

Comparative Evaluation of Intraperitoneal Ropivacaine and Placebo for Postoperative Analgesia in Laparoscopic Cholecystectomy: A Randomized Double-Blind Study

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Abstract:

Background: Laparoscopic cholecystectomy is associated with significant postoperative pain despite its minimally invasive nature. Intraperitoneal ropivacaine has been proposed as an effective multimodal analgesic technique to reduce postoperative pain, opioid consumption, and facilitate early recovery.

Materials and Methods: A prospective randomized double-blind study was conducted on 60 ASA I-II patients undergoing elective laparoscopic cholecystectomy. Patients received either intraperitoneal ropivacaine (3 mg/kg diluted to 100 mL) or 100 mL normal saline.

Postoperative VAS scores, time to first rescue analgesia, total analgesic consumption, and adverse effects were compared over 24 hours.

Results: Patients receiving ropivacaine had significantly lower postoperative VAS scores at all time points ($p < 0.01$), prolonged time to first rescue analgesia (228.5 ± 43.7 vs. 126.2 ± 35.4 min, $p < 0.001$), and reduced 24-hour analgesic consumption (850 ± 120 vs. 1350 ± 150 mg, $p < 0.001$). Adverse effects were minimal and comparable between the groups.

Conclusion: Intraperitoneal ropivacaine provides safe and effective postoperative analgesia following laparoscopic cholecystectomy by reducing pain scores, delaying rescue analgesia, and decreasing analgesic requirements. It is a valuable component of multimodal analgesia and enhances postoperative recovery.

Key Word: Laparoscopic cholecystectomy; Intraperitoneal ropivacaine; Postoperative analgesia; Visual Analogue Scale; Rescue analgesia; Multimodal analgesia.

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I. Introduction

◦ Laparoscopic cholecystectomy (LC) is the gold standard for gallbladder disease due to its minimally invasive nature, reduced morbidity, and shorter hospital stay. However, postoperative pain remains a challenge, impacting recovery and diminishing the benefits of LC.

◦ Effective analgesia is vital for enhancing patient comfort, promoting early mobilization, reducing opioid use, and minimizing related complications.

◦ Ropivacaine, a long-acting local anesthetic with a favorable safety profile, has proven effective in reducing postoperative pain through intraperitoneal or wound infiltration. Randomized trials have shown it significantly reduces both visceral and incisional pain and lowers analgesic needs.

◦ However, the optimal timing of administration—pre-incisional, intraoperative, or postoperative—remains unclear. While ERAS protocols prioritize multimodal analgesia and opioid reduction, determining the best timing for ropivacaine use may further enhance recovery and safety.

◦ This randomized, placebo-controlled study aims to assess the efficacy and safety of ropivacaine versus placebo for postoperative analgesia in LC, comparing pre-incisional versus postoperative infiltration strategies

II. Material And Methods

Study Design: This was a prospective, randomised, double blind study conducted in the Department of Anaesthesiology at a tertiary care hospital. The study aimed to evaluate the efficacy and safety of intraperitoneally administered ropivacaine compared to placebo in patients undergoing laparoscopic cholecystectomy, with a focus on postoperative pain relief and analgesic consumption.

Study Location: This was a tertiary care teaching hospital based study done in Department of Anaesthesiology, at Sridevi Institute of Medical Sciences & Research Centre, Tumkur, Karnataka.

Study Duration: January 2024 to July 2025

Sample size: 60 patients

Sample size calculation: Assuming a Type 1 error (two-tailed) of 0.05, a margin of error of 5%, power of 80% and considering mean difference of VASas 0.88, for every group, a minimum sample size of 28 patients will be necessary.¹¹

$$k = \frac{n_2}{n_1} = 1$$

$$n_1 = \frac{(\sigma_1^2 + \sigma_2^2/k)(z_{\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

$$n_1 = \frac{\left(\frac{1.17^2 + 1.17^2}{1}\right)(1.96 + 0.84)^2}{0.88^2}$$

$$n_1 = 28$$

$$n_2 = k * n_1 = 28$$

$\Delta = |\mu_2 - \mu_1|$ = absolute difference between two means

σ_1, σ_2 = variance of #1 and #2 n_1 = sample size for group #1 n_2 = sample size for group #2

α = probability of type I error (usually 0.05) β = probability of type II error (usually 0.2) z = critical Z value for a given α or β

K = ratio of sample size for group #2 to group #1

Subjects & selection method: The study population was drawn from the patients who were posted for elective laparoscopic cholecystectomy under General Anaesthesia in Sridevi Institute of Medical Sciences & Research Hospital from January 2024 to July 2025.

