International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Hemodynamic Stability with Intraperitoneal Ropivacaine 0.375% in Laparoscopic Abdominal Surgery: A Comparative Study with Placebo

Dr. Arpita M Tellur[1], Dr. Ranjith Kumar R T[2], Dr. Shruti Ghodageri[3]

[1]Postgraduate, Department of Anaesthesia, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.
[2]Professor, Department of Anaesthesia, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.
[3]Associate Professor, Department of Anaesthesia, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.

Corresponding Author:

Dr. Arpita M Tellur
Postgraduate, Department of Anaesthesia, Basaveshwar Medical College and Hospital, Chitradurga, Karnataka, India.

Received: 05-06-2026
Accepted: 25-06-2026
Available online: 08-07-2026

ABSTRACT

Background: Intraperitoneal instillation of local anesthetics is increasingly used for postoperative analgesia in laparoscopic surgery. Ropivacaine, a long-acting amide local anesthetic with a favorable safety profile, is preferred due to its reduced cardiotoxicity and neurotoxicity. However, data regarding its hemodynamic effects when administered intraperitoneally remains limited.
Aim: To evaluate the hemodynamic stability following intraperitoneal instillation of 0.375% ropivacaine compared with placebo in patients undergoing laparoscopic abdominal surgery.
Methodology: A prospective, randomized, double-blind, placebo-controlled study was conducted on 60 ASA physical status I and II patients aged 18-60 years undergoing elective laparoscopic abdominal surgery. Patients were randomly allocated into two groups: Group R (n=30) received 20 ml of 0.375% ropivacaine intraperitoneally, and Group S (n=30) received 20 ml of 0.9% normal saline as placebo at the end of surgery. Hemodynamic parameters including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), oxygen saturation (SpO_2), and body temperature were recorded at baseline, at 1, 2, 5, 8, and 10 minutes after drug instillation, and postoperatively at 0, 0.5, 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24 hours.
Results: Both groups were comparable with respect to demographic characteristics and baseline hemodynamic parameters. There were no statistically significant differences in HR, SBP, DBP, MAP, SpO_2, or temperature between the groups at any measured time interval ($p > 0.05$ for all parameters). All hemodynamic parameters remained within clinically acceptable ranges throughout the study period. No adverse effects such as hypotension, bradycardia, arrhythmias, or respiratory depression were observed in either group.
Conclusion: Intraperitoneal instillation of 0.375% ropivacaine does not produce significant hemodynamic alterations when compared with placebo. It is a safe technique with excellent hemodynamic stability, making it a reliable option for postoperative analgesia in patients undergoing laparoscopic abdominal surgery.

Keywords: *Ropivacaine, Intraperitoneal instillation, Hemodynamic stability, Laparoscopic surgery, Safety.*

INTRODUCTION

Laparoscopic abdominal surgery has become the standard of care for many surgical procedures due to its well-established benefits including reduced tissue trauma, decreased postoperative pain, shorter hospital stays, faster recovery, and improved cosmetic outcomes. However, postoperative pain remains a significant concern, arising from multiple sources including parietal peritoneal stretch, visceral irritation, diaphragmatic irritation from residual carbon dioxide, and referred shoulder pain.[1-3]

Effective postoperative pain management is crucial for early mobilization, enhanced recovery, and patient satisfaction. While systemic opioids have traditionally been used, their adverse effects such as nausea, vomiting, sedation, respiratory depression, and delayed bowel motility have prompted the search for alternative, opioid-sparing analgesic techniques.[4]

Intraperitoneal instillation of local anesthetics has emerged as a simple, cost-effective, and safe technique for managing postoperative pain following laparoscopic procedures.[5] Among the various local anesthetics available, ropivacaine has gained widespread acceptance due to its favorable pharmacological profile. Ropivacaine is a pure S-enantiomer amide local anesthetic that provides effective sensory blockade with significantly reduced cardiotoxicity and neurotoxicity compared to its predecessor bupivacaine.[6,7] The reduced cardiotoxicity of ropivacaine is attributed to its weaker binding affinity for cardiac sodium channels and its stereoselective properties.[8]

