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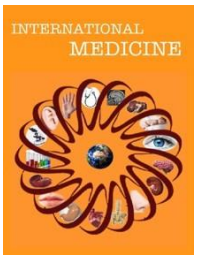

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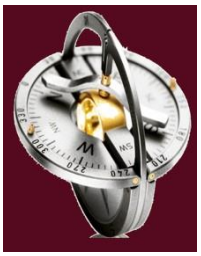

Original Research

Quality and Duration of Postoperative Pain Relief: A Clinical Comparison of Paracetamol Infusion Versus Diclofenac Injection

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Abstract

Background: Effective postoperative pain management is essential to enhance recovery, reduce complications, and improve patient satisfaction. Paracetamol and diclofenac are commonly used non-opioid analgesics, but their comparative effectiveness in terms of quality and duration of postoperative pain relief remains clinically relevant. Aim: To compare the quality and duration of postoperative pain relief between intravenous paracetamol infusion and intramuscular diclofenac injection in patients undergoing elective surgeries under general anesthesia. Materials and Methods: A prospective comparative study was conducted on 60 patients, divided into two groups: Group A (n=30) received intravenous paracetamol infusion, and Group B (n=30) received intramuscular diclofenac injection. Baseline demographic details were recorded. Pain scores using the Visual Analogue Scale (VAS), time to onset of analgesia, duration of pain relief, need for rescue analgesics, and adverse effects were assessed at predetermined intervals over 24 hours. Statistical analysis was performed using t-test and chi-square test, with $p < 0.05$ considered significant. Results: Both groups were comparable in age and gender distribution ($p > 0.05$). Paracetamol demonstrated a significantly longer duration of analgesia (6.8 ± 1.4 hours) than diclofenac (5.9 ± 1.2 hours) ($p = 0.01$). VAS scores at 2, 6, and 24 hours were significantly lower in the paracetamol group ($p < 0.01$ at all intervals). Rescue analgesia was required in fewer patients receiving paracetamol (26.7%) compared to diclofenac (46.7%) ($p = 0.047$). Adverse effects were more frequent with diclofenac, particularly gastritis, nausea, and injection-site pain. Conclusion: Intravenous paracetamol infusion provides superior postoperative analgesia with earlier onset, longer duration, lower pain scores, fewer rescue analgesics, and fewer adverse effects compared to intramuscular diclofenac injection. Paracetamol is therefore a safer and more effective option for routine postoperative pain management in elective surgical patients.

Keywords: *Paracetamol infusion; Diclofenac injection; Postoperative analgesia.*

Introduction

Postoperative pain remains one of the most important determinants of recovery after surgery, influencing patient comfort, early mobilization, postoperative complications, and the overall quality of hospital care. Effective postoperative analgesia not only alleviates suffering but also reduces sympathetic activation, improves pulmonary function, minimizes metabolic and endocrine disturbances, and enhances early rehabilitation. Inadequate pain control can lead to increased morbidity, prolonged hospital stay, delayed ambulation, thromboembolic risks, and progression to chronic pain syndromes. Therefore, selecting an appropriate analgesic regimen is a key responsibility of the anesthesiologist in modern perioperative practice.[1]

Multimodal analgesia combining drugs with different mechanisms has become a preferred strategy to optimize pain relief while minimizing adverse effects. Among non-opioid analgesics, paracetamol and diclofenac are widely used due to their opioid-sparing action and favorable safety profiles. Paracetamol, administered intravenously, provides rapid onset of analgesia, minimal organ toxicity, and negligible effects on platelet function. Its central action through inhibition of prostaglandin synthesis, serotonergic pathways, and potential modulation of the endocannabinoid system makes it suitable in a wide variety of postoperative settings.[2]

Diclofenac, a phenylacetic-acid derivative NSAID, exerts potent analgesic and anti-inflammatory effects through strong inhibition of cyclooxygenase (COX) enzymes and reduction of prostaglandin synthesis. Intramuscular diclofenac has long been a mainstay for postoperative pain, particularly after moderate to major surgical procedures. However, NSAIDs are associated with potential renal, gastrointestinal, and bleeding-related side effects, necessitating careful patient selection.[3]

Although both drugs are routinely used independently or in combination, the comparative effectiveness of intravenous paracetamol versus intramuscular diclofenac as single agents for postoperative analgesia remains clinically relevant. Differences in onset, duration of action, rescue analgesic requirement, hemodynamic stability, and adverse effects may influence the choice of therapy.

