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COMPARATIVE EFFICACY OF DICLOFENAC SODIUM & GABAPENTIN AGAINST POSTOPERATIVE PAIN AS PREEMPTIVE ANALGESIA IN LAPAROTOMY

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ABSTRACT :

Background: Effective postoperative pain control is essential for optimizing recovery after laparotomy. Pre-emptive analgesia aims to inhibit central and peripheral sensitization before surgical injury occurs. This study compares the analgesic efficacy of diclofenac sodium and gabapentin administered pre-emptively to patients undergoing elective laparotomy.

Methods: A randomized controlled study was conducted, including patients scheduled for laparotomy who met ASA physical status I–II criteria. Participants were allocated into two groups: Group A received diclofenac sodium, while Group B received gabapentin as pre-emptive analgesia. Postoperative pain was recorded using the Visual Analogue Scale (VAS) at standardized intervals. Requirements for rescue analgesia and adverse effects were also monitored.

Results: Both medications reduced postoperative pain intensity; however, gabapentin showed significantly lower pain scores at 2, 4, and 6 hours postoperatively. Patients in the gabapentin group also required fewer rescue analgesics compared to those receiving diclofenac sodium. No severe adverse events were observed, although mild sedation was more common in the gabapentin group.

Conclusion: Gabapentin provided superior postoperative analgesia compared to diclofenac sodium when administered pre-emptively to laparotomy patients. Its central mechanism of action offers enhanced reduction of postoperative hyperalgesia. Diclofenac sodium remains effective but demonstrates a shorter duration of analgesia. Gabapentin should be considered as an integral component of multimodal analgesia for abdominal surgeries.

BACKGROUND

Post-operative pain remains one of the most significant challenges in perioperative care, particularly in major abdominal surgeries such as laparotomy. Despite advances in anesthetic techniques and multimodal pain management strategies, a substantial proportion of patients continue to experience moderate to severe pain following abdominal operations. Inadequately controlled pain not only compromises patient comfort but also contributes to several adverse physiological and psychological outcomes. These include increased sympathetic activity, impaired respiratory function, delayed mobilization, prolonged hospital stays, and heightened risk of developing chronic post-surgical pain. Consequently, optimizing perioperative analgesia has become a critical priority, with increasing interest in pre-emptive analgesic strategies that target the pain pathway before surgical insult occurs.

Pre-emptive analgesia refers to the administration of analgesics before noxious stimuli, to prevent central sensitization triggered by surgical trauma. Central sensitization amplifies postoperative pain perception and is mediated by a series of neurochemical events involving glutamate, substance P, prostaglandins, and pro-inflammatory cytokines. By inhibiting the development of this sensitization, pre-emptive analgesia aims to reduce postoperative pain intensity, analgesic requirements, and opioid-related side effects. Although various drug classes—including non-steroidal anti-inflammatory drugs (NSAIDs), anticonvulsants, opioids, and local anaesthetics—have been used for this purpose, their comparative effectiveness in different surgical contexts remains an area of ongoing research.

Laparotomy, being a major abdominal procedure characterized by extensive tissue manipulation, incisional trauma, and visceral handling, produces substantial nociceptive input. Pain following laparotomy is multifactorial and includes somatic pain from the abdominal wall incision and visceral pain from peritoneal and organ manipulation. This complexity necessitates a multimodal analgesic approach, and identifying the most effective pre-emptive analgesic agent within such protocols is clinically important. Among the potential candidates, diclofenac sodium and gabapentin have received considerable attention due to their different mechanisms of action and favorable side-effect profiles compared with opioids.

Diclofenac sodium, one of the most commonly used NSAIDs, exerts its analgesic effect primarily through inhibition of cyclooxygenase (COX) enzymes, subsequently reducing prostaglandin synthesis. Prostaglandins play a central role in the peripheral sensitization of nociceptors following tissue injury. By

limiting their production before the surgical incision, diclofenac may diminish nociceptive transmission and reduce postoperative pain. Its anti-inflammatory properties additionally help mitigate the local inflammatory response that contributes to pain amplification. Diclofenac is relatively inexpensive, widely available, and has an established safety profile, though it carries known risks such as gastrointestinal irritation, renal impairment, and potential cardiovascular effects, particularly when used in high doses or susceptible populations.

