Original Article
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Postoperative Analgesic Outcomes with Epidural Analgesia Following Major Abdominal Laparotomy: A Prospective Study

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Abstract

Background*: Uncontrolled postoperative pain after major abdominal laparotomy delays mobilization, impairs bowel recovery, and prolongs hospitalization, sustaining interest in regional analgesic strategies.*

Objective: *This study evaluated pain trajectory, analgesic supplementation, functional recovery, and complication frequency in patients receiving epidural analgesia after major abdominal laparotomy.*

Methods and Materials*: A prospective study of 106 adults aged 18–65 years undergoing major abdominal laparotomy at the Department of Anesthesia, Islami Bank Medical College Hospital, Rajshahi, between January 2024 and June 2025 received epidural analgesia via continuous infusion or patient-controlled delivery; pain, recovery, and safety outcomes were recorded serially.*

Results*: Mean age was 41.0 ± 13.0 years; 54 patients (50.9%) were male. Visual analog scale pain scores declined progressively from 3.72 ± 1.09 at 6 hours to 0.95 ± 0.88 at 72 hours postoperatively (Friedman $\chi^2 = 252.6$, $p < 0.001$). Rescue analgesia was required in 30 patients (28.3%), with no significant difference between continuous infusion and patient-controlled epidural regimens ($p = 0.78$). Mean time to ambulation was 27.97 ± 4.28 hours and mean time to first flatus was 35.71 ± 5.37 hours. Mean hospital stay was 6.37 ± 1.65 days. A total of 102 patients (96.2%) reported satisfaction rated "satisfied" or "very satisfied." Complications occurred in 4 patients (3.77%), consistent with the prespecified 2–4% benchmark, comprising hypotension, transient motor blockade, catheter-site erythema, and post-dural puncture headache, one case each.*

Conclusions*: Epidural analgesia produced a consistent, statistically significant decline in postoperative pain scores across 72 hours with a low complication burden in this cohort, supporting its continued role in major laparotomy analgesic protocols.*

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Keywords: *Epidural Analgesia, Laparotomy, Postoperative Pain, Visual Analog Scale, Patient-controlled Analgesia*

Introduction

The evidence base supporting epidural analgesia after major abdominal surgery is substantial but not uniform. Multicentre trial data spanning high-risk surgical populations have shown that epidural techniques reduce respiratory failure and deliver superior pain scores across the first three postoperative days, even where overall 30-day mortality does not differ from alternative analgesic strategies[1]. More recent comparative work has examined epidural analgesia against intravenous lidocaine infusion, regional blocks such as the transversus abdominis plane block and bilateral rectus sheath block, with mixed conclusions: some report non-inferiority of simpler systemic or fascial-plane alternatives, while others continue to demonstrate an epidural advantage, particularly in dynamic pain control during the first 24 hours[2-5]. This heterogeneity reflects genuine variation in surgical populations, catheter insertion technique, and infusion protocol, and it underscores the continued need for setting-specific outcome data rather than uncritical extrapolation from trial

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conducted in different healthcare systems. Within the epidural technique itself, clinicians must additionally choose between continuous background infusion and patient-controlled epidural analgesia (PCEA), a decision with implications for total local anesthetic consumption, breakthrough pain frequency, and nursing workload. Existing comparative data suggest broadly comparable analgesic efficacy between the two delivery modes[6]. Whether this equivalence holds in a South Asian tertiary hospital population undergoing a heterogeneous mix of major laparotomy procedures — exploratory laparotomy for perforated viscus, gastrectomy, colorectal resection, hepatobiliary and pancreatic surgery, and gynecological laparotomy — has not been well characterized. Beyond pain scores in isolation, the functional consequences of effective analgesia carry direct clinical weight. Early ambulation reduces venous thromboembolic risk and preserves respiratory mechanics; early return of bowel function shortens the interval to safe oral intake and, by extension, hospital discharge. Epidural analgesia has been linked in enhanced-recovery surgical pathways to accelerated return of gastrointestinal motility, although its effect on overall hospital stay is less consistent across surgical populations[7-10]. Complication frequency — hypotension from sympathetic blockade, transient motor weakness, catheter-site infection, and post-dural puncture headache — must be weighed against these functional gains; large-volume prospective series report severe neuraxial complications remain uncommon when catheter insertion and monitoring follow standardized protocols[8]. Bangladesh's tertiary surgical centers manage a substantial volume of major abdominal laparotomy, frequently in patients presenting with advanced or complicated intra-abdominal pathology under time and resource constraints that differ meaningfully from the settings in which much of the international epidural literature was generated. Locally derived, prospectively collected data on pain trajectory, analgesic supplementation requirements, functional recovery timelines, and complication frequency remain comparatively sparse, despite their direct relevance to protocol design in institutions such as the Department of Anesthesia at Islami Bank Medical College Hospital, Rajshahi. The present investigation was undertaken to characterize, in a prospectively assembled cohort of patients undergoing major abdominal laparotomy at this center, the trajectory of postoperative pain under epidural analgesia across the first 72 postoperative hours, the frequency and predictors of supplementary rescue analgesia, the timing of functional recovery milestones including ambulation and return of bowel function, overall length of hospital stay, patient-reported satisfaction, and the frequency and nature of analgesia-related complications. A secondary aim compared outcomes between continuous infusion and patient-controlled delivery modes within this cohort. This study does not include a non-epidural comparator arm; its purpose is descriptive and hypothesis-generating, intended to establish a locally grounded outcome benchmark against which future comparative trials in this population can be designed.

