Case Report

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The First Awake Craniotomy for Eloquent Glioblastoma in Southern Thailand

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Abstract:

Awake craniotomy (AC) with direct cortical stimulation is becoming the gold standard for functional brain mapping. It is used to identify the safe brain area before pathologic resection. This method indicates the pathology near or at the eloquent cortex, such as gliomas or metastasis. AC can optimize the patient's quality of life and oncologic outcome. This task requires the active cooperation of a patient care team familiar with advanced neuroscience and challenging to learn. We report the first time this operation which performed in our institute with technical details, in terms of anesthesia, and surgical aspects.

Keywords: awake craniotomy, brain tumor, glioblastoma

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Introduction

Awake craniotomy is a neurosurgical procedure for remove intracranial lesionthat is performed while patients are awake and alert.[1] This kind of surgery is helpful for the lesion located near the functional area, called the "eloquent cortex." Previous studies have demonstrated that it can decrease the postoperative neurological deficit and increase the volume of lesion resection.[1,2] This procedure is indicated for intrinsic brain lesions, especially for gliomas (both low and high grades) and metastasis.[2] However, the success of this operation requires appropriate patient selection, preparation, a specialized anesthetic technique, adequate intraoperative testing, and monitoring.[3] We report the first case of awake craniotomy at our institute in June 2017. The case is presented following the Surgical Case Report guideline.[4]

Case presentation

The patient was a 60-year-old, right-handed man. He presented with progressive headache and dizziness for two weeks and a mild degree of weakness on the left. He had no underlying diseases and physical examination was unremarkable. The magnetic resonance imaging (MRI) showed a heterogeneous rim gadolinium-enhancing lesion at the right parieto-temporal lobe; mass volume was 47.6 milliliters (ml), with surrounding brain edema and a midline shift to the left side of 1.2 centimeters (cm) (Figure 1). He was admitted to the neurosurgery ward and received 20 milligrams (mg) of dexamethasone per day and phenytoin for seizure prophylaxis Awake craniotomy was considered beneficial for this patient because his tumor was near the eloquent cortex. The patient received preoperative information about the risks and benefits of awake craniotomy, and underwent an operation on the fifth day after his admission.

Patient preparation

Patient preparation included disease explanation, management plan, and the steps of surgery and anesthesia. The patient rehearsed his intraoperative tasks before the date of the operation with a motor command, sensory examination, reading, and picture naming test with the commercial alphabet test. He also simulated the supine operative position and turned his head and body to the left side in this preparatory phase. On the day of surgery, the patient was premedicated with dexamethasone 10 mg intravenously and phenytoin level was 7.6 milligrams per liter (mg/L). He received an additional dose of 500 mg of intravenous phenytoin before starting the operation.

Intraoperative: anesthesia and cortical stimulation

In the operating room, we selected the asleep-awake-asleep method for anesthetic management. Firstly, basic anesthetic monitoring (blood pressure, pulse oximeter and electrocardiography), and additionally processed electroencephalography (BIS™ Medtronic Covidien, Dublin, Ireland) were applied. The proper sized nasal airway was used for assuring airway patency, and oxygen supplement was delivered via nasal cannula with EtCO2 monitoring. Dexmedetomidine 1 μg/kg was administered over 10 minutes as a loading dose, then followed by a maintenance infusion of 0.7 micrograms per kilogram per hour (μg/kg/hr). After the dexmedetomidine was started, a scalp block was performed on the right side with 20 ml of 0.5% levobupivacaine. After that, the target-controlled infusion was started with Propofol according to Schnider's model between 1.5 and 2.5 micrograms per milliliter (μg/ml) to maintain BIS values 40 and 60 during the asleep period. Afterward, invasive blood pressure monitoring and another large-bore intravenous line were done.

