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Research Article

Comparison of Intraperitoneal Instillation of 20ml of 0.25% Ropivacaine with 20ml of 0.5% Ropivacaine for Post-Operative Analgesia in Laproscopic Cholecystectomy

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ABSTRACT
Background: Postoperative pain remains a concern after laparoscopic cholecystectomy. This study compared the analgesic efficacy of intraperitoneal 0.25% and 0.5% ropivacaine.
Methods: Forty ASA I–II patients aged 20–50 years undergoing elective laparoscopic cholecystectomy were randomized into two groups. Group A received 20 mL of 0.25% ropivacaine, while Group B received 20 mL of 0.5% ropivacaine intraperitoneally. Postoperative VAS scores, time to first rescue analgesia, total analgesic consumption, haemodynamic parameters, and adverse effects were assessed over 24 hours.
Results: Baseline characteristics were comparable. VAS scores were significantly lower in Group B up to 12 hours, while the difference at 24 hours was not significant. Time to first rescue analgesia was longer in Group B (6.1 ± 1.7 versus 3.8 ± 1.2 hours; $p<0.001$), and 24-hour diclofenac consumption was lower (78.8 ± 51.7 versus 138.8 ± 56.3 mg; $p=0.001$). Haemodynamic parameters and adverse effects were comparable.
Conclusion: Intraperitoneal instillation of 20 mL of 0.5% ropivacaine provided better early postoperative analgesia and reduced rescue-analgesic requirements compared with 0.25% ropivacaine.

Keywords: Laparoscopic Cholecystectomy, Postoperative Analgesia, Ropivacaine, Intraperitoneal Instillation, VAS.

INTRODUCTION

Laparoscopic cholecystectomy is the preferred surgical treatment for symptomatic gallbladder disease because it is associated with reduced surgical trauma, smaller incisions, shorter hospitalization, and faster postoperative recovery than open cholecystectomy. Nevertheless, postoperative pain remains clinically important, particularly during the early postoperative period, and may interfere with respiration, ambulation, oral intake, sleep, and timely discharge.[1,2]

Pain following laparoscopic cholecystectomy is multifactorial and comprises somatic, visceral, and referred components. Somatic pain arises from trocar-site incisions, whereas visceral pain results from gallbladder dissection, peritoneal inflammation, and tissue manipulation. Carbon dioxide pneumoperitoneum produces peritoneal stretching and diaphragmatic irritation, while residual intraperitoneal gas may contribute to referred shoulder-tip pain.[2–4] The relative contribution of these mechanisms varies during the postoperative period, making effective analgesia challenging.Opioids are frequently used to manage postoperative pain but may cause nausea, vomiting, sedation, pruritus, urinary retention, respiratory depression, and delayed mobilization. These adverse effects may offset the recovery benefits of minimally invasive surgery. Consequently, multimodal analgesic strategies incorporating non-opioid medications and local or regional anaesthetic techniques have gained importance. However, commonly used measures such as paracetamol, nonsteroidal anti-inflammatory drugs, port-site infiltration, and abdominal wall blocks may not provide adequate analgesia when used alone.Intraperitoneal instillation of a local anaesthetic is a simple, inexpensive, and minimally invasive technique that can be performed under direct laparoscopic vision without requiring an additional procedure. Local anaesthetics applied over the gallbladder bed and subdiaphragmatic peritoneum may block

visceral afferent nerve endings, inhibit nociceptive transmission, and attenuate the inflammatory response associated with pneumoperitoneum and surgical manipulation.[1,4] A meta-analysis of 39 randomized studies involving 3,045 patients demonstrated that intraperitoneal local anaesthetics reduced postoperative abdominal, visceral, and shoulder pain at rest and decreased the incidence of shoulder-tip pain after laparoscopic cholecystectomy.[2]

