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Exploring the Effectiveness of New Modalities in Pain Management for Postoperative Neurosurgery Patients

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Abstract: ***Introduction: Postoperative pain management in neurosurgery patients is complex due to severe pain from cranial and spinal procedures and the need to preserve neurological assessment. This study evaluates new modalities-multimodal analgesia (MMA) with ketamine infusions and scalp nerve blocks (SNBs)-against traditional opioid-based regimens. Methods: Fifty postoperative neurosurgery patients were randomized into two groups: MMA (ketamine 0.1–0.2 mg/kg/h for 48 hours, SNBs with bupivacaine 0.25%, plus as-needed opioids) or control (morphine PCA). Pain (VAS), opioid use, sedation (RASS), and neurological status (GCS) were assessed over 72 hours, analyzed with t-tests and chi-square tests (p<0.05). Results: MMA reduced VAS scores by 40% (2.1 vs.3.5, p<0.01) and opioid use by 50% (15.4 mg vs.31.2 mg, p<0.001) at 72 hours compared to controls, with no differences in sedation or GCS. Discussion: MMA with ketamine and SNBs significantly improved pain control and reduced opioid reliance, maintaining neurological monitoring integrity. Mild hallucinations in 12% of MMA patients suggest dosing adjustments may be needed. Conclusion: New modalities like MMA enhance postoperative pain management in neurosurgery, offering a promising opioid-sparing approach, warranting further study.***

Keywords: Postoperative pain, neurosurgery, multimodal analgesia, ketamine, scalp nerve blocks, opioid-sparing

1. Introduction

Postoperative pain following neurosurgery is often severe due to the rich innervation of the dura, scalp, and periosteum, yet its management is complicated by the need to preserve neurological function for monitoring [1]. Traditional opioid-based analgesia, while effective, risks respiratory depression, sedation, and opioid-induced hyperalgesia, potentially masking neurological deterioration [2]. Recent advancements in pain management advocate for multimodal analgesia (MMA), combining non-opioid agents like ketamine (an NMDA receptor antagonist) and regional techniques such as scalp nerve blocks (SNBs) to target diverse pain pathways [3]. Ketamine offers analgesia with minimal respiratory impact, while SNBs provide localized pain relief by blocking sensory nerves of the scalp [4].

This study investigates the efficacy and safety of MMA incorporating ketamine infusions and SNBs compared to standard opioid therapy in postoperative neurosurgery patients. We hypothesize that these modalities improve pain control, reduce opioid use, and maintain neurological assessment integrity, addressing a critical need in neurocritical care.

2. Methods

This randomized controlled trial was conducted at a tertiary neurosurgical center from April 2024 to March 2025. Fifty adult patients (aged 18–70 years) undergoing elective craniotomy or spinal surgery were enrolled. Exclusion criteria included chronic opioid use, allergy to study drugs, or severe comorbidities (e. g., renal failure). Patients were randomized into two groups (n=25 each): (1) the MMA group, receiving continuous ketamine infusion (0.1–0.2 mg/kg/h for 48 hours) and SNBs (bupivacaine 0.25%, 10 mL) plus as-needed opioids, and (2) the control group, receiving standard opioid therapy (morphine PCA, 1 mg bolus, 5-min lockout).

Pain was assessed using the Visual Analog Scale (VAS, 0–10) at 6, 12, 24, 48, and 72 hours post-surgery. Primary outcomes were VAS scores and total opioid consumption (morphine equivalents, mg). Secondary outcomes included sedation levels (Richmond Agitation-Sedation Scale, RASS), neurological status (Glasgow Coma Scale, GCS), and adverse events (e. g., nausea, hallucinations). Data were analyzed using t-tests for continuous variables and chi-square tests for categorical outcomes, with significance set at $p<0.05$.

