



ANAESTHESIA FOR SUPRATENTORIAL SURGERIES

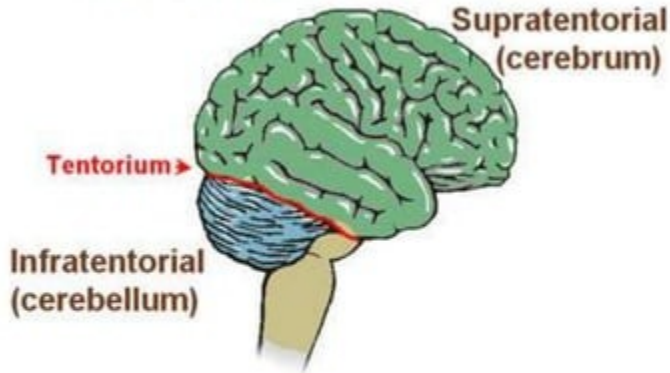
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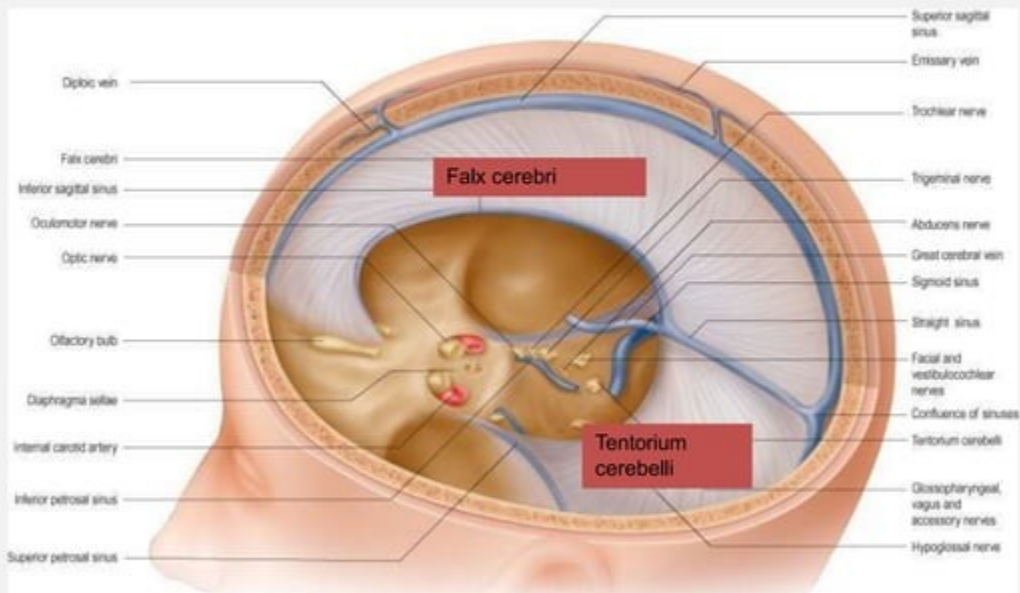
Dr.Gopinath sir

The Tentorium Cerebelli



- The tent shape of the tentorium cerebelli helps to maintain the anatomy of the brain by providing protection against the pressure caused by the heavier upper part of the brain.
- cerebrum, lateral ventricle and third ventricle, choroid plexus, pineal gland, hypothalamus, pituitary gland, and optic nerve.

