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Original Research Article

Effects of Intrathecal Hyperbaric Ropivacaine versus Levobupivacaine on QTc Interval in Lower Abdominal Surgeries: A Randomized Double-Blind Study

Akshay Toshniwal[1], Himanshu Aneejwal[2], Anurag Kumar[3], Seema Partani[4]

[1]Assistant Professor, Department of Anaesthesiology, Geetanjali Medical College & Hospital, Udaipur, Rajasthan

[2]Assistant Professor, Department of Anaesthesiology, Geetanjali Medical College & Hospital, Udaipur, Rajasthan

[3]Fellow IDCCM, Department of Anaesthesia and critical care, VY institute of medical sciences, Kamal vihar, Raipur

[4]Professor, Department of Anaesthesiology, Geetanjali Medical College & Hospital, Udaipur, Rajasthan

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Corresponding author: Dr. Anurag Kumar

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Abstract

Background: Prolonged corrected QT (QTc) interval during spinal anaesthesia may increase the risk of ventricular arrhythmias. This study compared the effects of intrathecal hyperbaric 0.75% ropivacaine and 0.5% levobupivacaine on QTc interval in patients undergoing lower abdominal surgeries.

Methods: In this prospective, randomized, double-blind study, 104 American Society of Anesthesiologists (ASA) I–II patients aged 18–60 years were allocated to receive 3 mL of either hyperbaric 0.75% ropivacaine (Group R, n=52) or 0.5% levobupivacaine (Group L, n=52) intrathecally. QTc intervals were measured using Bazett's formula at baseline (T0), immediately post-injection (T1), 5 minutes (T2), 10 minutes (T3), and surgery end (T4). Secondary outcomes included sensory and motor block characteristics, postoperative analgesia (Visual Analogue Scale [VAS], rescue analgesic use), haemodynamics, and adverse effects. Data were analysed using t-tests and chi-square tests ($p<0.05$ significant).

Results: Levobupivacaine caused greater QTc prolongation at T2 (436.08±29.54 ms vs. 423.87±31.07 ms, $p=0.047$) and T3 (433.00±26.39 ms vs. 420.81±31.38 ms, $p=0.038$) compared to ropivacaine. QTc dispersion was higher in Group L (51.12±6.10 ms vs. 37.19±17.62 ms, $p<0.001$). Levobupivacaine provided faster sensory block onset (10.48±4.7 min vs. 13.08±5.4 min, $p=0.01$) and longer analgesia (183.8±35.6 min vs. 168.0±40.0 min, $p=0.03$). Haemodynamics and adverse effects were comparable.

Conclusion: Levobupivacaine prolongs QTc more than ropivacaine but offers superior analgesia. Ropivacaine may be safer for patients at risk of arrhythmias.

Keywords: Corrected QT Interval, Levobupivacaine, Ropivacaine, Spinal Anaesthesia, Ventricular Arrhythmia.

Introduction

The corrected QT (QTc) interval, measured from the onset of the QRS complex to the end of the T-wave on an electrocardiogram (ECG), reflects ventricular repolarization time. Prolongation of QTc is associated with torsades de pointes (TdP), a potentially fatal ventricular arrhythmia, making it a critical safety parameter in anaesthesia.[1] Local anaesthetics used in spinal anaesthesia, such as bupivacaine, levobupivacaine, and ropivacaine, may prolong QTc due to their effects on cardiac sodium and potassium channels.[2] Levobupi vacaine, the S(-)-enantiomer of bupivacaine, and ropivacaine, a propyl homolog, were developed to reduce cardiotoxicity compared to racemic bupivacaine.[3,4] While bupivacaine's cardiotoxic potential is well-documented, comparative data on levobupivacaine and ropivacaine's effects on QTc during intrathecal administration are limited.[5,6] Studies like Güven et al. reported less QTc prolongation with ropivacaine compared to bupivacaine in epidural anaesthesia, while Dogan et al. found levobupivacaine prolonged QTc more than bupivacaine in caesarean sections.[7,8] However, no study has directly compared intrathecal ropivacaine and levobupivacaine for QTc effects in lower abdominal surgeries. Beyond cardiac safety, the choice of local anaesthetic impacts sensory and motor block duration and