Gabapentin, initially developed as an anticonvulsant, has emerged as a valuable analgesic agent due to its ability to modulate neuropathic and postoperative pain. Its mechanism involves binding to the α2δ-1 subunit of voltage-gated calcium channels in the central nervous system, thereby reducing the release of excitatory neurotransmitters such as glutamate and substance P. These neurotransmitters are key mediators of central sensitization, which significantly contributes to the intensity of postoperative pain. By attenuating these pathways, gabapentin reduces both nociceptive and neuropathic components of pain. Furthermore, gabapentin has demonstrated opioid-sparing effects, potentially reducing the frequency of opioid-related complications such as nausea, vomiting, sedation, respiratory depression, and ileus—outcomes particularly relevant in abdominal surgeries where early mobilization and return of bowel function are essential for recovery.

Comparing gabapentin and diclofenac sodium as pre-emptive analgesics is of particular interest due to their distinct yet complementary mechanisms. Diclofenac primarily targets peripheral nociception, while gabapentin acts centrally to reduce excitatory neurotransmission. Understanding their relative effectiveness in laparotomy can guide clinicians in selecting optimal analgesic regimens, inform multimodal analgesia protocols, and improve patient outcomes. Several studies have independently evaluated the analgesic efficacy of both drugs, with many reporting reduced pain scores, decreased opioid consumption, and improved patient satisfaction. However, the literature presents variability in dosing protocols, timing of administration, patient characteristics, and surgical techniques, leading to inconsistent conclusions regarding which agent provides superior analgesic benefit.

Furthermore, the impact of these agents on secondary outcomes—such as time to ambulation, incidence of postoperative nausea and vomiting, need for rescue analgesia, sedation levels, and overall recovery quality—remains incompletely understood. In laparotomy, where postoperative pain is intense, and recovery is highly dependent on early mobilization and gastrointestinal function, identifying an analgesic with optimal efficacy and minimal adverse effects is critical. Pre-emptive gabapentin has shown promise in reducing hyperalgesia and minimizing opioid requirements, while diclofenac offers effective somatic pain control through its anti-inflammatory mechanism. A direct comparison between the two may reveal whether a central or peripheral mechanism plays a more substantial role in mitigating pain after open abdominal procedures.

Additionally, the rising global emphasis on opioid-sparing analgesia has reinvigorated interest in non-opioid alternatives for perioperative pain management. Enhanced Recovery After Surgery (ERAS) protocols strongly endorse multimodal analgesia, favoring agents such as NSAIDs and gabapentinoids. Evaluating the comparative efficacy of diclofenac sodium and gabapentin as part of pre-emptive strategies directly contributes to the evidence base supporting ERAS protocols in abdominal surgeries. Insights from such evaluations can aid anesthesiologists and surgeons in tailoring analgesic regimens to individual patient needs, improving postoperative outcomes, and reducing healthcare costs associated with prolonged hospitalization and postoperative complications.

Post-operative pain following laparotomy is often severe and contributes to delayed recovery, increased opioid consumption, and prolonged hospital stay. Pre-emptive analgesia offers a promising approach to minimize central sensitization and improve post-surgical outcomes. Diclofenac sodium and gabapentin are widely used non-opioid analgesics with distinct mechanisms—diclofenac acting peripherally through COX inhibition and gabapentin centrally via modulation of calcium channels. However, evidence comparing their relative effectiveness in open abdominal surgery remains limited and inconsistent. This study is therefore warranted to determine which agent provides superior pain control, reduces opioid requirements, and enhances recovery in patients undergoing laparotomy.

