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ORIGINAL RESEARCH

ANALGESIC EFFECT OF BILATERAL ULTRASOUND-GUIDED ERECTOR SPINAE PLANE BLOCK WITH 0.375% ROPIVACAINE IN LUMBAR SPINE SURGERY

Milind Pol[1*], **Vaijayanti Badhe**[2]

[1] *Associate Professor, Department of Anaesthesiology, DVVPF's Medical College, Vilad Ghat, Ahilyanagar, Maharashtra, India*

[2] *Professor, Department of Anaesthesiology, PMT Medi, cal College, Loni, Ahilyanagar, Maharashtra, India*

*Correspondence: Milind Pol <drpolmilind@gmail.com>

ABSTRACT

Background: Lumbar spine surgery is frequently followed by moderate-to-severe postoperative pain and substantial opioid exposure. The erector spinae plane block (ESPB) is an ultrasound-guided fascial plane block increasingly used as part of multimodal analgesia. This study evaluated perioperative haemodynamic trends and postoperative analgesia after bilateral ESPB with 0.375% ropivacaine in adults undergoing elective lumbar spine surgery.

Methods: This prospective observational study included 32 adults with American Society of Anesthesiologists physical status I or II undergoing elective lumbar spine surgery under general anaesthesia. After induction, tracheal intubation, and prone positioning, bilateral ultrasound-guided ESPB was performed at the L3 vertebral level using 20 mL of 0.375% ropivacaine on each side. Intraoperative heart rate and arterial blood pressure were recorded serially. Postoperative pain was assessed using a visual analogue scale (VAS) for 24 hours. The duration of analgesia was defined as the interval from block administration to the first rescue analgesic requirement at VAS >4. Repeated haemodynamic measurements were evaluated using the Friedman test.

Results: Serial heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure differed significantly across the recorded time points (all $p<0.001$), although clinically stable intraoperative trends were observed. The mean time to first rescue analgesia was 571.62 ± 32.74 minutes (median, 562.5 minutes; interquartile range, 550-600 minutes; range, 500-660 minutes). Postoperative VAS scores were low during the early recovery period and remained manageable during 24-hour follow-up. The Ramsay Sedation Scale score remained 1 after the immediate postoperative assessment, and no block-related complication was recorded.

Conclusion: In this single-arm observational cohort, bilateral ultrasound-guided ESPB with 0.375% ropivacaine was associated with prolonged postoperative analgesia and clinically stable perioperative haemodynamic trends after lumbar spine surgery. Controlled studies are required before causal conclusions can be drawn regarding opioid-sparing efficacy or superiority over standard multimodal analgesia.

Keywords: Erector spinae plane block; Ropivacaine; Lumbar spine surgery; Postoperative analgesia; Regional anaesthesia; Haemodynamics

INTRODUCTION

Pain following lumbar spine surgery may be substantial because of extensive dissection of skin, paraspinal muscles, ligaments, bone, and neural structures. Inadequately treated pain can intensify the surgical stress response, impair ventilation and mobilisation, increase opioid exposure, and delay recovery. Contemporary enhanced-recovery pathways therefore emphasise multimodal, opioid-sparing analgesia, including regional anaesthetic techniques where appropriate.

The erector spinae plane block was first described by Forero et al. as an ultrasound-guided interfascial injection deep to the erector spinae muscle and superficial to the transverse process [1]. The local anaesthetic may spread longitudinally within the fascial plane and influence dorsal rami and adjacent neural structures, although the precise mechanism and extent of

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spread remain variable [1,2]. The block is technically attractive because the transverse process provides a readily identifiable bony endpoint and separates the needle from deeper neuraxial and pleural structures.

Evidence from randomised trials and meta-analyses suggests that ESPB can reduce postoperative pain and perioperative opioid consumption in lumbar spine surgery [3-6]. Nevertheless, findings vary according to surgical procedure, vertebral level, injectate, comparator, and background analgesic regimen. Ropivacaine is a long-acting S-enantiomeric amide local anaesthetic with a comparatively favourable cardiotoxicity and neurotoxicity profile relative to racemic bupivacaine [7].

The present study evaluated postoperative analgesia and serial perioperative haemodynamic measurements after bilateral ultrasound-guided ESPB with 0.375% ropivacaine in patients undergoing elective lumbar spine surgery.

