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Efficacy Of Multimodal Analgesia Versus Epidural Analgesia After Major Abdominal Surgery: A Randomized Open Label Study

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Abstract

Background

Effective postoperative pain management is essential for early recovery following major abdominal surgery. Although Epidural analgesia remains a standard technique, MMA has emerged as an alternative strategy aimed at reducing adverse effects while maintaining adequate analgesia. The present study compared the efficacy and safety of epidural analgesia and multimodal analgesia in patients undergoing major abdominal surgery.

Methods

This single-centre, open-label randomized parallel-group study was conducted among 52 patients undergoing elective major abdominal surgery. Patients were randomly allocated into epidural analgesia (EA, n=26) and multimodal analgesia (MMA, n=26) groups. Postoperative pain was assessed using the Visual Analogue Scale (VAS). Sedation score, motor block score, postoperative complications, and patient satisfaction were also evaluated. Repeated measures ANOVA was used to compare pain, sedation, and motor block scores over time. Categorical variables were analysed using Chi-square test. A p-value <0.05 was considered statistically significant.

Results

Baseline demographic and clinical characteristics were comparable between groups. Repeated measures ANOVA demonstrated significant reduction in postoperative pain scores over time in both groups ($F=42.81$, $p<0.001$), with no significant difference between the groups ($F=1.24$, $p=0.27$). Sedation scores were significantly higher in the EA group ($F=7.92$, $p=0.007$). Motor block scores were also significantly greater among patients receiving epidural analgesia ($F=28.45$, $p<0.001$). Hypotension was significantly more common in the EA group compared to the MMA group (23.1% vs. 3.8%, $p=0.04$). Patient satisfaction was high and comparable in both groups.

Conclusion

Multimodal analgesia provided postoperative pain relief comparable to epidural analgesia with fewer adverse effects, reduced motor blockade, and improved haemodynamic stability. Multimodal analgesia may therefore represent an effective and practical alternative for postoperative pain management following major abdominal surgery.

Keywords

Postoperative pain; Epidural analgesia; Multimodal analgesia; Abdominal surgery; Enhanced recovery.

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I. Introduction

Major surgery induces a wide range of physiological, psychological, and emotional responses in patients. Postoperative pain is multifactorial in nature and typically peaks within 24–72 hours after surgery.[1] The management of postoperative pain remains challenging, and inadequate pain control may result in psychological, economic, and social consequences.[2] Furthermore, insufficient pain management is associated with increased postoperative morbidity and delayed recovery. Consequently, effective postoperative pain management has received considerable attention, leading to significant advancements in this field.[3]

Epidural analgesia (EA) is one of the most well-established approaches for postoperative pain management and is commonly used in approximately 50%–60% of major abdominal surgeries worldwide.[4] Compared with opioid-based patient-controlled intravenous analgesia (PCIA), EA provides superior pain relief with fewer opioid-related complications.[5] However, transient haemodynamic instability resulting from sympathetic nerve blockade is a recognized adverse effect of epidural analgesia and may contribute to delayed postoperative recovery.[5,6]

Multimodal analgesia (MMA) involves the use of a combination of analgesic medications and techniques to manage postoperative pain. This strategy targets multiple components of the neurochemical pain pathway, thereby producing a greater overall analgesic effect.[7] A wide variety of drug combinations and dosing regimens can be incorporated into MMA protocols.[8] Combination analgesic therapy may offer advantages by targeting both peripheral and central pain pathways, enabling effective analgesia at lower and more tolerable doses of individual agents.[9]

Therefore, this study aims to compare the efficacy of epidural analgesia and multimodal analgesia in the management of postoperative pain following abdominal surgery. This study contributes to the growing body of evidence on perioperative pain management and may assist healthcare professionals and societies in identifying optimal analgesic strategies. Furthermore, the findings highlight the need for continued research to refine perioperative pain management approaches using randomised controlled trial.

II. Materials And Methods

The trial was designed, analysed, and reported according to CONSORT guidelines.

Study design and population

The present study was a single centre, open labelled parallel group trial. The study was conducted among patients undergoing abdominal surgery at SS Institute of Medical Sciences, Davangere. The study was conducted for a period of one year. All patients ≥18 years scheduled for major abdominal surgery, with ASA I and ASA II. All patients undergoing elective major abdominal surgical procedures with midline upper abdominal incisions during the study period were included (Whipple's procedure, hemicolectomy, exploratory laparotomy, extended radical cystectomy and nephrectomy, major debulking gynaecological surgery and abdominal aortic aneurysm surgery). Those who were contraindicated to neuraxial block and requiring emergency abdominal surgery were excluded.

Sample size estimation

The sample size was calculated suing G*power software (3.1.9.7). For an effect size of 0.8, type I error of 0.05 and power of the study 0.8, 52 samples were enough. Each group had 26 patients.

