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Neuroanesthesia Abstracts

Contents

Analgesic strategies and glioma outcomes: a systematic review of opioid-based and opioid-sparing techniques

Submission ID

78

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INTRODUCTION

Gliomas are aggressive primary brain tumors with poor long-term survival despite advances in surgery and adjuvant therapy. Perioperative factors, including anesthetic and analgesic techniques, have been hypothesized to influence tumor biology and disease progression. Opioids, a cornerstone of perioperative analgesia, have demonstrated immunomodulatory and tumor-related effects in several systemic malignancies, raising concern about their potential impact on glioma outcomes. Conversely, opioid-sparing strategies such as dexmedetomidine-based anesthesia and regional techniques have gained interest for their perioperative benefits and possible oncologic implications. However, evidence in glioma remains fragmented and inconsistent. This systematic review synthesizes clinical and preclinical evidence evaluating the effects of opioid-based versus opioid-sparing anesthesia and analgesia on glioma biology, perioperative outcomes, and disease progression.

METHODS

This systematic review was conducted in accordance with PRISMA guidelines. MEDLINE, EMBASE, and CENTRAL were searched from January 1, 2010 to December 21, 2025. Eligible studies included clinical investigations of patients undergoing supratentorial craniotomy for glioma resection and preclinical in vitro or in vivo glioma models evaluating opioid-based or opioid-sparing analgesic strategies. Opioids of interest included morphine, fentanyl, remifentanil, and D,L-methadone, while opioid-sparing strategies included dexmedetomidine, scalp block, ketamine, paracetamol, and NSAIDs. Outcomes included glioma progression and survival, perioperative hemodynamic stability, postoperative recovery, and tumor-biologic endpoints such as proliferation, apoptosis, and invasion. Two reviewers independently screened studies and extracted data, with disagreements resolved by a third reviewer. Given heterogeneity in study designs and outcomes, findings were synthesized narratively.

RESULTS

Sixteen studies met inclusion criteria, comprising four clinical studies and twelve preclinical studies. Preclinical data demonstrated heterogeneous, context-dependent opioid–glioma interactions that varied by opioid type, receptor subtype, and concentration, with many observed effects occurring at supraphysiologic levels. Most opioid-based studies reported neutral or inhibitory effects on glioma proliferation and invasion, while methadone showed inconsistent effects and no reliable synergy with chemotherapy at clinically relevant doses. Opioid-sparing agents demonstrated mixed experimental findings, including dose-dependent effects with dexmedetomidine. Clinically, opioid-sparing strategies were consistently associated with improved perioperative profiles, including greater hemodynamic stability, reduced postoperative pain, and lower opioid requirements. Intraoperative opioid exposure was not associated with worse progression-free survival, and methadone did not confer a survival benefit. Scalp block was associated with improved progression-free survival in a single retrospective study.

DISCUSSION

Current evidence does not support a clinically meaningful tumor-promoting effect of perioperative opioids in glioma. While preclinical studies suggest complex, dose-dependent biological interactions, evidence of clinical benefit remains unclear. Opioid-sparing techniques offer clear perioperative benefits, though their impact on long-term oncologic outcomes remains uncertain. The limited number of clinical studies and substantial heterogeneity highlight the need for prospective trials using standardized opioid quantification and clinically relevant models to clarify whether opioid strategy influences glioma progression.

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Cervical spine stability during tracheal intubation: a randomized controlled clinical trial comparing the Storz CMAC vs Videostylet to the flexible bronchoscope

Submission ID

65

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INTRODUCTION

Spinal cord injury during intubation in the setting of cervical spine (C-spine) instability is a rare but devastating outcome[1-3]. Flexible bronchoscopic (FB) intubation is the clinical standard for airway management in patients with C-spine instability, but the additional time required for its use compared to direct or videolaryngoscopy can limit its applicability in a trauma scenario, even when C-spine injury/instability cannot be ruled out.[1]

The Storz CMAC VS videoStylet (VS) is a rigid intubating endoscope with a ~10 cm flexible distal portion that may provide for faster intubation than the standard flexible bronchoscope while still minimising C-spine movement. We hypothesized that the VS would demonstrate faster time-to-intubation compared to FB in patients in a simulated trauma intubation scenario, without increasing segmental C-spine movement.

METHODS

Local research ethics board approval was obtained.

In this parallel-group randomized controlled trial, 50 elective-GA adult patients were randomized to intubation with the Storz CMAC VS (n=25) or flexible bronchoscope (FB, n=25). Patients were situated on a backboard with manual in-line stabilization (MILS) provided to simulate intubating conditions for a potential C-spine instability scenario. Lateral fluoroscopy of the intubation was recorded for measurement of intubation duration and analysis of C-spine movement by a neuroradiologist.

