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Original Research Article

# A Study Comparing 0.5% Levobupivacaine and 0.75% Ropivacaine for Thoracic Epidural Anaesthesia in Abdominal Surgeries

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**Conflict of interest: Nil**

**Abstract:**

**Background:** Thoracic epidural anaesthesia (TEA) is widely used for abdominal surgeries as it provides effective segmental anaesthesia, reduces systemic opioid requirement, and improves perioperative analgesia. Levobupivacaine and ropivacaine are long-acting amide local anaesthetics with favourable safety profiles.

**Aim:** To compare the anaesthetic efficacy, duration of blockade, haemodynamic stability, conversion to general anaesthesia, and early postoperative analgesia between 0.5% levobupivacaine and 0.75% ropivacaine administered through the thoracic epidural route.

**Methods:** This comparative clinical study included 60 patients undergoing abdominal surgeries under TEA. Patients were allocated into two groups of 30 each. Group A received 15 ml of 0.5% levobupivacaine, while Group B received 15 ml of 0.75% ropivacaine. Onset of sensory block, time to maximum sensory level, duration of epidural anaesthesia, intraoperative fentanyl requirement, haemodynamic parameters, conversion to general anaesthesia, adverse effects, and postoperative VAS scores were recorded.

**Results:** Levobupivacaine produced significantly faster onset of sensory block, shorter time to maximum sensory level, longer duration of epidural anaesthesia, lower fentanyl requirement, and lower VAS scores at 1 and 2 hours compared with ropivacaine. Haemodynamic stability and adverse effects were comparable.

**Conclusion:** Levobupivacaine 0.5% provided superior sensory blockade and early postoperative analgesia compared with ropivacaine 0.75%, with comparable safety.

**Keywords:** Thoracic epidural anaesthesia; Levobupivacaine; Ropivacaine; Abdominal surgery; Postoperative analgesia.

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## Introduction

Major abdominal surgery is associated with marked intraoperative nociceptive stimulation and significant postoperative pain, which can delay mobilization, impair respiratory function, and prolong recovery [1]. Thoracic epidural anaesthesia (TEA) remains an important component of perioperative pain management for open abdominal procedures because it provides dense segmental analgesia, reduces systemic opioid requirement, and may improve functional recovery, although its precise role continues to evolve within enhanced recovery pathways [1, 2]. Among long-acting amide local anaesthetics, levobupivacaine and ropivacaine are attractive alternatives to racemic bupivacaine because of their improved safety profiles, with ropivacaine generally producing less motor blockade and levobupivacaine offering potent sensory blockade with favourable cardiovascular tolerability [1, 3]. Recent evidence also shows that epidural techniques continue to be clinically relevant in major abdominal surgery, but the choice of the ideal epidural drug should balance onset, quality of block, haemodynamic stability, duration of analgesia, and adverse effects [2 – 4]. Therefore, this study was undertaken to compare the anaesthetic efficacy, duration of blockade, intraoperative haemodynamic stability, need for conversion to general anaesthesia (GA), and early postoperative pain relief between 0.5% levobupivacaine and 0.75% ropivacaine administered for TEA.

## Methods

This cross-sectional clinical comparative study was conducted from April to May 2026, in the departments of Anaesthesiology, Government Medical College, Vizianagaram, after obtaining approval from the Institutional Ethics Committee (SERIAL NO: 103 /IEC GMC /APRIL 2026). The study included 60 patients who underwent abdominal surgeries under TEA, including laparoscopic cholecystectomy, open cholecystectomy, umbilical hernia repair, surgery for intestinal obstruction, incisional hernia repair, epigastric hernia repair, and total abdominal hysterectomy. Patients aged 20–60 years, belonging to ASA physical status I or II, and willing to provide written informed consent were included. Patients with allergy or hypersensitivity to local anaesthetic or opioid drugs, spinal deformities, contraindications to epidural anaesthesia (EA), pre-existing neurological disorders, impaired ability to communicate, unconscious or critically ill status, or known coagulation disorders were excluded.

All eligible patients underwent detailed pre-anaesthetic evaluation, including history taking, general physical examination, systemic examination, airway assessment, ASA grading, and relevant laboratory investigations. Standard preoperative fasting guidelines were followed. After shifting the patient to the operating theatre, baseline heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), respiratory rate (RR), and oxygen saturation were recorded. Standard monitors including electrocardiography, non-invasive blood pressure, pulse oximetry, and RR monitoring were attached. Intravenous access was secured with an 18G cannula, and emergency drugs and resuscitation equipment were kept ready. Patients were randomly allocated into two equal groups of 30 each. Group A received 15 ml of 0.5% levobupivacaine, while Group B received 15 ml of 0.75% ropivacaine through the thoracic epidural route. Under strict aseptic precautions, the patient was placed in the sitting or lateral decubitus position, and the thoracic epidural space was identified at an appropriate intervertebral level according to the surgical site. After local infiltration with 2 ml of 2% lignocaine, an 18G Tuohy needle was introduced using a midline or paramedian approach, and the epidural space was identified by the loss-of-resistance technique. An epidural catheter was threaded and fixed securely. Correct placement was confirmed by negative aspiration for blood or cerebrospinal fluid, followed by a test dose of 3 ml of 2% lignocaine with adrenaline 1:200,000 to rule out intrathecal or intravascular placement.