Objectives

The primary objective was to determine the duration of postoperative analgesia, defined as the time from ESPB administration to the first rescue analgesic requirement. Secondary objectives were to describe postoperative VAS pain scores, intraoperative haemodynamic trends, sedation, and perioperative complications.

MATERIALS AND METHODS

Study design and setting

A prospective, single-centre observational study was conducted among 32 adult patients scheduled for elective lumbar spine surgery. The study period was of 2 years and the stydy was conducted at Rural Medical College & Hospital, Pravara Medical Trust, Loni, a tertiary care centre hospital. **Ethical considerations:** The study protocol was approved by the Institutional Ethics Committee before enrolment (ref No. PIMS- DU, Ref. PIMS/PhD/1892, dated 17/10/2023). Written informed consent was obtained from all participants.

Eligibility criteria

Adults aged 18 years or older with American Society of Anesthesiologists physical status I or II were eligible [8]. Exclusion criteria were infection at the intended puncture site, coagulation abnormality, known hypersensitivity to amide local anaesthetics, clinically important cardiac or pulmonary disease, cardiac arrhythmia, hepatic or renal insufficiency, psychiatric illness interfering with assessment, chronic pain, long-term analgesic use, major perioperative or anaesthesia-related complications, and inability to complete postoperative VAS assessment.

Preoperative preparation and general anaesthesia

All participants underwent pre-anaesthetic evaluation and routine investigations according to institutional practice. Patients fasted for at least 6 hours for solid food, and clear fluids were allowed until 2 hours before induction. On arrival in the operating room, intravenous access was secured, Ringer's lactate was commenced, and electrocardiography, non-invasive blood pressure, and pulse oximetry were applied. Baseline heart rate, blood pressure, respiratory rate, and oxygen saturation were recorded. General anaesthesia was administered according to the institutional protocol.

Block technique

After induction of general anaesthesia, tracheal intubation, and prone positioning, bilateral ESPB was performed at the L3 vertebral level under ultrasound guidance. After aseptic preparation, the L3 transverse process and overlying erector spinae muscle were identified. A Low Frequency Curvilinear ultrasound probe(6-13MHz) was placed on the sagittal axis of the horizontal midline of the L3 vertebral body. The spinous processes were first observed, and then the probe was moved laterally to observe the transverse process and erector spinae muscle approximately 3 cm from the midline. Local anesthesia was injected between the deep fascia of the erector spinae muscle and the vertebral transverse process during ultrasound-guided block. An ultrasound-visible 22-gauge 100 mm puncture needle was inserted from the cranial portion to the caudal portion using the in-plane technique, and the correct position of the needle was confirmed by injecting 2–3 ml of saline solution, after which 20 ml of 0.375% ropivacaine was injected on each side, giving a total dose of 150 mg.

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Appropriate longitudinal spread and elevation of the erector spinae muscle were confirmed sonographically. The monitoring for local anaesthetic systemic toxicity was done. The block was given by Anaesthesiologist experienced in ultrasound guided blocks.

Outcome assessment

The primary outcome was the duration of postoperative analgesia, measured from completion of the block to the first rescue analgesic dose. Postoperative pain intensity was assessed using a 0-10 VAS, where 0 represented no pain and 10 represented the worst imaginable pain [9] Rescue analgesia was administered when VAS exceeded 4. Pain scores were recorded at 30-minute intervals during the first 2 postoperative hours, followed by assessments at 2, 3, 4, 6, 8, and 12 hours, with continued observation up to 16 hours. VAS was measured at rest for12 hrs & then in both rest & with movements. Heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded at baseline and serially during the perioperative period. Sedation was assessed using the Ramsay Sedation Scale [9] Adverse events, including block failure, vascular puncture, haematoma, neurological symptoms, infection, local anaesthetic systemic toxicity, postoperative nausea and vomiting, hypotension, and bradycardia, were monitored.

Statistical analysis

Continuous variables were summarised as mean ± standard deviation when approximately normally distributed and as median with interquartile range when distributional assumptions were not met. Categorical variables were summarised as frequencies and percentages. Serial haemodynamic measurements were compared using the Friedman test.