ANATOMY OF SUPRATENTORIAL SPACE



SUPRATENTORIAL MASSES

1. INFECTION

- Subdural abscess
- Epidural abscess

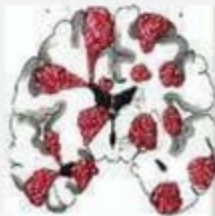


2. HEMATOMA

- SDH, EDH, Intracranial bleed

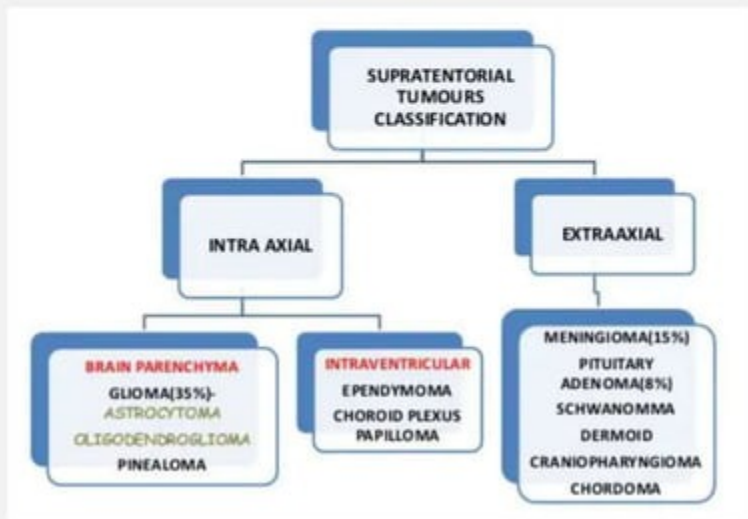
3. NEOPLASMS

4. ANEURYSMS & AV MALFORMATIONS



NEOPLASMS OF BRAIN

- PRIMARY
- METASTASIS



Intracranial tumours

WHO classification

1. Neuro epithelial tumors

Gliomas

- Astrocytoma
- Oligodendromas
- Ependymoma
- Choroids plexus tumour

Pineal tumour

Neuronal tumour

- Gangliomas
- Gangliocytoma
- Neuroblastoma

Medulloblastoma

2. Nerve sheath tumour.

Acoustic neuroma

3. Meningeal tumour

4. Pituitary tumour

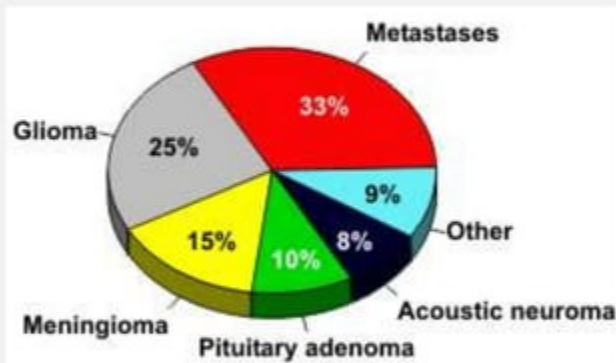
5. Germ cell tumour

Germinoma

Teratoma

6. Lymphoma

7. Metastatic tumour.

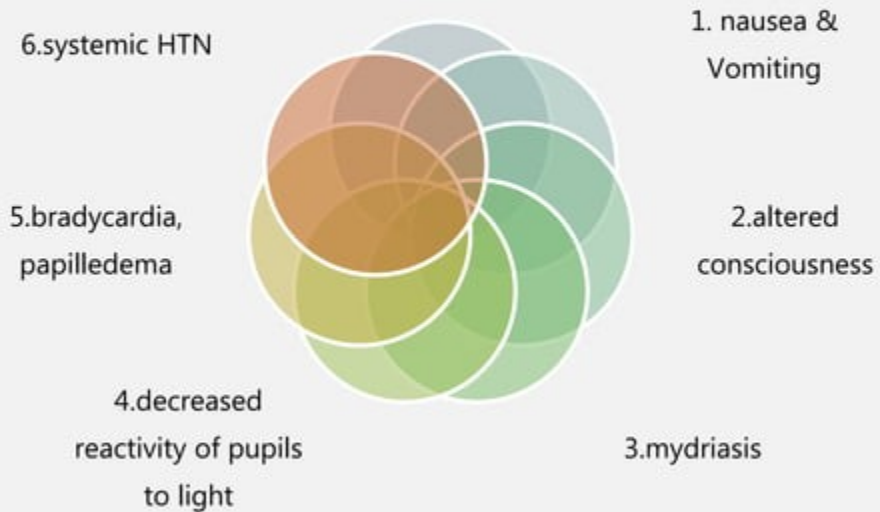


CLINICAL FEATURES

- Raised ICP—headache –
worst, bursting or throbbing,awaken from sleep,aggravated by change of posture/cough/strain
- Vomiting , papilloedema
- Seizures
- Focal neurologic signs-
 - sensory deficits /hemiparesis/cranial nerve palsies

- **Frontal**-hemiparesis
 - subtle personality changes, cognitive dysfunction
- **Parietal**-sensory changes
- **Temporal lobe**-focal seizures
- **Sellar and parasellar**-visual field changes
 - Hypopituitarism
 - Features of Cushing syndrome or acromegaly

Symptoms of increased ICP



PRE OPERATIVE ASSESSMENT

1. Complete Medical History
2. cardio pulmonary assessment.
3. History of CNS Disorders – Seizure disorders need to be assessed for type and for adequacy of therapy.
4. Cerebral hemorrhage or prior strokes are noted.- for any neurological deficit.
5. Any recent intracranial or diagnostic procedure and consider possibility of residual pneumocephalus.
6. Review the patient list of Medications: steroids, mannitol, anti hypertensives.

7. Physical Examination : Airway, Lungs and cardio vascular system.

8. Signs of hypovolemia usually common because they are often somnolent and have inadequate oral intake.

9. They may also have increased urinary water loss resulting from contrast dye or diuretics.

10. Mild to moderate hypovolemia usually well tolerated but significant hypovolemia should be corrected before the induction of anaesthesia.

11. Neurological Examination

Assess Level of consciousness

Document any focal motor or sensory deficit.

Look for any signs and symptoms of increased ICP.

PREOPERATIVE MEDICATIONS

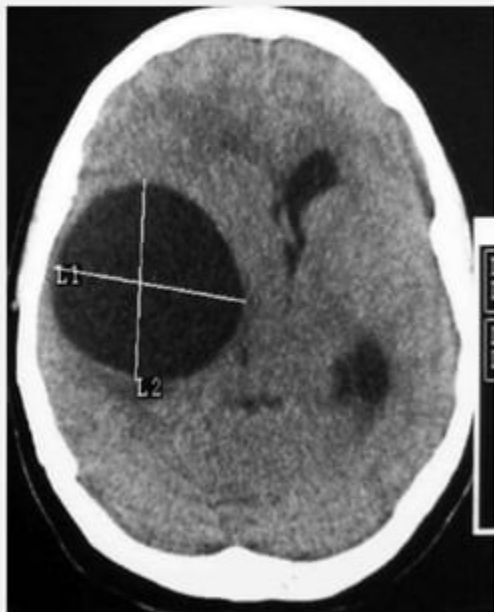
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|-------------------------|-----------------------------------|
| 1. Anti-convulsants | 5. Diuretics |
| 2. Antihypertensives | 6. Hormonal therapy |
| 3. Steroids | 7. Anticoagulants / antiplatelets |
| 4. Hypoglycaemic agents | |

- Anticonvulsant agent like phenytoin may decrease the duration of action of non depolarising muscle relaxants
- Adrenocortical suppression due to prolonged steroid therapy may cause hypotension intraoperatively.
- Patients who are alert and anxious may receive an anxiolytic before coming to OR.

