Original Article

Effect of Dexmedetomidine and Clonidine as Adjuvants to 0.75% Ropivacaine for Epidural Anaesthesia in Lower Abdominal and Lower Limb Surgeries

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Abstract

Background: Epidural anaesthesia with ropivacaine provides effective surgical anaesthesia and postoperative analgesia but is limited by relatively slow onset and moderate duration. α_2-adrenergic agonists such as clonidine and dexmedetomidine have been proposed as adjuvants to enhance block characteristics and prolong analgesia. This study compared the effects of dexmedetomidine and clonidine as adjuvants to 0.75% ropivacaine in epidural anaesthesia for lower abdominal and lower limb surgeries. **Material and Methods:** Ninety ASA I–II patients, aged 18–60 years, scheduled for elective lower abdominal or lower limb surgery under epidural anaesthesia, were randomised into three groups (n=30 each). Group R received 18 ml 0.75% ropivacaine with 2 ml saline, Group RD received ropivacaine with dexmedetomidine (1 µg/kg), and Group RC received ropivacaine with clonidine (2 µg/kg). Onset and duration of sensory and motor block, time to first rescue analgesia, sedation scores, hemodynamic changes, and adverse events were recorded. **Results:** Demographic variables were comparable across groups. Sensory and motor block onset was fastest in Group RD (6.2 ± 1.8 and 10.8 ± 2.6 min, respectively), followed by Group RC, and slowest in Group R ($p<0.001$). Duration of sensory block, motor block, and analgesia was significantly longer in adjuvant groups, with Group RD showing maximum prolongation (276.8 ± 31.7, 248.5 ± 27.6, and 364.1 ± 34.2 min, respectively; $p<0.001$). Sedation was higher in Group RD (Ramsay score 2–3) than RC and R. Hemodynamic alterations were mild but more frequent with dexmedetomidine (bradycardia 10%, hypotension 13%). No respiratory depression or neurological complications occurred. **Conclusion:** Adding clonidine or dexmedetomidine to epidural ropivacaine significantly improves block quality and prolongs postoperative analgesia compared with ropivacaine alone. Dexmedetomidine provides faster onset, longer duration, and better sedation than clonidine, though with a slightly higher incidence of manageable bradycardia and hypotension. It may, therefore, be considered a more effective adjuvant when close monitoring is ensured.

Keywords: Epidural anaesthesia, ropivacaine, dexmedetomidine, clonidine, α_2-agonist, postoperative analgesia.

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Introduction

Epidural anaesthesia is widely used for lower abdominal and lower limb surgeries because it provides effective intraoperative anaesthesia and good postoperative pain relief while maintaining patient consciousness and allowing segmental sensory and motor fibres blockade. However, when used alone, epidural local anaesthetics may have limitations such as a relatively slow onset, limited duration of analgesia, and requirement for supplemental analgesics in the postoperative period.

Ropivacaine, a long-acting amide local anaesthetic, has emerged as a preferred choice in neuraxial blocks due to its favourable safety profile, lower cardiotoxicity, and less intense motor blockade than bupivacaine. Nevertheless, even with ropivacaine, the duration of analgesia may be insufficient for extended postoperative pain control, motivating clinical interest in adjunctive agents that can enhance block quality and prolong analgesia.

Among adjuvants, α_2-adrenergic agonists—especially clonidine and dexmedetomidine—have gained attention for their ability to enhance neuraxial block characteristics. These drugs exert analgesic and sedative effects via activation of spinal α_2-receptors, inhibition of nociceptive neuron firing, and suppression of sympathetic outflow, without significant respiratory depression. Clonidine, one of the earlier α_2-agonists used in neuraxial anaesthesia, has been shown to prolong sensory and motor block and reduce analgesic requirements when added

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to local anaesthetics. Dexmedetomidine, a more selective and potent α_2-agonist, is increasingly studied for its superior sedative, analgesic and sympatholytic properties, and for achieving a favourable block profile with minimal respiratory compromise.

Several studies have evaluated dexmedetomidine or clonidine as adjuvants to ropivacaine in epidural or related neuraxial blocks. For instance, Arunkumar et al. compared clonidine and dexmedetomidine as adjuvants to epidural ropivacaine in lower abdominal and lower limb surgeries and reported prolongation of analgesia and improved block characteristics.[1] In meta-analyses, the addition of dexmedetomidine to ropivacaine in epidural anaesthesia has been shown to shorten the onset of sensory and motor block and significantly extend analgesic duration, albeit with some increase in bradycardia incidence.[2,3] A recent randomised controlled trial also explored the dose–response of epidural dexmedetomidine with ropivacaine (for labour analgesia), highlighting the importance of optimising dose for efficacy versus safety.[4]

Despite these data, direct comparative evidence on dexmedetomidine vs clonidine when used with 0.75% ropivacaine in epidural anaesthesia for lower abdominal and lower limb surgeries remains limited. Therefore, a systematic, head-to-head comparison addressing onset times, block duration, hemodynamic changes, side effect profile, and analgesic requirement is warranted.

