Original Article

Efficacy of Multimodal Analgesia in Reducing Opioid Consumption After Major Abdominal Surgery

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Abstract

Background: Major abdominal surgery frequently leaves patients in significant post-operative pain, which is usually treated with opioids. Opioids are effective analgesics but have a variety of side effects, such as sedation, delayed recovery, ileus, urinary retention, nausea, vomiting and respiratory depression. The combination of pharmacologic and non-pharmacologic analgesics with multiple methods and modalities that produce diverse effects (multimodal analgesia) has proved effective in decreasing postoperative opioid requirements and enhancing recovery. The aim is to determine the effectiveness of multimodal analgesia as a means of decreasing postoperative opioid usage after large abdominal surgery. **Material and Methods:** A prospective comparative study was performed in 140 patients that were undergoing elective major surgery in the abdomen, with general anesthesia. The 140 patients were randomly assigned to two groups of 70. Group M were treated with multimodal analgesia (paracetamol, non-steroidal anti-inflammatory drugs and regional techniques) and limited opioids whilst Group O was given conventional opioid-based analgesia. Opioid consumption in the postoperative period, the Visual Analogue Scale (VAS), requirement for rescue analgesics, adverse effects, time to bowel recovery, ambulation and length of stay were evaluated. Student's t-test and Chi-square test were done to analyze the statistical data. A p-value <0.05 was considered statistically significant. **Results:** The multimodal analgesia group had a significantly reduced amount of opioids used after surgery ($p<0.001$) than the conventional opioid group. In Group M, mean VAS scores at 6, 12 and 24 hours were significantly lower and incidence of nausea, vomiting, sedation and postoperative ileus was significantly lower in the multimodal group. Patients receiving multimodal analgesia were also observed to have shorter hospital stay and early ambulation. **Conclusion:** Multimodal analgesia leads to a substantial decrease in post-op opioid requirement and better recovery following major abdominal surgery. This technique allows for greater pain control and reduced opioid side effects while promoting improved recovery after surgery.

Keywords: Multi modal analgesia, opioid consumption, abdominal surgery, postoperative pain, enhanced recovery and regional analgesia.

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Introduction

Postoperative pain after major abdominal surgery is expected to be significant due to pain resulting from inflammation from surgery, extensive dissection of abdominal tissue and manipulation of the abdominal organs. Regardless of the surgical intervention, postoperative pain management is one of the most important aspects of peri-operative pain management, as prolonged hospital stay, chronic pain syndromes, more healthcare expenses, delayed mobilization, and increased risk for postoperative respiratory complications are all possible consequences of inadequate analgesia. The use of opioids has long been the mainstay of postoperative pain control because of their potent analgesic effects. In contrast, the use of opioids often causes major side effects such as postoperative nausea and vomiting, ileus, urinary retention, sedation, respiratory depression, constipation, pruritus and opioid dependence. These complications can have a negative impact on patient recovery and on the overall surgery outcome.[1,2]

There has been a growing understanding in recent years of the potential complications of opioids and the global opioid crisis, which has prompted an opioid-sparing focus on perioperative pain management among anesthesiologists and surgeons. Multimodal analgesia is a technique of using several different analgesics and/or techniques that have different mechanisms of action to achieve synergy and reduce required amounts of opioids for adequate pain control. This approach may involve using a mixture of acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentinoids, ketamine, local anesthetics, epidural, transversus abdominis plane blocks, and controlled opiate use.[3,4]

Multimodal Analgesia is based on the physiological principles of targeting different nociceptive pathways that transmit pain and modulate it. Multimodal regimens offer greater efficacy in pain

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relief with lowered doses and side-effects of a single agent, acting at peripheral, spinal and supraspinal levels. Research has demonstrated that decreasing opioid exposure can increase bowel recovery, decrease pulmonary complications, facilitate early ambulation and shorten hospital stay.[5,6]

Multimodal analgesia is an integral part of Peri-Operative optimization which is strongly recommended by Enhanced Recovery After Surgery (ERAS) protocols. ERAS pathways emphasize early mobilization, minimal opioid usage, a quick return of gastrointestinal function and a reduction in postoperative morbidity. There have been several clinical trials that have shown that multimodal analgesia enhances patients' satisfaction and quality of recovery and reduces opioid-related side effects.[7]

Furthermore, the regional anesthesia techniques like epidural analgesia and fascial plane blocks have enhanced multimodal anesthesia approaches in abdominal surgery. These methods will deliver targeted pain relief and reduce surgical stress response contributing to better postoperative results. Furthermore, other medications that are added on (as adjunctive treatments) like intravenous paracetamol and NSAIDs have been proven to be opioid-sparing in action without much sedation effects.[8]

