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Original Research Article

STUDY ON THE EFFICACY OF MULTIMODAL ANALGESIA IN REDUCING OPIOID CONSUMPTION AFTER ABDOMINAL SURGERY

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Abstract

Background: This study aimed to evaluate the efficacy of multimodal analgesia (MMA) in reducing opioid consumption and improving postoperative outcomes in patients undergoing abdominal surgery. **Materials and Methods:** A prospective, single-center, observational study was conducted with 80 adult patients aged 18 to 80 years, undergoing elective abdominal surgery. Patients were randomly assigned to either the Multimodal Analgesia (MMA) group or the Standard Care (SC) group. The MMA group received a combination of acetaminophen, ibuprofen, local anesthetic infiltration, and adjunct medications such as gabapentin and dexmedetomidine, while the SC group received opioid analgesia alone. Primary outcomes included opioid consumption (measured in morphine milligram equivalents, MME) and secondary outcomes included pain intensity, opioid-related side effects, hospital stay duration, and patient satisfaction with pain control. **Result:** The MMA group showed a significant reduction in total opioid consumption (48.2 ± 22.3 MME) compared to the SC group (92.5 ± 31.6 MME, $p < 0.001$). Postoperative pain intensity, as measured by the Visual Analog Scale (VAS), was consistently lower in the MMA group at all-time points (1, 6, 12, and 24 hours) with significant differences ($p < 0.001$). The incidence of opioid-related side effects such as nausea, vomiting, and sedation was significantly lower in the MMA group. The MMA group also had a shorter hospital stay (4.2 ± 1.3 days vs. 5.1 ± 1.7 days, $p = 0.045$) and higher patient satisfaction with pain control (4.5 ± 0.6 vs. 3.2 ± 1.1, $p < 0.001$). **Conclusion:** Multimodal analgesia significantly reduces opioid consumption, improves pain control, minimizes opioid-related side effects, and shortens hospital stays in patients undergoing abdominal surgery. These results support MMA as a superior approach for postoperative pain management, promoting faster recovery and enhancing patient satisfaction.

INTRODUCTION

Abdominal surgeries, both major and minor, are common procedures that require effective postoperative pain management to ensure optimal patient recovery and comfort. Pain management after surgery is a critical component of patient care, as inadequate pain control can lead to complications such as delayed recovery, increased risk of infections, and prolonged hospital stays. Traditionally, opioid analgesics have been the cornerstone of postoperative pain management due to their potent pain-relieving properties. However, the reliance on opioids in postoperative care has raised concerns due to their well-known adverse effects, including nausea, vomiting, constipation, respiratory depression, and, in the long term, the risk of addiction and opioid dependence.[1] In response to these concerns, there has been growing interest in multimodal analgesia (MMA) as an alternative approach to pain management in the postoperative setting. Multimodal analgesia refers to the use of multiple analgesic techniques and medications that act at different sites of pain processing, with the goal of achieving superior pain relief while minimizing opioid consumption and reducing the risk of opioid-related side effects. This approach often involves the combination of non-opioid analgesics, local anesthetics, and non-pharmacological methods, such as nerve blocks or patient-controlled analgesia.[2] The concept of multimodal analgesia is based on the understanding that pain is a complex, multifactorial experience that involves both peripheral and central mechanisms. Traditional opioid therapy primarily targets the central nervous system, where opioids bind to receptors in the brain and spinal cord to block pain signals. However, opioids alone may not address the peripheral components of pain, such as inflammation and tissue damage. By combining opioids with other medications and techniques that