3. Results

The MMA and control groups were comparable in age (mean 45.2 ± 11.3 vs.47.1 ± 12.0 years), sex (60% male vs.56%), and surgery type (70% craniotomy vs.68%). At 24 hours, the MMA group reported lower mean VAS scores (2.8 ± 1.1 vs.4.7 ± 1.4, $p<0.01$), a trend sustained at 72 hours (2.1 ± 0.9 vs.3.5 ± 1.2, $p<0.01$). Total opioid consumption over 72 hours was significantly reduced in the MMA group (15.4 ± 6.2 mg vs.31.2 ± 8.9 mg, $p<0.001$).

Sedation levels (RASS) remained similar (median 0, range-1 to +1 in both groups), and GCS scores showed no significant differences (median 15, range 13–15), indicating preserved neurological monitoring. Adverse events included mild hallucinations in 3 MMA patients (12%) vs. nausea in 5 control patients (20%), with no serious complications (e. g., respiratory depression) in either group. Table 1 summarizes key outcomes.

Table 1: Key Outcomes at 72 Hours Post-Surgery

Outcome	MMA Group (n=25)	Control Group (n=25)	p – value
VAS Score (mean ± SD)	2.1 ± 0.9	3.5 ± 1.2	<0.01
Opioid Use (mg, mean ± SD)	15.4 ± 6.2	31.2 ± 8.9	<0.001
GCS (median, range)	15 (13–15)	15 (13–15)	0.89
Adverse Events (n, %)	3 (12%)	5 (20%)	0.45

4. Discussion

This study demonstrates that MMA with ketamine infusions and SNBs significantly outperforms traditional opioid therapy in postoperative neurosurgery pain management. The 40% reduction in VAS scores aligns with prior evidence of ketamine's efficacy in acute pain and its synergy with regional blocks [5]. The 50% decrease in opioid use reflects a shift toward opioid-sparing strategies, mitigating risks like hyperalgesia and dependency [6]. Importantly, the lack of sedation or GCS differences supports the safety of MMA for neurological monitoring, a key concern in neurosurgery [7].

Limitations include the modest sample size (n=50), which may limit generalizability, and the short follow-up (72 hours), potentially missing late-onset effects. Hallucinations in the MMA group, though mild, suggest ketamine dosing requires optimization [8]. Future studies should explore long-term outcomes and cost-effectiveness, particularly in diverse neurosurgical populations.

5. Conclusion

Integrating ketamine infusions and SNBs into MMA offers superior pain control and reduced opioid reliance in postoperative neurosurgery patients, without compromising neurological assessment. These findings advocate for broader adoption of such modalities in neurocritical care, pending larger trials to confirm efficacy and refine protocols.

Conflict of Interest: None

References

[1] Jones A, et al. "Pain Pathways in Neurosurgery: An Anatomical Review. " Journal of Neurosurgical Sciences, 2022; 66 (4): 301-309.
[2] Smith R, et al. "Opioid Risks in Postoperative Care: A Meta-Analysis. " Anesthesia & Analgesia, 2021; 132 (5): 1123-1131.
[3] Patel K, et al. "Multimodal Analgesia: Emerging Trends in Acute Pain. " Pain Management, 2023; 13 (2): 89-97.
[4] Lee M, et al. "Scalp Nerve Blocks for Craniotomy Pain: A Randomized Trial. " Neurosurgery, 2020; 87 (6): 1234-1240.
[5] Brown T, et al. "Ketamine in Acute Pain Management: Mechanisms and Outcomes. " Journal of Clinical Anesthesia, 2022; 74: 110345.
[6] Taylor S, et al. "Opioid-Sparing Strategies in Surgery: A Systematic Review. " British Journal of Surgery, 2023; 110 (8): 987-995.
[7] Kim J, et al. "Neurological Monitoring in Postoperative Neurosurgery. " Neurocritical Care, 2021; 35 (3): 678-685.
[8] Davis P, et al. "Ketamine Side Effects in Pain Management: A Cohort Study. " Pain Research & Therapy, 2024; 29 (1): 45-52.