Ropivacaine is a long-acting amide local anaesthetic that acts by reversibly blocking neuronal sodium channels and preventing the initiation and propagation of painful impulses. It produces effective sensory blockade and has a relatively favourable cardiovascular and central nervous system toxicity profile compared with bupivacaine.[5] These properties make it a suitable agent for intraperitoneal administration as part of multimodal analgesia.Previous studies have reported favourable results with intraperitoneal ropivacaine after laparoscopic cholecystectomy. Kim et al. observed reduced postoperative pain and analgesic consumption following intraperitoneal administration of ropivacaine.[6] Shivhare et al. reported that 30 mL of 0.5% ropivacaine reduced abdominal pain at 6 and 12 hours and decreased shoulder-tip pain during the first postoperative day compared with normal saline.[7] Bindra et al. demonstrated that pre-emptive intraperitoneal instillation of ropivacaine provided effective postoperative analgesia.[8]Lower-concentration ropivacaine has also shown analgesic benefits. Gupta et al. found that intraperitoneal instillation of 0.25% ropivacaine provided satisfactory analgesia following laparoscopic cholecystectomy.[9] In a randomized controlled trial, Javillier et al. reported that 20 mL of 0.25% ropivacaine significantly reduced pain during the first six postoperative hours and decreased opioid consumption compared with saline.[10] A systematic review and meta-analysis further suggested that intraperitoneal ropivacaine may reduce acute postoperative pain and opioid consumption following laparoscopic digestive surgery, although heterogeneity among the available studies was considerable.[11]The analgesic effect of intraperitoneal ropivacaine may be influenced by its concentration, total dose, volume, timing, and site of administration. When administered in an equal volume of 20 mL, 0.25% ropivacaine provides a total dose of 50 mg, whereas 0.5% ropivacaine provides 100 mg. The lower concentration may provide sufficient analgesia with reduced drug exposure, while the higher concentration may produce a more intense and prolonged analgesic effect. However, direct evidence comparing these two concentrations using an identical volume is limited.

Therefore, the present prospective randomized study was conducted to compare the postoperative analgesic efficacy of intraperitoneal instillation of 20 mL of 0.25% ropivacaine with 20 mL of 0.5% ropivacaine in patients undergoing laparoscopic cholecystectomy.

MATERIALS AND METHODS

This prospective, randomized, comparative interventional study was conducted in the Departments of Anaesthesiology.The study included 40 patients of either sex, aged 20–50 years, with ASA physical status I or II, scheduled for elective laparoscopic cholecystectomy under general anaesthesia.

Inclusion Criteria

Patients aged 20–50 years, classified as ASA physical status I or II, scheduled for elective laparoscopic cholecystectomy, able to understand the Visual Analogue Scale (VAS), and willing to provide written informed consent were included.

Exclusion Criteria

Patients who refused participation or had hypersensitivity to amide local anaesthetics, pregnancy or lactation, significant systemic illness, chronic pain, regular analgesic or opioid use, substance dependence, conversion to open surgery, major intraoperative complications, or postoperative ventilatory requirements were excluded.A total of 40 patients were enrolled and allocated equally into two groups of 20 patients each.

Randomization and Blinding

Patients were randomized in a 1:1 ratio using a computer-generated sequence, with allocation concealed using sequentially numbered, opaque, sealed envelopes. The study solutions were prepared by an anaesthesiologist who was not involved in postoperative assessment. Patients and outcome assessors remained unaware of group allocation.

Group A: Patients received 20 mL of 0.25% ropivacaine intraperitoneally (50 mg).

Group B: Patients received 20 mL of 0.5% ropivacaine intraperitoneally (100 mg).

Preanaesthetic Assessment

All patients underwent routine history-taking, physical and airway examinations, and relevant laboratory investigations. The use of a 10-cm VAS ranging from 0 (no pain) to 10 (worst imaginable pain) was explained preoperatively. Fasting and premedication followed institutional guidelines.

