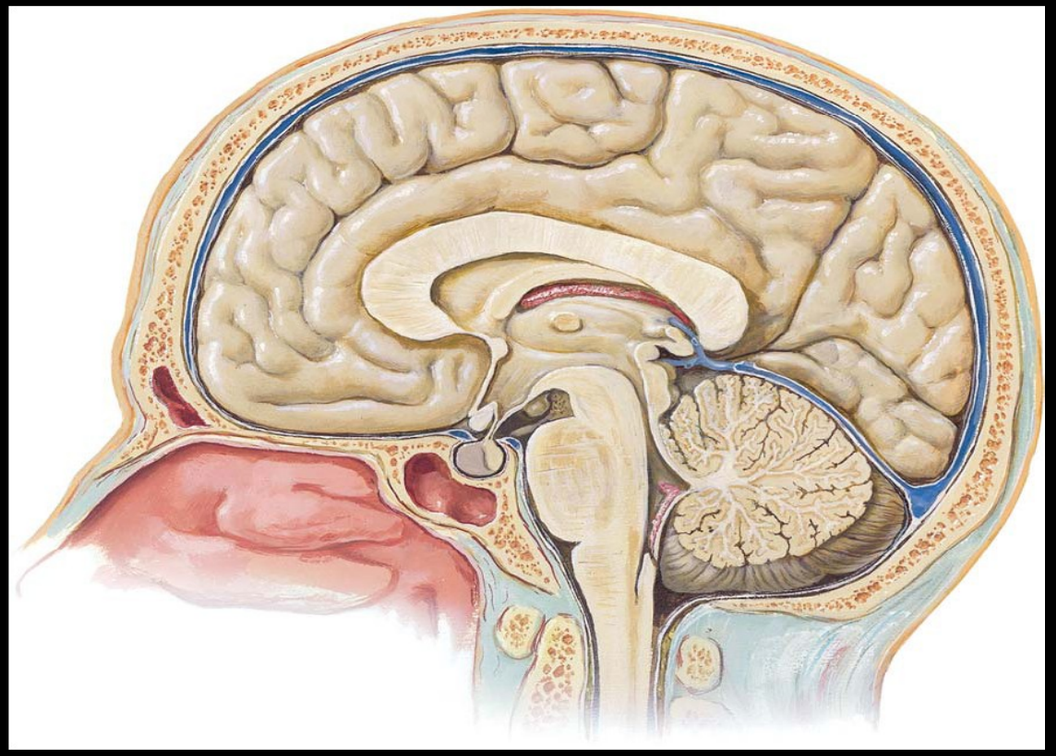
Posterior fossa tumors, Anesthetic management & special problems

Moderator : Dr. M. P. Pandia

Presenter : Dr. Praveen. Talawar
Dr. Bijay Kumar

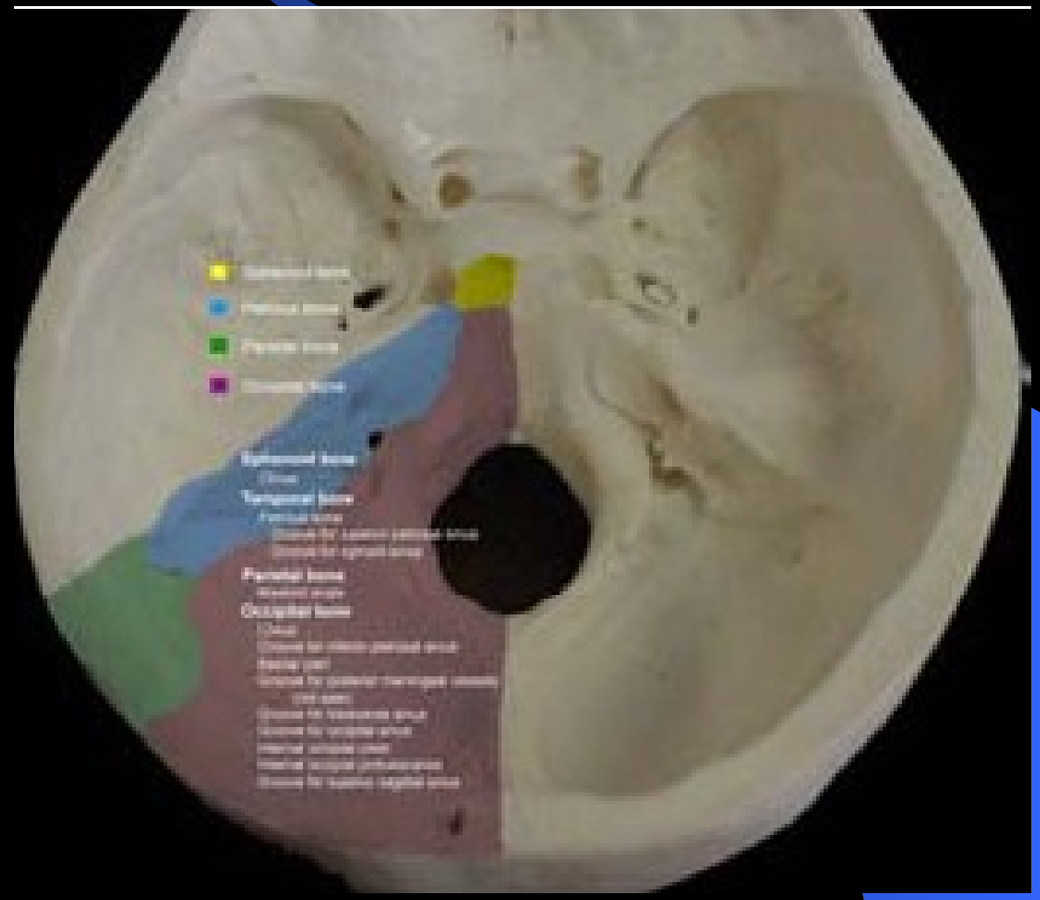
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Boundaries of Posterior Fossa

- Ant – Clivus
- Post – Occipital Bone
- Lat – Temporal Bone
- Floor – Occipital bone
  - Foramen magnum
  - Roof - Tentorium cerebelli

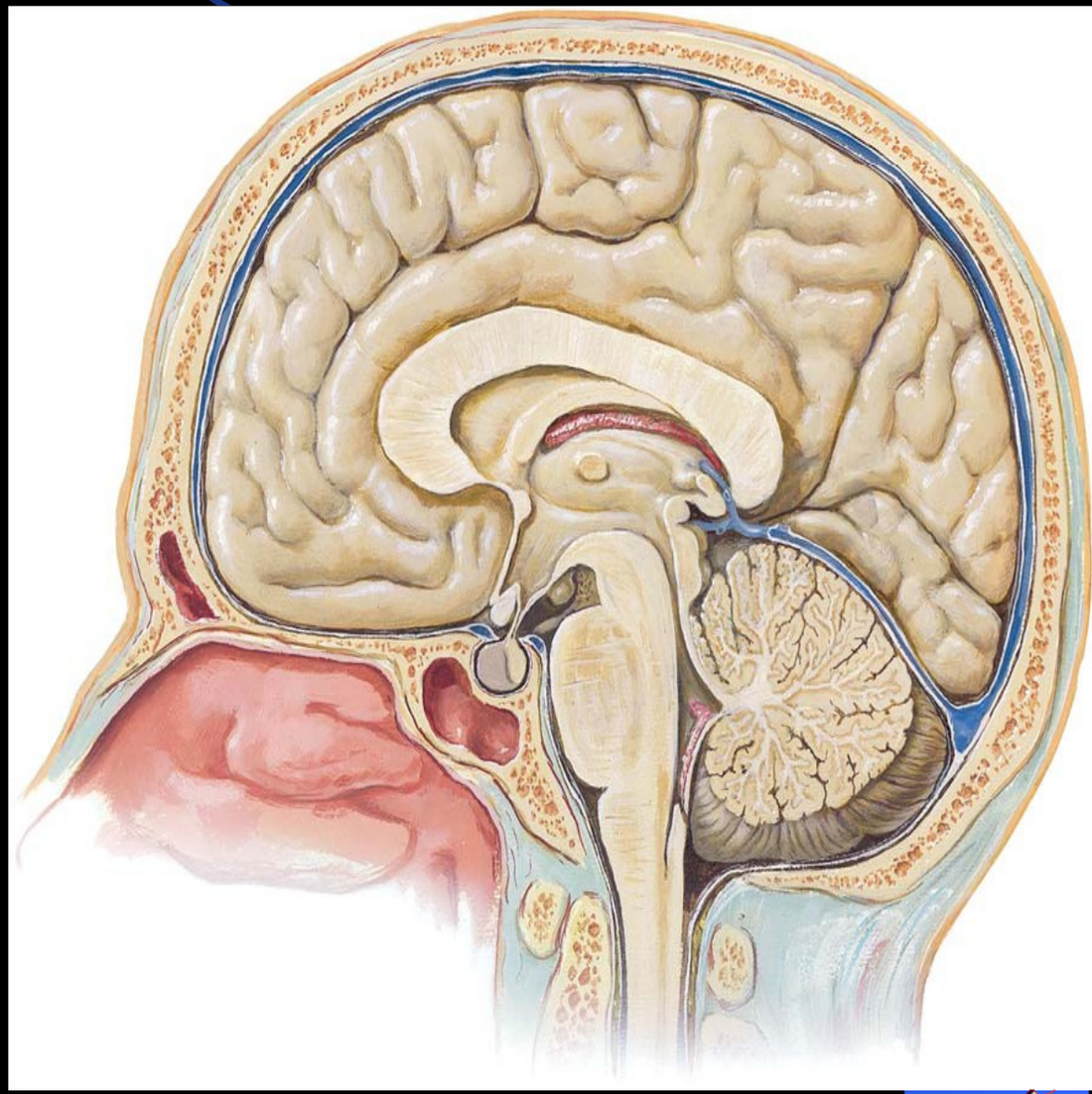


Contents

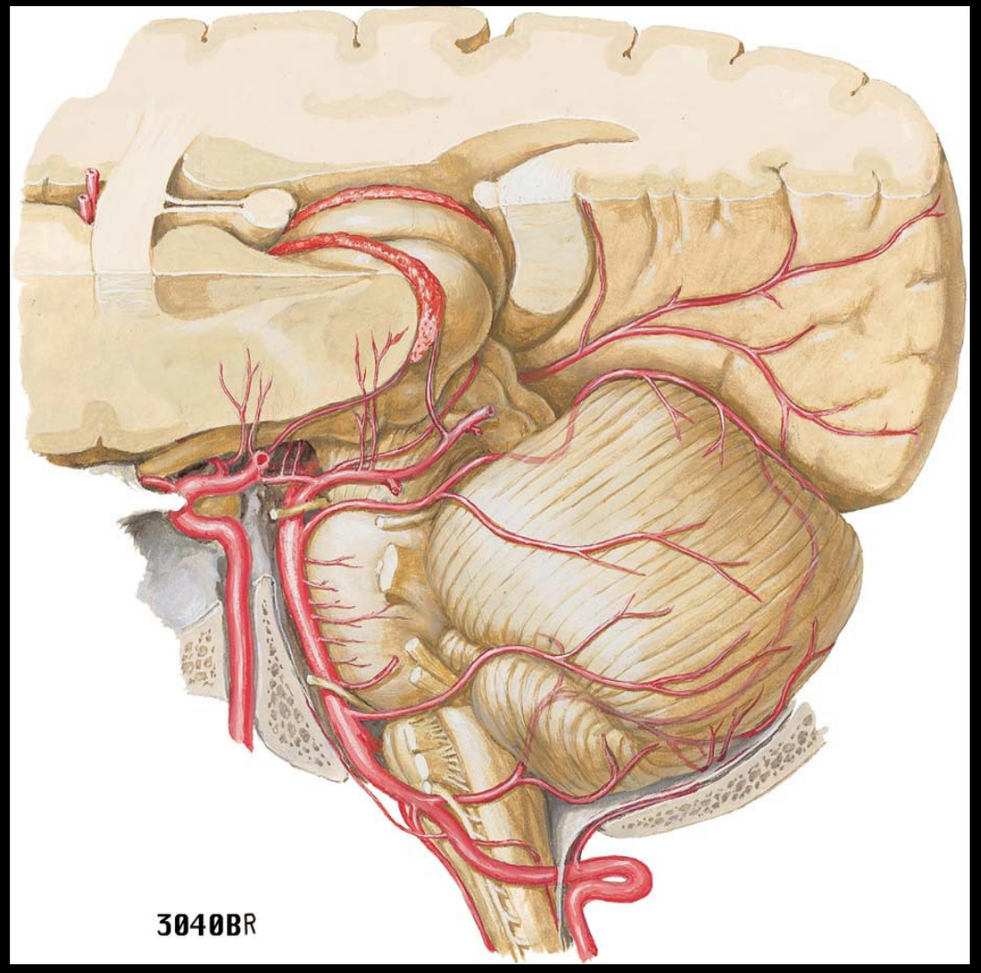
- Neural structure
- CSF
- Artereries and veins
- Venous Sinuses