The primary outcome was the duration of intubation, defined from when the intubating device first passed the patient's lips until the time that the device had exited the mouth after

successful intubation. The secondary outcome was maximal angular relative movement measured at four cervical segments (Occciput-C1, C1-C2, C2-C5, C5-Thorax.) Additional outcomes included the number of attempts, subjective ease of intubation recorded on a 100-mm visual analog scale, and the presence/severity (mild, moderate, or severe) of postoperative sore throat and/or vocal changes at 24 hours.

Intubation duration was analyzed using Kaplan-Meier survival curves and log-rank test, with log-rank test for subjective ease of intubation. Segmental C-spine movement was analyzed using the Mann-Whitney U test. Vocal/sore throat outcomes were compared using Fisher's exact test.

RESULTS

The groups' baseline morphological and airway exam characteristics were similar. Intubation duration was significantly shorter in the VS group (Median 14.3 s, interquartile range [IQR] 12.7–17.8) compared to FB (Median 31.9 s, IQR 24.8–40.8), a median difference of 17.6 seconds (Log-rank $p<0.001$). See Figure, which shows a Kaplan-Meier plot of completed intubation vs. time. Shaded areas represent the interquartile ranges.

There were no significant differences in segmental movement: Oc-C1 (VS median 3.8° vs FB 3.3°, $p=0.59$), C1-C2 ($p=0.35$), C2-C5 ($p=0.37$), or C5-T ($p=0.10$).

Subjective ease of intubation was similar ($p=0.92$). Postoperative sore throat incidence was similar for the VS (None:13, Mild:8, Moderate:4) and FB (None:17, Mild:5, Moderate:3), $p=0.57$. Vocal change incidence was also similar, VS (None:13, Mild:6, Moderate:6) and FB (None:20, Mild:2, Moderate:2, Severe:1), $p=0.08$. There was 1 patient in each group where MILS was released and an alternate devise used, per protocol.

DISCUSSION

In the setting of experienced anesthesiologists intubating patients in a simulated unstable C-spine scenario, the CMAC videostylet was approximately twice as fast as the flexible bronchoscope, with a statistically significant 18 second advantage over FB, comparable to direct larygoscopy[2], while limiting C-spine movement similar to the flexible bronchoscope. We hypothesize this is partly due to the VS positioning the ETT distally, avoiding the FB step of advancing the ETT past the cords.

The clinical significance of this time advantage would be situation specific. Clinicians can weigh its value against the encumbrance of maintaining clinical competence with an additional device.

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Figure Caption: Kaplan-Meier plot of completed intubation (%) vs. time. Arrow: Median intubation duration. Shaded areas represent the interquartile ranges.