INVESTIGATIONS

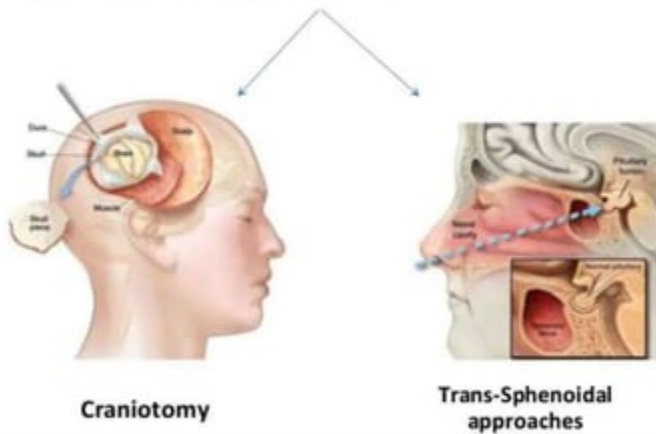
- Following are preoperative tests ordered:
 - Complete blood picture.
 - PT/APTT & INR .
 - BGT
 - Serum electrolytes, Blood sugar.
 - Glycosylated hemoglobin (HbA1c) in patients with long standing DM.
 - Renal function test, LFT
 - ECG
 - Echocardiography specially in patients scheduled for tumors in sitting position.
 - USG abdomen for polycystic kidney, pheochromocytoma .
 - Chest x Ray: to look for any secondaries.

- CT / MRI SCAN:
- Look for evidence of midline shifts (>0.5 cm) on CT /MRI which suggests raised ICP.



SURGICAL APPROACH

Surgeries commonly involved



PREOPERATIVE PREPARATION

- Measures to decrease ICP can be started pre operatively if ICP is high such as
 1. Normovolemia
 2. Head up tilt to decrease cerebral venous pressure.
 3. Cerebral dehydrating measures like mannitol, diuretics.
 4. Steroids like dexamethasone for brain tumours.
 5. Decreasing csf volume by EVD

PLANNING

Preop knowledge of Surgery to plan technique

- Position
- Intra op Neurophysiological monitoring
- Blood conservation strategies

Major goals during anesthesia include:

- (1) maintenance of adequate cerebral perfusion & oxygenation.
- (2) optimizing operative conditions to facilitate resection.
- (3) ensuring a rapid emergence for neurologic assessment.
- (4) accommodating intraoperative electrophysiologic monitoring.

PREMEDICATION

- Sedative or opioid premedication is best avoided if intracranial hypertension and altered consciousness is present.
- Hypercapnia secondary to respiratory depression increases ICP.
- Continue steroids, anticonvulsants, antihypertensives, other cardiac drugs
- Consider starting anticonvulsant therapy if not already initiated (e.g., loading dose of phenytoin, 15 mg/kg over 30 minutes)
- H2 blockers (for ↓ gastric emptying, ↑ acid secretion with steroids)

INTRA OPERATIVE MANAGEMENT

- MONITORING
- INDUCTION
- POSITIONING
- MAINTENANCE OF ANAESTHESIA
- EMERGENCE

MONITORING

- ECG monitoring : Detects responses related to intracranial tumors/ surgery.
- Cardiac arrhythmias range from acute sinus arrhythmias to VT.
- Capnography : can facilitates ventilation & PaCO₂ management and detection of VAE.
- Nasopharyngeal /esophageal **temperature** monitoring.
- A bladder catheter is necessary because of the use of diuretics, the long duration of most neurosurgical procedures, and its utility in guiding fluid therapy

- **INVASIVE BLOOD PRESSURE MONITORING**
- Measurement of **intra-arterial blood pressure** recommended for major neurosurgical procedures.
- Arterial cannula is inserted before induction of anesthesia to continuously monitor ABP & estimate CPP.
- When pressure transducer is at midhead level (level of external auditory meatus), it approximates MAP at level of circle of Willis.
- Arterial catheter access for intraop ABG, hct, serum electrolytes, glucose, & osmolality. (to verify adequacy of hyperventilation).
- **CEREBRAL FUNCTIONAL MONITORING:** not std
- EEG
- Evoked potentials (SSEP, VEP, BAEP)
- EMG

- CVP - reliable means of large-bore IV, monitor of fluid status.
- CVP catheter can be inserted through antecubital vein/ internal jugular/ subclavian veins.
- TEE and PAC selectively used, e.g. In pts with IHD.
- Peripheral nerve stimulator: monitoring persistence of drug-induced skeletal muscle weakness/paralysis.
- Neuromuscular function should be monitored on the unaffected side in patients with hemiparesis because the twitch response is often abnormally resistant on the affected side.
- Monitoring visual evoked potentials may be useful in preventing optic nerve damage during resections of large pituitary tumors.
- SSEP useful in large tumours particularly involving frontal lobe.

POSITIONING AND CONCERNS

Hazards of Prone Positioning

- Pressure over the eyeballs, pinna , genitalia
- Kinking of the neck veins
- Extreme flexion – endobronchial migration of the tube, kinking
- Brachial plexus , ulnar and sciatic nerve injuries



LATERAL POSITION

Ventilation perfusion mismatch

- Common peroneal nerve injury
- Dependent pinna injury



SITTING POSITION

- Good surgical exposure, enhanced CSF & venous drainage, minimal blood loss.
- Unstable haemodynamics and potential for venous air embolism.
- Excessive neck flexion.

INDUCTION

- Induction of anesthesia and tracheal intubation are critical periods for patients with compromised intracranial pressure to volume relationships, particularly if there is an elevated ICP.
- The goal of any technique should be to induce anesthesia and intubate the trachea without increasing ICP or compromising CBF.
- Arterial hypertension during induction increases CBV and promotes cerebral edema.
- Sustained hypertension can lead to marked increases in ICP, decreasing CPP and risking herniation.
- Excessive decreases in arterial blood pressure can be equally detrimental by compromising CPP

EFFECT OF ANAESTHETIC DRUGS

BARBITURATES	PROPOFOL	ETOMIDATE	KETAMINE
CMRO2 ↓	CMRO2 ↓	CMRO2 ↓	CMRO2 ↑
CBF ↓	CBF ↓	CBF ↓	CBF ↑
ICP ↓	ICP ↓	ICP ↓	ICP ↑
Cerebral protection +			
CPP preserved	CPP decreased	No reduction in CPP	
Autoregulation maintained	Autoregulation maintained	Autoregulation not evaluated	
CO2 responsiveness preserved	CO2 responsiveness preserved	CO2 responsiveness preserved	

NEURO MUSCULAR BLOCKERS

- Neuro muscular blocker (NMB) is given to facilitate ventilation and prevent straining or coughing, both of which can abruptly increase ICP.
- Adequate depth & profound skeletal muscle paralysis should be achieved prior to laryngoscopy, as any movement can abruptly increase CBF, CBV & ICP.