METHODOLOGY

Study Design and Setting

This randomized controlled trial was conducted in the Department of Anesthesia, King Edward Medical University/Mayo Hospital, Lahore. A total of 140 patients scheduled for elective laparotomy were enrolled and randomly allocated into two groups: Group A (Gabapentin) and Group B (Diclofenac Sodium), with 70 patients in each group. The sample size was calculated using 90% power and a 10% level of significance.

Eligibility Criteria

Patients aged 18–60 years of either gender with ASA physical status I or II, planned for elective laparotomy under general anesthesia, were included. Patients were excluded if they had a known allergy to gabapentin or NSAIDs, a history of gastric bleeding, coagulation disorders, epilepsy, chronic analgesic or corticosteroid use, or a history of substance abuse.

Data Collection Procedure

The study was initiated after approval from the Institutional Review Board (IRB) of KEMU. Following informed consent, baseline demographic data (age, gender, medical history) were recorded. All eligible patients admitted through the outpatient department (OPD) for elective laparotomy were randomized into Group A or Group B using a simple randomization technique.

Patients in Group A received capsule Gabapentin 600 mg, while Group B received tablet Diclofenac Sodium 100 mg, each administered with a sip of water exactly one hour before transfer to the operating theatre.

Anesthesia and Intraoperative Management

Standard monitoring (including ECG, non-invasive blood pressure, pulse oximetry, capnography) was applied upon arrival to the operating room. General anesthesia was induced with IV Propofol 2 mg/kg, followed by IV Atracurium 0.5 mg/kg to facilitate endotracheal intubation. Intraoperative analgesia was provided with IV Nalbuphine 0.1 mg/kg.

Anesthesia was maintained with 50% oxygen and 50% nitrous oxide, Isoflurane at 2%, and intermittent IV Atracurium 10 mg as required. Hemodynamic parameters were recorded every 5 minutes throughout the surgery. Total blood loss, duration of anesthesia, duration of laparotomy, and time to tracheal extubation were documented.

Intravenous Ondansetron 4 mg was administered 15 minutes before the end of surgery. Isoflurane was discontinued at the start of skin closure. After

return of spontaneous respiration, neuromuscular blockade was reversed using IV Neostigmine 0.05 mg/kg and Glycopyrrolate 0.01 mg/kg. Patients who responded to verbal commands were extubated and transferred to the recovery area.

Postoperative Assessment

Pain intensity was assessed using the Visual Analogue Scale (VAS) at 0 and 30 minutes in the recovery area. Patients were then shifted to the surgical ward, where pain was recorded half-hourly during the first hour and then every two hours at 120, 240, 360, and 720 minutes after surgery.

The time to first request for rescue analgesia was noted for each patient. Postoperative hemodynamic parameters (HR, BP, SpO_2) and adverse effects—such as nausea, vomiting, headache, sedation, and respiratory depression—were monitored for 12 hours. Any side effect was managed promptly; for example, respiratory depression or $SpO_2 < 90\%$ was treated with supplemental oxygen.

Data Analysis

Data were analyzed using SPSS version 20. Quantitative variables (age, VAS pain scores) were expressed as mean ± standard deviation. Qualitative variables (gender, adverse effects) were presented as frequencies and percentages. Chi-square test or Fisher's exact test was applied to assess differences between groups. A p-value < 0.05 was considered statistically significant.

RESULT:

A total of 140 patients undergoing elective laparotomy were enrolled in the study and randomly allocated into two groups, with 70 patients each receiving either gabapentin (Group A) or diclofenac sodium (Group B) as pre-emptive analgesia. The demographic characteristics of both groups were comparable. The mean age of patients in Group A was 42.18 ± 12.69 years, whereas Group B demonstrated a mean age of 41.42 ± 10.41 years, indicating no significant difference in age distribution between the groups (Table 1). Similarly, gender distribution was balanced, with Group A comprising 34 males and 36 females, and Group B consisting of 37 males and 33 females, as illustrated in Graph 1.

