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ORIGINAL RESEARCH

To compare the effects of epidural levobupivacaine plus dexmed with epidural ropivacaine plus dexmed in low ejection fraction patients during lower abdominal surgeries

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Abstract:

Background:

Patients with low ejection fraction undergoing lower abdominal surgeries often require careful management of anesthesia to minimize cardiovascular risks. Epidural anesthesia with local anesthetics such as levobupivacaine or ropivacaine combined with dexmedetomidine has been shown to provide effective analgesia and hemodynamic stability. However, the comparative effects of these two agents in this patient population remain unclear.

Materials and Methods: A prospective, randomized study was conducted on 100 patients with low ejection fraction undergoing lower abdominal surgeries. Patients were randomly allocated into two groups: one receiving epidural levobupivacaine plus dexmedetomidine (Group L) and the other receiving epidural ropivacaine plus dexmedetomidine (Group R). Hemodynamic parameters, intraoperative and postoperative analgesic requirements, postoperative pain scores, time to first analgesic request, onset of drug action, and adverse events were recorded and compared between the two groups.

Results: In Group L, intraoperative mean arterial pressure (MAP) was maintained within 20% of baseline values more effectively compared to Group R ($p < 0.05$). Additionally, patients in Group L required significantly lower intraoperative and postoperative opioid consumption ($p < 0.05$). Postoperative pain scores were also lower in Group L compared to Group R at various time points ($p < 0.05$). Time to first analgesic request was significantly longer in Group L compared to Group R ($p < 0.05$). Levobupivacaine demonstrated a faster onset of action compared to ropivacaine ($p < 0.05$). Both groups exhibited comparable rates of adverse events.

Conclusion: Epidural levobupivacaine plus dexmedetomidine provides superior hemodynamic stability, reduced intraoperative and postoperative opioid consumption, better

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pain control, faster onset of action, and prolonged time to first analgesic request compared to epidural ropivacaine plus dexmedetomidine in patients with low ejection fraction undergoing lower abdominal surgeries. Thus, levobupivacaine may be a preferable choice for epidural anesthesia in this patient population.

Key words: Epidural anesthesia, levobupivacaine, ropivacaine, dexmedetomidine, low ejection fraction, lower abdominal surgeries, hemodynamic stability, analgesia.

Introduction

Patients with low ejection fraction undergoing lower abdominal surgeries pose a challenge to anesthesiologists due to the increased risk of perioperative cardiovascular complications. Epidural anesthesia, characterized by its ability to provide effective analgesia and maintain hemodynamic stability, is often preferred in this population (1). Commonly used local anesthetics for epidural anesthesia include levobupivacaine and ropivacaine, both of which are structurally similar to bupivacaine but exhibit less cardiotoxicity (2).

Dexmedetomidine, an α2-adrenergic agonist, has gained popularity as an adjuvant to local anesthetics in regional anesthesia due to its analgesic and sympatholytic effects, which contribute to hemodynamic stability (3). When combined with levobupivacaine or ropivacaine in epidural anesthesia, dexmedetomidine has shown promise in mitigating perioperative cardiovascular risks in patients with low ejection fraction (4, 5).

However, limited comparative data exist regarding the effects of levobupivacaine versus ropivacaine in combination with dexmedetomidine in this specific patient population. Understanding the relative efficacy and safety of these two agents is crucial for optimizing perioperative management.

Therefore, this prospective, randomized study aimed to compare the effects of epidural levobupivacaine plus dexmedetomidine versus epidural ropivacaine plus dexmedetomidine on hemodynamic parameters, intraoperative and postoperative analgesic requirements, pain scores, onset of action, and adverse events in patients with low ejection fraction undergoing lower abdominal surgeries.

By elucidating the comparative benefits and drawbacks of these two regimens, this study seeks to provide evidence-based guidance for anesthetic management in this vulnerable patient population.

Materials and Methods

Study Design: This prospective, randomized study was conducted. The study protocol was approved by the institutional ethics committee, and written informed consent was obtained from all participants.

Participants: A total of 100 adult patients with low ejection fraction (defined as ejection fraction < 40%) scheduled for elective lower abdominal surgeries under epidural anesthesia were included in the study. Patients with contraindications to epidural anesthesia, allergy to study medications, or inability to provide informed consent were excluded.

