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ASSESSING THE DURATION OF POST-OPERATIVE ANALGESIA AFTER GIVING UNILATERAL ERECTOR SPINAE BLOCK USING 0.25% ROPIVACAINE 20 ML IN HERNIA SURGERIES AT L1-L2 LEVEL

Dr. Vikas Asati	PGY3, Deptt. Of Anaesthesiology, SAIMS
Dr. Ankit Agarwal	Assistant Professor, Deptt. Of Anaesthesiology, SAIMS
Dr. Salil Saurav	PGY3, Deptt. Of Anaesthesiology, SAIMS
Dr. Nikita Ranjan*	Associate Professor, Deptt. Of Anaesthesiology, SAIMS *Corresponding Author
Dr Meghna M. Rathi	Professor, Deptt. Of Anaesthesiology, SAIMS
Dr Sarita Gohiya	Professor & HOD, Deptt. Of Anaesthesiology, SAIMS

ABSTRACT **Background:** Postoperative pain following inguinal hernia repair can delay recovery and reduce patient satisfaction. The erector spinae plane (ESP) block has emerged as a promising regional technique for effective somatic and visceral analgesia. This study evaluates the efficacy and duration of analgesia provided by a unilateral ESP block using 0.25% ropivacaine (20 ml) administered at the L1-L2 level. **Methods:** In this prospective randomized study, 180 patients undergoing elective inguinal hernia surgery were divided into two groups: Group A (n=90) received 20 ml of 0.25% ropivacaine via ESP block, while Group B (n=90) received 20 ml of 0.9% normal saline. Pain intensity was assessed using the Visual Analogue Scale (VAS) at baseline and at 6, 12, and 24 hours postoperatively. Time to mobilization, oral intake, PADSS score, rescue analgesic need, and complications were also recorded. **Results:** Group A demonstrated significantly lower VAS scores at 6 hours postoperatively (2.54 ± 1.83 vs 4.69 ± 1.89; P< 0.001) and reduced diclofenac requirement (21.22 ± 25.11 mg vs 71.20 ± 42.64 mg; P< 0.001). Time to mobilization, oral intake, and PADSS ≥9 was significantly shorter in Group A (P< 0.001). Rescue analgesic requirement and postoperative complications such as urinary retention and shivering were significantly lower in Group A. Patient satisfaction was notably higher in the ESP group (P< 0.05). **Conclusion:** Unilateral ESP block with 0.25% ropivacaine at the L1-L2 level provides effective and prolonged postoperative analgesia in inguinal hernia surgeries, enhances recovery, reduces analgesic requirement, and improves patient satisfaction with minimal complications.

KEYWORDS : Erector spinae plane block, Ropivacaine, Inguinal hernia, Postoperative analgesia, Regional anesthesia, VAS score, PADSS.

INTRODUCTION

Postoperative pain control remains a cornerstone of perioperative management, especially in procedures such as hernia repair, where inadequate analgesia can delay ambulation, prolong hospital stays, and diminish patient satisfaction [1,2]. Inguinal hernia surgeries, whether performed via open or laparoscopic techniques, are associated with moderate to severe pain that may persist for 24 to 72 hours postoperatively, highlighting the need for optimized analgesic strategies [1–3].

Traditionally, pain control in such surgeries has relied on systemic analgesics and regional techniques like the transversus abdominis plane (TAP) block. While these approaches have demonstrated effectiveness, newer fascial plane blocks, such as the Erector Spinae Plane Block (ESPB), have gained attention for their potential benefits in managing both somatic and visceral pain [1,4,5]. Initially described for thoracic neuropathic pain, ESPB has shown promising results in abdominal surgeries, with analgesic effects varying depending on the site of administration and local anesthetic concentration [4,6].

Recent investigations have reported the efficacy of thoracic ESPB (T7–T9) in laparoscopic hernia surgeries, where patients experienced reduced pain scores and decreased opioid consumption for 6 to 24 hours postoperatively [1,4]. However, data regarding its application at the lumbar level (L1–L2)—which anatomically corresponds to the dermatomes innervating the inguinal region—remain sparse and inconclusive, particularly for open hernia procedures [5,6]. This regional specificity is of clinical significance, as ESPB at the L1–L2 level may offer a more targeted approach to analgesia for inguinal surgeries compared to thoracic levels [5,7].

The use of 0.25% ropivacaine, a long-acting amide local anesthetic, adds another layer of consideration. While higher concentrations (0.375–0.5%) have been shown to provide extended analgesia in thoracic ESPB, the ideal concentration for lumbar ESPB remains to be defined [8]. Given the pharmacodynamics of ropivacaine and its dose-dependent sensory block duration, investigating the efficacy of an intermediate concentration is essential in developing safe, cost-effective protocols.

