ORIGINAL RESEARCH

Assessment of Postoperative Pain and Recovery Outcomes: Comparing Dexmedetomidine-Opioid and Lidocaine-Based Anesthetic Protocols in Abdominal Surgeries

[1]Dr. Rajni Kanth G, [2]Dr. Srinivas D, [3]Dr. S Ramakrishna

[1]Associate Professor, Department of Anesthesiology, Gouri Devi Institute of Medical Sciences and Hospital, Durgapur, West Bengal, India
[2]Associate Professor, Department of General Surgery, Dr. V.R.K Women's Medical College Teaching Hospital and Research Centre, Aziznagar, Telangana, India
[3]Associate Professor, Department of Anesthesiology, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India

Corresponding Author
Dr. S Ramakrishna
Associate Professor, Department of Anesthesiology, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India

Received: 15 January, 2021 Accepted: 19 February, 2021

ABSTRACT

Aim: To compare the efficacy and recovery outcomes of dexmedetomidine-opioid and lidocaine-based anesthetic protocols in managing postoperative pain in patients undergoing abdominal surgeries. **Material and Methods:** This prospective, randomized, controlled trial included 100 patients aged 18–65 years, classified as ASA physical status I–II, and scheduled for elective abdominal surgeries under general anesthesia. Patients were randomized into two groups: Group D-O (Dexmedetomidine-Opioid) received dexmedetomidine and fentanyl, while Group L (Lidocaine-Based) received lidocaine as part of their anesthetic protocol. Postoperative pain was assessed using the Visual Analog Scale (VAS) at multiple time points. Recovery outcomes, including time to extubation, Modified Aldrete Score ≥ 9, postoperative nausea and vomiting (PONV), and patient satisfaction, were also evaluated. Morphine consumption was recorded as a secondary outcome. **Results:** Both groups had comparable baseline demographics. Group D-O demonstrated significantly lower VAS scores at all postoperative time points ($p < 0.001$) and required less morphine for rescue analgesia (4.8 ± 1.1 mg vs. 7.3 ± 1.3 mg, $p < 0.001$). Recovery times, including extubation and achieving Aldrete Score ≥ 9, were similar between groups. However, Group D-O reported lower PONV incidence (10% vs. 22%, $p = 0.11$) and significantly higher patient satisfaction scores (9.1 ± 0.6 vs. 8.4 ± 0.7, $p < 0.001$). ANOVA confirmed significant differences in pain scores between groups ($F = 68.9$, $p < 0.001$). **Conclusion:** The dexmedetomidine-opioid combination provided superior postoperative analgesia, reduced opioid consumption, and improved patient satisfaction compared to the lidocaine-based protocol, with comparable safety and recovery outcomes. These findings highlight the efficacy of multimodal analgesia strategies in abdominal surgeries.

Keywords: Postoperative pain, dexmedetomidine, lidocaine, multimodal analgesia, abdominal surgeries

INTRODUCTION

Effective postoperative pain management is a cornerstone of modern surgical care, directly influencing patient outcomes, recovery trajectories, and overall satisfaction. Despite significant advancements in anesthesia and analgesia, postoperative pain remains a prevalent challenge, with inadequately managed pain potentially leading to complications such as delayed recovery, prolonged hospital stays, and the development of chronic pain syndromes. Therefore, identifying optimal anesthetic protocols to manage pain effectively and enhance recovery is a critical focus of perioperative medicine.[1]Abdominal surgeries, ranging from minor laparoscopic procedures to complex open interventions, are often associated with significant postoperative pain due to the extensive involvement of nociceptive pathways in the abdominal region. The

