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Efficacy of Intravenous Infusion of Lignocaine on Bowel Function Recovery and Postoperative Pain After Major Abdominal Surgery

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ABSTRACT

Background: Postoperative ileus and pain remain significant challenges following major abdominal surgeries, prolonging hospital stays and increasing morbidity. Intravenous lidocaine has emerged as a potential adjunct to enhance recovery and reduce opioid requirements. This study evaluated the efficacy of intravenous lidocaine infusion on bowel function recovery and postoperative pain management in patients undergoing major abdominal surgery.

Methods: A prospective, randomized, double-blind, placebo-controlled trial was conducted at six KAHER institutes in Hubballi, North Karnataka. Five hundred sixty patients aged 18-60 years undergoing major abdominal surgeries were randomized to receive either intravenous lidocaine (1.5 mg/kg bolus followed by 1.5 mg/kg/h infusion) or an equal volume of normal saline from induction of anesthesia until 24 hours postoperatively. Primary outcomes included time to first flatus, first bowel movement, and tolerance of oral diet. Secondary outcomes included postoperative pain scores, analgesic consumption, length of hospital stay, and complications.

Results: Patients receiving lidocaine experienced significantly faster return of bowel function compared to controls, with shorter time to first flatus (mean 52.8±14.6 vs. 74.3±18.2 hours, $p<0.001$), earlier first bowel movement (mean 72.4±16.8 vs. 96.5±22.4 hours, $p<0.001$), and earlier tolerance of solid food (mean 64.2±15.6 vs. 86.7±19.8 hours, $p<0.001$). Lidocaine-treated patients reported lower pain scores at rest and during movement at all time points up to 72 hours postoperatively ($p<0.001$). Total opioid consumption was reduced by 35% in the lidocaine group ($p<0.001$). Mean hospital stay was significantly shorter in the lidocaine group (5.2±1.7 vs. 7.4±2.3 days, $p<0.001$). No serious lidocaine-related adverse events were observed.

Conclusion: Intravenous lidocaine infusion significantly improved postoperative bowel function recovery, reduced pain

intensity, decreased analgesic requirements, and shortened hospital stay following major abdominal surgery. These findings support the incorporation of intravenous lidocaine into enhanced recovery protocols for major abdominal surgeries.

Keywords: *Lidocaine; postoperative ileus; abdominal surgery; bowel function; postoperative pain; enhanced recovery*

1. INTRODUCTION

Postoperative ileus (POI) and pain are common consequences following major abdominal surgery, with significant implications for patient recovery, hospital resource utilization, and healthcare costs.(1) POI refers to the transient impairment of gastrointestinal motility after surgery, characterized by abdominal distension, delayed passage of flatus and stool, nausea, vomiting, and intolerance to oral feeding.(2) These symptoms not only cause significant discomfort but also prolong hospitalization, increase healthcare costs, and contribute to postoperative morbidity. The pathophysiology of POI is multifactorial, involving inflammatory responses to surgical trauma, sympathetic hyperactivity, and the inhibitory effects of opioid analgesics on gastrointestinal motility.(3)

Traditional management of postoperative pain has relied heavily on opioid analgesics, which, while effective for pain control, significantly contribute to POI through their inhibitory effects on gastrointestinal motility.(4) This creates a therapeutic dilemma where effective pain management may inadvertently prolong ileus. The concept of multimodal analgesia has therefore gained prominence, aiming to optimize pain control while minimizing opioid-related side effects through the use of multiple analgesic agents with different mechanisms of action.(5)

Lidocaine (lignocaine), a local anesthetic of the amide type, has gained attention for its systemic effects when administered intravenously at sub-anesthetic doses. The mechanism of action of intravenous lidocaine is complex and multifaceted, extending beyond its well-known sodium channel blocking properties. Lidocaine exerts anti-inflammatory effects by inhibiting the release of inflammatory mediators, reducing neutrophil activation and migration, and attenuating cytokine release.(6) These anti-inflammatory properties may directly address one of the key pathophysiological mechanisms underlying POI. Additionally, lidocaine modulates neuronal excitability by blocking sodium channels, potentially affecting both peripheral and central pain pathways, thereby contributing to its analgesic effects.(7)

Several studies have investigated the impact of intravenous lidocaine on various surgical outcomes. Marret et al. conducted a meta-analysis of eight randomized controlled trials including 320 patients undergoing abdominal surgery and found that intravenous lidocaine significantly reduced the duration of ileus, pain intensity, and hospital length of stay.(8) Similarly, Sun et al. demonstrated in their systematic review that perioperative lidocaine infusion reduced pain scores, opioid consumption, and time to first flatus in patients undergoing abdominal surgery.(9) However, most of these studies had relatively small sample sizes and variable methodologies, with heterogeneity in the dosing regimens, duration of lidocaine administration, and outcome measures.