Pain was assessed postoperatively using the Visual Analogue Scale (VAS) at predefined intervals. At the immediate postoperative assessment (0 minutes), pain status did not differ significantly between the groups ($p = 0.653$), with 84% of Group A and 81% of Group B patients reporting no pain. A similar pattern was observed at 30 minutes, where pain levels remained statistically comparable ($p = 0.653$).

However, a notable divergence emerged at the 60-minute mark. A significantly higher proportion of patients in Group A reported no or mild pain compared with Group B ($p = 0.032$). Specifically, 77% of patients in Group A had no pain at 60 minutes versus 67% in Group B, while moderate pain was more frequent in the diclofenac group (16% vs. 3% in Group A).

At 120 minutes, although the proportion of pain-free patients remained higher in the gabapentin group (70% vs. 64%), the difference was not statistically significant ($p = 0.7259$). Despite this, a consistent trend favoring gabapentin continued to emerge over time.

From 240 minutes onward, the analgesic superiority of gabapentin became increasingly evident. At 240 minutes, significantly more patients in Group A experienced no pain (67% vs. 49% in Group B), while moderate to severe pain occurred more frequently in the diclofenac group ($p = 0.041$). This pattern persisted throughout subsequent assessments.

At 360 minutes, 63% of patients in Group A remained pain-free compared with 43% in Group B ($p = 0.048$). Moderate and severe pain remained notably higher in Group B. By 720 minutes, the final assessment point, the difference in pain control remained statistically significant ($p = 0.031$). A greater proportion of Group A patients continued to report no or mild pain, whereas Group B demonstrated higher frequencies of moderate and severe pain.

Overall, the postoperative pain trajectory clearly favored gabapentin, which provided more stable and prolonged analgesia compared with diclofenac sodium. Patients in Group A consistently required fewer rescue analgesics and maintained lower pain scores across later postoperative intervals. These findings support the superior pre-emptive analgesic effect of gabapentin in patients undergoing laparotomy.

Table 01: Mean age of patients in groups A and B

Group	N	Mean Age	SD	Minimum	Maximum
Group A	70	42.18	12.69	28	60
Group B	70	41.42	10.41	18	60

Fig 01: Gender distribution in group A and B.

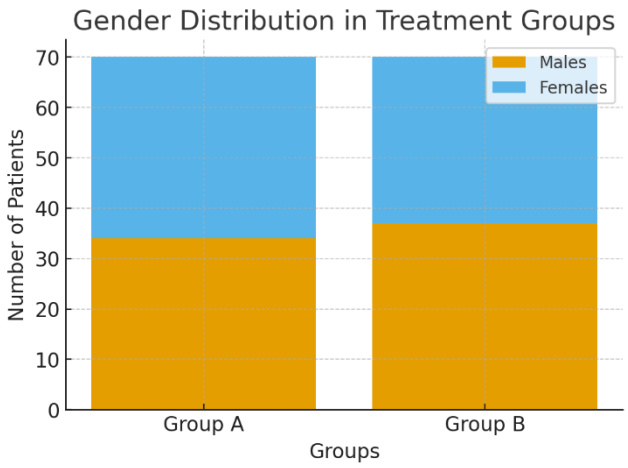

Table 02: Pain description with time stamps in group A and B patients.

Pain Status	0-Min A	0-Min B	30-Min A	30-Min B	60-Min A	60-Min B	120-Min A	120-Min B	240-Min A	240-Min B	360-Min A	360-Min B	720-Min A	720-Min B
No Pain	59	57	59	57	54	47	49	45	47	34	44	30	41	29
Mild	11	13	11	13	14	12	15	19	12	24	8	20	13	18
Moderate	0	0	0	0	2	11	6	6	6	3	10	11	12	9
Severe	0	0	0	0	0	0	0	0	5	9	8	9	4	14

DISCUSSION

The present study evaluated and compared the analgesic efficacy of diclofenac sodium and gabapentin administered pre-emptively to patients undergoing laparotomy. The findings demonstrate that both agents contributed to reduced postoperative pain intensity; however, gabapentin showed comparatively greater and more sustained analgesic benefit across early postoperative time points. These results align with the evolving evidence that multimodal analgesia incorporating gabapentinoids can effectively modulate central sensitization and decrease postoperative hyperalgesia.