AVOID INTUBATION RESPONSE

- ET intubation should be performed as rapidly & smoothly as possible.
- Fentanyl administered in 50µg increments to total dose of 10µg/kg, depending on BP.
- Lidocaine (1.5 mg/kg) also administered IV 90sec before intubation to suppress laryngeal reflexes other forms of intraop stimulation like placement of pins, skin incision.
- Esmolol infusion / bolus may be used to reduce HR & BP response to DLscopy & intubation.
- Sustained hypotension must also be avoided (ischemia due to decreased CPP).

- Patient's lungs are ventilated at a rate & tidal volume that maintain PaCO₂ near 35 mm Hg.
- Routine hyperventilation no longer recommended in neurosurgical patients due to risk of ischemia in some pathologic conditions. (surgical conditions should define PaCO₂ level for each pt).
- Eg, in pts with significant intracranial HTN / using volatile agents, PaCO₂ adjusted btwn 30-35 mmHg to reduce brain bulk.
- PEEP should be used with caution, attention paid to ICP, MAP & CPP effects.

MUSCLE RELAXANTS

SUCCINYLCHOLINE

- **succinylcholine causes** activation of EEG & increases in CBF / ICP.
- Pts with compromised intracranial compliance, scoline shown to increase ICP.
- Not recommended for elective cases; but remains best agent for achieving total paralysis for rapid-sequence intubation.
- In Hemiplegic /paraplegic pt, scoline avoided due to risk of hyperkalemia.

NONDEPOLARISING RELAXANTS

- Agents that release histamine avoided (Histamine alone may lower BP & increase ICP, thus lowering CPP).
- When BBB disrupted, histamine can produce cerebro vasodilation & increases in CBF.
- Most **benzylisoquinolinium** compounds (d-tc, metocurine, atracurium, mivacurium) potential to release histamine.
- **Cisatracurium** produce minimal /no histamine release.
- **Steroidal agents** (pancuronium, pipecuronium, vecuronium & rocuronium) may be better relaxants (do not directly affect ICP).
- **Pancuronium** does not produce an increase in CBF, CMRO₂, ICP.
- However, pancuronium's vagolytic effects can increase HR & BP, & elevate ICP in pts with disturbed autoregulation.
- **Vecuronium and rocuronium** has no effect on ICP, HR/BP in neurosurgical pts.

POSITIONING

- Frontal, temporal, and parietooccipital craniotomies are performed in the supine position.
- The head is elevated 15–30° to facilitate venous and CSF drainage.
- The head may also be turned to one side to facilitate exposure.
- Excessive flexion or rotation of the neck impedes jugular venous drainage and can increase ICP.
- Before and after positioning, the tracheal tube should be secured, and all breathing circuit connections checked.
- The risk of unrecognized disconnections may be increased because the patient's airway will not be easily assessed after surgical draping;
- Moreover, the operating table is usually turned 90° or 180° away from the anesthesiologist.

MAINTENANCE

- Anesthesia can be maintained with inhalation anesthesia, total intravenous anesthesia techniques (TIVA), or a combination of an opioid and intravenous hypnotic (most often propofol) and a low-dose inhalation agent.
- Even though periods of stimulation are few, neuromuscular blockade is recommended— unless neurophysiological monitoring contradicts its use to prevent straining, bucking, or movement.
- TIVA with remifentanyl and propofol facilitates rapid emergence and immediate neurological assessment.
- Hyperventilation should be continued intraoperatively to maintain P_{aCO_2} at roughly 30–35 mm Hg
- Positive end-expiratory pressure (PEEP) and ventilatory patterns resulting in high mean airway pressures (a low rate with large tidal volumes) should be avoided because of a potentially adverse effect on ICP

- Nitrous oxide & volatile anesthetics potential to increase CBV & ICP as result of direct cerebral vasodilation.
- In elevated ICP / low compliance, better avoid nitrous oxide / high conc of isoflurane ($> 1.0\%$).
- Peripheral vasodilating drugs (nitroprusside/nitroglycerin), may increase CBV & ICP despite decrease in SBP (best used after craniotomy & opening dura).
- Spontaneous movement by pts must be prevented (dangerous increases in ICP/herniation/bleeding).
- In addition to adequate depths of anesthesia, skeletal muscle paralysis maintained.

EMERGEN CE

Neurologically intact preop & uneventful Intraop

- Smooth emergence
- No coughing or straining

Neurologically compromised & extensive manipulations

- Also if there is facial or neck swelling
- Continue intubation & ventilation

Causes of Delayed Awakening

1. Preoperative low GCS
2. Large tumour
3. Residual anesthetics
4. Metabolic / electrolyte disturbances
5. Residual hypothermia
6. Pneumocephalus
7. Vessel occlusion/ischemia

- Emergence from anesthesia should be as smooth as possible, avoiding straining/ bucking.
- Bucking can cause HTN & elevated ICP, leading to postop hge & cerebral edema.
- IV lidocaine (1.5 mg/kg) 90 seconds before suctioning & extubation .
- Extubated only when fully reversed or awake & following commands. If not responsive, not extubated and considered for elective ventilation.
- Brief neurologic exam performed before & after extubation.
- Pt positioned with head elevated 15-30°, shifted to recovery room with oxygen by mask & SpO2 monitoring.

ICP

- ICP monitoring is rarely used in patients for elective supratentorial tumor operations.
- ICP monitoring is invasive procedure that can cause bleeding or infection.
- Measurement of optic nerve sheath diameter through ultrasound is a non invasive means to detect elevated ICP.
- This is usually measured 3 mm behind the globe with 2–3 measurements taken in each eye.
- The threshold for denoting elevated ICP usually ranges from 0.48 cm to 0.63 cm

MEASURES TO REDUCE ICP

Diuretics:

- Osmotic: Mannitol (0.25-1 g/kg iv), hypertonic saline.
- Furosemide: 0.5-1 mg/kg iv, or 0.15-0.3 mg/kg with mannitol.