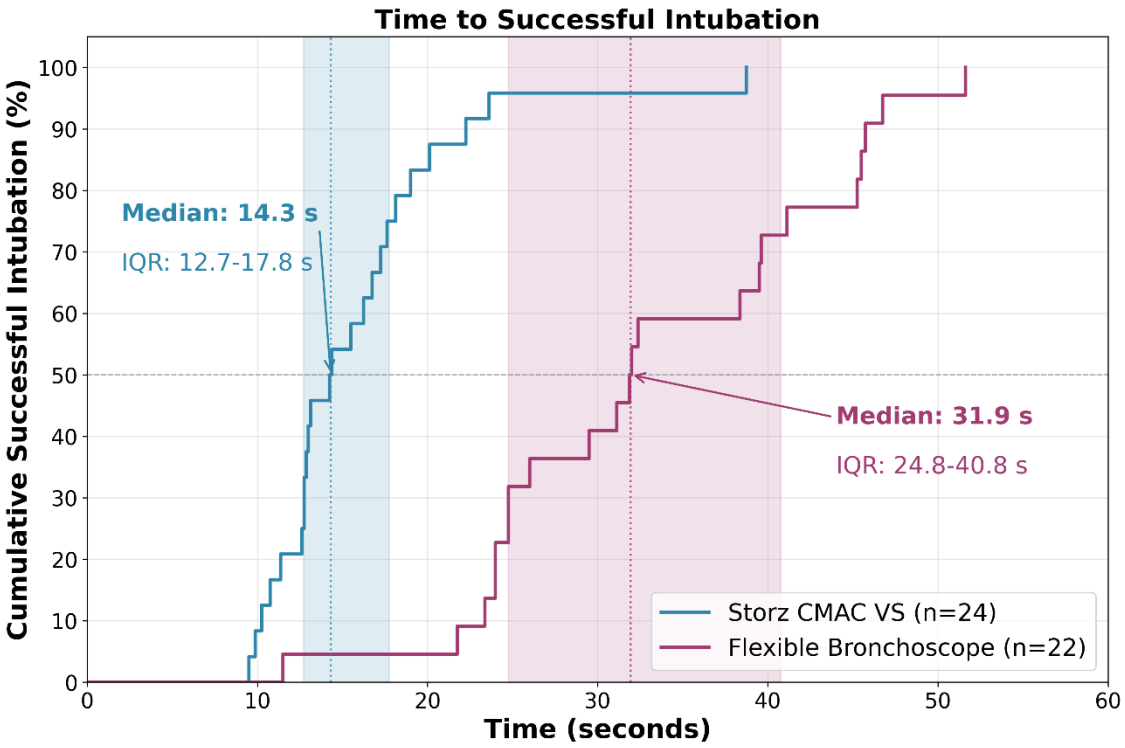

Figure 1

Impact of anesthetic technique on brain cancer progression: a randomized feasibility study

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145

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INTRODUCTION

High-grade gliomas (HGGs) are aggressive primary brain tumors with poor long-term survival and high rates of recurrence despite multimodal therapy.[1] Growing interest has focused on whether perioperative factors, including anesthetic technique, may influence tumor biology, immune function, and disease progression.[2] While observational studies in other malignancies suggest differential effects of intravenous and volatile anesthetics on cancer-related outcomes, prospective evidence in neuro-oncology is lacking.[3] No randomized studies have evaluated the feasibility of comparing anesthetic techniques during HGG resection. This study aimed to assess the feasibility of a randomized controlled trial (RCT) comparing propofol-based and sevoflurane-based anesthesia in patients undergoing surgical resection of HGG.

METHODS

After obtaining ethics approval and written informed consent, we conducted a two-center, randomized feasibility trial enrolling adult patients (≥18 years) with newly diagnosed HGG scheduled for tumor resection through elective craniotomy. Patients were not eligible if they had significant adrenal disease, recurrent disease or presumed low-grade glioma (WHO

grade I–II), lesions involving the brainstem or optic pathways, or non-glial intracranial tumors, including suspected metastatic disease. Participants were randomized to receive either propofol-based total intravenous anesthesia (TIVA) or sevoflurane inhalational anesthesia. Feasibility outcomes included screening-to-enrollment rate, compliance with the assigned anesthetic technique, follow-up retention, and completeness of outcome data. Exploratory clinical outcomes included overall survival (OS), progression-free survival (PFS), hospital length of stay (LOS), and postoperative opioid requirements.

RESULTS

From March 2022 to September 2024, 260 patients were screened, of whom 36 were randomized to propofol (n = 17) or sevoflurane (n = 19). Consent rates among eligible patients were high (76%), and moderate adherence (69%) to the allocated anesthetic protocol was achieved. Follow-up retention declined over time, with 56% retained at 6 months and 20% at 12 months. Exploratory analyses suggested favorable trends with propofol, including longer OS ($p = 0.083$) and PFS ($p = 0.061$) on Kaplan–Meier analysis. Multivariable Cox regression demonstrated a significantly reduced risk of progression or death at 12 months in the propofol group (HR 0.15, 95% CI 0.03–0.73; $p = 0.019$). Propofol was also associated with a modest reduction in postoperative opioid use and a non-significant increase in LOS.

DISCUSSION

This randomized feasibility study demonstrates that recruitment is achievable in patients undergoing HGG resection. However, protocol modifications are necessary to improve adherence and retention for a future large-scale RCT. While exploratory analyses suggested trends in OS and PFS between anesthetic techniques, these findings should be interpreted cautiously. The feasibility outcomes support the practicality of conducting a larger RCT, with future efforts focused on improving adherence, long-term follow-up, and outcome ascertainment.

