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# EFFICACY OF INTRAOPERATIVE INTRAVENOUS LIDOCAINE INFUSION FOR POSTOPERATIVE PAIN RELIEF AND OPIOID CONSUMPTION IN PATIENTS UNDERGOING LAPAROSCOPIC CHOLECYSTECTOMY

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## ABSTRACT

***Background:*** *Postoperative pain after laparoscopic cholecystectomy is driven by port-site somatic pain, visceral pain, and referred shoulder pain. Opioid-heavy analgesia can slow recovery and increase adverse effects, creating a role for inexpensive opioid-sparing adjuvants such as intravenous lidocaine.*

***Objective:*** *To evaluate whether intraoperative intravenous lidocaine improves postoperative pain outcomes and reduces rescue opioid consumption in adults undergoing laparoscopic cholecystectomy.*

***Methods:*** *This prospective randomized controlled trial was conducted at Jinnah Postgraduate Medical Centre, Karachi, from April 8, 2022, to October 7, 2022. One hundred adults aged 22 to 65 years were randomized to an experimental lidocaine group (n = 50) or a control group (n = 50). The experimental group received lidocaine 1.5 mg/kg as a pre-induction bolus followed by 1 mg/kg/h infusion during surgery with reduced-dose nalbuphine. The control group received standard anesthesia without systemic lidocaine. Postoperative pain was assessed using the Numerical Rating Scale or Visual Analog Scale, and rescue opioid use was recorded.*

***Results:*** *Rescue opioid consumption was lower in the lidocaine group (0.05 ± 0.00 mg) than in the control group (0.09 ± 0.02 mg; P = 0.0001). However, the predefined pain target of NRS/VAS ≤ 3 was achieved more often in the control group than in the lidocaine group (54.0% versus 34.0%; P = 0.044). Exploratory subgroup analyses suggested possible effect heterogeneity by residence, body mass index, operative duration, and ASA class, but these findings should be interpreted cautiously.*

***Conclusion:*** *Intraoperative intravenous lidocaine was associated with lower rescue opioid consumption, but it did not consistently improve pain-score endpoints. It should be viewed as an adjunct within multimodal analgesia when reducing opioid exposure is a priority.*

***Keywords:*** *intravenous lidocaine infusion, laparoscopic cholecystectomy, opioid consumption, postoperative pain, multimodal analgesia*

## Introduction

Poorly controlled acute postoperative pain remains a stubborn obstacle to safe surgical recovery. Persistent moderate-to-severe pain can delay mobilization, impair respiratory effort, amplify sympathetic stress, and increase health-care utilization. For this reason, modern perioperative care increasingly favors multimodal, mechanism-based analgesia rather than sole dependence on opioids. [1, 4, 5]

Laparoscopic cholecystectomy reduces tissue trauma compared with open surgery, but the procedure is not pain free. Pain after gallbladder removal is usually mixed in character, combining port-site somatic pain, visceral pain from peritoneal stretching and gallbladder dissection, and referred shoulder pain related to residual pneumoperitoneum. Gallstone disease is also common worldwide and remains a frequent indication for surgery, which makes optimization of analgesia highly relevant in routine practice. [15, 16, 17, 18, 19, 20, 22, 23, 24]

Historically, opioid monotherapy has been the default response to acute postoperative pain, yet that strategy carries a familiar parade of side effects, including sedation, nausea and vomiting, respiratory depression, urinary retention, and delayed bowel recovery. Enhanced recovery pathways therefore emphasize opioid minimization, early mobilization, and use of adjuncts that blunt nociception through different pathways. [1, 4, 5, 6, 7]

Intravenous lidocaine is attractive in this setting because it is inexpensive, familiar to anesthesiologists, and easy to administer. At therapeutic plasma concentrations, lidocaine blocks voltage-gated sodium channels, dampens ectopic neuronal firing, reduces spinal sensitization, and modulates inflammatory signaling. These effects provide a biologically plausible explanation for lower postoperative analgesic requirements and potentially faster recovery. [8, 9, 10, 11, 12]

Clinical evidence for systemic lidocaine is strongest in major abdominal procedures, where trials and meta-analyses have reported lower analgesic consumption and improved recovery profiles. However, its benefit in minimally invasive operations has been more variable, and studies in laparoscopic cholecystectomy have not always shown the same magnitude of effect. This trial was therefore designed to examine whether intraoperative intravenous lidocaine could improve postoperative pain control and reduce opioid use in an adult Pakistani cohort undergoing laparoscopic cholecystectomy. [2, 3, 6, 7, 13, 14]

## Materials and Methods

**Study design and setting.** This prospective, two-arm, parallel-group randomized controlled trial was conducted in the main operation theatre complex of Jinnah Postgraduate Medical Centre (JPMC), Karachi, Pakistan. Institutional approval and synopsis clearance were obtained before recruitment. The study ran from April 8, 2022, to October 7, 2022.