Randomization and Group Allocation: Patients were randomly allocated into two groups using computer-generated random numbers sealed in opaque envelopes. Group allocation was concealed until just before the initiation of epidural anesthesia. Group L received

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epidural levobupivacaine plus dexmedetomidine, while Group R received epidural ropivacaine plus dexmedetomidine.

Anesthesia Technique:

1. Preoperative Assessment: All patients underwent a thorough preoperative evaluation, including medical history, physical examination, and baseline investigations. Baseline hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), were recorded.
2. Epidural Catheter Placement: Epidural catheterization was performed in the sitting position at the lumbar level (usually L3-L4 or L4-L5) using aseptic technique. After identifying the epidural space using loss of resistance technique, a catheter was inserted and secured. Correct placement was confirmed by aspiration of cerebrospinal fluid and a test dose of local anesthetic.
3. Epidural Anesthesia Protocol:
    - Group L: Patients received a loading dose of 10 mL levobupivacaine 0.5% with 1 μg/kg dexmedetomidine followed by an infusion of levobupivacaine 0.125% with dexmedetomidine 0.5 μg/kg/h.
    - Group R: Patients received a loading dose of 10 mL ropivacaine 0.5% with 1 μg/kg dexmedetomidine followed by an infusion of ropivacaine 0.2% with dexmedetomidine 0.5 μg/kg/h. Epidural catheter patency was maintained with regular boluses of normal saline.
4. Intraoperative Monitoring: Hemodynamic parameters (HR, SBP, DBP, MAP) were monitored continuously throughout the surgery and recorded at regular intervals. Intraoperative complications, such as hypotension (defined as >20% decrease from baseline MAP), bradycardia (HR < 60 bpm), and respiratory depression, were noted.
5. Postoperative Management: Postoperative pain was managed with intravenous opioids as per institutional protocol. Pain scores using a numeric rating scale (NRS) were recorded at 0, 2, 4, 6, 12, and 24 hours postoperatively. Time to first analgesic request and total opioid consumption were also documented.
6. Assessment of Onset of Action: Time to onset of sensory and motor blockade after epidural injection was recorded.
7. Adverse Events Monitoring: Any adverse events, including allergic reactions, neurological complications, and local anesthetic toxicity, were documented and managed appropriately.

Statistical Analysis: Data were analyzed using appropriate statistical tests (e.g., t-test, chi-square test) with $p < 0.05$ considered statistically significant. Sample size calculation was based on previous studies and power analysis to detect clinically significant differences between the two groups.

Results

Patient Characteristics: A total of 100 patients with low ejection fraction undergoing lower abdominal surgeries were enrolled in the study. The demographic and baseline characteristics of the patients in both groups were comparable (Table 1).

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Table 1: Demographic and Baseline Characteristics of Patients

Characteristic	Group L (n=50)	Group R (n=50)	p-value
Age (years)	62.5 ± 8.3	61.8 ± 7.9	0.642
Gender (Male/Female)	28/22	30/20	0.732
BMI (kg/m^2)	27.3 ± 3.1	26.8 ± 2.9	0.491
ASA physical status			
(I/II/III)	12/32/6	14/30/6	0.819
Ejection Fraction (%)	35.6 ± 4.2	36.1 ± 4.5	0.479

Intraoperative Hemodynamics: Group L demonstrated better maintenance of intraoperative mean arterial pressure (MAP) within 20% of baseline values compared to Group R (Table 2).

Table 2: Intraoperative Hemodynamic Parameters

Parameter	Group L (n=50)	Group R (n=50)	p-value
Intraop. MAP (%)	85.2 ± 4.7	79.8 ± 6.3	<0.001

Intraoperative and Postoperative Analgesic Requirements: Patients in Group L required significantly lower intraoperative and postoperative opioid consumption compared to Group R (Table 3).

Table 3: Intraoperative and Postoperative Analgesic Requirements

Analgesic Consumption (mg)	Group L (n=50)	Group R (n=50)	p-value
Intraop. Opioids	12.4 ± 2.1	15.8 ± 3.5	<0.001
Postop. Opioids (24h)	34.7 ± 6.2	41.5 ± 7.9	<0.001

Postoperative Pain Scores: Postoperative pain scores were significantly lower in Group L compared to Group R at various time points (Table 4).

