

## Anesthetic Technique During Awake Craniotomy-A Case Report

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### Abstract

A range of anesthetic techniques have been developed for awake craniotomy surgery. However, there are few anesthetic methods suitable for resection of epileptic lesions near the language function area. Herein, we present a case of a 21-year-old woman who was diagnosed with left frontal and insular lobe symptomatic epilepsy, which required surgical resection. Magnetic resonance imaging showed a significant lesion in the left frontotemporal region. Anatomically, the epileptic lesion involved the language function area. Thus, we decided to perform a craniotomy with the patient awake during the procedure, to remove the largest range of the lesion while maintaining the maximal language function. This case was managed with a scalp local infiltration block with 0.5% ropivacaine plus general anesthesia using a laryngeal mask for airway management. This anesthesia method ensures patient safety, and is painless and comfortable. The postoperative complications were reduced, and the prognosis was improved.

**Keywords:** Awake Craniotomy Surgery; Bispectral Index; General Anesthesia; Language Function Area; Sedline; Symptomatic Epilepsy

**Abbreviations:** BIS: Bispectral Index; LMA: Laryngeal Mask; EEG: Electroencephalogram; PSI: Patient State Index; DSA: Density Spectral Array

### Introduction

A wide range of anesthetic methods have been reported for awake surgery, to allow surgical examination of language function and cortical electrical stimulation in the presence or absence of airway manipulation, and removal of focal lesions or tumors near eloquent areas and the motor cortex. These procedures include local anesthesia or local anesthesia with sedation; intermittent general anesthesia, with low-dose infusion of dexmedetomidine, propofol, and remifentanyl, without the need of airway management; and scalp nerve block with local anesthetics combined with infusion of propofol and remifentanyl [1,2]. However, the standard anesthetic management for awake craniotomy is not yet fully determined. Herein, we present a case using intermittent general anesthesia with a Laryngeal Mask (LMA) and infusion of low-dose propofol and remifentanyl. The patient cooperated with the surgeon during

the operation to allow successful positioning of the eloquent area, and safe and accurate removal of epileptic lesions. This report gives further strategies for anesthetic management related to awake craniotomy.

### Case Report

The case was a 21-year-old woman admitted for surgical resection of an epileptic foci under an asleep-awake-asleep anesthetic technique using craniotomy with cortical mapping. She had signed informed consents for anesthesia and surgery prior to surgery. This report was approved by the Xuanwu Hospital Bioethics Committee, and informed written consent from the patient was obtained, subject to the rules on confidentiality and personal data protection. The patient has suffered paroxysmal loss of consciousness for 12 years. Each attack was characterized by sudden loss of consciousness, limb twitching, and rolling up the eyes for 1-2 minutes. Three months prior to the surgical intervention, she had a magnetic resonance imaging scan, which showed an epileptic foci (Figure 1A). As the lesion was close to the eloquent areas, we performed an awake craniotomy to allow intraoperative cortical Electroencephalogram (EEG) monitoring and language testing, with the aim of preserving language function during resection of the epileptic foci.

## Physical Examination

The patient (weight, 50 kg; height, 1.60 m) was in good general condition, with normal pulse, blood pressure, and respiratory rate, and regular heart sounds. Her airway was evaluated with the Mallampati grade II, and she showed no language difficulties when performing neuropsychological assessment, except during the ictal period. Cardiology assessment showed that the patient was grade II of American Society of Anesthesiologists for anesthetic and surgery. Thus, no special perioperative considerations were required.

