Awake Craniotomy- for Management of Intracranial Lesions Safely in Eloquent Areas of Brain.

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Abstract

The awake craniotomy is a procedure where the craniotomy and excision of the lesion is done in awake patient without general anaesthesia. This surgical technique enable surgeons to avoid damaging normal cerebral regions and allow real-time patient feedback while operating on important functional areas of brain like motor cortex and speech areas (motor, somatosensory, and language areas). Such surgical interventions would not be possible without anesthesia. This technique was originally introduced for the surgical treatment of epilepsy and has subsequently been used in patients undergoing surgical management of supratentorial tumours, deep brain stimulation and near critical brain regions. This surgical approach aims to maximize lesion resection while sparing important areas of the brain.

Keywords: Awake craniotomy, anaesthesia, cortical mapping, motor cortex, speech areas.

Introduction

The main challenge of excising the tumour is the radical removal which is limited due to adjacent eloquent areas. A general assertion states that the larger the resection the lower the risk of recurrence of the lesion and the higher the chance of the patient's survival. But an extensive tissue excision may favour the occurrence of an unpredictable degree of disabilities like motor weakness and language disturbances affecting patient's social life. Therefore, the aim to remove the maximum amount of lesion without impairing neurological function, has pushed the surgeons to develop sophisticated surgical approaches to be performed in awake and responding patients, so as to evaluate neurological dysfunction before tissue removal [1].

The awake craniotomy technique was originally introduced for the surgical treatment of epilepsy in second half of 19th century. Subsequently, this surgical practice has been extended also to the resection of tumour involving the functional cortex and finally, in more recent years, the indications have further been extended to include the removal of supratentorial tumours, regardless of the involvement of the cortex [2] .

The main advantage for the awake neurosurgical approach is to facilitate intraoperative electrocorticography and cortical mapping for the accurate identification of brain areas which control motor function and speech [3].

Functional magnetic resonance imaging is a non-invasive modality as preoperative and intraoperative mapping of brain functional areas, however radiological and functional correlation is not always accurate. Intrao-perative testing of language and motor function continues to be the gold standard for a radical surgical resection while minimizing eloquent brain damage.

Apart from tumour anatomical location, mandatory prerequisites for awake craniotomy are a fully cooperative patient and optimal collaboration between anaesthesia and neurosurgical staff, to realize what is defined as function-controlled neurosurgery [4,5].

Evolution of general anaesthesia in neurosurgery benefits adequate control of vital parameters, neurological function and intracranial pressure; at the same time it provides the optimal

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working conditions for the neurosurgeon; but intraoperative monitoring of functional lesions of the central nervous system is severely inhibited by general anaesthesia: some higher cortical brain functions (i.e. speech) cannot be monitored during surgery.

Case reports

Case 1: In a 56 year old male patient, with history of two episodes of seizures, in MRI revealed enhancing lesion just anterior to motor cortex. Neurologically patient had mild weakness of limbs. He underwent awake parietal craniotomy, cortical mapping and excision of the lesion safely. Throughout the procedure, patient was cooperative and conscious and limb movements were monitored.

Case 2: A 27 year old female, presented with raised intracranial pressure (ICP) symptoms with no focal deficits. Radiological evaluation revealed left temporal lesion. She underwent left temporoparietal craniotomy and cortical mapping was done. She was communicating throughout the procedure. Her speech was monitored. Lesion was excised safely. She had no focal deficits.

Case 3: A 45 year old male patient presented with mild weakness of right upper limb and no other neurological deficits. Radiological evaluation revealed 2.5 cms lesion adjacent to motor cortex. He underwent awake craniotomy with cortical mapping for motor cortex. Contralateral movements were monitored during the procedure. However, he had mild worsening of the motor power postoperatively due to cerebral edema which subsequently recovered.

Anesthetic technique used

In these cases, after a thorough preoperative evaluation of the patient, procedure was informed to patient in detail.

Patients were premedicated with Inj. Midazolam 1mg I.V. and Inj.Fentanyl 50 mcg I.V. Under aseptic precautions scalp block was performed using 23G spinal needle with 40ml of local anaesthetic (20 ml of 2% Lignocaine with Adrenaline + 20 ml of 0.5% Bupivacaine).

A line of intradermal, subcutaneous, subfascial, intramuscular and periosteal infiltration was given, passing through the glabella and occiput, encircling the head, to provide anaesthesia of the scalp by specifically blocking the supraorbital, supratrochlear, temporomalar, deep temporal, auriculo-temporal, lesser and greater occipital and greater auricular nerves. Patients were sedated with a bolus dose of dexmedetomidine 1mcg/kg body weight, followed by infusion of Propofol at a dose of 0.5-1.0 mg/kg/hr until the opening of dura, after which infusion was stopped. No more sedation was required until the end of the procedure. Patients were comfortable and communicative, maintaining stable vital signs throughout the procedure and tolerated it well. Table I shows the anaesthetic agents which can be used in awake cranitomy.

The anaesthesiologist dealing with awake craniotomy has to be aware of the difficulties in predicting the individual right dose of a drug for an awake and anxious patient, as well as respiratory complications due to a post critical state after seizures.

Complications

Complications of awake craniotomies can include seizures, swelling of the brain, nausea and vomiting, decreased level of consciousness, neurological deficits, pain and loss of patient cooperation.

Conclusion

Awake craniotomy is procedure which is very useful in selective patients where the lesion is located in eloquent areas. It gives real time monitoring functional integrity. Due to developments of newer anaesthetic drugs and modern monitoring systems, it is safe and effective. Functional MRI though useful has its own limitations. Cortical mapping gives better clue as a intra-operating monitoring tool.

Table I : Anesthetic agents used in awake craniotomy

Drugs	Mechanism of	Advantages	Disadvantages	Classification
Propofol	GABAA agonist	Rapid onset; antiemetic; anntiepileptic; decreased intracranial pressure	Respiratory depression in combination with other narcotics	Intravenous anesthetic
Remifentanil	Selective μ-opioid agonist	Rapid offsed; blunted hemodynamic responses	Bradycardia	Opioid
Dexmedetomidine	Selective α2-agonist	Anxiolysis; analgesia; respirations maintainted	Bradycardia; hypotension	Adrenergic receptor agonist
Fentanyl, (if possible avoid)	Opioid agonist	Pain control	Prolonged wakeup; respiratory depression	Opioid
Midazolam, (if possible avoid)	GABAA agonist	Amnesia	Causes confusion during awakening	Benzodiazepines

Abbreviation: GABAA, γ-aminobutyric acid ionotropic receptor family A.

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