When administered intraperitoneally, ropivacaine acts locally on peritoneal nociceptors, inhibiting sodium channel conductance and preventing the initiation and propagation of action potentials in afferent nerve fibers. This results in effective analgesia for both visceral and somatic components of postoperative pain.[9] The drug is gradually absorbed from the peritoneal surface through mesothelial cells and diaphragmatic lymphatics, providing sustained local effect without high plasma peaks.[10]

Despite the growing body of evidence supporting the analgesic efficacy of intraperitoneal ropivacaine, comprehensive data regarding its hemodynamic safety profile when administered through this route remains limited. Previous studies have primarily focused on analgesic outcomes, with hemodynamic parameters often reported as secondary observations.[11-13]

The present study was therefore designed to specifically evaluate the hemodynamic stability associated with intraperitoneal instillation of 0.375% ropivacaine compared with placebo in patients undergoing laparoscopic abdominal surgery, with the hypothesis that ropivacaine would not produce significant hemodynamic alterations.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective, randomized, double-blind, placebo-controlled comparative study conducted at Basaveshwara Medical College and Hospital, Chitradurga, over a period from February 2024 to August 2025. The study was approved by the Institutional Ethical Committee (IEC No: 197/23-24) and was registered with the institutional clinical trial registry. The study was conducted in accordance with the principles of the Declaration of Helsinki and Good Clinical Practice guidelines. Written informed consent was obtained from all participants prior to their enrollment.

Study Population

A total of 60 patients of either sex, aged 18-60 years, with body weight between 50-80 kg, and classified as American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective laparoscopic abdominal surgery under general anesthesia, were included in the study.

Inclusion Criteria:

- Patients willing to participate in the study
- ASA Grade I and II patients scheduled for elective laparoscopic abdominal surgery
- Age between 18-60 years of either sex
- Weight between 50-80 kg

Exclusion Criteria:

- Patients with severe systemic diseases
- Patients with morbid obesity, heart block, hepatorenal disturbances
- Patients converted to open surgery
- History of chronic use of analgesics
- History of hypersensitivity to ropivacaine
- Pregnancy

2.3 Sample Size Calculation

Sample size was calculated based on published data from a previous study,[11] considering the anticipated difference in pain scores between groups. Assuming Type I error of 5% and Type II error of 20% (power of 80%), with a clinically significant decrease in pain score of 25%, the calculated sample size was 27 patients per group. To account for potential dropouts, the final sample size was rounded to 30 patients in each group.

Randomization and Blinding
Patients were randomly allocated into two groups of 30 each using computer-generated random numbers. The allocation sequence was concealed in sequentially numbered, opaque, sealed envelopes. Both the patients and the investigator responsible for recording hemodynamic parameters and assessing outcomes were blinded to group allocation.

Group R (n=30): Received intraperitoneal instillation of 20 ml of 0.375% ropivacaine (75 mg).

Group S (n=30): Received intraperitoneal instillation of 20 ml of 0.9% normal saline as placebo.

The study drug was prepared by an independent anesthesiologist not involved in patient assessment, ensuring blinding. The total dose of ropivacaine (75 mg) was calculated to remain below the maximum recommended dose of 3 mg/kg in all patients.

Preoperative Preparation
All patients underwent a thorough preanesthetic evaluation one day prior to surgery, including detailed history, clinical examination, airway assessment using Mallampati grading, and baseline investigations (complete hemogram, blood glucose, renal function tests, liver function tests, urine analysis, 12-lead ECG, and chest X-ray). Patients were instructed to fast according to ASA nil per oral guidelines. Premedication with Tab Alprazolam 0.25 mg and Tab Pantoprazole 40 mg was given orally the night before surgery.

Anesthesia Protocol
On the day of surgery, patients were shifted to the operation theater and connected to a multichannel monitor (Philips IntelliVue) for continuous monitoring of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), end-tidal carbon dioxide ($EtCO_2$), oxygen saturation (SpO_2), and electrocardiogram (ECG - Lead II). Baseline readings were recorded by the blinded anesthesiologist.