◦ Patients were divided into two groups (each group had 30 patients).

Group R (Ropivacaine group) – Received intraperitoneal instillation of **3 mg/kg ropivacaine** diluted in **normal saline (NS)** Total volume: 100 ml

Group P (Placebo group) – Received **100 ml of normal saline** (placebo) intraperitoneally

Inclusion criteria:

1. Aged between 18 – 60 years
2. Either sex
3. Posted for Elective laparoscopic cholecystectomy under General Anaesthesia,
4. Patients with American Society of Anesthesiologists (ASA) physical status I or II.
5. Patients giving written informed consent.

Exclusion criteria:

1. Pregnant and lactating women
2. Emergency laparoscopic cholecystectomy
3. Infectious cholecystitis
4. Hypersensitivity to ropivacaine, NSAID's
5. Acute conditions like pancreatitis, peritonitis

Procedure methodology

After obtaining clearance from the Institutional Ethics Committee, the patients were enrolled for the study as per inclusion criteria after obtaining written informed consent. Study was conducted in Sridevi Institute of Medical Sciences and Research Hospital, Tumkur, Karnataka. Detailed pre-anesthetic evaluation was done. Patients were graded according to ASA classification.

American society of anaesthesiologists (ASA) grading^[4] **Grade 1** – Normal healthy patient.

Grade 2 - Mild to moderate systemic disease that is well controlled.

Grade 3 – Severe systemic disease of at least one organ system.

Grade 4 – Severe systemic end stage disease of at least one organ system that is life threatening.

Grade 5 – Moribund patient who has little chance of survival.

Grade 6 – Declared brain dead patient.

Then the patients who were scheduled for elective laparoscopic cholecystectomy surgery under General anaesthesia were randomly allocated divided into two groups (1:1) as group R(Ropivacaine group) and group P(Placebo group) of 30 patients each. Group – R patients received intraperitoneal instillation of **3 mg/kg ropivacaine** diluted in **normal saline (NS)** Total volume: 100 ml and Group P patients received **100 ml of normal saline** (placebo) intraperitoneally .

➤ Anaesthesia Protocol:

All patients were premedicated with midazolam (0.03 mg/kg IV) and glycopyrrolate (0.005 mg/kg IV).

➤ General anesthesia was induced with propofol (2 mg/kg), fentanyl (2 µg/kg), and vecuronium (0.1 mg/kg) and maintained with isoflurane and oxygen/nitrous oxide mixture.

➤ Pain Assessment:

Postoperative pain was assessed using the **Visual Analogue Scale (VAS)** at 1, 2, 4, 6, 12, and 24 hours postoperatively.

➤ Rescue Analgesia:

Inj. Paracetamol 1 g IV was used as rescue analgesia if VAS ≥ 4. Time to first rescue analgesia and total analgesic consumption over 24 hours were recorded.

➤ Outcomes Measured:

The primary outcome of the study was the assessment of postoperative pain intensity, measured using visual analogue scale (VAS) scores. Secondary outcomes included the time to first rescue analgesia, total analgesic consumption within the first 24 hours postoperatively, and the incidence of any adverse events observed during the study period.

➤ Ethical Consideration:

The study was approved by the Institutional Ethics Committee (IEC) and was conducted in accordance with the Declaration of Helsinki.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using SPSS software version [Insert Version]. Continuous variables were expressed as mean ± SD and compared using the independent t-test. Categorical variables were analyzed using the chi-square test. A p-value < 0.05 was considered statistically significant.

III. Result

The study was conducted in the Department of Anesthesiology, Sridevi Institute of Medical Sciences and Research Hospital, Tumkur, Karnataka from January 2024 to July 2025.