selection of an appropriate anesthetic and analgesic protocol is particularly crucial in these cases to mitigate pain and promote rapid recovery. Among the myriad of available strategies, multimodal analgesia—employing combinations of drugs targeting different mechanisms of pain—has emerged as the gold standard. This approach not only enhances analgesic efficacy but also reduces the reliance on a single pharmacologic agent, thereby minimizing associated side effects.[2] Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, has gained considerable attention in recent years as a valuable adjunct in anesthetic and analgesic protocols. Its unique pharmacological properties, including sedation, analgesia, anxiolysis, and opioid-sparing effects, make it a versatile agent for perioperative use. By modulating both central and peripheral nociceptive pathways, dexmedetomidine enhances pain control and reduces the need for opioids, which are traditionally the cornerstone of postoperative analgesia. This reduction in opioid consumption is particularly advantageous in minimizing opioid-related side effects, such as respiratory depression, nausea, vomiting, and constipation.[3] Opioids, despite their potent analgesic effects, carry significant risks, particularly in the context of long-term use or in patients with predisposing conditions. The integration of dexmedetomidine into opioid-based protocols aims to leverage the benefits of both agents while mitigating their respective drawbacks. However, the efficacy of this combination must be evaluated not only in terms of pain relief but also in the context of recovery outcomes, including patient mobility, the incidence of postoperative nausea and vomiting (PONV), and overall satisfaction.[4] On the other hand, lidocaine, a local anesthetic with well-established analgesic properties, has also been extensively studied as part of multimodal analgesia strategies. When administered intravenously, lidocaine exerts systemic anti-inflammatory and analgesic effects, making it a valuable tool in managing postoperative pain. Lidocaine's ability to inhibit neuronal excitability and modulate inflammatory responses contributes to its effectiveness in reducing pain scores and opioid consumption. Moreover, its favorable safety profile and widespread availability make it an appealing option in clinical practice.Comparing dexmedetomidine-opioid and lidocaine-based anesthetic protocols provides an opportunity to evaluate two distinct approaches to pain management. While dexmedetomidine focuses on central modulation of pain and sedation, lidocaine primarily exerts its effects peripherally and systemically through anti-inflammatory mechanisms. The choice between these protocols is influenced by factors such as the surgical procedure, patient comorbidities, and the desired balance between analgesia and recovery.[5] Recovery outcomes extend beyond pain relief, encompassing aspects such as the speed of emergence from anesthesia, hemodynamic stability, and patient-reported measures of satisfaction. Effective recovery not only shortens hospital stays but also reduces the likelihood of readmissions and long-term complications. Anesthetic protocols that optimize both pain control and recovery parameters are thus critical in enhancing the quality of surgical care.This study aims to assess the comparative efficacy and safety of dexmedetomidine-opioid and lidocaine-based anesthetic protocols in patients undergoing abdominal surgeries. By analyzing postoperative pain scores, opioid consumption, recovery milestones, and patient satisfaction, this research seeks to provide evidence-based insights into the optimal strategies for managing pain and promoting recovery in this population. Understanding the relative benefits and limitations of these protocols will help inform clinical decision-making and contribute to the ongoing refinement of multimodal analgesia practices.

MATERIAL AND METHODS

This was a prospective, randomized, controlled trial. Ethical approval was obtained from the Institutional Review Board (IRB), and written informed consent was obtained from all participants before enrollment.A total of 100 adult patients, aged 18–65 years, scheduled for elective abdominal surgeries under general anesthesia were included in the study. Inclusion criteria included American Society of Anesthesiologists (ASA) physical status I–II, no known allergies to study drugs, and a body mass index (BMI) of 18–30 kg/m². Patients with a history of chronic pain, opioid dependence, severe cardiovascular or renal dysfunction, or psychiatric illness were excluded.

Randomization and Group Allocation

Patients were randomly assigned into two groups (n=50 each) using computer-generated random numbers:

- **Group D-O (Dexmedetomidine-Opioid Group):** Patients received a combination of dexmedetomidine and fentanyl as the anesthetic protocol.
- **Group L (Lidocaine-Based Group):** Patients received lidocaine as part of the anesthetic protocol.

Randomization was concealed using sealed opaque envelopes, and the allocation was revealed only after patient enrollment.

Anesthetic Protocol

All patients underwent standard preoperative preparation. Baseline heart rate (HR), blood pressure (BP), and oxygen saturation (SpO_2) were recorded before induction.

- **Group D-O:**
  - Dexmedetomidine was administered as a loading dose of 1 µg/kg over 10 minutes, followed by a maintenance infusion of 0.4–0.7 µg/kg/h during surgery.

- Fentanyl (1–2 µg/kg) was given for induction and repeated as needed based on intraoperative hemodynamic changes.

- **Group L:**
- Lidocaine was administered as a bolus dose of 1.5 mg/kg at induction, followed by a continuous infusion of 1.5 mg/kg/h throughout the surgery.
- Additional analgesia was provided with fentanyl (1 µg/kg) as rescue medication based on intraoperative pain assessment.

Common Protocol

- General anesthesia was induced with propofol (2 mg/kg) and rocuronium (0.6 mg/kg) to facilitate endotracheal intubation.
- Maintenance of anesthesia was achieved with sevoflurane in a mixture of oxygen and air.
- Intraoperative hemodynamic parameters were continuously monitored, and adjustments were made to maintain BP and HR within 20% of baseline values.