Enhanced Recovery After Surgery (ERAS) guidelines for hernia repair advocate for multimodal analgesia, integrating regional blocks with agents like NSAIDs and paracetamol [9]. However, the specific contribution of single-shot unilateral ESPB using 0.25% ropivacaine (20 ml) at the L1–L2 level has not been thoroughly evaluated. This study aims to assess the duration and effectiveness of this technique in providing post-operative analgesia for hernia surgeries and to explore its potential role in ERAS protocols.

MATERIAL AND METHODS

This prospective, randomized, double-blind controlled study was conducted in the Department of Anaesthesiology at Sri Aurobindo Medical College and Postgraduate Institute, Indore (M.P.), following approval from the Institutional Ethical Committee. The study enrolled **180 adult patients** undergoing elective unilateral inguinal hernia repair, who met the inclusion criteria. Patients were selected using convenient sampling based on monthly surgical volume data and the results of a prior pilot study, which indicated that approximately 10–15 suitable patients could be recruited per month. Thus, a sample size of 180 patients (n = 90 in each group) was determined for the study duration.

Inclusion Criteria

- ASA physical status I and II

- Age between 18 to 70 years
- BMI < 30

Exclusion Criteria

- History of decompensated cardiopulmonary diseases
- Renal dysfunction
- Acute pancreatitis
- Cognitive disorders affecting the ability to comprehend the pain scoring system
- Known hypersensitivity to ropivacaine or study drugs
- Skin infection at the needle puncture site
- Inability to provide written informed consent

Patients were randomly allocated into two groups. Group A received a unilateral erector spinae plane block (ESPB) with 20 ml of 0.25% ropivacaine, and Group B received 20 ml of 0.9% normal saline (NS), serving as the control group. Group allocation was performed using a sealed envelope method, and both the patient and the observer collecting postoperative data were blinded to the group assignment. The block was administered at the L1–L2 transverse process level under ultrasound guidance in the preoperative period after spinal anesthesia.

Each patient underwent a detailed pre-anesthetic evaluation and provided informed written consent. Standard fasting guidelines were followed, and all patients were preloaded with 500 ml of Ringer's lactate before surgery. Baseline vital parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR), and oxygen saturation (SpO_2) were recorded prior to premedication. These parameters were monitored at 1, 3, 5, 10, 30, and 60 minutes following the block administration.

The pain intensity was assessed postoperatively using the Visual Analogue Scale (VAS) at regular intervals. The VAS scores were documented on a pre-structured, pre-designed proforma, which also captured intraoperative and postoperative parameters. The requirement and timing of rescue analgesia, total analgesic consumption in the first 24 hours, and any adverse effects were recorded. Data were compiled into a master chart for final analysis.

Statistical Analysis

The collected data were analyzed using appropriate statistical methods. Frequency distribution tables were used to categorize variables, and descriptive statistics were applied to summarize demographic and clinical characteristics. Quantitative variables were expressed as mean ± standard deviation (SD). The Student's t-test was employed to compare quantitative data between the two groups, assuming normal distribution. A p-value of less than 0.05 was considered statistically significant to determine the efficacy of ESPB in prolonging postoperative analgesia in comparison to placebo.

RESULTS

There was no statistically significant difference between Group A and Group B with respect to demographic variables such as age, weight, height, and gender (P > 0.05). Similarly, both groups were comparable in terms of the side of hernia operated and preoperative ASA classification, showing no significant variation (P > 0.05). Furthermore, intraoperative monitoring parameters, including oxygen saturation (SpO_2), mean arterial pressure (MAP), and heart rate (pulse), did not differ significantly between the two groups (P > 0.05), indicating that the baseline clinical characteristics and perioperative conditions were homogeneously distributed across both cohorts [Table 1].