Contents – neural structures

- Brainstem
  - major sensory and motor pathways
  - vital centers
  - midbrain, pons and medulla
- Cerebellum
- Cranial nerves V-XII

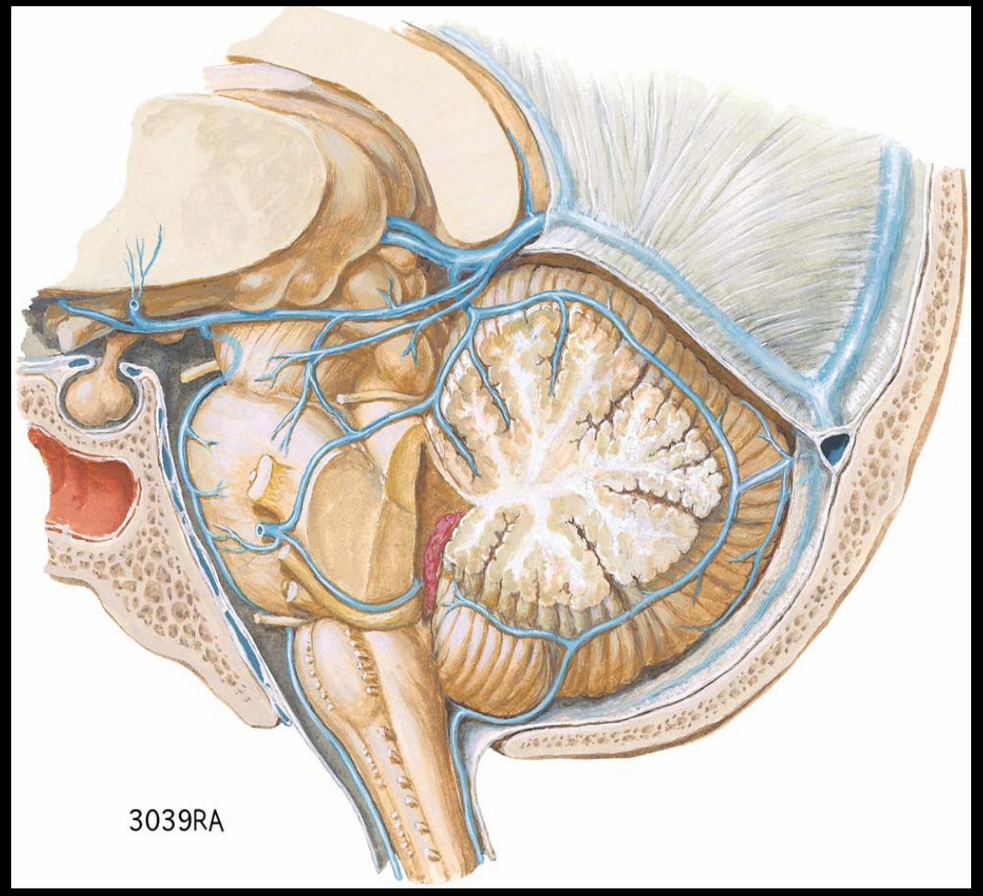


Blood vessels



- Posterior inferior cerebellar artery
- Anterior inferior cerebellar artery
- Superior cerebellar artery.

Venous drainage



The veins of the posterior fossa

drain the cerebellum and

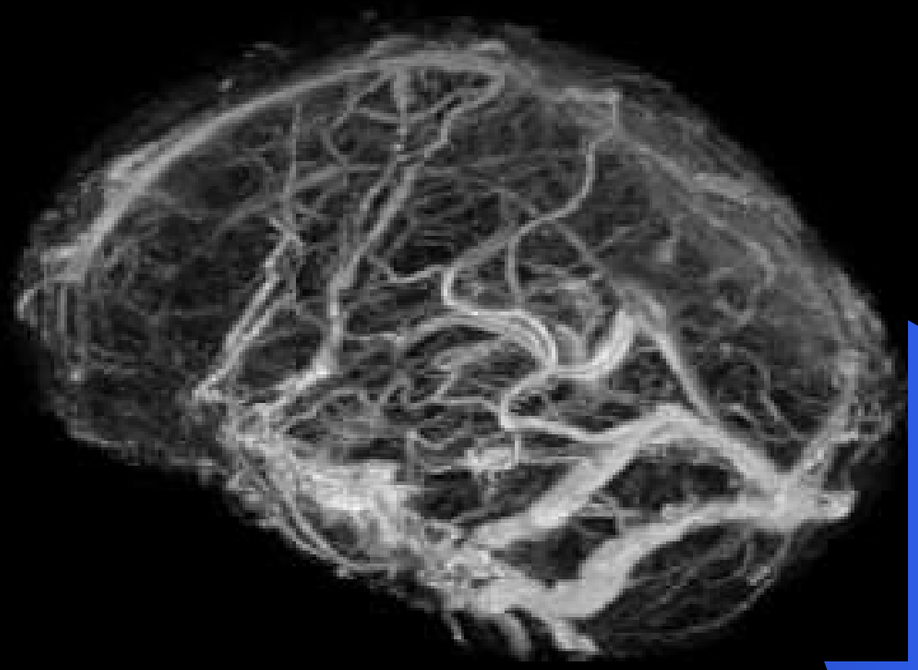
brainstem.

The major venous structures include:

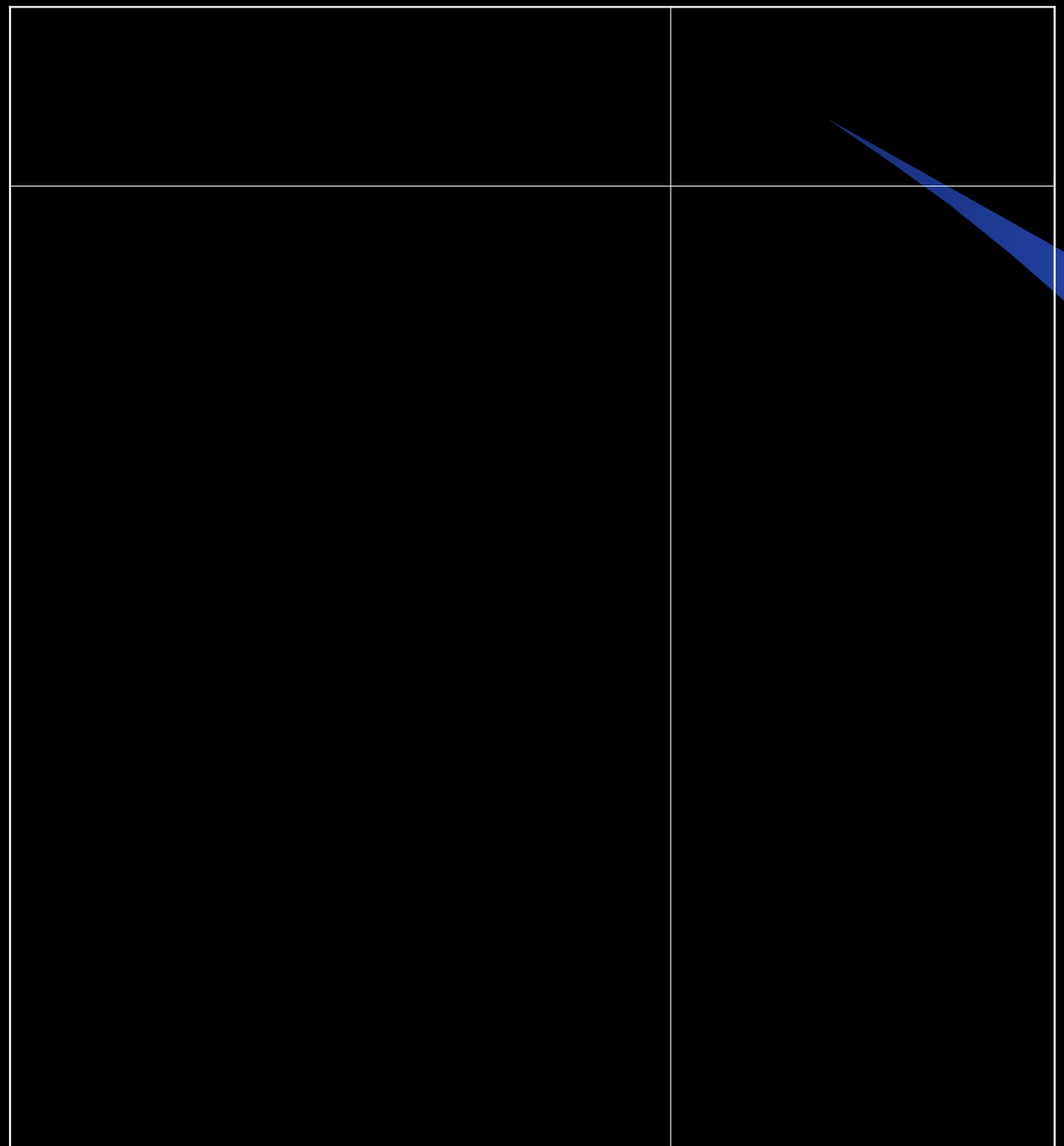
- The venous sinuses (straight, lateral, occipital, superior petrosal, left and right transverse)
- Great vein of Galen
- Petrosal vein.

- Large Venous Sinuses
  - Bleeding problem

  - Air entrainment



Tumors in the posterior fossa



Positioning for posterior fossa surgeries

Principles

- Age
- Surgical requirement
- General fitness

Positioning

- Sitting
- Prone
- Lateral
- Park bench



Sitting position

- Introduced into clinical practice in 1913 by De Martel.
- First reported use – brain tumor surgery (LA)
- Use remains controversial



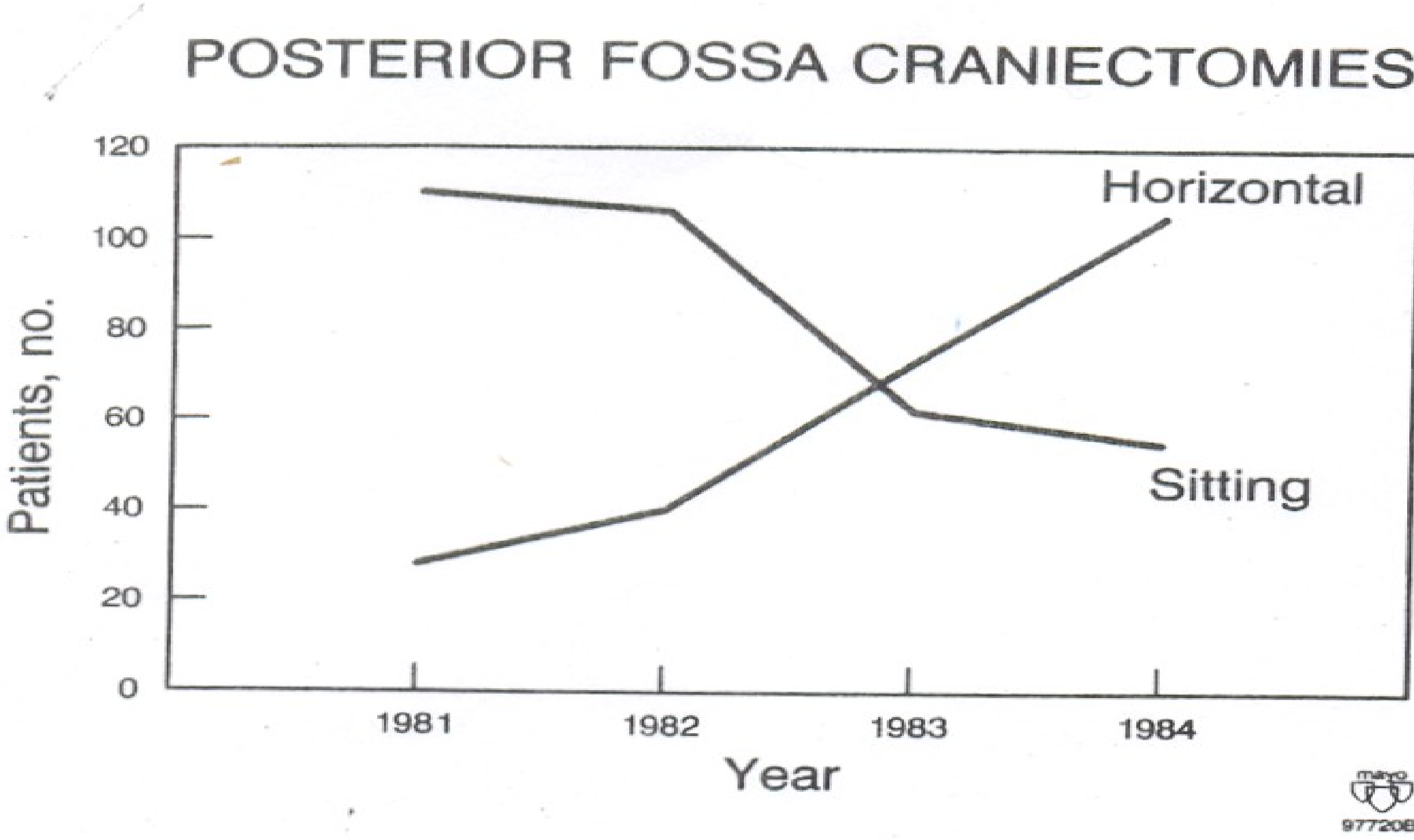


FIG. 1. Number of posterior fossa craniectomies by patient position by year.