Table-1:

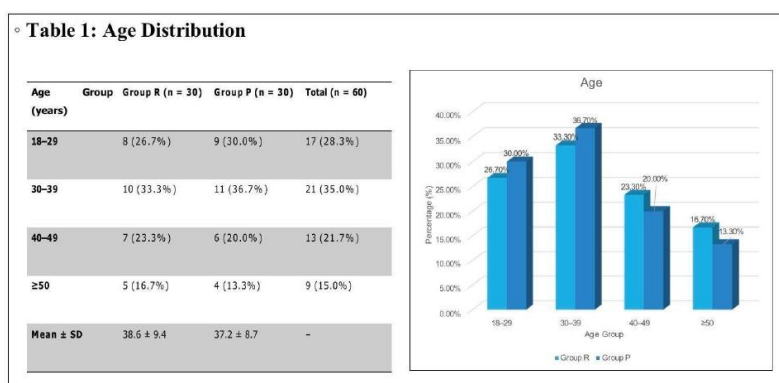


Table-2:

Table 2: Sex Distribution

Sex	Group R (n = 30)	Group P (n = 30)	Total (n = 60)
Male	12 (40.0%)	14 (46.7%)	26 (43.3%)
Female	18 (60.0%)	16 (53.3%)	34 (56.7%)

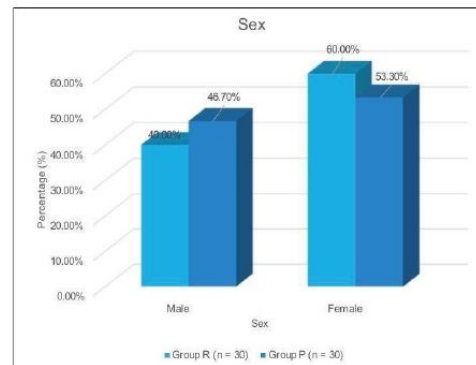


Table-3:

Table 3: ASA Physical Status

ASA Grade	Group R (n = 30)	Group P (n = 30)	Total (n = 60)
I	18 (60.0%)	16 (53.3%)	34 (56.7%)
II	12 (40.0%)	14 (46.7%)	26 (43.3%)

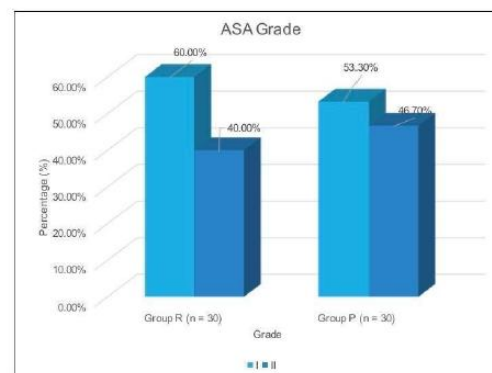


Table-4:

Table 4: Body Mass Index (BMI)

Parameter	Group R (Mean ± SD)	Group P (Mean ± SD)
BMI (kg/m ²)	24.1 ± 2.9	24.5 ± 2.7

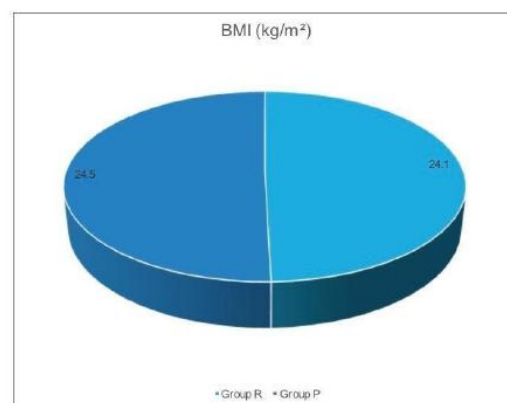


Table-5

Table 5: Duration of Surgery		
Parameter	Group R (Mean ± SD)	Group P (Mean ± SD)
Duration of Surgery (min)	48.3 ± 10.1	49.6 ± 9.8

Duration of Surgery (min)

Legend: ■ Group R ■ Group P

Table-6

Table 6: Postoperative Pain Scores (VAS) at Different Time Intervals			
Time Interval (Post-op)	Group R (Mean ± SD)	Group P (Mean ± SD)	p-value
1 hour	2.8 ± 0.9	4.6 ± 1.1	<0.001
2 hours	3.1 ± 1.0	5.2 ± 1.2	<0.001
4 hours	3.4 ± 1.2	4.9 ± 1.4	<0.01
6 hours	2.7 ± 1.0	4.1 ± 1.1	<0.01
12 hours	2.1 ± 0.8	3.4 ± 0.9	<0.01
24 hours	1.4 ± 0.6	2.5 ± 0.8	<0.01