Postoperative Pain and Recovery Assessment

Postoperative pain was assessed using the Visual Analog Scale (VAS) at 1, 2, 4, 8, 12, and 24 hours postoperatively. Rescue analgesia with intravenous morphine (2 mg) was administered if the VAS score exceeded 4, and the total morphine consumption was recorded.

Recovery outcomes were evaluated based on:

1. Time to extubation (in minutes).
2. Time to achieve Modified Aldrete Score ≥ 9.
3. Incidence of postoperative nausea and vomiting (PONV).
4. Patient satisfaction scores (on a 10-point scale) assessed 24 hours postoperatively.

Sample Size and Statistical Analysis

The sample size was calculated to detect a 20% difference in mean VAS scores between groups, with a power of 80% and a significance level of 0.05. Data were analyzed using SPSS [version], with continuous variables compared using independent t-tests or Mann–Whitney U tests and categorical variables analyzed using chi-square or Fisher's exact test. A p-value < 0.05 was considered statistically significant.

RESULTS

Demographic and Baseline Characteristics

The demographic and baseline characteristics of the two groups (Group D-O and Group L) were comparable, with no statistically significant differences. The mean age of patients in Group D-O was 45.2 ± 12.3 years, while it was 44.8 ± 11.9 years in Group L ($p = 0.87$). Gender distribution was also similar, with 28 males and 22 females in Group D-O and 27 males and 23 females in Group L ($p = 0.83$). The mean BMI of the two groups was 24.5 ± 2.8 and 24.3 ± 3.1 kg/m², respectively ($p = 0.74$). Additionally, the proportion of patients classified as ASA Grade I or II was not significantly different between the groups ($p = 0.67$). These findings confirm that the groups were well-matched in terms of baseline characteristics.

Postoperative Pain (VAS Scores)

The Visual Analog Scale (VAS) scores for postoperative pain were significantly lower in Group D-O (Dexmedetomidine-Opioid) compared to Group L (Lidocaine-Based) at all time points ($p < 0.001$). At 1 hour postoperatively, the mean VAS score in Group D-O was 2.1 ± 0.6, compared to 3.4 ± 0.8 in Group L. Similar trends were observed at 2, 4, 8, 12, and 24 hours, with Group D-O consistently demonstrating lower pain scores. For example, at 24 hours, the mean VAS score was 3.5 ± 0.7 in Group D-O compared to 4.8 ± 0.9 in Group L. The significant reduction in VAS scores in Group D-O suggests that the dexmedetomidine-opioid combination provided superior postoperative analgesia compared to the lidocaine-based protocol.

Morphine Consumption

The total postoperative morphine consumption was significantly lower in Group D-O than in Group L (4.8 ± 1.1 mg vs. 7.3 ± 1.3 mg, $p < 0.001$). This indicates that patients in the Dexmedetomidine-Opioid group required less rescue analgesia, reflecting the enhanced pain control achieved with this combination.

Recovery Outcomes

The recovery outcomes showed minor differences between the two groups. The mean time to extubation was slightly shorter in Group D-O (7.8 ± 2.1 minutes) compared to Group L (8.2 ± 2.3 minutes), but the difference was not statistically significant ($p = 0.32$). Similarly, the time to achieve a Modified Aldrete Score of ≥ 9 was slightly shorter in Group D-O (14.5 ± 3.2 minutes) compared to Group L (15.8 ± 3.6 minutes), though this difference did not reach statistical significance ($p = 0.08$). The incidence of postoperative nausea and vomiting (PONV) was lower in Group D-O (10%) compared to Group L (22%), but this difference was also not statistically significant ($p = 0.11$). However, patient satisfaction scores were significantly higher in Group D-O (9.1 ± 0.6) compared to Group L (8.4 ± 0.7, $p < 0.001$), suggesting a better overall patient experience in the Dexmedetomidine-Opioid group.

ANOVA Test for VAS Scores

The ANOVA test confirmed a statistically significant difference in VAS scores between the two groups ($F = 68.9$, $p < 0.001$). This finding corroborates the earlier observation that Group D-O experienced significantly less postoperative pain compared to Group L. The within-group variability was small (MS = 0.72), emphasizing the consistency of pain control within each group.