Although there is increasing evidence supporting multimodal analgesia, there are still some variations in actual practice, particularly where a multimodal regimen is not possible, such as resource-limited environments where opioids remain the predominant method of managing postoperative pain. To establish optimal evidence-based multimodal analgesia protocols, therefore, the efficacy and safety of multimodal analgesics in different surgical populations must be evaluated.[9]

The present study was undertaken to assess the effectiveness of multimodal analgesia in reducing postoperative opioid consumption among patients undergoing major abdominal surgery and to evaluate its impact on postoperative pain, adverse effects, recovery profile, and hospital stay.[10,11]

Materials and Methods

Study Design and Setting: This prospective randomized comparative study was conducted in the Department of Anesthesiology in collaboration with the Department of General Surgery at a tertiary care teaching hospital over a period of 18 months after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment.

Study Population: A total of 140 adult patients scheduled for elective major abdominal surgery under general anesthesia were included in the study. Patients aged between 18 and 70 years belonging to American Society of Anesthesiologists (ASA) physical status I and II were enrolled.

Inclusion Criteria

- Patients aged between 18 and 70 years
- Patients undergoing elective major abdominal surgery
- ASA physical status I and II
- Patients willing to participate in the study and provide informed consent

Exclusion Criteria

- Chronic opioid use
- Hepatic dysfunction
- Renal impairment
- Coagulation disorders
- Psychiatric illness
- Allergy to study medications
- Pregnancy
- Inability to understand pain scoring systems

Randomization and Group Allocation

Patients were randomly divided into two groups of 70 each using computer-generated randomization.

Group M (Multimodal Analgesia Group)

Patients received:

- Intravenous paracetamol 1 g every 8 hours
- Diclofenac 75 mg twice daily
- Regional analgesic technique (epidural analgesia or transversus abdominis plane block depending on surgical procedure)
- Opioids only as rescue analgesia when required

Group O (Opioid Group)

Patients received conventional opioid-based postoperative analgesia using intravenous tramadol or morphine according to institutional protocol.

Preoperative Assessment

All patients underwent detailed preoperative evaluation including:

- Detailed medical history
- Physical examination
- Routine laboratory investigations
- Electrocardiography (ECG)
- Chest radiography when indicated

Standard fasting guidelines were followed for all patients before surgery.

Anesthetic Technique

Intraoperative monitoring included:

- Electrocardiography (ECG)
- Pulse oximetry
- Noninvasive blood pressure monitoring
- Capnography
- Temperature monitoring

General anesthesia was induced using:

- Propofol
- Fentanyl
- Vecuronium

Maintenance of anesthesia was achieved using inhalational anesthetic agents with oxygen-air mixture. Intraoperative opioid administration was standardized in both groups.

Postoperative Assessment: Postoperatively, all patients were monitored in the recovery room and surgical ward. Pain intensity was assessed using the Visual Analogue Scale (VAS) at:

- 2 hours
- 6 hours
- 12 hours
- 24 hours postoperatively

Total opioid consumption during the first 24 postoperative hours was recorded. Rescue analgesia was administered whenever the VAS score exceeded 4.

Outcome Measures

Primary Outcome

- Total postoperative opioid consumption during the first 24 hours

Secondary Outcomes

- Postoperative pain scores
- Requirement of rescue analgesia
- Incidence of nausea and vomiting
- Sedation
- Respiratory depression
- Postoperative ileus
- Time to ambulation
- Time to bowel recovery
- Duration of hospital stay

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS software version 25. Quantitative variables were expressed as mean ± standard deviation, while categorical variables were expressed as percentages. Student's t-test and Chi-square test were applied wherever appropriate. A p-value less than 0.05 was considered statistically significant.

Results

A total of 140 patients completed the study successfully. Both groups were comparable with respect to age, gender distribution, body mass index, ASA grading, and duration of surgery.

Table 1: Demographic and Baseline Characteristics

Parameter	Group M (n=70)	Group O (n=70)	p-value
Mean age (years)	46.8 ± 11.2	47.5 ± 10.8	0.72
Male patients	42 (60%)	40 (57.1%)	0.73
Female patients	28 (40%)	30 (42.9%)	0.73
Mean BMI (kg/m²)	24.6 ± 3.2	25.1 ± 3.5	0.48
ASA I	44 (62.9%)	41 (58.6%)	0.60
ASA II	26 (37.1%)	29 (41.4%)	0.60
Mean duration of surgery (min)	128.4 ± 22.6	131.7 ± 24.1	0.41

Both study groups were statistically comparable regarding demographic and perioperative baseline characteristics. No significant difference was observed in age, gender distribution, BMI, ASA grading, or operative duration ($p>0.05$), indicating appropriate randomization.