Achieving sitting position

- Modified recumbent position – rather than truly sitting

- Legs are kept as high as possible
  (pillows under the knees)
  * to promote venous return

- Head holders- attached to the back portion of the table rather than to the portions under the thighs or legs




Takeuchi

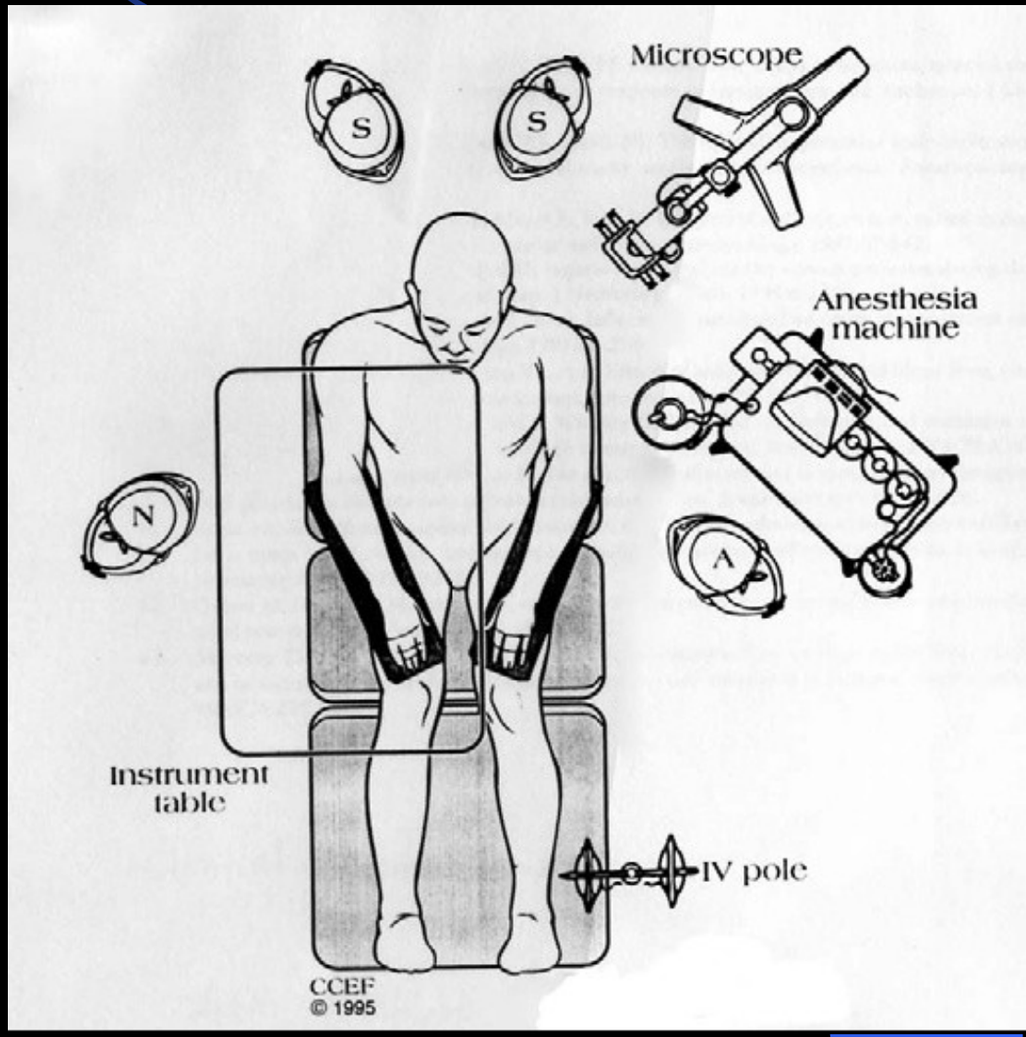
Sitting position – advantages to surgeon

- Optimum access to midline lesions
- Improved visibility
- Clear surgical field
- Promotes gravity drainage of blood & CSF
- Relaxed brain
  - Central venous decompression
  - Lower intracranial pressure

- Reduced cerebellar retraction

Sitting position – advantages to anesthesiologist

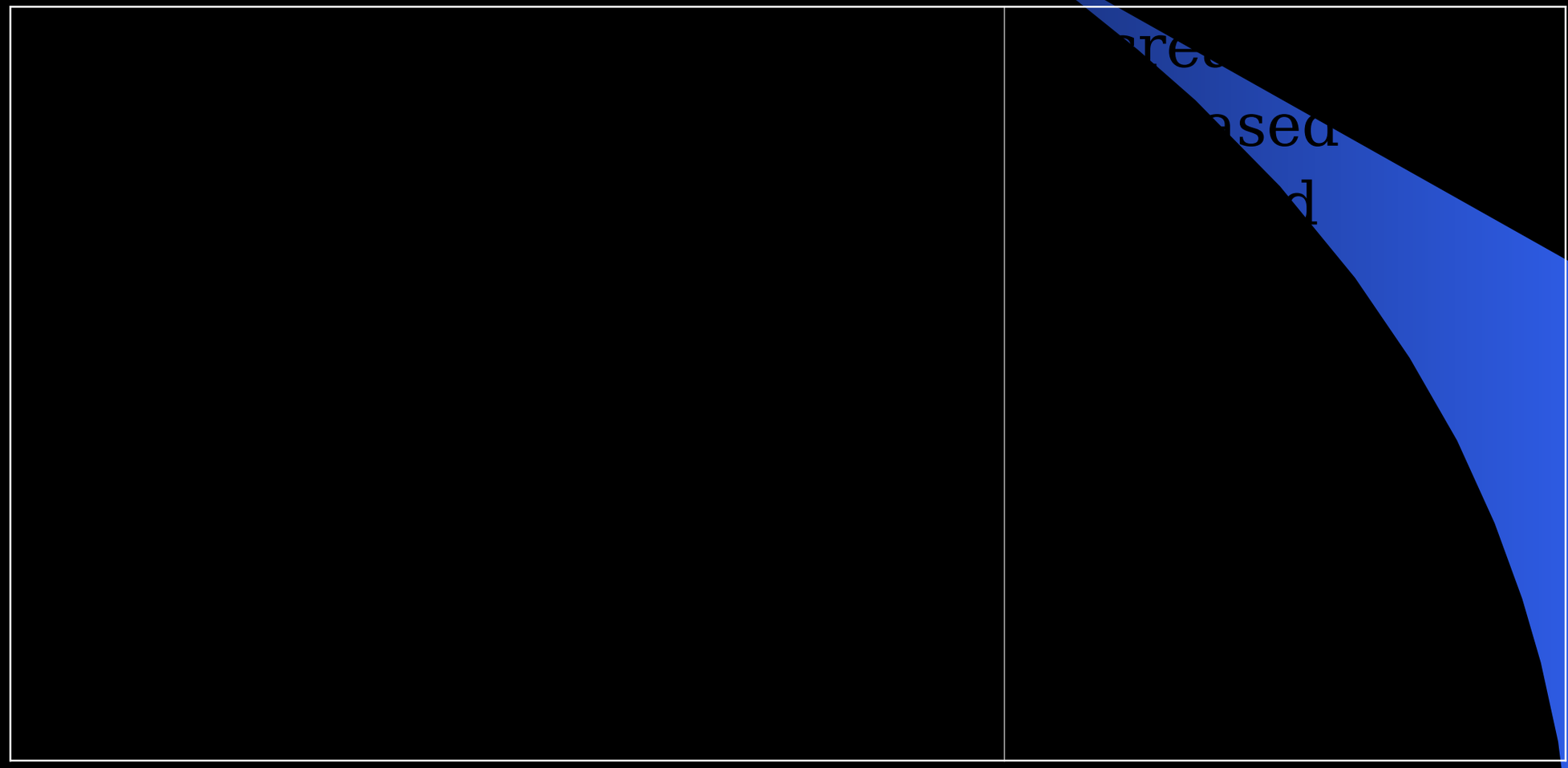
- Good access to chest & face
- Improved ventilation with lower airway pressures
- Easier for resuscitation



Advantages to the patient

- Decreased bleeding & reduced blood transfusion
- Avoidance of ophthalmic injury
- Improved post operative cranial nerve function compared to other positions

Physiological changes in sitting position - cardiovascular system



Physiological changes in sitting position –

Respiratory system

- ↓ FRC , → a/c reduction in perfusion→ Effect is

  nullified
- Unimpeded Ventilation – (greater diaphragmatic excursions)
- FEV1-unchanged,
- VAE is not associated with increased incidence of pulmonary dysfunction

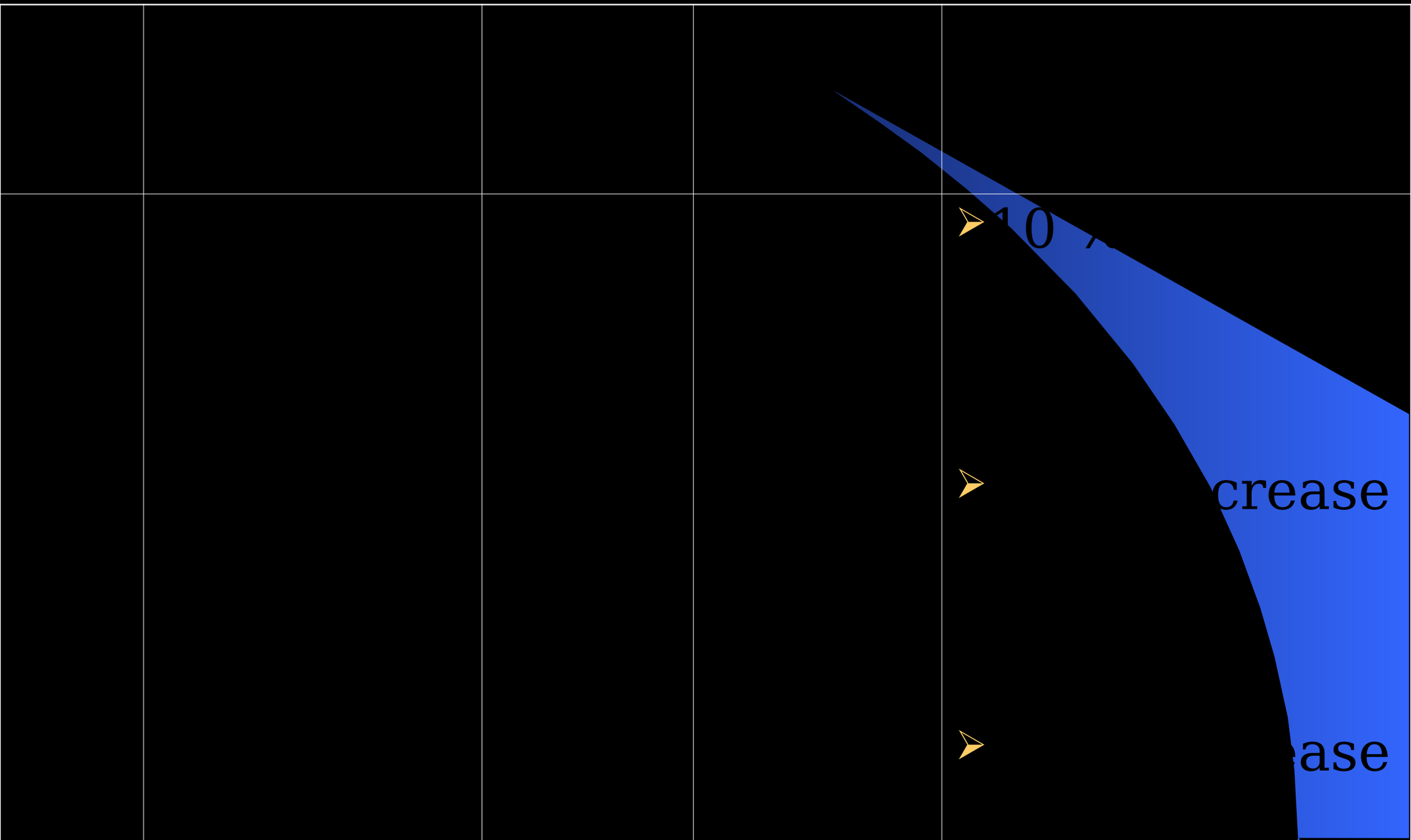
position – CNS changes

- Reduction in arterial and venous pressure - gravitational effect of head above the heart level.
- Arterial pressure is reduced by 0.77mm Hg for each cm. above the heart
- Inadequate cerebral perfusion
- Positioning of the arterial pressure transducer at the level of the mid- cerebrum - allows estimation of CPP

