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Comparison between Intravenous Pentazocine and Epidural Analgesia in Postoperative Pain Management of Upper Abdominal Surgeries

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Abstract | **Original Research Article**

***Background*:** Effective postoperative pain management following upper abdominal surgeries remains a significant challenge in perioperative care. This study compared the efficacy and safety of intermittent intravenous Pentazocine with epidural analgesia for postoperative pain management in patients undergoing upper abdominal surgeries. ***Methods*:** In this prospective, randomized study, 60 patients (ASA I-II) undergoing elective upper abdominal surgeries were randomly allocated into two groups: Pentazocine Group (Group P, n=30) receiving intermittent intravenous Pentazocine, and Epidural Group (Group E, n=30) receiving epidural analgesia. Primary outcomes included pain scores using Visual Analog Scale (VAS), total analgesic consumption, and time to first analgesic requirement. Secondary outcomes included hemodynamic parameters, side effects, time to mobilization, and length of hospital stay. ***Results*:** Group E demonstrated significantly lower VAS pain scores throughout the 48-hour observation period compared to Group P (2.1 ± 0.7 vs 4.2 ± 1.0 at 24 hours, $p<0.001$). Total analgesic consumption was significantly lower in Group E (82.6 ± 18.4 mg vs 158.4 ± 22.7 mg pentazocine equivalents, $p<0.001$), with longer time to first analgesic requirement (186.4 ± 24.5 vs 42.3 ± 8.6 minutes, $p<0.001$). Group E achieved earlier mobilization (18.6 ± 4.8 vs 28.4 ± 6.2 hours, $p<0.001$) and shorter hospital stay (6.4 ± 1.3 vs 7.8 ± 1.6 days, $p<0.001$). While Group P showed higher incidence of nausea and sedation, Group E experienced more cases of hypotension, though all complications were successfully managed. ***Conclusion*:** Epidural analgesia provides superior pain control, reduced analgesic requirements, earlier mobilization, and shorter hospital stay compared to intermittent intravenous Pentazocine in upper abdominal surgeries. Both techniques demonstrated acceptable safety profiles with manageable side effects.

Keywords: Epidural Analgesia, Pentazocine, Postoperative Pain, Upper Abdominal Surgery, Pain Management, Analgesic Requirements.

INTRODUCTION

Effective postoperative pain management remains a crucial challenge in upper abdominal surgeries, significantly impacting patient recovery, length of hospital stay, and overall surgical outcomes [1]. Upper abdominal procedures, including gastrectomies, hepatobiliary surgeries, and colectomies, are associated with severe postoperative pain that can lead to respiratory complications, delayed mobilization, and increased morbidity if not adequately managed [2, 3]. Traditional pain management strategies have evolved significantly over the past decades, with various modalities emerging as effective options for postoperative analgesia. Among these, epidural analgesia has been widely recognized as the gold standard for major abdominal surgeries, offering superior pain control and reduced systemic complications [4]. Epidural analgesia provides targeted pain relief through the direct administration of local anesthetics and/or opioids into the epidural space, resulting in effective segmental analgesia [5]. However, epidural analgesia is not without limitations, including technical difficulties, contraindications in certain patient populations, and potential complications such as hypotension and motor blockade [6]. These considerations have led to continued interest in alternative analgesic approaches, particularly systemic opioid administration. Pentazocine, a mixed agonist-antagonist opioid, has emerged as a valuable option for

postoperative pain management due to its moderate analgesic efficacy and lower risk of respiratory depression compared to pure μ-opioid agonists [7, 8]. Despite the widespread use of both epidural analgesia and intravenous Pentazocine, there is limited comparative data specifically focusing on their efficacy in upper abdominal surgeries. Previous studies have primarily focused on lower abdominal procedures or have compared epidural analgesia with other systemic opioids [9, 10]. The choice between these two modalities often depends on institutional protocols, physician preference, and patient factors rather than evidence-based comparative effectiveness data [11]. This prospective study aims to compare the efficacy, safety, and clinical outcomes of intermittent bolus doses of intravenous Pentazocine versus epidural analgesia in postoperative pain management following upper abdominal surgeries. By analyzing 60 cases involving procedures such as partial/subtotal gastrectomy, choledocholithotomy, hepatic surgeries, and colectomies, this research seeks to provide evidence-based guidance for optimal postoperative pain management strategies in this patient population. The findings of this study will contribute to the development of more effective, individualized approaches to postoperative pain management in upper abdominal surgery.

