

Comparison of the Efficacy of Bupivacaine versus Bupivacaine Plus Dexamethasone using USG Guided Tap Block for Post Operative Analgesia After Caesarean Section: A Quasi Experimental Study

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Received: 20-07-2026 / Revised: 24-08-2026 / Accepted: 25-09-2026

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Conflict of interest: Nil

Abstract:

Introduction: Caesarean section (CS) is one of the most frequently performed obstetric surgical procedures, and effective postoperative analgesia is essential for early mobilisation, breastfeeding, newborn care and maternal recovery. Transversus abdominis plane (TAP) block provides effective somatic analgesia after lower segment caesarean section (LSCS); however, the duration of analgesia with bupivacaine alone is limited. Dexamethasone has been investigated as an adjuvant to prolong the duration and improve the quality of analgesia.

Aim: To compare the efficacy and safety of ultrasound-guided bilateral TAP block using 0.25% bupivacaine alone versus 0.25% bupivacaine with dexamethasone 8 mg for postoperative analgesia following elective LSCS.

Methods: This quasi-experimental study included 72 women undergoing elective LSCS under spinal anaesthesia. Participants were allocated equally into two groups of 36 each. Group A received ultrasound-guided bilateral TAP block with 0.25% bupivacaine, while Group B received 0.25% bupivacaine with dexamethasone 8 mg. Postoperative pain was assessed using the visual analogue scale (VAS) at predetermined intervals up to 24 hours. The primary outcomes were duration of analgesia and postoperative pain scores. Secondary outcomes included rescue analgesic consumption, haemodynamic parameters and adverse effects. Duration of analgesia was defined as the time from completion of TAP block to the first request for rescue analgesia at VAS ≥ 4 .

Results: The two groups were comparable regarding baseline demographic and clinical characteristics. Postoperative VAS scores were significantly lower in the dexamethasone group at all assessed time points from 2 to 24 hours. The maximum difference was observed at 12 hours, with mean VAS scores of 5.6 ± 1.2 in Group A and 3.1 ± 1.0 in Group B ($p < 0.001$). The duration of analgesia was significantly longer with dexamethasone, measuring 468.7 ± 131.4 minutes (approximately 7.8 hours) compared with 276.4 ± 82.6 minutes (approximately 4.6 hours) with bupivacaine alone ($p < 0.001$). Within 24 hours, all patients in Group A required rescue analgesia compared with 77.8% in Group B ($p = 0.004$). Mean rescue analgesic requirements were significantly lower in Group B (0.83 ± 0.71 vs 1.86 ± 0.74 doses; $p < 0.001$). Haemodynamic parameters remained stable, and adverse effects were comparable between groups (25.0% vs 27.8%; $p = 0.797$).

Conclusion: Addition of dexamethasone 8 mg to 0.25% bupivacaine significantly prolongs the duration of analgesia, reduces postoperative pain and decreases rescue analgesic requirements following elective LSCS. Ultrasound-guided bilateral TAP block with dexamethasone appears to be an effective, safe and opioid-sparing component of multimodal post-caesarean analgesia.

Keywords: Caesarean Section; Transversus Abdominis Plane Block; Bupivacaine; Dexamethasone; Postoperative Analgesia; Ultrasound-Guided Block; Rescue Analgesia.

DOI: 10.25258/ijcpr.18.9.130

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Introduction

Caesarean section (CS) is one of the most frequently performed surgical procedures in obstetric practice and plays a vital role in reducing maternal and neonatal morbidity and mortality when vaginal delivery is neither possible nor safe. Global data showed that the caesarean section rate increased

from about 7% in 1990 to 21% in 2018, substantially exceeding the World Health Organization (WHO) recommended rate of 10–15%. [1]

According to the National Family Health Survey (NFHS-5), the caesarean delivery rate increased from 17.2% to 21.5%. [2]

Postoperative pain after lower segment caesarean section (LSCS) is often moderate to severe, with studies reporting that more than half of women experience significant postoperative pain. [3] Somatic pain results from incision of the abdominal wall involving the skin, muscles and fascia, whereas visceral pain results from uterine manipulation, peritoneal irritation and postoperative uterine contractions. Thus, the multiple sources of pain necessitate a comprehensive approach to postoperative analgesia.

Effective control of postoperative pain is important not only for maternal comfort but also for overall recovery. Poor pain management following caesarean section may result in delayed mobilisation, increased risk of thromboembolic complications, prolonged hospital stay, difficulty in caring for the newborn, impaired mother–infant bonding and delayed initiation of breastfeeding. [4] Severe postoperative pain is also associated with an increased risk of postpartum depression and chronic persistent pain. Inadequate pain relief may increase opioid consumption and related adverse effects, including nausea, vomiting, sedation, respiratory depression, pruritus and urinary retention, thereby negatively affecting maternal recovery and newborn well-being.

To overcome these challenges, multimodal analgesia has become the standard of care for post-caesarean pain management. It combines analgesic drugs and techniques with different mechanisms of action to provide effective analgesia while reducing opioid requirements and their adverse effects. Current recommendations include non-opioid analgesics, neuraxial adjuvants and regional anaesthetic techniques as components of multimodal analgesia. [5]

The transversus abdominis plane (TAP) block is a regional anaesthetic technique that has gained popularity for postoperative pain control following caesarean section. [6] It targets the fascial plane between the internal oblique and transversus abdominis muscles, where thoracolumbar nerves supplying the anterior abdominal wall course before terminating in their branches. [7] Administration of local anaesthetic in this plane blocks these nerves and provides effective somatic analgesia for lower abdominal surgical incisions, including the Pfannenstiel incision commonly used for LSCS.

Ultrasound guided TAP block allows direct visualisation of the abdominal wall muscle layers, needle placement and spread of local anaesthetic, thereby improving safety, accuracy and success while reducing complications. [8] Consequently, ultrasound-guided TAP block has become an important component of multimodal analgesia in obstetric anaesthesia. [9] However, the duration of analgesia with local anaesthetics alone is limited,

leading to interest in adjuvants that can prolong analgesia and improve postoperative pain relief.

Bupivacaine is one of the most widely used local anaesthetic agents for TAP block. It is a long-acting amide local anaesthetic that produces reversible nerve blockade by inhibiting sodium channel conduction in nerve fibres. Its high protein binding and lipid solubility provide prolonged analgesic action, making it widely used in peripheral nerve blocks. [10] Bilateral administration of 0.25% bupivacaine provides effective postoperative analgesia without significant motor blockade, which is particularly beneficial in obstetric patients requiring early mobilisation and newborn care. However, analgesia produced by bupivacaine alone generally lasts approximately 6–8 hours, [11] necessitating additional rescue analgesics during the first postoperative day.

Local anaesthetics have therefore been combined with various adjuvants to improve the duration and quality of analgesia. Dexamethasone has emerged as a promising option. It is a synthetic glucocorticoid with potent anti-inflammatory properties and a long biological half-life. It has been shown to prolong analgesia when used as an adjunct in peripheral nerve blocks. Proposed mechanisms include suppression of inflammatory responses, inhibition of nociceptor sensitisation, inhibition of neural transmission in pain fibres and decreased vascular uptake of local anaesthetic from the injection site. [12] Experimental studies have also suggested potential neuroprotective properties. [13]

Although TAP block is effective for post-caesarean analgesia, the relatively short duration of bupivacaine alone may result in inadequate analgesic coverage during the early postoperative period. Dexamethasone is a simple, inexpensive and readily available adjunct that may prolong analgesia without increasing the local anaesthetic dose or the risk of local anaesthetic systemic toxicity. [14] Its antiemetic properties may provide additional postoperative benefits.

Despite encouraging findings from previous studies, prospective data from Indian obstetric populations remain limited. Hence, the present study was conducted to compare the efficacy and safety of ultrasound-guided bilateral TAP block using 0.25% bupivacaine alone versus 0.25% bupivacaine with dexamethasone 8 mg for postoperative analgesia following elective lower segment caesarean section. The study aimed to evaluate whether the addition of dexamethasone could prolong analgesia, reduce postoperative pain scores and rescue analgesic requirements, and thereby improve the quality of postoperative pain management in women undergoing caesarean delivery.