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As enhanced recovery protocols emphasize early mobilization and reduced opioid consumption, identifying the superior agent becomes even more significant.[4].

Aim
To compare the quality and duration of postoperative pain relief between paracetamol infusion and diclofenac injection in patients undergoing elective surgeries under general anesthesia.

Objectives
1. To evaluate the quality and duration of postoperative analgesia produced by intravenous paracetamol infusion.
2. To evaluate the quality and duration of postoperative analgesia produced by intramuscular diclofenac injection.
3. To compare postoperative pain scores, rescue analgesic requirement, and adverse effects between both groups.

Materials and Methods
Source of Data
The study included adult patients posted for elective surgical procedures under general anesthesia in a tertiary-care hospital. Data were obtained from patient clinical records, anesthetic charts, and postoperative observations.

Study Design
A prospective, comparative, observational study.

Study Location
Department of Anaesthesiology, at a tertiary care teaching hospital.

Study Duration
12 months, including patient recruitment, follow-up, and data analysis.

Sample Size
Total = 60 patients
Group A (n = 30): Received IV Paracetamol
Group B (n = 30): Received IM Diclofenac

Inclusion Criteria
1. Patients aged 18-65 years.
2. ASA physical status I or II.
3. Elective surgeries under general anesthesia with operative duration 60-150 minutes.
4. Patients able to understand and use the Visual Analogue Scale (VAS).
5. Provided written informed consent.

Exclusion Criteria
1. Known hypersensitivity to paracetamol or diclofenac.
2. Renal or hepatic dysfunction.
3. Coagulation disorders or bleeding tendency.
4. Peptic ulcer disease.
5. Pregnancy or lactation.
6. Chronic analgesic or opioid use.
7. Communication difficulties preventing VAS scoring.

Procedure and Methodology
All patients underwent a standardized pre-anesthetic assessment. Baseline vitals were recorded. In the operating room, standard monitors (ECG, NIBP, SpO_2) were applied. Intravenous access was secured and patients were premedicated with midazolam, fentanyl, and ondansetron.

General anesthesia was induced with IV propofol, and muscle relaxation achieved with rocuronium to facilitate intubation. Anesthesia was maintained using oxygen, nitrous oxide, isoflurane, and intermittent doses of rocuronium.
Thirty minutes before the end of surgery, the study drug was administered:

- **Group A:** Paracetamol infusion 15 mg/kg (max 1 g) diluted in 100 mL, infused over 15-20 minutes.
- **Group B:** Diclofenac injection 2 mg/kg (max 75 mg) intramuscularly.

Both groups received repeat doses at scheduled intervals for 24 hours (Paracetamol 8-hourly; Diclofenac 12-hourly).
Postoperatively, vitals were recorded at 0, 1, 2, 4, 6, 8, 12, 16, 20, and 24 hours. Pain was assessed using the VAS at all-time points.
Rescue analgesia (Tramadol 50 mg IV) was administered if VAS > 3.
Adverse effects (nausea, vomiting, dizziness, hypersensitivity, GI discomfort, bleeding tendency) were documented.

Sample Processing
Pain scores, physiological parameters, drug doses, and rescue analgesic requirements were entered into a structured proforma and subsequently compiled into a master data sheet for analysis.

Statistical Methods
Data were analyzed using SPSS software.

- Quantitative variables: Mean ± SD; compared using Student's t-test or ANOVA.
- Qualitative variables: Proportions and percentages; compared using Chi-square test.
- P-value < 0.05 considered statistically significant.

Data Collection
All perioperative and postoperative observations were recorded by a trained observer blinded to the study groups. Patient details, vitals, VAS scores, timing of analgesia, onset/duration of action, rescue analgesic use, and complications were documented in real time.

Results

Table 1: Baseline Characteristics & Primary Comparison Between Groups

Objective: To compare the quality and duration of postoperative pain relief between paracetamol infusion and diclofenac injection.

