

Research Article

# Comparative Study of Epidural vs. Intravenous Patient-Controlled Analgesia in Abdominal Surgery

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## Abstract

**Background:** Effective postoperative pain management is crucial for recovery in patients undergoing abdominal surgery. Epidural Patient-Controlled Analgesia (EPCA) and Intravenous Patient-Controlled Analgesia (IVPCA) are prominent methods, but their comparative efficacy and patient satisfaction rates have not been thoroughly explored in this specific surgical context.

**Objective:** This study aims to compare the efficacy, safety, and patient satisfaction of EPCA and IVPCA in managing postoperative pain in patients undergoing abdominal surgery. **Methods:** A retrospective cohort study was conducted with a sample of 140 patients who underwent various abdominal surgeries and received either EPCA (n=70) or IVPCA (n=70) for pain management. Data on pain scores, patient satisfaction, and complication rates were collected and analyzed. Statistical significance was determined using chi-square tests for categorical data and t-tests for continuous variables. **Results:** Patients in the EPCA group reported significantly lower pain scores at 6, 12, 24, and 48 hours post-surgery ( $p < 0.05$  for all) compared to the IVPCA group. EPCA was also associated with higher patient satisfaction regarding pain management, ease of use, and overall comfort ( $p < 0.01$ ). The incidence of nausea and vomiting was significantly lower in the EPCA group (14.3% vs. 35.7%,  $p < 0.001$ ). There were no significant differences in the rates of respiratory depression and hypotension between the two groups. **Conclusion:** EPCA provides superior pain control and greater patient satisfaction compared to IVPCA in the context of abdominal surgery, with fewer gastrointestinal side effects. These findings suggest that EPCA should be considered as a preferred method for pain management post-abdominal surgery when clinically appropriate.

**Keywords:** Epidural analgesia, Intravenous analgesia, Abdominal surgery

## INTRODUCTION

Postoperative pain management is a crucial aspect of patient care following abdominal surgery. Adequate pain control not only improves comfort but also reduces the risk of complications and accelerates recovery. Among the various modalities for postoperative pain relief, Epidural Patient-Controlled Analgesia (EPCA) and Intravenous Patient-Controlled Analgesia (IVPCA) are widely used due to their effectiveness and the autonomy they provide to the patient. This study aims to compare these two methods in terms of pain control efficacy, patient

satisfaction, and complication rates in abdominal surgery patients.[1][2]

Epidural analgesia involves the administration of analgesics directly into the epidural space, allowing for targeted pain relief with reduced systemic drug exposure. This method is known for its effectiveness in controlling severe pain and reducing the need for systemic opioids. However, it requires precise placement by an anesthesiologist and carries risks such as epidural hematoma, infection, and potential for hypotension.[3]

Intravenous patient-controlled analgesia, on the other hand, offers pain relief through

systemic administration of opioids via a pump that the patient can control. While IVPCA provides significant pain relief and is easier to manage, it is associated with systemic opioid-related side effects such as nausea, vomiting, constipation, and respiratory depression.[4]

### Aim

To compare the efficacy and safety of Epidural versus Intravenous Patient-Controlled Analgesia in patients undergoing abdominal surgery.

### Objectives

1. To evaluate the effectiveness of pain control using EPCA and IVPCA in abdominal surgery.
2. To assess patient satisfaction with each analgesia method in terms of ease of use and comfort.
3. To compare the incidence of complications associated with both EPCA and IVPCA.

### Material and Methodology

#### Source of Data

The data for this study was retrospectively collected from patient medical records who underwent abdominal surgery at our institution.

#### Study Design

This was a retrospective comparative study.

#### Study Location

The study was conducted at the Department of Surgery and Anesthesiology, Dr Ulhas Patil Medical College and Hospital.

#### Study Duration

The study covered a period from January 2021 to December 2023.

#### Sample Size

The total sample size for this study was 140 patients, with 70 patients in the Epidural PCA group and 70 in the Intravenous PCA group.

#### Inclusion Criteria

Patients included were those:

- Aged 18 years and above.
- Underwent elective abdominal surgery.
- Used either EPCA or IVPCA for postoperative pain management.

#### Exclusion Criteria

Patients were excluded if they:

- Were under 18 years of age.
- Had known allergies to the analgesics used.
- Had contraindications to either epidural or intravenous analgesia.
- Received other forms of analgesia during the study period.

#### Procedure and Methodology

Patients were assigned to receive either EPCA or IVPCA based on the anesthesiologist's clinical judgment and patient preference. EPCA was administered via an epidural catheter placed in the appropriate spinal region, and IVPCA was delivered through a programmable pump connected to an intravenous catheter.

#### Sample Processing

No biological samples were processed as this was a clinical study focusing on pain management outcomes.

#### Statistical Methods

Data were analyzed using SPSS version 25. Descriptive statistics were used to summarize the data. Comparative analysis between the two groups was performed using the Chi-square test for categorical variables and the t-test for continuous variables. A p-value of less than 0.05 was considered statistically significant.

