ANESTHETIC SAFETY IN AWAKE CRANIOTOMY

Presented by
Mohamad Abdulrazik El saaid

Under supervision of

Professor Amir Ibrahim Mohamad Salah
Doctor Mohamad Anwar El Shafei
Doctor Mostafa Gamal Eldin Mahran

Introduction

- Awake craniotomy literally means a procedure where the patient is awake during critical portions of the surgery so that his vital functions such as speech and movement can be monitored continuously.



1.Adequate patient comfort.
2.Analgesia.
3.Immobility.
4.Patient co-operation.

1.Patient Safety.
2.Control and maintainance of critical functions.

Advantage of awake craniotomy

1.Intraoperative Electrocorticography:

It is the "gold standard" for defining epileptogenic zones in clinical practice.

2.Cortical Mapping:

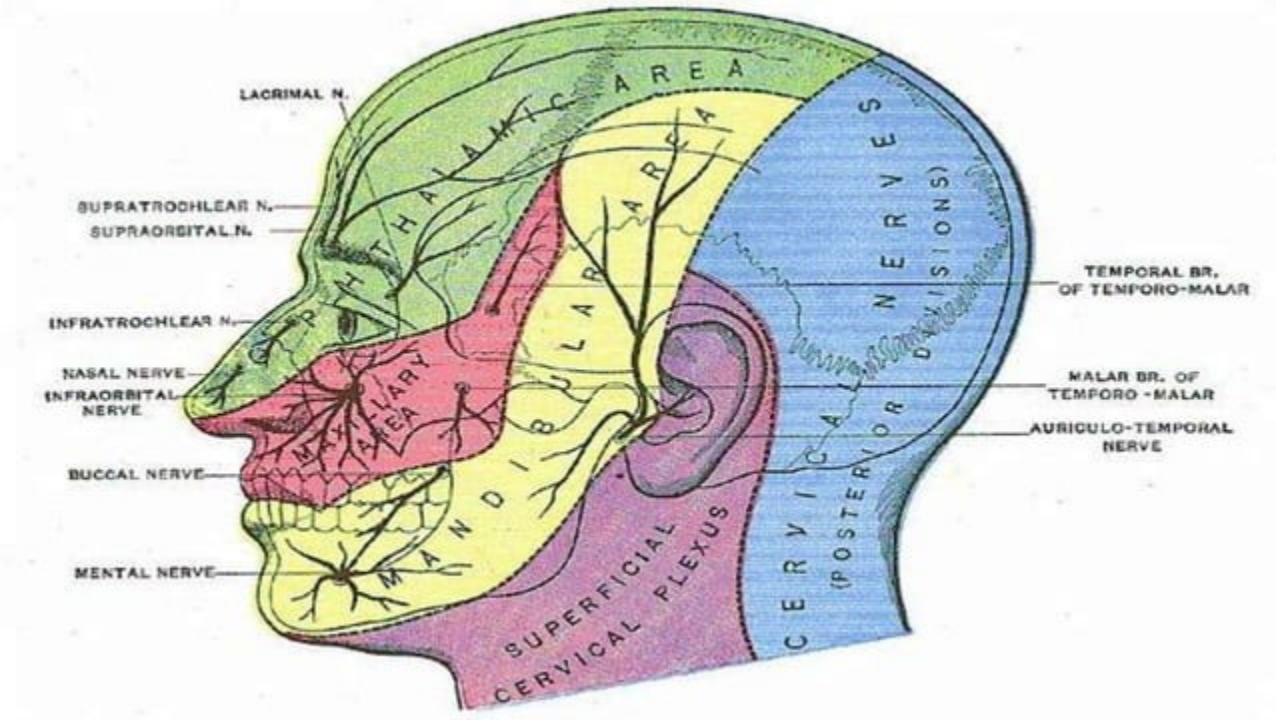
Recording the electric currents that result from muscle contractions in order to identify motor areas of the cortex

Language areas are identified from the verbal responses of an awake patient.