RESULTS

All 32 enrolled patients were included in the analysis. Most patients were residents of nearby villages and were farmers by occupation. Their ages ranged from 20 to 80 years, with a mean age of 59.82 ± 13.96 years. There were 21 female and 11 male patients. The mean height was 161.14 ± 5.81 cm, and the mean weight was 66.76 ± 4.02 kg. Twenty-nine patients were classified as ASA physical status I, while three were classified as ASA physical status II. All patients underwent lumbar spine surgery for single- or two-level disc prolapse, spondylolisthesis, or spinal fracture. Posterior lumbar interbody fusion was performed with or without discectomy. The mean duration of surgery was 93.82 ± 5.51 minutes. Each patient received intravenous pentazocine 30 mg and midazolam 2 mg for sedation.

Table. Perioperative haemodynamic measurements

Heart rate differed significantly across the recorded perioperative time points (Friedman $\chi^2=118.614$, df=5, $p<0.001$). Systolic blood pressure ($\chi^2=144.41$, df=5, $p<0.001$), diastolic blood pressure ($\chi^2=103.77$, df=5, $p<0.001$), and mean arterial pressure ($\chi^2=136.88$, df=5, $p<0.001$) also varied significantly over time. Values decreased after positioning and block administration, remained clinically stable during surgery, and showed a transient increase during early recovery.

Pre Op vs At Positioning vs At ESEB vs At 60 min vs ImmPostOp vs At 2 Hrs

Table 1.

	Heart Rate (/Min)	SBP (mm/Hg)	DBP (mm/Hg)	MAP	Ramsay Sedation Scale score
Pre OP	81.24±3.7	130.94±5.4	82.12±3.7	104.12±3.4	1.00±.0
Af Posi	75.41±2.6	122.29±3.5	78.94±2.8	100.47±1.6	4.00±.0
ATESPB	74.47±2.1	120.29±3	78.59±2.3	99.82±1.7	4.00±.0
At 60min	74.53±1.9	119.00±2.5	78.18±2.3	98.88±2	4.00±.0
Imm Post OP	82.71±2.1	130.59±3.7	82.53±2.3	104.12±2	2.00±.0
At 2hrs	75.12±2.5	119.88±2.6	78.94±1.8	99.35±1.37	1.00±.0

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HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure MAP: Mean arterial pressure. Imm. post Op: Immediate post operative

Table 2. Statistical summary of study outcomes

Outcome	Statistical test/results	Effect size
Heart rate	Friedman test: $\chi^2 = 118.614$, df = 5, $p < 0.001$	Kendall's W = 0.69
SBP	Friedman test: $\chi^2 = 144.41$, df = 5, $p < 0.001$	Kendall's W = 0.85
DBP	Friedman test: $\chi^2 = 103.77$, df = 5, $p < 0.001$	Kendall's W = 0.61
MAP	Friedman test: $\chi^2 = 136.88$, df = 5, $p < 0.001$	Kendall's W = 0.80
Ramsay Sedation Scale score	Friedman test: $\chi^2 = 170.00$, df = 5, $p < 0.001$	Kendall's W = 1.00
Postoperative VAS score	VAS assessments were performed immediately after surgery and every 2 hours for up to 16 hours	Fig 1
Time to first rescue analgesia	Range: 500–660 minutes; mean ± SD: 571.62 ± 32.74 minutes; median: 562.5 minutes; IQR: 550–600 minutes	Fig 2
Postoperative sedation	Ramsay Sedation Scale score was 2 immediately after surgery and 1 at subsequent assessments	Fig 3
Safety and complications	No block-related or clinically significant perioperative complications were documented	—