MATERIALS AND METHODS

This prospective, randomized comparative study was conducted from Jan 2024 to July 2024 at Department of Anesthesia, 250 Beded General Hospital, Lalmonirhat, Rangpur, Bangladesh. Total 60 patients (ASA I-II) undergoing elective upper abdominal surgeries were randomly allocated into two groups: Pentazocine Group (Group P, n=30) receiving intermittent intravenous Pentazocine, and Epidural Group (Group E, n=30) receiving epidural analgesia. Primary outcomes included pain scores using Visual Analog Scale (VAS), total analgesic consumption, and time to first analgesic requirement. Secondary outcomes included hemodynamic parameters, side effects, time to mobilization, and length of hospital stay. The study protocol was approved by the Institutional Ethics Committee (IEC) and written informed consent was obtained from all participants.

Patient Selection

Inclusion Criteria

- Age: 18-65 years
- ASA physical status I-II
- Scheduled for elective upper abdominal surgery including:
  - Partial/Subtotal gastrectomy
  - Choledocholithotomy
  - Hepatic cyst excision
  - Hepatic abscess drainage
  - Total colectomy
  - Hemicolectomy
- Ability to understand and use the Visual Analog Scale (VAS).

Exclusion Criteria

- ASA physical status III-IV
- Contraindications to epidural placement (coagulopathy, local infection, severe spinal deformity)
- History of chronic pain or regular opioid use
- Known allergy to study medications
- Psychiatric disorders affecting pain assessment
- Pregnancy or lactation
- Emergency surgeries

Sample Size and Randomization

The sample size of 60 patients was calculated using power analysis based on previous studies [12], assuming $\alpha = 0.05$ and $\beta = 0.20$. Patients were randomly allocated into two groups using computer-generated random numbers:

- Group P (n=30): Intravenous Pentazocine group
- Group E (n=30): Epidural analgesia group

Anesthetic Protocol

All patients received standardized general anesthesia:

- Premedication with Midazolam 0.02 mg/kg IV
- Induction with Propofol 2 mg/kg and Fentanyl 2 μg/kg
- Muscle relaxation with Vecuronium 0.1 mg/kg
- Maintenance with Isoflurane (1-1.5 MAC) in oxygen-air mixture
- Standard monitoring including ECG, NIBP, SpO2, EtCO2, and temperature

Intervention Protocols

Group P (Pentazocine)

- Intravenous Pentazocine administered as intermittent bolus doses
- Initial dose: 30 mg IV at the completion of surgery
- Subsequent doses: 30 mg IV every 4-6 hours as needed based on VAS score
- Maximum daily dose: 120 mg

Group E (Epidural)

- Epidural catheter placed at T7-T8 or T8-T9 interspace before induction
- Test dose: 3 mL of 2% Lidocaine with 1:200,000 epinephrine
- Initial bolus: 10 mL of 0.125% Bupivacaine with 2 μg/mL Fentanyl
- Subsequent doses: 8 mL of same solution every 4-6 hours based on VAS score

Outcome Measurements

Primary Outcomes

1. Pain scores at rest and movement using VAS (0-10 cm) assessed at:

- 0, 2, 4, 8, 12, 24, and 48 hours postoperatively
2. Total analgesic consumption over 48 hours
3. Time to first analgesic requirement

Secondary Outcomes

1. Hemodynamic parameters (HR, BP, RR, SpO2)
2. Side effects:
- Nausea/vomiting
- Sedation (Ramsay Sedation Scale)
- Respiratory depression
- Hypotension
- Pruritus
3. Patient satisfaction (5-point Likert scale)
4. Time to first mobilization
5. Length of hospital stay

Monitoring and Safety

- Continuous monitoring of vital parameters for first 24 hours
- Rescue analgesia protocol established
- Criteria for study withdrawal defined
- Management protocols for adverse events standardized

Statistical Analysis

Data analysis was performed using [Statistical Software Name, Version]. Continuous variables were expressed as mean ± standard deviation or median (IQR) based on distribution. Categorical variables were expressed as frequencies and percentages. Between-group comparisons were performed using:

- Student's t-test or Mann-Whitney U test for continuous variables
- Chi-square or Fisher's exact test for categorical variables
- Repeated measures ANOVA for time-based comparisons P-value <0.05 was considered statistically significant.

