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CASE SERIES

Anaesthesia Management of Awake Craniotomy: A Case Series

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ABSTRACT

Background and aims: Awake craniotomy (AC) permits real-time functional assessment during resection of lesions involving or adjacent to eloquent cortex. Anaesthesia must provide analgesia and anxiolysis while preserving spontaneous ventilation, airway patency, haemodynamic stability, and patient cooperation. We describe our institutional experience with dexmedetomidine-based monitored anaesthesia care (MAC) combined with bilateral scalp block.

Methods and Methodology: This retrospective case series included eight consecutive eligible adults who underwent AC between August and December 2025. All patients received dexmedetomidine, titrated Propofol, and fentanyl with a bilateral scalp block using bupivacaine and lignocaine with adrenaline. The primary objective is to evaluate the feasibility of the anaesthetic management protocol for awake craniotomy under monitored anaesthesia care, particularly successful completion without unplanned conversion to general anaesthesia.

The secondary objectives include assessment of sedation, respiratory abnormality, haemodynamic stability, perioperative analgesia, patient satisfaction, and intraoperative complications.

Results: Eight patients (mean age 46.8 ± 9.7 years; 3 males/5 females) underwent AC for tumours adjacent to motor and/or speech-related eloquent cortical areas. The target RSS was 2–3; contemporaneous records described sedation as remaining within this target during mapping, with

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SpO_2 >95%, respiratory rate 14–18/min, and $EtCO_2$ 32–40 mmHg. Heart rate remained 70–85/min, systolic blood pressure 120–146 mmHg, and diastolic blood pressure 70–90 mmHg. One patient (12.5%) developed a transient seizure during cortical manipulation and was treated with cold saline irrigation and a 20–30 mg propofol bolus. Two patients (25%) developed clinically recognised anxiety and were managed with reassurance and counselling. No patient required rescue airway intervention or unplanned conversion to GA. Postoperative nausea and vomiting occurred in one patient (12.5%). No new neurological deterioration was documented at discharge. Patient satisfaction scores ranged from 8 to 9/10 (mean 8.50 ± 0.53), with all patients reporting scores ≥8/10. Intraoperative NRS pain scores ranged from 1 to 4 (mean 2.63 ± 0.92), while postoperative NRS scores ranged from 2 to 4 (mean 3.13 ± 0.83). Intraoperative and postoperative NRS pain scores and patient satisfaction ratings were documented contemporaneously in routine perioperative records.

Conclusion: In this small retrospective series of selected patients, dexmedetomidine-based MAC with bilateral scalp block permitted completion of AC without unplanned conversion to GA or rescue airway intervention. The findings support feasibility in appropriately selected patients and experienced neuroanaesthesia teams; they do not establish superiority over other techniques.

Keywords: Awake craniotomy, monitored anaesthesia care, dexmedetomidine, scalp block, cortical mapping, neuroanaesthesia

INTRODUCTION

Awake craniotomy is an established approach for lesions within or adjacent to eloquent cortical regions, particularly areas responsible for motor and language function. Direct cortical stimulation and neurological testing permit functional mapping during resection and may help balance tumour removal with preservation of neurological function.[1-3]

Anaesthetic management is challenging because the patient must remain comfortable during painful stages such as pin fixation, incision and craniotomy while being sufficiently awake and cooperative for cortical mapping. Spontaneous ventilation, airway patency and haemodynamic stability must also be preserved. Both asleep–awake–asleep and MAC techniques are used, and current evidence does not establish a single universally superior regimen.[3,4]

Dexmedetomidine provides readily arousable sedation with relatively limited respiratory depression and is increasingly used for MAC during AC. A 2024 systematic review and meta-analysis of 22 studies involving 2,137 patients found no statistically significant difference in surgical outcomes or conversion to GA between dexmedetomidine-based and non-dexmedetomidine regimens.[5] Scalp block is an important component of multimodal analgesia because it reduces nociceptive input from pin fixation, incision, and other surgical stimuli.[6,7]

We report our experience with eight patients undergoing AC under dexmedetomidine-based MAC and bilateral scalp block. The primary objective was to describe feasibility, maintenance of spontaneous ventilation and cooperation, and avoidance of unplanned conversion to GA. Secondary outcomes included sedation score, respiratory and

haemodynamic events, NSR score, anxiety, seizure, postoperative nausea and vomiting.

MATERIALS AND METHODS

Study design and setting

This retrospective case series was conducted in the Departments of Anaesthesia and Neurosurgery at GCS Medical College, Ahmedabad. Eight consecutive eligible adult patients undergoing AC between August and December 2025 were included. Institutional Ethics Committee approval was obtained (Ref. No. GCSMC/EC/Project/APPROVE/2025). Written informed consent was obtained from all patients for the procedure and for publication/use of clinical information.