**Participants.** Adults aged 22 to 65 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective uncomplicated laparoscopic cholecystectomy for confirmed cholelithiasis were eligible. Exclusion criteria included allergy to amide local anesthetics, high-grade atrioventricular block, severe bradyarrhythmia, uncompensated ischemic heart disease, Child-Pugh class C hepatic impairment, estimated glomerular filtration rate below 30 mL/min/1.73 m2, chronic opioid dependence, active substance misuse, major psychiatric illness affecting pain assessment, and conversion to open surgery.

**Randomization and blinding.** After informed written consent, 100 eligible patients were randomized in a 1:1 ratio to the experimental group (Group L) or the control group (Group C) using a computer-generated sequence. Allocation concealment was maintained with sequentially numbered opaque envelopes. The technician opening the envelope was independent of outcome assessment, and postoperative evaluators remained blinded to group assignment.

**Anesthetic and interventional protocol.** All patients fasted according to standard preoperative instructions and were monitored with non-invasive blood pressure, electrocardiography, and pulse oximetry. Group L received preservative-free lidocaine 1.5 mg/kg intravenously over 5 minutes before induction, followed by infusion at 1 mg/kg/h until skin closure, with reduced-dose nalbuphine. Group C received matching saline placebo and standard induction with propofol, nalbuphine, and atracurium. Anesthesia maintenance in both groups used isoflurane in nitrous oxide and oxygen, with mechanical ventilation adjusted to keep end-tidal carbon dioxide within 35 to 40 mmHg. Neuromuscular block was reversed with neostigmine and glycopyrrolate at the end of surgery.

**Outcome measures.** Postoperative pain was assessed in the PACU and ward using a 10-point Numerical Rating Scale (NRS) or Visual Analog Scale (VAS), depending on patient communication ability. The primary outcomes were target pain relief, defined as a score of 3 or less, and total rescue opioid consumption during the early postoperative period. Rescue nalbuphine was administered when pain scores exceeded 4 or by patient request.

**Statistical analysis.** Data were analyzed using IBM SPSS Statistics version 26.0. Continuous variables were tested for normality with the Shapiro-Wilk test and summarized as mean ± standard deviation or median with interquartile range as appropriate. Categorical variables were compared using Pearson chi-square test or Fisher's exact test. Stratified analysis was performed across age, gender, residential status, BMI, duration of cholelithiasis, operative duration, diabetes, hypertension, smoking, and ASA class. A two-sided P value below 0.05 was considered statistically significant.

## Results

A total of 100 randomized patients completed the trial, with 50 patients in each group. The groups were broadly comparable at baseline, and the efficacy findings are summarized in the merged tables below.

**Table 1. Baseline demographic and perioperative characteristics**

| Variable | Lidocaine group | Control group | Total | P value |
|---|---|---|---|---|
| **Continuous variables** | | | | |
| Age (years) | 40.74 ± 9.87 | 41.90 ± 11.59 | 41.32 ± 10.73 | 0.591 |
| Weight (kg) | 74.02 ± 11.03 | 76.60 ± 8.69 | 75.31 ± 9.86 | 0.197 |
| Height (cm) | 160.50 ± 3.88 | 161.90 ± 4.03 | 161.20 ± 3.96 | 0.080 |
| Body mass index (kg/m2) | 28.65 ± 3.54 | 29.18 ± 2.77 | 28.91 ± 3.16 | 0.407 |
| Duration of surgery (min) | 110.90 ± 23.96 | 107.50 ± 19.09 | 109.20 ± 21.52 | 0.435 |
| Duration of cholelithiasis (months) | 8.92 ± 4.09 | 9.40 ± 4.38 | 9.16 ± 4.23 | 0.572 |
| **Categorical variables** | | | | |
| Gender - Male | 4 (8.0%) | 4 (8.0%) | 8 (8.0%) | 1.000 |
| Gender - Female | 46 (92.0%) | 46 (92.0%) | 92 (92.0%) | 1.000 |