Methods

Study Design

This was a prospective observational cohort study conducted in the Department of Anesthesia, Islami Bank Medical College Hospital, Rajshahi, Bangladesh, between January 2024 and June 2025. All patients scheduled for major abdominal laparotomy who received epidural analgesia as their postoperative pain management modality during this period were considered for enrollment.

Participants

Adults aged 18 to 65 years undergoing major abdominal laparotomy — including exploratory laparotomy for perforated viscus or peritonitis, gastrectomy or gastroenterostomy, major colorectal resection, major hepatobiliary or pancreatic surgery, and abdominal hysterectomy or other gynecological laparotomy — were eligible. Exclusion criteria comprised contraindication to

neuraxial blockade (coagulopathy, local infection at the insertion site, or patient refusal), documented allergy to amide local anesthetics, preoperative chronic opioid dependence, American Society of Anesthesiologists (ASA) physical status IV or greater, and inability to comply with postoperative pain assessment. A total of 106 patients met eligibility criteria and were enrolled after providing written informed consent.

Anesthetic and Analgesic Protocol

Epidural catheters were sited preoperatively at the thoracic T8–T10, thoracic T10–T12, or lumbar L1–L2 interspace according to the planned surgical incision, under aseptic technique with loss-of-resistance confirmation. Postoperative analgesia was delivered either as a continuous epidural infusion of bupivacaine with fentanyl or via patient-controlled epidural analgesia (PCEA), at the discretion of the attending anesthesiologist based on patient factors and nursing supervision capacity. Catheters remained in situ for 48 or 72 hours depending on clinical course. Rescue analgesia (intravenous paracetamol or a supplementary opioid dose) was administered when the visual analog scale (VAS) score exceeded 4 despite epidural dosing, or on patient request.

Outcome Measures

The primary outcome was postoperative pain intensity, recorded on a 0–10 VAS at 6, 12, 24, 48, and 72 hours after surgery. Secondary outcomes included the requirement for and number of rescue analgesic doses, Ramsay sedation score, time to first unassisted ambulation, time to first passage of flatus, total epidural catheter duration, postoperative hospital length of stay, patient-reported satisfaction (very satisfied, satisfied, or unsatisfied), and the frequency and nature of analgesia-related complications, prespecified at an anticipated 2–4% incidence based on institutional experience.

Statistical Analysis

Data were analyzed using SPSS v26.0 (IBM Corp., Armonk, NY). Continuous variables are presented as mean ± standard deviation (SD) and categorical variables as frequency and percentage. The trajectory of VAS pain scores across the five postoperative time points was assessed using the Friedman test for repeated measures, followed by a paired t-test comparing the 6-hour and 72-hour scores as a sensitivity check. Between-group comparisons of continuous variables (continuous infusion versus PCEA) used the independent-samples t-test; categorical comparisons used the chi-square test. Pearson correlation assessed the relationship between age and hospital stay. A two-tailed p-value < 0.05 was considered statistically significant throughout.