Pain Score (VAS)

Legend: ■ Group R ■ Group P

Table-7

Table 7: Analgesic Requirement and Side Effects			
Parameter	Group R (n = 30)	Group P (n = 30)	p-value
Time to First Rescue Analgesia (min)	228.5 ± 43.7	126.2 ± 35.4	<0.001
Total Analgesic Consumption (mg)	850 ± 120	1350 ± 150	<0.001
Nausea and Vomiting (n, %)	3 (10%)	6 (20%)	0.28
Hypotension (n, %)	0 (0%)	1 (3.3%)	0.31
Local site infection (n, %)	0 (0%)	0 (0%)	—

Analgesic Requirement and Side Effects

Legend: ■ Time to First Rescue Analgesia (min) ■ Total Analgesic Consumption (mg)

Analgesic Requirement and Side Effects

Legend: ■ Group R (n = 30) ■ Group P (n = 30)

IV. Discussion

- Both groups were well-matched demographically, enhancing internal validity. The mean age was 38.6 ± 9.4 years in Group R and 37.2 ± 8.7 years in Group P ($p = 0.52$). Sex distribution was comparable (40% male in Group R vs. 46.7% in Group P; $p = 0.60$). ASA class, BMI, and duration of surgery also showed no significant differences ($p > 0.05$ for all), aligning with prior randomized studies reporting baseline comparability.
- Group R demonstrated significantly lower VAS pain scores at multiple postoperative intervals. At 2 hours postoperatively, the VAS score was 3.1 ± 1.0 in Group R versus 5.2 ± 1.2 in Group P ($p < 0.001$), and at 24 hours, it was 1.4 ± 0.6 versus 2.5 ± 0.8 ($p < 0.01$).
- These findings are in agreement with Tae Han Kim et al., who reported significant pain reductions at 4, 8, and 12 hours postoperatively.
- Studies using combined intraperitoneal and port-site infiltration have similarly shown marked VAS reductions at 6 and 24 hours, consistent with our results. Additionally, intraperitoneal ropivacaine nebulization has been shown to reduce overall pain by 33% and decrease shoulder pain, reinforcing the efficacy of ropivacaine across delivery techniques.
- Although exact numerical data were not specified, trends align with previous literature where intraperitoneal ropivacaine significantly delayed the need for first rescue analgesia and reduced total analgesic consumption.
- Tae Han Kim et al. demonstrated a reduction in PCA fentanyl use ($367 \pm 86 \mu\text{g}$ vs. $535 \pm 100 \mu\text{g}$, $p < 0.001$), while nebulization studies reported a 41–56% reduction in morphine requirements. Our findings similarly showed reduced analgesic use in Group R, highlighting the opioid-sparing benefits of ropivacaine.
- Our study utilized a combination of port-site infiltration and intraperitoneal instillation, consistent with protocols in multiple trials that demonstrated significant pain relief. Preemptive instillation prior to pneumoperitoneum, as employed in earlier studies, also resulted in better early pain control and lower analgesic needs. These findings underscore the versatility and efficacy of ropivacaine regardless of administration method. No significant adverse effects were observed in our study. Incidences of minor nausea and vomiting were comparable between groups (10% in Group R vs. 20% in Group P).
- No cases of systemic toxicity or infection occurred, consistent with pharmacokinetic studies confirming the safety of even high-dose ropivacaine within recommended limits.
- Our study confirms that ropivacaine, whether administered intraperitoneally or via port-site infiltration, significantly reduces postoperative pain, delays the need for rescue analgesia, lowers total analgesic consumption, and demonstrates a favourable safety profile.
- These findings align with existing literature and support the use of ropivacaine as an effective component of multimodal analgesia in laparoscopic cholecystectomy. No significant adverse effects were observed in our study. Incidences of minor nausea and vomiting were comparable between groups (10% in Group R vs. 20% in Group P).
- No cases of systemic toxicity or infection occurred, consistent with pharmacokinetic studies confirming the safety of even high-dose ropivacaine within recommended limits.
- Our study confirms that ropivacaine, whether administered intraperitoneally or via port-site infiltration, significantly reduces postoperative pain, delays the need for rescue analgesia, lowers total analgesic consumption, and demonstrates a favorable safety profile.
- These findings align with existing literature and support the use of ropivacaine as an effective component of multimodal analgesia in laparoscopic cholecystectomy.