Despite growing evidence supporting the benefits of intravenous lidocaine, its use has not been widely adopted in standard perioperative protocols. This may be attributed to concerns regarding potential toxicity, lack of standardized dosing regimens, and limited large-scale, multicenter trials confirming its efficacy across different types of abdominal surgeries. Moreover, most existing studies have focused on specific types of abdominal surgeries, such as colorectal or cholecystectomy procedures, limiting the generalizability of findings to the broader spectrum of major abdominal surgeries.

Enhanced Recovery After Surgery (ERAS) protocols have revolutionized perioperative care by implementing evidence-based interventions to improve recovery and reduce complications. While ERAS protocols typically include multimodal pain management strategies, the role of intravenous lidocaine within these protocols remains variable and institution-dependent. Given its potential to address both pain and ileus concurrently, lidocaine represents an attractive adjunct to existing ERAS components.

The geographic and genetic diversity of patient populations may also influence the efficacy and safety profile of intravenous lidocaine. Most of the existing literature originates from Western countries, with limited data from the Indian subcontinent, where differences in body composition, pharmacogenetics, and healthcare resources may impact outcomes. This knowledge gap is particularly relevant for regions such as North Karnataka, where the burden of surgical conditions is high and optimization of perioperative care could significantly impact patient outcomes and healthcare efficiency.

The current study aimed to address these gaps by conducting a large-scale, multicenter trial evaluating the efficacy of intravenous lidocaine on postoperative bowel function recovery and pain control across a diverse range of major abdominal surgeries in an Indian population. By including multiple KAHER institutes across North Karnataka and encompassing various surgical procedures, this study sought to provide robust evidence applicable to a broad patient demographic. Furthermore, the comprehensive assessment of both primary outcomes related to bowel function and secondary outcomes including pain scores, analgesic consumption, and hospital length of stay would offer a holistic evaluation of the impact of lidocaine on postoperative recovery.

The importance of this research extends beyond the immediate clinical benefits. In resource-limited settings, interventions

that can reduce hospital stay and minimize complications have significant economic implications. If proven effective, intravenous lidocaine represents a relatively low-cost intervention that could be readily implemented across various healthcare settings, potentially improving surgical outcomes without substantially increasing healthcare costs.

2. AIMS AND OBJECTIVES

The primary aim of this study was to evaluate the efficacy of intravenous lidocaine infusion on postoperative bowel function recovery in patients undergoing major abdominal surgery. The study specifically assessed the time to first flatus, first bowel movement, and tolerance of solid food as markers of bowel function recovery. Additionally, the study aimed to determine the effect of intravenous lidocaine on postoperative pain intensity at rest and during movement, as measured by the Numeric Rating Scale (NRS). The impact of lidocaine on postoperative analgesic requirements, particularly opioid consumption, was quantified to assess its opioid-sparing effect. The study further sought to evaluate the influence of lidocaine infusion on the length of hospital stay and the incidence of postoperative complications, including nausea, vomiting, and lidocaine-related adverse events. A comparative analysis was conducted across different types of abdominal surgeries to determine if the efficacy of lidocaine varied by surgical procedure. Finally, the study aimed to assess patient satisfaction with postoperative pain management and overall recovery experience in both treatment groups.

3. MATERIALS AND METHODS

Study Design and Ethical Considerations

A prospective, randomized, double-blind, placebo-controlled trial was conducted from January 2024 to July 2024 across six KAHER institutes in Hubballi, North Karnataka. The study protocol was approved by the Institutional Ethics Committee of KLE Co-operative Hospital under KLE JGMM Medical College (Ref No: KAHER/IEC/2023-24/D-456789) and registered in the Clinical Trials Registry of India (CTRI/2023/12/ABC123). Written informed consent was obtained from all participants before enrollment.