The present study is designed to compare the effects of dexmedetomidine and clonidine as adjuvants to 0.75% ropivacaine in epidural anaesthesia for lower abdominal and lower limb surgeries, with a focus on block characteristics, hemodynamic stability, postoperative analgesia, and adverse events.

Materials and Methods

Study Design and Setting: This was a prospective, randomised, double-blind, controlled clinical study conducted in the Department of Anaesthesiology at Konaseema Institute of Medical Sciences, Amalapuram, AP, between April 2023 and August 2025, following approval from the Institutional Ethics Committee (IEC No: IEC/PR/2023/017, dated 08-04-2023). Written informed consent was obtained from all participants.

A total of 90 patients, aged 18–60 years, of either sex, belonging to ASA physical status I and II, scheduled for elective lower abdominal and lower limb surgeries under epidural anaesthesia, were enrolled. Patients were randomly allocated into three groups of 30 each.

Inclusion Criteria

- Age between 18 and 60 years
- ASA physical status I and II
- Elective lower abdominal or lower limb surgery requiring epidural anaesthesia
- Consent to participate

Exclusion Criteria

- ASA III and above
- Known allergy to study drugs
- Local infection at the puncture site, spinal deformity, or neurological disorder
- Coagulopathy or anticoagulant therapy
- Severe cardiac, hepatic, or renal disease
- Chronic use of α2-agonists or antagonists

Randomisation and Grouping: Patients were randomised using a computer-generated table into three equal groups (n = 30). Allocation was concealed in sealed opaque envelopes. Study solutions were prepared by an anaesthesiologist who was not involved in patient care or data collection. Both patients and the assessing anaesthesiologist were blinded.

Group R (Control): 18 ml of 0.75% ropivacaine + 2 ml normal saline

Group RD (Dexmedetomidine): 18 ml of 0.75% ropivacaine + dexmedetomidine 1 μg/kg diluted to 2 ml

Group RC (Clonidine): 18 ml of 0.75% ropivacaine + clonidine 2 μg/kg diluted to 2 ml

Total volume in all groups: 20 ml.

Anaesthetic Technique: All patients were premedicated with oral ranitidine 150 mg and alprazolam 0.5 mg on the night before surgery. In the operating room, baseline vitals (HR, NIBP, SpO_2, ECG) were recorded, and an intravenous line was secured. Patients were preloaded with Ringer's lactate 10 ml/kg.

With the patient in a sitting position, an epidural puncture was performed at the L2–L3 or L3–L4 interspace using an 18-G Tuohy needle with the loss-of-resistance technique. After negative aspiration for blood/CSF, the study drug solution (20 ml) was injected slowly over 2–3 minutes. Patients were then placed supine.

Parameters Recorded:

Onset of sensory block: time to loss of pinprick at T10 dermatome

Onset of motor block: time to achieve Bromage score 3 Peak sensory level

Duration of sensory block: regression to S1

Duration of motor block: time to complete recovery

Duration of analgesia: time to first rescue analgesic request

Haemodynamic: HR, SBP, DBP, MAP, SpO_2 recorded at baseline, every 5 min for 30 min, every 15 min intraoperatively, and hourly for six h postoperatively

Sedation score: Ramsay Sedation Scale

Adverse effects: Hypotension, bradycardia, nausea, vomiting, shivering, respiratory depression

Statistical Analysis

Sample size: The calculation was based on detecting a minimum difference of 20 minutes in duration of analgesia between groups, with $\alpha = 0.05$ and power of 80%, yielding 30 patients per group. Data were analysed using SPSS version XX. Continuous variables were expressed as mean ± SD and analysed with one-way ANOVA followed by Tukey's post-hoc test. Categorical variables were compared using the Chi-square or Fisher's exact test. A $p < 0.05$ was considered statistically significant.

Results

Demographic Data: All three groups were comparable regarding age, sex, body weight, ASA status, and duration of surgery ($p > 0.05$).

Table 1: demographic data of the patient

Parameter	Group R (n=30)	Group RD (n=30)	Group RC (n=30)	p-value
Age (years) (Mean ± SD)	39.2 ± 11.3	38.6 ± 10.8	40.1 ± 12.2	0.84
Weight (kg) (Mean ± SD)	62.4 ± 9.6	61.7 ± 8.9	63.1 ± 9.1	0.77
Sex (M/F)	18/12	17/13	19/11	0.89
ASA I/II	20/10	21/9	19/11	0.91

Block Characteristics

The onset of sensory block was significantly faster in Group RD compared to Group RC and Group R.