Material and Methods

This quasi-experimental study was conducted to compare the efficacy of ultrasound guided Transversus Abdominis Plane (TAP) block using bupivacaine alone and bupivacaine with dexamethasone for postoperative analgesia in patients undergoing caesarean section was conducted at the Department of Anesthesiology, at a tertiary care center during a duration of 18 months. Amongst the women undergoing elective LSCS under spinal anesthesia at tertiary care center. Based on previous studies and statistical power analysis, a sample size of 72 patients was targeted, with 36 patients in each group (Group A: bupivacaine alone, Group B: bupivacaine with dexamethasone).

Sampling Method and Sample Size: Study done by Thakur et al. (2019) [15] showed Mean duration of analgesia for bupivacaine alone (control): 6.8 ± 1.2 hours and Mean duration of analgesia for bupivacaine + dexamethasone (Test): 12.5 ± 3.7 hours using these values. Sample size was calculated according to following standard formula. The calculated sample size came was 36 participants allotted in each group, resulting in a total study sample of 72 participants.

Procedure

All patients were given a TAP block with a single injection following induction of general anesthesia using a 38-mm broadband linear array ultrasound probe (5–10 MHz of a Hewlett-Packard 77020A ultrasound monitor [Andover, MA, USA]) under ultrasound guidance. The ultrasonic probe was placed in the midaxillary line in transverse plane to the lateral abdominal wall at the midpoint between the lower costal margin and iliac crest with the patient in the supine position. Then the needle was retained in plane and directly under the ultrasound probe and progressed until the plane between the internal oblique and transverses abdominis muscles (TAP) was reached. The local anesthetic solution was given at this plane causing enlargement of the TAP which appeared as a hypoechoic area. Before injecting, they carefully aspirated to be sure they had not punctured a vessel. The TAP block was then performed on the other side using the same procedure and similar injectate. The patients were moved to the post anesthesia care unit after the surgery and evaluated and monitored for PAIN by VAS at 2, 4, 6, 8th hour following the procedure. Study participants were selected based on following selection criteria

Inclusion Criteria

1. Women aged 18-45 years
2. ASA physical status II or III
3. Scheduled for elective LSCS under spinal anesthesia
4. Willing to provide informed consent

Exclusion Criteria

1. Known allergy to bupivacaine, dexamethasone, or any other local anesthetics
2. Pre-existing chronic pain conditions
3. Patients with significant co-morbidities (e.g., uncontrolled hypertension, diabetes).
4. History of substance abuse or chronic opioid use
5. Patients with infection at the injection site

Withdrawal Criteria

1. Patients who develop intraoperative complications necessitating conversion to general anesthesia
2. Patients who request withdrawal from the study at any point
3. Any adverse reactions necessitating withdrawal as per the investigator's discretion.

Pain Assessment: Pain was assessed using the Visual Analog Scale (VAS) at 2, 4, 6, 12, and 24 hours postoperatively,

- **Hemodynamic Monitoring:** Blood pressure and heart rate were recorded preoperatively, intraoperatively, and postoperatively at regular intervals.

Ethical Considerations - The study was conducted after getting written approval from the Institutional Ethics Committee (IEC).

Results

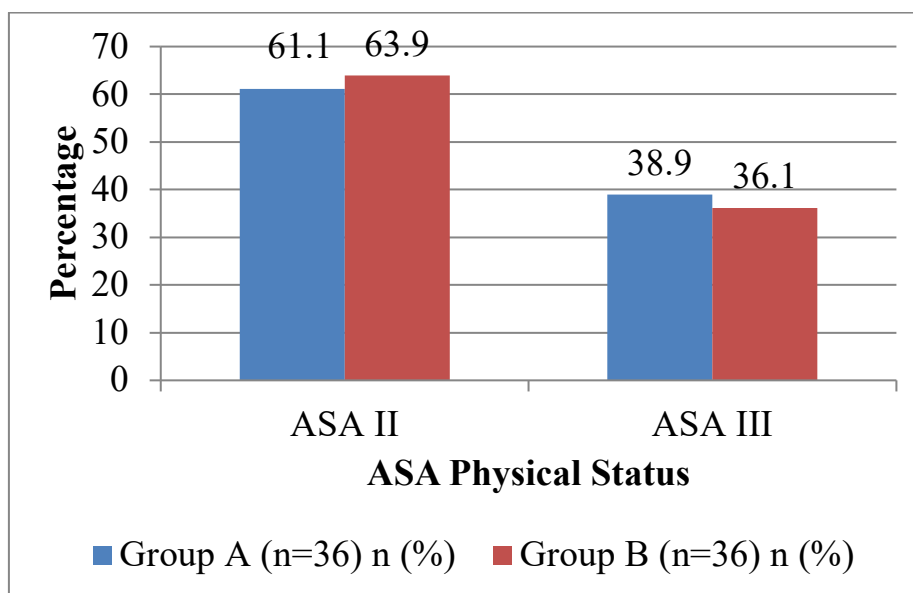
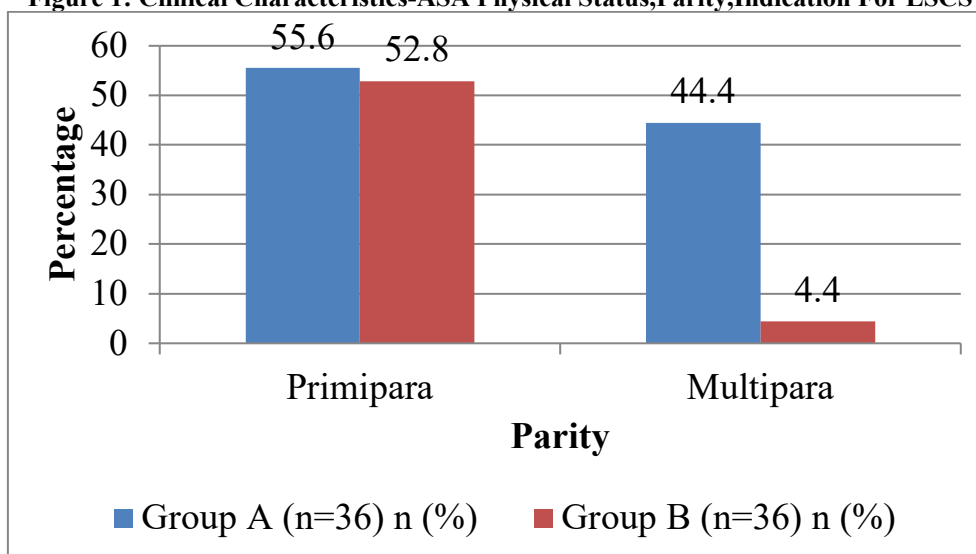
The present quasi-experimental study was conducted in the Department of Anaesthesiology, a tertiary care centre over a period of 18 months. 72 patients posted for elective lower segment caesarean section (LSCS) under spinal anaesthesia were enrolled and divided into two groups of 36 patients each. Group A (0.25% Bupivacaine alone) and Group B (0.25% Bupivacaine + Dexamethasone 8 mg) for ultrasound guided bilateral transversus abdominis plane (TAP) block. The results of the study are presented in the subsequent sub-sections.

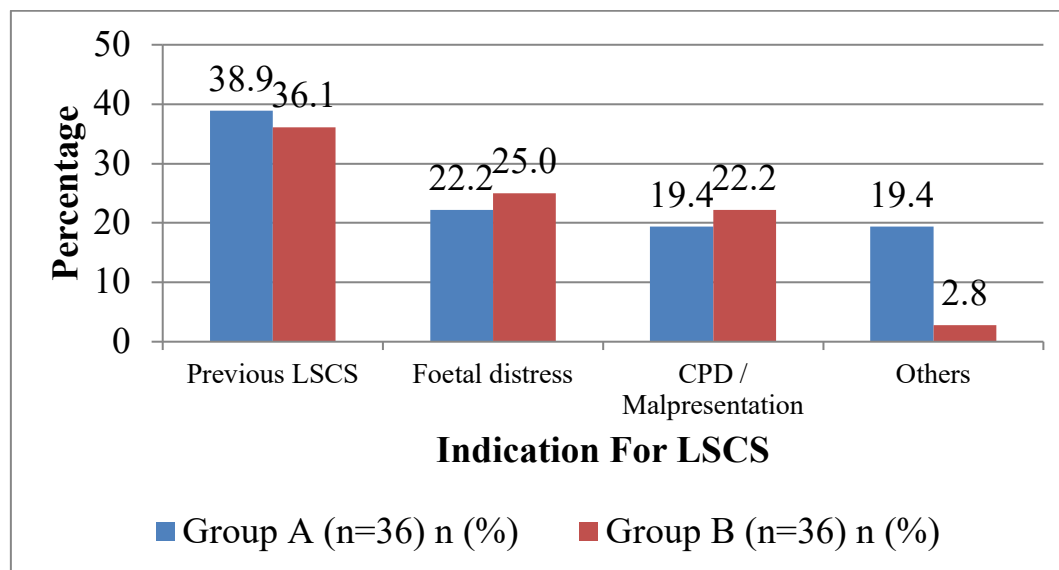
Table 1: Clinical Characteristics: ASA Physical Status, Parity, and Indication for LSCS