After confirmation of correct catheter placement, the allocated study drug was administered approximately 20 minutes before surgical incision. The onset of sensory block was assessed at regular intervals after epidural drug administration. Intraoperative sedation or analgesic supplementation with intravenous fentanyl was given when required and documented. Haemodynamic parameters including heart rate, SBP, DBP, MAP, RR, and oxygen saturation were recorded at baseline and at regular intraoperative intervals. The adequacy of sensory blockade, duration of EA, need for supplemental analgesia, and requirement for conversion to GA due to inadequate block or surgical necessity were noted. Patients were observed for adverse events such as hypotension, bradycardia, nausea, vomiting, shivering, paresthesia, respiratory depression, or any other complications. Postoperatively, pain intensity was assessed using the visual analogue scale at the first and second postoperative hours. All observations were entered into a predesigned proforma and later transferred to a master chart.

**Statistical Analysis:** The data was analysed using SPSS software version 21. Continuous variables were expressed in mean ± standard deviation, while categorical variables presented as frequencies and percentages. Comparison of continuous variables between the two study groups was carried out using the unpaired Student's t-test. Categorical variables was compared using the Chi-square test or Fisher's exact test where appropriate. $P < 0.05$ was considered statistically significant.

## Results

A total of 60 patients undergoing abdominal surgeries were included, 30 per group. The two groups were comparable with respect to age, gender distribution, body weight, ASA physical status and duration of surgery, and no statistically significant difference was observed between the groups for baseline variables (Table 1). The onset of sensory blockade was significantly faster in the levobupivacaine group compared with the ropivacaine group (8.64 ± 1.92 minutes vs 10.18 ± 2.14 minutes; p=0.005). Time to maximum sensory level was also shorter with levobupivacaine (p=0.016). The duration of EA was significantly longer in Group A than Group B (186.42 ± 28.76 minutes vs 162.54 ± 25.38 minutes; p=0.001). Intraoperative fentanyl requirement was significantly lower in the levobupivacaine group (p=0.023), suggesting better intraoperative analgesic efficacy (Table 2). Adequate sensory block was achieved in 93.3% of patients in Group A and 86.7% in Group B, while conversion to GA was required in 6.7% and 13.3%, respectively; however, these differences were not statistically significant. Mean intraoperative heart rate and mean arterial pressure were comparable between both groups, indicating similar haemodynamic stability. Postoperative VAS scores at 1 and 2 hours were significantly lower in the levobupivacaine group. Adverse effects were mild and statistically comparable between groups (Table 3).

| Table 1: Baseline demographic and clinical characteristics of the study population | | | | |
|---|---|---|---|---|
| **Parameter** | **Group A** | **Group B** | **Test value** | **p-value** |
| Age, years | 43.82 ± 8.64 | 44.76 ± 7.92 | t = 0.44 | 0.662 |
| Male | 14 (46.7%) | 13 (43.3%) | $\chi^2 = 0.07$ | 0.795 |
| Female | 16 (53.3%) | 17 (56.7%) | | |
| Weight, kg | 62.48 ± 7.16 | 63.21 ± 6.84 | t = 0.40 | 0.688 |
| ASA I | 18 (60.0%) | 17 (56.7%) | $\chi^2 = 0.07$ | 0.793 |
| ASA II | 12 (40.0%) | 13 (43.3%) | | |
| Duration of surgery, min | 86.42 ± 18.36 | 88.74 ± 19.12 | t = 0.48 | 0.633 |

| Table 2: Comparison of anaesthetic efficacy between the two groups | | | | |
|---|---|---|---|---|
| **Parameter** | **Group A** | **Group B** | **Test value** | **p-value** |
| Onset of sensory block, min | 8.64 ± 1.92 | 10.18 ± 2.14 | t = 2.93 | 0.005 |
| Time to maximum sensory level, min | 14.72 ± 3.28 | 16.86 ± 3.41 | t = 2.48 | 0.016 |
| Duration of EA, min | 186.42 ± 28.76 | 162.54 ± 25.38 | t = 3.41 | 0.001 |
| Intraoperative fentanyl requirement, µg | 34.16 ± 12.82 | 42.38 ± 14.46 | t = 2.33 | 0.023 |
| Adequate sensory block | 28 (93.3%) | 26 (86.7%) | $\chi^2 = 0.74$ | 0.389 |
| Conversion to GA | 2 (6.7%) | 4 (13.3%) | $\chi^2 = 0.74$ | 0.389 |