Patient selection

Adults scheduled for AC for tumours in or adjacent to eloquent cortical areas, particularly motor and speech-related regions, were eligible. Patients unable to cooperate, with uncontrolled psychiatric illness, severe obstructive sleep apnoea, major airway compromise or anticipated difficult airway were excluded. All eight eligible patients during the study period were included consecutively.

Anaesthetic management

Standard monitoring included ECG, non-invasive blood pressure, SpO_2, respiratory rate and continuous $EtCO_2$ monitoring through a nasal airway connected to a Bain circuit. Oxygen was administered at 6–8 L/min. A supraglottic airway and equipment for endotracheal intubation were kept immediately available for rescue or conversion to GA.

The procedure was divided into three stages: (1) pin fixation, craniotomy and exposure; (2) cortical/subcortical mapping and tumour excision, during which cooperation was required; and (3) haemostasis and closure. Sedation was adjusted according to surgical stimulus and mapping requirements.

Dexmedetomidine was administered without a loading dose. The maintenance infusion was commenced at approximately 0.4 µg/kg/h and titrated according to surgical stimulus, clinical response, and the need for cooperation during cortical mapping. Propofol was titrated according to clinical requirement, with sedation minimized during mapping. Fentanyl 25–50 µg boluses were administered when required for painful stimuli such as pin fixation or dural manipulation.

Bilateral scalp block was performed targeting the supraorbital, supratrochlear, auriculotemporal, zygomaticotemporal, and greater/lesser occipital nerves. Bupivacaine 0.5% was administered at 2 mg/kg and lignocaine 2% with adrenaline at 5 mg/kg. These were weight-adjusted doses. Scalp block was used as the principal regional analgesic component.

Sedation and outcome definitions

The target Ramsay Sedation Score (RSS) was 2–3. Sedation was assessed clinically during the procedure, particularly during cortical mapping, and the contemporaneous anaesthesia documentation described the level of sedation as remaining within the target range. However, serial numerical patient-level RSS values were not available in a form that permitted calculation of a mean or presentation of individual scores. Accordingly, no mean RSS is reported.

For retrospective classification and consistent reporting, the following thresholds were applied during review of the anaesthesia records; they were not prospectively specified before data collection. Hypoxia/desaturation

was defined as SpO_2 <94%. Hypotension was defined as systolic blood pressure (SBP) <90 mmHg or a decrease in SBP ≥20% from baseline. Bradycardia was defined as heart rate (HR) <50 beats/min or a decrease in HR ≥20% from baseline. Clinically significant hypertension was defined as SBP >160 mmHg or an increase in SBP ≥20% from baseline. Clinically significant respiratory abnormality was defined as respiratory rate (RR) <10 or >25/min or $EtCO_2$ <30 or >45 mmHg. Rescue airway intervention was defined as an unplanned airway manoeuvre or device intervention, including jaw thrust, airway repositioning, supraglottic airway placement or tracheal intubation. The routinely placed nasal airway was considered a planned airway adjunct and was not counted as rescue intervention.

Intraoperative anxiety was identified clinically by the attending anaesthesiologist from observable distress, apprehension, agitation or expressed fear. No formal anxiety scale was used. Anxiety was treated initially with verbal reassurance and counselling. For seizure, cortical stimulation was stopped, and cold saline irrigation with a 20–30 mg propofol bolus was used, followed by reassessment before continuation.

Patient satisfaction and pain assessment: Patient satisfaction was assessed postoperatively using a numerical rating scale from 0 to 10, where 0 represented complete dissatisfaction and 10 represented complete satisfaction with the overall anaesthetic experience. Pain intensity was assessed using the Numerical Rating Scale (NRS), where 0 represented no pain and 10 represented the worst imaginable pain. Intraoperative NRS scores were documented during the awake phase, particularly during potentially painful surgical stimuli, and postoperative NRS scores and patient satisfaction ratings were documented in the routine postoperative assessment records. These scores were recorded contemporaneously as part of routine perioperative care and were subsequently extracted from the existing anaesthesia and postoperative assessment records for this retrospective analysis; they were not obtained by contacting or interviewing patients retrospectively.

Data analysis

Demographic characteristics, tumour location, RSS, respiratory and haemodynamic variables, airway events, anxiety, seizure, conversion to GA, intraoperative and postoperative NRS pain scores, patient satisfaction, postoperative nausea/vomiting. Continuous data are presented as mean ± SD, median (range), or ranges as appropriate, and categorical data as counts and percentages.