Corticosteroids:

- Dexamethasone (localized cerebral edema surrounding tumors; requires 12-36 hrs).

Adequate ventilation:

- PaO₂ 100 mmHg, PaCO₂ 33-35 mmHg.

Optimize hemodynamics

- (MAP, CVP, PCWP, HR): normotension, maintain CPP .

Fluid therapy: Normovolemia before induction - prevent hypotension.

Position improve cerebral venous return (neutral, head-up position).

Drug-induced cerebral vasoconstriction (e.g., thiopental, propofol).

Temperature control.

CSF drainage to acutely reduce brain tension.

CLINICAL CONTROL OF RAISED ICP

&

- Severe intracranial HTN - reflex arterial hypertension bradycardia (Cushing's triad).
- Reduction in SBP can further aggravate ischemia (reducing CPP).
- Rapid brain dehydration & ICP reduction produced by administering osmotic diuretic, mannitol / loop diuretic, furosemide.
- **PHARMACOLOGICAL METHODS:**
- **Mannitol:**
- Infusion 0.25-1.0 g/kg.
- Action begins within 10-15 mins, effective for approx 2 hrs.
- Larger doses produce a longer duration of action but do not necessarily reduce ICP more effectively (metabolic derangement).
- Mannitol is effective when the blood-brain barrier is intact.

- By increasing osmolality of blood relative to brain, pulls water across intact BBB from brain to blood to restore the osmolar balance.
- Mannitol-induced vasodilation affects intracranial & extracranial vessels & can transiently increase CBV & ICP while simultaneously decreasing SBP.
- Hence should be given slowly (10-minute infusion) in conjunction
 - with maneuvers that decrease ICP (steroids / hyperventilation).
- Prolonged use of mannitol may produce
 - 1.dehydration,
 - 2.electrolyte disturbances,
 - 3.hyperosmolality,
 - 4.impaired renal function.

HYPERTONIC SALINE

- Alternative /adjunct to mannitol.

Potential Adverse Effects of IV Administration

- | | |
|--|----------------------------|
| 1.Decreased level of consciousness | 8. Hyperchloremic acidosis |
| 2.Hyperosmotic Hyponatremia | 9. Coagulopathy |
| 3.Seizures | 10. Rebound edema |
| 4.CHF | 11. Phlebitis |
| 5.Central pontine myelinolysis | 12. Renal failure |
| 6.Hypokalemia | |
| 7.Subdural & intraparenchymal hemorrhage | |

FUROSEMIDE

- better agent in pts with impaired cardiac reserve.
- Loop diuretic : reduces ICP by inducing systemic diuresis, decreasing CSF production & resolving cerebral edema by improving cellular water transport.
- lowers ICP without increasing CBV or blood osmolality; but not as effective as mannitol.
- Can be given alone, initial dose (0.5-1 mg/kg) or lower dose with mannitol (0.15-0.30 mg/kg).
- combination of mannitol & furosemide diuresis more effective than mannitol alone in reducing ICP & brain bulk but causes more severe dehydration & electrolyte imbalances.
- Thus necessary to monitor electrolytes intraop & replace K as indicated.

CORTICOSTEROIDS

- reduce edema around tumors; require many hrs/days before reduction in ICP.
- Steroids preop frequently cause neurologic improvement that precede ICP reduction.

Postulated MOA for steroidal reduction in brain edema

- 1.brain dehydration,
- 2.BBB repair,
- 3.prevention of lysosomal activity,
- 4.enhanced cerebral electrolyte transport,
- 5.improved brain metabolism,
- 6.promotion of H₂O & electrolyte excretion,
- 7.inhibition of phospholipase A₂ activity.

NON PHARMCOLOGICAL METHODS

- **HYPERVENTILATION:**
- Reduces brain volume by decreasing CBF through cerebral vasoconstriction.
- For every 1 mm Hg change in PaCO_2 , CBF changes by 2 mL/100 g/min.
- Duration of effectiveness for lowering ICP as short as 4-6 hrs, depending on pH of CSF.
- Only effective when CO_2 reactivity of cerebrovasculature intact.
- Impaired responsiveness to changes in CO_2 in areas of vasoparalysis (associated with ischemia, trauma, tumor & infection).
- Target PaCO_2 is 30-35 mmHg.
- Therapeutic effectiveness of hyperventilation determined by monitoring global cerebral oxygenation with SjVO_2 .

FLUID THERAPY

1. Avoid hypovolemia.
 2. Avoid hypotonic solutions
 3. Colloids
 4. Blood.
 5. Avoid over-transfusion
- In pts who are dehydrated since preop, IV volume must be restored to normal before induction to prevent hypotension.

- Relatively iso-osmolar solutions (NS, RL) do not adversely affect oedema (if intact BBB).
- Free water in hypo-osmolar solutions (0.45% NaCl) adversely affects ICP management.
- Hyper-osmolar solutions, 3% NaCl, initially tend to decrease ICP by increasing osmolarity of plasma.
- Regardless of solutions selected, any solution administered in large amounts can increase CBV & ICP.
- Blood loss should be corrected with PRBCs/ colloids supplemented with balanced salt solutions.
- Glucose-containing solutions should be used with caution since hyperglycemia, in CNS ischemia exacerbates neuronal injury.
- Replacement at approx 3:1 ratio (crystalloid:blood) to hct of approx 25-30%, depending on physiologic status.

POSITION

- Neutral head position, elevated 15-30° to decrease ICP by improving venous drainage.
- Flexing /turning of head may obstruct cerebral venous outflow (dramatic ICP elevation, resolves with neutral head position).