| | | | | |
|---|---|---|---|---|
| Residence - Urban | 12 (24.0%) | 24 (48.0%) | 36 (36.0%) | 0.021 |
| Residence - Rural | 38 (76.0%) | 26 (52.0%) | 64 (64.0%) | 0.021 |
| ASA status - ASA I | 11 (22.0%) | 10 (20.0%) | 21 (21.0%) | 1.000 |
| ASA status - ASA II | 39 (78.0%) | 40 (80.0%) | 79 (79.0%) | 1.000 |
| Hypertension - Yes | 14 (28.0%) | 16 (32.0%) | 30 (30.0%) | 0.828 |
| Hypertension - No | 36 (72.0%) | 34 (68.0%) | 70 (70.0%) | 0.828 |
| Diabetes - Yes | 2 (4.0%) | 3 (6.0%) | 5 (5.0%) | 1.000 |
| Diabetes - No | 48 (96.0%) | 47 (94.0%) | 95 (95.0%) | 1.000 |
| Smoking - Yes | 7 (14.0%) | 16 (32.0%) | 23 (23.0%) | 0.056 |
| Smoking - No | 43 (86.0%) | 34 (68.0%) | 77 (77.0%) | 0.056 |

Interpretation: Baseline and perioperative characteristics were largely comparable between the two groups, although residence differed at baseline. Any observed differences were modest and unlikely to explain the postoperative opioid-sparing signal by themselves.

**Table 2. Postoperative pain and opioid outcomes**

| Outcome | Lidocaine group | Control group | Total | P value |
|---|---|---|---|---|
| Postoperative pain score (NRS/VAS) | 4.44 ± 2.03 | 4.12 ± 2.14 | 4.28 ± 2.08 | 0.445 |
| Target pain relief achieved | 17 (34.0%) | 27 (54.0%) | 44 (44.0%) | 0.044 |
| Rescue opioid consumption (mg) | 0.05 ± 0.00 | 0.09 ± 0.02 | 0.07 ± 0.02 | 0.0001 |

Interpretation: Lidocaine was associated with lower rescue opioid requirement, but the pain-score endpoint did not consistently favor lidocaine. The analgesic effect in this dataset was therefore mainly opioid-sparing rather than uniformly reflected in target pain scores.

**Table 3. Exploratory stratified analysis of target pain relief**

| Subgroup | Lidocaine yes / no | Control yes / no | P value |
|---|---|---|---|
| Age ≤40 years | 10 / 14 | 14 / 13 | 0.443 |
| Age >40 years | 7 / 19 | 13 / 10 | 0.058 |
| Male | 0 / 4 | 4 / 0 | 0.014 |
| Female | 17 / 29 | 23 / 23 | 0.207 |
| Urban | 6 / 6 | 11 / 13 | 0.813 |
| Rural | 11 / 27 | 16 / 10 | 0.010 |
| BMI 20.0-26.0 kg/m2 | 4 / 6 | 2 / 7 | 0.414 |
| BMI >26.0 kg/m2 | 13 / 27 | 25 / 16 | 0.019 |
| Cholelithiasis ≤10 months | 11 / 22 | 19 / 18 | 0.165 |
| Cholelithiasis >10 months | 6 / 11 | 8 / 5 | 0.187 |
| Surgery ≤100 min | 6 / 10 | 12 / 10 | 0.354 |
| Surgery >100 min | 11 / 23 | 15 / 13 | 0.041 |
| Diabetes present | 0 / 2 | 0 / 3 | 1.000 |
| Diabetes absent | 17 / 31 | 27 / 20 | 0.032 |

| | | | |
|---|---|---|---|
| Hypertension present | 4 / 10 | 10 / 6 | 0.071 |
| Hypertension absent | 13 / 23 | 17 / 17 | 0.231 |
| Smoker | 1 / 6 | 9 / 7 | 0.082 |
| Non-smoker | 16 / 27 | 18 / 16 | 0.208 |
| ASA I | 4 / 7 | 4 / 6 | 0.635 |
| ASA II | 13 / 26 | 23 / 17 | 0.038 |

Interpretation: Exploratory subgroup analysis suggested heterogeneity across some strata, particularly residence, operative duration, BMI, and ASA class. These findings are hypothesis-generating only and should not be overinterpreted in a sample of this size.

**Discussion**

This randomized controlled trial showed that intraoperative intravenous lidocaine was associated with lower postoperative rescue opioid consumption after laparoscopic cholecystectomy. The difference in cumulative nalbuphine use between the lidocaine and control groups was statistically significant, although the magnitude of the effect in this dataset was small. 2, 3, 5, 6, 7, 13, 14

The pain-score findings were more nuanced. Although the control group had a greater proportion of patients reaching the target pain score, this did not translate into lower rescue opioid use across the study period. Taken together, the data suggest that lidocaine may have produced a modest opioid-sparing effect without a parallel and uniform improvement in pain-score thresholds. This pattern is not unusual in perioperative analgesia studies, where pain intensity, rescue dosing, and patient-reported thresholds do not always move in lockstep. 1, 5, 6, 7, 8, 13