Variable	Group A (n=36) n (%)	Group B (n=36) n (%)	Total (n=72) n (%)	Chi-square	p-value
ASA Physical Status					
ASA II	22 (61.1)	23 (63.9)	45 (62.5)	0.063	0.802
ASA III	14 (38.9)	13 (36.1)	27 (37.5)		
Parity					
Primipara	20 (55.6)	19 (52.8)	39 (54.2)	0.056	0.813
Multipara	16 (44.4)	17 (47.2)	33 (45.8)		
Indication for LSCS					
Previous LSCS	14 (38.9)	13 (36.1)	27 (37.5)	1.204	0.877
Foetal distress	8 (22.2)	9 (25.0)	17 (23.6)		
CPD / Malpresentation	7 (19.4)	8 (22.2)	15 (20.8)		
Others	7 (19.4)	6 (16.7)	13 (18.1)		

Table 1 shows that ASA physical status, parity and surgical indication were similar in both groups. Most of the participants in both groups were ASA I (62.5% overall) and primipara (54.2% overall). The most common indication for elective LSCS was

previous caesarean section (37.5%). No statistically significant inter-group difference was found for any categorical variable (all $p > 0.05$), confirming the baseline equivalence.

**Figure 1: Clinical Characteristics-ASA Physical Status, Parity, Indication For LSCS**



Comparison of Postoperative VAS Pain Scores between the Two Groups. The main objective of this study was to compare the analgesic efficacy of bupivacaine with dexamethasone and bupivacaine

alone by ultrasound-guided TAP block in patients undergoing LSCS. Pain intensity was evaluated with the Visual Analogue Scale (VAS; 0–10), 2, 4, 6, 8, 12 and 24 hours after surgery.

Table 2: Comparison Of Mean VAS Pain Scores At Various Postoperative Time Points Between Group A (Bupivacaine) And Group B (Bupivacaine + Dexamethasone)

Time Point (Post-block)	Group A (n=36) Mean VAS±SD	Group B (n=36) Mean VAS ±SD	Mean Difference	t-value	p-value
2 hours	1.9 ±0.7	1.6 ±0.6	0.3	2.064	0.042*
4 hours	2.4 ±0.8	1.8 ±0.7	0.6	3.548	<0.001*
6 hours	3.1 ±0.9	2.0 ±0.8	1.1	5.712	<0.001*
8 hours	4.2 ±1.1	2.4 ±0.9	1.8	7.981	<0.001*
12 hours	5.6 ±1.2	3.1 ±1.0	2.5	10.062	<0.001*
24 hours	4.1 ±1.0	2.8 ±0.9	1.3	6.144	<0.001*

Table 2 demonstrates that the mean VAS pain scores in Group B were lower than those in Group A at all postoperative time points. The difference was small but statistically significant at 2 hours (Group A, 1.9 ± 0.7; Group B, 1.6 ± 0.6; p=0.042). Divergence increased progressively and was highest at 12 hours (Group A: 5.6 ± 1.2 vs Group B: 3.1 ± 1.0; p <

0.001). VAS scores were lower at 24 hours in group B (2.8 ± 0.9) than in group A (4.1 ± 1.0; p < 0.001) reflecting the prolonged anti-inflammatory and analgesic effect of dexamethasone. From 4h onwards, all inter-group differences were highly statistically significant (p < 0.001).

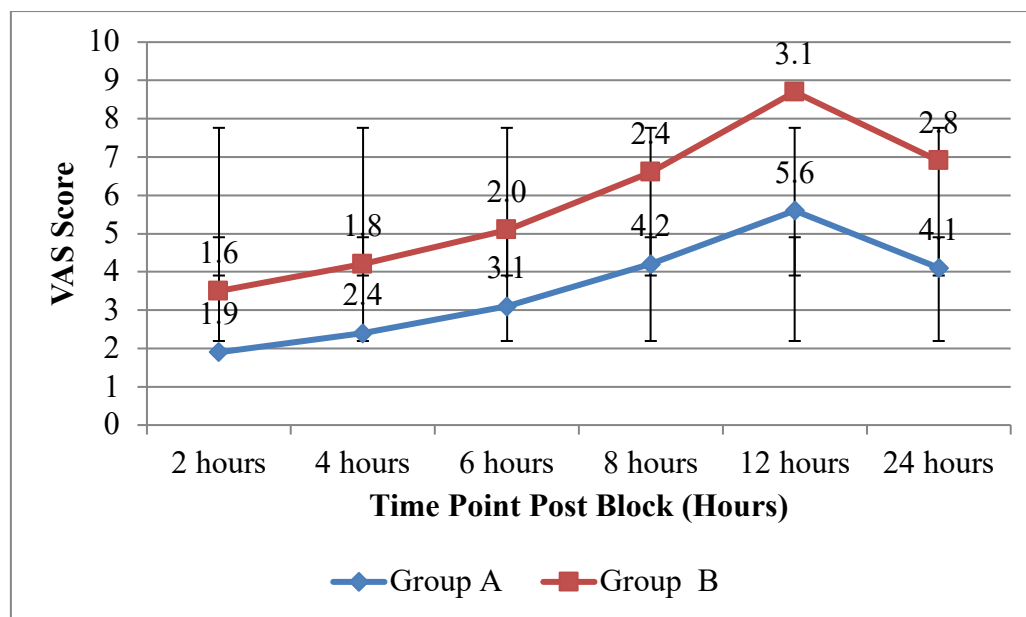


Figure 2: Comparison Of Mean Vas Pain Scores At Various Postoperative Time Points Between Group A (Bupivacaine) And Group B (Bupivacaine + Dexamethasone)

Comparison of Postoperative Analgesic

Duration: The duration of postoperative analgesia was defined as the time from the end of the TAP

block to the first patient request for rescue analgesia (VAS ≥ 4). The primary secondary outcome was the actual duration of the TAP block in each group.

Table 3: Comparison Of Duration of Postoperative Analgesia Between Group A (Bupivacaine) And Group B (Bupivacaine + Dexamethasone)

Parameter	Group A(n=36) Mean $\pm$ SD	Group B(n=36) Mean $\pm$ SD	t-value	p-value
Duration of analgesia (minutes)	276.4 $\pm$ 82.6	468.7 $\pm$ 131.4	8.024	<0.001*
Duration of analgesia (hours)	4.6 $\pm$ 1.4	7.8 $\pm$ 2.2	8.024	<0.001*
Minimum (minutes)	145	285	-	-
Maximum (minutes)	480	825	-	-
Median [IQR] (minutes)	265[210-330]	450[375-560]	Z=7.512	<0.001*

It is evident from Table 3 that the mean duration of postoperative analgesia in Group B (468.7 $\pm$ 131.4 minutes; approximately 7.8 hours) was significantly and substantially longer than in Group A (276.4 $\pm$ 82.6 minutes; approximately 4.6 hours) with a mean difference of 192.3 minutes (t=8.024; p<0.001). The minimum analgesic duration in Group B (285 minutes) was greater than the maximum of the lower

quartile in Group A, suggesting a clinically important shift in the distribution. The median duration of analgesia was 265 minutes [IQR: 210-330] in Group A and 450 minutes [IQR: 375-560] in Group B (Mann-Whitney U; z=7.512; p<0.001). The results indicate that adding dexamethasone to bupivacaine in TAP block almost doubles the effective duration of analgesia.