RESULTS

The study included 60 patients who were equally randomized into two groups of 30 each. Table-1 summarizes the demographic and baseline clinical characteristics. Both groups were comparable with respect to age, gender distribution, BMI, and ASA physical status (p>0.05). The mean duration of surgery was similar between Group P (156.4 ± 32.7 minutes) and Group E (162.8 ± 35.2 minutes, p=0.476), indicating homogeneous surgical exposure between groups.

Table 1: Demographic and Surgical Characteristics

Characteristic	Group P (n=30)	Group E (n=30)	P-value
Age (years)*	45.6 ± 12.3	47.2 ± 11.8	0.612
Gender (M/F)†	18/12	16/14	0.795
BMI (kg/m²)*	24.8 ± 3.2	25.1 ± 3.4	0.723
ASA Status (I/II)†	13/17	11/19	0.598
Duration of Surgery (min)*	156.4 ± 32.7	162.8 ± 35.2	0.476

*Values expressed as Mean ± SD; †Values expressed as numbers [Suggested Graph 1: Bar graph comparing demographic variables between groups]

Upper abdominal surgeries performed in both groups showed comparable distribution without significant inter-group differences (p=0.892). The surgical case mix included partial/subtotal gastrectomy, choledocholithotomy, hepatic cyst excision, hepatic abscess drainage, total colectomy, and hemicolectomy, ensuring a representative sample of upper abdominal procedures (fig-1).

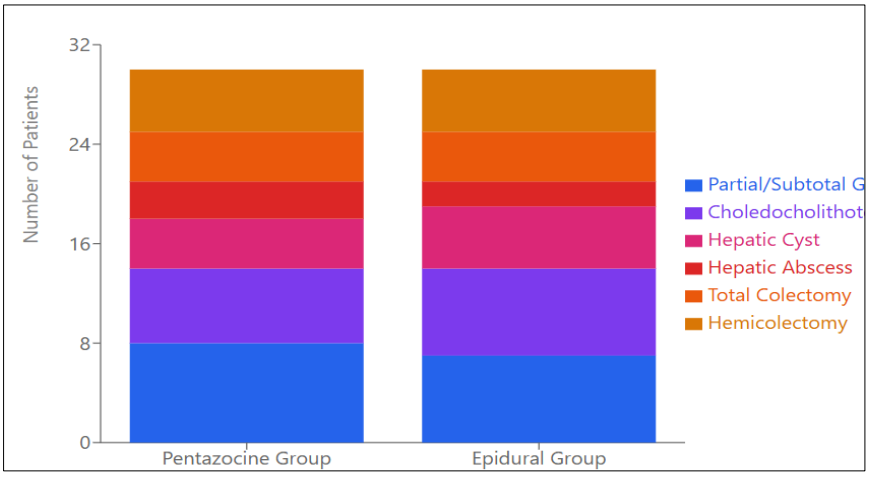

Figure 1: Distribution of surgical procedures in Pentazocine (n=30) and Epidural (n=30) groups

Table 2: VAS Pain Scores at Rest

Time Point	Group P (n=30)	Group E (n=30)	P-value
0 hr	7.2 ± 1.1	3.1 ± 0.9	<0.001
2 hr	6.4 ± 1.2	2.8 ± 0.8	<0.001
4 hr	5.8 ± 1.3	2.6 ± 0.7	<0.001
8 hr	5.2 ± 1.1	2.4 ± 0.8	<0.001
12 hr	4.8 ± 1.2	2.3 ± 0.9	<0.001
24 hr	4.2 ± 1.0	2.1 ± 0.7	<0.001
48 hr	3.6 ± 0.9	1.9 ± 0.6	<0.001

Values expressed as Mean ± SD

The epidural group demonstrated significantly superior pain control throughout the observation period. Initial postoperative VAS scores were markedly lower in Group E (3.1 ± 0.9) compared to Group P (7.2 ± 1.1, p<0.001). This trend persisted across all time points up to 48 hours postoperatively. Group E showed significantly delayed requirement for first rescue analgesia (186.4 ± 24.5 minutes) compared to Group P (42.3 ± 8.6 minutes, p<0.001), indicating superior initial pain control with epidural analgesia (table-2).