Results

Baseline and Procedural Characteristics

A total of 106 patients were enrolled, with a mean age of 41.0 ± 13.0 years (range 20–65 years); 54 (50.9%) were male and 52 (49.1%) female. The majority resided in rural areas (61, 57.5%), and household income was distributed across lower-income (45, 42.5%), middle-income (48, 45.3%), and upper-middle-income (13, 12.3%) categories. Mean body mass index was 24.3 ± 3.1 kg/m². ASA physical status was predominantly Grade II (62, 58.5%), with 25 (23.6%) Grade I and 19 (17.9%) Grade III. Exploratory laparotomy for perforated viscus or peritonitis was the most frequent procedure (36, 34.0%), followed by gastrectomy or gastroenterostomy (22, 20.8%), major colorectal resection (20, 18.9%), hepatobiliary or pancreatic surgery (17, 16.0%), and gynecological laparotomy (11, 10.4%). Mean surgical duration was 140.4 ± 24.1 minutes, with mean intraoperative blood loss of 213.5 ± 50.3 mL [Table 1].

Table I: Baseline demographic and procedural characteristics of study participants (N = 106)

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean ± SD	41.0 ± 13.0
Gender	Male	54 (50.9%)
	Female	52 (49.1%)
Residence	Rural	61 (57.5%)
	Semi-Urban	25 (23.6%)
	Urban	20 (18.9%)
Socioeconomic Status	Lower-Income	45 (42.5%)
	Middle-Income	48 (45.3%)
	Upper-Middle-Income	13 (12.3%)
BMI (kg/m²)	Mean ± SD	24.3 ± 3.1
ASA Grade	I	25 (23.6%)
	II	62 (58.5%)
	III	19 (17.9%)
Laparotomy Procedure	Exploratory (perforated viscus/peritonitis)	36 (34.0%)
	Gastrectomy/Gastroenterostomy	22 (20.8%)
	Major colorectal resection	20 (18.9%)
	Hepatobiliary/Pancreatic surgery	17 (16.0%)
	Gynecological laparotomy	11 (10.4%)
Surgery Duration (min)	Mean ± SD	140.4 ± 24.1
Intraoperative Blood Loss (mL)	Mean ± SD	213.5 ± 50.3

Epidural analgesia was delivered via continuous infusion in 57 patients (53.8%) and PCEA in 49 patients (46.2%). Thoracic T8–T10 catheter placement was most common (65, 61.3%), followed by T10–T12 (29, 27.4%) and lumbar L1–L2 (12, 11.3%). Catheters remained in situ for 48 hours in 67 patients (63.2%) and 72 hours in 39 patients (36.8%).