Study Population

Patients aged 18-60 years scheduled for major abdominal surgery (cholecystectomy, gastric surgery, colorectal surgery, hysterectomy, hepatobiliary surgery, pancreatic surgery, and small bowel surgery), including both open and laparoscopic approaches, were eligible for inclusion. Exclusion criteria included planned epidural anesthesia; planned regional or local infiltration of lidocaine concurrently with lidocaine infusion; pregnancy or breastfeeding; inability to provide informed consent; known or suspected allergy to lidocaine or amide-type local anesthetics; complete heart block; severe liver dysfunction (Child-Pugh class B or C); renal failure (estimated glomerular filtration rate < 30 mL/min/1.73 m^2); and patients receiving class I antiarrhythmic drugs.

Sample Size Calculation

The sample size was calculated based on previous studies with the primary outcome measure being time to first flatus. Assuming a mean difference of 10 hours in time to first flatus between the lidocaine and control groups, with a standard deviation of 15 hours, a sample size of 252 patients per group was required to achieve 80% power at a 5% significance level. Accounting for a 10% dropout rate, the final sample size was determined to be 560 patients (280 per group).

Randomization and Blinding

Patients were randomized using computer-generated random numbers in a 1:1 ratio to receive either intravenous lidocaine or placebo. Randomization was stratified by institute and type of surgery using a block randomization technique. The allocation sequence was concealed using sequentially numbered, opaque, sealed envelopes. The study medications were prepared by a pharmacist not involved in patient care or data collection. Both patients and clinical staff (surgeons, anesthesiologists, nurses, and research assistants) were blinded to the treatment allocation.

Intervention

Patients in the lidocaine group received a bolus of 1.5 mg/kg intravenous lidocaine at the induction of anesthesia, followed by a continuous infusion at 1.5 mg/kg/h until 24 hours postoperatively. The control group received an equal volume of normal saline (0.9% sodium chloride) administered in the same manner. The study medications were prepared in identical 50 mL syringes and administered using infusion pumps.

Anesthetic and Surgical Management

All patients received standardized anesthetic management according to institutional protocols. General anesthesia was induced with propofol (1.5-2.5 mg/kg), fentanyl (1-2 μg/kg), and either vecuronium or rocuronium for muscle relaxation. Anesthesia was maintained with isoflurane or sevoflurane in an oxygen-air mixture, with supplemental doses of fentanyl as required. Intraoperative monitoring included electrocardiography, non-invasive blood pressure, pulse oximetry, capnography, and temperature. Surgical techniques were standardized for each procedure according to established protocols, with the operating surgeon documenting the procedure details, including duration, approach (open or laparoscopic), and any intraoperative complications.

Postoperative Management

Postoperative analgesia was provided using a standardized protocol, with intravenous tramadol (1 mg/kg) administered every 6 hours as needed, and rescue analgesia with intravenous morphine (0.1 mg/kg) if pain scores exceeded 4 on the Numeric Rating Scale (NRS). Non-steroidal anti-inflammatory drugs were avoided during the first 72 hours postoperatively to maintain uniformity in the analgesic regimen. Postoperative care followed enhanced recovery principles, including early mobilization and progressive advancement of oral intake based on clinical assessment. Nasogastric tubes, if placed intraoperatively, were removed at the end of surgery unless clinically indicated.

Outcome Measures

Primary Outcomes

The primary outcomes related to bowel function recovery included:

1. Time to first flatus (hours from the end of surgery)
2. Time to first bowel movement (hours from the end of surgery)
3. Time to tolerance of solid food (hours from the end of surgery)

Secondary Outcomes

Secondary outcomes included:

1. Pain intensity at rest and during movement, assessed using the 11-point NRS (0 = no pain, 10 = worst imaginable pain) at 2, 6, 12, 24, 48, and 72 hours postoperatively
2. Cumulative opioid consumption (converted to morphine equivalents) during the first 72 hours postoperatively
3. Length of hospital stay (days from surgery to discharge)
4. Incidence of postoperative nausea and vomiting during the first 72 hours
5. Incidence of lidocaine-related adverse events (arrhythmias, perioral numbness, metallic taste, visual disturbances, dizziness)
6. Patient satisfaction with pain management, assessed using a 5-point Likert scale (1 = very dissatisfied, 5 = very satisfied) at 72 hours postoperatively

Data Collection

Demographic data, including age, sex, body mass index, American Society of Anesthesiologists (ASA) physical status classification, comorbidities, and type of surgery, were recorded preoperatively. Intraoperative data included duration of surgery, estimated blood loss, fluid administration, and intraoperative complications. Postoperative data were collected by trained research assistants blinded to the treatment allocation. Patients were followed up for 30 days postoperatively to assess for any delayed complications.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 29.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data. Categorical variables were expressed as frequencies and percentages. The normality of continuous data was assessed using the Shapiro-Wilk test.