- **PEEP**

- Can increase ICP (increases mean intrathoracic pressure, impairing cerebral venous outflow & CO).
- If PEEP required to maintain SpO₂, applied cautiously & with appropriate monitoring to minimize decreases in CO & increases in ICP.

PEEP 10 cm H₂O < used without significant increases in ICP / decreases in CPP.

- If higher levels of PEEP required to optimize SpO₂, both CVP & ICP monitoring indicated.

TEMPERATURE

- Intraop, modest degree of hypothermia, approx 34°C, way to confer neuronal protection during focal ischemia.
- Hypothermic techniques are indicated for febrile neurosurgical patients.
- Hyperthermia particularly dangerous as it increases brain metabolism, CBF & cerebral edema.

CSF DRAINAGE

- To acutely reduce ICP, CSF drainage either by direct surgical puncture of lateral ventricle /lumbar spinal catheter employed.
- Lumbar CSF drainage used cautiously & only when dura open & pt mildly hyperventilated to prevent acute brain herniation.
- Brain tension can be effectively reduced by draining 10-20 mL of CSF.



- Therapeutic goals are to maintain CPP & control intracranial dynamics so that cerebral ischemia, edema, hemorrhage & herniation are avoided.
- Severe hypotension results in cerebral ischemia & should be treated with volume replacement, inotropes, or vasopressors as dictated by clinical need.
- Severe HTN, can worsen edema & cause IC hemorrhage & herniation.
- β 2-adrenergic blockers propranolol & esmolol , combined $\alpha\beta$ -adrenergic blocker labetalol effective in reducing SBP in pts with raised ICP with minimal or no effect on CBF / ICP.

VENOUS AIR EMBOLISM

1. Patients undergoing intracranial surgery are at increased risk
2. Early detection is important for successful treatment.
3. Doppler transducer placed over the right heart .
4. Most sensitive indicator of intracardiac air is TEE.
5. Sudden decrease in PCO_2 may reflect increased deadspace
6. Late signs: Hypotension, Tachycardia, Cardiac dysrhythmias, Cyanosis, Mill wheel murmur.

- **Treatment:**

- Irrigate operative site
- Apply occlusive material
- Aspiration of air through right atrial catheter
- Discontinue nitrous oxide
- Apply PEEP
- Require sympathomimetic drugs to improve MAP
- Beta-agonists if marked decreases in cardiac output
- Hyperbaric chamber if transfer can be accomplished within 8 hours

CHEMICAL BRAIN RETRACTOR CONCEPT

- Etco₂ between 25 and 29 mm Hg.
- Mild hyperoxygenation.
- Map around 100 mmhg
- Osmolar therapy with mannitol or 3%saline.
- Normovolemia.
- Elevation of head
- Minimal PEEP
- Maintaining adequate depth of anesthesia and muscle relaxation,
- Drainage of CSF
- Avoidance of brain retractors.

POST OP

- IC hematoma & major cerebral edema most feared complications.
- Adequate post operative analgesia is essential to shorten recovery.
- Opioid, Nsaids, gabapentin ,pregabalin etc are some of the options.

TRANS SPHENOIDAL SURGERIES

- Acromegaly, cushings syndrome – difficult intubation.
- Epinephrine application to decrease bleeding.
- Intense stimulation at the time of retractor placement.
- Blood and tissue debris in pharynx.
- Risk of hemorrhage associated with entry of cavernous sinus or internal carotid artery.
- Cranial nerve damage
- Propofol and N₂O- technique of choice.
- Pituitary hypofunction – diabetes insipidus



ANAESTHESIA FOR AWAKE CRANIOTOMIES

INTRODUCTION

- Awake Craniotomy is an operation performed same as a conventional craniotomy but the patient remains awake during the procedure.
- Aim to remove max amount of lesion without impairing neurological function has pushed physicians to develop sophisticated approaches performed in awake & responding pts, to evaluate neurological dysfunction before tissue removal.
- During this surgery, neurosurgeon performs cortical mapping to identify vital areas, that should not be disturbed while removing the tumour.

INDICATION

1. In a variety of brain tumours near eloquent cortex (e.g. gliomas, glioblastomas, metastasis)
2. Epilepsy surgery, deep brain stimulation (DBS) surgery, neuro-endoscopic procedures, ventriculostomy & excision of small lesions
3. Mycotic aneurysms and A-V malformations near critical brain areas

CONTRAINDICATIONS

- Absolute contraindication:

- Patient refusal/ Uncooperative/Low GCS
- Mental retardation
- Profound dysphasia/language problem
- Anticipated difficult intubation
 - Highly vascular lesions
 - Low occipital lobe lesions
 - Obstructive sleep apnoea
 - Children <10 years

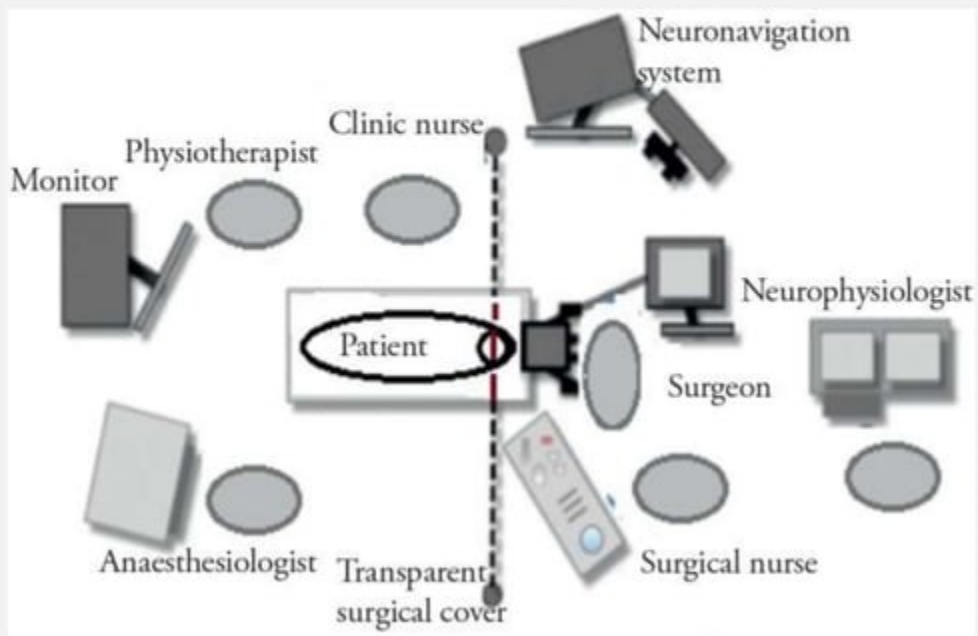
- Relative contraindication:

- Low tolerance to pain
- Chronic cough/wheezing
- Obese patients
- Uncontrolled seizures

- "Awake craniotomy" is misleading term, as different Sx phases require various levels of sedation & pt maintained completely awake only during mapping procedure & early resection of tumor.
- Preop selection, evaluation & preparation of pts is different than GA.
- Patient must be able to Co-operate and participate in neurocognitive testing.
- Must have uncomplicated airway,

CHALLENGES FOR THE ANAESTHETIST

- Like any craniotomy, adequate surgical exposure & brain relaxation required.
- Continuous, rapid modulation of sedation & analgesia level necessary to manage painful stimuli & cortical testing.
- Adequate analgesia & sedation needed for head frame application, skin incision, craniotomy & opening of dura.
- Of utmost importance, pt must be awake & alert during brain mapping, able to participate in complex neurocognitive testing.
- Vital functions to be ensured, emergency support if deterioration of clinical status occurs.
- Positioning : comfortably with bolsters & additional padding.



PREOP

- Careful patient selection is the major components of success
- • Well- motivated and mature patients are the best candidates for awake craniotomy
- • Preoperative psychological preparation and rapport building are the important components of preoperative preparation
- • This include realistic description of procedure, expected discomforts, level of cooperation desired, tasks that must be performed & possibility of adverse events

INTRA OP

- 3 major anaesthetic challenges for awake craniotomy:
 - 1. Provision of a rapid and smooth transition of the anaesthetic depth according to the different surgical stages.
 - 2. Maintenance of stable cerebral hemodynamic and cardiopulmonary function
 - 3. Crisis management for an awake patient with an open cranium.
- Over-sedation lead to apnea, hypoxemia, hypercapnia & cerebral swelling, whereas under-sedation may result in agitation, arterial hypertension & tachycardia
- The requirement regarding the depth of anaesthesia varies markedly at the different stages of surgery Intraoperative management

ANAESTHETIC PROTOCOLS



Neurolept anesthesia

Propofol +/- opioid infusions

Asleep, awake, asleep techniques using LMAS

MAC / conscious sedation technique, requires use of short acting anesthetic agents combined with LA during painful phases of Sx

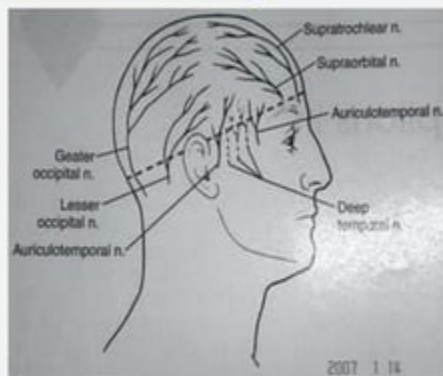
TECHNIQUE SELECTED REQUIRES

1. optimal analgesia during nociceptive stimulations
2. sedation/anxiolysis, immobility/comfort during mapping & resection
3. prevention of nausea, vomiting & seizures
4. Maintenance of airway & adequate ventilation
5. hemodynamic stability
6. brain relaxation

In asleep, awake, asleep techniques, initial phase of GA, with insertion of supraglottic airway device, followed by intraop awakening for language mapping during tumor resection & finally, back to GA during craniotomy closure.

REGIONAL BLOCK FOR AWAKE CRANIOTOMY

1. Supraorbital
2. Supratrochlear
3. Zygomaticotemporal
4. Auriculotemporal
5. Greater occipital
6. Lesser occipital



- In addition, line of scalp incision infiltrated with LA.
- Scalp blocks & infiltration with large volumes of LA carry potential of toxicity in patients
- Studies have shown LA absorbed rapidly & potentially toxic conc achieved in some pts.
- Total solution– 80ml 0.5% Bupivacaine – 40ml 2% Lidocaine – 20ml

Adrenaline – 100 mcg (in 4ml saline)

LANDMARKS

- a) Supraorbital & supratrochlear - above eyebrow at midpoint, needle inserted perpendicular to skin, & medial margin of orbit.
- b) Auriculotemporal - 1.5cm anterior to tragus, perpendicular to skin.
- c) Zygomatico temporal - midway between supraorbital ridge & post margin of Zygoma; deep infiltration within temporalis & fascia
- d) Post auricular branches(greater auricular) - 1.5 cm posterior to ear at level of tragus btwn skin & bone.
- e) Greater & lesser occipital- along superior nuchal line approx halfway between occipital protruberance & mastoid process;
- f) Remaining solution used to infiltrate pin sites & line of incision, 15 mins before procedure & lasts atleast 4-5 hours.

MAINTENANCE OF ANAESTHESIA

Propofol

- 1st choice hypnotic
- Can be administered using target control infusion
- With remifentanyl, which has very short $t_{1/2}$, rapid & fine modulation of sedation depth

Dexmedetomidine

- Highly specific α_2 adrenoreceptor agonist.
- Advantage of providing sedation & analgesia without respiratory depression.
- Provides sedation closer to natural sleep, anxiolysis & analgesia, decreasing need for opioids & antiHTN drugs.