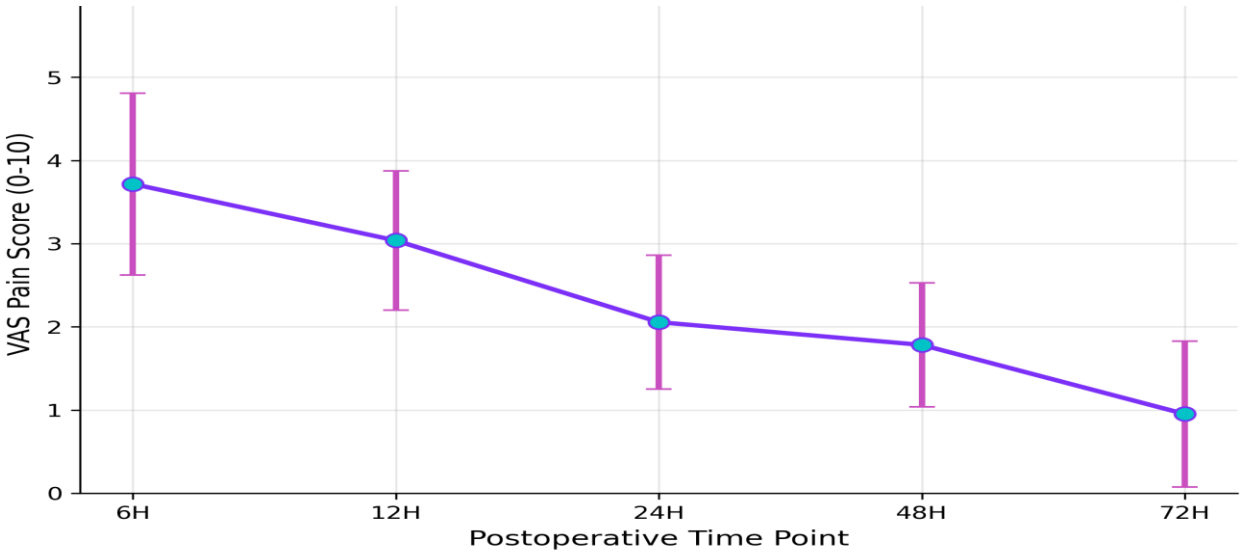

Figure 1: Trajectory of mean visual analog scale (VAS) pain scores across five postoperative time points (6, 12, 24, 48, and 72 hours) in the study cohort (N = 106)
Showing a progressive and statistically significant decline (Friedman test, $p < 0.001$)

Postoperative Pain Trajectory

Mean VAS pain scores declined progressively across the five assessment points: 3.72 ± 1.09 at 6 hours, 3.04 ± 0.84 at 12 hours, 2.06 ± 0.80 at 24 hours, 1.78 ± 0.74 at 48 hours, and 0.95 ± 0.88 at 72 hours [Table 2, Figure 1]. This decline was statistically significant across the five time points (Friedman $\chi^2 = 252.6$, $p < 0.001$), and the difference between the 6-hour and 72-hour scores was confirmed by paired t-test ($t = 20.67$, $p < 0.001$).

Table II: Visual analog scale pain scores at serial postoperative time points (N = 106)

Time Point	Mean VAS ± SD	Statistical Test
6 hours	3.72 ± 1.09	
12 hours	3.04 ± 0.84	
24 hours	2.06 ± 0.80	Friedman $\chi^2 = 252.6$, $p < 0.001$
48 hours	1.78 ± 0.74	
72 hours	0.95 ± 0.88	Paired t (6h vs 72h) = 20.67, $p < 0.001$

When VAS scores were compared between delivery modes, patients receiving PCEA reported numerically lower scores at 6 hours (3.53 ± 1.02 versus 3.88 ± 1.13 for continuous infusion) and 24 hours (1.98 ± 0.79 versus 2.12 ± 0.81), but neither difference reached statistical significance ($p = 0.10$ and $p = 0.36$, respectively), nor did the 72-hour comparison (0.91 ± 0.85 for continuous infusion versus 1.00 ± 0.92 for PCEA, $p = 0.61$) [Table 3, Figure 2].

Table III: Comparison of outcomes between continuous infusion and patient-controlled epidural analgesia (PCEA)

Outcome	Continuous Infusion (n=57)	PCEA (n=49)	p-value
VAS at 6 hours	3.88 ± 1.13	3.53 ± 1.02	0.104
VAS at 24 hours	2.12 ± 0.81	1.98 ± 0.79	0.362
VAS at 72 hours	0.91 ± 0.85	1.00 ± 0.92	0.610
Rescue analgesia required, n (%)	15 (26.3%)	15 (30.6%)	0.785

