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Research Article

Paracetamol versus Diclofenac as Intravenous Postoperative Analgesia in Patients Undergoing Laparoscopic Surgeries

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BACKGROUND

Laparoscopic surgery is increasingly preferred because of its minimally invasive nature and faster postoperative recovery. Postoperative pain is a significant stressor and is inherently subjective. Inadequate pain management can adversely affect recovery, prolong hospital stay, and increase patient discomfort. This study aimed to compare the efficacy of intravenous paracetamol and intravenous diclofenac for postoperative analgesia in patients undergoing laparoscopic surgeries. **METHODS:** This randomized, double-blind, prospective controlled study was conducted from October 2024 to September 2025 and included 56 patients scheduled for elective laparoscopic abdominal surgeries. Participants were block-randomized into two groups of 28 each. All patients received general anesthesia. Thirty minutes prior to extubation, the assigned study drug was administered using a closed-envelope technique and continued postoperatively at prescribed intervals. Postoperative pain was assessed using the Visual Analogue Scale (VAS), along with monitoring of systolic and diastolic blood pressure and heart rate at 2, 4, 6, 12, and 24 hours postoperatively. The requirement for rescue analgesia with intramuscular tramadol (50 mg) and the incidence of postoperative nausea and vomiting (PONV) were also recorded. **RESULTS:** VAS scores were higher in the diclofenac group up to 12 hours postoperatively; however, the difference was not statistically significant. At 24 hours, the diclofenac group demonstrated significantly higher pain scores compared to the paracetamol group ($p = 0.0264$). PONV was observed in four patients in the diclofenac group. Patients receiving intravenous paracetamol exhibited better hemodynamic stability throughout the postoperative period. **CONCLUSIONS:** Both intravenous paracetamol and intravenous diclofenac are effective for postoperative analgesia following laparoscopic surgeries. However, intravenous paracetamol provides superior analgesia at 24 hours and offers the additional advantage of improved hemodynamic stability.

KEYWORDS

Intravenous Paracetamol, Intravenous Diclofenac, Laparoscopic Surgeries, Postoperative Analgesia

Introduction

Pain is one of the most common complications following surgery and primarily results from intraoperative tissue injury due to handling of various organs. The severity of postoperative pain depends on multiple factors, including the patient's age, type of surgery, and surgical site [1]. Effective postoperative pain management plays a crucial role in determining overall surgical outcomes in patients undergoing procedures under general anaesthesia [2]. Inadequately controlled pain can have detrimental effects on the cardiovascular, central nervous, and respiratory systems due to excessive sympathetic stimulation. Consequently, the concept of multimodal analgesia has evolved to ensure optimal pain control and smooth recovery following general anaesthesia [3].

Laparoscopic cholecystectomy is the treatment of choice for cholelithiasis because of its numerous advantages, such as smaller and more cosmetic incisions, reduced blood loss, shorter hospital stay, fewer postoperative complications, and early mobilization. However, postoperative pain remains a significant drawback of this procedure. Therefore, adequate analgesia is essential during both intraoperative and postoperative periods to enhance patient comfort and recovery. Among the non-opioid analgesics, diclofenac and paracetamol play an important role in pain management following laparoscopic cholecystectomy.

Paracetamol is available in intravenous formulations such as paracetamol 100 mL solution for infusion, containing paracetamol, cysteine hydrochloride monohydrate, disodium phosphate dihydrate, hydrochloric acid, mannitol, and sodium hydroxide (Perfalgan®, Bristol-Myers Squibb India Pvt. Ltd.), as well as paracetamol with lignocaine injection, containing paracetamol, lignocaine hydrochloride, and benzyl alcohol (Fevastin®, Tablets India Ltd.).

Paracetamol and diclofenac, the two non-opioid drugs selected for this study, are commonly preferred for postoperative pain control, particularly in situations where opioid use is limited due to their adverse effects [4]. Paracetamol is widely available and extensively used in both hospital and community settings; however, despite its widespread use, its efficacy as a postoperative analgesic has not been fully elucidated. With the recent availability of intravenous paracetamol, there has been renewed interest in its role in perioperative pain management. Paracetamol has been shown to be effective in managing postoperative pain either alone or in combination with other analgesics [5,6]. Moreover, it is not associated with the increased risk of gastrointestinal, hematological, renal, or cardiovascular adverse effects commonly seen with non-steroidal anti-inflammatory drugs (NSAIDs), including selective cyclo-oxygenase-2 (COX-2) inhibitors [7].