Table 2: Postoperative Opioid Consumption and Pain Scores

Parameter	Group M	Group O	p-value
Mean opioid consumption (mg)	38.5 ± 10.6	72.4 ± 14.2	<0.001*
VAS at 2 hours	3.8 ± 0.9	5.6 ± 1.1	<0.001*
VAS at 6 hours	3.2 ± 0.8	5.1 ± 1.0	<0.001*
VAS at 12 hours	2.9 ± 0.7	4.7 ± 0.9	<0.001*
VAS at 24 hours	2.4 ± 0.6	3.9 ± 0.8	<0.001*
Rescue analgesia requirement	16 (22.9%)	39 (55.7%)	<0.001*

Patients receiving multimodal analgesia demonstrated a 46.8% reduction in postoperative opioid consumption compared with the opioid-only group. VAS pain scores were significantly lower at all postoperative intervals among Group M patients. Requirement for rescue analgesia was also significantly reduced, confirming superior postoperative analgesia.

Table 3: Postoperative Adverse Effects

Adverse Effect	Group M	Group O	p-value
Nausea and vomiting	12 (17.1%)	31 (44.3%)	<0.001*
Sedation	8 (11.4%)	27 (38.6%)	<0.001*
Respiratory depression	2 (2.9%)	9 (12.9%)	0.03*
Postoperative ileus	5 (7.1%)	18 (25.7%)	0.002*
Urinary retention	4 (5.7%)	11 (15.7%)	0.048*

The multi-modal analgesia group had significantly fewer opioid-related adverse effects. Approximately 61% fewer postoperative nausea and vomiting (PONV), and significantly fewer sedation and ileus were seen in patients in Group M. Overall, the safety profile of multimodal analgesia was reinforced by reduced respiratory depression.

Table 4: Recovery Outcomes

Recovery Parameter	Group M	Group O	p-value
Time to ambulation (hours)	14.6 ± 3.8	22.5 ± 5.2	<0.001*
Return of bowel sounds (hours)	18.4 ± 4.1	29.7 ± 5.9	<0.001*
Mean hospital stay (days)	5.2 ± 1.1	7.4 ± 1.6	<0.001*
Patient satisfaction (%)	91.4%	68.6%	<0.001*

Multimodal analgesia resulted in marked postoperative recovery parameters improvement. Faster recovery of bowel function and earlier ambulation were seen in Group M patients. This multimodal analgesia group had a stay in hospital of about 30% shorter and very high levels of satisfaction.

Discussion

Inadequate postoperative pain management following major abdominal surgery can impact on the respiratory function, gastrointestinal recovery, early mobilisation, and overall surgery or anaesthetic outcome, and it is therefore a standard part of perioperative care. Historically opioids have been the preferred method of postoperative pain management because they provide excellent pain relief, but their adverse effects and the growing concern over opioid addiction have led to multimodal approaches to postoperative pain management. In the present study, multimodal analgesia significantly decreased the amount of opioid required after surgery, while simultaneously enhancing pain management and limiting adverse events and improving postoperative recovery.

An important observation from this present study was that patients receiving multimodal analgesia had significant less opioid consumption following the surgery. The patients in the Group M had almost 47% fewer consumed opioids than the conventional opioid-based analgesia group. These results help evolve the idea of opioid-sparing perioperative management. Park noted that multimodal analgesia no longer is focused solely on pain management, it also aims to reduce opioid exposure and enhance functional recovery in the postoperative period. Similarly, Deshler et al. noted that the synergistic effects of non-opioid analgesics and regional techniques are effective with significant reduction in perioperative opioid consumption.[2]

There was a significant reduction in VAS pain scores at all postoperative times for the multimodal analgesia group. The increase in the effectiveness of the drugs can perhaps be explained by the synergic effect of various drugs that act on several nociceptive pathways at once. Multimodal anesthesia, using paracetamol, NSAIDs and regional blocks is superior to opioid-only anesthesia for post-operative pain relief, Bhatia and Buvanendran said. After abdominal surgery, adequate post-operative pain control is especially crucial since pain related splinting may affect the mechanics of respiration and result in delayed ambulation.