An 18G intravenous cannula was secured, and preloading with crystalloid solution was initiated. Patients were premedicated with IV Glycopyrrolate 0.2 mg and IV Fentanyl 2 mcg/kg. After preoxygenation with 100% oxygen for 3 minutes, general anesthesia was induced with IV Propofol 2 mg/kg and IV Suxamethonium 2 mg/kg to facilitate endotracheal intubation. An appropriately sized cuffed endotracheal tube was inserted under direct laryngoscopy, and bilateral air entry was confirmed along with end-tidal capnography. Anesthesia was maintained with a mixture of oxygen, nitrous oxide, isoflurane, and Vecuronium.

Laparoscopic surgeries were performed according to standard surgical and anesthesia protocols. Pneumoperitoneum was achieved using non-humidified and non-heated carbon dioxide, with intra-abdominal pressure maintained between 12-14 mmHg. All patients received IV Paracetamol 15 mg/kg 30 minutes prior to extubation.

Intervention
At the end of the surgical procedure, before removal of the trocars, the study drug (20 ml of either 0.375% ropivacaine or normal saline) was injected intraperitoneally with the patient in Trendelenburg's position to facilitate dispersion of the drug solution in the subhepatic region.

Data Collection and Outcome Measures
Primary Outcome Measures:

- Comparison of hemodynamic parameters (HR, SBP, DBP, MAP, SpO_2, and temperature) between the two groups at various time intervals

Secondary Outcome Measures:

- Incidence of adverse effects (hypotension, bradycardia, arrhythmias, respiratory depression, nausea, vomiting)

Hemodynamic parameters were recorded at the following time points:

Baseline: Before induction of anesthesia
After Drug Instillation: 1, 2, 5, 8, and 10 minutes after intraperitoneal instillation
Postoperatively: 0 hours (immediately after surgery), 0.5 hours, 1 hour, 2 hours, and then at 2-hourly intervals up to 24 hours (4, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24 hours)
All recordings were performed using the same monitoring equipment and by the same blinded investigator to minimize measurement bias. Any episodes of hemodynamic instability, defined as hypotension (SBP < 90 mmHg or > 30% decrease from baseline), bradycardia (HR < 50 beats/min), or any arrhythmia requiring intervention, were recorded and managed according to standard protocols.

Statistical Analysis

Data were compiled using Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 20. Continuous variables were expressed as mean ± standard deviation (SD) and analyzed using the independent samples t-test after checking for normality of distribution. Categorical variables were expressed as frequencies and percentages and analyzed using the Chi-square test. A p-value of < 0.05 was considered statistically significant, and $p < 0.001$ was considered highly significant.

RESULTS

A total of 60 patients completed the study, with 30 patients in each group. Both groups were comparable with respect to demographic characteristics and baseline parameters, confirming successful randomization.

Table 1: Demographic Characteristics

Parameter	Group R (Ropivacaine) (n=30)	Group S (Placebo) (n=30)	P Value
Mean Age (years) ± SD	43.33 ± 9.62	42.56 ± 9.91	0.7612
Mean Weight (kg) ± SD	66.86 ± 9.60	65.96 ± 7.68	0.6899
Gender (M/F)	13 (43.3%) / 17 (56.7%)	14 (46.7%) / 16 (53.3%)	0.793
ASA I/II	16 (53.3%) / 14 (46.7%)	15 (50%) / 15 (50%)	0.786

Statistical comparison using unpaired t-test for continuous variables and Chi-square test for categorical variables. $P < 0.05$ considered significant.

There were no statistically significant differences between the groups in terms of age ($p = 0.7612$), weight ($p = 0.6899$), gender distribution ($p = 0.793$), or ASA grade distribution ($p = 0.786$). This homogeneity is crucial for ensuring that any differences observed can be attributed to the intervention rather than demographic variations.