The biological plausibility of lidocaine remains strong. Lidocaine blocks voltage-gated sodium channels, decreases ectopic neuronal firing, attenuates spinal sensitization, and may reduce inflammatory signaling. These actions provide a credible mechanism for reduced opioid requirement during the early postoperative period. In abdominal surgery, this pharmacologic profile is particularly attractive because visceral nociception and inflammatory drive are important contributors to postoperative discomfort. [8, 9, 10, 11, 12]

Our findings are broadly consistent with earlier work. Song and colleagues reported improved early postoperative recovery and lower analgesic requirements after laparoscopic cholecystectomy with perioperative lidocaine infusion, while broader systematic reviews have suggested opioid sparing and improved recovery after abdominal surgery. At the same time, not all minimally invasive surgery trials demonstrate the same magnitude of benefit, which may reflect variation in anesthetic technique, background analgesia, surgical duration, and outcome measurement. [2, 3, 7, 13, 14]

The subgroup analysis is informative but should be interpreted cautiously. Apparent differences by rural residence, longer operative time, higher BMI, and ASA class may reflect different nociceptive burdens or unmeasured confounders rather than a true biological interaction. Longer laparoscopic procedures can plausibly increase peritoneal irritation, tissue handling, and inflammatory stress, making analgesic adjuvants more useful in such cases. 4, 5, 8, 10, 11

From a practical standpoint, intravenous lidocaine is appealing because it is inexpensive, widely available, and easy to integrate into multimodal anesthesia. In resource-limited settings, even a modest reduction in opioid requirement may matter because it can reduce nausea, sedation, and other opioid-related adverse effects while preserving recovery quality. [1, 5, 10, 14]

The present study therefore supports lidocaine as a useful adjunct rather than a stand-alone analgesic strategy. Its strongest signal in this dataset lies in reducing rescue opioid burden, while the pain-score effect appears smaller and less consistent. Future studies should measure plasma lidocaine levels, inflammatory

biomarkers, early ambulation, bowel recovery, and post-discharge pain to better define the clinical niche of this intervention. 3, 7, 8, 9, 10, 11, 13, 14, 17, 18, 19, 20

Several limitations deserve mention. Plasma lidocaine concentrations were not measured, recovery endpoints beyond the immediate postoperative period were not collected, and inflammatory biomarkers were not assessed. In addition, the subgroup findings were exploratory and the pain-score results were not uniformly aligned with opioid consumption. These limitations do not invalidate the observed opioid-sparing signal, but they do call for cautious interpretation and external validation. 3, 7, 8, 9, 10, 11, 13, 14

## Conclusion

Intraoperative intravenous lidocaine was associated with lower postoperative rescue opioid consumption after laparoscopic cholecystectomy. The effect on pain-score endpoints was modest and not uniformly superior to control, so lidocaine should be viewed as a practical adjuvant within multimodal perioperative analgesia rather than a stand-alone analgesic strategy. Its role is best viewed as supportive rather than definitive, especially where limiting opioid exposure is an important goal.

## Declarations

**Conflict of Interest.** The authors declare no personal, financial, or institutional conflicts of interest.

**Funding.** This study was conducted using departmental resources only. No external funding was received.

**Author Contributions.** Dr. Erum Naz contributed to study design, recruitment, data collection, database entry, and manuscript drafting. Prof. Muhammad Nadeem Muneer supervised the study, provided clinical oversight, reviewed the manuscript, and approved the final version.

## References

Chou R, Gordon DB, de Leon-Casasola OA, Rosenberg JM, Bickler S, Brennan T, et al. Management of postoperative pain: a clinical practice guideline from the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. J Pain. 2016;17(2):131-157.

Barak M, Ziser A, Greenberg G, Alon I, Bowes WA. Intravenous lidocaine infusion for postoperative pain relief after laparoscopic cholecystectomy: a double-blind, randomized, placebo-controlled study. Surg Endosc. 2012;26(12):3456-3461.

Marret E, Rolin M, Beaussier M, Bonnet F. Meta-analysis of intravenous lidocaine and postoperative recovery after abdominal surgery. Br J Surg. 2008;95(11):1331-1338.

Feldman LS, Carli F, Baldini G, Popescu C, Stein B, Al-Nasser MM, et al. Impact of an enhanced recovery pathway on length of stay and complications after elective laparoscopic colorectal surgery. Surg Endosc. 2011;25(12):3730-3740.

McCarthy GC, Megalla SA, Habib AS. Impact of intravenous lidocaine infusion on postoperative analgesia and recovery from surgery: a systematic review of randomized controlled trials. Drugs. 2010;70(9):1149-1163.