Anaesthetic Technique

Standard monitoring included electrocardiography, non-invasive blood pressure, peripheral oxygen saturation, and end-tidal carbon dioxide. General anaesthesia was induced and maintained using a standardized protocol. Following neuromuscular blockade, endotracheal intubation and controlled ventilation were performed.Carbon dioxide pneumoperitoneum was maintained at approximately 12–14 mmHg. All patients underwent conventional laparoscopic cholecystectomy, and perioperative analgesics, antiemetics, intravenous fluids, and other medications were standardized between the groups.

Intraperitoneal Drug Administration

After completion of cholecystectomy and confirmation of haemostasis, the allocated solution was instilled under direct laparoscopic vision over the gallbladder bed, right subdiaphragmatic region, and adjacent peritoneum. Residual carbon dioxide was evacuated before port removal and wound closure.

Reversal and Postoperative Management

Residual neuromuscular blockade was reversed, and patients were extubated after adequate recovery. They were transferred to the post-anaesthesia care unit, where haemodynamic parameters, oxygen saturation, pain scores, rescue-analgesic requirements, and adverse events were monitored.

Postoperative Pain Assessment

Postoperative pain was assessed using the VAS at 0, 1, 2, 4, 6, 12, and 24 hours. Pain scores were recorded by an investigator blinded to group allocation. Abdominal and shoulder-tip pain were recorded separately, where applicable.

Rescue Analgesia

Rescue analgesia with intravenous [drug and dose] was administered when the VAS score was ≥4 or upon patient request. The time to first rescue analgesia, number of rescue doses, and total analgesic consumption during the first 24 hours were recorded.

Haemodynamic Assessment

Heart rate, blood pressure, respiratory rate, and peripheral oxygen saturation were recorded at baseline and predefined intraoperative and postoperative intervals. Hypotension was defined as a reduction in systolic blood pressure of more than 20% from baseline, while bradycardia was defined as a heart rate below 50 beats/min. Both were managed according to institutional protocols.

Adverse-Effect Assessment

Patients were observed for nausea, vomiting, sedation, dizziness, pruritus, urinary retention, respiratory depression, and manifestations of local anaesthetic systemic toxicity. All adverse events and their management were documented.

Outcome Measures

The primary outcome was postoperative pain intensity measured using the VAS. Secondary outcomes included time to first rescue analgesia, number and total dose of rescue analgesics, haemodynamic changes, postoperative nausea and vomiting, and adverse effects related to ropivacaine.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS.26. Continuous variables were expressed as mean ± standard deviation or median (interquartile range), while categorical variables were presented as frequencies and percentages.Normality was evaluated using the Shapiro–Wilk test. Continuous variables were compared using the independent-samples t-test or Mann–Whitney U test. Repeated measurements were analysed using repeated-measures analysis of variance or an appropriate non-parametric test. Categorical variables were compared using the Chi-square test or Fisher's exact test. A two-sided p value <0.05 was considered statistically significant.

RESULTS

A total of 40 patients were included, with 20 patients each receiving 0.25% ropivacaine (Group A) or 0.5% ropivacaine (Group B).The two groups were comparable regarding age, weight, sex distribution, ASA physical status, duration of surgery, and duration of anaesthesia. None of these baseline or operative characteristics differed significantly

between the groups (all p>0.05), indicating adequate comparability (Table 1).Postoperative VAS scores were consistently lower in Group B than in Group A from 0 to 12 hours. The differences were statistically significant at 0 hour (3.30±0.86 vs 3.90±0.91; p=0.039), 1 hour (3.35±0.81 vs 4.35±0.88; p<0.001), 2 hours (3.05±0.76 vs 4.10±0.85; p<0.001), 4 hours (2.75±0.72 vs 3.75±0.79; p<0.001), 6 hours (2.65±0.67 vs 3.45±0.83; p=0.002), and 12 hours (2.30±0.57 vs 2.80±0.70; p=0.018). At 24 hours, the VAS score remained numerically lower in Group B, but the difference was not statistically significant (1.50±0.61 vs 1.75±0.64; p=0.214) (Table 2; Figure 1).The mean time to first rescue analgesia was significantly longer in Group B than in Group A (6.1±1.7 vs 3.8±1.2 hours; p<0.001). The proportion of patients requiring rescue analgesia was also significantly lower in Group B (60.0% vs 90.0%; p=0.028). Group B required fewer rescue doses, with a median of 1 (IQR: 0–2), compared with 2 (IQR: 1–2) in Group A (p=0.002).