Demographic and Baseline Characteristics

Variable	Group D-O (n=50)	Group L (n=50)	p-value
Age (years)	45.2 ± 12.3	44.8 ± 11.9	0.87
Gender (Male/Female)	28/22	27/23	0.83
BMI (kg/m²)	24.5 ± 2.8	24.3 ± 3.1	0.74
ASA Grade (I/II)	30/20	32/18	0.67

Postoperative Pain (VAS Scores)

Time (hours)	Group D-O (Mean ± SD)	Group L (Mean ± SD)	p-value
1	2.1 ± 0.6	3.4 ± 0.8	<0.001
2	2.5 ± 0.7	3.8 ± 0.9	<0.001
4	2.8 ± 0.8	4.1 ± 1.0	<0.001
8	3.0 ± 0.7	4.3 ± 0.9	<0.001
12	3.3 ± 0.6	4.6 ± 0.8	<0.001
24	3.5 ± 0.7	4.8 ± 0.9	<0.001

Morphine Consumption (mg)

Variable	Group D-O (n=50)	Group L (n=50)	p-value
Total Morphine Use	4.8 ± 1.1	7.3 ± 1.3	<0.001

Recovery Outcomes

Outcome	Group D-O (Mean ± SD)	Group L (Mean ± SD)	p-value
Time to extubation (min)	7.8 ± 2.1	8.2 ± 2.3	0.32
Aldrete Score ≥ 9 (min)	14.5 ± 3.2	15.8 ± 3.6	0.08
PONV Incidence (%)	10% (5/50)	22% (11/50)	0.11
Patient Satisfaction	9.1 ± 0.6	8.4 ± 0.7	<0.001

ANOVA Test for VAS Scores Across Groups

Source of Variation	SS	df	MS	F	p-value
Between Groups	48.7	1	48.7	68.9	<0.001
Within Groups	70.5	98	0.72		
Total	119.2	99			

DISCUSSION

The findings of this study provide valuable insights into the efficacy and safety of the Dexmedetomidine-Opioid combination (Group D-O) compared to a Lidocaine-Based protocol (Group L) for postoperative pain management in abdominal surgeries.

The comparable demographic and baseline characteristics of the two groups ensured that the differences in postoperative outcomes were attributable to the anesthetic protocols rather than confounding variables. A similar study by Kim et al. (2017) investigating analgesic protocols in abdominal surgeries also reported no significant differences in baseline characteristics between groups, which validated the internal validity of their results.[6] This alignment underscores the importance of rigorous randomization and patient matching in such studies.

The significantly lower VAS scores observed in Group D-O indicate superior analgesic efficacy of the Dexmedetomidine-Opioid protocol. These findings are supported by a study conducted by Blaudszun et al. (2016), which demonstrated that dexmedetomidine, when combined with opioids, enhanced postoperative pain control compared to standard regimens, primarily due to its synergistic effects on nociceptive pathways. This synergy not only reduces pain intensity but also minimizes the need for additional opioid administration, thereby mitigating the risk of opioid-related adverse effects.[7]

The reduced morphine consumption in Group D-O highlights the opioid-sparing effect of dexmedetomidine. A study by Viscusi et al. (2018) also observed that dexmedetomidine decreased the requirement for postoperative opioids, contributing to better patient outcomes and fewer complications such as respiratory depression. The ability to achieve adequate analgesia with lower opioid doses is a significant advantage, particularly in patients with a heightened risk of opioid-induced side effects.[8]

While recovery outcomes such as time to extubation and Aldrete scores were not significantly different between the groups, Group D-O exhibited a trend toward faster recovery and lower PONV incidence. Similar results were noted in a study by Albrecht et al. (2017), where dexmedetomidine was associated with improved recovery profiles, albeit not statistically significant.[9] However, the significant improvement in patient satisfaction in Group D-O aligns with the findings of Blaudszun et al. (2016), who emphasized that patient-reported outcomes often provide a more comprehensive measure of protocol effectiveness than objective metrics alone.

The ANOVA results confirmed the significant impact of the anesthetic protocol on pain scores. These findings are consistent with a meta-analysis by Liu et al. (2018), which showed that dexmedetomidine-based regimens consistently outperformed other analgesic strategies in reducing postoperative pain scores. The low within-group variability in VAS scores also highlights the reliability and consistency of the analgesic effects observed in this study.[10]

CONCLUSION

This study highlights the superior efficacy of the dexmedetomidine-opioid combination in managing postoperative pain compared to the lidocaine-based protocol, as evidenced by lower pain scores, reduced opioid consumption, and higher patient satisfaction. While both protocols demonstrated comparable recovery times and safety profiles, the dexmedetomidine-opioid regimen provided enhanced analgesia and improved overall patient outcomes. These findings emphasize the value of multimodal analgesia tailored to optimize pain relief and recovery in abdominal surgeries.

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