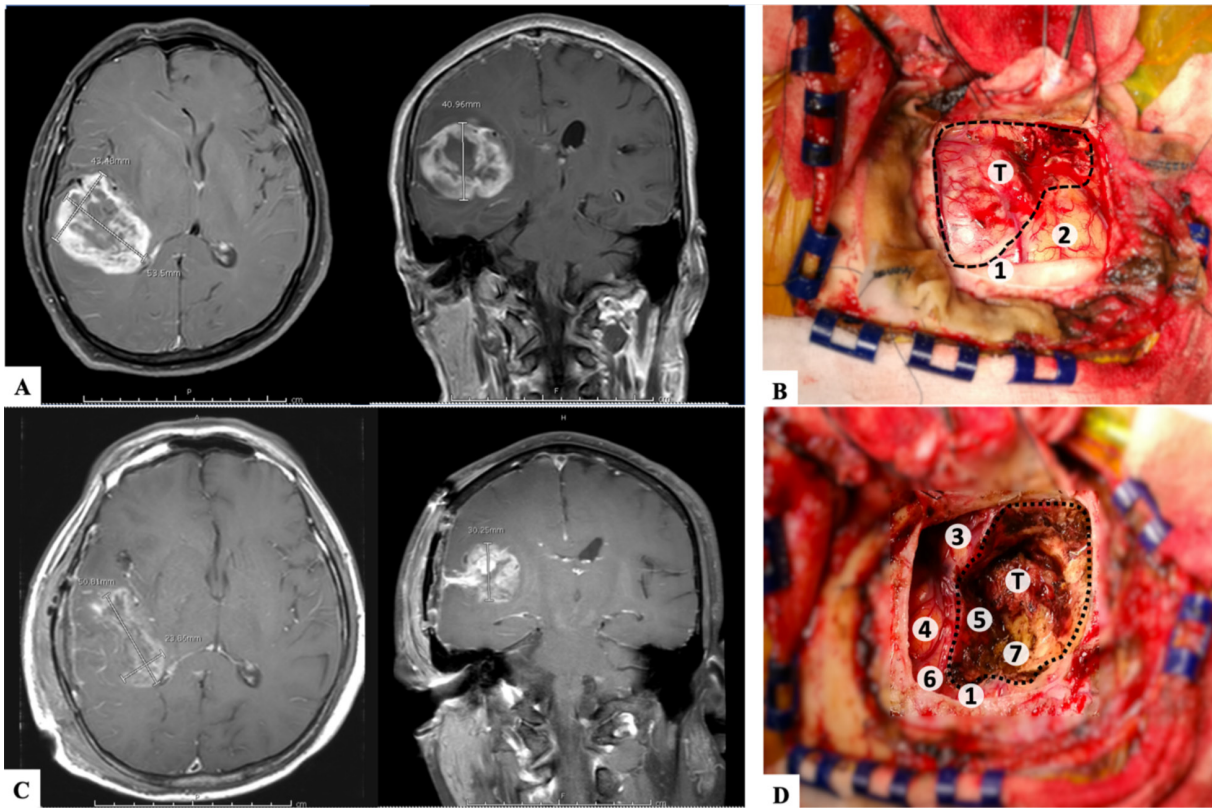

Figure 1 **A** Preoperative axial and coronal T1-weighted with gadolinium injected magnetic resonance imaging showing an enhancing tumor at right temporo-parietal lobe with calculated volume 47.6 milliliters. **B** Intraoperative finding before resection. Alphabet tag (T) and dash line showing the boundary of tumor, which defined by intraoperative ultrasound. The number of tags related to the eloquent cortex: Tag 1, the primary somatosensory cortex, eliciting left face and lip dysesthesia Tag 2, suspected the inferior parietal lobule which found negative stimulation. **C** Postoperative day 3, axial, and coronal T1-weighted with gadolinium injected magnetic resonance imaging showing an enhancing residual tumor, calculated volume 18.3 milliliters. **D** Intraoperative finding after resection, dot line showing the boundary of the tumor resection cavity. Alphabet tag (T) showing the remaining tumor. Tag 3, the superior temporal gyrus Tag 4 and 5, the primary motor cortex, eliciting left face and finger movement Tag 1 and 6, the primary somatosensory cortex and Tag 7, suspected subcortical thalamocortical fibers, eliciting left face and lip dysesthesia.

