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A COMPARATIVE EVALUATION OF LEVOBUPIVACAINE WITH DEXMEDETOMIDINE AND LEVOBUPIVACAINE WITH CLONIDINE IN THORACOTOMY FOR POST -OP ANALGESIA THROUGH THORACIC EPIDURAL

Anaesthesiology

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ABSTRACT

Background: Thoracotomy causes severe postoperative pain that may impair respiratory function if inadequately managed. Thoracic epidural analgesia (TEA) is the gold standard for such pain control. Levobupivacaine is a safer alternative to bupivacaine, and α2-agonists like clonidine and dexmedetomidine are widely used as epidural adjuvants, though comparative data in thoracotomy remain limited. **Objectives:** To compare postoperative analgesic efficacy, sedation levels, hemodynamic stability, and rescue analgesia requirements between levobupivacaine combined with dexmedetomidine and levobupivacaine combined with clonidine in patients undergoing thoracotomy. **Methods:** In this randomized, double-blind study, 60 ASA I/II patients undergoing elective thoracotomy were divided into two groups. Group A received 0.125% levobupivacaine with dexmedetomidine (1 µg/kg), and Group B received 0.125% levobupivacaine with clonidine (1 µg/kg) via thoracic epidural. Postoperative pain (VAS), sedation (Ramsay score), hemodynamic parameters, and need for rescue analgesia were recorded for 24 hours. **Results:** Group A had significantly lower VAS scores ($p<0.001$), prolonged analgesia (first top-up at 346.07 min vs. 223.10 min in Group B), and fewer total top-ups. Sedation scores were higher in Group A without respiratory depression. Hemodynamic stability was better in the dexmedetomidine group, and minimal complications were observed in both groups. **Conclusion:** Dexmedetomidine as an adjuvant to levobupivacaine offers superior postoperative analgesia, prolonged sedation, and improved hemodynamic stability compared to clonidine, making it a more effective option for thoracic epidural analgesia in thoracotomy.

KEYWORDS

Thoracic Epidural Analgesia; Dexmedetomidine; Clonidine; Levobupivacaine; Thoracotomy.

INTRODUCTION

Thoracotomy is considered one of the most painful surgical procedures due to extensive disruption of chest wall structures, including intercostal nerves and pleura. Inadequate pain control following thoracotomy impairs respiratory mechanics, leading to hypoventilation, atelectasis, and delayed recovery.[1,2] Thoracic epidural analgesia (TEA) remains the gold standard for managing post-thoracotomy pain, offering superior relief of both somatic and visceral pain components compared to systemic opioids.[3] Levobupivacaine, the S(-) enantiomer of bupivacaine, is increasingly preferred in TEA due to its lower cardiotoxicity and favorable sensory blockade profile.[4] Adjuvants like α2-adrenergic agonists enhance analgesic effects while minimizing local anesthetic doses. Clonidine has long been used epidurally for its analgesic and sedative properties, but dexmedetomidine-an agent with higher α2/α1 receptor selectivity-offers potential advantages such as prolonged analgesia, stable hemodynamics, and reduced opioid requirements.[5,6] Although both clonidine and dexmedetomidine have demonstrated efficacy as neuraxial adjuvants, direct comparative data in thoracic epidural analgesia, specifically with levobupivacaine in thoracotomy, are limited. This clinical gap necessitates evidence-based evaluation to optimize postoperative pain protocols in thoracic surgery. The purpose of the study was to compare postoperative analgesic efficacy, hemodynamic stability, sedation levels, and rescue analgesic requirements between thoracic epidural levobupivacaine with dexmedetomidine and with clonidine in thoracotomy patients, aiming to guide optimal adjuvant selection for enhanced recovery.

MATERIALS AND METHODS

This prospective, randomized, double-blind, comparative study was conducted in the Department of Anaesthesiology, King George's Medical University, Lucknow, following approval from the institutional ethics committee. Written informed consent was obtained from all participants or their legal representatives.

The study included adult patients aged 18–50 years, of either sex, classified as ASA physical status I or II, and within ±30% of ideal body weight, scheduled for elective anterolateral thoracotomy. Patients were excluded if they were on chronic analgesics, opioids, steroids, allergic to study drugs, had contraindications to regional anesthesia, required postoperative mechanical ventilation, or had communication difficulties.