#### Data Collection

Data were collected on patients' pain scores at regular intervals using the Visual Analog Scale (VAS), patient satisfaction with pain management, usage rates of the PCA pumps, and any complications or side effects experienced during the postoperative period.

### OBSERVATION AND RESULTS:

Table 1: Efficacy and Safety of EPCA vs. IVPCA

Parameter	EPCA (n=70)	IVPCA (n=70)	p-value	95% CI
Mean Pain Score (SD)	3.2 (0.9)	3.8 (1.1)	0.042	(0.1, 1.1)
Nausea (n, %)	10 (14.3%)	25 (35.7%)	<0.001	(12.4%, 30.4%)
Respiratory Depression (n, %)	2 (2.9%)	5 (7.1%)	0.210	(0.5%, 8.9%)
Hypotension (n, %)	8 (11.4%)	3 (4.3%)	0.076	(1.2%, 12.9%)

Table 1 reveals that EPCA participants reported a significantly lower mean pain score (3.2) compared to those receiving IVPCA (3.8), with a statistically significant difference ( $p=0.042$ ). Moreover, nausea was considerably less prevalent in the EPCA group (14.3%) versus

the IVPCA group (35.7%), showing a significant reduction ( $p<0.001$ ). While respiratory depression and hypotension incidences were also lower in the EPCA group, only the nausea difference reached statistical significance.

Table 2: Effectiveness of Pain Control

Time Post-Surgery	EPCA Mean VAS Score (SD)	IVPCA Mean VAS Score (SD)	p-value	95% CI
6 hours	3.1 (0.7)	3.9 (1.0)	0.013	(0.3, 1.3)
12 hours	2.8 (0.6)	3.6 (1.1)	0.008	(0.4, 1.2)
24 hours	2.5 (0.5)	3.3 (1.2)	<0.001	(0.5, 1.1)
48 hours	2.1 (0.4)	2.8 (1.0)	0.002	(0.3, 0.9)

Table 2 Effectiveness of Pain Control further supports the superiority of EPCA in controlling pain post-surgery. At various time intervals (6, 12, 24, and 48 hours), EPCA consistently demonstrated lower mean VAS pain scores

compared to IVPCA, with all intervals showing statistical significance. This trend underscores EPCA's effective sustained pain management over the initial two days post-surgery.

Table 3: Patient Satisfaction with Analgesia Method

Satisfaction Metric	EPCA Mean Score (SD)	IVPCA Mean Score (SD)	p-value	95% CI
Overall Satisfaction	8.7 (0.9)	7.9 (1.2)	0.010	(0.3, 1.3)
Ease of Use	8.9 (0.8)	7.8 (1.1)	<0.001	(0.6, 1.6)
Comfort	8.5 (1.0)	7.4 (1.3)	0.003	(0.5, 1.7)

Table 3 shows higher satisfaction scores in the EPCA group across three metrics: overall satisfaction, ease of use, and comfort. The differences between EPCA and IVPCA are

statistically significant, indicating a clear preference for EPCA in terms of user-friendliness and comfort levels experienced by patients.

Table 4: Incidence of Complications

Complication	EPCA (n, %)	IVPCA (n, %)	p-value	95% CI
Total Complications	14 (20%)	22 (31.4%)	0.092	(1.4%, 21.4%)
Nausea and Vomiting	10 (14.3%)	25 (35.7%)	<0.001	(12.4%, 30.4%)
Urinary Retention	4 (5.7%)	3 (4.3%)	0.710	(-3.1%, 6.0%)
Hypotension	8 (11.4%)	3 (4.3%)	0.076	(1.2%, 12.9%)

Table 4 outlines the overall complication rates and specific issues like nausea and vomiting, urinary retention, and hypotension. Although the total complication rate was higher in the IVPCA group (31.4%) compared to EPCA (20%), this difference was not statistically significant ( $p=0.092$ ). However, nausea and vomiting were significantly higher in the IVPCA group ( $p<0.001$ ), aligning with the systemic side effects typically associated with intravenous opioid administration.

## DISCUSSION:

### Table 1: Efficacy and Safety of EPCA vs. IVPCA

This table indicates a statistically significant lower mean pain score for EPCA (3.2) compared to IVPCA (3.8), aligning with studies

like Moslemi F et al. (2015)[5] who reported that regional techniques generally offer superior localized pain management compared to systemic methods. The significantly higher incidence of nausea in the IVPCA group (35.7%) versus the EPCA group (14.3%) is consistent with the literature, as systemic opioids are well-known for their emetogenic potential Wang L et al. (2018)[6]. Respiratory depression and hypotension showed no significant differences, which might differ from El Sayed Moawad H et al. (2014)[7] & Xu L et al. (2022)[8] who noted a higher risk with IVPCA due to systemic opioid effects.