Sitting position - complications

- Hypotension
- Venous air embolism
- Paradoxical air embolism
- Tension- pneumocephalus
- Macroglossia
- Quadriplegia
- Peripheral nerve injuries

Hypotension - Incidence



Hypotension & reduced CPP

- Factors influencing the cardiovascular stability
  - Intravascular volume status
  - Mode of ventilation
  - Degree of head up tilt
  - Pre-existing hypertension

Hypotension & reduced CPP

- Upright position
- Depressant effects of IV induction & volatile agents on myocardial contractility
- Venous pooling after IPPV

Strategies to reduce hypotension

- Assuming the sitting position slowly – over 5-10 min
- Administration of IV fluids before sitting (CVP /PA guided)
- Compressive stockings
- Vasopressors

Venous air embolism

- The first fatality as a result of VAE in sitting position – recorded in 1830
- 50 years later – Dr. Senn (animal experiment)
  VAE produces death by “ mechanical over distension of the right ventricle of the heart…and asphyxia from obstruction to pulmonary circulation consequent upon embolism of the pulmonary artery”
- Proposed catheterization and aspiration of the right auricle

Venous air embolism - incidence

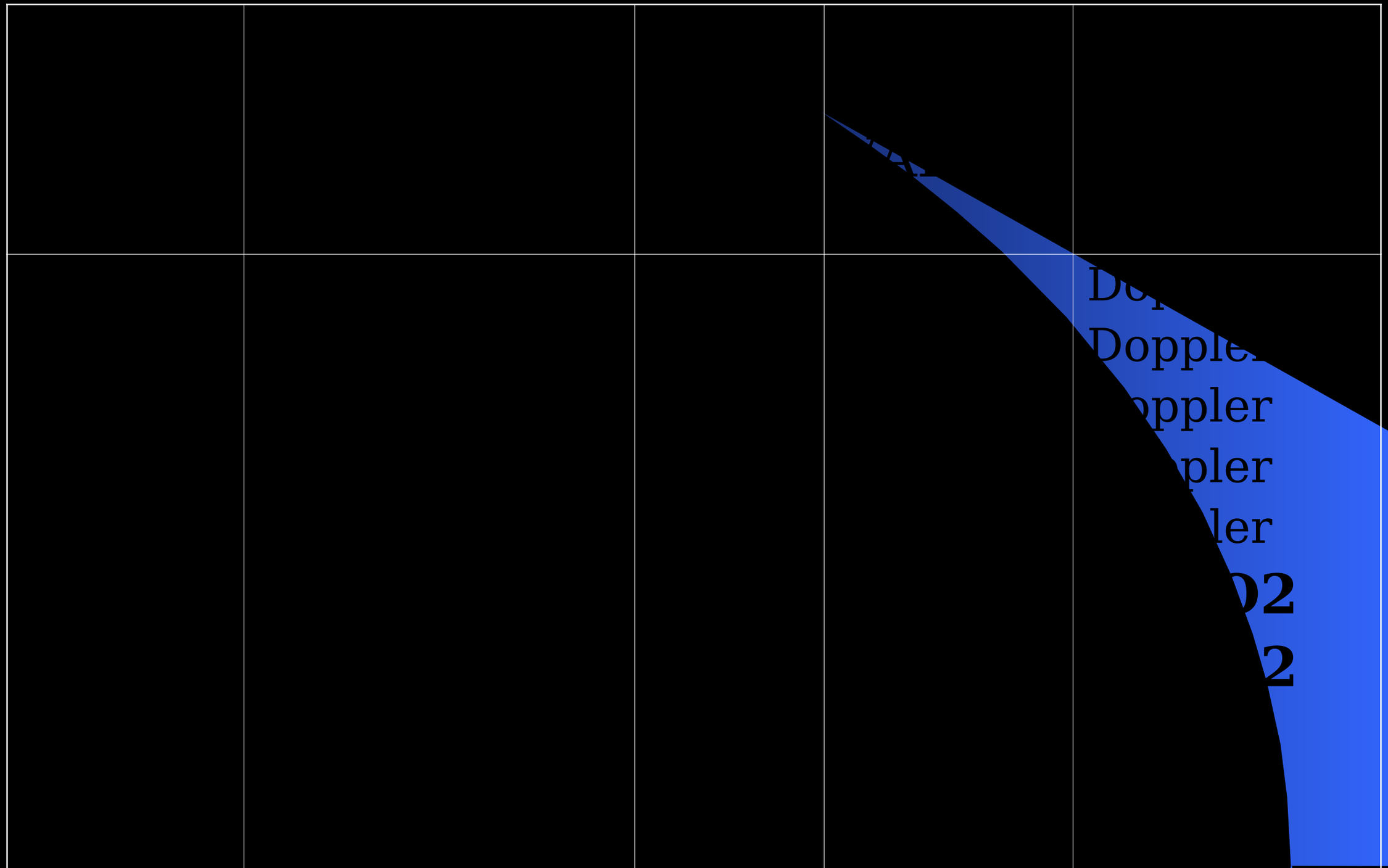
- Depends upon multiple factors
  - Sensitivity of monitoring
  - Height of the surgical site above the heart
  - Local factors– presence of venous plexuses