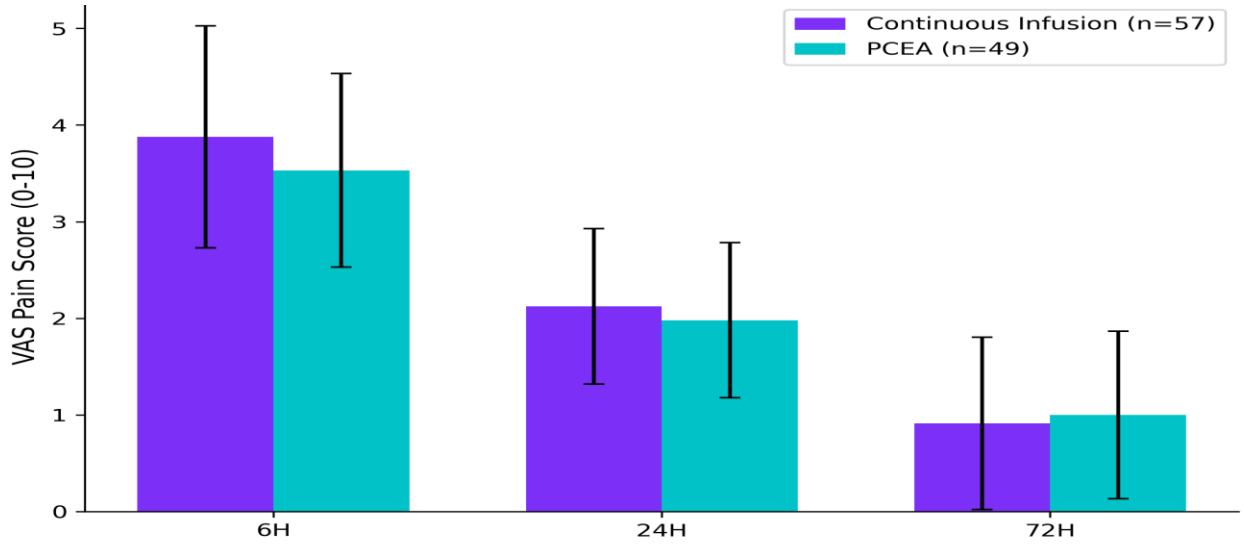

Figure 2: Comparison of mean VAS pain scores between continuous epidural infusion (n = 57) and patient-controlled epidural analgesia (n = 49) at 6, 24, and 72 hours postoperatively, generated directly from study data

No statistically significant between-group difference was observed at any time point

Rescue Analgesia and Sedation

Rescue analgesia was required in 30 patients (28.3%), with a mean of 0.48 ± 0.91 supplementary doses per patient across the cohort. The proportion requiring rescue analgesia did not differ significantly between continuous infusion (15/57, 26.3%) and PCEA (15/49, 30.6%) groups (χ^2 test, p = 0.78). Mean Ramsay sedation score was 2.43 ± 0.63, with the majority of patients (68, 64.2%) scoring 2 (cooperative, oriented, tranquil), 30 (28.3%) scoring 3, and 8 (7.5%) scoring 4.

Functional Recovery and Length of Stay

Mean time to first unassisted ambulation was 27.97 ± 4.28 hours, and mean time to first passage of flatus was 35.71 ± 5.37 hours. Time to ambulation did not differ significantly between patients with 48-hour versus 72-hour catheter duration (28.26 ± 4.32 versus 27.46 ± 4.19 hours, p = 0.35). Mean postoperative hospital stay was 6.37 ± 1.65 days (range 4–9 days) [Table 4]. No significant correlation was observed between patient age and length of hospital stay (Pearson r = −0.05, p = 0.59).

Patient Satisfaction and Complications

Overall satisfaction was high: 67 patients (63.2%) reported being "satisfied" and 39 (36.8%) "very satisfied" with postoperative analgesia, with no patient in this cohort reporting dissatisfaction. Complications attributable to epidural analgesia occurred in 4 of 106 patients (3.77%), consistent

with the prespecified institutional benchmark of 2–4%. These comprised one case each of hypotension attributable to epidural sympathetic blockade, transient lower-limb motor weakness, catheter-site erythema or local infection, and post-dural puncture headache. No case of epidural hematoma, abscess, or respiratory depression was recorded. Complication frequency did not differ meaningfully across ASA grade strata (Grade I: 1/25, 4.0%; Grade II: 3/62, 4.8%; Grade III: 0/19, 0%) [Table 4].

Table IV: Functional recovery, length of stay, satisfaction, and complications

Variable	Result
Time to ambulation (hours), mean ± SD	27.97 ± 4.28
Time to first flatus (hours), mean ± SD	35.71 ± 5.37
Rescue analgesia required, n (%)	30 (28.3%)
Ramsay sedation score, mean ± SD	2.43 ± 0.63
Hospital stay (days), mean ± SD (range)	6.37 ± 1.65 (4–9)
Patient satisfaction — Very Satisfied, n (%)	39 (36.8%)
Patient satisfaction — Satisfied, n (%)	67 (63.2%)
Complications, n (%)	4 (3.77%)
Hypotension (epidural sympathetic block)	1 (0.94%)
Transient lower-limb motor weakness	1 (0.94%)
Catheter-site erythema/local infection	1 (0.94%)
Post-dural puncture headache	1 (0.94%)