Standard monitoring (ECG, pulse oximetry, non-invasive blood pressure) was established. Intravenous access was secured with an 18G cannula. Under aseptic precautions, a thoracic epidural catheter was placed at the T6–T7 interspace. Premedication included IV ondansetron 4 mg, fentanyl 100 µg, and glycopyrrolate 0.2 mg. General anesthesia was induced with IV propofol 2 mg/kg and intubation facilitated with succinylcholine 2 mg/kg. Maintenance was achieved with N_2O:O_2 (50:50), halothane (0.5%), and vecuronium.

Twenty minutes before extubation, patients were randomly assigned using a computer-generated sequence to one of two groups (n=30 each):

- **Group A:** 9 ml of 0.125% levobupivacaine + 1 ml dexmedetomidine (1 µg/kg)
- **Group B:** 9 ml of 0.125% levobupivacaine + 1 ml clonidine (1 µg/kg)

Postoperatively, a blinded observer recorded hemodynamic parameters (HR, MAP, SpO_2) every 10 minutes for the first 30 minutes and then every 2 hours for 24 hours. Pain was assessed using a 10-point Visual Analogue Scale (VAS) and sedation via the Ramsay Sedation Score.

Rescue analgesia (IV paracetamol 1000 mg) was administered if VAS exceeded 4. Hypotension (MAP <65 mmHg) and bradycardia (HR <50 bpm) were treated with mephentermine and atropine, respectively.

Sample size was calculated to detect a clinically significant VAS difference of 2 ± 2 between groups. With power considerations, 30 patients per group were included.

RESULTS

The two groups were comparable in age, height, weight, and BMI with no statistically significant differences. This indicates a well-matched study population, minimizing baseline confounding. Such homogeneity in anthropometric variables supports the validity of outcome comparisons, particularly regarding analgesic efficacy and hemodynamic parameters across both intervention groups (See Table 1).

Table 1: Intergroup Comparison of Age and Anthropometric Characteristics of Study Population

Variable	Group A	Group B
	Mean +SD	Mean +SD
Age (years)	30.30+3.39	31.17+3.66
Statistical significance	F=0.338 (ANOVA); p=0.798 (NS)	
Height (cm)	167.43 +5.17	165.43 +5.07
Weight (kg)	59.50+3.12	59.57 +3.05
BMI (kg/m2)	21.28 +1.68	21.80 +1.39

There were no significant differences in baseline heart rate, systolic and diastolic blood pressure, mean arterial pressure, or oxygen saturation between Group A and Group B. This confirms that both groups had similar physiological status before intervention, strengthening the reliability of intergroup comparisons in subsequent postoperative time points (See Table 2).

Table 2: Intergroup Comparison of Hemodynamic Variables at Baseline

Variable	Group A (n=30)		Group B (n=30)		Statistical Significance	
	Mean	SD	Mean	SD	F	'p'
Heart Rate (per min)	89.60	2.25	90.33	6.38	0.361	0.781
Systolic BP (mm Hg)	121.40	6.40	122.30	6.43	0.131	0.941
Diastolic BP (mm Hg)	76.53	3.92	78.60	5.12	1.666	0.178
Mean Arterial Pressure (mm Hg)	91.43	3.14	93.17	4.36	1.917	0.131
SPO2	98.00	0.79	98.07	0.91	3.818	0.012

Group A exhibited more stable heart rate values across most time intervals, indicating better autonomic control. Group B showed greater fluctuations and elevated heart rates between 4 to 18 hours, suggesting comparatively increased sympathetic activity (See Figure 1).

Figure 1: Comparison of Heart Rate Between Group A and Group B over 24 hrs

Group B exhibited consistently higher systolic blood pressure at multiple time points, particularly from 4 to 14 hours post-extubation, indicating greater hemodynamic fluctuations. In contrast, Group A maintained relatively stable SBP values, suggesting better cardiovascular stability with dexmedetomidine (See Figure 2).

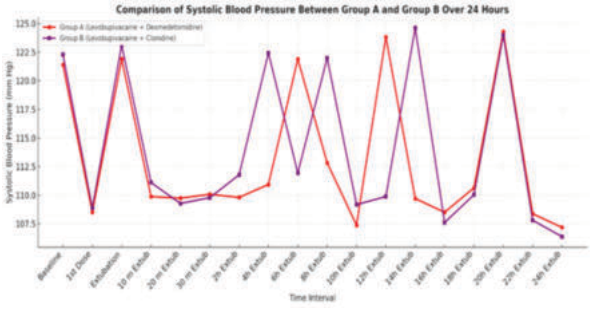

Figure 2: Comparison of Systolic Blood Pressure at Different Time Intervals

Group B exhibited higher DBP values at multiple intervals, particularly between 4 to 14 hours post-extubation, indicating greater vascular sympathetic activity. In contrast, Group A showed more stable DBP trends, suggesting better autonomic modulation with dexmedetomidine (See Figure 3).