- Incidence

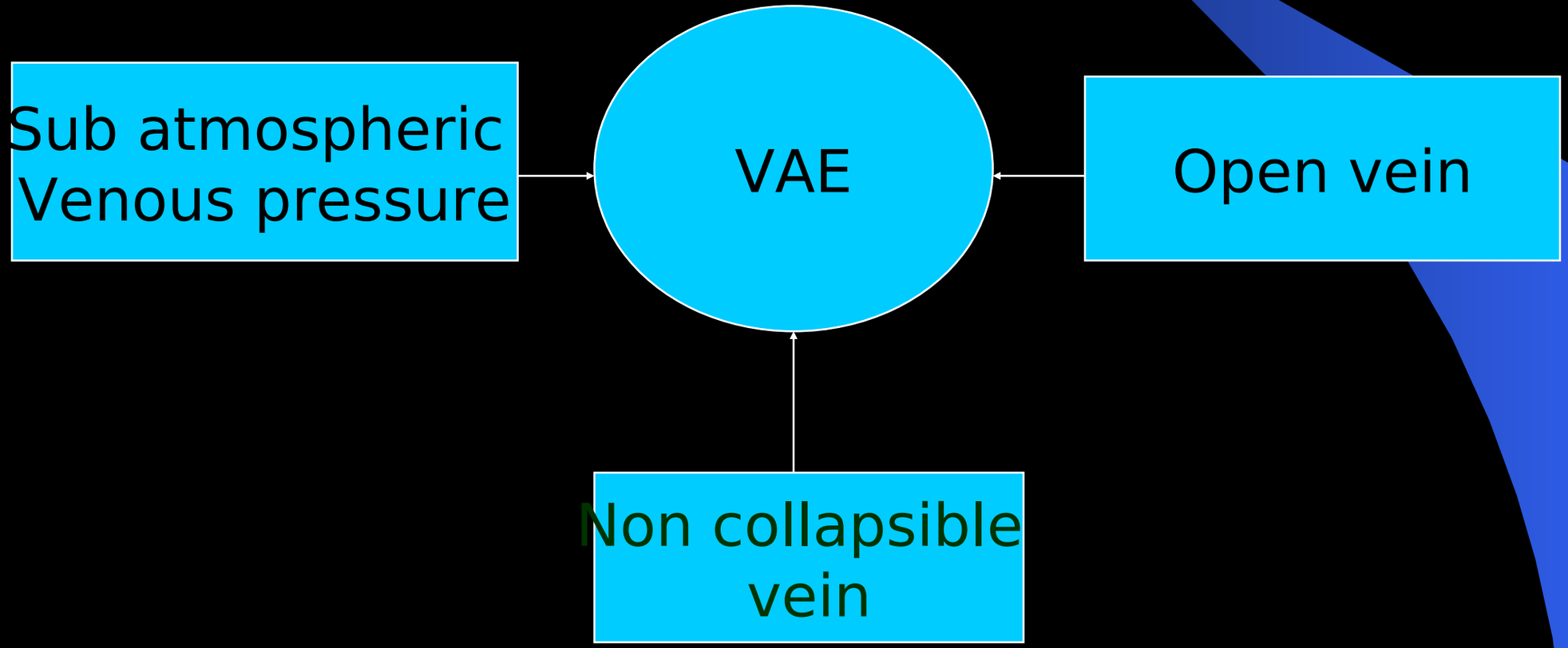
  Before TEE – 40%

  With TEE – 100 %

Incidence of VAE in sitting position



Pathophysiology of VAE

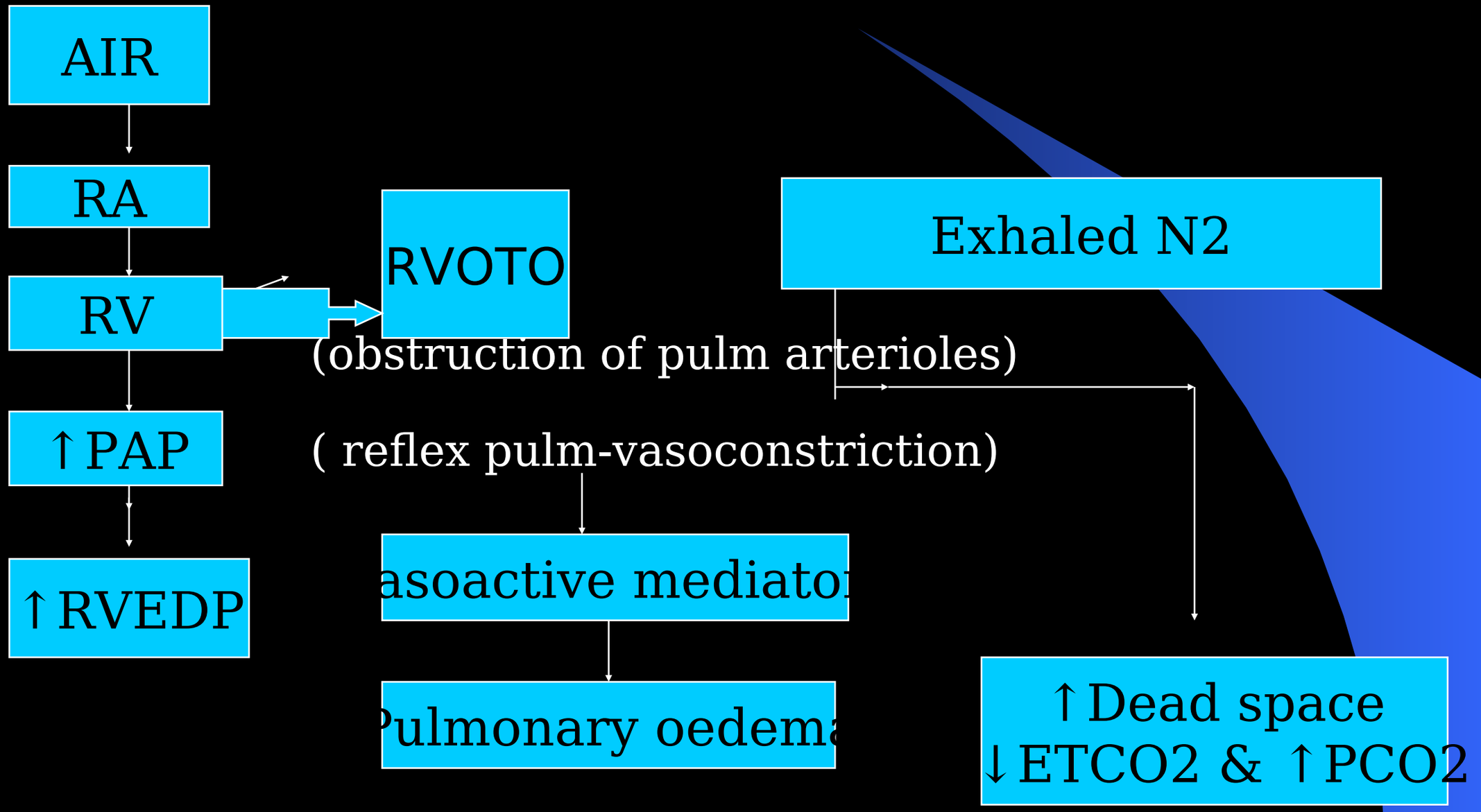


VAE- Pathophysiology

- Air sucked into the venous system may follow any of four paths

1. Classic venous air embolism
2. Paradoxical air embolism
3. Air collection in SVC
4. Trans-pulmonary passage of air

1.Classical venous air embolism



Paradoxical air embolism

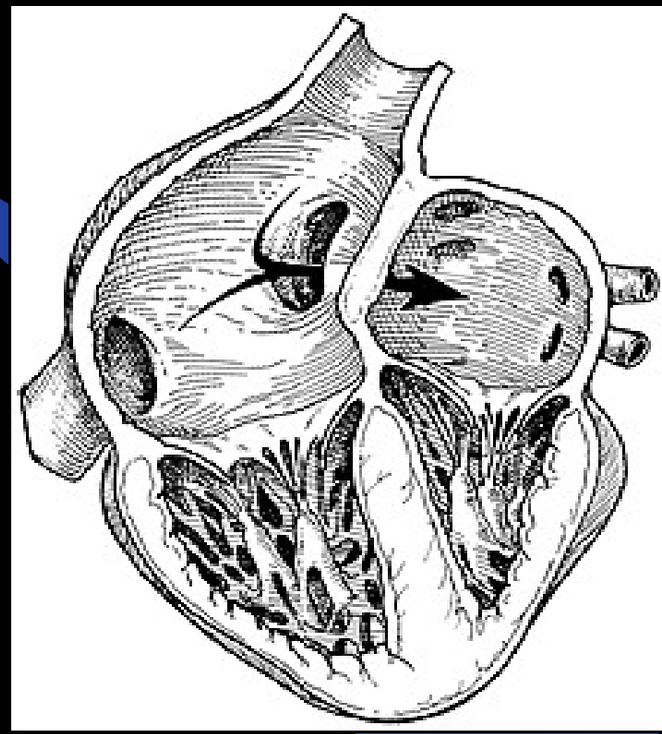
- During VAE air can enter the systemic circulation

  - Through PFO (25-35 % of population)

    Right to left shunt if RAP>LAP

    Up to 50 % of patients may develop reversal of shunt after 1 hr in sitting position

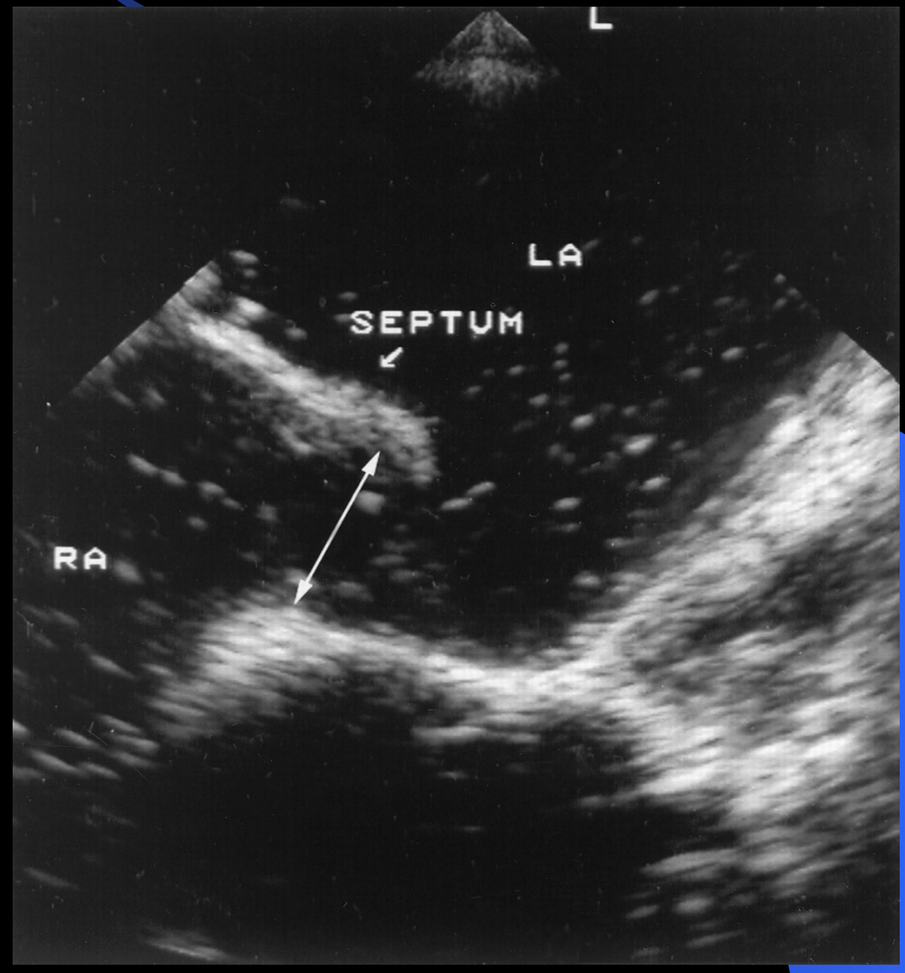
    Considering the incidence of PFO (25-35 %), VAE (100 %) and RAP>LAP (50 %) the estimated risk is 15 %



Reversal of shunt

If RAP exceeds LAP

- sitting up
- venous air embolism (↑PAP)
- hypovolemia
- PEEP

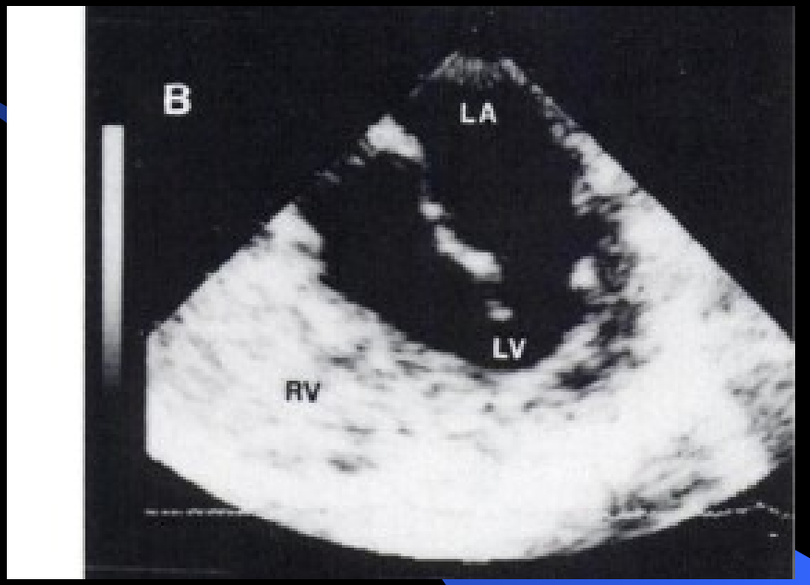


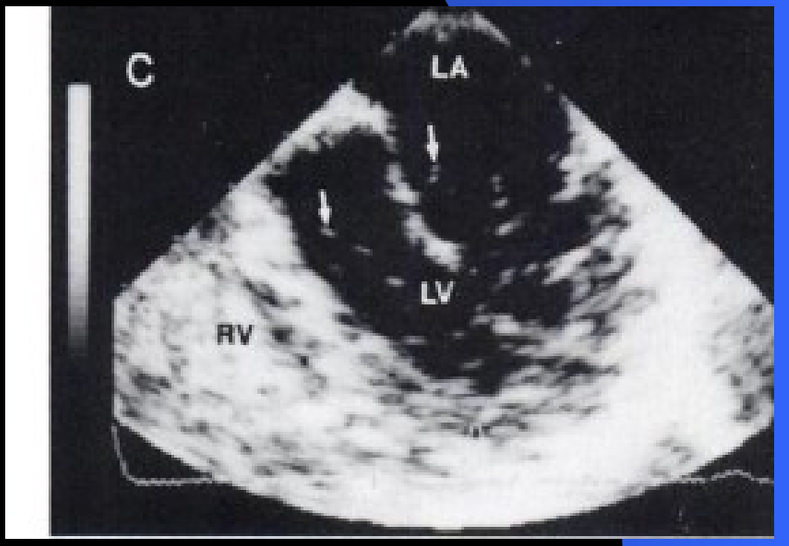
Can we prevent PAE ?

- PAE occurs following the severe grades of VAE only
- Early detection and prompt management to impede the expansion of VAE
- Chances of PAE cant be eliminated completely

Detection of PFO

- Transesophageal Echocardiography
  - Gold standard
  - Four chamber view
  - Contrast moves during release of PEEP
- TTE
  - Less sensitive
  - 6 %
- C -TCD





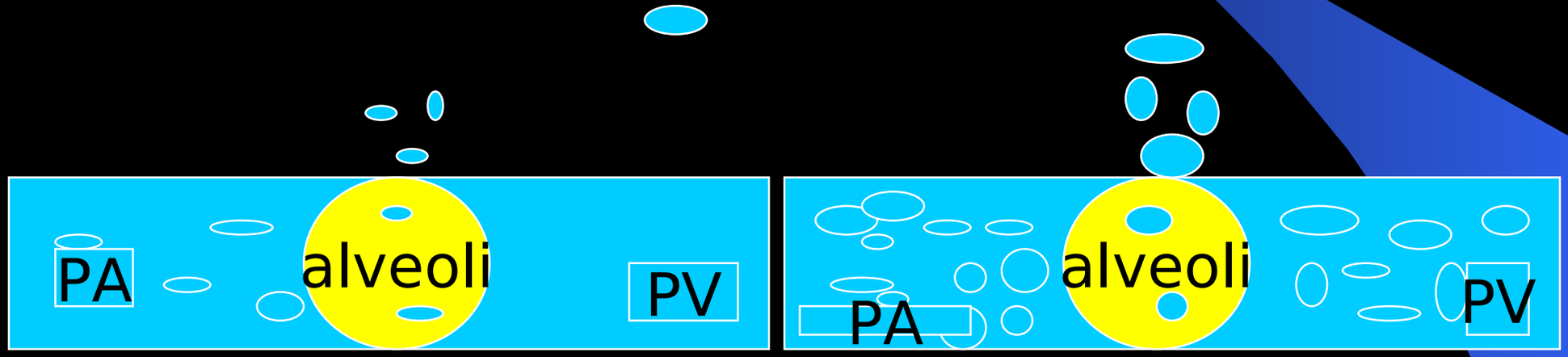
Air collection

- Air can collect in SVC-RA junction
- Displaced by patient movements, coughing
- All the monitoring for VAE be maintained until after return to supine position