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target these peripheral pain pathways, multimodal analgesia aims to provide a more comprehensive approach to pain management.[3] The use of multimodal analgesia has gained considerable attention in recent years, especially in the context of reducing opioid consumption. Opioid-related side effects, coupled with the ongoing opioid epidemic, have led to a shift in the clinical approach to pain management, with a growing emphasis on minimizing opioid use while still providing effective pain relief. By incorporating a variety of analgesic agents, such as non-steroidal anti-inflammatory drugs (NSAIDs), acetaminophen, regional anesthesia, and adjuncts like gabapentinoids, the goal is to provide effective pain relief while reducing opioid requirements.[4] Recent studies have shown that multimodal analgesia can be effective in reducing opioid consumption after abdominal surgery, while still maintaining satisfactory pain control. Techniques such as transversus abdominis plane (TAP) blocks, epidural anesthesia, and perioperative use of NSAIDs have been investigated in various clinical settings to assess their ability to reduce opioid use and improve postoperative outcomes. The rationale behind these approaches is to target different pain pathways simultaneously, reducing the need for high-dose opioids and minimizing the risk of side effects.[5] One of the key advantages of multimodal analgesia is its ability to reduce opioid consumption without compromising pain control. In many cases, this approach has been shown to not only reduce opioid consumption but also improve patient satisfaction with pain management. This is particularly important in abdominal surgery, where postoperative pain can be intense due to the invasive nature of the procedure and the involvement of abdominal muscles, nerves, and organs. The implementation of multimodal analgesia can potentially lead to faster recovery times, shorter hospital stays, and a reduced incidence of opioid-related complications, such as addiction and overdose.[6] However, despite the promising results of multimodal analgesia in reducing opioid consumption, several challenges remain in its widespread implementation. One of the key barriers to the adoption of multimodal analgesia is the lack of standardized protocols and clinical guidelines. Different institutions may have varying practices, and the availability of certain analgesic agents or techniques may differ depending on the hospital or surgical team. Additionally, individual patient factors, such as comorbidities, allergies, and response to medications, may influence the selection of appropriate analgesic strategies. Furthermore, while the benefits of multimodal analgesia in reducing opioid consumption are well-documented, the long-term outcomes of this approach remain an area of ongoing research. Questions remain regarding the potential for opioid-sparing analgesia to cause increased pain or discomfort later in the postoperative period, especially as the effects of non-opioid medications wear off. Additionally, while multimodal analgesia can reduce opioid use in the immediate postoperative period, it is unclear whether this approach has a significant impact on the long-term opioid consumption patterns of patients following discharge from the hospital.[7] In light of these considerations, it is essential to continue investigating the efficacy of multimodal analgesia in reducing opioid consumption following abdominal surgery. Understanding the best combinations of analgesic agents and techniques, as well as the optimal timing and dosage of these interventions, will be key to advancing postoperative pain management and minimizing the reliance on opioids. The goal is not only to reduce opioid consumption but also to improve overall patient outcomes, including faster recovery, reduced hospital stay, and lower rates of opioid-related complications. Multimodal analgesia represents a promising strategy for enhancing postoperative pain management after abdominal surgery. By targeting multiple pain pathways and reducing opioid consumption, this approach has the potential to improve patient outcomes while mitigating the risks associated with opioid use.

MATERIALS AND METHODS

This was a prospective, single-center, observational study conducted to evaluate the efficacy of multimodal analgesia in reducing opioid consumption following abdominal surgery. Ethical approval was obtained from the institutional review board (IRB), and all participants provided written informed consent prior to enrollment. A total of 80 adult patients aged 18 to 80 years, undergoing elective abdominal surgery, were recruited for this study. Inclusion criteria included patients scheduled for major abdominal surgery (e.g., colectomy, gastrectomy, cholecystectomy), who were otherwise healthy or had controlled comorbidities (American Society of Anesthesiologists (ASA) Class I-III). Exclusion criteria included patients with contraindications to regional anesthesia (e.g., allergy to local anesthetics, infection at the injection site), those who had previously undergone abdominal surgery, and individuals with chronic opioid use or dependency.

Study Groups

Patients were divided into two groups:

- Multimodal Analgesia Group (MMA): The intervention group, in which patients received a combination of analgesic modalities, including preoperative oral acetaminophen (1000 mg) and ibuprofen (400 mg), intraoperative local anesthetic infiltration, and postoperative intravenous (IV) patient-controlled analgesia (PCA) with opioids, along with adjunct medications such as gabapentin (300 mg), and dexmedetomidine (0.2-0.5 mcg/kg/hour).
- Standard Care Group (SC): The control group, where patients received opioid analgesia alone, using IV PCA with morphine, with standard

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postoperative pain management strategies including oral acetaminophen (1000 mg) and NSAIDs as needed.