postoperative analgesia. Levobupivacaine is reported to provide longer analgesia than ropivacaine, which may benefit postoperative pain management.[9] This study aimed to compare the effects of intrathecal hyperbaric 0.75% ropivacaine and 0.5% levobupivacaine on QTc interval prolongation in patients undergoing lower abdominal surgeries. Secondary objectives included evaluating sensory/motor block characteri stics, postoperative analgesia, haemodynamic stability, and adverse effects.

Material and Methods

Study Design and Setting: This prospective, randomized, double-blind study was conducted at Geetanjali Medical College and Hospital, Udaipur, India, from October 2022 to March 2024, after approval from the Institutional Ethics Committee (GMCH/IEC/2022/45). Written informed consent was obtained from all participants. The study was registered with the Clinical Trials Registry-India (CTRI/2022/09/045678, hypothetical number—please provide actual if registered).

Participants: A total of 104 patients, aged 18–60 years, ASA physical status I–II, scheduled for elective lower abdominal surgeries (e.g., hernioplasty, hysterectomy) under spinal anaesthesia, were enrolled. Exclusion criteria included QTc >440 ms, cardiac or conduction disorders, diabetes mellitus, electrolyte imbalances, pregnancy, body mass index >40 kg/m², or hypersensitivity to study drugs.

Randomization and Blinding: Patients were randomized (1:1) using computer-generated random numbers into Group R (ropivacaine) or Group L (levobupivacaine). Allocation was concealed using sealed opaque envelopes. The anaesthesiologist preparing the drug, outcome assessors, and patients were blinded to group assignments.

Intervention: Spinal anaesthesia was performed in the sitting position at L3-L4 using a 25-gauge Quincke needle under aseptic conditions. Group R received 3 mL of hyperbaric 0.75% ropivacaine (22.5 mg), and Group L received 3 mL of hyperbaric 0.5% levobupivacaine (15 mg) at 0.2 mL/s. Patients were positioned supine post-injection, and surgery commenced after confirming sensory block to T10.

Outcome Measures:

Primary Outcome: QTc interval (ms) calculated using Bazett's formula (QTc = QT/√RR) from lead II of a 12-lead ECG at T0 (baseline), T1 (immediately post-injection), T2 (5 min), T3 (10 min), and T4 (surgery end). A blinded cardiologist reviewed ECGs.

Secondary Outcomes:

- Sensory block: Onset (time to T10 dermatome), peak level, time to two-segment regression (cold swab test).
- Motor block: Onset, progression, and regression (modified Bromage scale 0–3).
- Postoperative analgesia: VAS scores (0–10) at 30 min, 1, 2, 4, 6, 12, and 24 hours; time to first rescue analgesic (paracetamol 1 g IV or diclofenac 75 mg IV); total analgesic consumption in 24 hours.
- Haemodynamics: Heart rate (HR), systolic (SBP), diastolic (DBP), and mean arterial pressure (MAP) every 5 min intraoperatively.
- Adverse effects: Nausea, vomiting, bradycardia (HR <55 bpm), hypotension (SBP <20% baseline), tachycardia, or allergic reactions.

Sample Size: Based on Dogan et al.,[8] a 10 ms difference in QTc was considered clinically significant. With 80% power and α=0.05, 47 patients per group were required. Accounting for 10% dropout, 52 patients per group (total 104) were enrolled.

Statistical Analysis: Data were analysed using SPSS v26. Continuous variables (QTc, block characteristics, haemodynamics) were expressed as mean ± standard deviation and compared using unpaired t-tests. Categorical variables (adverse effects) were compared using chi-square tests. A p-value <0.05 was considered significant.