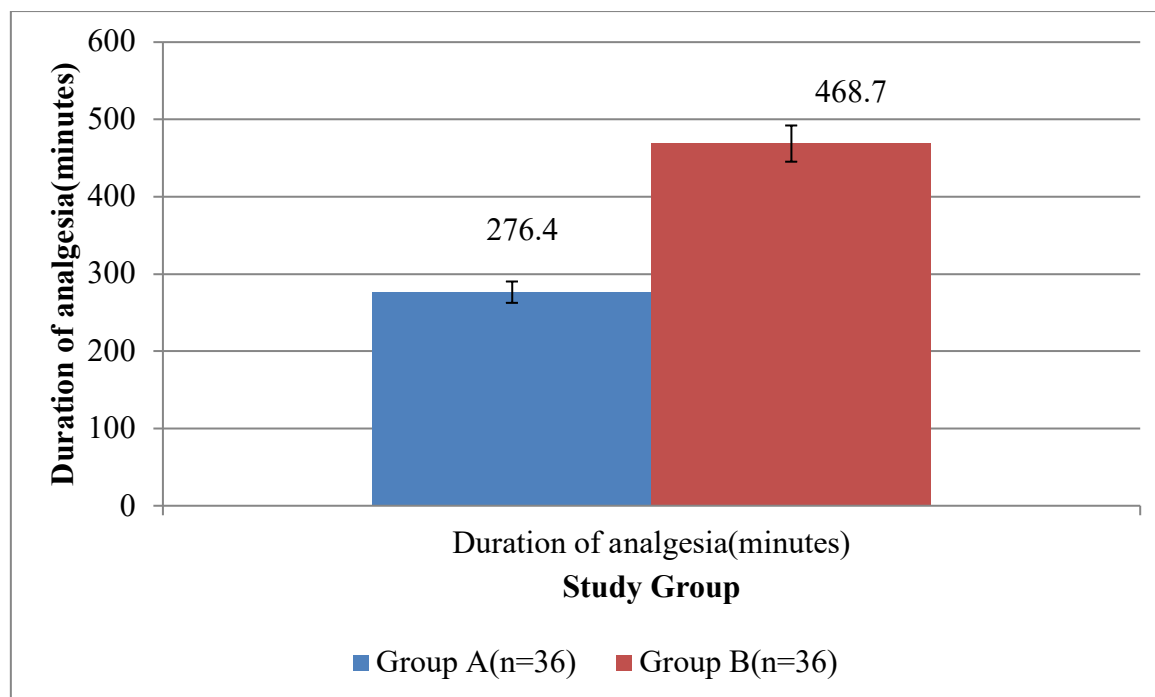


Figure 3: Comparison Of Duration of Postoperative Analgesia Between Group A(Bupivacaine) And Group B(Bupivacaine+Dexamethasone)

Comparison of Rescue Analgesic Requirement within 24 Hrs. Rescue analgesia was given as Inj. Diclofenac 75 mg IV whenever patient complained

of VAS score of ≥ 4 . The number of rescue analgesic doses given in first 24 h of postoperative period was noted and compared between two groups.

Table 4: Comparison Of Rescue Analgesic Requirement Within The First 24 Postoperative Hours Between Group A And Group B

Variable	Group A (n=36) n (%) / Mean $\pm$ SD	Group B (n=36) n (%) / Mean $\pm$ SD	Total (n=72)	Test value	p-value
Patients requiring rescue analgesia in first 24 h	36 (100.0)	28 (77.8)	64 (88.9)	$\chi^2=8.471$	0.004*
Time to first rescue analgesic (minutes)	276.4 $\pm$ 82.6	468.7 $\pm$ 131.4	—	t = 8.024	<0.001*
Number of rescue doses in 24 hours					
0 doses	0 (0.0)	8 (22.2)	8 (11.1)	$\chi^2=9.812$	0.020*
1 dose	11 (30.6)	18 (50.0)	29 (40.3)		
2 doses	19 (52.8)	9 (25.0)	28 (38.9)		
3 or more doses	6 (16.7)	1 (2.8)	7 (9.7)		
Mean number of rescue doses $\pm$ SD	1.86 $\pm$ 0.74	0.83 $\pm$ 0.71	-	T=6.328	<0.001*

As shown in Table 4, 36 patients (100%) in Group A received at least one dose of rescue analgesia within 24 hours compared with 28 patients (77.8%) in Group B. This was statistically significant ($\chi^2 = 8.471$; $p = 0.004$).

In Group A the most common pattern was 2 doses (52.8%) or 3 or more doses (16.7%) whereas in Group B the most common pattern was 1 dose (50.0%) with 8 patients (22.2%) not requiring any

rescue analgesia at all. The mean number of rescue doses in Group A (1.86 ± 0.74) was significantly higher than in Group B (0.83 ± 0.71 ; $t = 6.328$; $p < 0.001$), which represents more than 55% decrease in the rescue analgesic consumption in the dexamethasone group. These results confirm a clinically meaningful and statistically significant opioid sparing and analgesic sparing effect of dexamethasone as an adjunctive treatment.

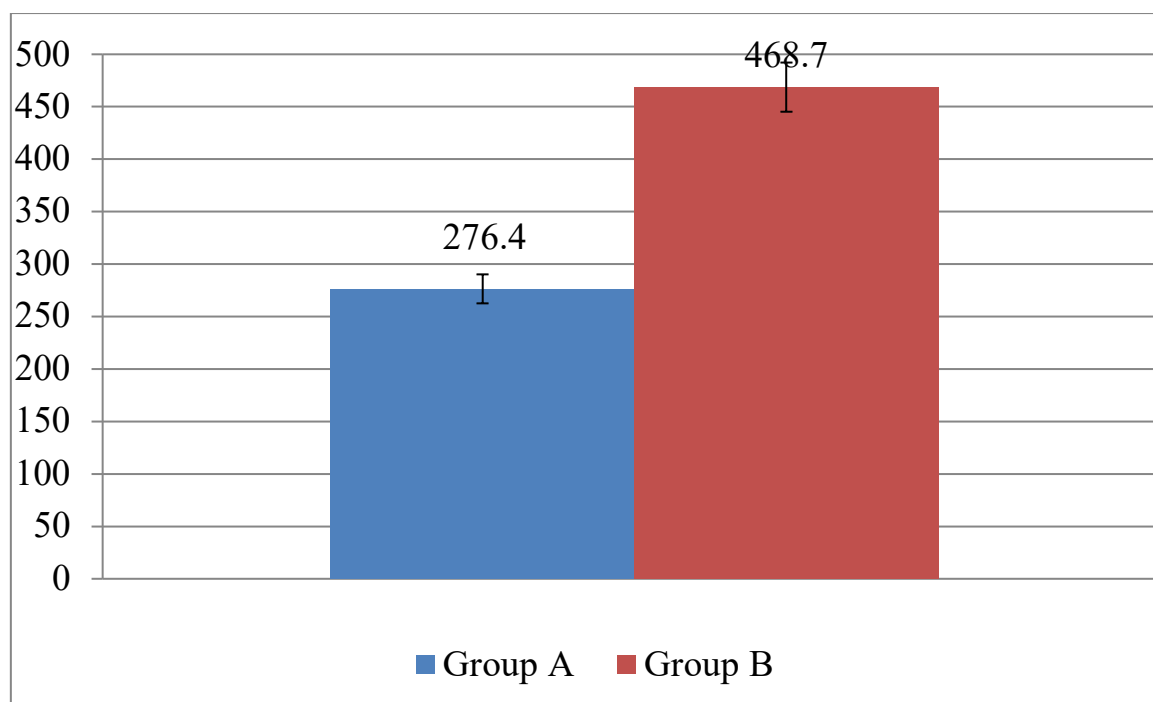
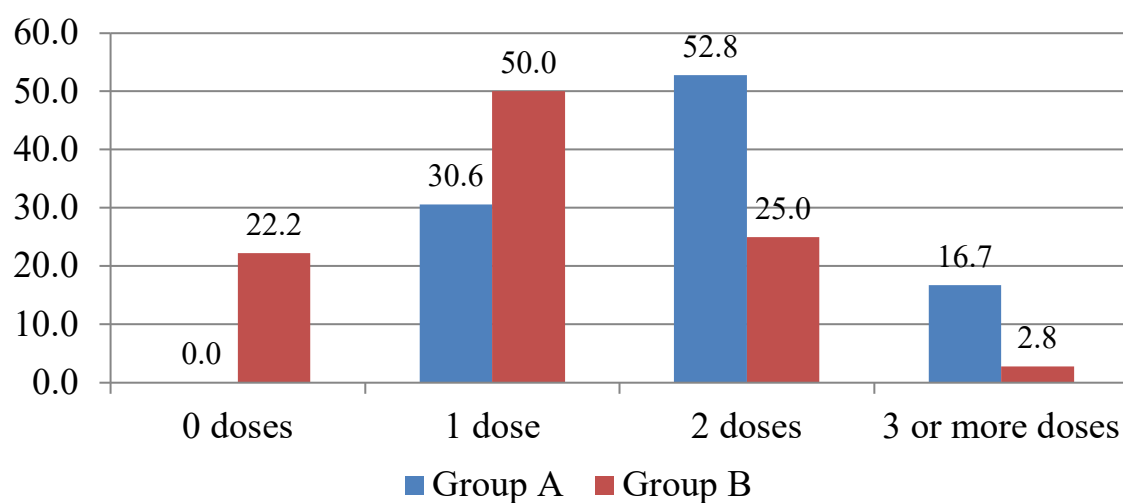
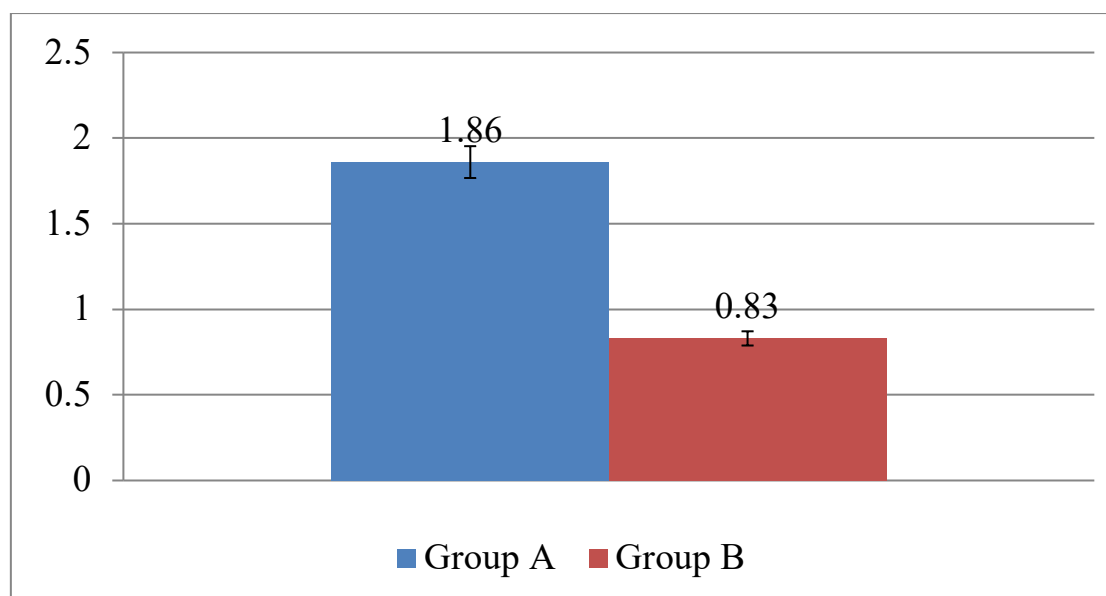


