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Original Research Article

Impact of Postoperative Pain and Opioid Analgesic Use on Gastrointestinal Motility Following Surgery

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Abstract: ***Background***: Delayed recovery of gastrointestinal motility is a common problem after abdominal surgery and leads to patient discomfort, prolonged hospital stay, and increased healthcare burden. Postoperative pain and opioid analgesics are considered major contributors to this delay, but local data from Pakistani surgical settings are limited. ***Objective***: To evaluate the impact of postoperative pain intensity and opioid analgesic use on gastrointestinal motility following elective abdominal surgery. ***Methods***: This prospective observational study was conducted at Khyber Teaching Hospital, Khyber Medical College, Peshawar, Pakistan, from February 26, 2025, to August 25, 2025. Adult patients undergoing elective gastrointestinal or hepatobiliary surgery were enrolled using consecutive sampling. Postoperative pain was assessed using the Numerical Rating Scale at 12, 24, and 48 hours. Opioid consumption was calculated as cumulative oral morphine milligram equivalents within 48 hours. Gastrointestinal motility was evaluated by time to first bowel sound, first passage of flatus, and first bowel movement. Multivariable linear regression was used to adjust for confounders. ***Results***: Out of 420 enrolled patients, 398 were included in the final analysis. The mean pain score at 24 hours was 5.2 ± 1.3, and the mean cumulative opioid dose was 78.4 ± 21.6 mg. The mean time to first bowel sound was 27.6 ± 8.5 hours, while time to first bowel movement was 68.9 ± 15.6 hours. Pain score at 24 hours showed a significant correlation with delayed bowel movement ($r = 0.46$, $p < 0.001$). Opioid dose demonstrated a stronger correlation ($r = 0.58$, $p < 0.001$). On multivariable analysis, both pain score ($\beta = 2.18$, $p < 0.001$) and opioid dose ($\beta = 0.41$, $p < 0.001$) were independent predictors of delayed gastrointestinal recovery. ***Conclusion***: Higher postoperative pain and increased opioid use are independently associated with delayed gastrointestinal motility following surgery. Opioid-sparing pain management strategies may help improve postoperative recovery.

Keywords: Postoperative Ileus; Gastrointestinal Motility; Postoperative Pain; Opioid Analgesics; Abdominal Surgery.

INTRODUCTION

Postoperative recovery of gastrointestinal motility is a critical factor in patient outcomes after abdominal surgery. Delay in the return of bowel function can lead to abdominal discomfort, nausea, vomiting, prolonged fasting, and extended hospital stay. This condition, commonly referred to as postoperative ileus, remains a frequent complication despite advances in surgical and anesthetic techniques. Understanding the factors that influence gastrointestinal recovery is important for improving postoperative care and reducing healthcare costs [1].

Surgical stress triggers complex physiological responses that affect intestinal function. Tissue injury during surgery activates inflammatory mediators and autonomic nervous system pathways that suppress coordinated bowel movements. General anesthesia and prolonged surgical manipulation further contribute to impaired gut motility. These effects are often more pronounced after gastrointestinal and hepatobiliary procedures, where direct handling of the intestines is common.

Postoperative pain is another important but often overlooked factor affecting bowel recovery. Pain

activates the sympathetic nervous system and increases stress hormone release, which can inhibit gastrointestinal activity [2]. Poorly controlled pain may therefore delay the return of normal bowel function. At the same time, effective pain control is essential for patient comfort, early mobilization, and overall recovery, creating a clinical challenge in balancing analgesia and gastrointestinal function [3]. Opioid analgesics remain the most commonly used drugs for managing moderate to severe postoperative pain [4]. However, opioids act on μ-opioid receptors present in the gastrointestinal tract, leading to reduced intestinal contractions, decreased secretions, and prolonged transit time. This opioid-induced gut dysfunction is a well-recognized contributor to postoperative ileus [5]. While international studies have shown a clear association between opioid use and delayed bowel recovery, local data from Pakistani hospitals are scarce [6] [7].

In low- and middle-income countries, including Pakistan, opioid-based analgesia is frequently used due to limited access to advanced pain management techniques. There is a need for locally generated evidence to guide clinicians toward safer and more effective postoperative pain strategies. Evaluating the combined effect of pain intensity and opioid dose on gastrointestinal motility can help identify modifiable risk factors and improve recovery protocols [8].

This study was designed to assess the impact of postoperative pain and opioid analgesic use on gastrointestinal motility following elective abdominal surgery at a tertiary care hospital in Peshawar. By analyzing pain scores, opioid consumption, and objective markers of bowel recovery, this research aims to provide clinically relevant evidence that can support improved postoperative management and inform future opioid-sparing strategies in similar healthcare settings.