Mean total diclofenac consumption during the first 24 hours was significantly lower in Group B than in Group A (78.8±51.7 mg vs 138.8±56.3 mg; p=0.001). Moreover, fewer patients in Group B required two or more rescue doses (25.0% vs 65.0%; p=0.011), while a greater proportion required no rescue analgesia (40.0% vs 10.0%; p=0.028) (Table 3).The overall distribution of rescue-analgesic doses differed significantly between the groups (p=0.031). No rescue dose was required by 40.0% of patients in Group B compared with 10.0% in Group A. Conversely, two or three rescue doses were required by 65.0% of patients in Group A compared with 25.0% in Group B (Table 4; Figure 2).Postoperative haemodynamic parameters were comparable between the groups. No statistically significant differences were observed in mean heart rate, mean arterial pressure, or peripheral oxygen saturation (all p>0.05). The incidences of nausea, vomiting, dizziness, and hypotension were low and comparable between the groups, with no statistically significant differences (Table 5).Ropivacaine concentration showed a significant moderate inverse correlation with the mean VAS score during the first 0–6 hours (r=−0.55; p<0.001) and with the VAS score at 12 hours (r=−0.37; p=0.018). Its correlation with the VAS score at 24 hours was weak and not statistically significant (r=−0.20; p=0.214).A significant positive correlation was observed between ropivacaine concentration and time to first rescue analgesia (r=0.62; p<0.001). Significant inverse correlations were found with the number of rescue doses (r=−0.49; p=0.001) and total 24-hour analgesic consumption (r=−0.50; p=0.001) (Table 6; Figure 3). These findings indicated that 0.5% ropivacaine provided superior early postoperative analgesia and reduced rescue-analgesic requirements without increasing adverse effects.

Table 1. Baseline Demographic and Operative Characteristics

Variable	Group A: 0.25% ropivacaine (n=20)	Group B: 0.5% ropivacaine (n=20)	p value	Statistical test
Age (years), mean ± SD	36.7 ± 8.2	37.4 ± 7.9	0.785	Independent-samples t-test
Weight (kg), mean ± SD	62.8 ± 7.6	63.5 ± 8.1	0.780	Independent-samples t-test
Male, n (%)	6 (30.0)	5 (25.0)	0.723	Chi-square test
Female, n (%)	14 (70.0)	15 (75.0)		
ASA physical status I, n (%)	13 (65.0)	14 (70.0)	0.736	Chi-square test
ASA physical status II, n (%)	7 (35.0)	6 (30.0)		
Duration of surgery (min), mean ± SD	59.6 ± 10.8	58.9 ± 11.2	0.842	Independent-samples t-test
Duration of anaesthesia (min), mean ± SD	74.8 ± 11.5	73.6 ± 12.1	0.750	

Table 2. Comparison of Postoperative VAS Scores

Postoperative interval	Group A: 0.25% ropivacaine	Group B: 0.5% ropivacaine	Mean difference	p value	Statistical test
0 hour	3.90 ± 0.91	3.30 ± 0.86	0.60	0.039	Independent-samples t-test
1 hour	4.35 ± 0.88	3.35 ± 0.81	1.00	<0.001	
2 hours	4.10 ± 0.85	3.05 ± 0.76	1.05	<0.001	
4 hours	3.75 ± 0.79	2.75 ± 0.72	1.00	<0.001	
6 hours	3.45 ± 0.83	2.65 ± 0.67	0.80	0.002	
12 hours	2.80 ± 0.70	2.30 ± 0.57	0.50	0.018	
24 hours	1.75 ± 0.64	1.50 ± 0.61	0.25	0.214	

