POSITIONING IN NEUROANAESTHESIA

TECHNIQUES EQUIPMENT & PHYSIOLOGY

DR UNNIKRISHNAN P
SENIOR RESIDENT-
NEUROANAESTHESIA
SCTIMST,TRIVANDRUM

OUTLINE

- Why so much concern is involved
- Brief description of equipments
- Positions: physiology

  technique

Its importance....

- Proper positioning allows optimal exposure of the brain
- Should be physically and physiologically safe for the anaesthetized patient
- We should be aware of its adverse effects on the operation and on the patient
- Prolonged duration of neurosurgeries is to be considered
- Mistakes in this area cause PREVENTABLE injuries
- Knowledge improves our preparedness...

OUR MAIN CONCERNS

- Raised intracranial pressure : causes may be

  - ↑ intraabdominal pressure
  - Kinking of IJV & venous congestion
  - Head below the level of heart

OUR MAIN CONCERNS

Venous congestion : ↑brain swelling & ↑venous bleeding

- Insufficient abdominal bolstering
- ↑ PEEP
- Hyper rotation / flexion of neck

OUR MAIN CONCERNS

- Airway compromise

Hyperflexion → kinking of ETT

- Keep a distance one or two fingerbreadths between chin & chest during flexion

- Use armored tubes

OUR CONCERNS

- Prolonged pressure on pressure points
- Stretching of nerves ; especially brachial plexus
- Corneal abrasions
- Thromboembolic complications

HEAD UP

- **For cranial procedures, almost invariably, some head-up posturing [15-20°] is appropriate**
- Exceptions:After evacuation of c/c SDH[↓Reaccumulation]
- After CSF shunting [to avoid too rapid collapse of ventricles]

POSITIONING AIDS AND SUPPORTS

- Pin (Mayfield) head holder
- Radiolucent pin head holder
- Horseshoe head rest
- Foam head support (e.g., Voss, O.S.I., Prone-View)
- Vacuum mattress (“bean bag”)
- Wilson-type frame
- Andrews (“hinder binder”)-type frame
- Relton-Hall (four-poster) frame

PIN FIXATION DEVICES
e.g. Mayfield head holder

- Skull block before application
- Placed in a band like area just above orbits & pinna [~sweatband]
- Avoid over thin temporal bone; caution when over frontal sinus
- Not < 3 years; 3-10 years paediatric pins
- Coated with antibiotic ointment

PIN FIXATION DEVICES
e.g. Mayfield head holder





MAYFIELD® Child Disposable
Skull Pins (Steel)



MAYFIELD® Adult Disposable
Skull Pins (Steel)



MAYFIELD® Triad™ Skull Clamp
Provides 3-point rigid cranial fixation.



MAYFIELD® Radiolucent Skull Clamp
Provides 3-point rigid cranial fixation.
- Composite carbon fiber



PIN FIXATION DEVICES
e.g. Mayfield head holder

- Clamp squeezed together, allowing the gears to slide, until the pins are seated in the skull
- Knob housing the tension spring & gauge is tightened
- Each ring 20lbs; adult→60-80 lbs ; pediatric: 30-40lbs
- Pediatrics: horse shoe is better
- Radiolucent pins if intraoperative CT/MRI used [minimal artefact]e.g Titanium, Macor,Silicon nitride

PIN FIXATION DEVICES
e.g. Mayfield head holder

COMPLICATIONS

MALPOSITION; POOR FIXATION→MOVEMENT

OVER TIGHTENING,INCORRECT PIN, SOFT SKULL→ INJURY,DELAYED ABCESS, EPIDURAL HEMATOMA

SKIN NECROSIS

SKULL FRACTURE

SLIPPAGE OF JOINTS TO OPERATING TABLE

CLAMP BREAKAGE

BLEEDING ; Rx: SUTURING

HORSESHOE HEADREST



MAYFIELD® Adult Horseshoe Headrest
Horseshoe shaped headrest that provides cranial support in the prone or supine position for adults and older children.

- Vertical and lateral adjustments allow flexibility in patient positioning
- Adjustable pad base accommodates various head sizes
- Fluid resistant gel pads provide comfort and reduce the incidence of pressure necrosis
- Easily cleaned
- Pulley Rod attachment for skeletal traction



MAYFIELD® Pediatric Horseshoe Headrest
Horseshoe shaped headrest that provides cranial support in the prone or supine position for infants and young children.