Kaba A, Laurent SR, Merlin BJ, Neuprez A, Vandenbosch S, Robert S, et al. Intravenous lidocaine infusion facilitates acute rehabilitation after laparoscopic colectomy. Anesthesiology. 2007;106(1):11-18.

Vigneault L, Turgeon AF, Cote D, Lauzier F, Zarychanski R, Moore L, et al. Perioperative intravenous lidocaine infusion for postoperative pain control: a meta-analysis of randomized controlled trials. Can J Anaesth. 2011;58(1):22-37.

Koppert W, Weigand M, Neumann F, Sittl R, Schuettler J, Schmelz M, et al. Perioperative intravenous lidocaine has preventive effects on postoperative pain and hyperalgesia after major abdominal surgery. Anesth Analg. 2004;98(4):1050-1055.

Hollmann MW, Durieux ME. Local anesthetics and the inflammatory response: a new therapeutic indication? Anesthesiology. 2000;93(3):855-875.

Herroeder S, Pecher S, Schonherr ME, Kaulbach G, Honemann C, Podesta R, et al. Systemic lidocaine shortens length of hospital stay and accelerates recovery of bowel function after colorectal surgery. Ann Surg. 2007;246(2):192-200.

Lahat A, Ben-Horin S, Lang A, Goldstein S, Eldar S, Bardan E, et al. Lidocaine down-regulates nuclear factor-kappaB activation and up-regulates intestinal epithelial cell tolerance to inflammatory stimuli. Int J Colorectal Dis. 2008;23(9):897-904.

Groudine SB, Fisher HA, Kaufman RP Jr, Avramov MN, Melendez JA, DeLaura MA, et al. Intravenous lidocaine infusion facilitates acute rehabilitation after radical retropubic prostatectomy. Anesth Analg. 1998;86(2):235-239.

Song X, Sun Y, Zhang X, Li T, Yang B. Effect of perioperative intravenous lidocaine infusion on postoperative recovery and systemic inflammatory response after laparoscopic cholecystectomy. J Surg Res. 2017;212:126-133.

Sun Y, Li T, Wang N, Yun Y, Gan TJ. Perioperative systemic lidocaine for postoperative analgesia and recovery after abdominal surgery: a meta-analysis of randomized controlled trials. Dis Colon Rectum. 2012;55(11):1183-1194.

Lammert F, Gurusamy K, Keating CW, Morris DB, Kaufmann DM, Rapoport AB, et al. Gallstone disease. Nat Rev Dis Primers. 2016;2:16024.

Portincasa P, Moschetta A, Palasciano G. Cholesterol gallstone disease. Lancet. 2006;368(9531):230-239.

Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: cholelithiasis and cancer. Gut Liver. 2012;6(2):172-187.

Everhart JE, Ruhl CE. Making sense of the global burden of gallstone disease. Gastroenterology. 2009;136(2):393-395.

Shaffer EA. Gallstone disease: epidemiology of gallbladder stone disease. Best Pract Res Clin Gastroenterol. 2006;20(6):981-996.

Venneman NG, van Erpecum KJ. Pathogenesis of gallstones. Gastroenterol Clin North Am. 2010;39(2):171-183.

Tazuma S. Gallstone disease: pathogenesis and epidemiology of gallstones. J Gastroenterol Hepatol. 2006;21(3):526-531.

Ansaloni L, Pisano M, Coccolini F, Peitzman AB, Fingerhut A, Catena F, et al. 2016 WSES guidelines on acute calculous cholecystitis. World J Emerg Surg. 2016;11:25.

Heuman DM, Allen JI. Biliary colic and uncomplicated cholelithiasis: clinical manifestations and diagnosis. Clin Liver Dis. 2016;20(1):125-134.

Yokoe M, Hata J, Takada T, Strasberg SM, Asbun HJ, Wakabayashi G, et al. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholecystitis. J Hepatobiliary Pancreat Sci. 2018;25(1):41-54.

Williams EJ, Green J, Beckingham I, Parks R, Martin D, Taylor M, et al. Guidelines on the management of common bile duct stones (CBDS). Gut. 2008;57(7):1004-1021.

Kiriyama S, Kozaka K, Takada T, Strasberg SM, Pitt HA, Gabata T, et al. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholangitis. J Hepatobiliary Pancreat Sci. 2018;25(1):17-30.

Gurusamy KS, Vaughan J, Rossi M, Davidson BR. Less-versus more-invasive methods for the diagnosis of common bile duct stones. Cochrane Database Syst Rev. 2014;(2):CD009336.

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