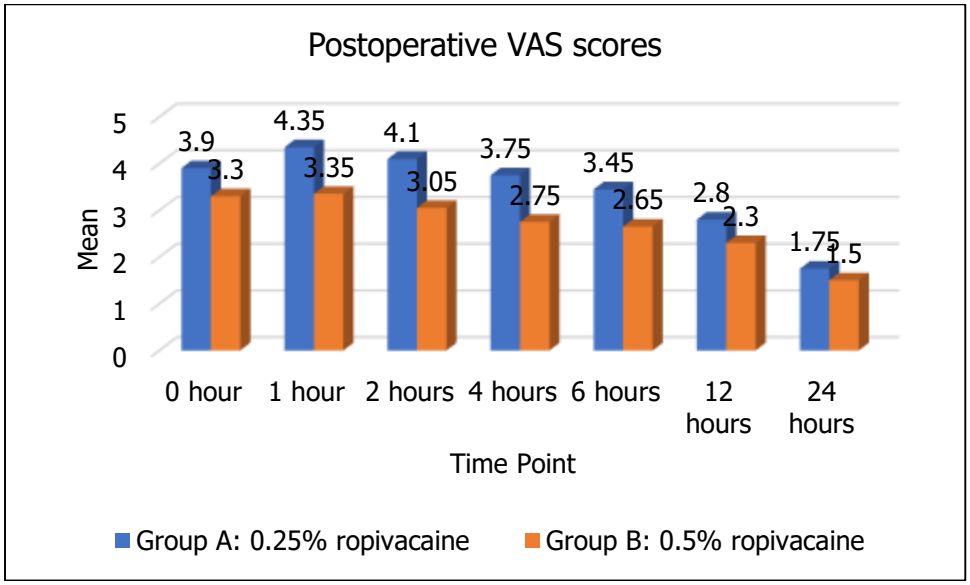

Figure 1. Comparison of Postoperative VAS Scores

Table 3. Rescue-Analgesic Requirements during the First 24 Hours

Outcome	Group A: 0.25% ropivacaine	Group B: 0.5% ropivacaine	p value	Statistical test
Time to first rescue analgesia (hours), mean ± SD	3.8 ± 1.2	6.1 ± 1.7	<0.001	Independent-samples t-test
Patients requiring rescue analgesia, n (%)	18 (90.0)	12 (60.0)	0.028	Fisher's exact test
Number of rescue doses, median (IQR)	2 (1–2)	1 (0–2)	0.002	Mann–Whitney U test
Total diclofenac consumption (mg), mean ± SD	138.8 ± 56.3	78.8 ± 51.7	0.001	Independent-samples t-test
Patients requiring ≥2 rescue doses, n (%)	13 (65.0)	5 (25.0)	0.011	Chi-square test
Patients requiring no rescue analgesia, n (%)	2 (10.0)	8 (40.0)	0.028	Fisher's exact test

Table 4. Distribution of Rescue-Analgesic Doses

Number of doses during 24 hours	Group A, n (%)	Group B, n (%)	p value	Statistical test
No dose	2 (10.0)	8 (40.0)	0.031	Chi-square test
One dose	5 (25.0)	7 (35.0)		
Two doses	9 (45.0)	4 (20.0)		
Three doses	4 (20.0)	1 (5.0)		