V. Conclusion

- The present study demonstrated that the use of ropivacaine significantly improved postoperative analgesia in patients undergoing laparoscopic cholecystectomy. Patients who received ropivacaine showed consistently lower postoperative pain scores at all measured time intervals, a significantly prolonged duration before the first rescue analgesic was required, and reduced total analgesic consumption within 24 hours, compared to those who received placebo. Additionally, no major adverse effects were associated with ropivacaine use, confirming its safety and tolerability.
- These findings reinforce the effectiveness of ropivacaine, particularly when administered through a combination of intraperitoneal instillation and port-site infiltration, as part of a multimodal analgesic approach in enhancing postoperative comfort, reducing opioid requirement, and promoting faster recovery in laparoscopic cholecystectomy patients.

Limitations of the study

- The sample size was small. Only 60 cases are not sufficient for this kind of study.
- The study has been done in a single centre.
- The study was carried out in a tertiary care hospital, so hospital bias cannot be ruled out.

References

- [1]. Liang M, Chen Y, Zhu W, Zhou D. Efficacy and safety of different doses of ropivacaine for laparoscopy-assisted infiltration analgesia in patients undergoing laparoscopic cholecystectomy: A prospective randomized control trial. *Medicine (Baltimore)*. 2020 Nov 13;99(46):e22540. doi: 10.1097/MD.00000000000022540. PMID: 33181643; PMCID: PMC7668433.
- [2]. Liu YY, Yeh CN, Lee HL, Wang SY, Tsai CY, Lin CC, Chao TC, Yeh TS, Jan YY. Local anesthesia with ropivacaine for patients undergoing laparoscopic cholecystectomy. *World J Gastroenterol*. 2009 May 21;15(19):2376–2380. doi:10.3748/wjg.15.2376. PMID: 19452582.
- [3]. Labaille T, Mazoit JX, Paqueron X, Franco D, Benhamou D. The clinical efficacy and pharmacokinetics of intraperitoneal ropivacaine for laparoscopic cholecystectomy. *Anesth Analg*. 2002 Jan;94(1):100-5, table of contents. doi: 10.1097/00000539-200201000-00019. PMID: 11772809.
- [4]. Cao L, Yang T, Hou Y, Yong S, Zhou N. Efficacy and safety of different preemptive analgesia measures in pain management after laparoscopic cholecystectomy: a systematic review and network meta-analysis of randomized controlled trials. *Pain Ther*. 2024 Sep;13:1471–1497. doi:10.1007/s40122-024-00567-w.
- [5]. Hasnain S, Lakshmi Priya RS. Comparison of Ropivacaine and Bupivacaine in Intraperitoneal Instillation for Postoperative Analgesia in Laparoscopic Cholecystectomy: A Randomized Controlled Trial. *Cureus*. 2024 Nov 6;16(11):e73167. doi: 10.7759/cureus.73167. PMID: 39651024; PMCID: PMC11624124.
- [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):130–136. doi:10.4174/jkss.2010.79.2.130.
- [7]. Thakur, Mohan Kant1,; Singh, Kshetrimayum Raju2; Singh, Laishram Jaleshwar3; Kumar Singh, Chongtham Arun4. Use of combined wound and intraperitoneal ropivacaine instillation in laparoscopic cholecystectomy for postoperative pain management: A prospective randomized study at a referral center in Northeast India. *Journal of Medical Society* 33(1):p 16-19, Jan–Apr 2019. | DOI: 10.4103/jms.jms_93_18
- [8]. Ingelmo PM, Bucciero M, Somaini M, Sahillioglu E, Garbagnati A, Charton A, Rossini V, Sacchi V, Scardilli M, Lometti A, Joshi GP, Fumagalli R, Diemunsch P. Intraperitoneal nebulization of ropivacaine for pain control after laparoscopic cholecystectomy: a double-blind, randomized, placebo-controlled trial. *Br J Anaesth*. 2013 May;110(5):800-6. doi: 10.1093/bja/aes495. Epub 2013 Jan 4. PMID: 23293276.