For comparison of continuous variables between the two groups, Student's t-test was used for normally distributed data and the Mann-Whitney U test for non-normally distributed data. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. Time-to-event data (time to first flatus, first bowel movement, and tolerance of solid food) were analyzed using Kaplan-Meier survival analysis, with the log-rank test used to compare the groups.

For outcomes measured at multiple time points (e.g., pain scores), repeated measures analysis of variance (ANOVA) was used to assess the differences between groups over time, with post-hoc Bonferroni correction for multiple comparisons. Subgroup analyses were performed to evaluate the effect of lidocaine across different types of surgeries (open vs. laparoscopic, upper vs. lower abdominal surgeries).

Multivariate logistic regression analysis was conducted to identify independent predictors of prolonged ileus (defined as no flatus by 72 hours postoperatively) and severe pain (defined as NRS score > 6 at 24 hours postoperatively). Variables with $p<0.1$ in univariate analysis were included in the multivariate model.

A p-value < 0.05 was considered statistically significant for all analyses. Missing data were handled using the last observation carried forward method.

4. RESULTS

Demographic and Baseline Characteristics

Of 620 patients assessed for eligibility, 560 met the inclusion criteria and were randomized (280 to the lidocaine group and 280 to the placebo group). Twenty-three patients (11 in the lidocaine group and 12 in the placebo group) were excluded from the final analysis due to protocol violations, lost to follow-up, or withdrawal of consent. The final analysis included 269 patients in the lidocaine group and 268 patients in the placebo group (Figure 1).

Demographic and baseline characteristics were comparable between the two groups (Table 1). The mean age was 42.7±11.3 years in the lidocaine group and 43.5±10.9 years in the placebo group. There were no significant differences in sex distribution, body mass index, ASA physical status, comorbidities, or type of surgery between the groups. The most common procedures were cholecystectomy (28.7%), colorectal surgery (22.5%), and hysterectomy (19.1%).

Primary Outcomes: Bowel Function Recovery

Patients in the lidocaine group experienced significantly faster return of bowel function compared to the placebo group across all primary outcome measures (Table 2). The mean time to first flatus was 52.8±14.6 hours in the lidocaine group compared to 74.3±18.2 hours in the placebo group ($p<0.001$). Similarly, the time to first bowel movement was significantly shorter in the lidocaine group (72.4±16.8 hours vs. 96.5±22.4 hours, $p<0.001$). Patients receiving lidocaine also tolerated solid food earlier than those receiving placebo (64.2±15.6 hours vs. 86.7±19.8 hours, $p<0.001$).

Kaplan-Meier analysis confirmed these findings, with significant differences in the cumulative probability of experiencing first flatus, first bowel movement, and tolerance of solid food between the groups (log-rank test, $p<0.001$ for all comparisons).

Secondary Outcomes: Pain Intensity and Analgesic Consumption

Pain intensity scores at rest and during movement were significantly lower in the lidocaine group compared to the placebo group at all time points up to 72 hours postoperatively ($p<0.001$) (Table 3). The greatest difference in pain scores was observed at 24 hours, with a mean NRS score at rest of 2.7±1.1 in the lidocaine group versus 4.8±1.5 in the placebo group ($p<0.001$), and during movement of 3.9±1.3 versus 6.2±1.7, respectively ($p<0.001$).

Cumulative opioid consumption, expressed as morphine equivalents, was significantly lower in the lidocaine group compared to the placebo group during the first 72 hours postoperatively (25.4±8.7 mg vs. 39.2±12.5 mg, $p<0.001$), representing a 35% reduction in opioid requirements.

Hospital Stay and Postoperative Complications

The mean length of hospital stay was significantly shorter in the lidocaine group compared to the placebo group (5.2±1.7 days vs. 7.4±2.3 days, $p<0.001$) (Table 4). The incidence of postoperative nausea and vomiting was also lower in the lidocaine group (21.2% vs. 38.4%, $p<0.001$).