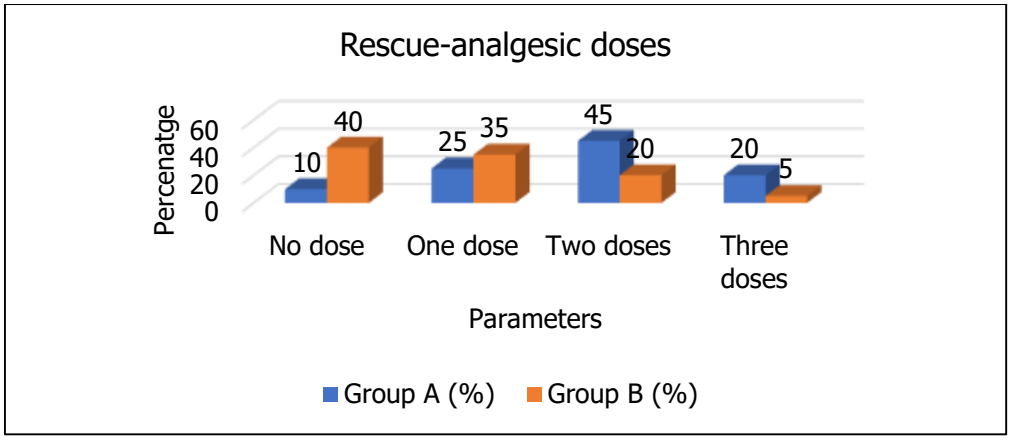

Figure 2. Distribution of Rescue-Analgesic Doses

Table 5. Postoperative Haemodynamic Parameters and Adverse Effects

Parameter	Group A: 0.25% ropivacaine	Group B: 0.5% ropivacaine	p value	Statistical test
Mean postoperative heart rate (beats/min)	78.6 ± 7.9	77.8 ± 7.4	0.743	Independent-samples t-test
Mean arterial pressure (mmHg)	87.4 ± 6.8	86.7 ± 7.1	0.752	
Peripheral oxygen saturation (%)	98.1 ± 1.0	98.2 ± 0.9	0.741	
Nausea, n (%)	4 (20.0)	3 (15.0)	1.000	Fisher's exact test
Vomiting, n (%)	2 (10.0)	1 (5.0)	1.000	
Dizziness, n (%)	1 (5.0)	1 (5.0)	1.000	
Hypotension, n (%)	1 (5.0)	1 (5.0)	1.000	

Table 6. Correlation between Ropivacaine Concentration and Analgesic Outcomes

Outcome	Correlation coefficient	p value	Statistical test
Mean VAS score during 0–6 hours	−0.55	<0.001	Spearman rank correlation
VAS score at 12 hours	−0.37	0.018	
VAS score at 24 hours	−0.20	0.214	
Time to first rescue analgesia	0.62	<0.001	
Number of rescue doses	−0.49	0.001	
Total 24-hour analgesic consumption	−0.50	0.001	