Nerve Supply of head and neck

- Face sensory innervation is supplied by three branches of **trigeminal nerve (Opthalmic, Maxillary, Mandibular).**
- Front and Side of the neck by **cervical plexus.**
- Posterior head and neck by **cervical nerves.**




LACRIMAL N.
SUPRATROCHLEAR N.
SUPRAORBITAL N.
INFRATROCHLEAR N.
NASAL NERVE
INFRAORBITAL NERVE
BUCCAL NERVE
MENTAL NERVE
OPHTHALMIC AREA
MAXILLARY AREA
MANDIBULAR AREA
SUPERFICIAL CERVICAL PLEXUS
CERVICAL NERVES (POSTERIOR DIVISIONS)
TEMPORAL BR. OF TEMPORO-MALAR
MALAR BR. OF TEMPORO-MALAR
AURICULO-TEMPORAL NERVE

neurophysiology

- Poor anesthetic technique which allows coughing, straining, hypotension, exaggerated hypertension, hypoxia and hypercarbia will seriously damage the critically ill brain.

- Better results can be obtained by careful monitoring of the patient and attention to simple details than by complex pharmacological interventions.

Intracranial pressure [ICP]:

- The principle constituents within the skull are brain (80%), blood (12%) and cerebro-spinal fluid (8%).
- Normally range (5-13 mmHg).

Increased venous volume	Coughing, Obstructed airway, Head- down position, Obstructed neck veins	
Cerebral edema	**Avoid**	**Hypotonic IV solutions** (5% dextrose, dextrose saline , Hartmann's solution)
	Use	0.9% Normal saline
Increased CBF	Anesthetic drugs	

Cerebral Perfusion Pressure [CPP]:

- Cerebral perfusion pressure **[CPP]** is defined as the difference between mean arterial and intracranial pressures.

$$CPP = MAP - ICP$$

- Normal cerebral perfusion pressure is **80 mmHg**, but when reduced to less than 50 mmHg there is metabolic evidence of ischemia and reduced electrical activity.

Cerebral Blood Flow (CBF):

- The normal cerebral blood flow is 45-50 ml/100g/min.
- In decompensated brain as a result of major intracranial pathology, increases or decreases in CBF will in turn lead to a significant rise or fall in ICP.

Regulation of Cerebral Blood Flow :

- Chemical regulation.
- Myogenic regulation.
- Neurogenic regulation.
- Viscosity effect.
- Vasoactive agents.

1.Chemical Regulation

1. $PaCO_2$:

- Co_2 causes cerebral vasodilatation.
- CBF changes 1 to 2 ml/100g/min for each 1 mmHg change in $PaCO_2$.
- ↑ CO_2 → ↑ CBF , ↓ CO_2 → ↓ CBF. This response is attenuated below a $PaCO_2$ of 25 mmHg.

2. CMR:

1. Functional State: Extreme increase in epileptic fit.
2. Anesthetic agents: anesthetic agents suppress CMR, with exception of ketamine and nitrous oxide.
3. Temperature: CMR decreases by 6 to 7% per Celsius of temperature reduction.

3. PaO_2: From 60 to more than 300 mmHg have little influence on CBF. When the PaO_2 is less than 60 mmHg, CBF increases rapidly.

II. Myogenic autoregulation:

- Autoregulation maintains a constant blood flow between MAP 50 mmHg and 150 mmHg

III. Neurogenic regulation:

- There is extensive innervation on the larger cerebral arteries.

IV. Viscosity effect:

- Within the normal range (33-45%) , there is only trivial alteration of CBF.

V. Vasoactive agents:

Inhalational agents:
Volatile anesthetis agents cause cerebral vasodilation in dose dependant way



Catecholamine Agonist/Antagonist

Systemic vasodilators:
Most drugs that cause hypotension causes cerebral vasodilation

Catecholamines

1. α_1-Agonists:

- Little direct influence on CBF in humans
- Norepinephrine may cause vasodilatation when the BBB is defective.

2. α_2-Agonists: As (Dexmedetomidine and Clonidine).

- ⬇ CBF, with analgesic and sedative effects.

3. β-Agonists:

- In large doses ⬆ CBF.

4. β-Blockers:

- No effect .

5. Dopamine:

- Its effect on CBF and CMR has not been defined with certainty.

Preoperative evaluation

Indication of awake craniotomy

1. Anatomical indications:

Lesions in or adjacent to motor or speech area. as cortical stimulation allows accurate planning of the resection margin.

2. Physiological indications:

Stimulation of deep brain nuclei in treatment of intractable movement disorders such as parkinson's disease and dystonias.

Accurate location of the stimulating electrodes can most be confirmed in awake patient.

3. Pharmacological indications:

To avoid drugs used in GA, as in awake patients, it allows better electrocoricography results that make the resection margins safe.

