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Research Article

Comparision of Ultrasound-guided Transversus Abdominis Plane Block and Erector Spinae Plane Block for Postoperative Analgesia in Caesarean Section

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ABSTRACT

Introduction: Pain is the most unpleasant subjective feeling comprising of innumerable emotional and psychological components that require medical advice for relief, regardless of the cause. Truncal blocks contribute to multimodal analgesia that enhances early recovery after caesarean delivery. The transversus abdominis plane (TAP) block is an established technique that offers somatic abdominal wall analgesia. The erector spinae plane (ESP) block is a fascial plane technique that may offer additional visceral analgesic effects. This study hypothesized that ESP block would offer superior analgesic efficacy to TAP block in women undergoing caesarean delivery under spinal anaesthesia. Transversus Abdominis Plane (TAP) block and Erector Spinae Plane (ESP) block are effectively studied blocks that provide adequate pain control.

Aim: To compare postoperative analgesic efficacy in pregnant women undergoing caesarean section under spinal anaesthesia with Ultrasound (USG)-guided TAP block and USG-guided ESP block.

Materials and Methods: Sixty patients (age>18) scheduled for elective cesarean section under spinal anesthesia, randomly divided into group I ESP block (n = 30) or Group II TAP block (n = 30) groups. After completion of surgery, ultrasound guided ESP or TAP block was given using 0.2% ropivacaine (0.2 ml/kg or 10ml on either side) with nalbuphine as an adjuvant. Postoperatively visual analogue scale (VAS) score 0 (no pain), 5 (moderate pain), 10(worst possible pain) and analgesic requirement of each patient was assessed at regular interval for 24 h by a blinded investigator. Statistical analysis was done using SPSS version 21.

Results: Subjects in group I had a mean age of 24.9±4.66 years while those in group II were 25. 5±3.99 years. Following the first dose, there was a significant delay in rescue analgesia and a reduction in the total administration of rescue analgesia within 24 hours. The first rescue analgesia in group I was at 8.4 ± 1.1 hours and in group II was at 6.5 ± 1.1 hours, with a p-value of 0.0001 indicating a statistically significant difference. P-value <0.05 is statistically significant.

Conclusion: ESP block provided a prolonged duration of analgesia, as shown by a decrease in the total VAS score. There was also a significant reduction in the total number of administrations of rescue analgesia within 24 hours when compared to TAP block, suggesting that ESP block provides superior analgesia.

Keywords*: Analgesia, elective cesarean section, ropivacaine, transversus abdominis plane block, erector spinae plane block, nalbuphine.*

INTRODUCTION

Cesarean delivery associated with moderate to severe pain in postoperative period which Is associated with numerous adverse neuro endocrine effects that can delay postoperative recovery of mother. Post operative pain is major risk factor for developing chronic pain, opioid use & opiod dependency. Globally caesarean delivery have high incidence of poorly controlled Post operative pain. Obtaining analgesia with minimal side effects to the mother and infant can be achieved with a multi modal approach includes truncal block. These blocks improve analgesia, are opioid sparing and enhance early post operative recovery.

Transversus abdominis plane (TAP)block. [2]

The transverses abdominis plane block involves deposition of local anaesthetic between the transverses abdominis muscle and internal oblique muscles of the abdominal wall. It provides somatic analgesia of the abdominal wall but lacks Visceral analgesic effect. TAP block reduces pain scores and opioid consumption, so several International guide lines recommend them as analgesic adjuncts after caesarean delivery.

Erector spinae plane(ESP)block [4].

The Erector spinae plane block is a fascial plane technique. It is a paraspinal technique which cause cranio-caudal spread of local anaesthetic drugs from below the ESP muscles to the para vertebral space. It provides somatic analgesia by blocking the dorsal and ventral rami of spinal nerves and potentially obtains visceral analgesia by blocking sympathetic rami communicantes.

The use of ESP block for caesarean delivery is supported by studies **[3] [4]** that showed opioid sparing analgesia with decreased pain scores. ESP block close to spinal nerves and the sympathetic chain, thus obtaining analgesic advantages over TAP block. **[5]**

Ropivacaine [1]

Ropivacaine is a long-acting **amide-type local anesthetic** commonly used for regional anesthesia and analgesia. It is the **S-enantiomer** of the parent compound and is structurally related to bupivacaine but with a better safety profile.