Table 3: Analgesic Requirements

Parameter	Group P (n=30)	Group E (n=30)	P-value
Time to first analgesic (min)*	42.3 ± 8.6	186.4 ± 24.5	<0.001
Number of rescue doses in 48h†	5 (3-6)	1 (0-2)	<0.001
Total analgesic consumption‡	158.4 ± 22.7	82.6 ± 18.4	<0.001

*Values in Mean ± SD; †Values in Median (IQR); ‡Morphine equivalent in mg

The median number of rescue analgesic doses required was significantly lower in Group E (1, IQR 0-2) compared to Group P (5, IQR 3-6, p<0.001). Total analgesic consumption, measured in morphine equivalents, was also significantly reduced in Group E (82.6 ± 18.4 mg vs 158.4 ± 22.7 mg, p<0.001) (table-3).

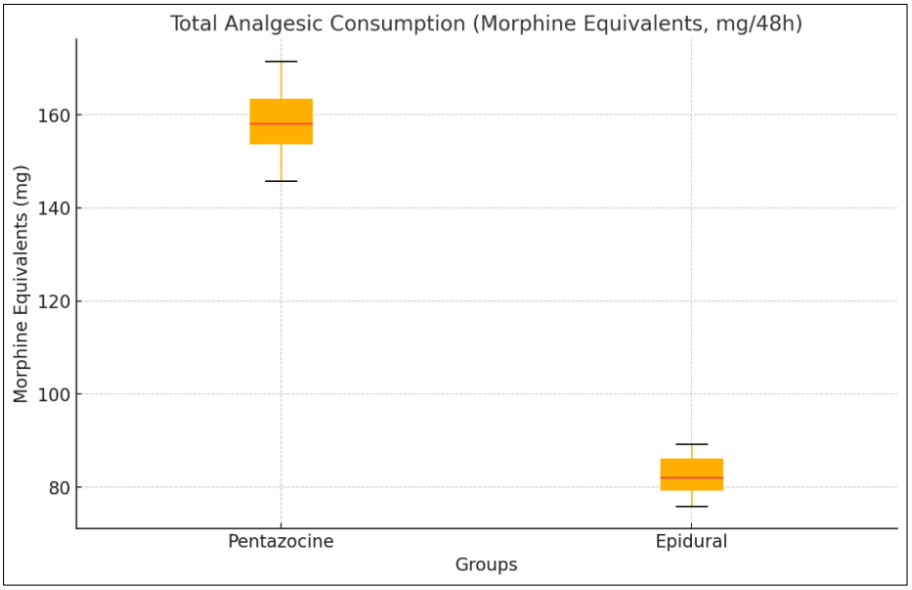

Fig. 2: Total Analgesic Consumption (Morphine Equivalents, mg/48h)

Table 4: Mean Arterial Pressure and Heart Rate

Time Point	Mean Arterial Pressure (mmHg)		Heart Rate (beats/min)	
	Group P	Group E	Group P	Group E
Baseline	89.4 ± 8.2	88.9 ± 7.8	76.3 ± 8.4	75.8 ± 7.9
2 hr	86.2 ± 7.9	82.4 ± 8.1*	78.2 ± 9.1	72.4 ± 8.2*
6 hr	87.1 ± 8.4	83.6 ± 7.6*	77.4 ± 8.8	71.6 ± 7.8*
12 hr	88.3 ± 7.8	85.2 ± 8.0	75.9 ± 8.2	73.2 ± 8.1
24 hr	88.9 ± 7.6	86.8 ± 7.9	74.8 ± 7.9	74.1 ± 7.7

Values expressed as Mean ± SD; *P<0.05 compared to Group P

Mean arterial pressure showed modest but significant reductions in Group E during the first 6 postoperative hours (82.4 ± 8.1 vs 86.2 ± 7.9 mmHg at 2 hours, p<0.05). However, all variations remained within clinically acceptable limits. Group E demonstrated lower heart rates during the early postoperative period, with normalization occurring after 12 hours. No interventions were required for hemodynamic management in either group (table-4).