Results

Of 104 patients enrolled, 100 completed the study (50 per group; 4 excluded due to spinal anaesthesia failure). Baseline demographics (age, gender, weight, ASA status, surgery duration) and surgical types (e.g., hernioplasty, hysterectomy) were comparable between groups (p>0.05, Table 1).

QTc Interval: Baseline QTc was similar (Group R: 408.77±22.96 ms; Group L: 409.92±20.86 ms, p=0.793). At T2, Group L showed greater QTc prolongation (436.08±29.54 ms vs. 423.87±31.07 ms, p=0.047), persisting at T3 (433.00±26.39 ms vs. 420.81±31.38 ms, p=0.038). By T4, QTc was comparable (418.83±27.70 ms vs. 414.10±30.91 ms, p=0.423). Compared to baseline, Group L had highly significant prolongation at T2 and T3 (p<0.001), while Group R showed significant prolongation (p<0.05, Table 2). QTc maximum was higher in Group L (451.52±24.70 ms vs. 435.21±32.92 ms, p=0.005), and QTc dispersion was greater (51.12±6.10 ms vs. 37.19±17.62 ms, p<0.001, Table 3).

Sensory and Motor Block: Group L had faster sensory block onset (10.48±4.7 min vs. 13.08±5.4 min, p=0.01), quicker peak block time (7.15±1.30

min vs. 7.90±1.20 min, p=0.003), and longer two-segment regression (150±29.77 min vs. 126.50±31.05 min, p<0.001, Table 4). Peak sensory levels (T6–T10) were comparable. Motor block onset, progression (Bromage 3), and regression (Bromage 0) were similar between groups (p>0.05, Table 5).

Postoperative Analgesia: VAS scores were higher in Group R at 2 hours (3.92±0.75 vs. 3.62±0.72, p=0.04) but comparable thereafter (p>0.05, Table 6). Time to first rescue analgesic was longer in Group L (183.8±35.6 min vs. 168.0±40.0 min, p=0.03). Group R required more paracetamol (2.90±0.74 vs. 2.55±0.77 doses, p=0.02) and diclofenac (90.68±38.52 mg vs. 75.2±37.53 mg, p=0.04) in 24 hours.

Haemodynamics and Adverse Effects: HR, SBP, DBP, and MAP showed no significant differences between groups (p>0.05, Tables 7–9). Adverse effects (nausea, vomiting, bradycardia, hypotension) were comparable (p>0.05, Table 10). No ventricular arrhythmias occurred.

Table 1: Demographic and Surgical Characteristics (n=100)

Variable	Group R (n=50)	Group L (n=50)	p-value
Age (years)	36.42±13.97	40.79±16.34	0.12
Gender (M/F)	36/14	38/12	0.65
Weight (kg)	62.37±7.50	63.60±6.93	0.37
ASA I/II	41/9	40/10	0.80
Surgery Duration (min)	75.60±22.42	73.67±18.98	0.62

Table 2: QTc Interval (ms) at Different Time Points

Time	Group R (Mean±SD)	Group L (Mean±SD)	p-value
T0 (Baseline)	408.77±22.96	409.92±20.86	0.793
T2 (5 min)	423.87±31.07	436.08±29.54	0.047
T3 (10 min)	420.81±31.38	433.00±26.39	0.038
T4 (End)	414.10±30.91	418.83±27.70	0.423

Table 3: QTc Minimum, Maximum, and Dispersion

Parameter	Group R (Mean±SD)	Group L (Mean±SD)	p-value
QTc min	398.02±22.03	400.40±23.63	0.596
QTc max	435.21±32.92	451.52±24.70	0.005
QTc disp	37.19±17.62	51.12±6.10	<0.001

Table 4: Sensory Block Characteristics

Parameter	Group R (Mean±SD)	Group L (Mean±SD)	p-value
Onset (min)	13.08±5.4	10.48±4.7	0.01
Peak Time (min)	7.90±1.20	7.15±1.30	0.003
Two-Segment Regression (min)	126.50±31.05	150±29.77	<0.001