The scalp was infiltrated with 6 ml of 1.0% xylocaine with 1:200,000 adrenaline (2 ml per site) before placement of the three-point Mayfieldò head clamp and further 20 ml of 1.0% xylocaine with 1:200,000 adrenaline along the incision. After skull removal step, the dura was injected with 1.0% xylocaine with 1:200,000 adrenaline via 30 gauze needle and a small dose of intravenous fentanyl was used as an adjunct when the blood pressure increased more than 20.0% from baseline. Twenty minutes after dexmedetomidine and Propofol discontinuation, the

patient became fully awake. The tumor was located by using intraoperative ultrasonography. Intraoperative electrocorticography was monitored. The rehearsing tasks (picture naming with or without simultaneous contralateral arm movement) were performed before electrical stimulation, upon which the entire resection phase was reassessed; both cortical and subcortical mapping. The direct cortical stimulation used a 5 millimeters (mm) space tip of the bipolar probe (Nim eclipse®, Metronic, USA). The setting of biphasic current was pulse frequency 60 Hertz (Hz), pulse duration of 1 millisecond (msec), amplitude 1.5 to 12 milliampere (mA), and duration of the stimulation was up to 4 seconds. The current amplitude was adjusted with a progressive fashion in the step of 0.5 mA until a response was detected. Indeed, the cortex that did not show the specific response to stimulation three consecutive times was defined as the negative area. For this patient, the positive stimulation was detected on the anterior aspect of the tumor with dysesthesia and tonic face and hand movement, as defined as the primary sensorimotor cortex. Intraoperative seizure detected by after discharge signal and briefly following with a focal seizure on his arm for a few seconds during cortical stimulation with amplitude 12 mA. Cold saline was irrigated and the operation was paused for around 5 minutes after stop clinical seizure and normalized electroencephalography. The partially tumor resection was stopped due to the patient very anxious after seizure and complained severe dysesthesia along his face and lip. The medio-inferior part of the tumor is remained. After dura closure by using water-tight technique, conscious sedation was provided with dexmedetomidine for skin closure. During the operation, the systolic blood pressure was maintained in the range of 100-150 mmHg, heart rate of 52-60 beats/min, peripheral oxygen saturation of 98.0-100.0%, and endtidal carbon dioxide (CO2) of 26-36 mmHg, and BIS value of 40-60. The duration of the operation was 8 hours.

Patient's outcome

The postoperative period was uneventful and the patient was discharged from the institute on the postoperative day 7. The extent of resection, 61.5%, was demonstrated on postoperative MRI (Figure 1). Pathological study reported glioblastoma multiforme, then the patient received postoperative concurrent chemoradiation, the standard Stupp's regimen. Eight months after the operation his tumor had progressed and thus he underwent craniotomy under general anesthesiadue to profound weakness. After that, his clinical condition rapidly deteriorated into dependent status. Regretfully, he died due to septic shock at 14 months from his diagnosis.

Discussion

Awake craniotomy is a neurosurgical operation that was developed for the patient safety. Its benefits provide minimizing the new postoperative neurological deficits, while maximizing adequate lesionectomy.The most common indication for this procedure is an intrinsic brain tumor, especially gliomas near the eloquent cortex as presented in this case.[4,5] To date, a growing body of evidence supports the concept of maximizing safe resections while balancingbetweenthe extent of resection and postoperative quality of life.[6] Hence, All steps of surgery and criticalevents, such as intraoperative seizure,were reconsidered for achieved the best of care in the future.

In this case, one episode of intraoperative seizure (IOS) was detected during cortical stimulation. Previous reports reveal IOS as one of the most common complications of awake craniotomy. Its incidence ranges from 2.2-21.5%.[6,7] It is also the leading cause of failed awake operations and related to poor postoperative outcomes.[6,7] To reduce the incidence of IOS, the existing evidence still posessome unresolved questions. First, the role of preoperative antiepileptic drugs (AEDs) in patients with

no preoperative seizures is inconclusive. The Japanese guideline for awake craniotomy recommends initiating the AEDs in advance to achieve a sufficient plasma drug concentration[3], whilst some European centers do not use the AEDs in a prophylaxis role.[7] Second, the stimulation parameter varies among centers, such as frequencies, pulse phasic, and intensity, which found an association between stimulation intensity and IOS rate in the linear fashion.[8] Generally, the intensity of bipolar stimulation does not exceed 20 mA; however, one report showed that the maximum stimulation current of 4 mAis adequate for creating the stimulation's effect with a low rate of IOS.[9]

After this case, we regularly perform awake craniotomy in almost all cases ofintrinsic supratentorial lesion near the eloquent cortex.

Conclusion

Despite lack of experience, the first case of awake craniotomy can be carried out safely and successfully, if it is well planned, prepared and organized.Team communication and preparation are the cornerstones of success.

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Conflict of interest

The authors have declared that no conflict of interests exist.

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