METHODOLOGY

This prospective observational study was conducted at Khyber Teaching Hospital in affiliation with Khyber Medical College, Peshawar, Pakistan, over a six-month period from February 26, 2025, to August 25, 2025. The study was designed and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [9]. Ethical approval was obtained from the Institutional Ethical Review Board of Khyber Medical College and Khyber Teaching Hospital (Ref No. KMC/KTH/ERB/02-2025 dated February 26, 2025). Written informed consent was obtained from all participants prior to enrollment.

Adult patients undergoing elective abdominal surgery under general anesthesia were included. The sample size was calculated using an expected incidence of postoperative gastrointestinal hypomotility of 40%, based on previously reported literature, with a 95% confidence level and a 5% margin of error. After accounting for a 10% potential attrition rate, a final sample size of 420 patients was determined to be adequate. Participants were recruited using consecutive non-probability sampling to minimize selection bias during the study period.

Patients aged 18 to 65 years of either sex who underwent elective gastrointestinal or hepatobiliary surgery and received postoperative opioid analgesia were included. Patients with pre-existing gastrointestinal motility disorders, chronic opioid use, inflammatory bowel disease, bowel obstruction, chronic liver disease, chronic kidney disease, uncontrolled diabetes mellitus, postoperative re-exploration, intensive care unit stay beyond 24 hours, or use of epidural or regional analgesia were excluded to reduce confounding. Patients who developed major postoperative complications such as anastomotic leak or sepsis were also excluded from final analysis.

Postoperative pain intensity was assessed using the Numerical Rating Scale, a freely available and widely accepted tool that does not require prior permission. Pain scores were recorded at 12, 24, and 48 hours after surgery. Opioid exposure was quantified by calculating the cumulative opioid dose administered in the first 48 postoperative hours and converting it into oral morphine milligram equivalents using standard conversion ratios. Gastrointestinal motility was assessed using clinically relevant parameters including time to first bowel sound, time to first passage of flatus, and time to first bowel movement, all recorded in hours postoperatively by the attending surgical team.

Relevant confounding variables such as age, sex, body mass index, type and duration of surgery, intraoperative fluid volume, use of non-opioid analgesics, and postoperative mobilization time were documented prospectively. These variables were selected based on biological plausibility and previous evidence linking them to gastrointestinal motility. Missing data were minimal due to prospective data collection; however, cases with incomplete primary outcome data were excluded from analysis using complete-case analysis, as the proportion of missing data was less than 5%.

Data were entered and analyzed using Statistical Package for Social Sciences version 26. Continuous variables were presented as mean ± standard deviation or median with interquartile range depending on data distribution, while categorical variables were expressed as frequencies and percentages. The association between postoperative pain scores, opioid dose, and gastrointestinal motility outcomes was assessed using Pearson or Spearman correlation as appropriate. Multivariable linear

regression analysis was performed to evaluate the independent impact of pain intensity and opioid use on gastrointestinal motility parameters after adjusting for identified confounders. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 420 patients were enrolled during the study period. Twenty-two patients were excluded due to incomplete primary outcome data, leaving 398 patients for final analysis. The mean age of participants was 44.6 ± 12.3 years, with a male predominance. Most surgeries were gastrointestinal resections, and all patients received opioid-based postoperative analgesia.

Table 1 shows the baseline demographic and clinical characteristics of the study population. The mean body mass index was 26.1 ± 3.8 kg/m². The average duration of surgery was 138.5 ± 41.2 minutes, and the median intraoperative fluid volume administered was 2.1 (1.6–2.7) liters.

Table 1. Baseline Demographic and Clinical Characteristics (n = 398)

Variable	Value
Age (years), mean ± SD	44.6 ± 12.3
Male sex, n (%)	241 (60.6)
Body mass index (kg/m²), mean ± SD	26.1 ± 3.8
Type of surgery	
– Gastrointestinal resection, n (%)	226 (56.8)
– Hepatobiliary surgery, n (%)	172 (43.2)
Duration of surgery (minutes), mean ± SD	138.5 ± 41.2
Intraoperative fluid volume (L), median (IQR)	2.1 (1.6–2.7)
Postoperative mobilization time (hours), mean ± SD	19.4 ± 6.8

Postoperative pain intensity and opioid consumption are summarized in Table 2. Pain scores were highest at 12 hours and showed a gradual decline over time. The mean cumulative opioid dose within the first 48 hours was 78.4 ± 21.6 mg oral morphine milligram equivalents.

Table 2. Postoperative Pain Scores and Opioid Consumption

Parameter	Mean ± SD
Pain score at 12 hours	6.7 ± 1.4
Pain score at 24 hours	5.2 ± 1.3
Pain score at 48 hours	3.9 ± 1.2
Cumulative opioid dose (MME, 48 hours)	78.4 ± 21.6

Gastrointestinal motility outcomes are presented in Table 3. The mean time to first bowel sound was 27.6 ± 8.5 hours, while the mean time to first passage of flatus and bowel movement were 43.8 ± 11.2 hours and 68.9 ± 15.6 hours, respectively.