The current study also revealed that patients treated with multimodal analgesia had a significantly lower incidence of postoperative nausea and vomiting (PONV), sedation and respiratory depression. In patients receiving opioids, adverse effects make a significant contribution to the postoperative morbidity and a prolonged hospital stay. Shah et al. highlighted that effective patient pain management and multimodal analgesia help to minimize opioid-related complications and ensure better patient safety perioperatively. Moreover, reduced exposure to opioids in the multimodal group would have played a role in the reduced incidence of sedation and respiratory compromise in the present study.

Opioid-sparing is a strong recommendation of Enhanced Recovery After Surgery (ERAS) protocols. In the current study patients receiving multimodal analgesia had shorter hospital stays and recovered bowel function more quickly, plus ambulated earlier. These results agree with the ERAS principles that aim at achieving rapid postoperative recovery and early restoration of physiological function. They explained that multimodal analgesia is an integral component of ERAS pathways due to reduction in opioid (indirectly) which leads to better gastrointestinal recovery and fewer postoperative complications. In the same way, Fu et al. showed that ERAS in gastrointestinal surgery results in the improvement of recovery outcomes, reduction in hospital stay, and increased patient satisfaction.[6]

In the present study, regional analgesics techniques, namely, epidural analgesia and transversus abdominis plane (TAP) block, were important components in the multimodal analgesia strategy. These techniques offer somatic analgesia with a focus on the surgical site and help to reduce the systemic opioid-related side effects. According to Ghosh and Ninave, TAP blocks are effective in reducing postoperative pain and opioid usage after abdominal surgeries. The results of the present study are further corroborated by the systematic review carried out by Irvine et al. which showed that TAP blocks given by anaesthesiologists or surgeons provided statistically significant better postoperative analgesia and fewer rescue opioid doses when compared to control.[12]

A key finding of the present study was the highly significant difference in favour of the patients' satisfaction in the multimodal analgesia group. Reducing the occurrence of nausea and vomiting, sedation and overall incidence of pain and discomfort are a key part of the improved patient comfort and quality of the patient's recovery. Lopez et al. highlighted that multimodal pain management after surgery is beneficial to patient outcomes and promotes improved recovery from surgery, along with reducing opioid-related side effects.[8]

These findings reinforce the importance of incorporating multimodal analgesic strategies into routine perioperative practice.

The reduction in opioid-related adverse effects observed in the present study is clinically relevant because opioid complications are associated with increased morbidity, prolonged hospitalization, and higher healthcare costs. Herzig et al. demonstrated that severe opioid-related adverse events remain an important concern among hospitalized patients and are associated with worse clinical outcomes.[9] Similarly, Shafi et al. reported that opioid-related adverse drug events significantly increase healthcare expenditure and prolong hospital stay among surgical patients.[10] The lower incidence of respiratory depression, postoperative ileus, and urinary retention observed in the present investigation further highlights the safety advantages of multimodal analgesia.

Postoperative nausea and vomiting (PONV) remain among the most distressing postoperative complications associated with opioid administration. In the present study, the incidence of PONV was significantly lower in the multimodal analgesia group. Sinha et al. reported that opioid administration is a major risk factor for postoperative nausea and vomiting and emphasized the importance of opioid-sparing approaches for

reducing PONV incidence.[13]

Recent literature increasingly supports transition toward non-opioid perioperative analgesic approaches. Al-Awadhi et al. discussed the evolving "post-opioid era" in perioperative medicine and emphasized the growing importance of multimodal non-opioid analgesic strategies for improving patient safety and reducing opioid dependence.[11] The results of the present study confirmed these current guidelines, and showed that the multimodal approach to postoperative analgesia after major abdominal surgeries is safe and effective.

However, some drawbacks of the present study should be recognized. The study took place at a single tertiary care center, and outcomes of chronic postoperative pain, long-term opioid use, and long-term quality of life were not assessed. Instead, surgical approach and technique as well as regional anesthesia methods could play a role in the efficacy of postoperative analgesia. However, the present study offers valuable clinical proof of the benefits of multimodal analgesia for surgery patients suffering from abdominal pain. In conclusion, this present study shows that multimodal pain management significantly reduces opioid consumption, contributes to better postoperative pain control, decreases opioid-related side effects and promotes postoperative recovery after major abdominal surgery.

Conclusion

After large abdominal surgery, multimodal analgesia is highly effective in decreasing opioid use after surgery. The technique offers superior pain control, reduced adverse effects of the opioids, earlier ambulation and bowel recovery, reduced hospital stays, and patients' satisfaction. There is strong potential that routine use of multimodal analgesia in the perioperative period can significantly improve postoperative recovery and opioid dependence.

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Conflicts of interest

There are no conflicts of interest.