Figure 4: Comparison of Rescue analgesic requirement within the first 24 postoperative hours between Group A and Group B time to first rescue analgesic





Comparison of Haemodynamic Parameters Post-operatively. Haemodynamic parameters such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and peripheral

oxygen saturation (SpO₂) were recorded at baseline (preoperatively) and at 2, 6 and 24 hours post-operatively. Values were compared between the two groups at each time point using an unpaired t-test.

Table 5: Comparison of Haemodynamic Parameters(HR, SBP, DBP, SPO₂) at baseline and postoperative time points between group A and group B

Parameter	Time	Group A Mean $\pm$ SD	Group B Mean $\pm$ SD	Mean Diff.	T-Value	P-Value
Heart Rate (Bpm)	Baseline	82.4 $\pm$ 7.6	81.9 $\pm$ 7.2	0.5	0.299	0.765
	2 H	80.6 $\pm$ 6.9	79.8 $\pm$ 6.4	0.8	0.537	0.593
	6 H	79.3 $\pm$ 6.5	78.7 $\pm$ 6.1	0.6	0.421	0.675
	24 H	78.1 $\pm$ 5.8	77.4 $\pm$ 5.6	0.7	0.549	0.584
Systolic BP (Mmhg)	Baseline	118.2 $\pm$ 9.4	117.6 $\pm$ 8.9	0.6	0.291	0.772
	2 H	116.4 $\pm$ 8.7	115.9 $\pm$ 8.4	0.5	0.260	0.795
	6 H	115.1 $\pm$ 8.2	114.6 $\pm$ 7.9	0.5	0.278	0.782
	24 H	113.8 $\pm$ 7.9	113.2 $\pm$ 7.6	0.6	0.342	0.734
Diastolic BP (Mmhg)	Baseline	76.4 $\pm$ 6.8	75.9 $\pm$ 6.5	0.5	0.334	0.739
	2 H	75.2 $\pm$ 6.3	74.8 $\pm$ 6.1	0.4	0.288	0.774
	6 H	74.1 $\pm$ 5.9	73.8 $\pm$ 5.7	0.3	0.232	0.817
	24 H	73.2 $\pm$ 5.6	72.9 $\pm$ 5.4	0.3	0.244	0.808
Spo ₂ (%)	Baseline	99 $\pm$ 0.7	99 $\pm$ 0.6	0.1	0.688	0.493
	24 H	99 $\pm$ 0.6	99 $\pm$ 0.7	0.1	0.692	0.491

Table 5 demonstrates that the baseline haemodynamic parameters were similar between the two groups (all $p > 0.05$), confirming equivalence at study entry. No statistically significant differences were observed between groups for heart rate, systolic blood pressure, diastolic blood pressure, and SpO₂ during the postoperative observation periods (2 hours, 6 hours, and 24 hours) (all $p > 0.05$). Both groups showed a mild decrease in HR and BP in the

post-operative period which was physiologically expected with the resolution of surgical stress and residual effects of spinal anaesthesia. There were no patients in either group who developed clinically significant hypotension (MAP < 60 mmHg) requiring vasopressor support beyond a transient fluid bolus. SpO₂ was kept $>97\%$ in all participants over the entire study period.