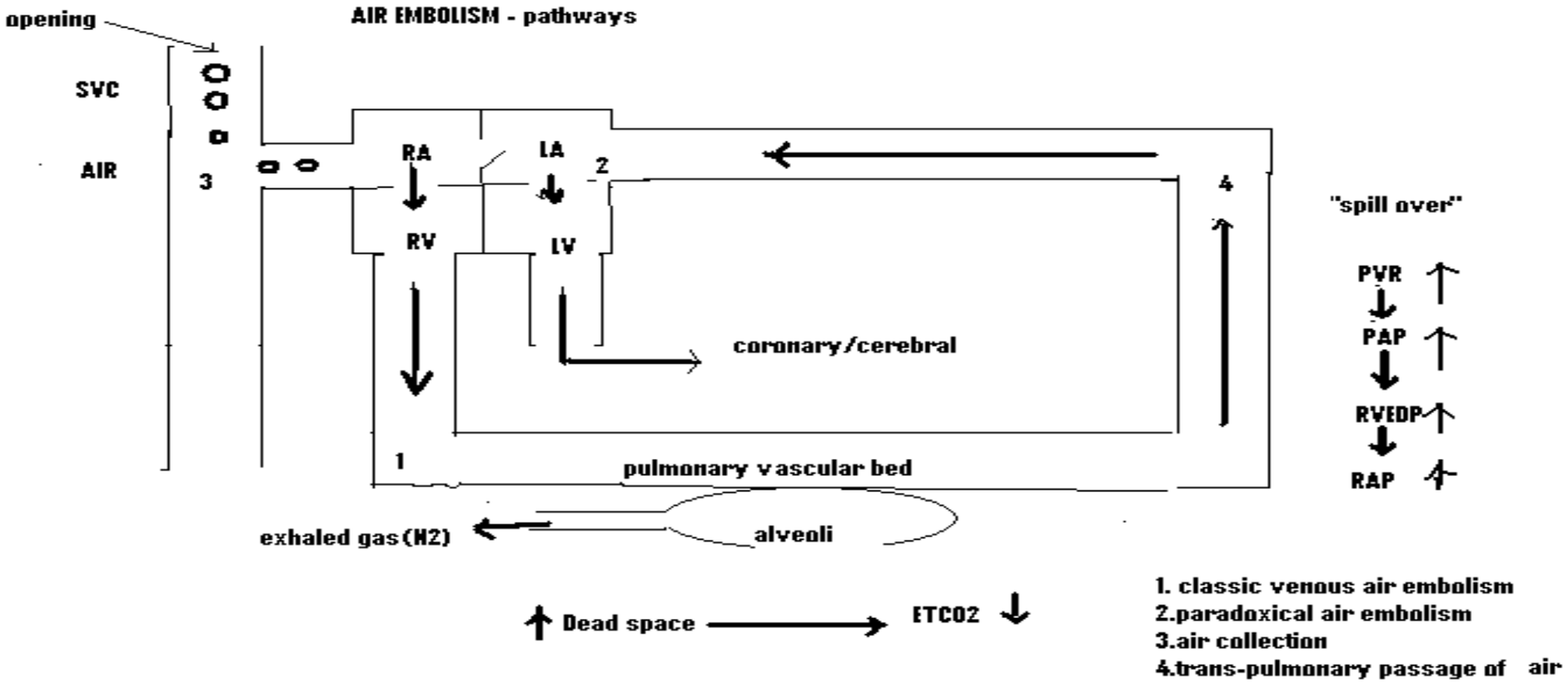
Transpulmonary passage of air

- Air in the systemic circulation without PFO
- Lung is a very good filter of air
- If overloaded, gas bubbles appear on the systemic side of the circulation
- Air pass through the lung capillaries and reach the pulmonary veins
- Air also enters through throw thebasian and bronchial vessels

Trans-pulmonary passage of air



Pathways of venous air embolism



Fatal dose of air

- Morbidity and mortality are directly related to the amount and the rate of air entry
- 50 ml of air have been retrieved in patients with clinical manifestations
- Animal study- tolerance to 1000 ml of air over 50-100 minutes
- As little as a micro bubble can be fatal if patient develops PAE

Monitors for VAE

- Highly sensitive
  - TEE and Doppler
- Intermediate sensitive
  - PCWP, $EtCO_2$, EtN_2,
- Low sensitive
  - CVP, PAP
- Least Sensitive
  - HR, BP,Murmur

TEE



- Gold standard for VAE monitoring
- Intra-op use TEE in sitting position-since 1983
- Reported incidence with TEE is 100%

<u>TEE is useful for</u> –

- Detection of VAE-
  - Most sensitive- 0.02 mL/kg of air and air bubbles as small as 5 -10mic
- Can detect air in the left heart
- Screening of PFO
- Positioning the tip of RAAC
- Detection of significant cardiac illness

Disadvantages of TEE

- Invasive –
  laryngeal edema, oropharyngeal trauma, esophageal injury

- Not quantitative
- Cant predict resolution

Disadvantages of TEE – case report

paranasal sinusitis: case report. *Neurosurgery* 1999;**44**:864–6, discussion 866–8.
28. Gatell JM, Esmatjes E, Serra C, et al. Diabetes insipidus and anterior pituitary dysfunction after staphylococcal meningitis and multiple brain abscesses. *J Infect Dis* 1982;**146**:102.
29. Maartens NF, Ellegala DB, Lopes MB. Pituitary abscess. *J Neurosurg* 2001;**95**:1110–2.
30. Hama S, Arita K, Nishisaka T, et al. Changes in the epithelium of Rathke cleft cyst associated with inflammation. *J Neurosurg* 2002;**96**:209–16.
31. Kleinschmidt-DeMasters BK, Lillehei KO, Stears JC. The pathologic, surgical, and MR spectrum of Rathke cleft cysts. *Surg Neurol* 1995;**44**:19–26, discussion 7.
32. Gokalp HZ, Deda H, Baskaya MK, et al. Pituitary abscesses. Report of three cases. *Neurosurg Rev* 1994;**17**:199–203.

doi:10.1016/j.jocn.2006.03.012

Airway obstruction after extubation following use of transesophageal echocardiography for posterior fossa surgery in the sitting position

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Abstract

Precordial Doppler

- Most sensitive(0.015ml/kg of air) device commonly available
- Frequency change of ultrasonic signal is converted to an audible signal
- Small volume of air is detected easily
- Placed just to the right of the sternum and few inches above the xiphoid

Precordial Doppler

- Advantages
  - Most sensitive
  - Commonly available
  - Cheap
  - Warns the surgeon
  - Non invasive

- Disadvantages
- Subjective (False negative -10 %).
- Continuous monitoring is easily missed
- IV mannitol may mimic air
- Useless during elctrocutery
- Not quantitative
- Difficult in obese & chest wall deformity

End- tidal CO_2

- Advantages
  - Sensitive
  - Semi quantitative
  - Widely available
  - Noninvasive
  - Predict resolution

- Disadvantages
  - -Less sensitive
  - Non specific





Right Atrial Catheter

- Both diagnostic and therapeutic use
- Now a days it is rarely required for the diagnosis.
- The catheter tip should be placed at the **atrio caval junction**.
- Disadvantage- Catheter position can change.



Pulmonary Artery Catheter

- PA catheter detects the pulmonary hypertension
- PCWP decreases in air lock associated with severe VAE
- More sensitive than $ETCO_2$
- Air aspiration difficult than larger diameter CVP catheters
- Simultaneous optimal positioning for detection and air aspiration is difficult

End – tidal Nitrogen

- Advantage - Specific for air
  - Detects earlier than ETCO2
- Disadvantage- May indicate air clearance from pulmonary circulation prematurely

Complications of VAE

- **CVS** – Hypotension or hypertension
  - Dysrhythmias
  - Myocardial ischemia
  - Acute right heart failure
  - Cardiac arrest
- **Pulmonary**–Hypercarbia
  - Hypoxemia
  - Pulmonary hypertension
  - Pulmonary oedema
- **CNS** – Hyperemia and brain swelling

Prevention of VAE incidence

- Volume loading
  - reduced negative venous pressure at wound level
- Use of neck tourniquet – gentle neck tourniquet to increase Cerebral venous pressure
- Positioning – semi-recumbent than sitting up

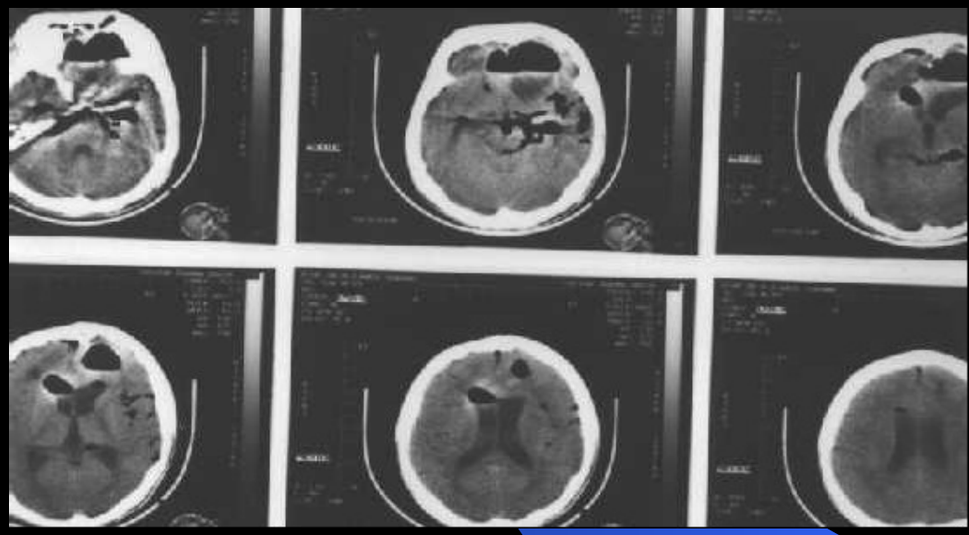
Management of VAE

- Intraoperative goals
  - Stop further air entry
  - Remove air already present
  - Correct hypotension, hypoxemia and hypercarbia

- Inform surgeon
- Stop nitrous oxide
- Aspirate air
- Provide cardiovascular support
- Change patient position
- External cardiac massage

Tension pneumocephalus

- More common following sitting position
- Air entry into the epidural/dural spaces in sufficient volumes to exert a mass effect
- Life threatening brain herniation
- Incidence – 3%
- **Serious and life-threatening emergency**



Tension pneumocephalus

- Diminution of brain volume

  Diuretics, mannitol, blood loss , CSF loss

  hyperventilation. Removal of SOL.
- Hydrocephalus patients – at risk

- ‘Inverted pop bottle’

Tension pneumocephalus

Strategies to reduce pneumocephalus

- Flushing the subdural space with NS
- Normocapnia during dural closure
- Minimize intracranial dehydration

Tension pneumocephalus

- **High index of suspicion**

- C/F- confusion, headache, convulsion, neurological deficit, Failure to regain consciousness
- Untreated pneumocephalus
  - cardiac arrest
  - brain herniation & death
- Early CT scanning

Treatment of Pneumoencephalus

- Rapid therapeutic intervention to prevent brain herniation.
- Immediate twist drill burr hole on either side of the vertex and aspiration of air.
- Rapid evacuation of air results in prompt recovery.