RESULTS

Eight patients underwent AC between August and December 2025. Mean age was 46.8 ± 9.7 years; three were male and five female. All lesions were adjacent to eloquent motor and/or speech-related cortical areas. Four were in the frontal region and four in the temporal region. Histopathological diagnoses were not available in the anaesthesia dataset and therefore are not reported.

Anaesthetic and sedation outcomes

All patients received dexmedetomidine-based MAC, propofol, fentanyl, and bilateral scalp block. Dexmedetomidine was administered without a loading dose. The maintenance infusion was approximately 0.4 μg/kg/h and was titrated clinically according to surgical stimulus and the need for cooperation during mapping. The target RSS was 2–3; anaesthesia documentation described sedation as remaining within this target range during

Table 1: Demographic and surgical characteristics of the eight patients

Characteristic	Finding
Study period	August–December 2025
Age	46.8 ± 9.7 years
Male/Female	3/5
Frontal-region lesions	4 (50%)
Temporal-region lesions	4 (50%)
Motor/speech eloquent areas	8 (100%)

Table 2: Anaesthetic and sedation characteristics

Variable	Results
Bilateral scalp block (n; %)	8/8 (100%)
Bupivacaine (dose)	2 mg/kg
Lignocaine with adrenaline (dose)	5 mg/kg
Dexmedetomidine (dose)	0.4 µg/kg/h; no loading dose
RSS during mapping (n; %)	2–3 in 8/8 (100%)
Propofol (dose)	Titrated clinically
Fentanyl (dose)	25–50 µg boluses as required
Unplanned conversion to GA (n; %)	0/8 (0%)

mapping. Serial numerical patient-level RSS values were not available to calculate a mean. The actual weight-adjusted scalp-block doses administered in each of the eight patients were bupivacaine 2 mg/kg and lignocaine 5 mg/kg with adrenaline. Fentanyl 25–50 µg boluses were used when required for painful stimuli. Propofol was titrated clinically.

Respiratory and haemodynamic outcomes

All patients maintained spontaneous ventilation. SpO_2 remained >95%, respiratory rate 14–18/min and $EtCO_2$ 32–40 mmHg. Heart rate remained 70–85/min, SBP 120–146 mmHg and DBP 70–90 mmHg. No patient crossed the thresholds applied retrospectively for adverse-event classiication.

Table 3: Intraoperative respiratory and haemodynamic variables and thresholds applied retrospectively for adverse-event classification

Parameter	Observed range	Clinically significant cut-off values	Patients crossing cut-off values (n)
SpO_2	>95%	<94%	0/8
$EtCO_2$	32–40 mmHg	<30 or >45 mmHg	0/8
Respiratory rate	14–18/min	<10 or >25/min	0/8
Heart rate	70–85/min	<50/min or ≥20% fall from baseline	0/8
SBP	120–146 mmHg	<90 mmHg or ≥20% fall; >160 mmHg or ≥20% rise	0/8
DBP	70–90 mmHg	<50 or >100 mmHg	0/8

Table 4: Intraoperative and postoperative clinical outcomes

Outcome	N=8 (%)
Intraoperative seizure	1 (12.5%)
Intraoperative anxiety	2 (25%)
Rescue airway intervention	0 (0%)
Desaturation (SpO_2 <94%)	0 (0%)
Respiratory abnormality	0 (0%)
Haemodynamic instability	0 (0%)
Unplanned conversion to GA	0 (0%)
Postoperative nausea/vomiting	1 (12.5%)

Patient satisfaction and analgesia outcomes

Patient satisfaction scores ranged from 8 to 9/10, with a mean score of 8.50 ± 0.53 and a median of 8.5 (range, 8–9). All eight patients (100%) reported satisfaction scores ≥8/10. Intraoperative NRS pain scores ranged from 1 to 4, with a mean of 2.63 ± 0.92 and a median of 3 (range, 1–4). Postoperative NRS scores ranged from 2 to 4, with a mean of 3.13 ± 0.83 and a median of 3 (range, 2–4). No patient reported an NRS score >4.

Table 5: Patient satisfaction scores

Patient	Satisfaction score /10
1	8
2	9
3	8
4	9
5	9
6	8
7	8
8	9
Mean ± SD	8.50 ± 0.53
Median (range)	8.5 (8–9)
Score ≥8/10	8/8 (100%)

Table 6: Intraoperative and postoperative pain scores rated on NRS

Patient	Intraoperative NRS	Postoperative NRS
1	3	3
2	3	2
3	4	4
4	3	4
5	2	3
6	1	2
7	2	4
8	3	3
Mean ± SD	2.63 ± 0.92	3.13 ± 0.83
Median (range)	3 (1–4)	3 (2–4)

DISCUSSION

The principal finding of this retrospective series is that eight consecutive selected patients underwent AC using dexmedetomidine-based MAC and bilateral scalp block without unplanned conversion to GA or rescue airway intervention.