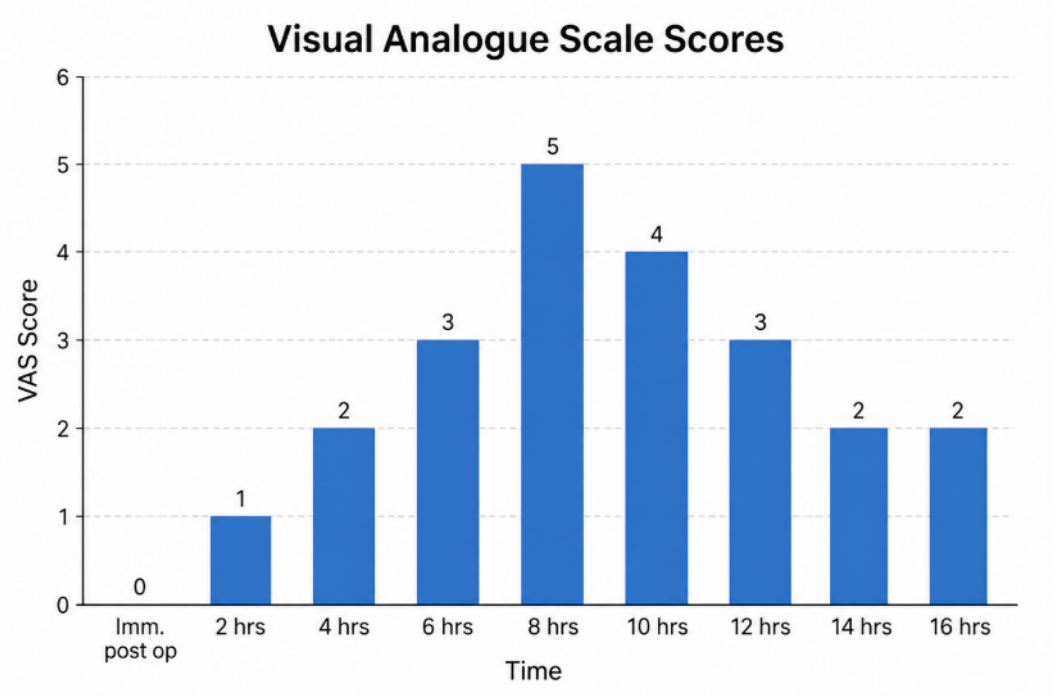

Figure 1. *Visual analog scale scores comparison*

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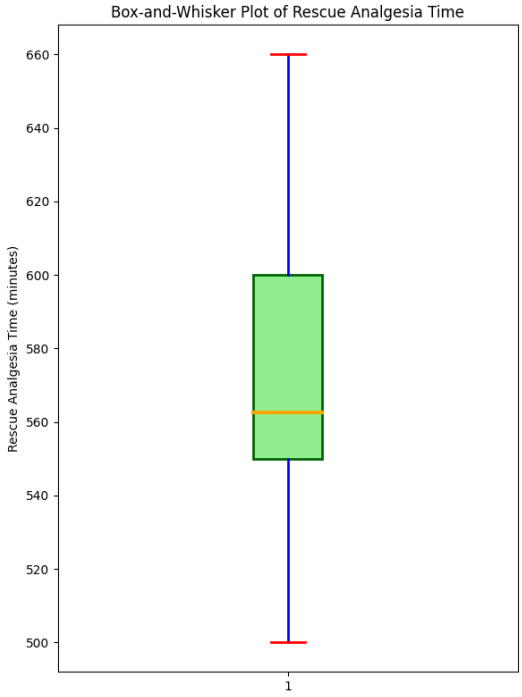

Figure 2. *Rescue analgesia timing*

Ramsey sedation score remained 1throughout the post-operative period. No obvious complication noted in intraop & post op period.