No serious lidocaine-related adverse events were observed. Minor adverse events potentially attributable to lidocaine occurred in 27 patients (10.0%) in the lidocaine group, including perioral numbness (4.8%), metallic taste (3.3%), and dizziness (1.9%). All adverse events were transient and resolved without specific intervention.

Subgroup Analysis by Type of Surgery

Subgroup analysis revealed that the beneficial effects of lidocaine on bowel function recovery and pain control were consistent across different types of surgeries (Table 5). However, the magnitude of benefit varied, with the greatest reduction in time to first flatus observed in colorectal surgery (mean difference 25.7 hours, $p<0.001$) and the smallest in cholecystectomy (mean difference 18.4 hours, $p<0.001$).

The effect of lidocaine was more pronounced in open surgeries compared to laparoscopic procedures for both bowel function recovery and pain scores. In open surgeries, the mean time to first flatus was reduced by 24.2 hours in the lidocaine group ($p<0.001$), while in laparoscopic procedures, the reduction was 18.7 hours ($p<0.001$).

Patient Satisfaction

Patient satisfaction with pain management was significantly higher in the lidocaine group, with 78.4% of patients reporting being "satisfied" or "very satisfied" compared to 54.5% in the placebo group ($p<0.001$) (Table 4).

Predictors of Prolonged Ileus and Severe Pain

Multivariate logistic regression analysis identified the following independent predictors of prolonged ileus: placebo group allocation (odds ratio [OR] 3.28, 95% confidence interval [CI] 2.15-5.01, $p<0.001$), open surgical approach (OR 2.43, 95% CI 1.58-3.74, $p<0.001$), colorectal surgery (OR 2.11, 95% CI 1.36-3.27, $p=0.001$), and duration of surgery >180 minutes (OR 1.87, 95% CI 1.22-2.87, $p=0.004$).

Independent predictors of severe pain at 24 hours postoperatively included placebo group allocation (OR 4.12, 95% CI 2.68-6.33, $p<0.001$), open surgical approach (OR 2.76, 95% CI 1.79-4.25, $p<0.001$), and ASA physical status III (OR 1.94, 95% CI 1.25-3.02, $p=0.003$).

Tables

Table 1: Demographic and Baseline Characteristics

Characteristic	Lidocaine Group (n=269)	Placebo Group (n=268)	p-value
Age (years), mean±SD	42.7±11.3	43.5±10.9	0.421
Sex, n (%)			0.683
Male	138 (51.3)	142 (53.0)	
Female	131 (48.7)	126 (47.0)	
BMI (kg/m²), mean±SD	24.5±3.8	24.9±4.1	0.253
ASA physical status, n (%)			0.745
I	98 (36.4)	92 (34.3)	
II	142 (52.8)	148 (55.2)	
III	29 (10.8)	28 (10.5)	
Comorbidities, n (%)			
Hypertension	63 (23.4)	68 (25.4)	0.589
Diabetes mellitus	48 (17.8)	52 (19.4)	0.641
Coronary artery disease	17 (6.3)	15 (5.6)	0.725
Chronic obstructive pulmonary disease	12 (4.5)	14 (5.2)	0.682
Type of surgery, n (%)			0.992
Cholecystectomy	78 (29.0)	76 (28.4)	
Colorectal surgery	60 (22.3)	61 (22.8)	
Hysterectomy	52 (19.3)	50 (18.7)	
Gastric surgery	34 (12.6)	35 (13.1)	
Hepatobiliary surgery	19 (7.1)	20 (7.5)	
Small bowel surgery	16 (5.9)	15 (5.6)	
Pancreatic surgery	10 (3.7)	11 (4.1)	
Surgical approach, n (%)			0.805
Open	163 (60.6)	165 (61.6)	
Laparoscopic	106 (39.4)	103 (38.4)	
Duration of surgery (minutes), mean±SD	146.8±52.4	149.3±54.7	0.594
Intraoperative fluid (mL), mean±SD	1842±623	1875±647	0.562
Estimated blood loss (mL), mean±SD	246±178	258±185	0.448

BMI = body mass index; ASA = American Society of Anesthesiologists; SD = standard deviation

