovery suggests that the incorporation of Dexmedetomidine led to an extended analgesic effect and improved postoperative pain management.

The average time to the initial requirement for rescue analgesia was significantly longer in Group A compared to Group B (11.9 ± 1.4 hours vs 9.1 ± 1.3

hours; $p < 0.001$). Patients administered dexmedetomidine exhibited an extended pain-free interval post-surgery and necessitated supplemental analgesia later than those treated with dexamethasone.

The disparities noted between the two groups were markedly statistically significant, indicating that dexmedetomidine is superior to dexamethasone as an adjunct to bupivacaine in TAP block for extending postoperative analgesia and postponing the necessity for rescue analgesics after cesarean section. These results align with prior research indicating the enhanced analgesic efficacy of dexmedetomidine as an adjunct in regional anesthesia techniques.

Table 3: Postoperative VAS scores

Time	Group A	Group B	P value
2 h	1.8 ± 0.7	2.0 ± 0.8	0.28
4 h	2.1 ± 0.9	3.0 ± 1.0	0.001
8 h	2.6 ± 1.0	4.1 ± 1.1	<0.001
12 h	3.1 ± 1.1	4.8 ± 1.2	<0.001
24 h	2.7 ± 1.0	3.5 ± 1.1	0.004

[Table 3] delineates the postoperative pain scores, assessed via the Visual Analog Scale (VAS), at various time intervals post-cesarean section, contrasting Group A (Bupivacaine + Dexmedetomidine) with Group B (Bupivacaine + Dexamethasone).

Two hours postoperatively, the average VAS scores were 1.8 ± 0.7 for Group A and 2.0 ± 0.8 for Group

B. The difference was not statistically significant ($p = 0.28$), suggesting that both groups offered comparable analgesia in the immediate postoperative phase.

From the fourth postoperative hour onward, Group A exhibited markedly lower pain scores than Group B. At 4 hours, the average VAS score was 2.1 ± 0.9 in Group A, whereas it was 3.0 ± 1.0 in Group B ($p =$

0.001). At 8 hours, pain scores in Group A (2.6 ± 1.0) were significantly lower than in Group B (4.1 ± 1.1) ($p < 0.001$).

At 12 hours, the disparity became more evident, with Group A exhibiting a mean VAS score of 3.1 ± 1.1 , while Group B reported a significantly elevated score

of 4.8 ± 1.2 ($p < 0.001$). At 24 hours postoperatively, Group A exhibited superior pain management with a mean VAS score of 2.7 ± 1.0 , in contrast to 3.5 ± 1.1 in Group B ($p = 0.004$).

Zero.

Table 4: Comparison of Total Analgesic Requirement, Maternal Satisfaction, and Adverse Effects Between the Study Groups

Parameter	Group A (n=30)	Group B (n=30)	p-value
Total Analgesic Requirement			
Tramadol consumption (mg)	78 ± 32	126 ± 38	<0.001
Maternal Satisfaction			
Satisfaction score	8.9 ± 0.8	7.8 ± 0.9	<0.001
Adverse Effects			
Nausea/Vomiting, n (%)	4 (13.3%)	7 (23.3%)	0.32
Sedation, n (%)	6 (20.0%)	2 (6.7%)	0.13
Hypotension, n (%)	2 (6.7%)	1 (3.3%)	0.55
Bradycardia, n (%)	1 (3.3%)	0 (0%)	0.31

[Table 4] describes the overall postoperative analgesic demand, maternal satisfaction ratings, and adverse effects between Group A (Bupivacaine + Dexmedetomidine) and Group B (Bupivacaine + Dexamethasone).

The average tramadol consumption in the initial 24 hours post-surgery was markedly reduced in Group A (78 ± 32 mg) relative to Group B (126 ± 38 mg), with a highly significant statistical difference ($p < 0.001$). This finding demonstrates that patients administered dexmedetomidine exhibited enhanced postoperative pain management and subsequently necessitated less rescue analgesia compared to those treated with dexamethasone.

Group A exhibited significantly elevated maternal satisfaction scores, with a mean of 8.9 ± 0.8 , in contrast to Group B's 7.8 ± 0.9 ($p < 0.001$). The elevated satisfaction scores noted in patients administered dexmedetomidine may be ascribed to the extended analgesic effect, diminished pain scores, and decreased requirement for additional analgesics. Nausea and vomiting were reported in 13.3% of patients in Group A and 23.3% of patients in Group B concerning adverse effects. Sedation occurred more frequently in Group A (20.0%) compared to Group B (6.7%), potentially attributable to the established sedative effects of dexmedetomidine. Hypotension was observed in 6.7% of patients in Group A and 3.3% in Group B, whereas bradycardia was recorded in one patient (3.3%) in Group A and absent in Group B. Nonetheless, none of these discrepancies reached statistical significance ($p > 0.05$).

The findings indicate that dexmedetomidine, when administered as an adjunct to bupivacaine in TAP block, offers enhanced postoperative analgesia and greater maternal satisfaction without a notable rise in adverse effects. No significant complications associated with the TAP block procedure were noted in either group, demonstrating that both techniques were safe and well tolerated.

DISCUSSION

This study compared dexmedetomidine and dexamethasone as adjuncts to bupivacaine in the transversus abdominis plane block after caesarean section. The results indicated that dexmedetomidine markedly extended postoperative analgesia and postponed the necessity for rescue analgesics.

The average duration of analgesia was markedly extended in the dexmedetomidine cohort. Previous studies have reported analogous findings, indicating that dexmedetomidine amplifies the analgesic efficacy of local anesthetics via alpha-2 receptor-mediated suppression of nociceptive transmission.^[14,15]

The dexmedetomidine cohort exhibited markedly diminished postoperative pain scores and decreased analgesic usage within the initial 24 hours. These findings endorse the efficacy of dexmedetomidine as a valuable adjunct for enhancing postoperative pain management after cesarean delivery.^[16]

Maternal satisfaction was markedly elevated in patients administered dexmedetomidine, presumably attributable to enhanced analgesia and diminished requirement for rescue medications. Mild sedation occurred more frequently in the dexmedetomidine group; however, it was clinically insignificant and did not necessitate intervention.

The results align with earlier studies comparing dexmedetomidine and dexamethasone in TAP block, reinforcing the superiority of dexmedetomidine in extending postoperative analgesia.

Limitations

This study was constrained by its single-center design, limited sample size, and brief postoperative follow-up duration. Furthermore, long-term outcomes and delayed complications were not evaluated. Consequently, extensive multicenter studies with prolonged follow-up are required to validate the findings and assess the long-term efficacy and safety of the interventions studied.

CONCLUSION

The incorporation of dexmedetomidine into bupivacaine for ultrasound-guided TAP block significantly extended the duration of postoperative analgesia, postponed the requirement for rescue analgesics, decreased postoperative pain scores, minimized analgesic consumption, and enhanced maternal satisfaction relative to dexamethasone. The findings indicate that dexmedetomidine is a superior adjuvant compared to dexamethasone for improving postoperative analgesia after cesarean section.

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