Diclofenac, a commonly used NSAID, is administered to reduce inflammation and pain in the postoperative period and is available in sodium and potassium salt formulations [8]. This study was conducted to compare the efficacy of intravenous paracetamol and intravenous diclofenac as postoperative analgesics in patients undergoing laparoscopic surgeries. The objectives were to assess postoperative pain using visual analogue scale (VAS) scores, evaluate total analgesic requirements during the first 24 hours, determine the need for rescue analgesia, and analyze associated side effects and hemodynamic parameters. This study aimed to explore the potential of an effective non-opioid analgesic regimen for postoperative pain management following laparoscopic surgeries.

METHODS

This randomized, controlled, double-blind, prospective study was conducted at a multispecialty teaching hospital from October 2024 to September 2025 after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment.

Selection of Patients and Sample Size

Sample size calculation was performed using OpenEpi version 3.03. Based on data from a previous study, the mean postoperative pain score measured using the Visual Analogue Scale (VAS) was 1.13 (SD 1.31) in the paracetamol group and 2.2 (SD 2.01) in the diclofenac group. With a confidence level of 95%, power of 90%, and 1:1 allocation ratio, a minimum sample size of 28 patients in each group was calculated. Thus, a total of 56 patients were included in the study.

Inclusion Criteria

- Age between 18 and 60 years
- American Society of Anesthesiologists (ASA) physical status I and II
- Patients of either gender
- Patients undergoing laparoscopic surgeries with incision-to-closure time > 30 minutes

Exclusion Criteria

- Known hypersensitivity to study drugs
- Impaired renal function
- Impaired hepatic function
- Bleeding diathesis or patients on anticoagulant therapy
- Inability to comprehend the Visual Analogue Scale

Randomization and Blinding

A total of 56 patients were randomized using block randomization to ensure equal distribution between the two groups. The randomization sequence was generated by an independent external unit (Department of Community Medicine) and provided as sequentially numbered, opaque, sealed envelopes. Variable block sizes (4, 6, and 8) were used to prevent predictability. After obtaining consent, the investigator opened the envelope and assigned the patient to the designated group. Both patients and observers were blinded to the group allocation.

Study Groups

Group A (Paracetamol Group):
Patients received intravenous paracetamol at a dose of 15 mg/kg (maximum 1 g diluted in 100 mL) administered over 15–20 minutes, 30 minutes before the end of surgery. Subsequent doses were administered every 8 hours postoperatively.

Group B (Diclofenac Group):
Patients received intravenous diclofenac at a dose of 2 mg/kg (maximum 75 mg diluted in 100 mL of normal saline) administered over 15–20 minutes, 30 minutes before the end of surgery. Subsequent doses were administered every 12 hours postoperatively.

Anaesthetic Technique and Perioperative Management

All patients received tablet alprazolam 0.25 mg and tablet ranitidine 150 mg on the night before surgery. On the morning of surgery, tablet ranitidine 150 mg and tablet metoclopramide 10 mg were administered at 7 a.m. Patients were reassessed in the preoperative holding area before being shifted to the operating room.

Standard monitoring as per American Society of Anesthesiologists (ASA) guidelines—electrocardiogram (ECG), heart rate (HR), non-invasive blood pressure (NIBP), and oxygen saturation (SpO_2)—was applied, and baseline

parameters were recorded. An intravenous line was secured using an 18G or 20G cannula. General anesthesia was administered using a standardized protocol. Intra-abdominal pressure during pneumoperitoneum was maintained between 12 and 15 mmHg in all patients.

The assigned study drug was administered 30 minutes before the completion of surgery. Any intraoperative complications were documented. At the end of surgery, the oropharynx was gently suctioned, and patients were extubated following standard reversal of neuromuscular blockade using neostigmine and glycopyrrolate. Patients were then transferred to the recovery room for monitoring.

Postoperative Assessment

Hemodynamic parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate were recorded at 2, 4, 6, 12, and 24 hours postoperatively. Pain intensity was assessed using the Visual Analogue Scale (VAS), consisting of a 10 cm horizontal line marked from "no pain" (0) to "worst pain imaginable" (10). The distance marked by the patient in centimeters was recorded as the pain score.

VAS scores were categorized as:

- Mild pain: 1–3
- Moderate pain: 4–6
- Severe pain: ≥7

Rescue analgesia was administered when the VAS score reached 7–10 or upon patient request, whichever occurred earlier. Rescue analgesic used was intramuscular tramadol 50 mg, repeated if necessary. Adverse effects such as nausea, vomiting, pruritus, sedation, respiratory depression (respiratory rate <10/min), or any other complications were recorded.