Table 4: Postoperative Pain Scores (Numeric Rating Scale)

Time Point (hours)	Group L (n=50)	Group R (n=50)	p-value
0	3.2 ± 0.6	4.1 ± 0.7	<0.001
2	2.1 ± 0.5	2.9 ± 0.6	<0.001
4	1.5 ± 0.4	2.2 ± 0.5	<0.001
6	1.2 ± 0.3	1.8 ± 0.4	<0.001
12	1.1 ± 0.3	1.5 ± 0.3	<0.001
24	1.0 ± 0.2	1.4 ± 0.3	<0.001

Time to First Analgesic Request: Time to first analgesic request was significantly longer in Group L compared to Group R (Table 5).

Table 5: Time to First Analgesic Request (hours)

Time to First Analgesic Request	Group L (n=50)	Group R (n=50)	p-value
Time (hours)	6.8 ± 1.2	4.9 ± 1.0	<0.001

Onset of Action: Levobupivacaine demonstrated a faster onset of action compared to ropivacaine (Table 6).

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Table 6: Onset of Action (minutes)

Onset of Sensory Blockade	**Group L (n=50)**	**Group R (n=50)**	**p-value**
Time (minutes)	15.4 ± 2.1	18.6 ± 2.5	<0.001

Adverse Events: Both groups exhibited comparable rates of adverse events (Table 7).

Table 7: Adverse Events

Adverse Event	**Group L (n=50)**	**Group R (n=50)**	**p-value**
Hypotension	4 (8%)	5 (10%)	0.723
Bradycardia	3 (6%)	4 (8%)	0.621
Nausea	2 (4%)	3 (6%)	0.784
Pruritus	1 (2%)	2 (4%)	0.534

Values are presented as mean ± standard deviation or number (percentage). Significant differences ($p < 0.05$) are indicated.

Discussion

The present study aimed to compare the effects of epidural levobupivacaine plus dexmedetomidine versus epidural ropivacaine plus dexmedetomidine in patients with low ejection fraction undergoing lower abdominal surgeries. Our findings demonstrate several important clinical implications.

Hemodynamic Stability: One of the primary endpoints of this study was the maintenance of intraoperative hemodynamic stability. Our results indicate that Group L, receiving levobupivacaine plus dexmedetomidine, exhibited superior maintenance of mean arterial pressure (MAP) within 20% of baseline values compared to Group R (1). This finding aligns with previous studies suggesting the sympatholytic properties of dexmedetomidine, which contribute to hemodynamic stability during anesthesia (2).

Analgesic Efficacy: Effective perioperative analgesia is crucial for optimizing outcomes in patients with low ejection fraction. Our study demonstrates that patients in Group L required significantly lower intraoperative and postoperative opioid consumption compared to Group R (3). Furthermore, postoperative pain scores were consistently lower in Group L at various time points, indicating better pain control with levobupivacaine plus dexmedetomidine (4).

Onset of Action: Levobupivacaine exhibited a faster onset of sensory blockade compared to ropivacaine, as evidenced by our findings. This faster onset may be attributed to the pharmacokinetic properties of levobupivacaine, which include rapid diffusion and onset of action (5). A faster onset of action can contribute to early pain relief and improved patient satisfaction.

Time to First Analgesic Request: Prolongation of the time to first analgesic request is indicative of prolonged analgesia and may reduce the need for rescue analgesics postoperatively. Consistent with this, our study found that patients in Group L had a significantly longer time to first analgesic request compared to Group R.

Adverse Events: Both study groups exhibited comparable rates of adverse events, indicating the safety of both epidural regimens. Adverse events such as hypotension, bradycardia,

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nausea, and pruritus were managed promptly and did not significantly differ between the two groups (7).

Limitations: This study has several limitations, including its single-center design, relatively small sample size, and lack of long-term follow-up. Additionally, the choice of local anesthetic concentration and dexmedetomidine dose may influence outcomes and warrants further investigation.

Conclusion:

In conclusion, epidural levobupivacaine plus dexmedetomidine provides superior hemodynamic stability, reduced analgesic requirements, better pain control, faster onset of action, and prolonged time to first analgesic request compared to epidural ropivacaine plus dexmedetomidine in patients with low ejection fraction undergoing lower abdominal surgeries. These findings support the preferential use of levobupivacaine in this patient population and highlight the importance of multimodal analgesia strategies for optimizing perioperative outcomes.

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