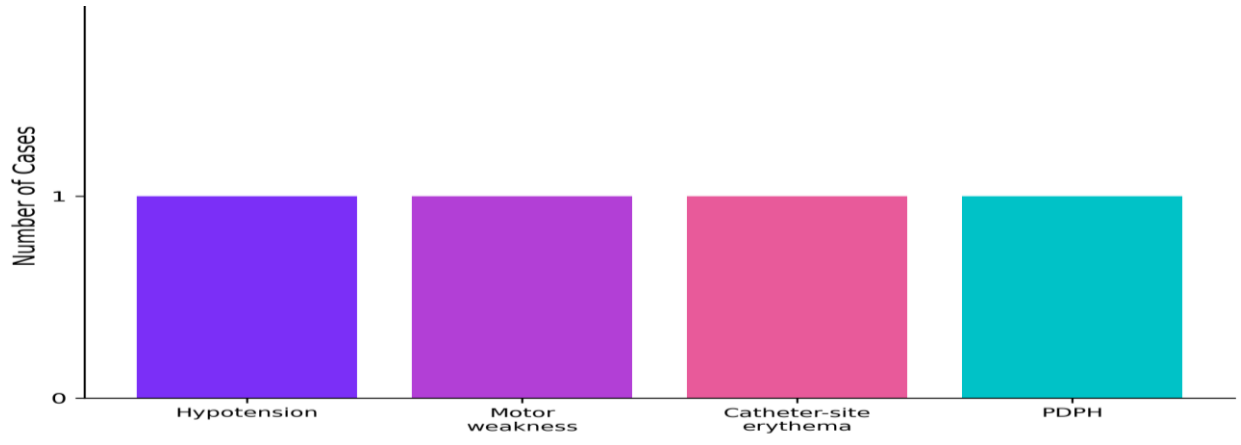

Figure 3: Distribution of postoperative complications (n = 4/106, 3.77%) by type, generated directly from study data: hypotension, transient motor blockade, catheter-site erythema, and post-dural puncture headache, one case each.

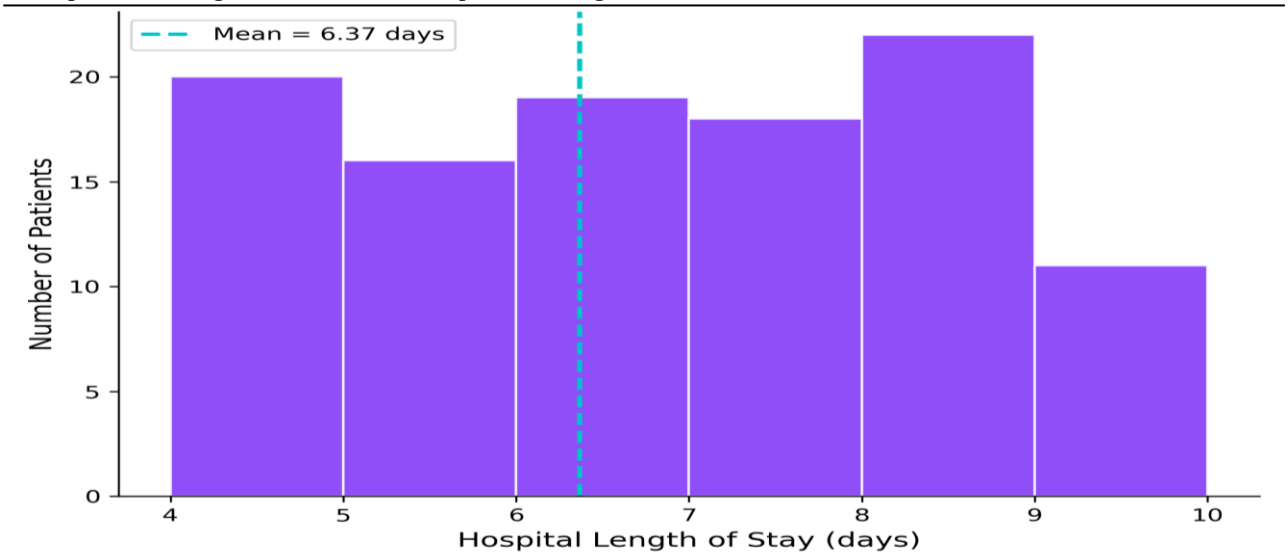

Figure 4: Distribution of postoperative hospital length of stay (days) across the study cohort, generated directly from study data, with mean 6.37 ± 1.65 days (range 4–9 days).