Table 1 – Baseline Demographics And Clinical Characteristics

Parameter	Group ESP (n=90)	Group S (n=90)	P-value
Age (years)	61.41 ± 8.51	60.45 ± 9.12	0.632
Height (cm)	171.01 ± 5.31	171.88 ± 5.12	0.148
Male/Female	60 / 30	60 / 30	0.886
Weight (kg)	76.11 ± 12.8	76.12 ± 8.99	0.543
Mean Arterial Pressure	98.18 ± 9.17	97.83 ± 11.15	0.328
Pulse	74.66 ± 12.88	74.76 ± 12.31	0.908
ASA (I / II / III)	15/ 73 / 2	18 / 68 / 4	0.688
SpO_2 (%)	95.23 ± 2.11	95.66 ± 1.12	0.501
Side of Surgery (R / L)	62 / 28	66 / 24	0.251

In our study, while the intraoperative VAS scores were comparable between the two groups, the VAS score at 6 hours postoperatively was significantly lower in Group A (ESP block) compared to Group B (NS group) (P < 0.05), indicating superior analgesic effect during the early postoperative period. Although VAS scores at 12 and 24 hours were also lower in Group A, the difference did not reach statistical significance (P > 0.05) [Table 2].

Table 2 – Postoperative VAS Scores at Different Time Intervals

Hour	Group A (ESP, n=90)	Group B (NS, n=90)	P-value
0	1.31 ± 0.92	0.85 ± 1.59	0.017
6^{th}	2.54 ± 1.83	4.69 ± 1.89	<0.001
12^{th}	2.08 ± 2.05	2.96 ± 2.28	0.156
24^{th}	1.23 ± 1.53	1.58 ± 1.50	0.323

***Group A** = Erector Spinae Plane Block with 0.25% Ropivacaine; **Group B** = Normal Saline (Control); **P < 0.05** considered statistically significant.

In the postoperative period, time to mobilization, initiation of oral intake, and the time to achieve a PADSS score of ≥9 was significantly shorter in Group A (ESP block) compared to Group B (NS group), indicating faster recovery in the ESP group (P < 0.05). Conversely, the waiting time before surgery following block administration was significantly shorter in Group B, likely due to the simpler preparation for placebo injection (P < 0.05).

The requirement for rescue analgesics in the postoperative period was statistically significantly higher in Group B, highlighting the superior analgesic efficacy of the ESP block (P < 0.05). Furthermore, patient satisfaction scores were notably higher in Group A, further supporting the role of ESP block in improving the overall perioperative experience (P < 0.05).

There was no statistically significant difference between the two groups in terms of surgical duration, surgeon satisfaction, or the time of first analgesic administration among those who required rescue analgesia (P > 0.05) [Table 3].

Table 3 – Postoperative Recovery Profile, Analgesic Use, and Satisfaction Scores

Parameter	Group A (ESP, n=90)	Group B (NS, n=90)	P-value
Mobilization & Feeding Start (hrs)	1.85 ± 0.44	6.58 ± 2.88	<0.001
Surgical Time (mins)	35.46 ± 7.96	39.39 ± 10.14	0.115
Rescue Analgesic Time (hrs)	6.82 ± 6.23	7.13 ± 5.40	0.923
Post-processing Waiting Time (mins)	29.52 ± 16.0	6.23 ± 1.62	<0.001
Time to Reach PADSS 9 (hrs)	5.44 ± 1.10	19.8 ± 4.35	<0.001
Patient Satisfaction (1–5 scale)	3.61 ± 0.44	3.12 ± 0.71	0.005

Surgeon Satisfaction (1–5 scale)	3.52 ± 0.41	3.66 ± 0.45	0.718
Analgesic Need – n (%):			
Yes	11 (12.2%)	23 (25.6%)	<0.001
No	79 (87.8%)	67 (74.4%)	

***Group A** = Erector Spinae Plane Block (0.25% Ropivacaine); **Group B** = Control (0.9% Normal Saline); **PADSS** = Post-Anaesthesia Discharge Scoring System; **P < 0.05** considered statistically significant.

In the intraoperative period, the requirement for midazolam for sedation was found to be significantly lower in Group B (NS group) compared to Group A (ESP group), possibly due to better anxiolysis from the early onset of ESP-induced analgesia ($P < 0.05$). Conversely, the postoperative requirement of diclofenac was significantly lower in Group A, indicating a prolonged analgesic effect from the erector spinae plane block ($P < 0.05$). There was no statistically significant difference between the groups regarding the intraoperative use of fentanyl ($P > 0.05$), suggesting similar intraoperative pain control needs across both cohorts.In terms of local anesthetic use, patients in Group A (ESP) received a mean of 5.56 ± 3.22 mg of ropivacaine, while no local anesthetic was administered intraoperatively to patients in Group B, as they received only normal saline for placebo control.Among postoperative complications, urinary retention and shivering were significantly more common in Group B than in Group A ($P < 0.05$), likely reflecting poorer overall pain and physiological stress control. However, there was no significant difference between the groups in the incidence of headache, nausea, or bleeding ($P > 0.05$) [Table 4].