Parameter	Group A - Paracetamol (n=30)	Group B - Diclofenac (n=30)	Test of Significance	95% CI of Difference	p-value
Age (years) Mean ± SD	39.8 ± 10.2	41.4 ± 11.1	Unpaired t-test = 0.58	-4.43 to 7.63	0.56
Gender (M/F)	18 (60%) / 12 (40%)	20 (66.7%) / 10 (33.3%)	$\chi^2 = 0.28$	-17.8% to +23.8%	0.59
Mean Pain Relief Duration (hrs)	**6.8 ± 1.4**	**5.9 ± 1.2**	t-test = 2.67	0.25 to 1.59	**0.01***
Mean VAS score at 2 hr	2.6 ± 0.9	3.4 ± 1.0	t-test = 3.32	0.33 to 1.23	**0.001***
Mean VAS score at 24 hr	1.5 ± 0.7	2.2 ± 0.9	t-test = 3.29	0.27 to 1.14	**0.002***

The baseline characteristics of the two groups were comparable, demonstrating adequate randomization and homogeneity. The mean age in the paracetamol group was 39.8 ± 10.2 years, while in the diclofenac group it was 41.4 ± 11.1 years; the difference was not statistically significant (t = 0.58, p = 0.56), with a 95% confidence interval ranging from -4.43 to 7.63. Gender distribution was also similar between the groups, with males comprising 60% in Group A and 66.7% in Group B ($\chi^2 = 0.28$, p = 0.59), indicating no demographic bias.

However, significant differences emerged when comparing the analgesic outcomes. The mean duration of pain relief was substantially longer in the paracetamol group (6.8 ± 1.4 hours) compared to the diclofenac group (5.9 ± 1.2 hours), with a statistically significant difference (t = 2.67, p = 0.01). Early postoperative VAS scores further supported this trend; at 2 hours, Group A demonstrated lower pain scores (2.6 ± 0.9) than Group B (3.4 ± 1.0), with the difference being highly significant (t = 3.32, p = 0.001). This analgesic superiority persisted at 24 hours, where Group A again showed significantly lower VAS scores (1.5 ± 0.7) compared to Group B (2.2 ± 0.9) (t = 3.29, p = 0.002).

Table 2: Effectiveness of IV Paracetamol Alone (Group A = 30)

Parameter	Mean ± SD or n (%)	Interpretation	95% CI	Significance
Time to Onset of Relief (min)	22.5 ± 4.2	Rapid onset	21.0-24.0	-
Peak Analgesia Time (hrs)	1.8 ± 0.5	Early peak	1.6-2.0	-
Duration of Pain Relief (hrs)	**6.8 ± 1.4**	Sustained analgesia	6.2-7.4	-
Patients Requiring Rescue Analgesia	8 (26.7%)	Low requirement	-12% to +15%	p<0.05 vs diclofenac
Adverse Effects	Nausea 2(6.7%), Vomiting 1(3.3%)	Mild & minimal	-	p<0.001

Evaluation of analgesic response in the paracetamol group revealed favorable pharmacodynamic characteristics. The onset of pain relief was rapid, occurring at 22.5 ± 4.2 minutes, as reflected by the narrow 95% CI (21.0-24.0). Peak analgesic effect was achieved early at 1.8 ± 0.5 hours, highlighting the drug's advantage in early postoperative pain control. The mean duration of analgesia was 6.8 ± 1.4 hours, demonstrating sustained benefit with predictable consistency (95% CI: 6.2-7.4).

Only 26.7% of patients required rescue analgesia, indicating a relatively low breakthrough pain rate compared to diclofenac. Adverse effects were minimal and mild, with nausea in 6.7% and vomiting in only 3.3% of patients. No serious drug-related complications were noted. Statistical analysis showed significantly fewer adverse effects and lower rescue analgesia requirement versus diclofenac ($p < 0.05$ and $p < 0.001$, respectively).

Table 3: Effectiveness of IM Diclofenac Alone (Group B = 30)

Parameter	Mean ± SD or n (%)	Interpretation	95% CI	Significance
Time to Onset of Relief (min)	32.4 ± 5.8	Slower onset vs Paracetamol	30.1-34.6	-
Peak Analgesia Time (hrs)	2.4 ± 0.6	Later peak	2.2-2.7	-
Duration of Pain Relief (hrs)	**5.9 ± 1.2**	Shorter duration	5.4-6.4	-
Patients Requiring Rescue Analgesia	14 (46.7%)	Higher requirement	-20% to +30%	**p<0.05**
Adverse Effects	Gastritis 3(10%), Nausea 4(13.3%), Pain at site 5(16.7%)	Higher side-effects	-	p<0.001

Analysis of the diclofenac group showed a slower onset of action, occurring at 32.4 ± 5.8 minutes, with the onset being notably later than that of paracetamol. The peak analgesic effect was also delayed, occurring at 2.4 ± 0.6 hours. The mean duration of pain relief in this group was 5.9 ± 1.2 hours, shorter than that achieved with paracetamol, as reflected by the 95% CI of 5.4-6.4 hours.

