

POSTOPERATIVE ANALGESIA FOLLOWING ELECTIVE CAESAREAN SECTION: A COMPARATIVE STUDY BETWEEN ERECTOR SPINAE PLANE AND TRANSVERSUS ABDOMINIS PLANE BLOCKS

Anaesthesiology

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ABSTRACT

Moderate to severe pain following lower segment caesarean section (LSCS) can negatively affect maternal recovery, early ambulation, and neonatal care. Regional anaesthetic techniques such as the transversus abdominis plane (TAP) block and the erector spinae plane (ESP) block are increasingly used for postoperative analgesia as part of multimodal, opioid-sparing strategies. The ESP block is a newer technique with simpler performance and potential for prolonged analgesic duration. This prospective observational study included 60 ASA I–II patients aged 20–35 years undergoing elective caesarean section under spinal anaesthesia at Government Medical College, Thrissur. Patients were divided into two groups: Group A received bilateral TAP block and Group B received bilateral ESP block, each using 20 mL of 0.25% bupivacaine. Postoperative pain was evaluated using the Numerical Rating Scale (NRS), and outcomes measured included time to first rescue analgesia and total analgesic requirement. Results showed that the ESP block provided significantly longer duration of analgesia, with a mean duration of approximately 14 hours ($p < 0.001$) compared to the TAP block. The ESP group also required fewer rescue analgesic doses. Additionally, NRS scores were consistently lower in the ESP group at all postoperative time intervals beyond 30 minutes, indicating superior pain control. In conclusion, the erector spinae plane block provides more effective and longer-lasting postoperative analgesia compared to the transversus abdominis plane block in elective caesarean section patients. It is a valuable component of multimodal analgesia, offering improved pain relief and reduced need for additional analgesics.

KEYWORDS

Analgesia, Caesarean Section, Erector Spinae Plane Block, Transversus Abdominis Plane Block, Bupivacaine.

INTRODUCTION

Postoperative pain following lower segment caesarean section (LSCS) remains a significant clinical concern, as effective analgesia is essential for maternal comfort, early ambulation, and optimal neonatal care. According to the International Association for the Study of Pain (IASP), pain is defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage” [1]. Post-caesarean pain is typically acute in nature and results from surgical trauma, leading to inflammatory responses and activation of nociceptive pathways. It includes both somatic and visceral components, contributing to significant postoperative discomfort [2].

The incidence of caesarean delivery has increased globally, with rates of approximately 32% in the United States and over 14% in India, with higher figures reported in urban regions [3]. Postoperative pain is among the most commonly reported adverse experiences after caesarean section and can negatively impact maternal recovery, breastfeeding, and mother–infant bonding [4,5].

Somatic pain arises from the abdominal wall incision and is transmitted via the anterior rami of spinal nerves T6–L1, while visceral pain originates from uterine manipulation and is conveyed through T10–L1 via the inferior hypogastric plexus [6]. Inadequate pain control may result in delayed mobilization, increased thromboembolic risk, higher opioid consumption, and the potential development of chronic pain and postpartum depression [7].

Spinal anaesthesia is widely preferred for caesarean delivery due to its rapid onset and safety profile; however, it provides limited postoperative analgesia. Therefore, multimodal analgesic techniques, including systemic analgesics, neuraxial adjuvants, and regional blocks, are commonly used to improve pain control [3,4].

Among regional techniques, the transversus abdominis plane (TAP) block provides effective somatic analgesia by targeting nerves within the neurofascial plane of the anterior abdominal wall [5]. More recently, the erector spinae plane (ESP) block has emerged as a promising alternative. By depositing local anaesthetic deep to the erector spinae muscle, it allows spread to the paravertebral space, potentially blocking both dorsal and ventral rami and providing broader somatic and visceral analgesia [6,7].

Recent evidence suggests that the ESP block may offer superior and

longer-lasting postoperative analgesia compared to the TAP block, making it a valuable component of multimodal, opioid-sparing analgesic strategies in caesarean deliveries [6,7].

METHOD

This prospective observational study was conducted in the Department of Anaesthesia and Critical Care at Government Medical College, Thrissur, Kerala, over a period of one year following approval from the Institutional Research and Ethics Committee. The study included 60 parturients aged 20–35 years, classified as ASA physical status I–II, scheduled for elective lower segment caesarean section (LSCS) under spinal anaesthesia.