Surgical Procedure and Anesthesia Protocol

All patients underwent the respective abdominal surgeries under general anesthesia, administered using a standardized anesthetic protocol. Induction of anesthesia was achieved with propofol (2-3 mg/kg), fentanyl (1-2 mcg/kg), and rocuronium (0.6 mg/kg). Maintenance of anesthesia was achieved with isoflurane (0.8-1.2 MAC), with supplementation of fentanyl as necessary to ensure hemodynamic stability and analgesia. For the MMA group, local anesthetic (e.g., bupivacaine 0.25% or lidocaine 1%) was infiltrated in the surgical incision site at the end of the procedure. Gabapentin (300 mg) was administered orally 1 hour before the surgery, and dexmedetomidine infusion was started intraoperatively and continued for the first 24 hours postoperatively. Postoperative analgesia in both groups was managed with IV PCA pumps. For the MMA group, a lower opioid requirement was expected due to the additional analgesic agents. The opioids administered were morphine (1 mg/mL) with a demand dose of 1 mg and a lock-out interval of 10 minutes. The standard care group was managed similarly, but without adjunct non-opioid analgesics. The primary outcome of the study was the total opioid consumption, measured in morphine milligram equivalents (MME), during the first 48 hours following surgery. Secondary outcomes included the assessment of postoperative pain intensity using the Visual Analog Scale (VAS) at 1, 6, 12, and 24 hours after surgery. Additionally, the study evaluated the incidence of opioid-related side effects, including nausea, vomiting, constipation, and sedation, which were recorded during the first 48 hours postoperatively. Another secondary outcome was the length of hospital stay, with particular attention to whether the use of multimodal analgesia influenced early discharge. Finally, patient satisfaction with pain control was assessed 48 hours after surgery using a 5-point Likert scale, where 1 represented "very dissatisfied" and 5 represented "very satisfied."

Statistical Analysis: The primary analysis was based on comparing opioid consumption (MME) between the two groups. Data were expressed as mean ± standard deviation (SD) or median (interquartile range) for non-normally distributed variables. The normality of data was assessed using the Shapiro-Wilk test. Between-group comparisons for continuous variables were performed using the independent t-test or Mann-Whitney U test, depending on the distribution of data. Categorical variables were compared using the chi-square test. A p-value of < 0.05 was considered statistically significant.

RESULTS

[Table 1] Demographic Characteristics of Patients

The demographic data of the patients enrolled in the study revealed no significant differences between the two groups (MMA and SC) regarding age, gender, ASA classification, type of surgery, or body mass index (BMI). The average age in the MMA group was 53.6 ± 12.4 years, while the SC group had a slightly higher average age of 55.2 ± 13.1 years. Both groups consisted of an equal number of male and female patients, with 20 males and 20 females in the MMA group, and 22 males and 18 females in the SC group. The distribution of ASA classification was also similar between the two groups, with a comparable number of patients in each group classified as ASA I, II, and III. The most common surgical procedures were colectomy, gastrectomy, and cholecystectomy, with no significant difference in the distribution of surgeries between the groups. The average BMI was slightly lower in the MMA group (27.3 ± 4.1) compared to the SC group (28.1 ± 4.5), though this difference was minimal and did not significantly affect the results.

[Table 2] Total Opioid Consumption (MME) in the First 48 Hours

The primary outcome of the study, total opioid consumption during the first 48 hours after surgery, showed a statistically significant reduction in the MMA group. Patients in the MMA group consumed 48.2 ± 22.3 morphine milligram equivalents (MME) in comparison to 92.5 ± 31.6 MME in the SC group ($p < 0.001$). This marked reduction in opioid use in the MMA group highlights the efficacy of the multimodal analgesia approach, which combined non-opioid analgesics and regional anesthesia techniques, resulting in a lower reliance on opioids for pain management.

[Table 3] Postoperative Pain Intensity (VAS) at Different Time Points

Postoperative pain intensity was significantly lower in the MMA group compared to the SC group at all measured time points (1, 6, 12, and 24 hours post-surgery). At 1-hour post-surgery, the average Visual Analog Scale (VAS) score was 3.4 ± 1.2 in the MMA group, while the SC group had a significantly higher score of 6.2 ± 1.1 ($p < 0.001$). Similarly, at subsequent time points (6, 12, and 24 hours), pain scores in the MMA group remained consistently lower than those in the SC group, with the VAS scores in the MMA group ranging from 2.6 ± 0.9 to 3.4 ± 1.3, compared to 5.1 ± 1.0 to 5.9 ± 1.2 in the SC group (all p-values < 0.001). These results indicate that multimodal analgesia provided better control of postoperative pain.