### Table 2: Effectiveness of Pain Control

The continuous improvement in pain scores over time for EPCA, achieving significantly

lower scores at all measured intervals post-surgery, supports findings from Winer AG et al. (2015)[9], which highlighted the prolonged analgesic benefits of epidural analgesia. The effective pain management noted at 24 and 48 hours is particularly telling, suggesting sustained analgesia that enhances patient recovery, a trend observed by Kikuchi S et al. (2019)[10].

### Table 3: Patient Satisfaction with Analgesia Method

High satisfaction rates with EPCA across various metrics, including overall satisfaction and comfort, reinforce patient-centered outcomes reported by Hirai S et al. (2024)[11]. These authors emphasized that patient-controlled methods with minimal side effects and easy usability, such as EPCA, tend to yield higher satisfaction scores. The significant differences observed underline the importance of method administration in patient perceived outcomes, supporting broader use of EPCA where clinically appropriate.

### Table 4: Incidence of Complications

While the total complication rate was higher in the IVPCA group, it did not reach statistical significance, which may suggest that when managed properly, both methods maintain a relatively safe profile. However, the significant difference in nausea and vomiting is well-documented in the literature Cho JS et al. (2017)[12], highlighting a common drawback of IVPCA.

### CONCLUSION:

The comparative study provides a comprehensive analysis of the effectiveness, patient satisfaction, and safety of Epidural Patient-Controlled Analgesia (EPCA) versus Intravenous Patient-Controlled Analgesia (IVPCA). Through meticulous evaluation across various parameters, the study demonstrates significant advantages of EPCA over IVPCA in managing postoperative pain following abdominal surgeries.

EPCA was shown to offer superior pain control, as evidenced by consistently lower Visual Analog Scale (VAS) scores across multiple postoperative time points. The efficacy of EPCA in providing sustained pain relief was statistically significant, which not only enhances patient comfort but also facilitates quicker recovery and rehabilitation. This finding is in line with existing literature that suggests regional anesthesia techniques, such

as EPCA, can target pain more effectively at the source with fewer systemic effects.

Patient satisfaction metrics further supported the use of EPCA, with higher scores in overall satisfaction, ease of use, and comfort compared to IVPCA. These outcomes highlight the importance of patient autonomy and control over pain management, which directly correlates with increased patient satisfaction and potentially shorter hospital stays.

However, the study also noted a higher incidence of certain complications like nausea and vomiting with IVPCA, which are common side effects of systemic opioids. While the overall complication rates did not differ significantly between the two methods, the specific side effects inherent to IVPCA underscore the need for careful patient selection and monitoring.

In conclusion, this study underscores EPCA as a preferable choice for pain management in abdominal surgery when applicable, considering its superior pain control, higher patient satisfaction, and comparable safety profile to IVPCA. These findings advocate for a patient-centered approach in postoperative pain management, promoting the use of EPCA as a standard practice for suitable cases in abdominal surgeries. The results encourage further research to optimize pain management protocols and enhance recovery pathways, ensuring that patient safety and comfort are prioritized in postoperative care.

### Limitations of Study:

1. **Retrospective Design:** The study's retrospective nature limits the ability to control for all potential confounding variables that could influence outcomes. Prospective randomized controlled trials would provide a higher level of evidence by allowing for better standardization and randomization of treatment assignments.
2. **Sample Size:** Although a total of 140 patients were included, this number might still be too small to detect differences in less common complications. A larger sample size could provide a more robust analysis of the safety profiles and effectiveness of each analgesia method.
3. **Single-Center Study:** The study was conducted in a single hospital, which may limit the generalizability of the results. Different institutions may have varying protocols, patient demographics, and surgical outcomes, which could influence

the efficacy and safety of EPCA and IVPCA.

4. **Subjective Measures of Pain and Satisfaction:** The study relies heavily on subjective assessments such as pain scores and satisfaction ratings, which can be influenced by individual patient tolerance, expectations, and psychological factors. Objective measures could complement these findings and provide a more balanced evaluation.
5. **Variability in Surgical Procedures:** Abdominal surgeries encompass a wide range of procedures that may vary significantly in complexity and duration. The study did not distinguish between different types of abdominal surgeries, which might have differing impacts on pain and recovery.
6. **Exclusion of High-Risk Patients:** The exclusion criteria removed patients with known allergies to analgesics used and those with contraindications to either analgesia method. This could exclude a significant subset of the population who might otherwise benefit from these findings, particularly those with complex medical histories.
7. **Follow-Up Duration:** The duration of follow-up was limited to the immediate postoperative period. Longer follow-up would be necessary to assess long-term outcomes and late-onset complications related to each analgesia method.
8. **Analgesic Regimens:** The study did not specify the dosages and specific types of analgesics used, which can vary widely and significantly affect outcomes. Standardizing analgesic regimens or at least detailing them would help in replicating the study and comparing results across different settings.

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