Anaesthesia for Awake Craniotomy: A Case Report

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ABSTRACT

Awake craniotomy (AC) is an operative method developed in the early 20th century that allows testing of functional cortical areas during tumor resection. We take the case of a 62-year-old male who was diagnosed with Grade IV Glioblastoma extending to the temporoinsular and temporal opercular region, with suspicion of infiltration into the right Wernicke's area. Considering comorbidities, the patient was found to be a good candidate for AC to allow intraoperative mapping of affected functional cortical areas. Using a combination of local anaesthesia (LA) to the scalp, in a combination with systemic infusion of propofol and boluses, the tumor was successfully excised while maintaining vital stability of the patient. We screened the literature for other possible methods and different dynamics of sedation, as well as possible complications.

INTRODUCTION

Historically, the AC is a procedure during which the patient maintains some level of consciousness. AC was used prior to the presence of anesthesia to rid the mind of 'evil air'[1]. In 1937, Wilder Penfield took the initiative in performing a craniotomy under conscious sedation. He claimed that the patient's consciousness and alertness ought to be maintained under LA and sedation, while maintaining minimum levels of pain[2,3]. Through the 20th century, this practice has evolved and been incorporated to treat conditions such as tenacious epilepsy, arteriovenous malformation, supratentorial tumours, and mycotic aneurysms situated closer to crucial areas of the brain[2]. The purpose of this type of technique is to accurately localise and excise any lesion in the brain while allowing for real-time evaluation of motor, sensory and language centers. This allows preservation of the patient's functional neurological capabilities as much as possible, and therefore, helps to achieve the highest quality of life possible for the patient post-operatively[2,4,5].

In recent years, the biggest concern for the Anaesthetist intraoperatively is tailoring an appropriate regimen to balance sedation and analgesia, with respiratory and haemodynamic stability; all while maintaining the patient's wakefulness and cooperation to evaluate their neurological status. Due to the psychologically and physically straining nature of an AC, it is of paramount importance to build and solidify mutual trust between the surgeon, the anesthetist, and the patient[1,6].

In this report, we describe a case of a 62-year-old male with multiple chronic diseases who presented with slowly progressive headaches, aphasia, and lower limb weakness. He was found to have a space occupying lesion (SOL) in the right temporal region, with possible infiltration to the Wernicke area, the eloquent area of the cerebral cortex responsible for comprehension of written and spoken language. Hence, a decision to perform an AC was made based on its anatomical position. The aim of this paper is to illustrate the steps and measures taken preoperatively to prepare the patient, intraoperatively to successfully resect the SOL, and postoperatively to manage the patient with minimal complications, until discharge.

CASE SUMMARY

A 62-year-old male presented to the emergency department after two brief episodes of slurred speech with mild headache associated with a 2-week history of left lower limb heaviness. The patient was a known case of hypertension, for which he takes two antihypertensives. He also had a history of asthma, hyperglycemia, and benign prostatic hyperplasia. He was fully conscious, with a GCS of 15/15, fully oriented to time, space, and person. Under the impression of a Transient Ischemic Attack, the patient underwent a brain CT with contrast that showed right sided temporoparietal heterogenous hyperdensity with vasogenic edema and effacement of the ipsilateral ventricle. There was minimal mass effect compressing the left ventricle. He was admitted for further investigation.

An MRI of the brain with contrast showed a hypervascular lesion with dimensions 62x40x45mm located at the level of the right superior and middle temporal gyrus extending to the temporoinsular and temporal opercular region, with suspicion of infiltration into the right Wernicke's area, along with marked necrotic content (Figure 1). These findings were suggestive of a high-grade glioblastoma. After careful consideration of the radiological findings and the patient's state, a decision to proceed with an AC and 5-Aminolevulinic acid-guided tumor excision was made.

Considering the vulnerability of the patient's position during an AC procedure, building rapport with the same members of the anesthesia team and surgery team is of utmost importance to ensure the patient's cooperation during the surgery.

After explaining the condition and need for AC as an intervention, the neurosurgery and anesthesia teams met with the patient and explained

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the nature of the condition and the need for an AC. The possibility of failure of the procedure and conversion to General Anaesthesia (GA) was also discussed and consented. To test the patient's cognitive and linguistic abilities, a set of questions and exchanges were set ahead of time in agreement with the patient. The exercises included memory-based questions like the patient's phone number and names of his children, as well as motor commands in the form of squeezing a 'squeaky toy' (Figure 2).

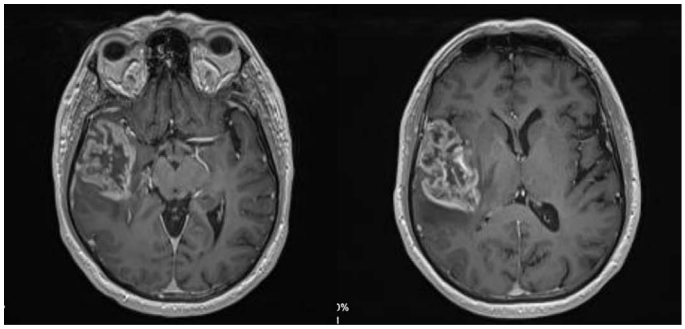

Figure 1: Pre-operative MRI of the brain

Figure 2: Patient holding toy intraoperatively

In the operating theatre, the patient underwent ultrasound guided insertion of a central line in the right jugular vein, insertion of a right radial arterial line, a urinary catheter, two venous lines, and an oxygen mask adjusted at 4-6 liters of Oxygen (O_2) per minute. He was put on Remifentanil and Propofol infusion at variable rates for conscious sedation.