Statistical Analysis

Data were entered into Microsoft Excel 2010 and analyzed using SPSS version 24.0. Tests of normality were applied to continuous variables. Continuous non-parametric data were analyzed using the Mann–Whitney U test, while categorical variables were compared using the Chi-square test. A p-value < 0.05 was considered statistically significant.

RESULTS

The demographic characteristics of patients in both groups were comparable, with no statistically significant differences in age, gender distribution, ASA physical status, or Modified Mallampati Score (MMS). The study population comprised 64.3% males and 35.7% females [Table 1].

Table 1. Distribution of Study Groups Based on Gender (N = 56)

Gender	Group A **N (%)**	Group B **N (%)**	Total **N (%)**	P-value
Male	20 (35.7**%**)	16 (28.6**%**)	36 (64.3**%**)	0.0264
Female	8 (14.3**%**)	12 (21.4**%**)	20 (35.7**%**)	
Total	28 (50**%**)	28 (50**%**)	56 (100**%**)	

Postoperative pain scores assessed using the Visual Analogue Scale (VAS) at 2, 4, 6, and 12 hours were lower in the paracetamol group compared to the diclofenac group; however, these differences were statistically significant. At 24 hours postoperatively, the diclofenac group demonstrated significantly higher VAS scores compared to the paracetamol group (p = 0.0264) [Table 2]. Additionally, two patients in the diclofenac group required rescue analgesia with intramuscular tramadol.

Table 2. Distribution of Study Groups Based on Score at 24 Hours (N = 56)

Pain Score at 24 Hours	Group A N (%)	Group B N (%)	Total N (%)	P-value
3	5(8.9%)	2(3.6%)	7(12.5%)	0.0656
4	18(32.1%)	9(16.1%)	27(48.2%)	
5	5(8.9%)	14(25%)	19(33.9%)	
6	0(%)	1(1.8%)	1(1.8%)	
7	0(%)	2(3.6%)	2(3.6%)	
Total	28(50%)	28(50%)	56(100%)	

Table 3. Distribution of Study Groups Based on DBP at 24 Hours (N = 56)

DBP at 24 Hours	Group A N (%)		Group B N (%)		P-value
	Median	IQR	Median	IQR	
	74.6	71.62 - 77.24	79.8	75.71-83.8	≥0.0001

Comparison of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) between the two groups showed no statistically significant differences at most postoperative time intervals. However, at 24 hours postoperatively, the diclofenac group demonstrated significantly higher DBP values compared to the paracetamol group. The median DBP was 74.6 mmHg in Group A and 79.8 mmHg in Group B, and this difference was statistically significant (p = 0.0001) [Table 3, Figure 1].

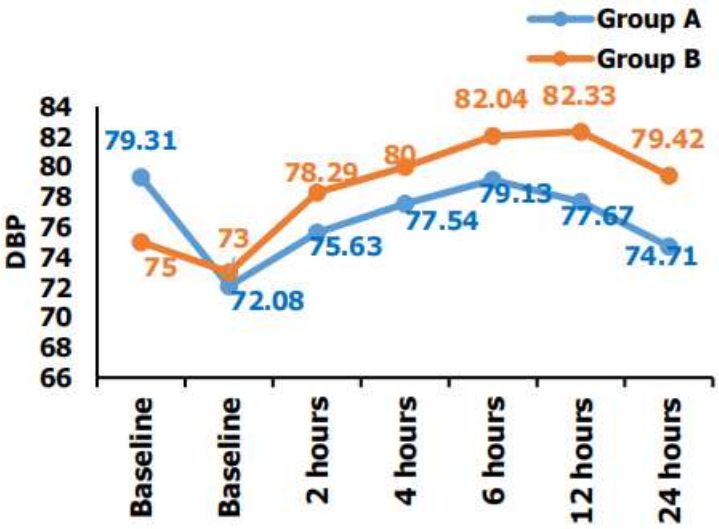

Figure 1. Mean DBP at Various Time Intervals

We observed that in patients of group-A, there is no case of post-operative complication; whereas in patients of group-B, 3 patients showed signs of post-operative nausea and vomiting [Table 4].