Contraindications of Awake craniotomy

1. Patient refusal.
2. Inability to communicate .
3. Low occipital tumors.
4. Significant dural invasion.
5. Pediatric patients with insufficient understanding and ability to cooperate.
6. Significant psychiatric illness.
7. Medical conditions that would prevent lying still for several hours.
8. Medical conditions that would compromise the patient's ability to lie sedated for prolonged periods without developing hypoxemia or hypercarbia.
9. Inexperienced neurosurgeon is absolute contraindication.

Preoperative psychological preparation:

- Psychological preparation is one of the most crucial aspects of operating on patients under local anesthesia.
- the patient has to be reassured that the awake part of the procedure will be painless.

Laboratory evaluation

- Special attention to therapeutic levels of antiepileptic drugs as it doubles after surgery.

Airway evaluation:

- Conversion from local anethesia to GA can occur at any moment.

Premedication:

1. Seditives:

- Midazolam is the best benzodiazepine for awake craniotomies.

2. Antiemetics and Antacids.

3. α_2-Agonists:

- Analgesic and sedetive effect with blunting of adrenergic response.

4. Anticholinergics:

- Antisalivation effect may be troublesome for some patients.

5. Anticonvulsants.

6. Dexamethasone:

- To decrease possible brain edema.

7. Antibiotics.

Intraoperative management

I. Preparation of the operating room.

II. Positioning.

III. Scalp Block:

6 Scalp nerves should be blocked + Wound infiltration + Dural block

A. Timing and duration: done at least 20 minutes prior to skin incision, lasts for 3-4 hours.

B. Technique: A scalp block is performed using approximately 2.5 to 5 ml bupivacaine 0.25% to 0.5% with epinephrine 1: 200.000 at each site. Injection is performed with a 1.25 inch 25 gauge needle.

1. Scalp Nerves block

1. Supraorbital Nerve Block:

Blocked with 2 ml of local anesthetic solution at the supraorbital notch, which is located at the supraorbital ridge above the pupil.

2. Supratrochlear N. Block:

Blocked with 1 ml of local anesthetic solution injected at superior medial corner of the orbital ridge with the needle introduced perpendicular to the skin.

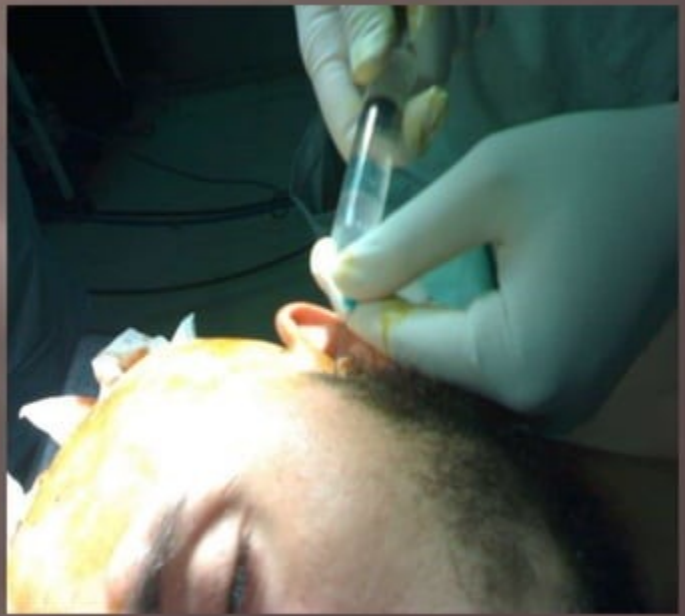


3. Auriculotemporal Nerve:

Blocked by injecting 3 ml of local anesthetic solution 1.5 cm anterior to the ear at the level of the tragus. With the needle perpendicular to the skin, infiltration of 1.5 ml is made under the deep fascia and another 1.5 ml is injected superficially as the needle is withdrawn.