Table 2: Baseline Hemodynamic Parameters

Parameter	Group R (Ropivacaine)	Group S (Placebo)	P Value
Heart Rate (beats/min)	89.03 ± 13.98	85.60 ± 8.41	0.2542
SBP (mmHg)	125.73 ± 12.88	121.93 ± 5.40	0.1416
DBP (mmHg)	79.56 ± 9.32	81.53 ± 6.50	0.3463
MAP (mmHg)	95.18 ± 8.93	94.97 ± 4.93	0.9446
SpO_2 (%)	98.93 ± 0.78	98.96 ± 0.49	0.8590
Temperature (°C)	36.88 ± 0.19	36.95 ± 0.22	0.1924

Baseline hemodynamic parameters recorded before induction of anesthesia were comparable between both groups, with no statistically significant differences observed ($p > 0.05$).

Table 3: Comparison of Heart Rate (beats/min) - Selected Time Points

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
Baseline	89.03 ± 13.98	85.60 ± 8.41	0.2542
1 min after instillation	86.83 ± 12.73	81.33 ± 8.12	0.0507

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
5 min after instillation	79.80 ± 8.73	76.43 ± 7.68	0.1178
10 min after instillation	75.53 ± 8.55	77.43 ± 7.85	0.3736
0 hr postop	73.13 ± 7.71	74.83 ± 6.14	0.3487
1 hr postop	72.96 ± 7.41	72.33 ± 5.12	0.7030
4 hr postop	74.56 ± 6.82	74.53 ± 5.48	0.9851
8 hr postop	76.50 ± 5.94	75.50 ± 6.01	0.5194
12 hr postop	79.60 ± 6.06	77.76 ± 5.87	0.2371
24 hr postop	80.90 ± 4.63	81.83 ± 5.54	0.4833

Values expressed as Mean ± SD. P < 0.05 considered significant.

Heart rate was monitored throughout the study period. Both groups showed a gradual decline in heart rate from baseline during the immediate postoperative period, which was expected due to the effects of anesthesia and surgical stress resolution. There were no statistically significant differences in heart rate between the two groups at any time point ($p > 0.05$ for all measurements).

Table 4: Comparison of Systolic Blood Pressure (mmHg) - Selected Time Points

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
Baseline	125.73 ± 12.88	121.93 ± 5.40	0.1416
1 min after instillation	120.66 ± 11.87	120.90 ± 6.70	0.9235
5 min after instillation	121.63 ± 10.09	117.73 ± 4.81	0.0609
10 min after instillation	117.90 ± 9.68	116.96 ± 6.62	0.6623
0 hr postop	116.56 ± 7.69	116.33 ± 6.35	0.8999
1 hr postop	115.66 ± 7.59	113.53 ± 5.13	0.2079
4 hr postop	116.56 ± 7.19	117.33 ± 6.35	0.6618
8 hr postop	118.70 ± 7.85	118.30 ± 8.32	0.8488
12 hr postop	121.03 ± 7.91	120.70 ± 6.75	0.8626
24 hr postop	124.13 ± 6.16	125.60 ± 6.04	0.3545

Values expressed as Mean ± SD. P < 0.05 considered significant.

Systolic blood pressure remained stable in both groups throughout the observation period. While there was a slight decline from baseline in both groups following drug instillation, the values remained within clinically acceptable ranges. No statistically significant differences were observed between the groups at any time point.

Table 5: Comparison of Diastolic Blood Pressure (mmHg) - Selected Time Points

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
Baseline	79.56 ± 9.32	81.53 ± 6.50	0.3463
1 min after instillation	77.80 ± 9.56	76.16 ± 6.47	0.5071
5 min after instillation	76.73 ± 6.13	77.10 ± 6.33	0.8189
10 min after instillation	72.70 ± 4.87	74.53 ± 6.48	0.2212
0 hr postop	70.56 ± 4.71	72.60 ± 6.15	0.1546
1 hr postop	71.36 ± 5.67	71.63 ± 4.59	0.8401
4 hr postop	72.06 ± 5.87	74.90 ± 6.42	0.0790
8 hr postop	73.43 ± 5.55	75.60 ± 5.78	0.1434
12 hr postop	77.33 ± 5.86	77.50 ± 5.88	0.9111
24 hr postop	75.63 ± 5.57	78.30 ± 6.81	0.1019

Values expressed as Mean ± SD. $P < 0.05$ considered significant.