Women who provided informed consent and met the inclusion criteria were enrolled. Exclusion criteria included hypersensitivity to local anaesthetics, coagulation disorders or anticoagulant therapy, morbid obesity ($\text{BMI} > 40 \text{ kg/m}^2$), opioid dependence, significant cardiovascular disease, conduction abnormalities or bradycardia, psychiatric illness affecting pain assessment, and spinal deformities.

The sample size was calculated as 60 patients (30 per group) based on previous literature, considering differences in Numerical Rating Scale (NRS) scores, 80% study power, and a 5% level of significance.

All patients received spinal anaesthesia with 1–2 mL of 0.5% hyperbaric bupivacaine, along with standard perioperative care including IV ondansetron (4 mg), preloading with Ringer's lactate (10 mL/kg), left uterine tilt positioning, and oxygen supplementation. Intraoperative hypotension ($\text{SBP} < 90 \text{ mmHg}$ or $> 20\%$ fall from baseline) was treated with IV ephedrine 5 mg, and bradycardia ($\text{HR} < 50 \text{ bpm}$) with IV atropine 0.5 mg. Oxytocin was administered after delivery as a slow IV bolus (5 U) followed by infusion (10 U).

Postoperatively, patients were allocated into two groups. Group A (TAP block) received bilateral ultrasound-guided transversus abdominis plane blocks with 20 mL of 0.25% bupivacaine per side, injected between the internal oblique and transversus abdominis muscles. Group B (ESP block) received bilateral erector spinae plane blocks at the T9 level, where 20 mL of 0.25% bupivacaine was injected deep to the erector spinae muscle under ultrasound guidance following confirmation with hydrodissection.

Patients were monitored for complications including local anaesthetic

systemic toxicity. Postoperative pain was assessed using the Numerical Rating Scale (NRS) and classified as mild (1–3), moderate (4–6), or severe (7–10). Rescue analgesia was provided with IV paracetamol (1 g) when NRS exceeded 4, and additional analgesia was delivered via patient-controlled analgesia (PCA) with IV tramadol (20 mg bolus, 10-minute lockout, maximum 50 mg/hour).

The primary outcome was duration of analgesia, defined as time from block administration to first rescue analgesic request. Secondary outcomes included NRS scores and total analgesic consumption.

RESULTS

This prospective observational study was conducted to compare the analgesic efficacy of erector spinae plane (ESP) block versus transversus abdominis plane (TAP) block in women undergoing elective caesarean sections. A total of 60 patients were included, with 30 patients in each group. Group A received TAP blocks, while Group B received ESP blocks.

General Characteristics of Participants

The mean age of all participants was 27.08 ± 4.09 years. The average weight was 58.17 ± 4.93 kg, with a mean BMI of 22.72 ± 3.46 kg/m². There was a fairly even distribution of socioeconomic status, with 83.3% of participants from above poverty line (APL) households and 16.7% from below poverty line (BPL). The majority of the participants (51.67%) were from rural areas, and 70% were multiparous. Additionally, 38.3% of participants reported a history of previous caesarean sections or abdominal surgeries. Comorbidities were also noted, with diabetes mellitus being the most prevalent (41.7%), followed by hypertension (31.7%). Table 1

Table 1-Distribution of General Characteristics of Study Participants

PARAMETERS	MEAN	STANDARD DEVIATION
AGE	27.08	4.093
WEIGHT	58.17	4.934
HEIGHT	4.3265	21.22576
BMI	22.7176	3.45657

Comparison Between Groups A and B

There were no statistically significant differences between Group A (TAP block) and Group B (ESP block) in terms of age, weight, height, BMI, socioeconomic status, parity, history of caesarean section, or comorbidities. This indicates a well-matched study population across both groups. Table 2

Table 2-Comparison of Demographic Data Among Group A and Group B

	GROUP A	GROUP B	P VALUE
AGE(YEAR)	27.13 $\pm$ 3.91	27.03 $\pm$ 4.33	0.198
WEIGHT(KG)	57.3 $\pm$ 3.67	59.03 $\pm$ 5.869	0.11
HEIGHT(M)	1.58 $\pm$ 0.038	1.54 $\pm$ 0.061	0.185
BMI(KG/M ²)	22.85 $\pm$ 1.41	22.57 $\pm$ 4.71	0.212

Analgesic Efficacy

A marked difference was observed in the use of rescue analgesia between the groups. Only 10% of patients in the ESP group (Group B) required rescue analgesia, compared to 93.3% in the TAP group (Group A), a statistically significant finding ($p < 0.001$). Additionally, the time of rescue analgesia administration varied significantly: most patients in the TAP group required analgesics at 6 to 12 hours postoperatively, while 48.3% of patients in the ESP group did not require any rescue analgesia within the first 24 hours. Table 3