Table 4. Distribution of Study Groups Based on Occurrence of PONV (N = 56)

Occurrence	Group A	Group B	Total	P-value

of PONV	N (%)	N (%)	N (%)	
Yes	0(%)	4(7.1%)	4(7.1%)	0.148
No	28(%)	24(42.9%)	52(92.9%)	
Total	28(50%)	28(50%)	56(100%)	

DISCUSSION

Postoperative pain is an unpleasant sensory and emotional experience associated with significant physiological, autonomic, endocrine–metabolic, and behavioral responses following surgery [9]. Pain after laparoscopic procedures has multiple components, including somatic pain from surgical incisions, visceral pain arising from intra-abdominal manipulation, and referred pain mediated through visceral innervation. Inadequately controlled postoperative pain may result in complications such as atelectasis, pneumonitis, hypoxemia, deep vein thrombosis, delayed recovery of bowel function, myocardial ischemia or infarction, urinary retention, and residual psychological trauma [10].

The present study was undertaken to compare the efficacy of intravenous paracetamol and intravenous diclofenac as postoperative analgesics in patients undergoing elective laparoscopic surgeries. Both study groups were comparable with respect to baseline demographic and clinical variables, including age, gender, Modified Mallampati Score (MMS), ASA physical status, body mass index (BMI), and duration of surgery, thereby minimizing confounding factors.

Postoperative pain scores were consistently lower in the paracetamol group compared to the diclofenac group up to 12 hours; however, these differences did not reach statistical significance. At 24 hours postoperatively, pain scores were significantly higher in the diclofenac group, suggesting a longer duration of effective analgesia with intravenous paracetamol. Hemodynamic parameters, including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure, remained comparable between the two groups across most postoperative time points. However, a significantly higher diastolic blood pressure was observed in the diclofenac group at 24 hours, indicating better hemodynamic stability in patients receiving paracetamol.

Paul et al. evaluated the analgesic efficacy of intravenous paracetamol and diclofenac in patients undergoing laparoscopic cholecystectomy and reported significantly lower VAS scores at multiple postoperative intervals in the paracetamol group, along with reduced rescue analgesic requirements and fewer adverse effects [11]. While their findings demonstrated statistically significant differences at earlier time intervals, the present study observed a significant difference only at 24 hours, with non-significant differences at earlier intervals.

Kharbuja et al. compared intravenous paracetamol and diclofenac in 120 patients undergoing laparoscopic cholecystectomy and found comparable hemodynamic profiles between the two groups, with significantly lower postoperative pain scores and prolonged analgesia in the paracetamol group [12]. These findings are consistent with the results of the present study.

Shah et al. assessed the analgesic efficacy and safety of intravenous paracetamol versus intravenous diclofenac and reported that both drugs were effective in providing postoperative pain relief, with no significant differences in analgesic efficacy between the two groups [13]. These observations align with the present study, which found both agents to be effective for postoperative analgesia.

CONCLUSIONS

Both intravenous paracetamol and intravenous diclofenac are effective for postoperative analgesia in patients undergoing laparoscopic surgeries. However, intravenous paracetamol provides superior analgesia of longer duration and demonstrates better hemodynamic stability compared to intravenous diclofenac. Additionally, intravenous paracetamol is associated with a reduced requirement for rescue opioid analgesia, thereby minimizing opioid-related adverse effects. No immediate adverse effects were observed with the use of intravenous paracetamol, supporting its safety and efficacy as a postoperative analgesic in laparoscopic surgeries.

Limitations and Future Scope

This study has certain limitations. First, the sample size was relatively small, which may limit the generalizability of the findings. Second, the study was conducted at a single center, and variations in surgical technique, anesthetic management, and postoperative care across institutions may influence outcomes. Third, pain assessment was based on the Visual Analogue Scale, which is a subjective measure and may vary according to individual pain perception and tolerance. Fourth, long-term outcomes such as chronic postoperative pain, patient satisfaction, and functional recovery were not assessed. Additionally, the study focused only on short-term postoperative analgesia within the first 24 hours and did not evaluate biochemical markers of inflammation or stress response.

Future studies with larger sample sizes and multicenter designs are required to validate these findings and improve their external applicability. Comparative trials involving different dosing regimens, combination therapy as part of multimodal analgesia, and comparison with other non-opioid analgesics may provide further insight into optimal postoperative pain management strategies. Assessment of long-term outcomes, patient-reported satisfaction scores, cost-effectiveness, and recovery profiles would help in formulating standardized postoperative analgesic protocols. Further research exploring the role of intravenous paracetamol in high-risk populations, such as elderly patients and those with cardiovascular or renal comorbidities, is also warranted.

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