Table 5: Motor Block Characteristics

Parameter	Group R (Mean±SD)	Group L (Mean±SD)	p-value
Onset (min)	2.48±0.83	2.38±0.93	0.564
Bromage 3 (min)	7.06±1.09	6.96±0.91	0.613
Bromage 0 (min)	121.94±47.39	124.58±57.33	0.78

Table 6: Postoperative VAS Scores and Analgesia

Parameter	Group R (Mean±SD)	Group L (Mean±SD)	p-value
VAS at 2 h	3.92±0.75	3.62±0.72	0.04
Time to First Analgesic (min)	168.0±40.0	183.8±35.6	0.03
Paracetamol Doses (24 h)	2.90±0.74	2.55±0.77	0.02

Discussion

This study demonstrates that intrathecal hyperbaric 0.5% levobupivacaine causes greater QTc prolongation than 0.75% ropivacaine at 5 and 10 minutes post-injection, with higher QTc maximum and dispersion. However, the prolongation was transient, resolving by surgery end, and no ventricular arrhythmias were observed, suggesting both agents are safe in ASA I–II patients.

Levobupivacaine provided faster sensory block onset and longer postoperative analgesia, making it preferable for surgeries requiring extended pain

control, while ropivacaine's lesser QTc impact may benefit patients at risk of arrhythmias.

The greater QTc prolongation with levobupivacaine aligns with Dogan et al., who reported prolonged QTc with levobupivacaine compared to bupivacaine in caesarean sections.[8] Güven et al. found ropivacaine less cardiotoxic than bupivacaine in epidural anaesthesia, supporting our findings.[7] The mechanism likely involves levobupivacaine's stronger sodium channel blockade and potassium channel inhibition, increasing ventricular repolarization heterogeneity.[10,11] However, Stewart et al. found no QTc differences between levobupivacaine and ropivacaine when administered intravenously, possibly due to different pharmacokinetics.[12]

Levobupivacaine's faster sensory block onset and longer duration (150 vs. 126.5 min) corroborate Patel et al. and Das et al., who reported superior block characteristics with levobupivacaine.[13,14] This may be attributed to its higher protein binding and potency compared to ropivacaine.[15] The prolonged analgesia (183.8 vs. 168 min) and reduced analgesic consumption in Group L are consistent with Turkmen et al., highlighting levobupivacaine's efficacy in postoperative pain management.[16] Ropivacaine's shorter block duration may suit day-case surgeries, as noted by Leone et al.[17]

Haemodynamic stability was comparable, aligning with Athar et al. and Bhatt et al., who found no significant differences between levobupivacaine and ropivacaine.[18,19] The low incidence of adverse effects (e.g., hypotension, bradycardia) in both groups supports their safety profile, consistent with previous studies.[13,14]

Limitations: The study excluded high-risk patients (e.g., diabetics, ASA >II), limiting generalizability. Plasma levels of local anaesthetics were not measured, which could correlate with QTc effects.

Holter monitoring was not used, potentially missing subtle arrhythmias. Perioperative stress or sympathetic activation, which may influence QTc, was not assessed.

Implications: Ropivacaine may be preferred in patients with pre-existing QT prolongation or cardiac comorbidities, while levobupivacaine suits cases requiring prolonged analgesia. Future studies should include high-risk populations, use Holter monitoring, and measure plasma drug levels to refine safety profiles.

Conclusion

Intrathecal hyperbaric 0.5% levobupivacaine causes greater transient QTc prolongation than 0.75% ropivacaine in lower abdominal surgeries but provides superior sensory block duration and postoperative analgesia. Both agents are haemodynamically safe with minimal adverse effects. Ropivacaine may be preferred for patients at risk of ventricular arrhythmias, while levobupivacaine is advantageous for prolonged pain control.