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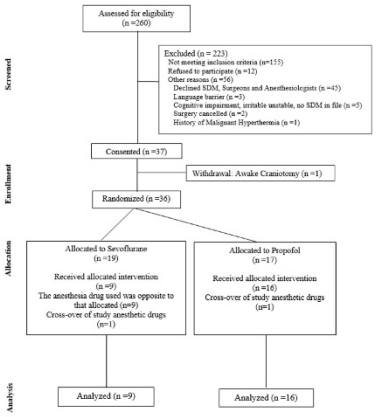
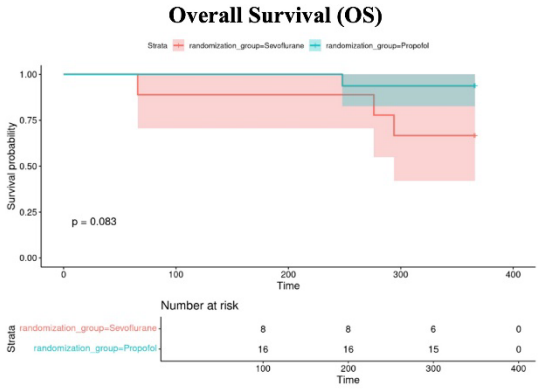


Characteristic	Propofol (n = 16)	Sevoflurane (n = 9)	P
Age (%), years			**0.328**
< 60	5 (31.3)	6 (66.7)	
> 60	11 (68.7)	3 (33.3)	
Sex (%)			**1.000**
Female	8 (50)	4 (44)	
Male	8 (50)	5 (56)	
BMI (%), kg/m²			**1.000**
< 30	13 (80)	8 (88)	
≥ 30	3 (20)	1 (12)	
ASA Grade			**-**
3	2 (12.5)	2 (22.2)	
4	14 (87.5)	7 (77.8)	
Pre-op KPS (%)			**0.602**
≤ 70	2 (12)	2 (22)	
>70	14 (88)	7 (78)	



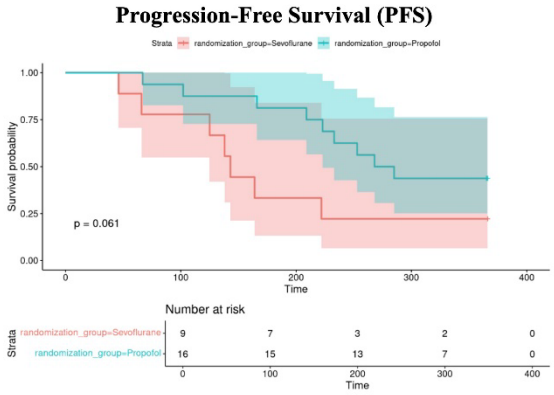


Figure 1

Incidence of postoperative intracranial hemorrhage in awake craniotomy patients receiving NSAIDS: a retrospective single-institution review

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52

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INTRODUCTION

Awake craniotomy facilitates maximal resection of tumours involving eloquent cortical/subcortical white matter, requiring anesthetic strategies that balance adequate perioperative analgesia with intraoperative patient alertness and cooperation. Although non-steroidal anti-inflammatory (NSAID) medications can provide opioid-sparing analgesia, their use in patients undergoing craniotomy is often limited by theoretical concerns of postoperative intracranial hemorrhage (PICH). Recent meta-analyses report reoperation rates for PICH ranging from 1.3-2.1%[1-3]; however, this outcome has not been examined specifically in awake craniotomy cohorts. Our institution performs ~120 awake craniotomies annually in patients considered high risk for awake surgery, including older adults, and those with significant medical comorbidities. The distinct physiological and pharmacologic features of this approach introduce uncertainty regarding NSAID safety in this population. This study aimed to quantify PICH incidence in adult patients undergoing awake craniotomy at our institution who received perioperative NSAIDs and compare this incidence with rates reported in the literature.

METHODS

This study was completed under a Quality Improvement Waiver from or institutions's Health Science Network Research Ethics Board, received on December 20, 2024, for a quality assurance retrospective review and database of patients undergoing awake craniotomy for brain tumour resection at our institution. Patients ≥17 years treated between June 2019-July 2023 were included, and those receiving perioperative NSAIDs were identified for analysis.

All patients were managed under a standardized Monitored Anesthesia Care protocol including regional and multimodal analgesia. Perioperative NSAID use was defined as preoperative oral celecoxib or postoperative celecoxib and/or intravenous ketorolac

administered day of surgery at the anesthesiologists' discretion. The primary outcome was PICH requiring surgical evacuation during the postoperative admission with a secondary outcome of symptomatic PICH causing neurological deficit; identified through review of postoperative discharge summaries, with CT imaging obtained following clinical neurological assessment. Continuous and categorical variables were summarized as means (SD) and frequencies (%). PICH incidence was calculated as a proportion with a 95% confidence interval. Institutional performance was benchmarked against a weighted average reoperation rate of 1.3-2.1% derived from large contemporary international cohorts (N > 10,800)[1-3]. Comparison to the upper benchmark threshold of 2.1% was performed using a one-sample binomial test ($p<.05$).