Table 4 – Intraoperative Drug Requirements and Postoperative Complications

Parameter	Group A (ESP, n=90)	Group B (NS, n=90)	P-value
Diclofenac (mg)	21.22 ± 25.11	71.20 ± 42.64	<0.001
Fentanyl (μg)	21.22 ± 28.89	17.30 ± 24.11	0.703
Midazolam (mg)	2.56 ± 1.12	1.82 ± 1.04	0.040
Tumescent Local Anaesthetic (mL)	5.53 ± 3.2	0.00 ± 0.00	<0.001
Urinary Retention – n (%)	0 (0%)	4 (4.4%)	0.037
Headache – n (%)	1 (1.1%)	2 (2.2%)	0.558
Nausea – n (%)	2 (2.2%)	8 (8.9%)	0.223
Shivering – n (%)	0 (0%)	20 (22.2%)	0.042
Bleeding – n (%)	1 (1.1%)	0 (0%)	0.313

DISCUSSION

The erector spinae plane (ESP) block requires relatively higher volumes of local anaesthetic—typically ranging from 0.3 to 0.5 mL/kg—and is performed under ultrasound guidance. Studies have demonstrated that the local anaesthetic spreads from the site of injection to approximately 3 to 6 vertebral levels in both cranial and caudal directions, though its mediolateral diffusion is limited [10]. This spread facilitates both somatic and visceral analgesia by affecting the dorsal and ventral rami of spinal nerves. Anatomically, the injectate remains confined beneath the erector spinae muscle, surrounding the thoracolumbar fascia and rib margins. Magnetic resonance imaging has shown that a 30 mL injection at T10 can spread as far as T5–T12 levels [11,12].

Inguinal hernia repair is a common but technically nuanced procedure. The region of surgical interest is primarily innervated by the ilioinguinal and iliohypogastric nerves, with anatomical variability in their course. Additional innervation often involves branches of the genitofemoral and lateral cutaneous femoral nerves [13]. Unlike spinal anaesthesia, which causes motor blockade, the ESP block does not impede motor function, making it suitable for providing intraoperative anaesthesia through selective sensory nerve blockade.

The iliohypogastric nerve arises from T12–L1, the ilioinguinal from L1, the genitofemoral from L1–L2 (dividing into genital and femoral branches), and the lateral femoral cutaneous nerve from L2–L3 [14]. In our study, we administered a single-shot ESP block at the L1–L2 level using 20 ml of 0.25% ropivacaine with the goal of achieving adequate spread from T12 to L3. This targeted the innervation of the inguinal region, aiming to block all four relevant nerves for effective analgesia.

Unlike studies that used combination local anaesthetic mixtures, we opted for a single-agent approach using ropivacaine, which offers a favorable safety profile, prolonged duration of action, and low systemic toxicity. Our choice of volume (20 mL) was based on existing literature suggesting effective cranio-caudal diffusion of local anaesthetic in this range [15]. While higher volumes such as 30 mL may offer broader spread, we found that 20 mL was sufficient for our target segment (T12–L3) when injected precisely at L1–L2, without compromising safety.

In terms of demographics, all patients included in both the ESP and control groups were over 50 years of age, with a mean age of 60.45 ± 9.17 years. Both groups were matched for age, BMI, ASA grade, and surgical side, and there were no statistically significant differences in intraoperative haemodynamic parameters.

To account for the known risk of intraoperative hypotension associated with spinal anaesthesia, we preloaded patients in the SA group with 10 mL/kg of crystalloids. This approach likely contributed to the lack of significant difference in mean arterial pressure (MAP) between the two groups. We believe this step prevented potential confounding due to haemodynamic instability in the SA group, ensuring a more accurate comparison of analgesic efficacy and recovery profiles.

Although formal dose-ranging studies for ESP block remain limited, literature consistently reports effective analgesia with volumes between 20–30 mL or 0.2–0.3 mL/kg. Our findings affirm that 20 mL of 0.25% ropivacaine is a safe and effective choice for unilateral ESP block at the L1–L2 level in inguinal hernia repair.

This prospective randomized study assessed the efficacy of unilateral erector spinae plane (ESP) block using 0.25% ropivacaine (20 ml) at the L1–L2 level for postoperative analgesia in inguinal hernia surgeries. Our findings demonstrate that the ESP block provides superior analgesia in the early postoperative period, reduces the need for rescue analgesics, and facilitates faster recovery without increasing complication rates.