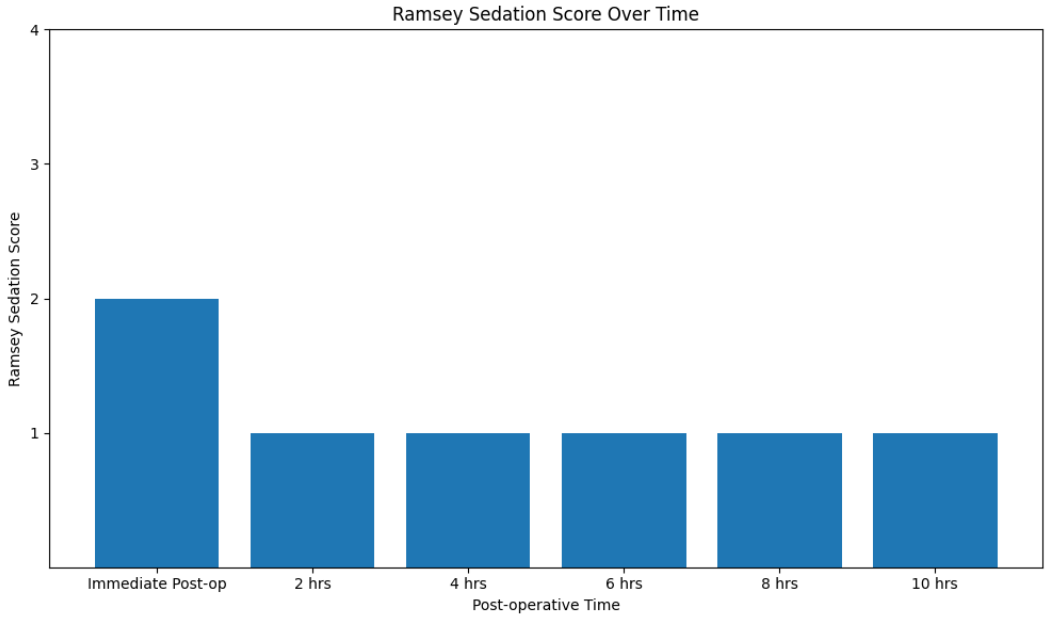

Figure 3. *Ramsey score comparison*

DISCUSSION

This prospective observational cohort found that bilateral L3 ESPB using 20 mL of 0.375% ropivacaine per side was followed by a mean analgesic duration of approximately 9.5 hours after lumbar spine surgery. Pain scores were low during early recovery, sedation was minimal, and no block-related complication was documented. Serial haemodynamic measurements changed significantly over time but remained clinically acceptable according to the authors' observations.

The observed duration of analgesia is clinically plausible for a single-injection fascial plane block with ropivacaine. However, the absence of a comparator group means that the analgesic contribution of ESPB cannot be separated from the

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effects of general anaesthesia, systemic opioids, non-opioid analgesics, surgical factors, and natural postoperative variation. Similarly, statistically significant temporal changes in haemodynamic variables should not be interpreted as proof that ESPB caused haemodynamic stability.

Randomised evidence supports an opioid-sparing effect of ESPB in lumbar spine surgery. Wittayapairoj et al. reported lower 24-hour morphine consumption and lower pain scores after bilateral ESPB in open lumbar spinal surgery [3]. Asar et al. also found reduced postoperative opioid requirements and lower pain scores after lumbar surgery [4]. Zhao et al. reported improved analgesic outcomes after lumbar unilateral biportal endoscopic surgery [5]. A systematic review and meta-analysis of 19 randomised trials concluded that ESPB reduced perioperative opioid consumption and postoperative pain after lumbar spine surgery, although heterogeneity and variation in comparator techniques remained important [6].

The present study used a total ropivacaine dose of 150 mg. Ropivacaine is widely used for peripheral and fascial plane blocks because it provides prolonged sensory analgesia with lower cardiotoxic potential than racemic bupivacaine [7]. Nevertheless, systemic absorption may be clinically relevant after bilateral high-volume injections. Weight-based dose reporting, aspiration before injection, incremental administration, continuous monitoring, and immediate access to lipid emulsion therapy are therefore essential.

The lack of clinically apparent complications is reassuring but should be interpreted cautiously in a cohort of only 32 participants. Rare events such as local anaesthetic systemic toxicity, infection, haematoma, and neurological injury cannot be excluded. Furthermore, because the block was performed after induction of general anaesthesia, sensory distribution and immediate block success could not be assessed reliably.

Strengths and limitations

The study reflects routine clinical practice and reports a clearly defined duration-of-analgesia outcome after a standardised bilateral block. Important limitations include small sample, absence of an a priori sample-size calculation, incomplete reporting of baseline and perioperative characteristics, no assessment of block success or dermatomal spread, no opioid-consumption endpoint, and incomplete time-specific numerical data. The findings should therefore be regarded as exploratory and hypothesis-generating.

CONCLUSION

Bilateral ultrasound-guided ESPB at L3 using 20 mL of 0.375% ropivacaine per side was associated with a mean time to first rescue analgesia of approximately 572 minutes in adults undergoing elective lumbar spine surgery. Pain scores were low during early recovery, sedation was minimal, and no block-related complication was recorded. Because this was an uncontrolled observational study, the findings do not establish superiority, opioid-sparing efficacy, or a causal effect on haemodynamic stability. Larger randomised controlled trials with complete perioperative analgesic data and standardised outcome reporting are warranted.

Declarations

Consent for publication: Not applicable, provided no identifiable participant information is included.
Funding: The study received no external funding.
Conflicts of interest: None declared
Data availability: on reasonable request.

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