The operation lasted a total of 6 hours, including the preparation by the anesthesia team. Throughout the operation, the patient was maintained under sedation, and awakened to test his response to previously agreed-upon commands. His conscious sedation level varied slightly throughout the surgery, but he never lost consciousness. The tumor was excised successfully, and the patient responded to all verbal motor commands successfully when required.

Postoperatively, the patient was taken to the Intensive Care Unit (ICU) under instructions of keeping the head elevated at 45 degrees. Post-operative neurological examination yielded normal power and good dexterity in all limbs, fluent speech, and intact function of all cranial nerves. A follow-up CT scan of the Brain 1-day post-operatively showed right parietal scattered hematomas unrelated to the surgical bed. The bleeding was minimal with no clinical manifestations.

Histopathology report of the excised tumor revealed a highly vascularized and infiltrative Grade IV Glioblastoma. The patient was referred to continue radiation and chemotherapy after being discharged in stable condition from the hospital.

DISCUSSION

The purpose of an AC is to localize and excise any intra-axial lesions that are invading eloquent cortical areas of the brain[4]. Those areas control motor, language, and cognitive functions, and hence, precise excision and real-time testing of function is needed to preserve neurological function to ensure the preservation of the patient's quality of life. Before the decision of the procedure is made, absolute and relative contraindications should be taken into consideration (Table 1)[1,7].

Table 1: Contraindications of AC

Absolute
Patient refusal
Inability to lay still for any length of time
Inability to co-operate (ex. Confusion)
Relative
Patient cough
Learning difficulties
Inability to lay flat
Patient anxiety
Language barriers
Obstructive sleep apnoea
Young age

The success for a procedure such as AC greatly relies on achieving a good level of communication, hence, any factor hindering adequate and clear communication with the patient would be considered as a definitive contraindication[7]. Those include a decreased baseline state of consciousness/awareness, difficulty speaking, and states of confusion. Relative contraindications would be any cause for less-than-optimal hemodynamic stability such as obesity, or large infiltrative vascular tumours that would increase the risk of damage to healthy tissue, as well as significantly increase the operation time[8,9]. Those contraindications should be recognized clearly during pre-operative assessment and counselling of the patient[1,10]. Improving the relativity of said complications can be done with pre-agreement on the questions and commands to be done intraoperatively to reduce confusion, as well as optimizing the management of comorbidities such any obstructive airway disease.

Additionally, the anesthetist and surgeon must establish a mutual understanding and communication prior to the surgery to increase the

time efficiency of the procedure. It is also essential to have all theatre staff fully informed on the nature and expectations of the procedure. Along with personnel, the operating theatre must be prepared to accommodate a prolonged procedure with an awake patient. This may include reduced noise levels, comfortable temperature, specialized operative table optimized for patient comfort.

The anaesthetic methods used in AC are to facilitate tumour excision and neurological functional mapping while protecting the eloquent portion of the cortex[1,2,4]. The anaesthetic techniques available for AC are the 'Asleep-Awake-Asleep' (AAA) technique and Monitored Anaesthesia Care (MAC) or conscious sedation[5]. The approach we chose for our case was LA and conscious sedation to achieve an awake-awake-awake technique.

Prior to the surgery, administration of LA by scalp blockade is done using a combination of bupivacaine and epinephrine which provides analgesic effects[4]. The targeted scalp nerves are auriculotemporal, zygomaticotemporal, supraorbital, supratrochlear, lesser and greater occipital nerves[10].

Administration of systemic propofol with short-acting opioid, fentanyl or remifentanil are the most common anaesthetic regimen for conscious sedation. The regimen is introduced by continuous infusion, intermittent bolus, or target-controlled infusion. Maintenance of spontaneous ventilation is done by keeping a non-invasive oxygen face mask. Although this technique is comfortable for the patient, close monitoring of respiratory rate and expired carbon dioxide is advised as some vulnerable patients may develop obstructive apnoea[5,9].

Even with correct preoperative identification, counselling, and management intraoperative complications can still occur. According to one retrospective study of 354 patients, complications such as nausea and vomiting due to dura manipulation, and seizures due to cortical stimulation are relatively common- 8% and 16% respectively[8]. When those complications arise, they can be managed without conversion to GA or termination of the procedure by using medications such as ondansetron, seizing the manipulation of the intracranial components, or cold saline wash of the cortex to halt seizures[7]. Postoperatively, patients were reported to have pain, nausea, partial seizures, or persistent motor weakness despite the lack of surgical manipulation[7]. Our patient had micro hematomas in the surgical bed developing within 24 hours of the surgery, as seen on his follow up CT scan of the Brain with contrast. The hematomas did not progress or cause any neurological deficit. They resolved spontaneously and are believed to be due to the weak smooth muscle function of malignant neovascularisations.

CONCLUSION

AC has been in development for nearly a century. Although stressful and intricate for all personnel involved, it can be safely and successfully done with adequate preparation. The anesthetist role is vital in both correctly identifying and optimizing risk factors that might impede the procedure, as well as choosing the continuum of sedation most befitting to the patient individually. Counselling preoperatively, close monitoring intra-operatively, and preparation for all complications ensures higher rates of success. In our case report, we found that scalp blockage using bupivacaine, continuous infusion with boluses of propofol and remifentanil provided a stable and safe continuum of sedation.

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