Macroglossia



Macroglossia

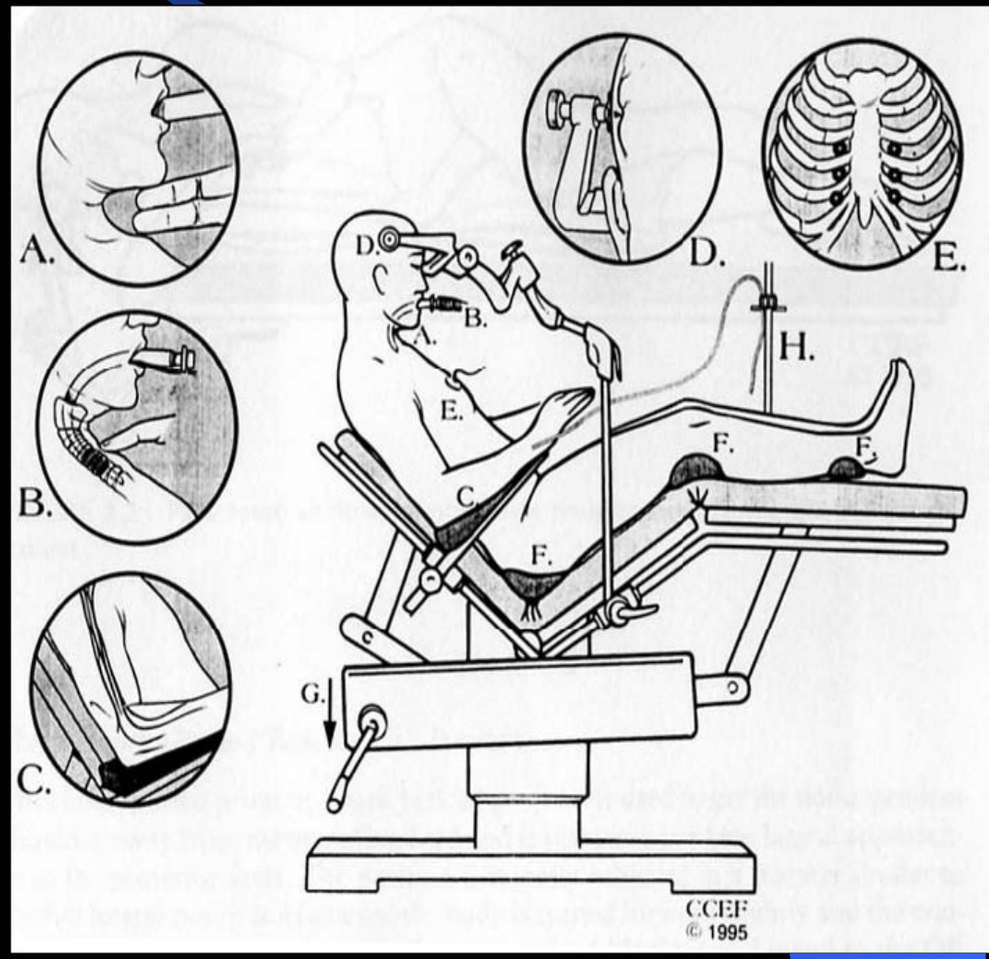


- Extreme flexion of head with the chin resting on the chest

+

- Prolonged presence of an oral airway

- Obstruction of venous & lymphatic drainage of the tongue



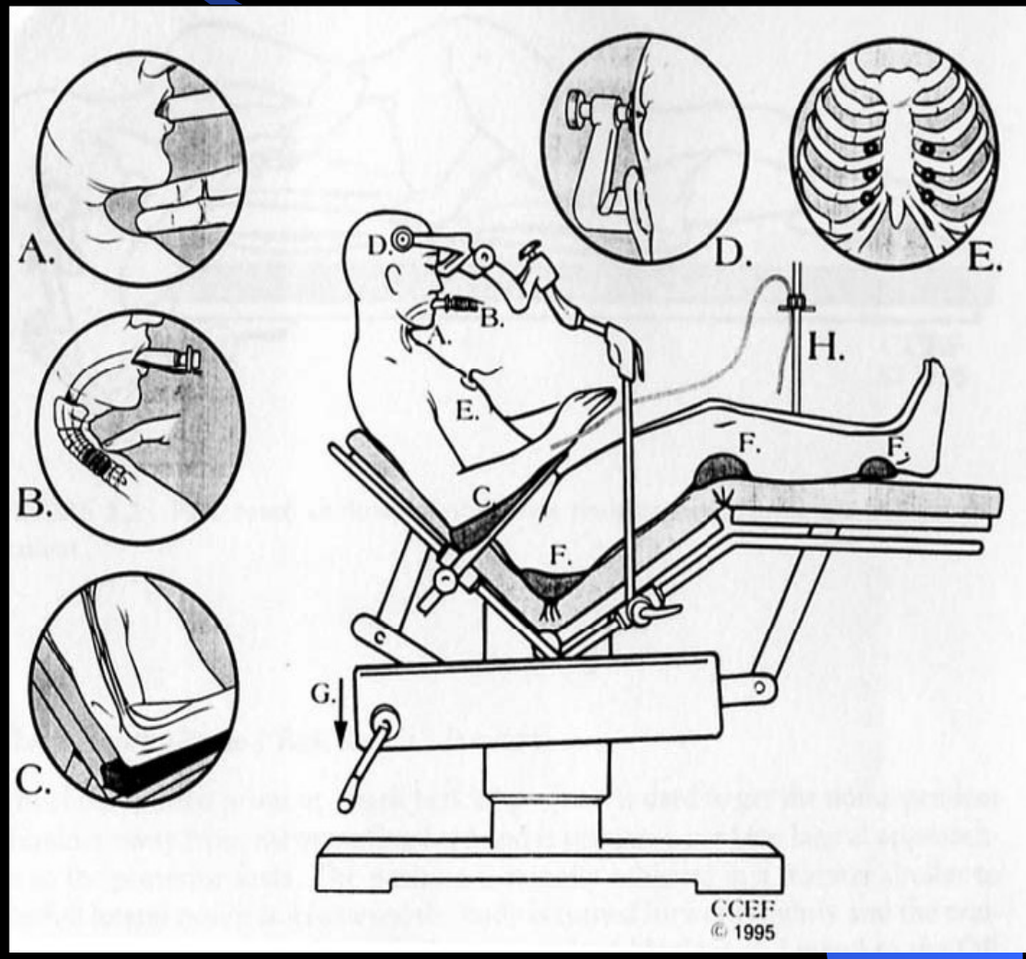
- Reported with lengthy procedure in sitting position
- Infants – at particular risk
- The use of TEE probe – laryngeal trauma
- Post operative – Macroglossia
  - Airway obstruction, hypoxemia & hypercapnia

Quadriplegia

- Rare

- Focal pressure on the spinal cord
- Marked neck flexion
- Vascular obstruction

- SSEP –monitoring
- Gap of 2 cm, between chin & the chest
- Head rotation – minimized
- Contraindicated in degenerative disease of the cervical spine



Peripheral nerve damage

1.Common peroneal nerve damage –foot drop

- Hyperflexion of the thigh and consequent compression or
- Stretching of the sciatic nerve

2.Recurrent laryngeal nerve palsy – in a/c TEE

- Rigid &large size of the probe
- Neck flexion &
- tracheal intubation
- Individual anatomic variations- cervical rib

Contraindications to sitting position

Absolute

- Patent ventriculo-atrial shunt
- Severe cardiovascular disease
- Large PFO / pulmonary-systemic shunt
- Cerebral ischemia when upright & awake

Relative

- Extremes of ages
- Uncontrolled HTN
- Hypovolemia
- COAD

Prone position







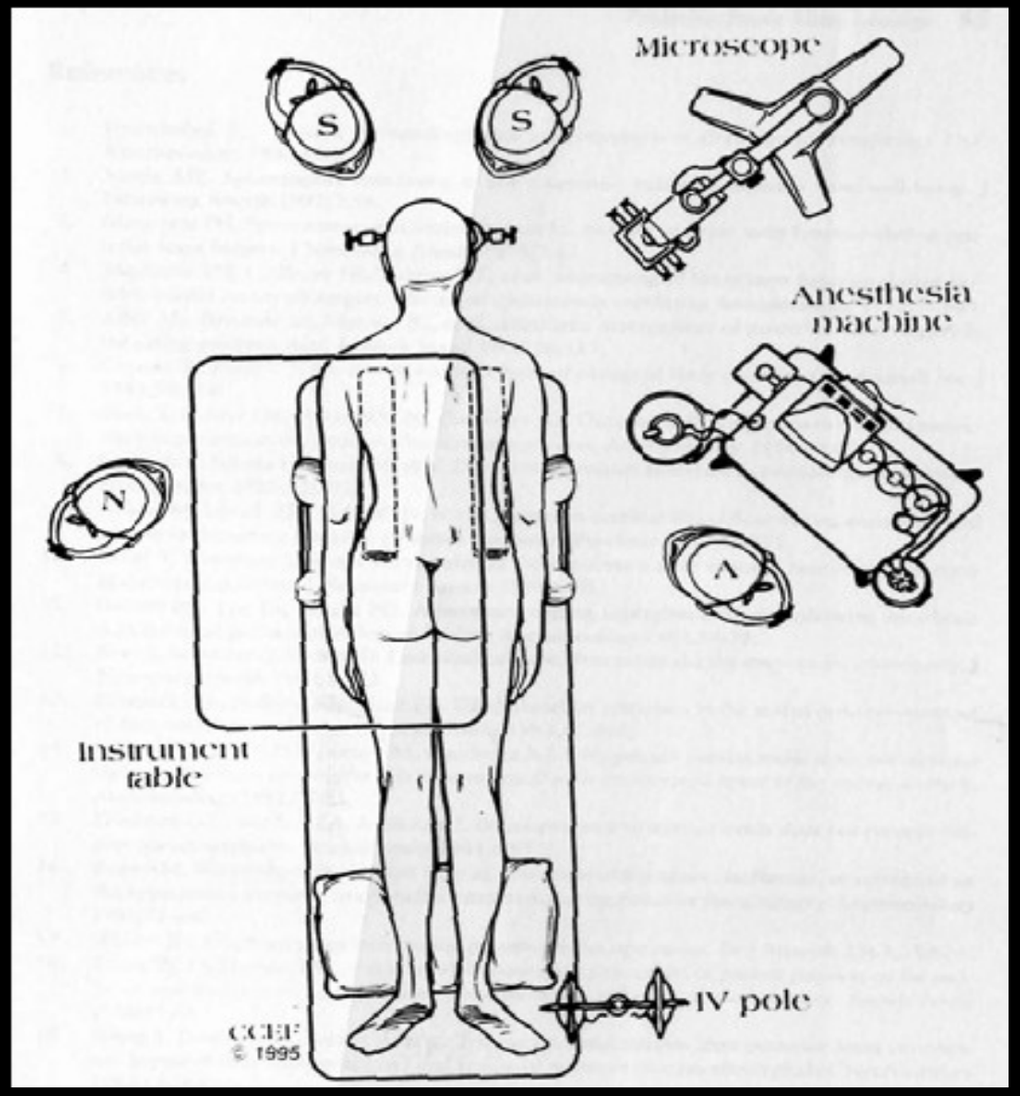






Prone position

- First description by Ecker et al







Anesthetized in supine position

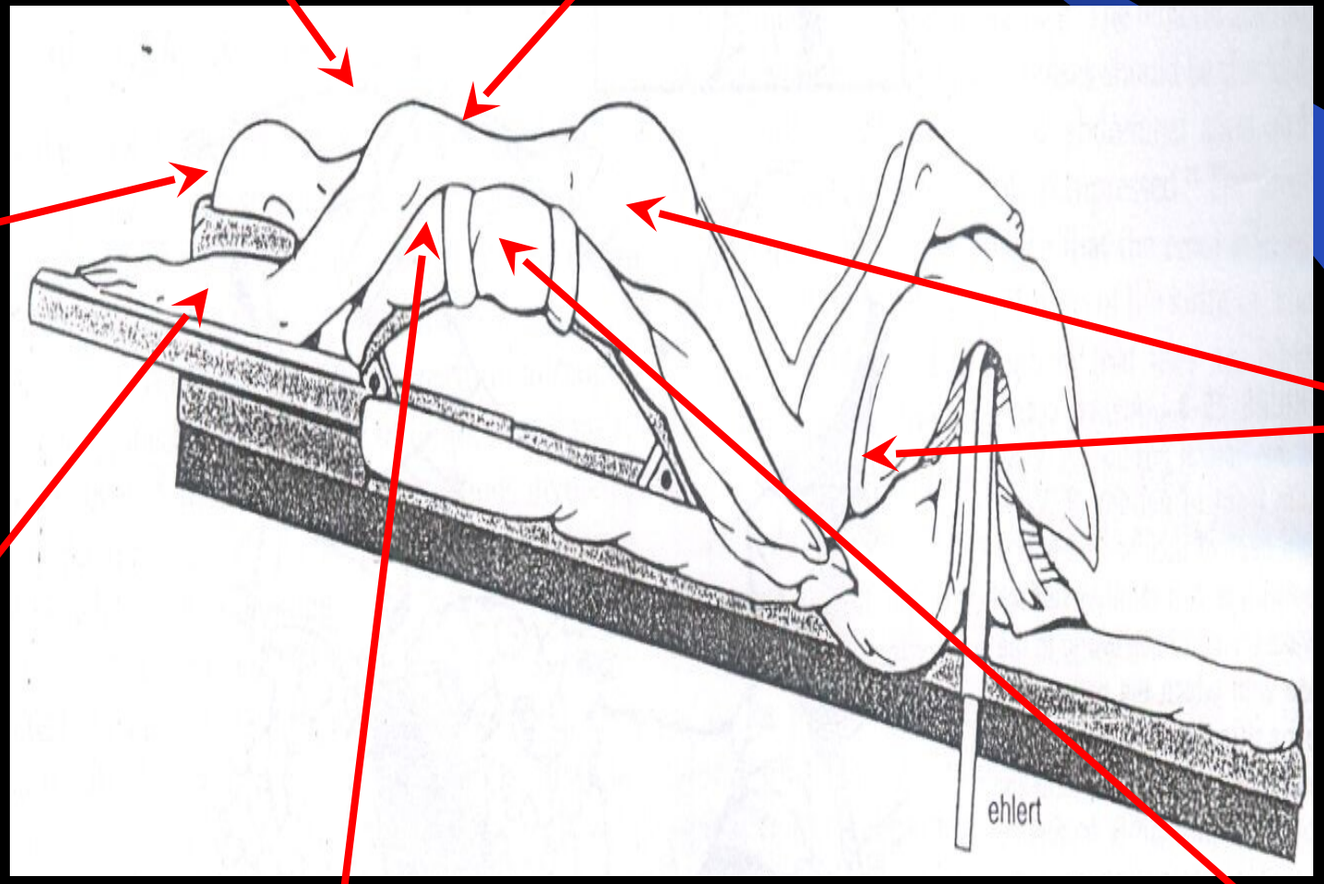
Shoulders taped

Breasts medially displaced
no undue pressure on nipples

Protection of eyes

Chin not to touch table

Upper extremities:
arm boards at the level of head
padding, palms facing the patient
thumbs down