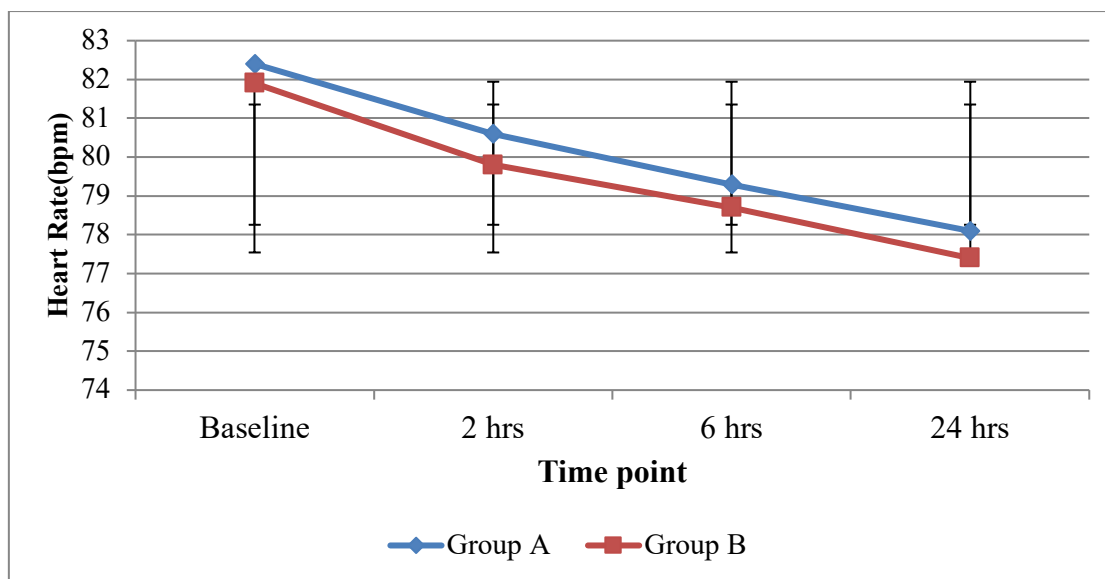
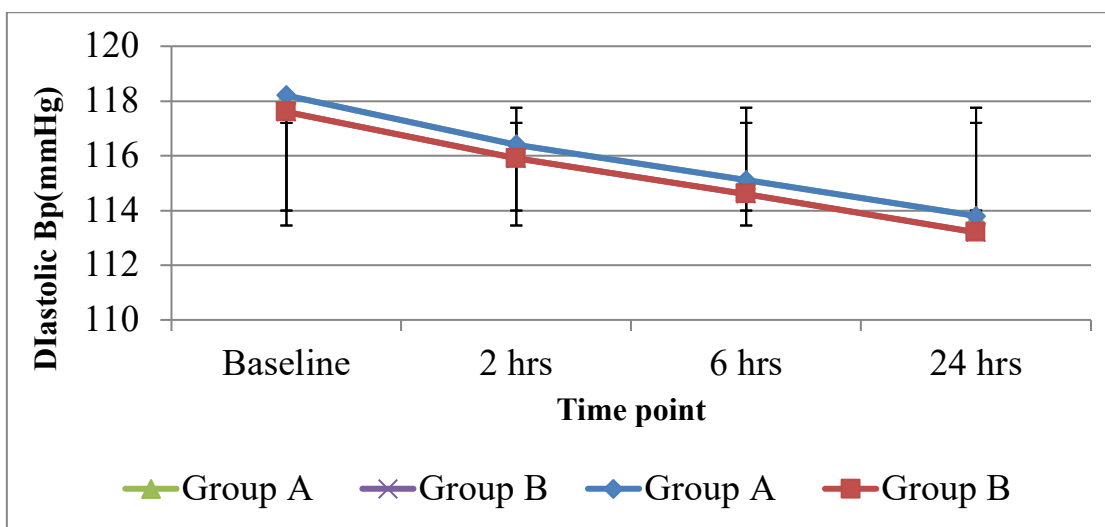
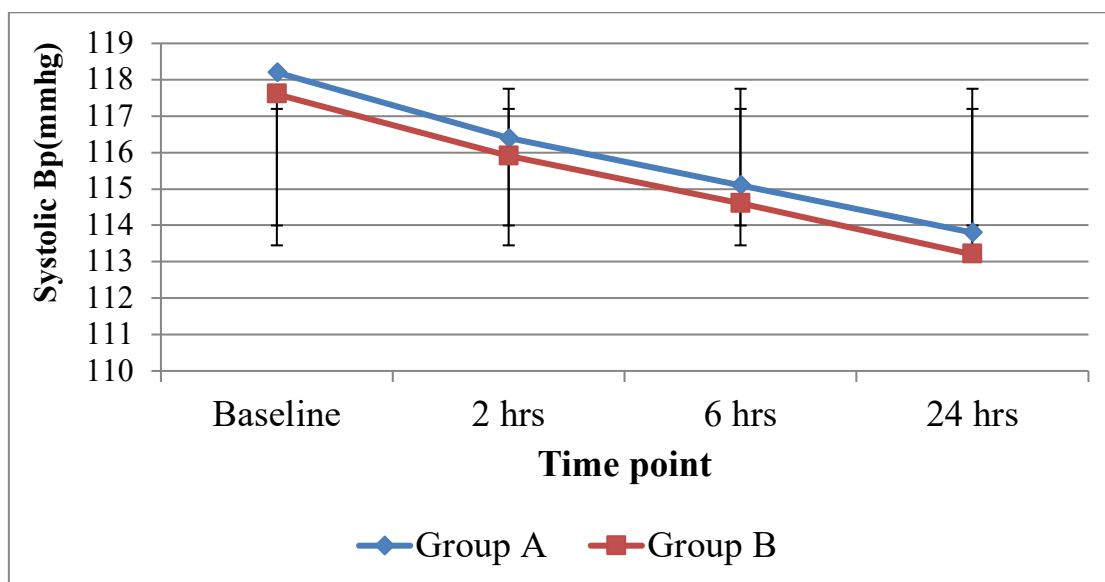


Figure 5: Comparison of Haemodynamic Parameters(HR, SBP, DBP, SPO2) at baseline and postoperative time points between group A and group B



Side Effects of Study Drugs Complications of TAP Block Complications directly attributable to the TAP block procedure (haematoma formation, nerve injury, peritoneal puncture, local anaesthetic

systemic toxicity) and adverse effects of the study drugs (nausea, vomiting, pruritus, hypotension, bradycardia, hyperglycaemia) were prospectively monitored and compared between the two groups.

Table 6: Incidence of TAP Block-Related Complication and Drug Adverse Effects in Group A and Group B

Complication	Group A (N=36) N (%)	Group B (N=36) N (%)	Total (N=72) N (%)	Fisher's Exact	P- Value
Nausea / Vomiting	5 (13.9)	4 (11.1)	9 (12.5)	0.109	0.741
Pruritus	3 (8.3)	2 (5.6)	5 (6.9)	0.212	1.000
Hypotension (MAP < 60 Mmhg)	2 (5.6)	3 (8.3)	5 (6.9)	0.212	1.000
Bradycardia (HR < 50 Bpm)	1 (2.8)	1 (2.8)	2 (2.8)	0.000	1.000
Hematoma At Injection Site	0 (0.0)	0 (0.0)	0 (0.0)	—	—
Local Anaesthetic Systemic Toxicity (LAST)	0 (0.0)	0 (0.0)	0 (0.0)	—	—
Hyperglycaemia (BSL > 180 Mg/Dl)*	0 (0.0)	2 (5.6)	2 (2.8)	2.040	0.494
Total Patients with Any Adverse Effect	9 (25.0)	10 (27.8)	19 (26.4)	0.066	0.797

The overall incidence of adverse effects was low and similar between the two groups (Table 6). The most frequent adverse effect was nausea/vomiting in 5 patients (13.9%) of Group A and 4 patients (11.1%) of Group B ($p = 0.741$). Mild pruritus was reported in 3 patients (8.3%) in Group A and 2 patients (5.6%) in Group B ($p=1.000$). Transient hypotension was seen in 2 patients (5.6%) in group A and 3 patients (8.3%) in group B which were treated with Inj. Mephentermine 6 mg IV and fluid bolus. In each group, one patient experienced mild bradycardia which spontaneously resolved. No haematoma

formation, peritoneal puncture or local anaesthetic systemic toxicity (LAST) was observed in either group, which confirmed the safety of the ultrasound-guided TAP block technique. There was transient increase in blood sugar level (> 180 mg/dL) in two patients of Group B which was attributed to the systemic effect of dexamethasone, however it was not statistically significant ($p = 0.494$) and resolved without any specific intervention. In Group A and Group B, 25.0% and 27.8% of patients, respectively, had at least one adverse effect, with no statistically significant inter-group difference ($p = 0.797$).