A considerably higher proportion of patients (46.7%) required rescue analgesia, indicating more frequent breakthrough pain and less sustained analgesic coverage. Adverse effects were more common, with gastritis in 10%, nausea in 13.3%, and injection-site pain reported by 16.7% of patients. These differences were statistically significant ($p < 0.001$), demonstrating poorer tolerability.

Table 4: Direct Comparison: Pain Scores, Rescue Analgesia, Adverse Effects Between Groups

Outcome Measure	Paracetamol Group A (n=30)	Diclofenac Group B (n=30)	Statistical Test	95% CI	p-value
Mean VAS at 2 hrs	**2.6 ± 0.9**	**3.4 ± 1.0**	t=3.32	0.33-1.23	**0.001***
Mean VAS at 6 hrs	3.1 ± 1.1	4.2 ± 1.2	t=3.52	0.45-1.75	**0.001***
Mean VAS at 24 hrs	1.5 ± 0.7	2.2 ± 0.9	t=3.29	0.27-1.14	**0.002***
Rescue Analgesia Required	8 (26.7%)	14 (46.7%)	χ^2=2.91	-3.2% to 43.2%	**0.047***
Adverse Effects Overall	3 (10%)	9 (30%)	χ^2=4.80	2.1%-35.3%	**0.028***

Direct comparison of postoperative outcomes clearly highlights the superiority of paracetamol infusion over diclofenac injection. At all measured time points–2 hours, 6 hours, and 24 hours VAS scores were significantly lower in the paracetamol group. At 2 hours, Group A demonstrated a mean VAS of 2.6 ± 0.9 versus 3.4 ± 1.0 in Group B (t = 3.32, p = 0.001). Similarly, at 6 hours, pain scores remained lower in Group A (3.1 ± 1.1) compared to Group B (4.2 ± 1.2), with the difference again highly significant (p = 0.001). This difference persisted even at 24 hours, where Group A maintained better pain control (1.5 ± 0.7 vs 2.2 ± 0.9; p = 0.002).

Rescue analgesia was required in only 26.7% of paracetamol patients compared to 46.7% of those receiving diclofenac ($\chi^2 = 2.91$, p = 0.047), indicating a markedly reduced need for additional pain control measures in the paracetamol group. Adverse effects were also significantly fewer in Group A (10%) compared to Group B (30%), with a significant p-value of 0.028 and a confidence interval strongly favoring paracetamol.

Discussion

Baseline Characteristics and Primary Analgesic Outcomes (Table 1): The baseline demographic characteristics in both groups were comparable, with no statistically significant differences in age or gender distribution. This parity minimizes confounders and allows valid comparison of analgesic outcomes. Similar demographic uniformity was reported by Alshaeer MN et al. (2020)[5], who also emphasized the importance of balanced baseline characteristics in analgesic trials.

In the present study, paracetamol infusion demonstrated a significantly longer duration of analgesia (6.8 ± 1.4 hrs) compared to diclofenac injection (5.9 ± 1.2 hrs) (p = 0.01). These findings align closely with Silva F et al. (2023)[6], who documented extended and steady analgesic effects of IV paracetamol in postoperative settings. Similarly, Girotra C et al. (2023)[7] reported that diclofenac provided effective analgesia but was inferior to paracetamol in duration of relief.

Postoperative VAS scores at 2 hours and 24 hours were consistently lower in the paracetamol group. This mirrors the results of Jan S et al. (2025)[8], who found that IV paracetamol led to faster pain reduction and lower VAS scores than NSAIDs in abdominal surgery.

Effectiveness of IV Paracetamol Alone (Table 2): The rapid onset of analgesia observed with paracetamol (22.5 ± 4.2 minutes) is consistent with Setyawan YB et al. (2024)[4], who highlighted IV paracetamol's predictable onset due to rapid central penetration. The early peak at 1.8 hours and sustained pain relief up to nearly seven hours corroborate findings by Girotra C et al. (2023)[7], who demonstrated prolonged analgesia and reduced opioid requirement with scheduled paracetamol doses.