Ropivacaine blocks nerve conduction by inhibiting sodium ion influx in nerve fibers, leading to reversible loss of sensation. It preferentially blocks **sensory fibers** more than motor fibers, allowing **sensory analgesia with less motor blockade** compared to bupivacaine. It exhibits **intrinsic vasoconstrictive properties**, which can reduce systemic absorption.

Lower cardiotoxicity and neurotoxicity than bupivacaine. Suitable for **continuous infusions** due to improved safety. Provides effective pain relief with reduced motor impairment

Nalbuphine [6]

Nalbuphine is categorized among **mixed opioid agonist–antagonists**, with primary activity at **κ opioid receptors** and antagonistic action at **μ opioid receptors**. It has lesser incidence of respiratory depression as compared to morphine Lower abuse liability compared to morphine; however, in opioid dependent patients, it can precipitate withdrawal Effective for **moderate to severe pain**, used in balanced anesthesia (pre- and post-op, labor analgesia) Reduces **morphine-induced pruritus** (itching) without compromising pain relief Sedation, nausea/vomiting, dizziness, dry mouth, headache. Lower risk of euphoria, dysphoria, hallucinations, or respiratory depression relative to full μ agonists.

MATERIALS AND METHODS

Study Setting and Design

This prospective, hospital-based, randomized controlled study was conducted in the Department of Anaesthesia at Shri Vinoba Bhave Civil Hospital, Silvassa. written informed consent was taken from each patient after clearly explaining the nature, purpose, risks, and benefits of the study in their own native language. Student's *t*-test used for demographic and other data.

Patient Selection and Eligibility

Sixty Patients scheduled for elective cesarian section under spinal anaesthesia were screened for eligibility. In two groups; Group I ESP (n=30) and Group TAP (n=30).

Inclusion criteria:-

1. age >18 years
2. American Society of Anesthesiologists (ASA) physical status II,
3. ability to provide informed consent.

Exclusion criteria:-

1. patient refusal
2. known allergy to local anaesthetics
3. infection at the injection site
4. ASA physical status III & IV
5. bleeding or coagulation disorders
6. significant hepatic or renal dysfunction, cardiovascular or respiratory instability
7. epilepsy
8. pre-existing neurological deficits such as hemiplegia.

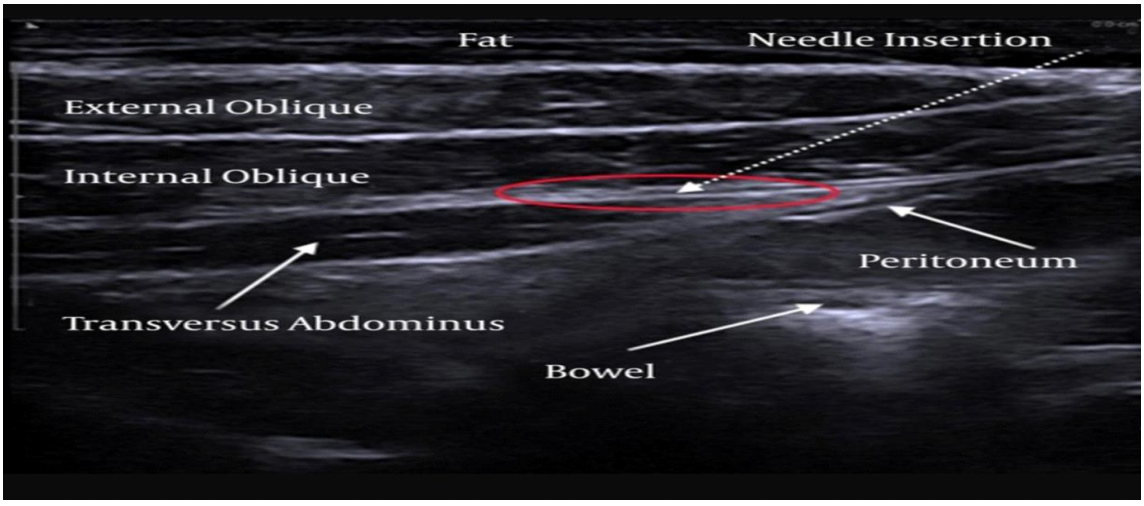
Preoperative Assessment and Preparation
All enrolled patients underwent a detailed pre-anaesthetic evaluation which included clinical history, general and systemic examination, and appropriate investigations. Routine laboratory tests included complete haemogram, serum electrolytes, blood urea, serum creatinine, urine routine analysis, and electrocardiogram (ECG). Patients were instructed to remain nil per oral for solids for 8 hours, liquids for 4 hours, and clear water for 2 hours before surgery.