Chest rolls/ frames (Wilson's)

Abdominal padding- no compression

Groin and knees appropriately padded

Prone position-physiology

Cardiovascular

- Decreased cardiac index
  - Reduced venous return
  - Direct effect on arterial filling
  - Reduced left ventricular compliance sec to increased intra thoracic pressure
- Inferior venacaval obstruction

Decreased cardiac output, increased bleeding, venous stasis & thrombotic complications

Prone position-physiology

Changes in respiratory physiology

- Lung volumes- FRC ↑

  - FVC & FEV1 - change very little

  - Airway resistance – no change

- Distribution of pulmonary blood flow & ventilation

  - Dorsal lung areas



Improved oxygenation

Prone position - complications

Injury to central nervous system

1. Excessive extension / rotation of head → Arterial occlusion & Venous occlusion → focal **neurological deficit**

2. Venous air embolism
3. Cervical spine injury

Injury to the peripheral nervous system

Compression - Brachial plexus, ulnar nerve , peroneal nerve & lateral femoral cutaneous nerve

Prone position - complications

2..Pressure injuries –

Direct - Pressure necrosis of the skin –
face, ears, breasts & genitalia

Indirect – Macroglossia & Oropharyngeal swelling

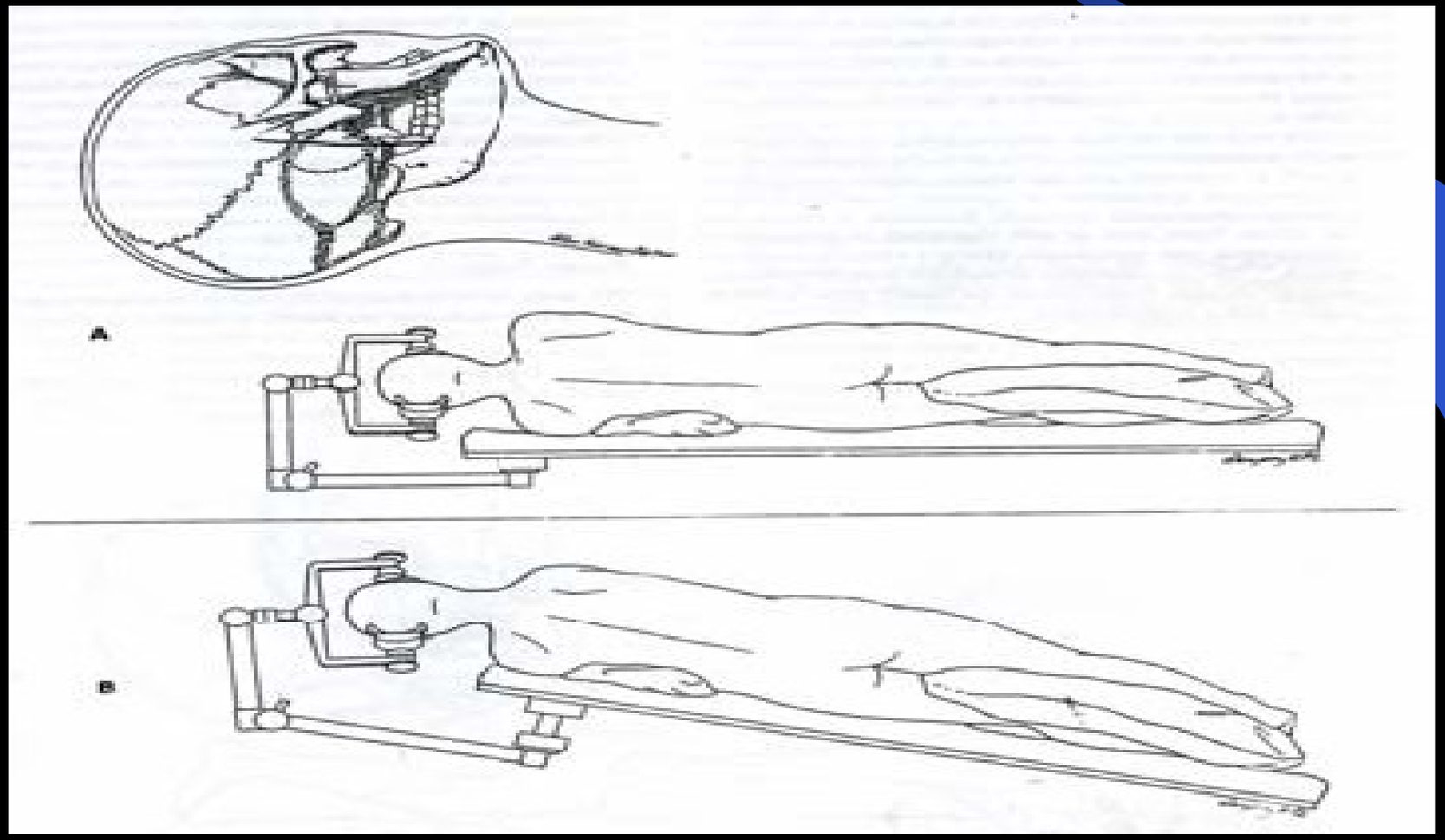
3. Ophthalmic injuries –

* General post-op risk of prolonged visual loss – 0.0008%

* Ischemic optic neuropathy

* Long surgical duration
Large blood loss
Administration of large volumes of fluids

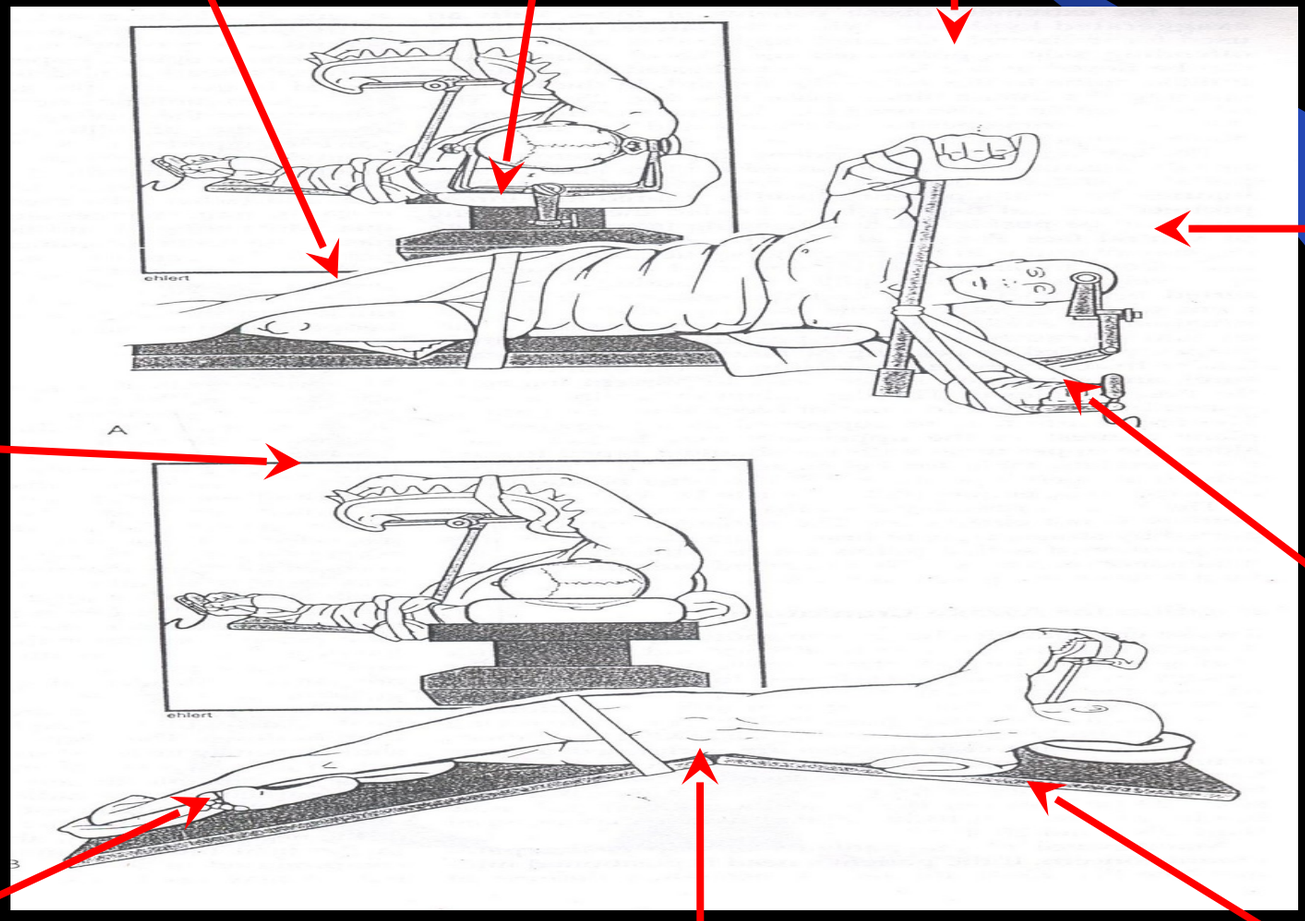
Lateral position



Patients trunk support: tapes, brace, straps

Pillow positioned between legs

hand in hanging or ventral position



Shoulder/ elbow abducted and flexed respectively
resting on a pillow or padded board

Three point fixation
Dependant extremity
-axillary artery
-brachial plexus injury

Dependant leg flexed: avoid pressure
-fibular head and peroneal nerve

Operating table flexed, kidney rest

Horse shoe rest: axillary role

Lateral position

- Approaches to
  CP angle, lateral/cerebellar hemisphere lesion, Lesions of the clivus, petrous ridge & foramen magnum

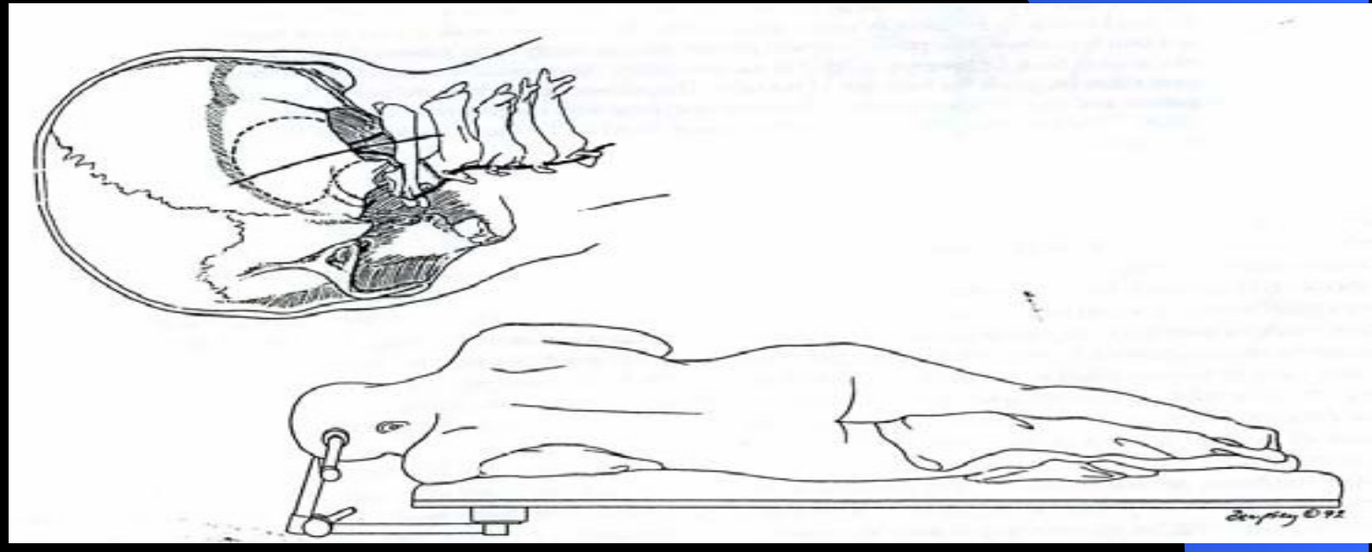
No risk of air embolism

Problems with the patient's shoulder & lateral popliteal nerve palsy

Three quarter prone position

- Allows rapid positioning
- Useful in emergency cases
- Can be used for both lateral & midline lesions

- Higher risk of neck twisting & venous obstruction



Thank you

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