RESULTS

A total of 429 charts of patients who underwent awake craniotomy were reviewed. Out of these, 340 adult patients received perioperative NSAIDs (mean age 54.8 (15.9) years, range 17-87; 44% female; mean BMI 26.7 (5.5) kg/m^2, range 15.1-47.5). The majority were classified as ASA physical status III (69%) or IV (26%), with high rates of cardiac (30%) and respiratory (21%) disease. Data regarding baseline kidney function was not available. Preoperative celecoxib was the predominant NSAID administered (79%). Symptomatic PICH causing neurological deficit occurred in 11 patients (3.2%). PICH requiring surgical evacuation occurred in 6 patients (all of whom underwent a primary rather than repeat awake craniotomy), yielding an overall incidence of 1.8% (95% CI: 0.7% to 3.8%). This incidence was not statistically significantly different from the upper benchmark of 2.1% reported in general craniotomy cohorts ($p=0.85$).

DISCUSSION

The 1.8% reoperation rate observed in this cohort, among the largest reported for NSAID-exposed craniotomy patients, is consistent with established craniotomy benchmarks[4-5]. These results suggest that the use of NSAIDs as part of a multimodal analgesic strategy in clinically complex patients undergoing awake craniotomy is safe. However, there are multiple limitations to this study, including its retrospective nature and confounding by indication, as discretionary NSAID use may have favoured patients with lower baseline bleeding risk. Accordingly, while these findings are reassuring, future studies using matched cohorts are necessary to more definitively establish safety and to further refine hemorrhage risk stratification.

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Mapping high level evidence in neuroanesthesia: a scoping review of multicenter randomized controlled trials in anesthesia for neurosurgery

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146

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INTRODUCTION

Anesthetic and perioperative management in intracranial neurosurgery requires careful control of cerebral physiology to minimize secondary brain injury and allow timely neurological assessment.[1] Despite this, many aspects of neuroanesthetic practice, including anesthetic technique, ventilation strategies, temperature management, and analgesic approaches, remain highly variable across institutions. This variability reflects a limited and uneven high-level evidence base, as much of the existing literature consists of small, single-centre studies with restricted generalizability. Multicenter randomized controlled trials (RCTs) offer an opportunity to generate more robust and practice-informing evidence by enrolling larger and more diverse patient populations.[2] However, the overall scope, focus, and methodological quality of multicenter RCTs in perioperative neuroanesthesia have not been systematically described. The objective of this scoping review was to identify, map, and characterize multicenter RCTs evaluating perioperative management strategies in adult patients undergoing intracranial neurosurgery, and to describe the outcomes studied and major gaps in the existing evidence base.

METHODS

We conducted a scoping review following established methodological frameworks and reported following the PRISMA-ScR reporting guideline.[3,4] MEDLINE, PubMed, EMBASE, Cochrane Central, and Web of Science were searched from inception to June 25, 2025. Eligible studies were multicenter RCTs enrolling adult patients undergoing intracranial neurosurgery and evaluating any perioperative intervention, including anesthetic technique, hemodynamic management, ventilation strategies, temperature control, analgesia, or other perioperative adjuncts. Studies involving spinal surgery, pediatric populations, or non-randomized designs were excluded. Title and abstract screening, full-text review, and data

extraction were performed in duplicate. Extracted data included publication year, number of centers, sample size, surgical population, intervention characteristics, timing of intervention, prespecified outcome domains, and follow-up duration. Interventions and outcomes were mapped to a priori thematic categories to enable structured descriptive synthesis. Risk of bias was assessed using the Cochrane Risk of Bias 2 tool to characterize the methodological quality of the included trials.[5]

RESULTS

From 417 records, 13 multicenter RCTs involving 2,765 patients across nine countries met inclusion criteria. All enrolled adults undergoing elective intracranial surgery. Trials ranged from 2-30 centers and sample sizes ranged from 20-1,000 patients. Twelve trials evaluated anesthetic or analgesic interventions and one evaluated intraoperative temperature management; interventions were delivered intraoperatively in 9 trials, preoperatively in 2, and postoperatively in 2. Seven trials compared anesthetic techniques or opioid regimens, three evaluated postoperative analgesic strategies, and one each evaluated antiemetic prophylaxis, ventilation and intracranial pressure management, and intraoperative hypothermia. Outcomes were short-term and physiologic in 12 trials: three assessed brain relaxation or intracranial pressure, five emergence and recovery profiles, five postoperative pain or opioid consumption, and one postoperative nausea and vomiting. Only one trial assessed longer-term functional outcomes at 3 months. Four trials were judged to be low risk of bias, two had some concerns, and seven were high risk.