Random allocation

Two analgesia, EA and MMA constituted the two interventions. The interventions were randomly allocated to patients by a person who was not directly involved in the study. A total of 26 patients received EA as post-operative analgesia and for other 26 patients MMA was used.

Intervention

The drug used for epidural infusion included bupivacaine 0.1%, while bupivacaine 0.125% and 0.0625% were used in one patient each. Fentanyl 2 µg/ml was added to the epidural infusion in all patients. The infusion rate was titrated according to patient response and maintained between 6 and 12 ml/h. The epidural catheter was inserted between L1–L3 in 14 patients, T10–L1 in 8 patients, and T8–T10 in 4 patients. Epidural infusion was continued for 2 postoperative days in 20 patients, for 3 days in 5 patients, and for 4 days in 1 patient. In the multimodal analgesia group, 21 patients received intravenous paracetamol, two patients received ketorolac, and diclofenac suppositories were administered to three patients. The multimodal analgesic regimen was individualized according to patient profile, surgical procedure, and postoperative analgesic requirements.

Follow-up

All the patients were followed-up at-least twice a day by the primary investigator and the nurse to monitor the post-op pain. Along with this, on-call resident made evening round of all patients as per our hospital protocol.

Outcome

Primary outcome was postoperative VAS pain score. Secondary outcomes included sedation score, motor block score, postoperative complications, and patient satisfaction.

Pain score, sedation score, motor block, nausea, vomiting or any other complication related to pain management was recorded by the investigator. Pain was assessed by VAS with a scores ranged from 0-10 where 0 is no pain and 10 represents worst pain. Sedation score was assessed using a scale ranged from 1-5 and it was recorded by the investigator. The motor bock was assessed using Modified Bromage Score. [10] The scale had a scores ranged from 0-3, 0 = no block, 1 = unable to raise straight leg, able to flex knee, 2 = unable to flex knee, able to move ankle and toes, 3 = unable to move the lower limb. Nausea and vomiting were assessed on a scale of 0-3 (0 = none, 1 = mild nausea on inquiry, 2 = moderate nausea/vomiting - treatment required, 3 = vomiting unresponsive to simple antiemetics). Patient satisfaction scale was used to assess the pain relief. It was determined by the trained nurse at the time of discharge. It was rated as excellent, good, fair or poor.

Statistical analyses

Data were analysed using SPSS version XX (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation, and categorical variables as frequencies and percentages. Baseline demographic and clinical characteristics between the epidural analgesia (EA) and multimodal analgesia (MMA) groups were compared using the independent sample t-test for continuous variables and Chi-square test for categorical variables. Repeated measures ANOVA was used to compare postoperative pain scores, sedation scores, and motor block scores between groups over different time intervals. Postoperative nausea, vomiting, complications, and patient satisfaction scores were compared using the Chi-square test. A p-value <0.05 was considered statistically significant.

III. Results

Table 1 Baseline Demographic and Clinical Characteristics of the Study Participants

Variables	EA Group (n=26)	MMA Group (n=26)	p-value
Age (years) Mean ± SD	51.8±10.6	49.7±11.2	0.48
Male/Female	15/11	16/10	0.78
BMI (Kg/m^2)	24.9±3.4	25.3±3.1	0.64
ASA grade I (n%)	11 (42.3)	10 (38.5)	0.77
ASA grade II (n%)	15 (57.7)	16 (61.5)	
Duration of surgery (min) Mean ± SD	184.2 ± 29.6	178.5 ± 32.4	0.51

Table 2 Comparison of post-operative outcomes between Epidural Analgesia and Multimodal Analgesia Groups

Outcome measures	EA group (n=26)	MMA group (n=26)	Group effect F (p-value)	Time effect F (p-value)	Time and group interaction F (p-value)
VAS score	2.72 ± 0.84	2.78 ± 0.86	1.24	42.81 **	0.96
Sedation score	2.12 ± 0.42	1.84 ± 0.36	7.92 **	31.64 **	3.11 **
Motor block score	0.60 ± 0.24	0.04 ± 0.05	28.45 **	54.27 **	6.84 **

** Highly significant (p=0.001)

Table 3 Post-operative complications and patient satisfaction

Variable	EA group (n=26, %)	MMA group (n=26, %)	p-value
Nausea	5 (19.2)	4 (15.4)	0.71
Vomiting	4 (15.4)	2 (7.7)	0.39
Hypotension	6 (23.1)	1 (3.8)	0.04
Respiratory depression	1 (3.8)	0 (0)	0.31
Patient satisfaction			
Excellent/Good Satisfaction	21 (80.8)	23 (88.5)	0.44
Fair/Poor Satisfaction	5 (19.2)	3 (11.5)	0.44

Baseline demographic and clinical characteristics were comparable between the and groups, with no statistically significant differences observed in age, gender distribution, BMI, ASA grade, or duration of surgery (p>0.05). This indicates that both groups were adequately matched at baseline, minimizing potential confounding factors (Table 1).