[Table 4] Incidence of Opioid-Related Side Effects (First 48 Hours)

The incidence of opioid-related side effects, including nausea, vomiting, constipation, and sedation, was significantly lower in the MMA group compared to the SC group. Nausea occurred in 10%

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of MMA patients versus 30% in the SC group ($p = 0.035$), and vomiting was observed in 5% of MMA patients compared to 25% in the SC group ($p = 0.028$). Sedation was reported in 12.5% of patients in the MMA group compared to 37.5% in the SC group ($p = 0.021$). Although the difference in constipation between the two groups (7.5% vs. 17.5%, respectively) was not statistically significant ($p = 0.147$), these results suggest that multimodal analgesia not only reduces opioid consumption but also helps minimize common opioid-related adverse effects.

[Table 5] Length of Hospital Stay (Days)

The length of hospital stay was significantly shorter in the MMA group compared to the SC group. Patients in the MMA group were discharged an average of 4.2 ± 1.3 days after surgery, while patients in the SC group had a longer average stay of 5.1 ± 1.7 days ($p = 0.045$). This shorter length of stay in the MMA group may be attributed to better pain control, fewer opioid-related side effects, and a faster recovery overall, which facilitated earlier discharge.

[Table 6] Patient Satisfaction with Pain Control (48 Hours Postoperatively)

Patient satisfaction with pain control was significantly higher in the MMA group, with an average satisfaction score of 4.5 ± 0.6 (out of 5), compared to 3.2 ± 1.1 in the SC group ($p < 0.001$). This difference in satisfaction suggests that patients in the MMA group perceived their pain to be better managed and experienced fewer discomforts associated with opioid use, further supporting the efficacy of multimodal analgesia in improving postoperative outcomes and patient well-being.

Table 1: Demographic Characteristics of Patients.

Characteristic	Multimodal Analgesia Group (MMA) (n=40)	Standard Care Group (SC) (n=40)
Age (years)	53.6 ± 12.4	55.2 ± 13.1
Gender		
Male	20	22
Female	20	18
ASA Classification	10/20/10	12/18/10
I	10	12
II	20	18
III	10	10
Type of Surgery		
Colectomy	14	15
Gastrectomy	12	13
Cholecystectomy	14	12
Average BMI (kg/m²)	27.3 ± 4.1	28.1 ± 4.5

Table 2: Total Opioid Consumption (MME) in the First 48 Hours.

Group	Total Opioid Consumption (MME)	p-value
Multimodal Analgesia Group (MMA)	48.2 ± 22.3	< 0.001
Standard Care Group (SC)	92.5 ± 31.6	

Table 3: Postoperative Pain Intensity (VAS) at Different Time Points.

Time Point (hrs)	MMA Group (VAS)	SC Group (VAS)	p-value
1	3.4 ± 1.2	6.2 ± 1.1	< 0.001
6	3.1 ± 1.3	5.9 ± 1.0	< 0.001
12	2.9 ± 1.0	5.5 ± 1.2	< 0.001
24	2.6 ± 0.9	5.1 ± 1.0	< 0.001

Table 4: Incidence of Opioid-Related Side Effects (First 48 Hours).

Side Effect	MMA Group (n=40)	SC Group (n=40)	p-value
Nausea	4 (10%)	12 (30%)	0.035
Vomiting	2 (5%)	10 (25%)	0.028
Constipation	3 (7.5%)	7 (17.5%)	0.147
Sedation	5 (12.5%)	15 (37.5%)	0.021

Table 5: Length of Hospital Stay (Days).

Group	Length of Stay (Days)	p-value
Multimodal Analgesia Group (MMA)	4.2 ± 1.3	0.045
Standard Care Group (SC)	5.1 ± 1.7	

Table 6: Patient Satisfaction with Pain Control (48 Hours Postoperatively)

Group	Satisfaction Score (out of 5)	p-value
Multimodal Analgesia Group (MMA)	4.5 ± 0.6	< 0.001
Standard Care Group (SC)	3.2 ± 1.1	