- Vertical and lateral adjustments allow flexibility in patient positioning
- Adjustable pad base accommodates various head sizes
- Fluid resistant gel pads provide comfort and reduce the incidence of pressure necrosis
- Easily cleaned

HORSESHOE HEADREST

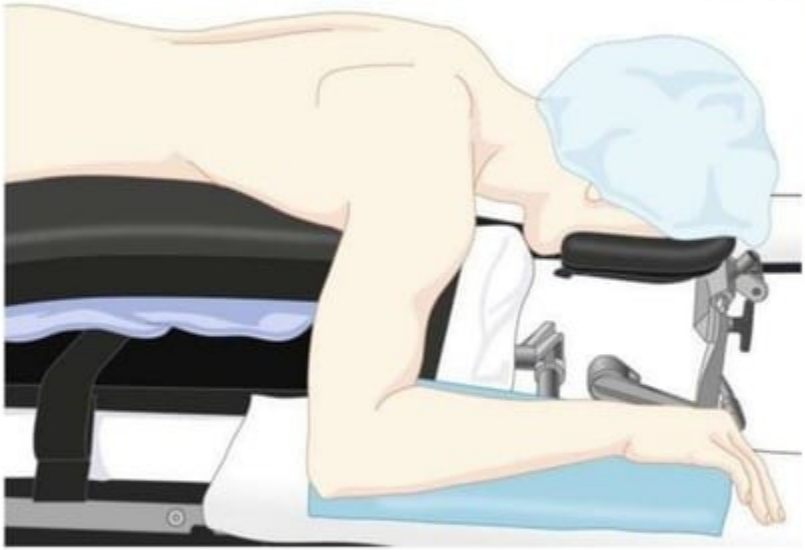


Figure 36-16 Prone position with horseshoe adapter. Head height is adjusted to position neck in a natural position

HORSESHOE HEADREST



FRAMES

- Spinal surgery frames optimize venous return
- E.g. Relton-Hall[four-poster,Wilson and Andrew[hinder –binder] variants

- risk of air embolism +

WILSONS FRAME



SUPINE POSITION PHYSIOLOGY

- **Respiratory system:**

Cephalad push of diaphragm: ↓FRC by 1L, ↑closing volume [so alveoli closes at a volume very near to FRC,distal airways cant participate in gas exchange→ V-P mismatch], ↓COMPLIANCE
Perfusion greatest in the dorsal aspect; Ventilation also. Why?

- Anaesthesia decrease FRC, increase closing volume, restricts and displaces diaphragm
- During controlled ventilation, abdominal contents decrease compliance of dorsal lung; so ventral lung receives same perfusion, but more ventilation: Hence V-P MISMATCH

SUPINE POSITION PHYSIOLOGY

- Cardiovascular system

↑Venous return ↑CO → baroreceptor reflexes
:↓HR,SV&CO/ atrial reflexes: act via RAAS/AVP/ANP
Sympathetic tone ↓→↓in HR,MAP& PVR[peripheral]
SBP same; DBP ↓; so pulse pressure ↑

- Anaesthesia, muscle relaxation and PPV interfere with venous return & autoregulatory mechanisms

- So circulatory effects of positioning may remain uncompensated in such patients

Also note...

- **Reverse Trendlenberg :** increase in head and neck venous drainage, reduction in intracranial pressure and reduced likelihood of passive regurgitation

- Elevation of the head 15 to 30 degrees will also encourage venous drainage



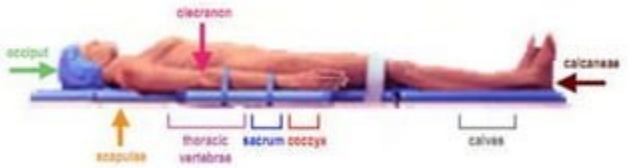
Figure 36-6 Trendelenburg and reverse Trendelenburg. Shoulder braces should be avoided to prevent brachial plexus compression injuries.

SUPINE POSITION

- Head neutral / rotated
- Neutral → Bifrontal craniotomy and transsphenoidal approach to pituitary
- Flexed for interhemispheric approach to lateral or third ventricle
- Slightly extended in subfrontal approach



Figure 2: Pressure points in the supine position



SUPINE POSITION
precautions

- Extremes of rotation can impair jugular venous drainage; a shoulder roll can attenuate this problem

- Extreme flexion cause kinking of ETT

- Flexion + reverse Trendelenburg = ↑risk of VAE {esp. In bifrontal craniotomy which traverses SSS}

SUPINE POSITION with Head Up

- Adjust table to a chase lounge (lawn chair) position

FLEXION + PILLOW UNDER KNEE + SLIGHT REV TRENDELENBERG

- Promote venous drainage and decrease back strain



Figure 36-4 Lawn chair position. Flexion of the hips and knees decreases tension on the back.