On arrival in the preoperative room, intravenous (IV) access was secured with an 18G cannula, and IV fluids were initiated based on body weight and fluid requirements. Standard preoperative preparations were ensured including anaesthesia machine check, airway equipment readiness, and availability of emergency drugs. Patients were then shifted to the operating theatre where they were connected to standard monitoring devices; heart rate (HR), pulse oximetry (SpO_2), non-invasive blood pressure (NIBP) and ECG. Baseline parameters were recorded.

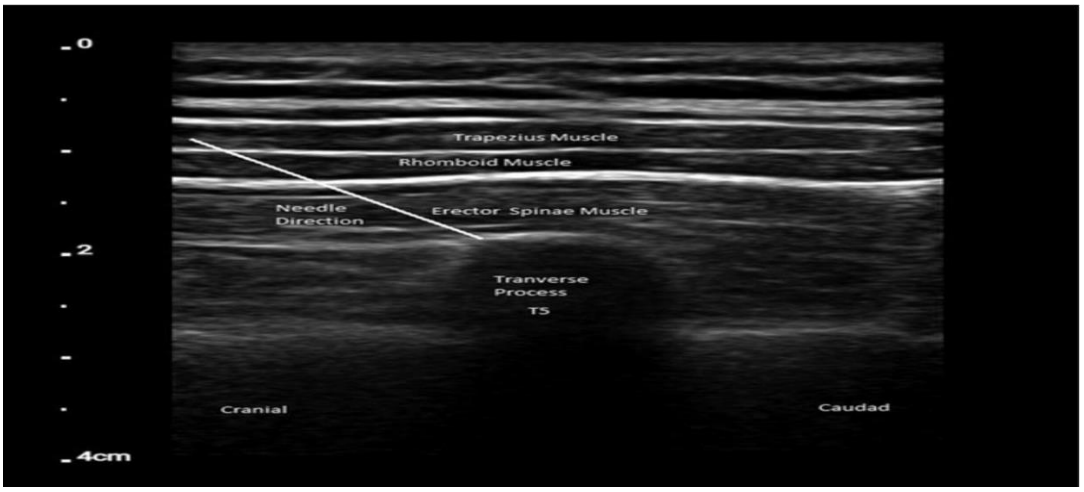
Premedication and Anaesthesia Technique
All patients received intravenous inj. ondansetron 4 mg as premedication to prevent intra operative nausea and vomiting. Pre-loading was done with 10-15mL/kg of inj. Ringer lactate solution. Under strict aseptic precautions and using midline approach, spinal anaesthesia was performed.

Spinal anesthesia was accomplished in all patients in the sitting position after determining the midline and intervertebral spaces of the L3–4 and L4–5 using a 25 gauge spinal needle (B. Braun Melsungen, Germany) with 12.5 mg hyperbaric bupivacaine. The patients were swiftly placed in the supine position with left uterine displacement. Spinal anesthesia was considered successful once T6 bilateral block, determined by the deficit of cold by ice cube and touch by blunt pin discrimination, after 5 min of spinal injection was checked. Anesthesia and surgical treatment were followed in the usual manner. At the end of the surgery, with the patient fully monitored, the ESP block or TAP block was accomplished under ultrasonographic guidance using a linear probe (6–13 MHz) transducer (LOGIQ GE HEALTHCARE)

Transversus abdominis plane block
The posterior approach for the TAP block was used. With the patients in the supine position, the transducer probe was first placed posterior to the mid axillary line between the costal margin and the iliac crest and moved more posteriorly to view the point where transversus abdominis ends and tails off turning into the aponeurosis. Quadratus lumborum was seen postero medial to the aponeurosis [Figure 1c]. The injection site was at the TAP between the internal oblique and transversus abdominis posterior to the midaxillary line and near the aponeurosis. A total of 0.2% ropivacaine (0.2ml/kg or 10ml) + nalbuphine 10mg was injected after hydrodissection. Likewise, the same block procedure was performed on the other side.