References

1. Park SY. Multimodal analgesia for postoperative pain: pursuing liberation from pain, not redemption. Ann Coloproctol. 2024 Jun;40(3):189-190. doi: 10.3393/ac.2024.00304.0043. Epub 2024 Jun 12. PMID: 38946090; PMCID: PMC11362757.
2. Bailee J. Deshler, Emily Rockenbach, Takshaka Patel, Brian V. Monahan, Juan Lucas Poggio. Current update on multimodal analgesia and nonopiate surgical pain management. Current Problems in Surgery. 2023;60(6):101332. https://doi.org/10.1016/j.cpsurg.2023.101332
3. Bhatia A, Buvanendran A. Anesthesia and postoperative pain control-multimodal anesthesia protocol. J Spine Surg. 2019 Sep;5(Suppl 2):S160-S165. doi: 10.21037/jss.2019.09.33. PMID: 31656870; PMCID: PMC6790811.
4. Shah PJ, Sahu S, Sharma R, Karim HMR. Predicting and evaluating pain after surgery…Newer methods to the rescue? Indian J Anaesth. 2023 Feb;67(Suppl 2):S77-S80. doi: 10.4103/ija.ija_65_23. Epub 2023 Feb 22. PMID: 37122932; PMCID: PMC10132677.
5. Grant MC, Engelman DT. Enhanced recovery after surgery: overarching themes of the ERAS® Society Guidelines & Consensus Statements for Adult Specialty Surgery. Perioper Med (Lond). 2025 Oct 30;14(1):120. doi: 10.1186/s13741-025-00590-0. PMID: 41168801; PMCID: PMC12577217.
6. Fu XJ, Ren JX, Yuan LL, Hong Y. Application of enhanced recovery after surgery techniques in gastrointestinal surgery patients. World J Gastrointest Surg. 2025 Sep 27;17(9):107605. doi: 10.4240/wjgs.v17.i9.107605. PMID: 41024788; PMCID: PMC12476762.
7. Ghosh A, Ninave S. Navigating Pain Relief: A Comprehensive Review of Transversus Abdominis Plane Block. Cureus. 2023 Dec 26;15(12):e51119. doi: 10.7759/cureus.51119. PMID: 38274920; PMCID: PMC10808892.
8. Lopez BM, Lee BM, Miller MD, Ibrahim MM, Vanderah TW and Riegel AC (2025) Postoperative multimodal pain management: a narrative review of current practices, clinical and educational gaps, and future directions. Front. Anesthesiol. 4:1709252. doi: 10.3389/fanes.2025.1709252
9. Herzig SJ, Stefan MS, Pekow PS, Shieh MS, Soares W, Raghunathan K, Lindenauer PK. Risk Factors for Severe Opioid-Related Adverse Events in a National Cohort of Medical Hospitalizations. J Gen Intern Med. 2020 Feb;35(2):538-545. doi: 10.1007/s11606-019-05490-w. Epub 2019 Nov 14. PMID: 31728892; PMCID: PMC7018928.
10. Shafi S, Collinsworth AW, Copeland LA, Ogola GO, Qiu T, Kouznetsova M, Liao IC, Mears N, Pham AT, Wan GJ, Masica AL. Association of Opioid-Related Adverse Drug Events With Clinical and Cost Outcomes Among Surgical Patients in a Large Integrated Health Care Delivery System. JAMA Surg. 2018 Aug 1;153(8):757-763. doi: 10.1001/jamasurg.2018.1039. PMID: 29799927; PMCID: PMC6142954.
11. Al-Awadhi AA, Yoosuf S, Malasevskaia IA. Navigating the Post-opioid Era: A Focus on Non-opioid Perioperative Analgesics. Cureus. 2026 Jan 10;18(1):e101209. doi: 10.7759/cureus.101209. PMID: 41669605; PMCID: PMC12884194.
12. Irvine D, Rennie C, Coughlin E, Thornton I, Mhaskar R, Huang J. The Efficacy of Transversus Abdominis Plane (TAP) Blocks When Completed by Anesthesiologists Versus by Surgeons: A Systematic Review and Meta-Analysis. Healthcare. 2024; 12(24):2586. https://doi.org/10.3390/healthcare12242586
13. Sinha V, Vivekanand D, Singh S. Prevalence and risk factors of post-operative nausea and vomiting in a tertiary-care hospital: A cross-sectional observational study. Med J Armed Forces India. 2022 Sep;78(Suppl 1):S158-S162. doi: 10.1016/j.mjafi.2020.10.024. Epub 2020 Dec 31. PMID: 36147426; PMCID: PMC9485772.