Diastolic blood pressure trends mirrored those of systolic blood pressure, remaining stable throughout the study period. No significant differences were observed between the ropivacaine and placebo groups at any measured time interval ($p > 0.05$ for all comparisons).

Table 6: Comparison of Mean Arterial Pressure (mmHg) - Selected Time Points

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
Baseline	95.18 ± 8.93	94.97 ± 4.93	0.9446
1 min after instillation	92.03 ± 8.97	91.10 ± 5.97	0.6382
5 min after instillation	91.70 ± 5.84	90.63 ± 4.75	0.4394
10 min after instillation	87.73 ± 4.95	88.70 ± 5.36	0.4694
0 hr postop	85.80 ± 4.26	87.17 ± 5.63	0.2923
1 hr postop	86.07 ± 4.78	85.53 ± 4.13	0.6414
4 hr postop	86.87 ± 4.99	89.00 ± 5.47	0.1205
8 hr postop	88.47 ± 5.17	89.77 ± 5.42	0.3457
12 hr postop	91.87 ± 5.72	91.90 ± 5.01	0.9828
24 hr postop	91.87 ± 5.28	94.10 ± 5.59	0.1176

Mean arterial pressure, a comprehensive indicator of tissue perfusion, remained stable and comparable between both groups at all time points. The MAP values gradually declined from baseline during the postoperative period and then recovered, with no significant intergroup differences ($p > 0.05$ for all measurements).

Table 7: Comparison of Oxygen Saturation (%) - Selected Time Points

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
Baseline	98.93 ± 0.78	98.96 ± 0.49	0.8590
1 min after instillation	99.33 ± 0.66	99.06 ± 0.44	0.0673
5 min after instillation	99.43 ± 0.67	99.23 ± 0.62	0.2350
10 min after instillation	99.60 ± 0.56	99.40 ± 0.56	0.1719
0 hr postop	99.63 ± 0.49	99.40 ± 0.56	0.0958
1 hr postop	99.83 ± 0.37	99.63 ± 0.49	0.0796
4 hr postop	99.66 ± 0.54	99.46 ± 0.57	0.1683
8 hr postop	99.90 ± 0.40	99.70 ± 0.46	0.0775
12 hr postop	99.93 ± 0.25	99.76 ± 0.43	0.0662
24 hr postop	99.80 ± 0.40	99.80 ± 0.48	1.0000

Values expressed as Mean ± SD. $P < 0.05$ considered significant.

Oxygen saturation remained consistently above 99% in both groups at all time points, reflecting adequate oxygenation throughout the perioperative period. No statistically significant differences were observed between the groups ($p > 0.05$ for all measurements), confirming that intraperitoneal ropivacaine does not impair respiratory function.

Table 8: Comparison of Body Temperature (°C) - Selected Time Points

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
Baseline	36.88 ± 0.19	36.95 ± 0.22	0.1924
1 min after instillation	36.92 ± 0.22	36.93 ± 0.26	0.8728
5 min after instillation	36.98 ± 0.22	37.04 ± 0.21	0.2844
10 min after instillation	36.95 ± 0.20	37.02 ± 0.15	0.1306
0 hr postop	36.87 ± 0.24	36.93 ± 0.26	0.3569
1 hr postop	36.88 ± 0.19	36.93 ± 0.24	0.3747
4 hr postop	36.84 ± 0.27	36.94 ± 0.17	0.0914
8 hr postop	36.95 ± 0.27	36.96 ± 0.29	0.8905

Time Point	Group R (Ropivacaine)	Group S (Placebo)	P Value
12 hr postop	36.81 ± 0.23	36.89 ± 0.22	0.1739
24 hr postop	36.86 ± 0.27	36.99 ± 0.25	0.0579

Body temperature remained stable throughout the perioperative period in both groups, with no significant intergroup differences ($p > 0.05$ for all measurements). The mean temperatures ranged from 36.81°C to 37.04°C, within the normal physiological range.