| Table 3: Haemodynamic stability, postoperative pain and adverse effects | | | | |
|---|---|---|---|---|
| **Parameter** | **Group A** | **Group B** | **Test value** | **p-value** |
| Mean intraoperative heart rate, bpm | 78.64 ± 8.42 | 80.26 ± 7.96 | t = 0.77 | 0.447 |
| Mean intraoperative MAP, mmHg | 82.48 ± 7.18 | 84.16 ± 6.92 | t = 0.92 | 0.36 |
| VAS score at 1 hour | 2.14 ± 0.78 | 2.82 ± 0.86 | t = 3.20 | 0.002 |
| VAS score at 2 hours | 3.06 ± 0.92 | 3.74 ± 1.04 | t = 2.68 | 0.01 |
| Hypotension | 4 (13.3%) | 3 (10.0%) | $\chi^2 = 0.16$ | 0.688 |
| Bradycardia | 2 (6.7%) | 1 (3.3%) | $\chi^2 = 0.35$ | 0.554 |
| Nausea/vomiting | 3 (10.0%) | 2 (6.7%) | $\chi^2 = 0.22$ | 0.64 |
| Shivering | 2 (6.7%) | 3 (10.0%) | $\chi^2 = 0.22$ | 0.64 |
| Paresthesia | 1 (3.3%) | 1 (3.3%) | $\chi^2 = 0.00$ | 1 |

## Discussion

In the present study, TEA with 0.5% levobupivacaine produced a faster onset of sensory block, shorter time to maximum sensory level, longer duration of EA, lower intraoperative fentanyl requirement, and lower early postoperative VAS scores compared with 0.75% ropivacaine. These findings support the clinical usefulness of levobupivacaine when a dense and sustained sensory block is required for abdominal surgeries. Major abdominal surgery produces intense somatic and visceral nociceptive stimulation, and inadequate analgesia may delay mobilization, impair breathing effort, increase opioid requirement, and interfere with recovery. EA remains important in selected abdominal procedures because it blocks afferent nociceptive input at the segmental level and provides better dynamic analgesia than systemic opioids alone. Recent discussions on enhanced recovery after surgery have questioned the routine use of epidurals for all abdominal operations, especially minimally invasive procedures, but epidural analgesia continues to have value in open and painful abdominal surgeries when properly selected and monitored [5, 6]. A 2024 discussion by Lobo et al. emphasized that epidural analgesia has historically been a major component of abdominal enhanced recovery pathways, although its role must now be individualized according to procedure type, invasiveness, and institutional expertise [5]. Similarly, meta-analytic evidence in major thoracoabdominal surgery suggests that thoracic epidural analgesia can reduce severe pain and pulmonary complications compared with intravenous opioid-based analgesia in selected patients [6]. Therefore, the better sensory block characteristics observed with levobupivacaine in this study are clinically meaningful, particularly for operations requiring reliable segmental anaesthesia and early postoperative analgesia.

The faster onset of sensory block in the levobupivacaine group may be explained by differences in potency, lipid solubility, protein binding, and sensory–motor differential blockade between the two local anaesthetics. Levobupivacaine is the S-enantiomer of bupivacaine and has been shown to provide effective EA and analgesia with less cardiovascular and central nervous system toxicity than racemic bupivacaine [7]. Ropivacaine, also a long-acting amide local anaesthetic, is known for reduced motor blockade and a favourable safety profile; however, at clinically used concentrations, it may be relatively less potent than levobupivacaine for dense sensory

blockade [8, 9]. In our study, the onset of sensory block was significantly earlier with levobupivacaine than ropivacaine, and the time to maximum sensory level was also shorter. This observation is consistent with the pharmacological expectation that levobupivacaine may provide a more intense sensory block. Previous comparative epidural studies reported broadly comparable analgesic efficacy between levobupivacaine and ropivacaine when used in dilute postoperative epidural infusions, but the results may differ when higher concentrations are used for surgical anaesthesia rather than only postoperative analgesia [10]. Senard et al. reported that epidural levobupivacaine 0.1% and ropivacaine 0.1% combined with morphine produced comparable postoperative analgesia after major abdominal surgery, but their study used dilute concentrations and focused mainly on postoperative analgesia rather than surgical EA [10]. In contrast, the present study used 0.5% levobupivacaine and 0.75% ropivacaine as epidural anaesthetic agents, which may have magnified clinically relevant differences in block onset, spread, and duration.