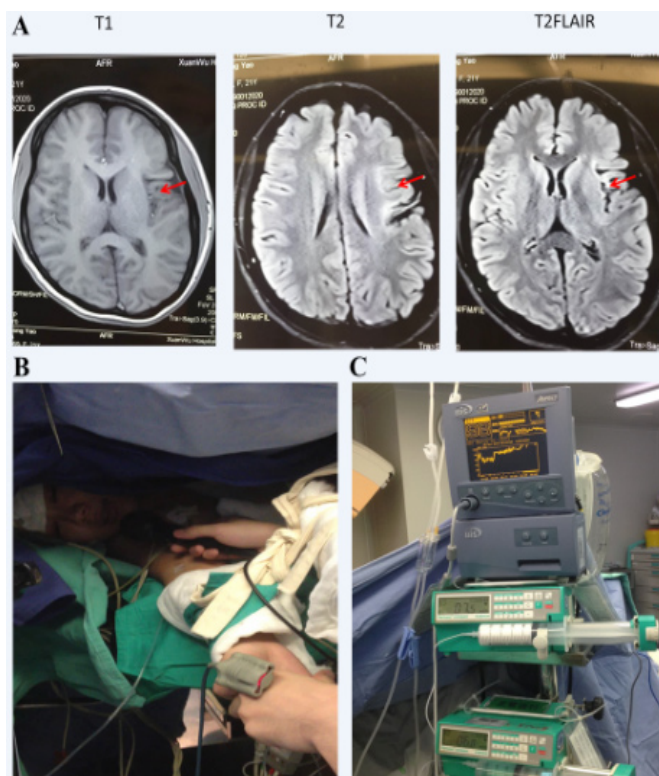
## Anesthetic Technique

The patient was taken into the operating room and positioned comfortably in the supine position on a thermal mattress. Before anesthesia induction, two peripheral lines were inserted for intravenous administration of methylprednisolone (40 mg), tropisetron (5 mg), ulinastatin (300,000 U; 5000 U/kg), and penicillin hydrochloride (0.3 mg; 5 µg/kg). She was attached to a five-lead electrocardiogram monitor, a pulse oximetry placed on a toe of her right hand, axillary temperature, an invasive blood pressure monitor via the radial artery, a Bispectral Index (BIS) and Sedline Sedation monitoring (Produced by Masimo corporation in USA). Parameters on admission included blood pressure of 105/70 mmHg, temperature of 36°C, heart rate of 62 beats per minute, SPO<sub>2</sub> of 97%, BIS of 98, and Sedline value of 97. General anesthesia was performed with a LMA placement. Anesthesia induction included etomidate (8 mg), sufentanil (15 µg), and cisbenzenesulfonate atracurium (12 mg) administered intravenously. After 2-3 min of adequate ventilation, the BIS and Patient State Index (PSI) of the Sedline value decreased to 42 and 26, and a number 4 Formia II laryngeal mask was used.

Anesthesia maintenance included remifentanyl infusion (started at 0.1-0.2 µg/kg/min), propofol (2-5 mg/kg/h), dexmedetomidine (0.1 µg/kg/h), and cisbenzenesulfonate atracurium (4 mg/h). After anesthesia induction, the patient was placed in the right lateral decubitus position, and placement of the LMA was reconfirmed. The surgical procedure was started at 1 h after induction of general anesthesia. The patient also received intravenous sufentanil (10 µg) and was routinely administered 0.5% ropivacaine local anesthesia on the skin incision site. The remifentanyl, propofol, and dexmedetomidine infusions were continued as previous, while the cisbenzenesulfonate atracurium infusion was stopped, with no significant changes in hemodynamic variables and maintenance of BIS from 45 to 56. Drilling of the skull was used to remove a bony flap, and the dura was cut. The amount of drugs used to maintain anesthesia was gradually decreased to increase the BIS value, which supports subsequent EEG monitoring and intraoperative wakefulness. Dexmedetomidine infusion was stopped during drilling. EEG monitoring was started when the BIS

and PSI value reached  $\geq 60$  and 50.