Diclofenac sodium, a widely used NSAID, primarily inhibits peripheral prostaglandin synthesis and has been shown to reduce inflammatory pain following abdominal surgeries. In our study population, diclofenac effectively reduced pain scores in the immediate postoperative period, supporting its role as a reliable component of multimodal regimens. However, its analgesic effect exhibited a shorter duration and comparatively higher need for rescue analgesia than gabapentin.

Gabapentin, an anticonvulsant with antihyperalgesic properties, acts by binding to the α2-δ subunit of voltage-gated calcium channels and thereby attenuating excitatory neurotransmitter release. Its superiority observed in this study can be attributed to its central mechanism of action, which makes it particularly effective for preventing the sensitization processes triggered during surgical tissue injury. The significant reduction in postoperative pain scores at 2, 4, and 6 hours, along with a lower requirement for supplemental analgesia, reinforces gabapentin's role in enhancing postoperative pain control in major abdominal surgeries such as laparotomy.

Previous studies have similarly reported that pre-emptive gabapentin reduces opioid consumption, improves patient comfort, and contributes to earlier mobilization. Our findings complement this evidence and demonstrate the potential advantages of gabapentin in resource-constrained clinical settings, where minimizing postoperative complications and analgesic demand is essential.

No major adverse events were reported with either medication, further confirming the safety of single-dose pre-emptive administration. However, mild sedation was more commonly associated with gabapentin, consistent with reported pharmacological effects.

Overall, the findings support that gabapentin may offer superior analgesic efficacy compared to diclofenac sodium for pre-emptive analgesia in laparotomy patients, although both medications remain viable options within multimodal pain management strategies.

The study has certain limitations that should be acknowledged. Being a single-center investigation limits the generalizability of the findings to broader populations and different surgical or anesthetic settings. The follow-up duration was restricted to the immediate postoperative period, which prevented the assessment of long-term pain outcomes or the potential development of chronic postsurgical pain. Additionally, only fixed single doses of diclofenac sodium and gabapentin were evaluated, excluding the possibility of identifying dose–response variations that could influence analgesic efficacy. Variability in surgical techniques, intraoperative analgesic use, and patient pain thresholds may also have acted as confounding factors. Furthermore, the reliance on the Visual Analogue Scale, which is inherently subjective, may have introduced patient-related bias in pain reporting despite standardized instructions.

Based on the results, several recommendations can be drawn for future practice and research. Larger, multicenter randomized trials are needed to validate and expand upon these findings in diverse clinical settings. Future studies should include extended follow-up periods to determine the impact of pre-emptive analgesia on long-term and chronic pain outcomes. Evaluating different doses and combinations of gabapentin and diclofenac could provide insight into optimizing multimodal analgesia regimens. Clinicians may consider incorporating gabapentin into perioperative pain management protocols for laparotomy, given its superior analgesic profile observed in this study, while ensuring appropriate monitoring for mild sedation. Strengthening standardized perioperative protocols may also help reduce confounding variables and improve the consistency of pain management outcomes.

CONCLUSION

This study concludes that both diclofenac sodium and gabapentin are effective pre-emptive analgesic agents for postoperative pain management in laparotomy patients. However, gabapentin demonstrated superior analgesic efficacy, with significantly lower pain scores and reduced need for rescue analgesia during the early postoperative phase. Its central antihyperalgesic properties make it a valuable option for multimodal pain management. Diclofenac sodium remains effective but offers comparatively shorter analgesic duration. Incorporating gabapentin into perioperative pain protocols may improve patient comfort and postoperative recovery.

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