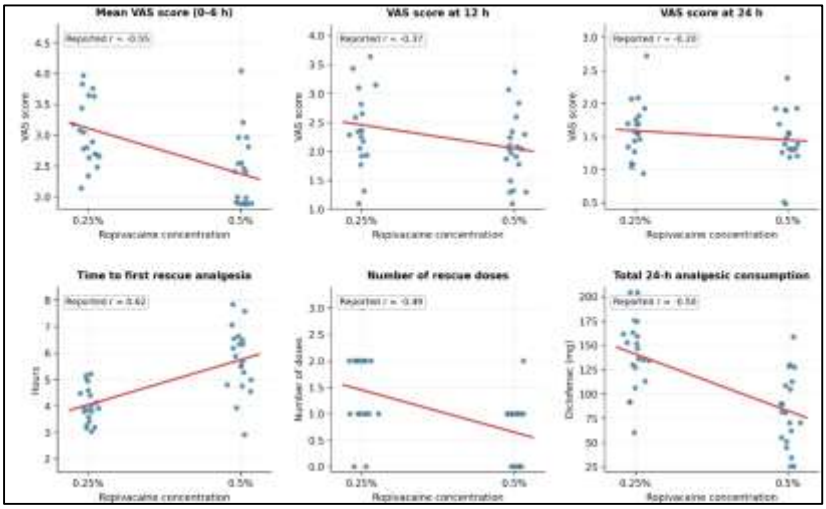

Figure 3. Correlation between Ropivacaine Concentration and Analgesic Outcomes

DISCUSSION

Both groups were comparable in age (36.7 ± 8.2 vs 37.4 ± 7.9 years; p=0.785), weight (62.8 ± 7.6 vs 63.5 ± 8.1 kg; p=0.780), sex, ASA status, surgical duration (59.6 ± 10.8 vs 58.9 ± 11.2 minutes; p=0.842), and anaesthesia duration (74.8 ± 11.5 vs 73.6 ± 12.1 minutes; p=0.750). Therefore, the observed analgesic differences were unlikely to be due to baseline variation. Crosbie et al. [12] also reported comparable groups regarding age, procedures, and underlying pathology.VAS scores were significantly lower with 0.5% ropivacaine from 0 to 12 hours. The greatest differences occurred at 1 hour (3.35 ± 0.81 vs 4.35 ± 0.88; p<0.001), 2 hours (3.05 ± 0.76 vs 4.10 ± 0.85; p<0.001), and 4 hours (2.75 ± 0.72 vs 3.75 ± 0.79; p<0.001). At 24 hours, the difference was not significant (1.50 ± 0.61 vs 1.75 ± 0.64; p=0.214). Azemati and Khosravi [13] found that bilateral rectus sheath block significantly reduced pain at 6 and 10 hours compared with intraperitoneal and incision-site local anaesthetic administration. Crosbie et al. [12] reported lower pain scores on awakening with rectus sheath block—median 0 (IQR 0–1) versus 2 (IQR 1–3) (p<0.001). Chundrigar et al. [14] similarly found lower pain scores with 0.25% intraperitoneal bupivacaine at 1 hour (1.99 vs 4.00; p<0.01) and 2 hours (1.23 vs 2.53; p<0.05), although differences disappeared after 4 hours.

The time to first rescue analgesia was longer with 0.5% ropivacaine (6.1 ± 1.7 vs 3.8 ± 1.2 hours; p<0.001). Rescue analgesia was required by 60.0% versus 90.0% of patients (p=0.028), while total diclofenac consumption was 78.8 ± 51.7 versus 138.8 ± 56.3 mg (p=0.001). No rescue dose was required by 40.0% of Group B compared with 10.0% of Group A, whereas two or three doses were required by 25.0% and 65.0%, respectively (p=0.031). Crosbie et al. [12] similarly reported reduced postoperative morphine consumption and shorter morphine-based PCA duration following rectus sheath block. Cornish and Deacon [15] described rectus sheath catheters as an effective method of continuous analgesia after upper abdominal surgery. Chundrigar et al. [14] also demonstrated effective early pain relief following intraperitoneal bupivacaine.

Heart rate (77.8 ± 7.4 vs 78.6 ± 7.9 beats/min; p=0.743), mean arterial pressure (86.7 ± 7.1 vs 87.4 ± 6.8 mmHg; p=0.752), and oxygen saturation (98.2 ± 0.9% vs 98.1 ± 1.0%; p=0.741) were comparable. Nausea, vomiting, dizziness, and hypotension were also similar, indicating that 0.5% ropivacaine improved analgesia without increasing adverse effects. Webster [16] emphasized that ultrasound guidance enables visualization of the needle and local anaesthetic spread, thereby improving block safety and reliability. Dolan et al. [17] found that loss-of-resistance placement was correct in only 45% of attempts; 34% were superficial and 21% were deeper than the intended plane, whereas ultrasound guidance significantly improved accuracy.

Higher ropivacaine concentration correlated with lower mean VAS during 0–6 hours (ρ=−0.55; p<0.001), longer time to rescue analgesia (ρ=0.62; p<0.001), fewer rescue doses (ρ=−0.49; p=0.001), and lower 24-hour analgesic consumption (ρ=−0.50; p=0.001). The correlation with VAS at 24 hours was not significant (ρ=−0.20; p=0.214).

CONCLUSION

Intraperitoneal instillation of 20 mL of 0.5% ropivacaine provided superior early postoperative analgesia compared with 20 mL of 0.25% ropivacaine after laparoscopic cholecystectomy. It produced lower VAS scores, prolonged the time to first rescue analgesia, and reduced 24-hour analgesic consumption. Both concentrations maintained haemodynamic stability and had comparable adverse-effect profiles.