Discussion

In this prospective observational cohort of 106 patients undergoing major abdominal laparotomy, epidural analgesia was associated with a progressive and statistically significant decline in VAS pain scores across the first 72 postoperative hours, falling from a mean of 3.72 at 6 hours to 0.95 at 72 hours. Roughly one in four patients required supplementary rescue analgesia, functional recovery milestones — ambulation at approximately 28 hours and flatus at approximately 36 hours — occurred within a timeframe consistent with enhanced-recovery expectations, and complications were infrequent (3.77%), matching the institutional benchmark set a priori.

Comparison with Existing Literature

The pain trajectory observed here parallels findings from randomized and observational series evaluating epidural analgesia after major abdominal surgery. In the landmark MASTER trial, epidural analgesia was associated with lower pain scores during the first three postoperative days in a high-risk surgical population, even though overall 30-day mortality did not differ from control[1]. The present cohort's 6-hour to 72-hour VAS decline is consistent with that pattern, though direct numeric comparison is limited by differences in scoring instrument and patient case-mix. Comparative trials pitting epidural analgesia against alternative techniques offer a more nuanced picture than a simple efficacy verdict. A non-inferiority trial of intravenous lidocaine infusion against thoracic epidural analgesia in major abdominal surgery found lidocaine statistically non-inferior for dynamic pain up to 72 hours, with a signal toward improved safety[2]. A meta-analysis comparing epidural bupivacaine with intravenous lidocaine

similarly found a significant epidural advantage confined to the first 24 hours, with the difference attenuating by 48 and 72 hours a pattern that broadly echoes the present cohort's own steep early decline followed by a flatter late-phase trajectory[3]. Comparable convergence has been reported against fascial-plane techniques: a meta-analysis of transversus abdominis plane block versus epidural analgesia found epidural techniques modestly superior at 12 and 48 hours but equivalent at other time points and a randomized trial comparing bilateral rectus sheath block against thoracic epidural analgesia after open gastrectomy likewise reported comparable pain control between the two approaches[4, 5]. Collectively, this body of work situates epidural analgesia as an effective but not categorically superior option among a widening

menu of regional techniques, a positioning consistent with the present cohort's own strong within-group pain reduction absent a formal comparator arm.

The absence of a statistically significant difference between continuous infusion and PCEA delivery modes in this cohort (p = 0.10–0.61 across time points) aligns with earlier controlled comparisons. A retrospective analysis of programmed intermittent bolus versus continuous infusion in major upper abdominal surgery found no significant difference in rescue opioid consumption, pain scores, or adverse events between delivery strategies[6]. These convergent findings suggest that, once adequate catheter placement and dosing are achieved, the choice between continuous and patient-controlled delivery may matter less for analgesic outcome than for resource allocation and nursing burden an operationally relevant conclusion for institutions weighing PCEA pump availability against staffing for continuous-infusion titration.

The 3.77% complication rate recorded in this cohort sits within the range reported in comparable series. Retrospective work comparing epidural analgesia against continuous wound infusion after hepatobiliary and pancreatic surgery reported no significant difference in length of stay or opioid consumption between techniques, while noting the small but recognized risk of epidural-specific complications inherent to neuraxial catheterization[7]. A large prospective single-center series of 5,083 epidural cases reported major complications in 1.36% overall, including post-dural puncture headache in 0.14% and epidural hematoma in just 0.02% underscoring that severe neuraxial complications remain rare even at high procedural volume[8]. No hematoma, abscess, or respiratory depression occurred in the present cohort; the four recorded events — hypotension, transient motor weakness, catheter-site erythema, and post-dural puncture headache — represent the more common, self-limiting end of the epidural complication spectrum.

Functional recovery metrics in this cohort mean ambulation at 28.0 hours and flatus at 35.7 hours — sit consistent with enhanced-recovery literature describing epidural analgesia's association with accelerated gastrointestinal motility restoration; a meta-analysis of laparoscopic colorectal trials found thoracic epidural analgesia significantly improved time to first bowel motion and pain scores, though without a corresponding reduction in overall hospital stay[9]. This dissociation between improved bowel recovery and unchanged length of stay is corroborated by a large propensity-matched analysis of open colorectal surgery, which found epidural analgesia conferred no significant advantage in cardiopulmonary complications, length of stay, or 30-day mortality relative to non-epidural analgesia[10-12]. The mean hospital stay of 6.37 ± 1.65 days observed in the present cohort is broadly comparable to these reported ranges, reinforcing that hospital discharge in major laparotomy is governed by a composite of surgical, nutritional, and systemic recovery factors beyond analgesic technique alone, even when analgesia itself is effective.