DISCUSSION

Over nearly three decades, relatively few multicenter RCTs have evaluated perioperative management in intracranial neurosurgery, and the existing literature has focused predominantly on short-term physiologic or recovery endpoints. Methodological quality was variable and long-term, patient-centered outcomes were rarely assessed. These findings highlight a substantial gap in high-level evidence to guide neuroanesthetic practice and underscore the need for larger, methodologically rigorous, collaborative trials that prioritize meaningful neurological and functional outcomes.

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Table Characteristics of included studies

Citation (author, year; country)	Number of centers	Population	Type of Surgery	Groups	Sample Size	Age (Mean ± SD)	Sex distribution, n (%) male	Timing of Intervention (perioperative phase)
Satici 2025; Türkiye	2	ASA status I-III adult patients aged 19–65 y	Elective craniotomy	Scalp Block	20	48 ± 17	10 (50)	Postoperatively
				Control group managed with multimodal analgesia alone	20	51 ± 16	11 (55)	Postoperatively
Han 2024; China	3	Adult patients aged 18 y or older	Elective craniotomy	Preemptive topical lidocaine 5% white hydrogel plasters	90	48.1 ± 2.7	33 (36.7)	Preoperatively
				Control group who received plain hydrogel plasters of the same pattern, size, appearance and material as L5Ps, but free of lidocaine	90	47.0 ± 2.8	40 (44.4)	Preoperatively
Kulikov 2021; Russia and Italy	2	Adult patients aged 18 y or older	Elective Supratentorial Craniotomy	Preoperative scalp block combined with incision line infiltration	28	51 ± 17	14 (50)	Preoperatively
				Postoperative scalp block combined with incision line infiltration	28	50 ± 12	15 (50)	Postoperatively
Ryu 2014; South Korea	4	ASA status I-II adult patients aged 19-65 y	Elective craniotomy	4 mg ondansetron intravenously at the time of dural closure	41	49 ± 10.1	14 (34)	Postoperatively
				8 mg ondansetron intravenously at the time of dural closure	44	48 ± 8.7	19 (43)	Postoperatively
				0.3 mg ramosetron intravenously at the time of dural closure	42	53 ± 9.4	13 (31	Postoperatively
Citerio 2012; Italy	14	Adult patients aged 18-75 y	Elective supratentorial craniotomy	Sevoflurane with fentanyl	130	NA	NA	Intraoperative
				Sevoflurane with remifentanil	130	NA	NA	Intraoperative
				Propofol with remifentanil	124	NA	NA	Intraoperative
Lauta 2010; Italy	3	ASA status I-III adult patients 18 - 75 y	Elective supratentorial craniotomy	Intravenous anesthesia (propofol/remifentanil-group P)	149	53.1	62 (41.6)	Intraoperative
				Inhalation anesthesia (sevoflurane/remifentanil-group S)	153	58.1	75 (49.0)	Intraoperative
Gelb 2008; Canada, China, India	4	ASA status I-III adult patients 18 - 75 y	Elective supratentorial craniotomy	Hyperventilation followed by normoventilation, propofol infusion	68	47 ± 14	39 (57)	Intraoperative
				Hyperventilation followed by normoventilation, isoflurane anesthesia	66	48 ± 17	40 (61)	Intraoperative
				Normoventilation followed by hyperventilation, propofol infusion	63	46 ± 13	36 (57)	Intraoperative
				Normoventilation followed by hyperventilation, isoflurane anesthesia	68	43 ± 12	39 (57)	Intraoperative
Martorano 2008; Italy	Not specified	Adult patients 18 - 75 y	Elective supratentorial craniotomy	Sufentanil in combination with propofol	31	52.8 ± 12.8	15 (48.4)	Intraoperative
				Remifentanil in combination with propofol	38	56.1 ± 13.5	20 (52.6)	Intraoperative
Todd 2005; USA	30	ASA status II-III adult patients aged 18 y or older	Craniotomy for Intracranial Aneurysm	Intraoperative hypothermia (target temperature, 33°C, with the use of surface cooling techniques)	499	52 ± 12	175 (35)	Intraoperative
				Intraoperative normothermia (target temperature, 36.5°C)	501	51 ± 13	170 (34)	Intraoperative
Petersen 2003; Denmark	3	Adult patients 18-70 y	Elective supratentorial craniotomy	Propofol, Fentanyl	41	55 ± 14	20 (48.7)	Intraoperative
				Isoflurane, Fentanyl	38	55 ± 10	16 (42.1)	Intraoperative
				Sevoflurane, Fentanyl	38	53 ± 11	20 (52.6)	Intraoperative
Gelb 2003; Canada	5	ASA status I-III adult patients 18 - 65 y	Elective supratentorial craniotomy	Thiopental and remifentanil with morphine	44	42 ± 11	24 (54.5)	Intraoperative
				Fentanyl with saline	45	45 ± 13	20 (42.6)	Intraoperative
Zattoni 2000; Italy	4	ASA status I-II adult patients 18 - 60 y	Elective craniotomy	Propofol 1%	37	46.7 ± 8.9	18 (48.6)	Intraoperative
				Propofol 2%	36	42.5 ± 13.3	16 (44.4)	Intraoperative
Guy 1997; USA	3	ASA status II-III adult patients aged 18 y or older	Elective supratentorial craniotomy	Fentanyl	31	49 ± 13	23 (74.2)	Intraoperative
				Remifentanil	32	51 ± 13	18 (56.3)	Intraoperative