α_2 agonist clonidine often used as analgesic co-adjuvant

ASLEEP-AWAKE-ASLEEP (AAA) TECHNIQUE

- It consists of 3 phases:
- 1 st phase under GA and controlled ventilation
- 2 nd phase, anaesthetics are discontinued and spontaneous ventilation is allowed to make the patient awake for functional & EP testing
- 3rd phase, GA is induced in the similar fashion as described in the first phase.
- A variant approach has been described consists of two-phase technique namely “AA technique” - the 2nd phase the patient remains awake or sedated for the rest of the procedure even after the testing is



INTRA OPERATIVE CORTICAL TESTING

- In lesions near motor cortex, electrical stimulation are used to test motor function & map area.
- With speech, considerable inter-patient variability in location & cortical representation of speech areas is seen.
- Intraoperative mapping of speech involves the identification of Broca's area by producing speech arrest with cortical stimulation, & other speech areas by a series of naming & word/sentence comprehension tests using books or slides.
- Computer programs available that allow dysphasic patients to respond to images.
- In pts who are fluent in >1 language, localization problematic as multiple representation sites.

INTRAOPERATIVE COMPLICATIONS

ANAESTHESIA RELATED

- Airway obstruction
- Desaturation/hypoxia
- Brain swelling
- Hypertension/hypotension
- Tachycardia/bradycardia
- Nausea/vomiting
- Shivering
- Local anaesthetic toxicity
- Pain
- Poor cooperation/agitation
- Conversion to G.A

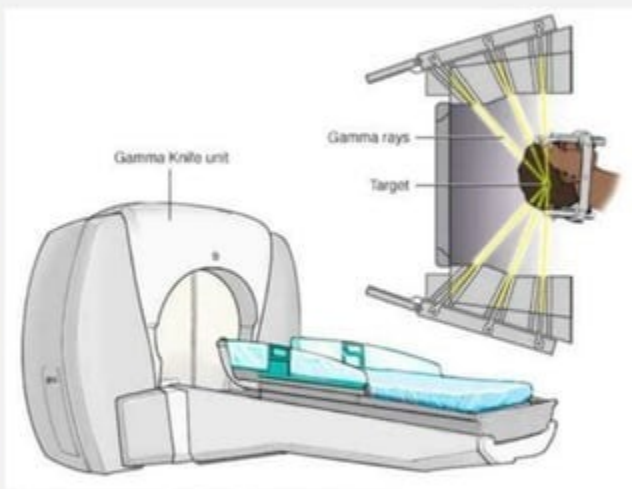
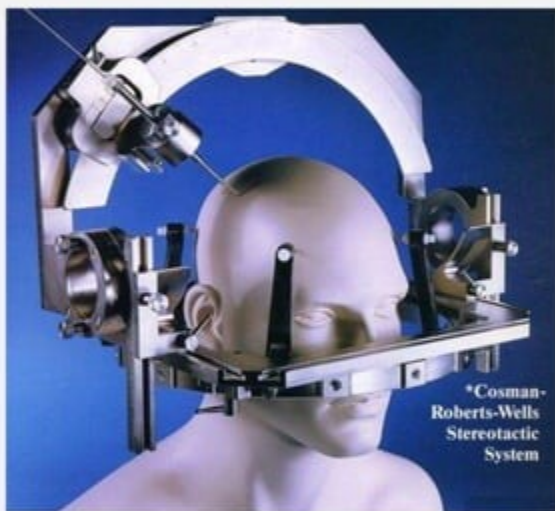
SURGICAL RELATED

- Focal seizures
- Generalized seizures
- Aphasia
- Bleeding
- Brain swelling
- Venous air embolism

STEREOTACTIC PROCEDURES

- A stereotactic brain surgery is a surgical procedure where lesion, frequently a brain tumor, is removed with assistance of image guidance
- **INDICATIONS:**
 1. biopsy of small, deep seated lesions.
 2. placement of deep brain stimulation electrodes (for the treatment of movement disorders)
- Procedures related to movement disorders most often target the subthalamic nucleus, the internal segment of the globus pallidus, or the ventral intermediate nucleus of the thalamus
- Preoperative evaluation should include ensuring that the coagulation process is intact and that the patient is not taking platelet-inhibiting agents
- **Airway access** : The stereotactic frame, will prevent mask application and ventilation, laryngoscopy, and neck extension

- **The effect of anesthetics on microelectrode recordings:**
- Benzodiazepines have the greatest potential to interfere and are best avoided.
- Propofol has been reported to cause severe dyskinesias in patients with movement disorders, but is used quite frequently.
- Window period between propofol administration and recording should be planned.
- Dexmedetomidine in low doses does not interfere with signals, hence used
- Remifentanyl also can be used.
- **Intracerebral hematoma and hypertension:**
- Because of multiple needles passing through the brain, hypertension will precipitate development of an intracerebral hematoma.
- In the event of a substantial hematoma, an urgent craniotomy may be required, and the anesthesiologist should be prepared from the outset for this eventuality
- Venous Air Embolism



SUMMARY

- Supra tentorial surgeries require global maintenance of metabolic, cardiovascular, and respiratory stability.
- Balancing CBF autoregulation and MAP and preserving cerebral vasoreactivity to PaCO₂.
- Achieving and maintaining brain relaxation.
- Awake craniotomy is a complex technique that requires good patient and equipment engagement.
- Timely awakening to facilitate early and ongoing neurologic assessment and treatment of complications is necessary.
- Personal experience, careful planning, and attention are the basis for obtaining good results.

REFERENCES

- Miller's Anesthesia, Eighth Edition.
- Manual of NeuroAnaesthesia Scott L. Mears, M.D., and Richard j.Sperry, M.D.
- ANAESTHETIC MANAGEMENT OF SUPRATENTORIAL INTRACRANIAL TUMOURS G.S. Umamaheswara Rao. Nimhans

DNB QUESTIONS

1. Management of ICP in a patient posted for supratentorial surgeries.
2. Short notes on awake craniotomy
Transphenoidal surgeries

THANK YOU