Limitations

The study was limited by its small sample size, single-centre design, and postoperative follow-up restricted to 24 hours. Plasma ropivacaine concentrations were not measured, and the study was insufficiently powered to detect rare adverse events.

REFERENCES

1. Gurusamy KS, Nagendran M, Toon CD, Guerrini GP, Zinnuroglu M, Davidson BR. Methods of intraperitoneal local anaesthetic instillation for laparoscopic cholecystectomy. Cochrane Database Syst Rev. 2014;(3):CD009060.
2. Choi GJ, Kang H, Baek CW, Jung YH, Kim DR. Effect of intraperitoneal local anesthetic on pain characteristics after laparoscopic cholecystectomy. World J Gastroenterol. 2015;21(47):13386-95.
3. 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):UC08–12.

4. Kahokehr A, Sammour T, Soop M, Hill AG. Intraperitoneal use of local anesthetic in laparoscopic cholecystectomy: systematic review and meta-analysis of randomized controlled trials. J Hepatobiliary Pancreat Sci. 2010;17(5):637–56.
5. Kuthiala G, Chaudhary G. Ropivacaine: a review of its pharmacology and clinical use. Indian J Anaesth. 2011;55(2):104–10.
6. 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):130–6.
7. Shivhare P, Dugg P, Singh H, Mittal S, Kumar A, Munghate A. A prospective randomized trial to study the effect of intraperitoneal instillation of ropivacaine in postoperative pain reduction in laparoscopic cholecystectomy. J Minim Invasive Surg Sci. 2014;3:e18009.
8. Bindra TK, Kumar P, Rani P, Kumar A, Bariar H. Preemptive analgesia by intraperitoneal instillation of ropivacaine in laparoscopic cholecystectomy. Anesth Essays Res. 2017;11(3):740–4.
9. Gupta M, Naithani U, Singariya G, Gupta S. Comparison of 0.25% ropivacaine for intraperitoneal instillation versus rectus sheath block for postoperative pain relief following laparoscopic cholecystectomy: a prospective study. J Clin Diagn Res. 2016;10(8):UC10–15.
10. Javillier B, Scohy M, Mestdag M, Lacroix S, Rubay R, Terwagne N, et al. Early intraperitoneal ropivacaine for acute pain relief after ambulatory laparoscopic cholecystectomy: a randomized controlled trial. Minerva Anestesiol. 2026;92(7–8):692–7.
11. Daghmouri MA, Chaouch MA, Deniau B, Benayoun L, Krimi B, Gouader A, et al. Efficacy and safety of intraperitoneal ropivacaine in pain management following laparoscopic digestive surgery: a systematic review and meta-analysis of randomized controlled trials. Medicine (Baltimore). 2024;103(29):e38856.
12. Crosbie EJ, Massiah NS, Achiampong JY, Dolling S, Slade RJ. The surgical rectus sheath block for postoperative analgesia: a modern approach to an established technique. Eur J Obstet Gynecol Reprod Biol. 2012;160:196–200.
13. Azemati S, Khosravi MB. An assessment of the value of rectus sheath block for postlaparoscopic pain in gynecologic surgery. J Minim Invasive Gynecol. 2005;12:12–5.
14. Chundrigar T, Hedges AR, Morris R, Stamatakis JD. Intraperitoneal bupivacaine for effective pain relief after laparoscopic cholecystectomy. Ann R Coll Surg Engl. 1993;75(6):437–9.
15. Cornish P, Deacon A. Rectus sheath catheters for continuous analgesia after upper abdominal surgery. ANZ J Surg. 2007;77:84.
16. Webster K. Ultrasound-guided rectus sheath block: analgesia for abdominal surgery. Update Anaesth. 2010;26:12–7.
17. Dolan J, Lucie P, Geary T, Smith M, Kenny GN. The rectus sheath block: accuracy of local anaesthetic placement by trainee anaesthesiologists using loss of resistance or ultrasound guidance. Reg Anesth Pain Med. 2009;34:247–50.