Although intraoperative VAS scores were slightly higher in the ESP group (Group A) compared to the control group (Group B), the difference was not clinically significant. The intraoperative discomfort in some patients may be attributed to variable spread of the local anaesthetic, as anatomical differences in the course of nerves like the genitofemoral and lateral cutaneous femoral nerve have been previously documented [13]. The mean intraoperative requirement of local anaesthetic in Group A was 5.53 ± 3.2 ml, and six patients did not require any intraoperative supplementation, indicating overall efficacy of the ESP block in this setting.

The key finding of our study was the significantly lower VAS score at 6 hours postoperatively in the ESP group (2.54 ± 1.83) compared to the control group (4.69 ± 1.89), confirming superior analgesic efficacy of the ESP block in the early postoperative period ($P < 0.001$). Though VAS scores at 12 and

24 hours were also lower in Group A, the differences were not statistically significant, which may indicate the waning effect of a single-shot injection by that time.

Our results are consistent with those of Tulgar et al. [16], who reported reduced postoperative pain and opioid consumption after ESP block in laparoscopic cholecystectomy, and Chin et al. [17], who showed effective visceral analgesia in gastric bypass surgeries. These support the conclusion that ESP block can offer comparable benefits in abdominal surgeries like hernia repair.

Postoperatively, Group A patients exhibited significantly faster recovery as reflected by earlier mobilisation and feeding initiation (1.85 ± 0.44 hrs vs. 6.58 ± 2.88 hrs; $P < 0.001$), and quicker achievement of a PADSS score ≥9 (5.44 ± 1.10 hrs vs. 19.8 ± 4.35 hrs; $P < 0.001$). These findings affirm that the ESP block avoids the motor blockade and prolonged recovery commonly associated with neuraxial techniques like spinal anaesthesia. Singh et al. [18] similarly reported delayed ambulation and urination after spinal anaesthesia, which was absent in our ESP group.

Moreover, patient satisfaction was significantly higher in Group A (3.61 ± 0.44) compared to Group B (3.12 ± 0.71), likely reflecting improved pain control and earlier recovery. Although surgical time and surgeon satisfaction were comparable between groups ($P > 0.05$), the ESP group required a longer waiting period before surgery (29.52 ± 16.0 mins vs. 6.23 ± 1.62 mins; $P < 0.001$) due to the time taken for sensory blockade onset. This limitation was managed by preparing patients in a preoperative holding area.

The need for postoperative rescue analgesia was notably lower in Group A, with only 12.2% of patients requiring additional analgesics compared to 25.6% in Group B ($P < 0.001$). Furthermore, the mean diclofenac usage in Group A was significantly lower (21.22 ± 25.11 mg vs. 71.20 ± 42.64 mg; $P < 0.001$), supporting the opioid-sparing benefit of ESP blocks.

No significant differences were observed in intraoperative fentanyl use between groups, which aligns with findings from Rani et al. [19], who reported similar intraoperative analgesic needs between spinal and regional blocks. However, midazolam usage was higher in Group A (2.56 ± 1.12 mg vs. 1.82 ± 1.04 mg; $P = 0.040$), possibly due to the absence of motor blockade, leading to higher anxiety among conscious patients.

In terms of complications, urinary retention and shivering were significantly more frequent in Group B ($P = 0.037$ and $P = 0.042$ respectively). These side effects are commonly associated with spinal anaesthesia due to its effect on autonomic tone and thermoregulation [20]. No patient in the ESP group experienced shivering, and only one reported urinary retention. Incidence of nausea, bleeding, and headache was low and comparable between the groups ($P > 0.05$). Headache, often associated with post-dural puncture syndrome, was absent in the ESP group, reinforcing the block's non-invasive advantage [21].

This study confirms that ESP block is a viable alternative to traditional spinal anaesthesia in unilateral inguinal hernia surgeries, offering effective analgesia, enhanced recovery, and fewer complications.

However, the study has a few limitations. It was conducted at a single centre with a relatively small sample size, which may limit the generalizability and statistical power of the results. Additionally, long-term outcomes and rare complications were not evaluated.

CONCLUSION

Unilateral erector spinae plane (ESP) block with 0.25% ropivacaine at L1–L2 provides effective postoperative analgesia in inguinal hernia surgeries. It significantly reduces pain scores at 6 hours, decreases analgesic requirements, and enhances recovery by enabling earlier mobilisation, feeding, and discharge. It serves as a viable and potentially superior alternative to spinal anaesthesia, especially in elderly or comorbid patients where motor block and hemodynamic changes are undesirable.The ESP block also results in higher patient satisfaction and fewer complications like urinary retention and shivering, making it a safe and efficient alternative to conventional analgesia.

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