Drug levels were then further reduced (propofol: 1-2 mg/kg/h, remifentanyl: 0.05-0.1 µg/kg/min), and the BIS value increased to 72-89. At this point, the patient resumed breathing, and could open her eyes when her name was gently called. The LMA was removed successfully with no cough, no restlessness, and normal language exchange under instructions (Figure 1B). Remifentanyl (0.1 µg/kg/min) and propofol (1-1.5 mg/kg/h) were used for the maintenance of the waking period, and the BIS and PSI value was stable between 90 and 98 (Figure 1C), 70 and 76 (Figure 4C). Intermittent monitoring of blood gas parameters was performed to prevent CO<sub>2</sub> accumulation and maintain hemodynamic stability (Figure 2). During the awake period, the patient was calm, pain free, cooperative, and suitably understood instructions. Continuous language testing was performed with the patient to assess for language barriers or impaired language function during surgery. The awake period surgery took approximately 2 h, and the procedures included EEG monitoring, language function area positioning, removal of the epileptic lesions under microscopy, and further EEG monitoring.

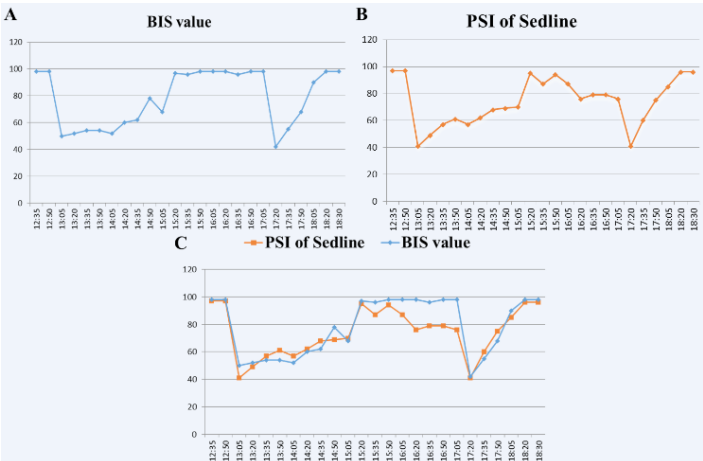


**Figure 1:** (A) Magnetic resonance imaging showing evidence of a frontal lesion; (B) Language tests in the awake patient; (C) Bispectral Index (BIS) values were maintained, and low-dose remifentanyl and propofol were used for the maintenance of the waking period during lesion resection.

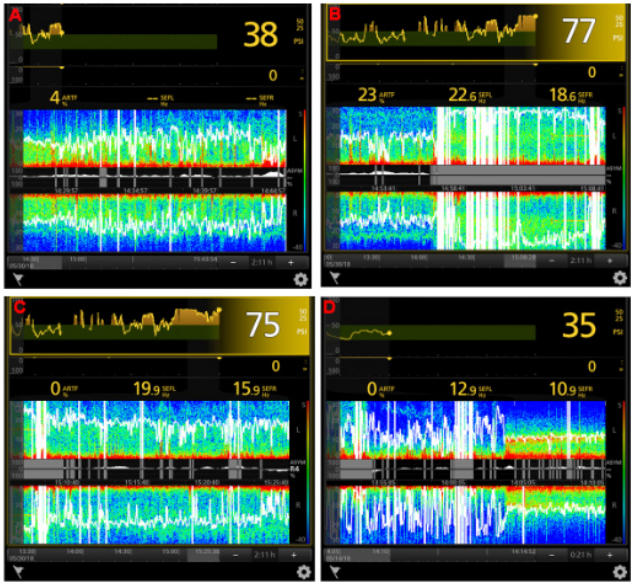
	pH	PaCO2	PaO2	K <sup>++</sup>	Ca <sup>++</sup>	HCO3 <sup>-</sup>	HGB	Hct	BE	SO2C
After awake	7.39	38.2	487	4.0	1.20	23.1	11.2	34%	0.7	100%
One hour after awake	7.34	43.6	110	3.97	1.21	22.5	11.3	35%	0.9	98%