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DISCUSSION

Multimodal analgesia (MMA) has emerged as a promising strategy for postoperative pain management, particularly in reducing opioid consumption following abdominal surgery. The primary outcome of this study, total opioid consumption during the first 48 hours after surgery, showed a marked reduction in the MMA group (48.2 ± 22.3 MME) compared to the standard care (SC) group (92.5 ± 31.6 MME), with a significant p-value of < 0.001. This result aligns with previous findings by Hooten et al. (2015), who discussed the role of multimodal analgesia in managing chronic pain and reducing opioid reliance.[7] Their review highlighted how using non-opioid adjuncts like acetaminophen, NSAIDs, and regional blocks could provide equivalent or better pain relief while limiting opioid consumption. Similarly, Wu et al. (2011) noted that postoperative pain management can be optimized by reducing opioid use through the combination of local anesthetics and other adjuvants, supporting the findings of this study.[8] This reduced opioid consumption is not only beneficial from a pain management perspective but also essential in light of the ongoing opioid epidemic. Stoicea et al. (2016) further emphasized that multimodal analgesia helps balance effective pain relief with the minimization of opioid side effects, which is particularly important in abdominal surgeries, where pain can be substantial.[9] This was reflected in the lower incidence of opioid-related side effects in the MMA group in our study, including nausea, vomiting, and sedation. These side effects were significantly lower in the MMA group compared to the SC group, which aligns with the observations of Guay et al. (2017), who found that multimodal analgesia reduces opioid side effects, contributing to better overall recovery and patient satisfaction.[10] Pain intensity, as measured by the Visual Analog Scale (VAS), was significantly lower in the MMA group at all postoperative time points (1, 6, 12, and 24 hours) compared to the SC group . At 1-hour post-surgery, the VAS score was 3.4 ± 1.2 in the MMA group, compared to 6.2 ± 1.1 in the SC group, with a p-value < 0.001. These results indicate that MMA provided superior early pain control, which is crucial for improving the patient's recovery experience. Eisenach et al. (2008) also supported this, stating that using non-opioid analgesics such as local anesthetics or gabapentinoids could achieve effective pain relief while lowering opioid requirements.[11] The lower pain scores in the MMA group were maintained at later time points, suggesting a prolonged analgesic effect that helped maintain comfort without escalating opioid doses. Sharrock et al. (2017) also found that combining regional anesthesia, NSAIDs, and gabapentinoids resulted in sustained pain control and opioid sparing, further validating the findings of our study.[12] The length of hospital stay was significantly shorter in the MMA group (4.2 ± 1.3 days) compared to the SC group (5.1 ± 1.7 days), which can be attributed to more effective pain management and reduced opioid-related side effects [Table 5]. This shorter hospital stay supports the findings of Lee et al. (2015), who reported that patients receiving multimodal analgesia experienced faster recovery and discharge following abdominal surgery.[13] Similarly, Gallagher et al. (2017) found that multimodal analgesia not only reduced opioid consumption but also accelerated recovery, enabling patients to leave the hospital sooner.[14] Patient satisfaction with pain control was significantly higher in the MMA group (4.5 ± 0.6) compared to the SC group (3.2 ± 1.1) [Table 6]. This difference in satisfaction suggests that patients in the MMA group perceived their pain to be better managed and experienced fewer discomforts related to opioid use. Albrecht et al. (2017) highlighted that multimodal analgesia enhances patient satisfaction by providing more comprehensive pain relief, reducing opioid reliance, and minimizing adverse effects.[15] Similarly, Kim et al. (2019) found that multimodal analgesia led to higher patient satisfaction and better recovery outcomes following laparoscopic colorectal surgery.[16] The effectiveness of multimodal analgesia has been a subject of extensive research, and our study adds to the growing body of evidence supporting its use in abdominal surgery. Jafri et al. (2020) discussed how multimodal analgesia could lead to significant reductions in opioid consumption, improved pain control, and better postoperative recovery.[17] This aligns with the results from our study, where patients in the MMA group showed a significant reduction in opioid consumption, lower pain intensity, fewer side effects, and faster recovery.

CONCLUSION

In conclusion, the results of this study strongly support the efficacy of multimodal analgesia (MMA) in reducing opioid consumption, managing postoperative pain, and improving recovery outcomes after abdominal surgery. The MMA approach significantly decreased opioid use, enhanced pain control, minimized opioid-related side effects, and shortened hospital stays compared to standard care. Additionally, patient satisfaction with pain management was notably higher in the MMA group. These findings highlight the potential of multimodal analgesia as a superior strategy for postoperative pain management, promoting faster recovery and reducing the risks associated with opioid use.

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