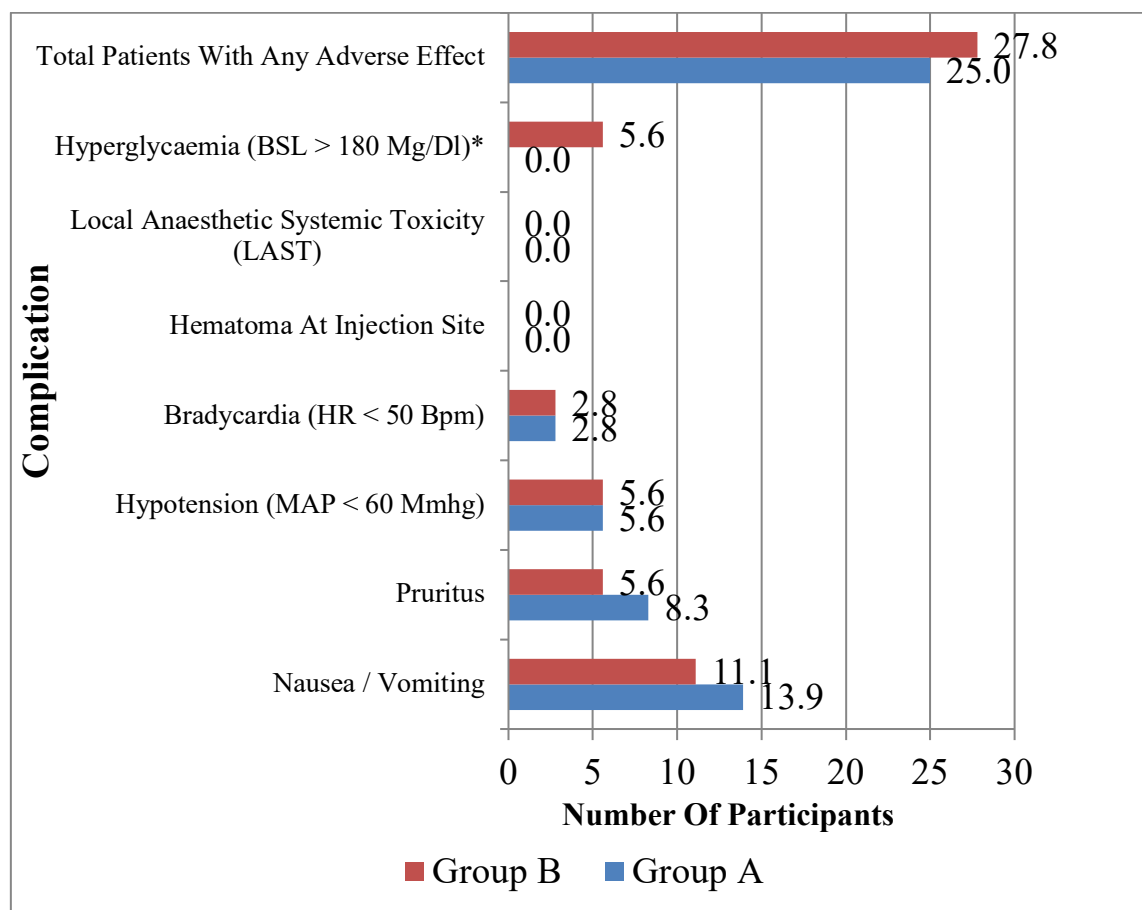


Figure 6: Incidence of TAP Block-Related Complication and Drug Adverse Effects in Group A and Group B

Discussion:

The two groups were comparable with respect to baseline demographic and clinical characteristics. The mean age was 27.4 ± 5.1 years in Group A and 26.9 ± 4.8 years in Group B, with no statistically significant difference ($p = 0.655$). Most participants were 25–30 years old. These findings were comparable with Jagdale et al. [16] who reported a mean age of 26.8 ± 4.3 years, and Thakur et al. [15], who reported mean ages ranging from 24 to 29 years. There were no significant differences in weight, height, BMI, gestational age, ASA physical status, parity or indications for elective LSCS.

The principal finding was significantly better postoperative analgesia with bupivacaine plus dexamethasone. Mean VAS pain scores were consistently and significantly lower in Group B at all postoperative assessment points from 2 to 24 hours. The maximum difference occurred at 12 hours, with VAS scores of 5.6 ± 1.2 in Group A and 3.1 ± 1.0 in Group B ($p < 0.001$). The scores partially converged at 24 hours, possibly reflecting resolution of the acute inflammatory response.

These findings are in close agreement with Jagdale et al. [16], who reported significantly lower VAS

scores with bupivacaine plus dexamethasone during the first 12 postoperative hours. Thakur et al. [15] similarly reported significantly higher VAS scores in the bupivacaine-alone group at all time points, while the dexamethasone group remained below the rescue threshold of 4 for a longer period. This pattern is consistent with the present findings and suggests that the anti-inflammatory action of dexamethasone may become more clinically apparent as the initial intense phase of acute nociception subsides.

In contrast, John et al. [17] found no significant difference in VAS scores between bupivacaine with fentanyl and bupivacaine alone, demonstrating that analgesic benefit cannot be assumed with every adjuvant. The superior pain control observed with dexamethasone in the present study supports its use as an effective adjuvant to bupivacaine in TAP block.

A clinically important finding was the significant prolongation of analgesia following dexamethasone administration. Duration of analgesia, defined as the time from completion of TAP block to the first rescue analgesic request at VAS ≥ 4 , was 468.7 ± 131.4 minutes (approximately 7.8 hours) in Group B compared with 276.4 ± 82.6 minutes (approximately

4.6 hours) in Group A ($p < 0.001$). Median duration was 450 minutes [IQR 375–560] in Group B compared with 265 minutes [IQR 210–330] in Group A ($p < 0.001$).

The results closely correspond to Jagdale et al. [16], who reported mean durations of analgesia of 466.82 ± 207.86 minutes with bupivacaine plus dexamethasone and 268.80 ± 125.53 minutes with bupivacaine alone. The close quantitative similarity strengthens the evidence supporting dexamethasone as an effective adjuvant for TAP block following LSCS. Thakur et al. [15] reported a longer mean duration of 12.5 ± 3.7 hours with bupivacaine plus dexamethasone. The difference from the present 7.8-hour duration may be related to differences in TAP block technique, patient demographics, bupivacaine concentration or other perioperative factors.

Raghukumar and Majigoudar [18] reported an approximately 2-hour increase in time to first rescue analgesia with dexamethasone compared with bupivacaine alone, whereas the present study demonstrated an approximately 3.2-hour difference. This variation may be related to the use of 0.5% bupivacaine in their study compared with 0.25% in the present study, as a higher baseline concentration may reduce the relative additive effect of dexamethasone.

Comparison with other regional techniques provides further context. Khanna et al. [19] reported that quadratus lumborum (QL) block provided longer analgesia than TAP block alone, with 85% of QL block patients requiring no rescue analgesia within 24 hours compared with 25% in the TAP group. Boules et al. [20] reported a median analgesic duration of 12 hours with erector spinae plane (ESP) block compared with 8 hours with TAP block alone. The approximately 7.8-hour duration achieved in Group B approaches but does not match these longer-acting techniques. Differences in block volume, ultrasound technique, patient characteristics and concurrent analgesic regimens may explain this variation.

The prolonged analgesia translated into a substantial reduction in rescue analgesic consumption. Within 24 hours, all 36 patients (100%) in Group A required at least one rescue analgesic dose compared with 28 patients (77.8%) in Group B ($\chi^2 = 8.471$, $p = 0.004$). The mean number of rescue analgesic doses was 1.86 ± 0.74 in Group A and 0.83 ± 0.71 in Group B ($p < 0.001$), representing more than a 55% reduction. Eight patients (22.2%) in Group B required no rescue analgesia during the first 24 hours. These findings agree with Jagdale et al. [16] and Thakur et al. [15], who also reported significantly lower rescue analgesic requirements with dexamethasone.

Leeladharan et al. [21] reported a mean time to rescue analgesia of 8.6 ± 2.8 hours in their

bupivacaine-alone TAP block group, longer than the 4.6 hours observed in Group A. Differences in local anaesthetic volume, patient population and rescue analgesic protocols may account for this variation. Their study nevertheless demonstrated the benefit of TAP block compared with no regional technique. Manam et al. [22] similarly demonstrated an opioid-sparing effect of TAP block, reporting significantly lower tramadol consumption and prolonged time to first tramadol request. The reduction in rescue analgesic requirements in the present study suggests that this benefit was further enhanced by dexamethasone.

Haemodynamic parameters remained stable in both groups. There were no statistically significant differences in heart rate, systolic blood pressure, diastolic blood pressure or SpO₂ at any postoperative time point. The mild reduction in heart rate and blood pressure over 24 hours was consistent with resolution of surgical stress and residual spinal anaesthetic effects. No patient required vasopressor support beyond a single fluid bolus. These findings agree with Jagdale et al. [16], Thakur et al. [15], Leeladharan et al. [21], and Boules et al. [20], who similarly reported haemodynamic stability following TAP block and dexamethasone administration.

The overall incidence of adverse effects was low and comparable between groups, occurring in 25.0% of Group A and 27.8% of Group B ($p = 0.797$). Nausea and vomiting were the most common adverse effects, occurring in 13.9% and 11.1%, respectively. No patient developed haematoma, peritoneal puncture, nerve injury or local anaesthetic systemic toxicity, supporting the safety of ultrasound-guided TAP block when performed by trained anaesthesiologists.

Two patients in Group B (5.6%) developed transient blood glucose elevation above 180 mg/dL in the early postoperative period. This resolved conservatively and is consistent with the known glucocorticoid effect of dexamethasone. Although clinically tolerated in the non-diabetic parturients, this finding is relevant in women with gestational or pre-existing diabetes.

The low incidence of pruritus in the present study also compares favourably with neuraxial opioids. The observed rates of 8.3% in Group A and 5.6% in Group B were considerably lower than the treatment-requiring pruritus reported with intrathecal morphine. Jagdale et al. [16], Raghukumar and Majigoudar [18], and Alalfy et al. [23] also reported favourable safety profiles and no significant block-related complications.