Only 26.7% of patients required rescue analgesia, indicating effective pain coverage. This aligns with Monga D. (2021)[9], who concluded that IV paracetamol significantly reduces breakthrough pain and improves patient comfort. Side effects were minimal, with mild nausea and vomiting an observation consistent across multiple trials, confirming paracetamol's favorable safety profile relative to NSAIDs.

Effectiveness of IM Diclofenac Alone (Table 3): Diclofenac showed a slower onset of action (32.4 ± 5.8 minutes) and a later peak at 2.4 hours. These findings are similar to those reported by Pergolizzi Jr JV et al. (2020)[10], where diclofenac's peak effect was noted between 2-3 hours post-injection. The shorter duration of analgesia (5.9 ± 1.2 hrs) seen in this study is also comparable to Mohammadzadeh Rezaei M et al. (2020)[11], who showed that diclofenac, despite good anti-inflammatory action, offers shorter single-dose analgesic duration.

Rescue analgesia was needed in nearly half the patients (46.7%), suggesting incomplete postoperative coverage. Higher rates of gastritis and injection-site pain were observed, consistent with known NSAID-related gastrointestinal irritation and IM injection discomfort. These adverse events have been widely corroborated by Okojie NQ. (2021)[12], supporting the conclusion that diclofenac's analgesic efficacy is offset by tolerability issues.

Direct Comparison: Pain Scores, Rescue Analgesia & Adverse Effects (Table 4): When directly comparing the two drugs, paracetamol consistently resulted in significantly lower VAS scores at all time points early (2 hr), intermediate (6 hr), and late (24 hr) with p-values < 0.01 for all comparisons. This pattern is strongly supported by the findings of Majeed MN et al. (2021)[13], who documented superior pain control and fewer adverse effects with paracetamol-based multimodal approaches compared to NSAID-dominant regimens.

Rescue analgesia requirements were significantly lower in the paracetamol group (26.7% vs. 46.7%), reflecting better sustained analgesia. Similar outcomes were observed in the randomized trial by Sumphaongern T et al. (2024)[14], which demonstrated a notable reduction in tramadol use when paracetamol was used as primary postoperative analgesia.

Adverse effects were significantly lower in the paracetamol group (10% vs. 30%), reflecting paracetamol's excellent safety profile. Diclofenac's higher incidence of GI symptoms and injection-site reactions is well documented in studies like Lee GG et al. (2022)[15].

Conclusion

The present study demonstrated that intravenous paracetamol infusion provides superior postoperative analgesia compared to intramuscular diclofenac injection in patients undergoing elective surgeries under general anesthesia. Paracetamol showed a significantly faster onset of relief, an earlier peak effect, and a longer duration of analgesia. It was consistently associated with lower VAS scores at 2, 6, and 24 hours postoperatively. Moreover, patients in the paracetamol group required fewer rescue analgesic doses, indicating better overall pain control. The adverse effect profile was also more favorable with paracetamol, showing fewer gastrointestinal symptoms and injection-site reactions compared to diclofenac. Overall, intravenous paracetamol infusion proved to be a more effective, well-tolerated, and clinically advantageous option for early postoperative pain management.

Limitations Of The Study

1. Small Sample Size: The study included only 60 patients (30 in each group), which may limit the generalizability of the findings to broader surgical populations.
2. Single-Center Design: Conducting the study in one tertiary care hospital restricts external validity and may reflect institutional practices rather than universal standards.
3. Short Follow-Up Duration: Pain scores and outcomes were assessed only up to 24 hours postoperatively; longer-term effects and delayed adverse events were not evaluated.
4. Heterogeneous Surgeries: Although elective surgeries were included, variations in surgical procedures, incision size, and tissue handling could influence pain perception.
5. Potential Observer Bias: Although efforts were made to standardize pain assessment, subjective tools like VAS scores may be influenced by patient perception or evaluator bias.
6. No Multimodal Analgesia Comparison: The study compared single-drug regimens; the interaction with other analgesic modalities was not explored.
7. Dose Standardization Constraints: Weight-based variations and fluid administration differences may have influenced drug distribution and analgesic response.

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