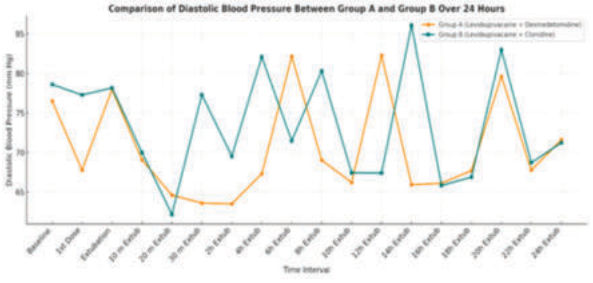

Figure 3: Comparison of Diastolic Blood Pressure Between Group A and Group Over 24 hours

Group B showed consistently higher MAP values from 2 to 14 hours post-extubation, indicating increased sympathetic vascular tone. Group A maintained more stable and moderate MAP levels, reflecting better hemodynamic control with dexmedetomidine (See Figure 4).

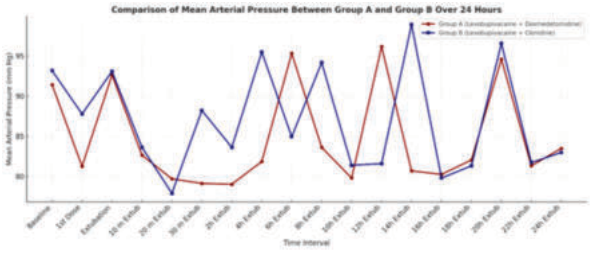

Figure 4: Comparison of Mean Arterial Pressure Between Group A and Group B over 24 hours

Both groups maintained high and stable SpO_2 levels throughout the 24-hour postoperative period. Minor fluctuations were observed, but all values remained clinically acceptable (>98%), indicating effective oxygenation with both drug combinations (See Figure 5).

Figure 5: Comparison of SpO^2 Between Group A and Group B over 24 hours

The intergroup comparison of Visual Analogue Scale (VAS) scores across different postoperative time points. Group A (Levobupivacaine + Dexmedetomidine) consistently exhibited lower VAS scores than Group B (Levobupivacaine + Clonidine), indicating superior and sustained analgesic efficacy of dexmedetomidine. Statistically significant differences ($p < 0.001$) were observed at nearly all intervals, confirming the clinical relevance (See Figure 6).

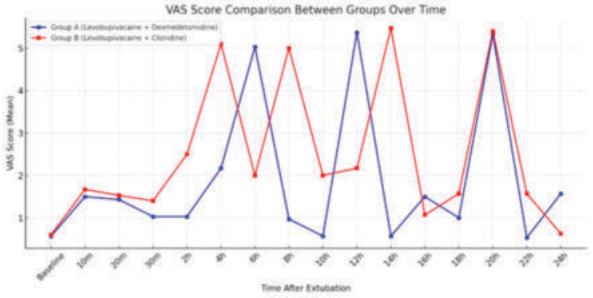

Figure 6: VAS Score Comparison Between Groups Over Time

RSS was consistently higher in Group A (levobupivacaine + dexmedetomidine) across most time points, indicating deeper and more sustained sedation compared to Group B (levobupivacaine + clonidine). The differences were statistically significant ($p < 0.001$), suggesting dexmedetomidine provides more effective and prolonged postoperative sedation in thoracotomy patients (See Figure 7).

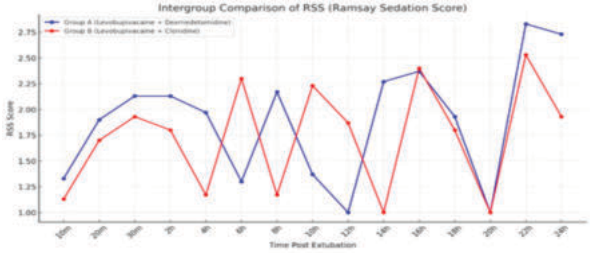

Figure 7: Intergroup Comparison of RSS (Ramsay Sedation Score)

Group A showed delayed time to first analgesic top-up, required fewer top-ups, and received a significantly lower total dose of levobupivacaine over 24 hours. These results underline the superior analgesic-sparing effect of dexmedetomidine when compared to clonidine, offering prolonged pain relief with reduced drug consumption (Table 3).