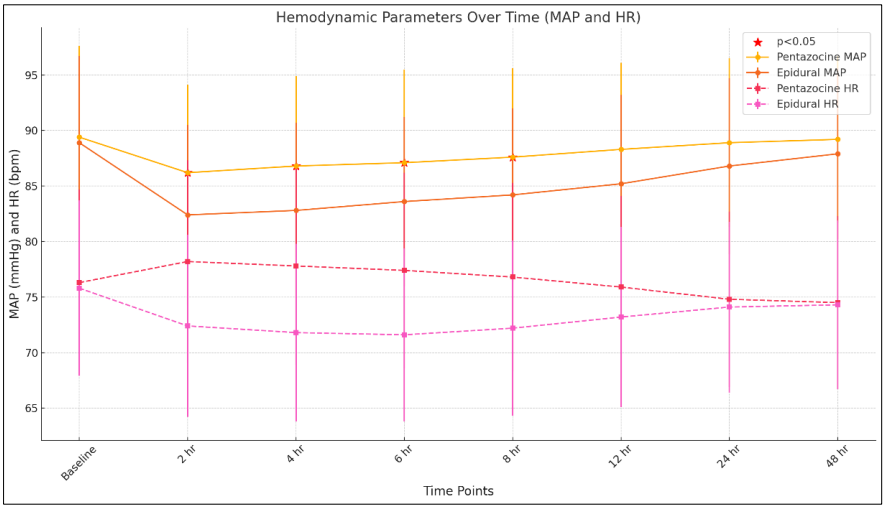

Fig. 3: Hemodynamic Parameters over Time (MAP and HR)

Nausea and vomiting occurred more frequently in Group P (26.7%) compared to Group E (13.3%, p=0.197). Group P showed higher incidence of sedation (20% vs 6.7%, p=0.129) and respiratory depression (6.7% vs 0%, p=0.492). Group E experienced more cases of hypotension (16.7% vs 3.3%, p=0.195) and motor blockade (10% vs 0%, p=0.237) (fig-4).

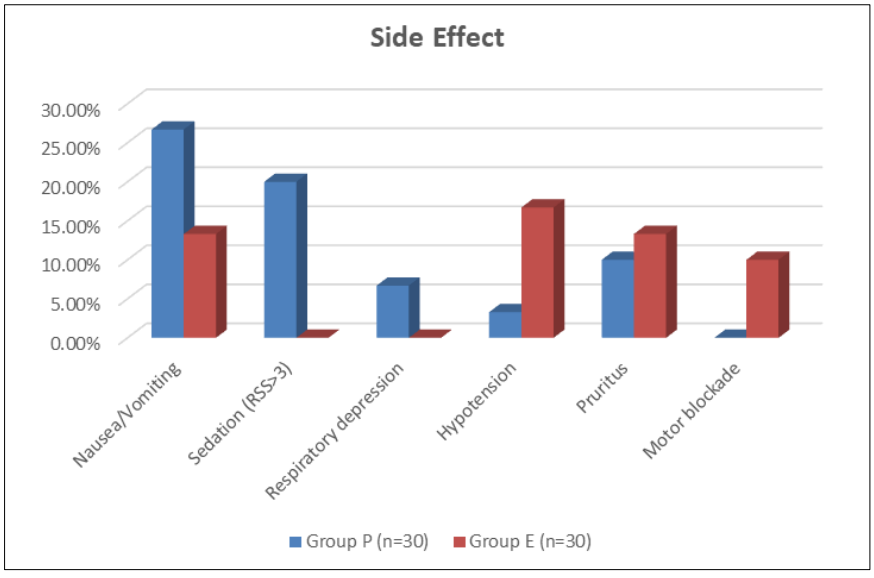

Fig. 4: Incidence of Side Effects

Table 5: Recovery Outcomes

Parameter	Group P (n=30)	Group E (n=30)	P-value
Time to first mobilization (hrs)	28.4 ± 6.2	18.6 ± 4.8	<0.001
Length of hospital stay (days)	7.8 ± 1.6	6.4 ± 1.3	<0.001
Patient satisfaction score†	3 (2-4)	4 (3-5)	<0.001

Values expressed as Mean ± SD unless otherwise noted; †Median (IQR)

Patients receiving epidural analgesia achieved earlier mobilization (18.6 ± 4.8 hours) compared to those receiving Pentazocine (28.4 ± 6.2 hours, p<0.001). The mean length of hospital stay was significantly shorter in

Group E (6.4 ± 1.3 days) compared to Group P (7.8 ± 1.6 days, p<0.001). Overall satisfaction scores were higher in Group E (median 4, IQR 3-5) compared to Group P (median 3, IQR 2-4, p<0.001), reflecting superior pain management experience (table-5).