Erector spinae plane block
For block performance, patients were turned laterally to one side and the T9 spinous process was marked; the transducer probe was shifted from the midline, 3cm laterally to visualize the T9 transverse process and erector spinae muscle [Figure 1a]. A 21 gauge needle was inserted in the plane cranial to caudal till the tip of the needle reached into the fascial plane between erector spinae muscle and transverse process. The position of the needle tip was checked by hydro dissection with 2 ml normal saline; thereafter, a total of 0.2% ropivacaine (0.2ml/kg or 10ml) + nalbuphine 10mg was injected. The spread of injectated was observed ultra sonographically. Likewise, the same block procedure was performed on the other side.



The vital parameters of each subject were recorded again five minutes after the procedure, and then the patients were transferred to the recovery room. In the recovery room, the patients were monitored for haemo dynamic changes, heart rate, mean arterial pressure, respiratory rate, and SpO2 at 15 minutes, 30 minutes, and one hour, respectively. Subsequently, the patients were transferred to the ward with clear instructions to monitor blood pressure and heart rate at 0, 2, 4, 6, 12, 18, and 24 hours. Following the procedure, a blinded investigator noted the following observations in both the groups:

1. VAS scores at the end of 0, 2, 4, 6, 12, 18, and 24 hours.
2. Duration from intervention to the first rescue analgesia in hours.
3. Total number of administrations of rescue analgesia in the initial 24 hours (using a standard dose of 2 mg/kg of body weight of tramadol for each dose of rescue analgesia).

Any postoperative side-effects such as nausea, vomiting, and pruritus in each group were also noted. In this manner, all the data were systematically collected for each patient. Later, a master chart was prepared for statistical analysis

Statistical Analysis

All collected data were recorded and analyzed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as age, BMI and VAS scores were presented as mean ± standard deviation (SD). Vas score 0 (no pain), 5 (moderate pain), 10(worst possible pain). P-value <0.05 is statistically significant.

RESULT

Table 1: Dermographic Data Comparison Between Groups of ESP AND TAP

Parameter	Group 1 (ESP n=30)	Group 2 (TAP n=30)	p-value
Age (year)	23.2 ± 2.6	23.5 ± 2.3	0.7061
BMI (kg/m²)	22.6 ± 1.5	22.4 ± 1.9	0.5247
Number of Rescue analgesia	1.3 ± 0.5	1.6 ± 0.5	0.0214
Time to first rescue analgesia (hours)	8.4 ± 1.1	6.5 ± 1.1	<0.001

Regarding the time of first rescue analgesia in group I it was 8.4 ± 1.1 hours compared to 6.5 ± 1.1 hours in group II. The p- value was 0.001 indicating significant difference between the two groups. Few post operative side-effects were observed in either group.