Table 3: Intergroup Comparison of Analgesic Properties

	Group A (n=30)		Group B (n=30)		Statistical Significance	
	Mean	SD	Mean	SD	F	'p'
Ist Topup Time (min)	346.07	23.23	223.10	40.76	1013.661	<0.001
Total Topups	3.10	0.31	4.10	0.31	356.447	<0.001
Total dose (mg)	34.88	3.43	46.13	3.43	356.447	<0.001

There were no major complications in either group. Nausea occurred in one patient from Group B, with more requiring rescue analgesia compared to Group A. Other complications such as bradycardia, hypotension, or respiratory depression were absent. This suggests that both adjuvants are safe, though dexmedetomidine had fewer minor adverse events (See Table 4).

Table 4: Intergroup Comparison of Complications

	Group A (n=30)		Group B (n=30)		Statistical Significance	
	No.	%	No.	%	2	'p'
Nausea & Vomiting	0	0.00	1	3.33	9.970	0.019
Bradycardia	0	0.00	0	0.00	–	–
Hypo-tension	0	0.00	0	0.00	3.025	0.388
Pruritis	0	0.00	0	0.00	25.714	<0.001
Urinary retention	0	0.00	0	0.00	–	–
Respiratory depression	0	0.00	0	0.00	–	–
Heart Block	0	0.00	0	0.00	–	–
Rescue analgesia	1	3.33	3	10.00	3.019	0.389

DISCUSSION

The present study established the superior efficacy and safety of dexmedetomidine over clonidine when used as an adjuvant to levobupivacaine in thoracic analgesia. Both groups were well matched demographically, with no significant differences in age, height, weight, or BMI—findings consistent with those reported by Sedky et al.[7], Mukherjee et al.[8], Abdallah et al.[9], and Patil et al.[10]. Baseline hemodynamic parameters, including heart rate, systolic and diastolic blood pressure, and MAP, were also comparable, reaffirming the internal validity of the current results. Although a statistically significant difference in baseline SpO_2 was observed, the clinical insignificance of this variation renders it negligible.

Postoperatively, Group A (dexmedetomidine) demonstrated more stable heart rate and blood pressure values, especially from 4 to 18 hours, as compared to Group B (clonidine). This is in alignment with findings from Sedky et al.[7] and Patil et al.[10], both of whom documented enhanced hemodynamic control and lower variability with dexmedetomidine. Mukherjee et al.[8] and Abdallah et al.[9] similarly reported reduced cardiovascular fluctuations with dexmedetomidine, underscoring its sympathetic modulating effects. No study reported greater hemodynamic stability with clonidine, supporting the current conclusion.

Analgesic outcomes were significantly better in Group A. The mean time to first top-up analgesia was 346.07 ± 23.23 minutes in Group A versus 223.10 ± 40.76 minutes in Group B ($p<0.001$). Group A also required fewer total top-ups and a lower cumulative dose of levobupivacaine. These results mirror those of Mukherjee et al.[8] and Abdallah et al.[9], both of whom observed prolonged analgesia and reduced analgesic consumption with dexmedetomidine. Sedky et al.[7] and Patil et al.[10] also reported similar findings, further validating the present data.

In terms of safety, one patient in the clonidine group experienced nausea and vomiting ($p=0.019$), while no major complications such as bradycardia, hypotension, or respiratory depression occurred in either group. This aligns with Sedky et al.[7] confirming the safety profile of dexmedetomidine, particularly at controlled doses. Notably, the total absence of any cardiovascular or respiratory complications in both groups is a unique and favorable finding of this study.

CONCLUSION

We concluded that levobupivacaine combined with dexmedetomidine provides more effective postoperative analgesia, longer duration of pain relief, and better sedation without significant side effects compared to levobupivacaine with clonidine. Its favorable hemodynamic profile and reduced requirement for rescue analgesia make it a superior choice for thoracic epidural analgesia in thoracotomy patients.

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Ethical Approval: Obtained.
Consent: Written consent secured.

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