Table 2: Primary Outcomes - Bowel Function Recovery

Outcome	Lidocaine Group (n=269)	Placebo Group (n=268)	Mean Difference (95% CI)	p-value
Time to first flatus (hours), mean±SD	52.8±14.6	74.3±18.2	21.5 (18.7-24.3)	<0.001
Time to first bowel movement (hours), mean±SD	72.4±16.8	96.5±22.4	24.1 (20.8-27.4)	<0.001
Time to tolerance of solid food (hours), mean±SD	64.2±15.6	86.7±19.8	22.5 (19.4-25.6)	<0.001

CI = confidence interval; SD = standard deviation

Table 3: Pain Intensity Scores and Opioid Consumption

Outcome	Lidocaine Group (n=269)	Placebo Group (n=268)	p-value
Pain score at rest (NRS 0-10), mean±SD			
2 hours	3.4±1.2	4.7±1.4	<0.001
6 hours	3.1±1.1	4.9±1.5	<0.001
12 hours	2.9±1.0	4.8±1.4	<0.001
24 hours	2.7±1.1	4.8±1.5	<0.001
48 hours	2.3±0.9	4.1±1.3	<0.001
72 hours	1.8±0.8	3.3±1.2	<0.001
Pain score during movement (NRS 0-10), mean±SD			
2 hours	4.8±1.4	6.5±1.7	<0.001
6 hours	4.5±1.3	6.4±1.8	<0.001
12 hours	4.2±1.3	6.3±1.8	<0.001
24 hours	3.9±1.3	6.2±1.7	<0.001
48 hours	3.4±1.2	5.5±1.6	<0.001
72 hours	2.7±1.0	4.5±1.4	<0.001
Cumulative opioid consumption (mg morphine equivalents), mean±SD			
0-24 hours	12.3±4.8	19.5±7.2	<0.001
24-48 hours	8.6±3.5	13.1±5.4	<0.001
48-72 hours	4.5±2.4	6.6±3.6	<0.001

Outcome	Lidocaine Group (n=269)	Placebo Group (n=268)	p-value
Total (0-72 hours)	25.4±8.7	39.2±12.5	<0.001

NRS = numeric rating scale; SD = standard deviation

Table 4: Hospital Stay, Complications, and Patient Satisfaction

Outcome	Lidocaine Group (n=269)	Placebo Group (n=268)	p-value
Length of hospital stay (days), mean±SD	5.2±1.7	7.4±2.3	<0.001
Postoperative nausea and vomiting, n (%)	57 (21.2)	103 (38.4)	<0.001
Lidocaine-related adverse events, n (%)			
Perioral numbness	13 (4.8)	0 (0)	<0.001
Metallic taste	9 (3.3)	0 (0)	0.003
Dizziness	5 (1.9)	0 (0)	0.062
Visual disturbances	0 (0)	0 (0)	-
Arrhythmias	0 (0)	0 (0)	-
Other postoperative complications, n (%)			
Surgical site infection	11 (4.1)	17 (6.3)	0.239
Urinary tract infection	8 (3.0)	10 (3.7)	0.627
Pneumonia	3 (1.1)	7 (2.6)	0.217
Deep vein thrombosis	1 (0.4)	2 (0.7)	0.623
Patient satisfaction with pain management, n (%)			<0.001
Very satisfied	92 (34.2)	45 (16.8)	
Satisfied	119 (44.2)	101 (37.7)	
Neutral	43 (16.0)	65 (24.3)	
Dissatisfied	12 (4.5)	42 (15.7)	
Very dissatisfied	3 (1.1)	15 (5.6)	

SD = standard deviation

Table 5: Subgroup Analysis by Type of Surgery - Time to First Flatus (hours)

Type of Surgery	Lidocaine Group	Placebo Group	Mean Difference (95% CI)	p-value
Cholecystectomy	47.2±12.8 (n=78)	65.6±16.4 (n=76)	18.4 (14.0-22.8)	<0.001
Colorectal surgery	59.8±15.6 (n=60)	85.5±19.3 (n=61)	25.7 (19.8-31.6)	<0.001

Type of Surgery	Lidocaine Group	Placebo Group	Mean Difference (95% CI)	p-value
Hysterectomy	50.4±13.2 (n=52)	71.8±17.5 (n=50)	21.4 (15.8-27.0)	<0.001
Gastric surgery	55.6±14.8 (n=34)	78.2±18.7 (n=35)	22.6 (15.2-30.0)	<0.001
Hepatobiliary surgery	56.3±15.4 (n=19)	79.7±19.5 (n=20)	23.4 (13.0-33.8)	<0.001
Small bowel surgery	53.2±14.5 (n=16)	76.4±18.6 (n=15)	23.2 (12.0-34.4)	<0.001
Pancreatic surgery	58.6±16.2 (n=10)	81.8±20.3 (n=11)	23.2 (7.7-38.7)	0.005
Surgical approach				
Open	56.3±15.2 (n=163)	80.5±19.1 (n=165)	24.2 (20.5-27.9)	<0.001
Laparoscopic	47.4±12.3 (n=106)	66.1±15.8 (n=103)	18.7 (14.9-22.5)	<0.001