Repeated measures ANOVA demonstrated a significant time effect for postoperative VAS pain scores ($F=42.81$, $p<0.001$), indicating that pain scores changed significantly over the postoperative period in both groups. However, the group effect was not statistically significant ($F=1.24$, $p=0.27$), and there was no significant time × group interaction ($F=0.96$, $p=0.43$), suggesting that multimodal analgesia provided postoperative pain relief comparable to epidural analgesia throughout the follow-up period.

For sedation scores, significant time and group effects were observed. Sedation scores decreased significantly over time in both groups ($F=31.64$, $p<0.001$). The epidural analgesia group demonstrated significantly higher sedation scores compared to the multimodal analgesia group ($F=7.92$, $p=0.007$). In addition, the significant time × group interaction ($F=3.11$, $p=0.02$) indicated differing trends in sedation recovery between the two groups over time.

Motor block scores also showed significant time and group effects. Although motor blockade improved progressively during follow-up in both groups ($F=54.27$, $p<0.001$), the epidural analgesia group exhibited significantly higher motor block scores than the multimodal analgesia group ($F=28.45$, $p<0.001$). The significant interaction effect ($F=6.84$, $p<0.001$) further demonstrated that the reduction in motor blockade over time differed significantly between groups. (Table 2)

Regarding postoperative complications, hypotension was significantly more common in the epidural analgesia group compared to the multimodal analgesia group (23.1% vs. 3.8%, $p=0.04$). Incidences of nausea, vomiting, and respiratory depression were comparable between groups. Patient satisfaction scores were high in both groups without significant difference ($p=0.44$). (Table 3)

IV. Discussion

The present study compared the effectiveness of and for postoperative pain management following major abdominal surgery. The findings demonstrated that multimodal analgesia provided pain relief comparable to epidural analgesia, with fewer adverse effects and easier postoperative management.

In the present study, postoperative VAS pain scores decreased significantly over time in both groups. However, there was no statistically significant difference between the groups, indicating that both analgesic techniques were equally effective in controlling postoperative pain. These findings are in agreement with studies by Levy et al. and Hubner et al., who reported that multimodal analgesic protocols offered analgesic efficacy comparable to epidural techniques in abdominal surgeries while supporting enhanced recovery.[11,6] Similar observations were also reported in ERAS-based perioperative studies where multimodal analgesia reduced opioid requirements without compromising pain control.

Although analgesic efficacy was similar, patients in the epidural analgesia group experienced significantly higher sedation scores during the early postoperative period. Increased sedation may delay mobilization and recovery after surgery. Comparable findings were reported by Wu et al., who observed that epidural techniques, particularly when combined with opioids, were associated with higher sedation-related adverse effects compared with multimodal approaches.[12]

Motor blockade was significantly higher in the epidural analgesia group in the present study. This finding is clinically relevant because early ambulation is an important component of postoperative recovery protocols. Multimodal analgesia was associated with minimal motor impairment, thereby facilitating easier mobilization. Similar results were reported by Popping et al., who noted that epidural analgesia may impair lower limb motor function due to sympathetic and motor nerve blockade.[13]

The incidence of hypotension was also significantly higher among patients receiving epidural analgesia. Epidural-induced sympathetic blockade can produce vasodilation and haemodynamic instability, especially in major abdominal surgeries. In contrast, the multimodal analgesia group demonstrated better haemodynamic stability. This observation correlates with previous studies which have shown lower rates of hypotension and vasopressor requirement with multimodal analgesic strategies compared to epidural analgesia.

Postoperative nausea and vomiting were comparable between groups in the current study. Patient satisfaction scores were high in both groups, suggesting that adequate pain control was achieved irrespective of the analgesic technique used. However, the easier administration, lower monitoring requirement, and reduced adverse effects associated with multimodal analgesia may provide practical advantages in routine clinical practice.

The findings of the present study support the growing trend toward multimodal and opioid-sparing analgesic strategies in perioperative care. Modern enhanced recovery protocols increasingly emphasize early mobilization, reduced catheter-related complications, and improved postoperative recovery, all of which favor multimodal analgesic approaches.

The study has certain limitations. The sample size was relatively small, and the study was conducted at a single centre, which may limit generalizability of the findings. In addition, the study was open-labelled, which could have introduced observer bias. Further multicentric studies with larger sample sizes are recommended to validate these findings.

V. Conclusion

Overall, the present study demonstrates that multimodal analgesia provides postoperative pain relief comparable to epidural analgesia with fewer adverse effects, reduced motor blockade, and improved haemodynamic stability, making it a practical and effective alternative for postoperative pain management following abdominal surgery.

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