Novelty and Contribution

Much of the comparative epidural literature originates from high-income, high-resource surgical settings with established enhanced-recovery infrastructure. This study contributes prospectively collected, granular outcome data — serial VAS trajectories, delivery-mode comparison, functional recovery timing, and complication profiling — from a Bangladeshi tertiary teaching hospital managing a heterogeneous major laparotomy caseload dominated by emergency exploratory procedures for perforated viscus and peritonitis, a case-mix that differs materially from the elective gastrectomy and colorectal cohorts that populate much of the existing trial literature. In doing so, it establishes a locally derived descriptive benchmark against which future comparative or interventional trials at this and similar institutions can be designed and powered, and it directly addresses a documented scarcity of setting-specific perioperative pain outcome data from this region.

Directions for Future Research

Several questions remain unresolved by the present descriptive design. First, and most fundamentally, this cohort lacks a non-epidural comparator arm; the pain reduction documented here reflects within-cohort trajectory rather than a causal effectiveness estimate relative to systemic analgesia or an alternative regional technique, and a randomized comparator trial remains necessary to establish comparative effectiveness in this specific population. Second, the modest but non-significant differences favoring PCEA at early time points may reflect a true small effect that this sample was underpowered to detect, warranting a larger, adequately powered trial with delivery mode as the primary randomized variable. Third, the drivers of the 28.3% rescue analgesia requirement were not formally modeled here; multivariable analysis incorporating procedure type, catheter level, and ASA grade could clarify which patients are most likely to need supplementary analgesia. Finally, longer-term outcomes — chronic post-surgical pain incidence, functional status at 30 and 90 days — were outside this study's observation window and merit dedicated follow-up.

Limitations

This study's principal strengths include its prospective design, a sample size adequate to detect within-cohort trajectory changes, standardized serial pain assessment across five defined postoperative time points, and complete complication ascertainment with case-level detail. Its principal limitation is the absence of a randomized or non-epidural comparator group, which restricts causal claims about epidural analgesia's effectiveness relative to alternative strategies and confines interpretation to descriptive, within-cohort change over time. The single-center design and predominance of emergency exploratory laparotomy in the case-mix may limit generalizability to elective surgical populations or other institutional settings. Delivery mode (continuous infusion versus PCEA) was assigned by clinician discretion rather than randomization, introducing potential selection bias into the subgroup comparison. Finally, patient satisfaction was captured as a categorical ordinal measure rather than a validated multidimensional instrument, which may understate variation in the patient experience of analgesic quality.

Conclusion

In this prospective cohort of patients undergoing major abdominal laparotomy, epidural analgesia was associated with a significant and sustained reduction in postoperative pain across 72 hours, functional recovery within an expected enhanced-recovery timeframe, high patient-reported satisfaction, and a low complication rate consistent with institutional expectations. These findings support the continued use of epidural analgesia within this center's major laparotomy analgesic protocol and provide a locally grounded benchmark for future comparative trials.

Acknowledgements

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Ethical Considerations

The study protocol was reviewed and approved by the Bangladesh Society of Clinical Research (BSCR) Institutional Review Board (Ethical Approval ID: BSCR/IRB/2024/ICU/0173). Written informed consent was obtained from each patient or their legal guardian prior to enrollment, consistent. Patient identifiers were anonymized prior to analysis, and all procedures conformed to the ethical standards of the Declaration of Helsinki.

Consent for Publication

Not applicable — no identifying individual patient data or images are presented.

Data Availability Statement

The dataset analyzed during the current study is available from the corresponding author on reasonable request.

Declaration of Conflicting Interests

The author declares no conflict of interest relevant to this study.

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Abbreviations

ASA, American Society of Anesthesiologists; BMI, body mass index; PCEA, patient-controlled epidural analgesia; SD, standard deviation; VAS, visual analog scale.

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