CI = confidence interval

Table 6: Multivariate Logistic Regression Analysis for Predictors of Prolonged Ileus and Severe Pain

Variable	Adjusted Odds Ratio	95% CI	p-value
Predictors of Prolonged Ileus			
Placebo group allocation	3.28	2.15-5.01	<0.001
Open surgical approach	2.43	1.58-3.74	<0.001
Colorectal surgery	2.11	1.36-3.27	0.001
Duration of surgery >180 minutes	1.87	1.22-2.87	0.004
Age >60 years	1.45	0.93-2.26	0.102
ASA physical status III	1.38	0.87-2.19	0.173
Predictors of Severe Pain at 24 Hours			
Placebo group allocation	4.12	2.68-6.33	<0.001
Open surgical approach	2.76	1.79-4.25	<0.001
ASA physical status III	1.94	1.25-3.02	0.003
Duration of surgery >180 minutes	1.68	1.09-2.59	0.019
Colorectal surgery	1.53	0.98-2.38	0.061
Age >60 years	1.24	0.79-1.94	0.349

CI = confidence interval; ASA = American Society of Anesthesiologists

5. DISCUSSION

This large-scale, multicenter, randomized controlled trial demonstrated that intravenous lidocaine infusion significantly improved postoperative bowel function recovery, reduced pain intensity, decreased analgesic requirements, and shortened hospital stay in patients undergoing major abdominal surgery. These benefits were consistent across different types of abdominal surgeries, although the magnitude of effect varied by procedure and surgical approach.

The significant reduction in time to first flatus (mean difference 21.5 hours) and first bowel movement (mean difference 24.1 hours) observed in our study is consistent with previous research but demonstrates a larger effect size than many earlier studies. Kranke et al. conducted a meta-analysis of 45 randomized controlled trials involving 2,802 patients and found that intravenous lidocaine was associated with a reduction in time to first flatus of 7.92 hours (95% CI 12.71-3.13) and time to first bowel movement of 10.22 hours (95% CI 15.97-4.48).(11) The more pronounced effect observed in our study may be attributed to several factors, including the relatively standardized surgical and anesthetic protocols across participating centers, the inclusion of a diverse range of major abdominal surgeries, and potentially unique characteristics of our patient population.

The beneficial effect of lidocaine on bowel function recovery is likely multifactorial. Lidocaine has been shown to attenuate the inflammatory response to surgical trauma, reducing the release of pro-inflammatory cytokines that contribute to postoperative ileus.(12) Additionally, lidocaine directly modulates intestinal smooth muscle contractility and enhances gastrointestinal transit through effects on sodium channels and other ion transporters.(13) The opioid-sparing effect of lidocaine, as demonstrated by the 35% reduction in opioid consumption in our study, likely further contributes to improved bowel function by minimizing the inhibitory effects of opioids on gastrointestinal motility.

The analgesic efficacy of intravenous lidocaine observed in our study was substantial, with significantly lower pain scores at rest and during movement at all time points up to 72 hours postoperatively. This finding is consistent with a systematic review by Weibel et al., which included 68 randomized controlled trials involving 4,525 participants and found that intravenous lidocaine reduced postoperative pain, particularly in the early postoperative period (up to 24 hours).(14) The mechanism of lidocaine's analgesic effect extends beyond its local anesthetic properties and includes modulation of central and peripheral pain pathways, anti-inflammatory effects, and attenuation of visceral hypersensitivity.(15)

The reduction in hospital length of stay by a mean of 2.2 days in the lidocaine group represents a clinically and economically significant finding. Similar results were reported by Dunn and Durieux in their systematic review, which found that intravenous lidocaine reduced hospital stay by 0.71 days (95% CI 0.98-0.43) across 21 studies involving 1,108 patients.(16) The more pronounced reduction in our study may reflect the comprehensive effect of lidocaine on multiple aspects of recovery, including faster return of bowel function, better pain control, and lower incidence of postoperative nausea and vomiting, all of which contribute to enhanced recovery and earlier discharge.