The duration of EA was significantly longer in the levobupivacaine group than in the ropivacaine group. This is an important finding because prolonged sensory blockade can reduce the need for intraoperative supplementation and improve early postoperative comfort. The lower intraoperative fentanyl requirement in the levobupivacaine group in the present study indicates better intraoperative analgesic efficacy. Epidural local anaesthetics reduce surgical stress response and opioid requirement by interrupting nociceptive transmission from the operative field. Previous studies have demonstrated the usefulness of epidural levobupivacaine in major abdominal surgery. Rangapriya et al. compared epidural levobupivacaine with epidural morphine after major abdominal surgery and showed that levobupivacaine provided effective postoperative analgesia, although morphine showed better pain scores in their setting [11]. Türkoğlu et al. also evaluated levobupivacaine-based epidural analgesia with opioid adjuvants after major abdominal surgery and supported its role as part of multimodal postoperative pain control [12]. Studies using ropivacaine-based epidural regimens have similarly shown effective analgesia, but they often highlight its motor-sparing property rather than superior sensory duration [13, 14]. Scott et al. demonstrated that ropivacaine with fentanyl improved epidural analgesia after major abdominal surgery, showing the value of opioid supplementation when ropivacaine alone is insufficient [13]. In the present study, the significantly lower fentanyl requirement in the levobupivacaine group suggests that levobupivacaine provided a more complete intraoperative block, thereby reducing the dependence on systemic opioid supplementation.

Haemodynamic stability was comparable between the two groups, as reflected by similar intraoperative heart rate and mean arterial pressure. This finding is clinically important because dense epidural blockade may theoretically increase sympathetic blockade and hypotension. However, the incidence of hypotension and bradycardia was low and statistically comparable between groups. These observations suggest that both 0.5% levobupivacaine and 0.75% ropivacaine were haemodynamically acceptable when administered in a controlled thoracic epidural setting with appropriate patient selection and monitoring. Similar safety findings have been reported in earlier epidural studies, where levobupivacaine and ropivacaine were associated with stable haemodynamics and acceptable adverse-effect profiles [10, 15]. Viderman et al. noted that epidural analgesia may be associated with hypotension compared with intravenous patient-controlled analgesia, emphasizing the need for careful monitoring and individualized use [16]. In our study, patients belonged to ASA physical status I or II, and those with major contraindications to EA were excluded, which may explain the low adverse-event rate. This highlights that the safety of thoracic EA depends not only on the drug selected but also on patient selection, catheter placement, test dosing, incremental administration, intraoperative vigilance, and availability of resuscitation measures. Recent literature on local anaesthetic systemic toxicity continues to emphasize aspiration, test dosing, incremental injection, dose calculation, and lipid emulsion readiness as essential safety measures whenever long-acting local anaesthetics are used [17, 18].

Postoperative VAS scores at 1 and 2 hours were significantly lower in the levobupivacaine group, indicating better early postoperative analgesia. Early pain control is particularly relevant in abdominal surgery because it facilitates deep breathing, coughing, early mobilization, and patient satisfaction. Although modern abdominal surgery increasingly uses multimodal analgesia and fascial plane blocks, epidural analgesia remains a strong option when intense visceral and somatic pain is expected. Hughes et al. reported that epidural analgesia after open abdominal surgery within enhanced recovery protocols may improve pain scores and gastrointestinal recovery, although this does not always translate into shorter hospital stay or reduced morbidity [19]. Therefore, the better early VAS scores in the present study should be interpreted as an analgesic advantage rather than proof of improved overall recovery. The absence of statistically significant differences in conversion to general anaesthesia and adverse effects suggests that both drugs were clinically usable, but levobupivacaine offered better block quality in this sample. The main limitation was the relatively small sample size of 60 patients and the inclusion of different types of abdominal surgeries,

which may vary in nociceptive intensity and duration. In addition, pain was assessed only during the first two postoperative hours, and longer follow-up would have clarified the duration of analgesic advantage, rescue analgesic consumption, mobilization, bowel recovery, and patient satisfaction. Despite these limitations, the study indicates that 0.5% levobupivacaine may be preferable to 0.75% ropivacaine for thoracic EA in abdominal surgeries when faster onset, longer sensory blockade, lower intraoperative opioid requirement, and better early postoperative pain relief are desired.

## Conclusion

This study showed that both 0.5% levobupivacaine and 0.75% ropivacaine were effective and safe for TEA in abdominal surgeries. However, levobupivacaine produced a faster onset of sensory block, shorter time to maximum sensory level, longer duration of EA, lower intraoperative fentanyl requirement, and better early postoperative pain relief compared with ropivacaine. Haemodynamic parameters and adverse effects were comparable between the two groups. Therefore, 0.5% levobupivacaine may be considered a preferable epidural local anaesthetic when dense sensory blockade and prolonged analgesia are desired in selected patients undergoing abdominal surgeries.

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