Table 3-Comparison of Study Participants Based on use of Rescue Analgesia-Group A and Group B

Use of Rescue Analgesia	GROUP A		GROUP B		P Value
	Frequency	Percent (%)	Frequency	Percent (%)	
YES	3	10.0	28	93.3	< 0.001
NO	27	90.0	2	6.7	
TOTAL	30	100.0	30	100.0	

Pain Scores

Postoperative pain, assessed using the numerical rating scale (NRS), was consistently lower in the ESP group at all time intervals. At 30 minutes postoperatively, the mean NRS score was 0.23 ± 0.43 for the ESP group, compared to 0.43 ± 0.57 in the TAP group. The difference became more pronounced over time. At 1 hour, 6 hours, 12 hours, and 24 hours, the ESP group had significantly lower pain scores (1.13,

1.77, 2.47, and 2.90, respectively) than the TAP group (2.13, 4.20, 4.83, and 3.77, respectively). The differences at 1 hour and beyond were statistically significant ($p < 0.01$). Figure 1

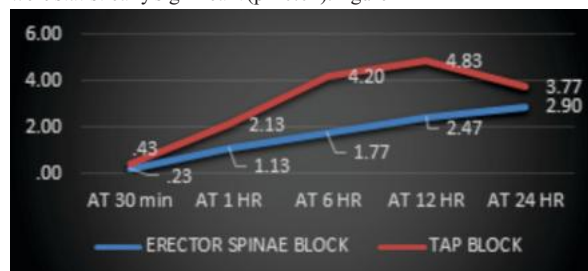


Figure 1- Comparison of Study Participants Based on Pain Score - Group A and Group B(Erector Spinae Block and TAP Block)

DISCUSSION

This prospective observational study conducted at Government Medical College, Thrissur compared the efficacy of transversus abdominis plane (TAP) block and erector spinae plane (ESP) block in 60 ASA I–II patients undergoing elective caesarean section. Both groups were comparable in demographic variables such as age, weight, height, and BMI, ensuring adequate homogeneity and minimizing confounding factors.

The study findings demonstrate that the ESP block provided significantly longer duration of analgesia and delayed time to first rescue analgesic requirement compared to the TAP block. This is consistent with the broader sensory coverage of the ESP block, which is believed to extend into the paravertebral space and provide both somatic and visceral analgesia. These results are in agreement with Malawat et al., [8] who also reported significantly prolonged analgesia with ESP block, lasting up to 43 hours compared to TAP block [10].

Postoperative pain scores (NRS) were consistently lower in the ESP group at all measured time intervals (30 minutes, 1, 6, 12, and 24 hours), indicating superior and sustained analgesic efficacy. Similar findings have been reported in previous studies, where improved pain control with ESP block contributed to better postoperative comfort and recovery [11]. Malawat et al. also observed a longer time to first analgesic request in the ESP group, findings which were replicated in this study [12]. In addition, Mankikar et al. reported a shorter analgesic duration with TAP block (approximately 9.53 hours), whereas in our study, the ESP group required rescue analgesia at around 14 hours, further supporting its prolonged effect [13].

The superior analgesic profile of the ESP block may be attributed to the spread of local anaesthetic into the paravertebral space, leading to blockade of both dorsal and ventral rami and providing wider dermatomal coverage. This mechanism has also been described by DeLara González et al., who suggested that paravertebral spread contributes to effective somatic and visceral analgesia [4].

Despite these advantages, the study has limitations. Its observational design and relatively small sample size limit the generalisability of the findings. The absence of randomisation may also introduce selection bias. Additionally, only a single concentration of local anaesthetic (0.25% bupivacaine) was used, and outcomes beyond 24 hours were not assessed. Further large-scale randomized controlled trials are required to confirm these findings and explore optimal dosing strategies [7,9].

CONCLUSION

The erector spinae plane (ESP) block provides superior postoperative analgesia compared to the transversus abdominis plane (TAP) block in patients undergoing elective caesarean section. It is associated with a significantly longer duration of analgesia and a delayed requirement for first rescue analgesic. Patients receiving ESP block experience consistently lower postoperative pain scores throughout the early postoperative period. The ESP block also reduces the overall need for opioid (tramadol) consumption, supporting its role in opioid-sparing multimodal analgesia. Therefore, the ESP block is a more effective regional anaesthetic technique than the TAP block for post-caesarean pain management and can be considered a preferred option in clinical practice. Further large-scale randomized studies are recommended to confirm these findings.

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