Respiratory variables remained within clinically acceptable ranges in all eight patients: SpO_2 >95%, $EtCO_2$ 32–40 mmHg, and respiratory rate 14–18/min. These observations are compatible with the respiratory-preserving characteristics of dexmedetomidine reported in awake-craniotomy studies. Mahajan et al. reported no desaturation among 27 patients receiving dexmedetomidine, while McAuliffe et al. reported no airway manipulation or conversion to GA in 55 patients managed with dexmedetomidine and scalp blocks.[8,9]

Haemodynamic variables also remained within the reporting thresholds. HR was 70–85/min, SBP 120–146 mmHg, and DBP 70–90 mmHg. Dexmedetomidine can cause bradycardia and hypotension, particularly with higher doses or loading doses; our protocol used an infusion without a loading dose. These observations remain descriptive and cannot establish comparative safety.

Sedation depth is critical during AC because excessive sedation can interfere with mapping, whereas inadequate sedation can produce anxiety and movement. In this series, the target RSS was 2–3 and, the reviewed level remained within this range during mapping in all eight patients. Because patient-level repeated RSS measurements were not available, we report the target range and proportion maintained within it rather than creating individual numerical values.

Bilateral scalp block was the principal regional analgesic component. Bupivacaine 2 mg/kg and lignocaine with adrenaline 5 mg/kg were administered as weight-adjusted doses. Scalp nerve block is supported as an important component of multimodal analgesia for craniotomy.[6,7]

Two patients developed anxiety identified clinically by the anaesthesiologist, and both responded to counselling. Patient satisfaction was assessed using a 0–10 numerical scale; the mean satisfaction score was 8.50 ± 0.53, and all patients scored ≥8/10. The mean intraoperative NRS was 2.63 ± 0.92, and the mean postoperative NRS was 3.13 ± 0.83. These patient-reported outcomes provide objective support for acceptable comfort and analgesia in this small series, although the absence of a comparator limits interpretation.

One patient developed a transient seizure during cortical manipulation. The event was managed by stopping stimulation, irrigating with cold saline, and administering a small propofol bolus, after which the procedure could continue. Seizure rates in published AC series vary; Mahajan et al. reported 18.5% and McAuliffe et al. 16%.[8,9] Our observed rate of 12.5% is within this reported range.

A 2024 systematic review and meta-analysis of 22 studies involving 2,137 patients found no statistically significant difference in surgical outcomes or conversion to GA between dexmedetomidine-based and non-dexmedetomidine MAC regimens.[5] A separate meta-analysis comparing dexmedetomidine and propofol also did not demonstrate significant differences in most intraoperative adverse events or patient satisfaction.[10] Thus, our findings should be interpreted as an institutional experience supporting feasibility rather than superiority of one regimen.

CONCLUSION

In this retrospective series of eight consecutive selected patients, awake craniotomy under dexmedetomidine-based MAC combined with bilateral scalp block was feasible. Spontaneous ventilation and clinically acceptable respiratory and haemodynamic parameters were maintained, with no rescue airway intervention or unplanned conversion to GA. One transient seizure and two episodes of clinically recognized anxiety occurred and were successfully managed. These findings support the technique's feasibility in appropriately selected patients when performed by an experienced multidisciplinary neuroanaesthesia team. They do not establish superiority over alternative techniques or demonstrate independent improvement in tumour resection or neurological outcomes.

LIMITATIONS

This is a small, single-centre retrospective case series without a comparator group. The sample size precludes meaningful statistical inference. The assessment was based on a small retrospective cohort, and standardized repeated postoperative time-point measurements and cumulative analgesic consumption were not consistently available. Duration of surgery, hospital stay, tumour pathology, and extent of resection were not consistently available in the anaesthesia dataset and are therefore not presented as efficacy outcomes. Long-term neurological and oncological outcomes were not assessed.

AUTHORS' CONTRIBUTIONS

Conceptualization and design: AC, KS

Literature search: BV

Data collection: AC

Data analysis: KS

Manuscript drafting and critical revision: AC, KS

Proofreading and approval of the manuscript: AC, KS, BV

FUNDING

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DECLARATION OF CONFLICTS OF INTEREST

There are no conflicts of interest to declare.

DECLARATION OF PATIENT'S CONSENT

Written informed consent was obtained from all patients for the procedure and the use of clinical information for publication.

ETHICAL CLEARANCE

Approved by the Institutional Ethics Committee of GCS Medical College (Ref. No. GCSMC/EC/Project/APPROVE/2025); Approval date: October 14, 2025.

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