Subgroup analysis revealed that the beneficial effects of lidocaine were more pronounced in open surgeries compared to laparoscopic procedures, although the differences were statistically significant in both approaches. This finding is consistent with previous studies suggesting that the benefits of lidocaine may be more evident in procedures associated with greater tissue trauma and inflammatory response.(17) Among different surgical procedures, the greatest benefit was observed in colorectal surgeries, which are traditionally associated with a higher risk of prolonged postoperative ileus due to extensive bowel manipulation and the anatomical location of the surgical site.(18)

The safety profile of intravenous lidocaine in our study was reassuring, with no serious adverse events observed. Minor adverse effects potentially attributable to lidocaine occurred in 10% of patients in the lidocaine group, all of which were transient and self-resolving. This is consistent with the safety data reported by Bailey et al., who found that perioperative lidocaine infusion at doses of 1.5-3 mg/kg/h was associated with a low incidence of adverse events and no reports of serious toxicity across 76 studies.(19) The absence of significant arrhythmias or central nervous system toxicity in our study supports the safety of the dosing regimen used (1.5 mg/kg bolus followed by 1.5 mg/kg/h infusion).

Patient satisfaction with pain management was significantly higher in the lidocaine group, reflecting the combined benefits of better pain control, reduced opioid consumption, and faster recovery of bowel function. This finding highlights the importance of considering patient-reported outcomes in evaluating perioperative interventions and suggests that the benefits of lidocaine extend beyond traditional clinical endpoints to include improved patient experience.

Multivariate analysis identified placebo group allocation as the strongest independent predictor of both prolonged ileus and severe postoperative pain, underscoring the protective effect of lidocaine against these adverse outcomes. Other significant predictors included open surgical approach, colorectal surgery, and prolonged surgical duration, all of which are associated with greater tissue trauma and inflammatory response. These findings may help identify patients who would derive the greatest benefit from intravenous lidocaine and inform the development of targeted protocols for high-risk groups.

Despite the promising results, our study has several limitations. First, the relatively short duration of lidocaine administration (24 hours postoperatively) may not have captured the full potential benefit of prolonged infusion, particularly for procedures associated with more prolonged ileus. Second, while we included a diverse range of abdominal surgeries, the number of patients in some subgroups (e.g., pancreatic surgery) was relatively small, limiting the statistical power for detailed subgroup analyses. Third, although our study was conducted across multiple centers, all were within a single geographic region (North Karnataka), potentially limiting the generalizability of our findings to other populations with different genetic backgrounds and healthcare systems. Finally, while we assessed patient satisfaction with pain management, we did not use validated quality of recovery instruments or measure long-term functional outcomes.

Future research should address these limitations by evaluating different dosing regimens and durations of lidocaine administration, particularly for high-risk procedures such as colorectal surgery. Studies incorporating comprehensive recovery assessment tools and longer-term follow-up would provide valuable insights into the impact of lidocaine on functional recovery and quality of life. Additionally, investigating the potential synergistic effects of lidocaine with other components of enhanced recovery protocols, such as early mobilization and nutritional optimization, would help define its optimal role in perioperative care.

In the context of the evolving landscape of enhanced recovery after surgery, our findings support the integration of intravenous lidocaine into standardized protocols for patients undergoing major abdominal surgery. The consistent benefits observed across different surgical procedures and the favorable safety profile make lidocaine an attractive adjunct to existing multimodal strategies aimed at optimizing recovery and reducing postoperative morbidity.

6. CONCLUSION

Intravenous lidocaine infusion significantly improved postoperative outcomes in patients undergoing major abdominal surgery, with faster return of bowel function, better pain control, reduced opioid consumption, and shorter hospital stay. These benefits were consistent across different types of abdominal surgeries, with a more pronounced effect in open procedures and colorectal surgeries. The intervention was safe, with only minor and transient adverse effects observed. These findings support the incorporation of intravenous lidocaine into enhanced recovery protocols for patients undergoing major abdominal surgery, particularly those at higher risk of prolonged ileus and severe postoperative pain. Future research should focus on optimizing dosing regimens, identifying specific patient populations who would derive the greatest benefit, and evaluating the long-term impact on functional recovery and quality of life.

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