DISCUSSION

The primary objective of this study was to evaluate the hemodynamic stability following intraperitoneal instillation of 0.375% ropivacaine compared with placebo in patients undergoing laparoscopic abdominal surgery. Our findings demonstrate that intraperitoneal ropivacaine does not produce significant hemodynamic alterations when compared with placebo, establishing it as a safe technique for postoperative analgesia.

The results of this study clearly demonstrate that all hemodynamic parameters—heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation, and body temperature—remained stable and comparable between the ropivacaine and placebo groups throughout the entire 24-hour observation period. No statistically significant differences were observed at any measured time interval ($p > 0.05$ for all parameters).

This finding is consistent with the known pharmacological profile of ropivacaine. Ropivacaine is a pure S-enantiomer amide local anesthetic that was specifically developed as a safer alternative to bupivacaine.[6] The reduced cardiotoxicity of ropivacaine is attributed to its lower affinity for cardiac sodium channels, resulting in less myocardial depression, fewer conduction disturbances, and a lower risk of arrhythmias.[8,14]

Several studies have supported the cardiovascular safety of ropivacaine. Scott et al. demonstrated that ropivacaine has a significantly wider margin of safety between its central nervous system and cardiovascular toxic doses compared to bupivacaine.[15] Similarly, Knudsen et al. reported that ropivacaine produced less cardiac toxicity in animal models.[16]

When administered intraperitoneally, ropivacaine undergoes gradual absorption from the peritoneal surface, resulting in moderate plasma concentrations that do not reach toxic levels.[10] The absorption occurs through mesothelial cells and diaphragmatic lymphatics, with peak plasma concentrations occurring approximately 30-60 minutes after instillation.[17] The moderate absorption profile explains why intraperitoneal administration does not result in the high plasma peaks associated with intravascular injection.

Our findings are consistent with previous studies that evaluated the hemodynamic effects of intraperitoneal local anesthetics. Labaille et al. studied the clinical efficacy and pharmacokinetics of intraperitoneal ropivacaine for laparoscopic cholecystectomy and reported no significant hemodynamic changes.[17] Similarly, Kim et al. evaluated intraperitoneal ropivacaine and found stable hemodynamics with no adverse effects.[18]

Neha T. Das and Charulata Deshpande, in their comparative study of intraperitoneal bupivacaine and ropivacaine, reported that ropivacaine provided superior analgesia without significant hemodynamic effects.[11] The absence of hemodynamic changes in their study, as in ours, supports the safety profile of ropivacaine.

Sharan et al., comparing intraperitoneal bupivacaine and ropivacaine for postoperative analgesia in laparoscopic cholecystectomy, found lower heart rates and blood pressure values in the ropivacaine group but concluded that these were clinically insignificant.[13] The ropivacaine group in their study had values within normal ranges, and the differences were not clinically meaningful.

Dinesh Singh et al. evaluated the effect of intraperitoneal ropivacaine for postoperative pain management and reported stable hemodynamics with no adverse effects.[19] These findings corroborate our results.

CONCLUSION

Intraperitoneal instillation of 0.375% ropivacaine (75 mg) at the end of laparoscopic abdominal surgery demonstrates excellent hemodynamic stability, with no statistically significant differences in heart rate, blood pressure, mean arterial pressure, oxygen saturation, or body temperature when compared with placebo over a 24-hour observation period. All hemodynamic parameters remained within clinically acceptable ranges, and no adverse effects such as hypotension,

bradycardia, arrhythmias, or respiratory depression were observed in either group. These findings confirm that intraperitoneal ropivacaine is a safe technique with a favorable cardiovascular safety profile, making it a reliable and effective option for postoperative analgesia in ASA I and II patients undergoing laparoscopic abdominal surgery, with the added benefit of avoiding opioid-related complications.