Periodic EEG signatures of a sub-anesthetic ketamine bolus during GABA-ergic general anesthesia

Submission ID

11

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INTRODUCTION

The frontal electroencephalogram (EEG) provides continuous assessment of brain dynamics during general anesthesia. Conventional anesthetic monitoring focuses on periodic oscillatory features such as delta, theta, alpha, beta, and gamma oscillations. However, the addition of a sub-anesthetic ketamine bolus can transiently disrupt these patterns, producing apparent EEG activation despite maintained unconsciousness. Although the standard frontal EEG signature of ketamine has previously been well-described, temporal dynamics and frequency-specific trajectories of EEG activity following a single sub-anesthetic ketamine bolus are still unclear. We analyzed intraoperative frontal EEG to characterize how a ketamine bolus modulates band-specific periodic power during GABAergic general anesthesia.

METHODS

Frontal EEG signals from 20 intraoperative cases during stable GABAergic general anesthesia (propofol, sevoflurane, or isoflurane) were analyzed. This investigation was conducted in human surgical patients under approval from the institutional Research Ethics Board (IRB_00187763). Each patient received a sub-anesthetic intravenous bolus of ketamine (0.2–0.5 mg/kg) after a stable 15-minute pre-bolus baseline. Frontal EEG data were acquired from the SedLine monitor (Masimo, Irvine, CA, USA; sampling rate = 178 Hz), visually inspected, and an artifact-free frontal channel was selected for further analysis in Matlab (Mathworks, Natick, MA, USA). Signals were mean-centered and underwent amplitude-threshold interpolation for artifact rejection. Power spectra were computed using the multitaper method (time–bandwidth = 1, tapers = 3; f ≤ 40 Hz). Band-limited power was calculated for delta (0–4 Hz), theta (4–8 Hz), alpha (8–12 Hz), beta (12–20 Hz), and gamma (20–40 Hz) ranges. Each power trajectory was baseline-normalized to the median power during the −15 to 0 min pre-bolus interval. Within-subject descent (post-ketamine to nadir) and recovery (nadir to +60 min) phases were quantified using linear regression fits applied to normalized

trajectories. Group-level summaries were visualized using bootstrapped medians ± 95 % confidence intervals (sampling with replacement, 1000 iterations).

RESULTS

Sub-anesthetic ketamine induced rapid, frequency-specific modulations in cortical oscillations. Alpha-band power significantly decreased from baseline, reaching 0.54x its baseline (95% CI [0.37–0.80]) at 8.5 min post-bolus and partially recovered to 0.73 x baseline (95 % CI [0.46–1.09]) by 59.6 min. Beta power increased, peaking at 1.86 × baseline (95% CI [1.33–2.63]) at 13 min, declining toward 1.02 ×baseline (95 % CI [0.74–1.52]) by 60 min. Gamma power rose sharply to 2.46 × baseline (95 % CI [1.75–3.48]) at ~4.5 min (+141 %), then gradually declined toward 1.14 × baseline (95 % CI [0.85–1.46]) by 60 min. Total broadband, delts and theta power showed non-significantly declines, whereas delta, theta and total power changes did not reach statistical significance. Collectively, slow rhythms were suppressed while fast rhythms were enhanced, indicating transient desynchronization and relative cortical excitation during GABAergic anesthesia.

DISCUSSION

A sub-anesthetic ketamine bolus produces transient, frequency-specific EEG changes characterized by suppression of slow oscillations and enhancement of high-frequency power. These findings highlight ketamine’s distinct cortical activation pattern during GABAergic anesthesia and demonstrate the need to account for its spectral effects when interpreting EEG-based depth monitors.