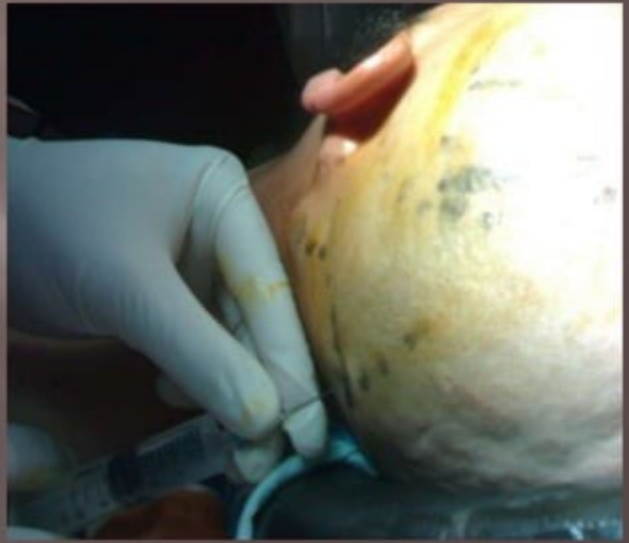
4. zygomaticotemporal Nerve

The zygomaticotemporal nerve is blocked by infiltration from the supraorbital margin to the posterior part of the zygomatic arch. Arising midway between auriculotemporal and supraorbital nerves where it emerges above the zygoma.



5. Greater occipital nerve:

It is blocked by injection of 3–5 ml of the local anesthetic solution halfway the distance between the external occipital protuberance and the mastoid process on the superior nuchal line



6. Lesser occipital nerve:

It is blocked by injecting 2 ml of local anesthetic solution 2.5 cm lateral from the greater occipital nerve block



Postauricular nerve:

It is blocked with 2 ml of local anesthetic solution 1.5 cm posterior to the ear at the level of the tragus.



II. Wound infiltration:

In a sterile fashion, the site of incision is infiltrated subcutaneously using a sterile syringe with a 22-gauge needle. It is effective, easy to apply and is relatively safe

III. Dural block:

Using a small syringe with a bent needle, a solution of 1% xylocaine with 0.25% bupivacaine is injected into the dural leaflets around the middle meningeal vessels which are usually clearly visible.





IV. Anesthetic technique:

1. Monitored Anesthesia care [MAC]:

- MAC is a specific anesthetic protocol that includes careful monitoring and support of vital functions.
- Patients receives fentanyl, with or without either droperidol or midazolam, followed by a propofol infusion.
- The craniotomy proceeds with the patient breathing spontaneously.

2. Asleep Awake Asleep [AAA] Technique:

A. LMA with Spontaneous Ventilation Technique:

B. LMA with Controlled Ventilation Technique:

- Artificial ventilation allows better control of $PaCO_2$, providing good operative conditions.
- A background infusion of remifentanyl is used to provide additional analgesia during the awake period.

V Intraoperative brain mapping

Speech mapping:

- Naming pictures, making simple sentences, and numbering while the suspected cerebral cortical areas are stimulated
- Excessive and prolonged sedation must be avoided.

Motor mapping:

- Direct cortical stimulation on the suspected brain surface to elicit movements in various parts of the face, eyelids, tongue, neck, shoulders, and upper and lower extremities



Drugs used in awake craniotomy

Propofol:

- Short-acting sedative with anti-emetic and amnesic properties in sedative doses.

Droperidol

- Neuroleptanalgesic having sedative and antiemetic properties.

Remifentanyl

- Short half-life (<5 minutes → rapid modulation of analgesia and sedation required during surgery.
- Disadvantage → Respiratory depression, airway obstruction, and desaturation and the associated nausea and vomiting.

Dexmedetomidine

- Reduces the intraoperative and postoperative anesthetic requirements.
- It produces dose-dependent decreases in blood pressure and heart rate.

Complications

Intraoperative complications:

Classification of intraoperative complications that may occur during awake craniotomy.

Anesthesia-related	Surgical-related
Airway obstruction	Focal seizures
Desaturation/hypoxia	Generalized seizures
Brain swelling	Aphasia
Hypertension/hypotension	Bleeding
Tachycardia/bradycardia	Brain swelling
Nausea/vomit	Venous air embolism
Shivering	Conversion to general anesthesia
Local anesthetic toxicity	
Pain	
Poor cooperation/agitation	
Conversion to general anesthesia	

Postoperative complications:

Neurological complications:

Transient deterioration in function - Permanent deficit at discharge - Confusion/delirium - Dysphasia - Postoperative seizures - Hydrocephalus.

Systemic complications:

Urinary retention - DVT - Nausea and vomiting - Drug reactions.

Cardiovascular complications:

Tachycardia – bradycardia – hypotension – hypertension – arrhythmias – myocardial ischemia.

Respiratory complications:

Respiratory depression.

Regional complications:

Hematoma - bleeding - Cerebrospinal fluid leak.



Thank you