**Figure 2:** Blood gas analysis in the awake patient during lesion resection.

Sufentanil (5 µg) and esmolol (30 mg) were administered once after removal of the LMA during the awake period. The patient remained awake for 110 min. She had no intra-anesthetic complications and did not develop any neurological deficits following the resection. After we confirmed that the lesion had been removed, and we had monitored for language area injury, we closed the skull under general anesthesia with re-placement of the laryngeal mask. Anesthesia induction was performed with Etomidate (6 mg), sufentanil (10 µg), and cisbenzenesulfonate atracurium (6 mg). Anesthesia was maintained with remifentanyl (0.2-0.4 µg/kg/min) and propofol (4-6 mg/kg/h). The BIS value was stable between 40 and 60, and the Patient State Index (PSI) of the Sedline was 30-50 until the end of surgery. The changes in the BIS values and Sedline [including PSI and Density Spectral Array (DSA)] over the entire operation are shown in (Figure 3 and 4).



**Figure 3:** (A) Changes in the BIS; (B) the PSI of the Sedline value throughout the operation. (C) Note the similar trend of these parameters.



**Figure 4:** Changes in DSA and PSI of Sedline monitoring at different stages of surgery, (A) induction of anesthesia; (B) awakening; (C) verbal testing; (D) re-induction of anesthesia.

**Postoperative Follow-Up**

The patient was removed after surgery and transferred to the functional neurosurgery intensive care unit for postoperative management and treatment, including postoperative anti-infection, decreased cranial pressure and continued use of antiepileptic drugs. The follow-up was conducted on the first, third, fifth, and seventh post-operative days. The patient was fluent in speech and had no longer seizures during the postoperative hospital stay. Discontinuation of the antiepileptic drug should be considered at least 3 years of follow-up without seizure.

**Discussion**

Awake craniotomy is now the preferred method for epilepsy or tumor surgery when located close to or within eloquent areas [3]. This technique requires the maintenance of painlessness, comfort, and immobility in awake patients, but minimizing hypoxemia, hypercapnia, nausea, vomiting, seizures, and hemodynamic instability, which provides more challenging anesthesia management [4-6]. A variety of anesthetic techniques



have been developed for awake craniotomy [4,5,7,8]. In the present study, we used intermittent general anesthesia with LMA placement for an asleep-awake-asleep approach [9], which allows accurate localization of epileptic foci in motor and eloquent areas, and thus optimal resection. Scalp infiltration anesthesia with 0.5% ropivacaine before skin incision was reported to provide adequate intra- or post-operative analgesia and reduce opioid consumption [10]. In the present case, we used 0.5% ropivacaine because of its prolonged effects and residual analgesia. Propofol is a short acting sedative with antiemetic and amnesic properties, and remifentanyl is a short acting opioid, which are ideal for conscious sedation during awake craniotomy.

Thus, we used a combination of low dose intravenous propofol and remifentanyl throughout the awake lesion resection to provide baseline sedation after removal of the LMA. During sleep before and after waking up, we adjusted the dosage of narcotic sedatives appropriately according to the BIS and Sedline values, to avoid effects on wake-up because of overdose or intraoperative awareness because of insufficient dose. The main benefits of awake craniotomy include a shorter hospital stay, a reduction in hospital costs, perioperative morbidity, and the incidence of nosocomial infections and thromboembolism, and improvement in postoperative functional status [11]. To improve the prognosis and quality of life of patients with epilepsy, a greater extent of epileptic foci resection is associated with lower seizure frequency, although it is also critical to ensure maximum protection of the language function area from damage. In the present case, the surgery was completed with no adverse events. Further, the patient was interviewed on the several post-operative days, with no evidence of language exchange barrier and no seizures. She was satisfied with the anesthetic and surgical procedures and was discharged 10 days after the operation.

## Conclusion

We report a case of successful management of awake craniotomy. This case may provide anesthesiologists with a framework for sedative and analgesic drug application for awake surgery in similar cases based on BIS and Sedline monitoring.

## Disclaimer

The authors report no conflicts of interest and they have no conflicting commercial or proprietary interests.

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