Despite these alternatives, TAP block remains attractive because of its technical accessibility, established ultrasound landmarks and lower risk of

visceral and vascular injury. It is also suitable for practitioners with limited advanced regional anaesthesia experience. The approximately 7.8-hour analgesic duration achieved with dexamethasone therefore represents a practical strategy for improving the efficacy of TAP block. Alalfy et al. [23] demonstrated that ilioinguinal-iliohypogastric nerve block using bupivacaine plus dexamethasone provided lower VAS scores and reduced rescue analgesic consumption compared with TAP block using the same drug combination, suggesting that targeted nerve blocks may provide more precise analgesia and warrant further evaluation.

The present study had several strengths. All TAP blocks were performed under real-time ultrasound guidance, ensuring consistent placement of local anaesthetic. The sample size was calculated a priori using published data from Thakur et al. [15]. Assessment included VAS scores, analgesic duration, rescue analgesic consumption, haemodynamic parameters and adverse effects. Standardisation of drug doses, volumes and assessment protocols further minimised variation.

Overall, the present study demonstrates that addition of dexamethasone 8 mg to 0.25% bupivacaine in ultrasound-guided bilateral TAP block for elective LSCS provides significantly superior postoperative analgesia compared with bupivacaine alone. The benefit was demonstrated by lower VAS scores, approximately 70% prolongation of analgesic duration and more than 55% reduction in rescue analgesic consumption, without additional haemodynamic instability or clinically significant procedural complications. These findings are consistent with Indian studies including Jagdale et al. [16] and Thakur et al. [15] and with the broader literature on dexamethasone as an adjunct to peripheral nerve blocks. The dexamethasone-augmented TAP block provided analgesia approaching that reported with intrathecal morphine while maintaining a favourable side-effect profile. The present study therefore supports the inclusion of dexamethasone as an effective adjuvant to bupivacaine-based TAP block for post-caesarean analgesia in tertiary-care centres in India.

Conclusion:

The present study concludes that addition of dexamethasone to bupivacaine in ultrasound guided bilateral transversus abdominis plane block provides better post-operative analgesia than bupivacaine alone in patients undergoing lower segment caesarean section. The two groups were similar in demographic and baseline clinical characteristics, suggesting that the difference in analgesic outcome was mainly attributable to the drug combination used in the TAP block.

The study results showed that patients who received bupivacaine combined with dexamethasone had lower post-operative pain scores throughout the observation time. The duration of analgesia was also longer in the dexamethasone group, which meant that patients were comfortable for a longer time before they needed more pain medication. This indicates that dexamethasone is effective in prolonging and enhancing analgesic action of bupivacaine when used as an adjuvant in TAP block.

The bupivacaine plus dexamethasone group required less rescue analgesia than the bupivacaine-only group. This reduction is clinically important as it may help in decreasing the need of systemic analgesics and its associated side effects hence improving maternal comfort, early mobilisation and ability to take care of the new born after caesarean section.

The combination was also well-tolerated and safe. Hemodynamic parameters were stable in both groups and there was no significant increase in adverse effects or TAP block related complications.

Therefore, ultrasound-guided TAP block with bupivacaine and dexamethasone can be considered an effective and safe part of multimodal analgesia for postoperative pain management after caesarean section.

References:

1. World Health Organization. WHO Statement on Caesarean Section Rates. *Reprod Health Matters*. 2015;23(45):149–150.
2. Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L, et al. Global epidemiology of use of and disparities in caesarean sections. *Lancet*. 2018;392(10155):1341-8.
3. Ministry of Health and Family Welfare. National Family Health Survey-5 State Factsheets. Government of India; 2021.
4. Desborough JP. The stress response to trauma and surgery. *Br J Anaesth*. 2000;85(1):109-17.
5. Bollag L, Lim G, Sultan P, Habib AS, Landau R, Zakowski M, et al. Society for Obstetric Anesthesia and Perinatology consensus statement on enhanced recovery after cesarean delivery. *Anesth Analg*. 2021;132(5):1362-77.
6. Wick EC, Grant MC, Wu CL. Postoperative multimodal analgesia pain management. *Anesthesiol Clin*. 2017;35(2).
7. McDonnell JG, O'Donnell B, Curley G, Heffernan A, Power C, Laffey JG. The analgesic efficacy of transversus abdominis plane block after abdominal surgery. *Anesth Analg*. 2007;104(1):193-7.
8. Hebbard P. Transversus abdominis plane block under ultrasound guidance. *Anaesth Intensive Care*. 2007;35(4):616-7.

9. Hebbard P, Fujiwara Y, Shibata Y, Royse C. Ultrasound-guided transversus abdominis plane block. *Anaesth Intensive Care*. 2007;35(4):616-7.
10. Butterworth JF, Strichartz GR. Molecular mechanisms of local anesthesia. *Anesthesiology*. 1990;72(4):711-34.
11. Rosenberg PH, Veering BT, Urme y WF. Maximum recommended doses of local anesthetics. *Reg Anesth Pain Med*. 2004;29(6):564-75.
12. Petersen PL, Mathiesen O, Torup H, Dahl JB. The transversus abdominis plane block: a valuable option for postoperative analgesia? *Acta Anaesthesiol Scand*. 2010;54(5):529-35.
13. Kirkham KR, Jacot-Guillarmod A, Albrecht E. Optimal dose of perineural dexamethasone to prolong analgesia after peripheral nerve blockade. *Anesth Analg*. 2018;126(1):270-9.
14. Williams BA, Hough KA, Tsui BYK, Ibinson JW, Gold MS, Gebhart GF. Neurotoxicity of adjuvants used in perineural anesthesia and analgesia. *Reg Anesth Pain Med*. 2011;36(3):225-30.
15. Thakur J, Gupta B, Gupta A, Bhargava A, Gothwal S, Bhargava A. A prospective randomized study to compare dexmedetomidine and dexamethasone as an adjunct to bupivacaine in transversus abdominis plane block for post-operative analgesia in cesarean delivery. *Int J Reprod Contracept Obstet Gynecol*. 2019;8(12):4824-4828.
16. Jagdale S, Kakade A, Wagh G. Comparison of the efficacy of bupivacaine versus bupivacaine plus dexamethasone during surgical TAP block for postoperative analgesia after cesarean section. *Indian J Obstet Gynecol Res*. 2019;6(4):492-494.
17. Roshan John R, Ranjan R, Ramachandran T, George S. Analgesic efficacy of transversus abdominal plane block after elective cesarean delivery – bupivacaine with fentanyl versus bupivacaine alone: a randomized, double-blind controlled clinical trial. *Anesth Essays Res*. 2017;11(2):181-184.
18. Raghukumar M, Majigoudar SS. A randomized clinical comparative trial to study the efficacy of adding clonidine or dexamethasone to bupivacaine (0.5%) in prolonging the duration of postoperative analgesia with ultrasound-guided TAP block in cesarean delivery. *Indian J Clin Anaesth*. 2017;4(2):198-201.
19. Khanna S, Prasad GVK, Sharma VJ, Biradar M, Bhasin D. Quadratus lumborum block versus transversus abdominis plane block for post Cesarean analgesia: A randomized prospective controlled study. *Med J Armed Forces India*. 2022;78(Suppl 1):S82-S88.
20. Boules M, Goda AS, Abdelhady M, Abu El-Nour SA, Hamed M. Comparison of analgesic effect between erector spinae plane block and transversus abdominis plane block after elective cesarean section: a prospective randomized single-blind controlled study. *J Pain Res*. 2020;13:1073-1080.
21. Leeladharan SP, Puthenveetil N, B, Nair SS, Kumar L. Analgesic efficacy and safety of ultrasound-guided transverse abdominis plane block in postcesarean section patients – a randomized control trial. *J Obstet Anaesth Crit Care*. 2020;10(1):16-20.
22. Manam S, Swetha R, Rao A, Murthy S. A prospective study of efficacy of ultrasound-guided transversus abdominis plane block for postcesarean analgesia. *Int J Reprod Contracept Obstet Gynecol*. 2019;8(5):1865-1870.
23. Alalfy RM, El-Demiry NM, Mandour OM. Comparison between ultrasound-guided bilateral ilioinguinal-iliohypogastric nerve block and ultrasound-guided transversus abdominis plane block with the usage of bupivacaine and dexamethasone for post-cesarean section analgesia: a pilot study. *Med J Cairo Univ*. 2021;89(7):8163-8173