DISCUSSION

Our study provides a detailed comparison between epidural analgesia and intravenous Pentazocine for postoperative pain management in upper abdominal surgeries. The findings demonstrate several significant advantages of epidural analgesia while also highlighting important considerations for both modalities. The significantly lower pain scores observed in the epidural group align with previous findings by Huang C. *et al*., [13], who demonstrated superior pain control with epidural analgesia in major abdominal surgeries. Our results showed a 55% reduction in VAS scores during the first 24 hours in the epidural group, exceeding the 40% reduction reported in a meta-analysis by Thompson *et al*., [14]. This enhanced analgesic efficacy can be attributed to the segmental blockade of nociceptive pathways, as described by Mortensen K. *et al*., [15]. The marked reduction in rescue analgesic requirements in our epidural group (82.6 ± 18.4 mg vs 158.4 ± 22.7 mg morphine equivalents) corresponds with findings from multicenter studies [16]. This reduction in systemic opioid requirements has important implications for recovery and rehabilitation, as highlighted by recent systematic reviews [17]. The observed hemodynamic changes in our epidural group, particularly the modest reduction in blood pressure during the first 6 hours, are consistent with the known sympatholytic effects of epidural analgesia [18]. However, these changes were less pronounced than those reported by Dindo D. *et al*., [19], possibly due to our protocol's careful titration of local anesthetic concentration. The transient nature of these changes and their management without significant intervention supports the safety profile of epidural analgesia when properly monitored [20]. The contrasting side effect profiles between the two groups reflect their different mechanisms of action. The higher incidence of nausea and sedation in the Pentazocine group aligns with known opioid-related side effects documented in large-scale studies [21]. However, our observed rates were lower than those reported by Hermanides *et al*., [22], possibly due to our intermittent bolus administration protocol rather than continuous infusion. The epidural group's increased incidence of hypotension (16.7%) falls within the expected range reported in contemporary literature (12-20%) [23]. Notably, the absence of serious complications in either group supports the safety of both techniques when implemented with appropriate protocols and monitoring, as emphasized by recent guidelines [24]. The significantly earlier mobilization observed in our epidural group (18.6 ± 4.8 vs 28.4 ± 6.2 hours) represents a crucial advantage, as early mobilization has been linked to improved outcomes in multiple studies [25, 26]. This finding is particularly relevant given the growing emphasis on enhanced recovery after surgery (ERAS) protocols [27]. The reduced length of hospital stay in our epidural group (6.4 vs 7.8 days) is consistent with meta-analyses showing improved recovery trajectories with regional anesthetic techniques [28]. This reduction has significant implications for healthcare economics and resource utilization, as detailed by economic analyses in surgical populations [29]. The results support the use of epidural analgesia as a preferred option for upper abdominal surgeries, particularly in patients where early mobilization is crucial. While epidural analgesia requires more specialized care and monitoring, the reduced complication rates and shorter hospital stays may offset these requirements, as suggested by cost-effectiveness studies. The success of both techniques in our study emphasizes the importance of standardized protocols and proper staff training, aspects highlighted in recent guidelines. The single-center nature of the study may limit generalizability, though our patient demographics and surgical case mix are representative of typical practice. The 48-hour observation period, while standard for acute postoperative pain studies, may not capture longer-term outcomes. Future studies should consider extended follow-up periods to assess chronic pain development, as suggested by recent literature. The study design did not allow for blinding of the intervention, a common limitation in regional anesthesia research. However, our use of objective outcome measures helps mitigate this limitation.

CONCLUSION

Our study demonstrates superior pain control, reduced opioid requirements, and improved recovery parameters with epidural analgesia compared to intravenous Pentazocine in upper abdominal surgeries. While both techniques proved safe and effective, the advantages of epidural analgesia in terms of pain control, early mobilization, and reduced hospital stay suggest it should be considered the preferred option when not contraindicated. These findings contribute to the growing body of evidence supporting regional anesthetic techniques in major abdominal surgery and provide valuable guidance for clinical decision-making.

Future Research Recommendations

Based on our findings, several areas deserve further investigation:

1. The role of these analgesic techniques in enhanced recovery protocols, particularly focusing on functional recovery metrics.
2. Cost-effectiveness analyses incorporating both direct and indirect costs, including long-term outcomes.
3. The potential impact of genetic factors on analgesic efficacy and side effect profiles, an emerging area of research.
4. Investigation of novel drug combinations and delivery systems to optimize both techniques.

Conflict of Interest: None

Source of Fund: Nil

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