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N/A

Sphenopalatine ganglion block for post-craniotomy pain in patients undergoing decompressive craniotomy for chiari malformation - a case report

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213

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INTRODUCTION

Chiari I malformation is characterized by caudal displacement of the cerebellar tonsils through the foramen magnum and commonly presents with a frontal or suboccipital headache often exacerbated by exertion or Valsalva maneuvers (1,2). Posterior fossa decompression is the definitive intervention for symptomatic patients; however, postoperative headache remains common and contributes to delayed recovery, prolonged hospitalization and increased healthcare utilization (3). The sphenopalatine ganglion (SPG) plays a central role in trigeminal–autonomic pain pathways, modulating parasympathetic outflow and the release of vasoactive neuropeptides involved in craniofacial nociception (4,5). Emerging evidence suggests that SPG block provides clinically meaningful analgesia after supratentorial craniotomy, reducing both early postoperative pain and opioid requirements (4). Despite its mechanistic relevance, the application of SPG block has not previously been described in patients undergoing posterior fossa surgery for Chiari decompression.

CASE PRESENTATION

38-year-old woman with Chiari I malformation presented for posterior fossa decompression. She underwent standard general anesthesia with endotracheal intubation. After induction, a bilateral sphenopalatine ganglion (SPG) block was performed using soft nasal cannulas to instill 1 mL of 0.5% bupivacaine each nostril. Total intravenous anesthesia was used for maintenance, and extubation occurred uneventfully at the conclusion of surgery. The operative duration was 210 minutes. Intraoperative analgesia consisted of fentanyl 250 µg and remifentanil (1.4 mg total).
In the PACU, pain remained well controlled, with scores of 1/10 on arrival, 1/10 at 30 minutes, and 3/10 at one hour. She required only 0.8 mg of IV hydromorphone, and her PACU stay lasted 70 minutes before comfortable transfer to the ward. The block was administered

at 08:25, and the minimal opioid requirement in PACU paralleled the very low pain scores recorded during this period.

The first pain score ≥4 occurred at 20:00, approximately 11.5 hours after block administration, marking the onset of analgesic decline consistent with expected SPG block offset. The highest pain spike (8/10) occurred the following morning at 08:00—23.5 hours after block placement—and coincided with a marked increase in oral hydromorphone requirements. Thereafter, the patient required progressively higher opioid doses, with daily post-offset MME totaling 30 mg on postoperative day (POD) 1, 76 mg on POD2, 72 mg on POD3, and 44 mg on POD4, indicating that opioid consumption rose substantially once the early analgesic effect of the SPG block had dissipated.

CONCLUSION

This case suggests that SPG blockade may attenuate early postoperative headache following Chiari decompression, particularly during the immediate recovery period when trigeminal–autonomic activation may contribute to nociception. In this patient, SPG blockade was associated with low early postoperative pain score, minimal opioid requirements during PACU recovery, and a subjective improvement in headache quality compared with preoperative symptoms. Although limited by its single-case design, these preliminary observations highlight the potential role of SPG block as an adjunct to multimodal analgesia in posterior fossa surgery and support further structured investigation in prospective, controlled studies.

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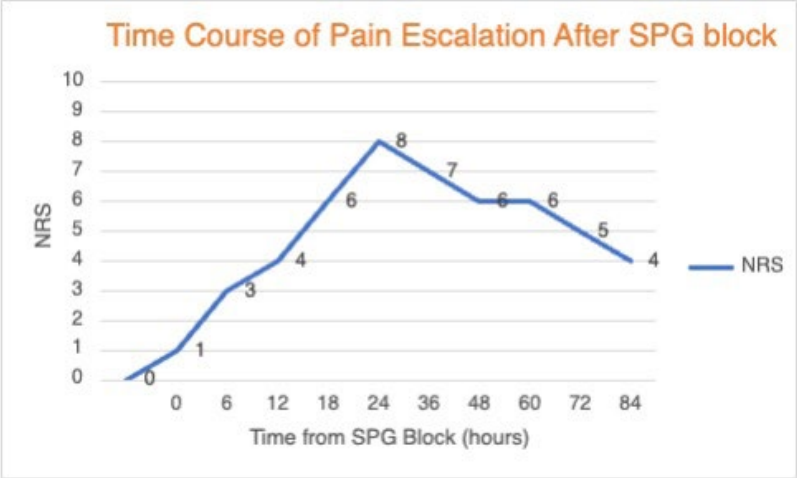
Time Course of Pain Escalation After SPG block
NRS
10
9
8
7
6
5
4
3
2
1
0
0
1
3
4
6
8
7
6
6
5
4
0
6
12
18
24
36
48
60
72
84
Time from SPG Block (hours)
NRS

Figure 1