The motor block onset was earlier in Group RD, followed by Group RC, and was slowest in Group R.

Duration of sensory block, motor block, and analgesia was significantly prolonged in both adjuvant groups, with Group RD showing the longest duration.

Table 2: Comparison of Characteristic of block between groups

Parameter	Group R (Control)	Group RD (Dexmedetomidine)	Group RC (Clonidine)	p-value
Onset of sensory block (min)	9.8 ± 2.4	6.2 ± 1.8	7.5 ± 2.0	<0.001
Onset of motor block (min)	15.4 ± 3.1	10.8 ± 2.6	12.6 ± 2.7	<0.001
Peak sensory level (median)	T8	T6–T7	T7	—
Duration of sensory block (min)	172.6 ± 24.3	276.8 ± 31.7	241.3 ± 29.4	<0.001
Duration of motor block (min)	150.2 ± 22.1	248.5 ± 27.6	216.2 ± 25.1	<0.001
Duration of analgesia (min)	188.5 ± 26.7	364.1 ± 34.2	302.6 ± 32.9	<0.001

Sedation Scores: Sedation was significantly higher in the dexmedetomidine group (Ramsay sedation score 2–3), compared to clonidine (score 2) and control (score 1). Sedation was adequate but without excessive drowsiness or delayed recovery in any patient.

Adverse Effects

Hypotension: Group RD (4 patients), Group RC (3 patients), Group R (2 patients)

Bradycardia: Group RD (3 patients), Group RC (2 patients), Group R (0 patients)

Nausea/Vomiting: Group RD (2 patients), Group RC (2 patients), Group R (1 patient)

Shivering: observed in 2 patients in the control group, none in the adjuvant groups

No respiratory depression, pruritus, or neurological complications were reported.

Discussion

The present study compared the efficacy of dexmedetomidine and clonidine as adjuvants to 0.75% ropivacaine for epidural anaesthesia in lower abdominal and lower limb surgeries. The findings demonstrated that both α_2-adrenergic agonists significantly improved block quality and prolonged duration of analgesia compared with ropivacaine alone. Dexmedetomidine provided an earlier onset, longer sensory and motor blockade duration, and superior postoperative analgesia compared to clonidine, though at the cost of a slightly higher incidence of bradycardia and hypotension.

These results are consistent with earlier studies. Arunkumar et al,[1] compared dexmedetomidine and clonidine as epidural adjuvants with ropivacaine and reported that dexmedetomidine produced a faster onset and prolonged duration of sensory and motor block, along with better sedation scores. Similarly, Bajwa et al,[3] observed that dexmedetomidine prolonged postoperative analgesia more effectively than clonidine when added to local anaesthetics for neuraxial anaesthesia.

The mechanism underlying the enhanced effect of α_2-adrenergic agonists is attributed to their action on pre- and post-synaptic α_2-receptors in the dorsal horn of the spinal cord, leading to inhibition of norepinephrine release, hyperpolarisation of interneurons, and suppression of nociceptive transmission.[3] Dexmedetomidine, being eight times more selective for α_2-receptors than clonidine,5 produces stronger analgesic and sedative effects, which explains the superior results observed in our study.

Haemodynamic changes observed in our study were within acceptable limits. A mild reduction in heart rate and blood pressure was noted in both adjuvant groups, more so with dexmedetomidine, which agrees with other reports.[5,6] These changes are due to decreased sympathetic outflow and central sympatholytic and were easily managed with standard measures. Importantly, none of the patients experienced respiratory depression, highlighting the safety of α_2-agonists in neuraxial anaesthesia.[7,8]

Sedation scores were significantly higher with dexmedetomidine, providing calm and cooperative patients without excessive drowsiness. This is a desirable perioperative effect, as highlighted in studies by Gupta et al. and Zhao et al,[9] who noted that dexmedetomidine produces anxiolysis and sedation without respiratory compromise.[10,11]

Taken together, our findings support the use of dexmedetomidine as a superior adjuvant to ropivacaine in epidural anaesthesia, although clinicians must remain vigilant for bradycardia and hypotension.

Conclusion

The addition of dexmedetomidine or clonidine to 0.75% ropivacaine in epidural anaesthesia for lower abdominal and lower limb surgeries significantly improves block quality, prolongs sensory and motor blockade, and enhances postoperative analgesia compared with ropivacaine alone. Between the two, dexmedetomidine provides a faster onset, longer block duration, and better sedation than clonidine, albeit with a slightly higher incidence of manageable haemodynamic side effects.

Thus, dexmedetomidine may be considered a more effective

adjuvant to ropivacaine for epidural anaesthesia, provided that patients are monitored carefully for bradycardia and hypotension.

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Conflicts of interest
There are no conflicts of interest.

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