Table 3. Postoperative Gastrointestinal Motility Outcomes

Outcome	Mean ± SD (hours)
Time to first bowel sound	27.6 ± 8.5
Time to first passage of flatus	43.8 ± 11.2
Time to first bowel movement	68.9 ± 15.6

Correlation analysis demonstrated that higher pain scores and greater opioid consumption were significantly associated with delayed gastrointestinal recovery. As shown in Table 4, pain score at 24 hours showed a moderate positive correlation with time to first bowel movement ($r = 0.46$, $p < 0.001$), while cumulative opioid dose demonstrated a stronger correlation ($r = 0.58$, $p < 0.001$).

Table 4. Correlation Between Pain, Opioid Use, and Gastrointestinal Motility

Variable	Time to flatus (r)	Time to bowel movement (r)	p-value
Pain score at 24 hours	0.39	0.46	<0.001
Cumulative opioid dose (MME)	0.51	0.58	<0.001

Multivariable linear regression analysis was performed to assess the independent effect of postoperative pain and

opioid use on gastrointestinal motility after adjusting for age, sex, body mass index, duration of surgery, intraoperative fluid volume, use of non-opioid analgesics, and mobilization time. As shown in Table 5, cumulative opioid dose and pain score at 24 hours remained significant independent predictors of delayed bowel movement.

Table 5. Multivariable Linear Regression Analysis for Time to First Bowel Movement

Predictor	β coefficient	95% CI	p-value
Pain score at 24 hours	2.18	1.45–2.91	<0.001
Cumulative opioid dose (MME)	0.41	0.31–0.52	<0.001
Duration of surgery (minutes)	0.07	0.02–0.12	0.006
Postoperative mobilization time	0.15	0.03–0.27	0.014
Age	0.04	−0.02–0.10	0.184

DISCUSSION

The results of this study add meaningful evidence to the understanding of how postoperative pain and opioid use influence gastrointestinal motility after major surgery. Our findings are significant because they support known physiological mechanisms and confirm observations seen in different settings, while also providing specific numerical evidence in our local surgical population.

Postoperative pain itself can activate stress responses and neural reflexes that slow gut movement [10]. Surgical trauma and anesthesia trigger inhibitory signals in the enteric nervous system, contributing to delayed gastric and intestinal motility. Published evidence shows that surgical stress and opioids act together to impair coordinated bowel activity after surgery, leading to delayed first bowel sounds, flatus, and bowel movement [11] [12]. Opioid receptors in the gut, when activated by analgesics, inhibit smooth muscle contractility and reduce secretion, which directly slows intestinal transit time and contributes to postoperative ileus (POI) [12]. This mechanism has been described as a key factor in delayed gastrointestinal recovery after abdominal operations in various studies and reviews [13] [14] [15] [16].

In our study, patients with higher pain scores at 24 hours had significantly longer times to first passage of flatus and first bowel movement. This aligns with literature indicating that poorly controlled pain is associated with greater sympathetic activity and suppressed bowel function, independent of opioid use. Additionally, our observation that greater cumulative opioid consumption was strongly correlated with delayed motility reinforces published findings that opioids suppress gut motility through μ-opioid receptor stimulation in the gut wall [17] [18]. Several clinical reviews and observational studies have confirmed that opioid use is a significant risk factor for POI and delayed gastrointestinal recovery [19] [20] [21].

The multivariable regression results confirm that both pain intensity and opioid dose are independent contributors to delayed bowel recovery, even after adjusting for potential confounders such as age, body mass index, duration of surgery, fluid administration, and mobilization time. This supports the notion that postoperative gastrointestinal recovery is multi-factorial, where surgical manipulation, analgesic strategy, and patient factors all interplay. Enhanced recovery after surgery (ERAS) protocols and pain management strategies that reduce opioid exposure, such as multimodal analgesia and early mobilization, have been shown in clinical evidence to shorten recovery and mitigate POI [22] [23].

Clinically, these findings are important for surgical teams and anesthesiologists in resource-limited settings like ours. We show that pain control and opioid dosing are not just comfort issues but have real impact on functional recovery of the gut, which affects length of hospital stay, early feeding, and overall recovery. Strategies that reduce opioid exposure—such as using non-opioid analgesics, NSAIDs, or regional analgesia where possible—should be considered to improve outcomes.

There are limitations. The study is observational, so causal relationships cannot be proven definitively. We depended on routine clinical measurements for motility outcomes, which may vary slightly by observer. Some other factors such as psychological pain responses and exact fluid balance were not quantified. Future research could test opioid-sparing protocols or regional analgesia techniques in similar settings to determine if these approaches improve gastrointestinal recovery further.

CONCLUSION

This study confirms that higher postoperative pain and greater opioid use are associated with delayed return of bowel function after abdominal surgery. These results are consistent with international medical literature and highlight the need to prioritize pain management strategies that balance effective analgesia with the preservation of gut motility to enhance patient recovery.

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