Table 2: VAS score comparison table

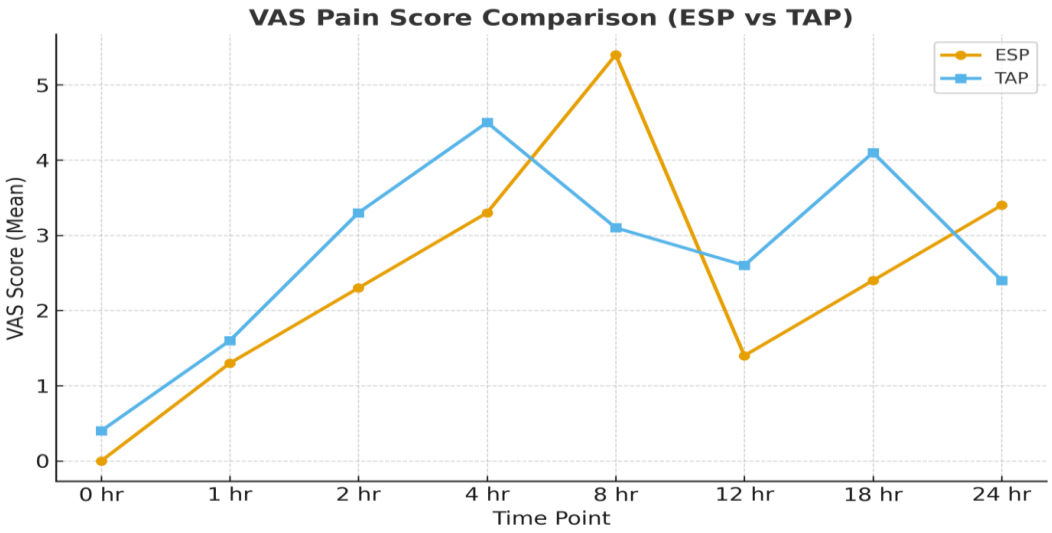
Time Point	ESP (Mean ± SD)	TAP (Mean ± SD)	p-value
0 hr	0.0 ± 0.2	0.4 ± 0.5	<0.001
1 hr	1.3 ± 0.5	1.6 ± 0.5	0.0395
2 hr	2.3 ± 0.5	3.3 ± 0.6	<0.001
4 hr	3.3 ± 0.5	4.5 ± 0.6	<0.001
8 hr	5.4 ± 0.5	3.1 ± 1.7	<0.001
12 hr	1.4 ± 0.6	2.6 ± 1.1	<0.001
18 hr	2.4 ± 0.5	4.1 ± 1.2	<0.001
24 hr	3.4 ± 0.5	2.4 ± 1.2	<0.001

Mean difference in VAS score at 0,1,2,4,8,12,18 and 24 hours between group 1 and group 2 patients. The quantitative data were expressed as mean and standard deviation and were compared by student t-test

DISCUSSION

In this prospective, randomized study, we compared the analgesic efficacy of the Erector Spinae Plane (ESP) block versus the Transversus Abdominis Plane (TAP) block in patients undergoing cesarean section. Our findings demonstrate that the ESP block significantly outperforms the TAP block in terms of both pain scores and postoperative analgesic requirements.

The VAS scores were consistently lower in the ESP group at all measured time intervals except at 24 hours, indicating more effective and prolonged pain control. **[8]**.



In this study, During the early postoperative phase (0–4 hours), patients receiving ESP reported significantly reduced VAS scores compared to TAP, highlighting its benefit in immediate pain control. Interestingly, at 8 hours, a peak in pain intensity was observed in the ESP group, which may reflect a waning block effect or delayed requirement for rescue analgesia. Beyond this point, ESP again provided better pain relief, with significantly lower scores at 12 and 18 hours. Although TAP demonstrated a steadier trend, its overall pain control remained inferior to ESP. These findings suggest postoperative pain scores were consistently lower in the ESP group compared to the TAP group across most time intervals, indicating superior analgesic efficacy of ESP

Importantly, the time to first rescue analgesia was significantly longer in the ESP group (8.4 ± 1.1 hrs) compared to the TAP group (6.5 ± 1.1 hrs), highlighting the prolonged duration of analgesia provided by ESP. Additionally, the number of rescue analgesia doses was lower in the ESP group, further supporting its superior analgesic profile.

Our findings are consistent with those of previous trials where ESP blocks demonstrated better analgesia in various abdominal surgeries **[7] [8] [9]**. The ability of the ESP block to affect both visceral and somatic pain may explain its enhanced performance, making it an appealing alternative in multimodal analgesic strategies for cesarean deliveries.

Limitations of the study include a relatively small sample size and single-center design. In addition, vital sign parameters like postoperative SBP, HR, and RR were not consistently available for analysis. Further large-scale, multi centric trials are recommended to validate these results and assess long-term maternal and neonatal outcomes.

CONCLUSION

This study demonstrates that the **Erector Spinae Plane (ESP) block** provides significantly better postoperative analgesia compared to the **Transversus Abdominis Plane (TAP) block** in patients undergoing cesarean section. Patients who received the ESP block experienced **longer duration of pain relief**, **lower VAS scores**, and required **fewer doses of rescue analgesia**.

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