REFERENCES

1. Masood S, Gardezi SJR, Haider U, Ansari A, Zubair Z. Effect of intraperitoneal instillation of bupivacaine injection in terms of post-operative pain and duration of hospital stay in patients undergoing laparoscopic cholecystectomy. Esculapio. 2014;10(1):31-34.
2. Alexander JI. Pain after laparoscopy. Br J Anaesth. 1997;79(3):369-378.
3. Joris J, Thiry E, Paris P, Lamy M. Pain after laparoscopic cholecystectomy: characteristics and effect of intraperitoneal bupivacaine. Anesth Analg. 1995;81(2):379-384.
4. Kehlet H, Dahl JB. The value of "multimodal" or "balanced analgesia" in postoperative pain treatment. Anesth Analg. 1993;77(5):1048-1056.
5. Datta PM, Roy A. Role of intraperitoneal instillation of bupivacaine after laparoscopic cholecystectomy for post-operative pain management: a randomized controlled trial. Int Surg J. 2020;7(10):3239-3245.
6. McClure JH. Ropivacaine. Br J Anaesth. 1996;76(2):300-307.
7. Kuthiala G, Chaudhary G. Ropivacaine: A review of its pharmacology and clinical use. Indian J Anaesth. 2011;55(2):104-110.
8. Scott DB, Lee A, Fagan D, Bowler GM, Bloomfield P, Lundh R. Acute toxicity of ropivacaine compared with that of bupivacaine. Anesth Analg. 1989;69(5):563-569.
9. Anand S, Sadhu R, Goyal P. Postoperative analgesic efficacy of intraperitoneal ropivacaine in patients undergoing laparoscopic cholecystectomy. IOSR J Dent Med Sci. 2018;17(4):51-55.
10. Kapoor R, Dua S, Saxena AK, Narayan S. Evaluation of the efficacy of intraperitoneal instillation of ropivacaine with dexmedetomidine versus ropivacaine with ketamine for postoperative pain relief following laparoscopic cholecystectomy: a randomized controlled study. Arch Anesthesiol Crit Care. 2023;9(Suppl 1):411-417.
11. Das NT, Deshpande C. Effects of intraperitoneal local anaesthetics bupivacaine and ropivacaine versus placebo on postoperative pain after laparoscopic cholecystectomy: a randomised double-blind study. J Clin Diagn Res. 2017;11(7):UC08-UC12.
12. Goldstein A, Grimault P, Henique A, Keller M, Fortin A, Darai E. Preventing postoperative pain by local anesthetic instillation after laparoscopic gynecologic surgery: a placebo-controlled comparison of bupivacaine and ropivacaine. Anesth Analg. 2000;91(2):403-407.
13. Sharan R, Singh M, Kataria AP, Jyoti K, Jarewal V, Kadian R. Intraperitoneal instillation of bupivacaine and ropivacaine for postoperative analgesia in laparoscopic cholecystectomy. Anesth Essays Res. 2018;12(2):377-381.
14. Butterworth JF, Mackey DC, Wasnick JD. Local anesthetics. In: Stoelting RK, Hillier SC, editors. Pharmacology and Physiology in Anesthetic Practice. 5th ed. Philadelphia: Wolters Kluwer; 2015. p. 179-203.
15. Scott DB, Lee A, Fagan D, Bowler GM, Bloomfield P, Lundh R. Acute toxicity of ropivacaine compared with that of bupivacaine. Anesth Analg. 1989;69(5):563-569.
16. Knudsen K, Beckman Suurküla M, Blomberg S, Sjövall J, Edvardsson N. Central nervous and cardiovascular effects of i.v. infusions of ropivacaine, bupivacaine and placebo in volunteers. Br J Anaesth. 1997;78(5):507-514.
17. Labaille T, Mazoit JX, Paqueron X, Franco D, Benhamou D. The clinical efficacy and pharmacokinetics of intraperitoneal ropivacaine for laparoscopic cholecystectomy. Anesth Analg. 2002;94(1):100-105.
18. Kim TH, Kang H, Park JS, Chang IT, Park SG. Intraperitoneal ropivacaine instillation for postoperative pain relief after laparoscopic cholecystectomy. J Korean Surg Soc. 2010;79(2):130-136.
19. Singh D, Bogra J, Saxena S, Chaudhary A, Bhusan S, Chandra G. The effect of intraperitoneal ropivacaine for post-operative pain management in patients undergoing laparoscopic cholecystectomy: A prospective double-blind randomized control study. Open J Anesthesiol. 2013;3:193-198.