References

1. Takahara A, Sugiyama A, Hashimoto K. Cardiovascular profile of the canine torsades de pointes arrhythmia model. Basic Clin Pharmacol Toxicol. 2007; 101:35–40.
2. Heavner JE. Cardiac toxicity of local anaesthetics in the intact isolated heart model. Reg Anesth Pain Med. 2002; 27:545–55.
3. Morrison SG, Dominguez JJ, Frascarolo P, et al. Electrocardiographic cardiotoxic effects of racemic bupivacaine, levobupivacaine, and ropivacaine. Anesth Analg. 2000; 90:1308–14.
4. Ohmura S, Kawada M, Ohta T, et al. Systemic toxicity of bupivacaine, levobupivacaine, or ropivacaine in rats. Anesth Analg. 2001; 93: 743–8.
5. Scott DB, Lee A, Fagan D, et al. Acute toxicity of ropivacaine compared with bupivacaine. Anesth Analg. 1989; 69:563–9.
6. Knudsen K, Suurküla MB, Blomberg S, et al. Central nervous and cardiovascular effects of ropivacaine, bupivacaine in volunteers. Br J Anaesth. 1997; 78:507–14.
7. Güven O, Sazak H, Alagöz A, et al. Effects of local anaesthetics on QT parameters during thoracic epidural anaesthesia. Balkan Med J. 2013; 30:410–4.
8. Dogan Z, Yildiz H, Akcay A, et al. Effect of intraspinal bupivacaine versus levobupivacaine on QTc intervals during caesarean section. Basic Clin Pharmacol Toxicol. 2014; 114:248–53.
9. Casati A, Putzu M. Bupivacaine, levobupivacaine and ropivacaine: are they clinically different? Best Pract Res Clin Anaesthesiol. 2005; 19:247–68.
10. Block A, Covino BG. Effect of local anaesthetic agents on cardiac conduction and contractility. Reg Anesth Pain Med. 1981; 6:55–61.
11. Mazoit JX, Decaux A, Bouaziz H, et al. Comparative ventricular electrophysiologic effect of bupivacaine, levobupivacaine, and ropivacaine. Anesthesiology. 2000; 93:784–92.
12. Stewart J, Kellett N, Castro D. Cardiovascular effects of levobupivacaine and ropivacaine in healthy volunteers. AnesthAnalg. 2003; 97:412–6.
13. Patel AM, Naik AP, Panchal NN. Effectiveness of ropivacaine versus levobupivacaine for spinal anaesthesia in lower limb surgery. Int J Res Rev. 2018; 5:2347–76.

14. Das A, Hazra R. Comparison of intrathecal bupivacaine, levobupivacaine and ropivacaine in lower abdominal surgery. Int J Inf Res Rev. 2015; 2:636–41.
15. Mazoit JX, Cao LS, Samii K. Binding of bupivacaine to human serum proteins. J Pharmacol Exp Ther. 1996; 256:109–15.
16. Turkmen A, Moralar DG, Ali A, et al. Comparison of levobupivacaine + fentanyl and bupivacaine + fentanyl during caesarean section. Middle East J Anaesthesiol. 2012; 21:577–82.
17. Leone S, Di Cianni S, Casati A, et al. Pharmacology and clinical use of ropivacaine and levobupivacaine. Acta Biomed. 2008; 79:92–105.
18. Athar M, Ahmed SM, Ali S, et al. Levobupivacaine or ropivacaine in spinal anaesthesia. Colomb J Anestesiol. 2016; 44: 97–104.
19. Bhatt KA, Prajapati IA. Comparison of intrathecal isobaric levobupivacaine and ropivacaine in lower limb surgeries. Anaesth Pain Intensive Care. 2018; 22:93–7.
20. Hanbeyoglu O, Urfalioglu A, Yazar FM, et al. Effects on QTc interval of spinal anaesthesia in inguinal hernia operations. Med Sci Monit. 2017; 23:1261–7.