Head is important; but dont forget others..

- Upper limbs usually @ the sides
- Dont abduct shoulder > 90° [Brachial plexus]
- foam padding to elbow & wrist [ulnar and median n]
- Knee elevated [↓ tension on lower paert of back]
- Heels padded

SEMILATERAL / JANETTA POSITION *

- Supine position with a bolster
- For petrosal, retromastoid & U/L frontotemporal approaches
- Lateral tilting of the table, 10-20° with I/L shoulder elevated

* *Named after the neurosurgeon who popularized its use for microvascular decompression of 5th nerve*

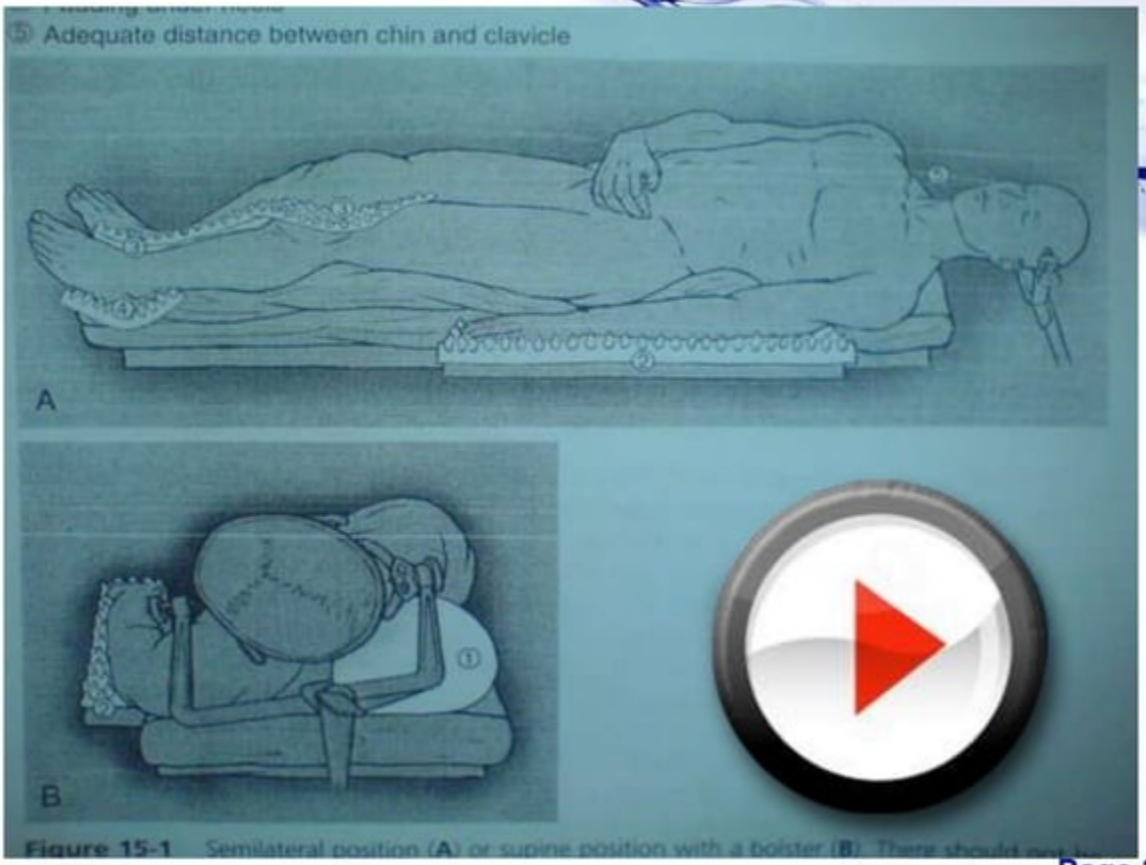


Figure 15-1 Semilateral position (**A**) or supine position with a bolster (**B**). There should not be

SEMILATERAL / JANETTA POSITION

- In petrosal & retrosigmoid approaches, elevated shoulder pulled down inferiorly with tape→minimize obstruction to view

- Shoulder bolster important in elderly patients with less flexible necks & to avoid kinking of IJV

- Extreme head rotation cause kinking of opposite IJV by the chin

- Excessive traction to shoulder→ stretch injury to brachial plexus

LATERAL POSTION

- For access to posterior parietal and occipital lobes and lateral posterior fossa
- Includes C-P angle tumours and vertebral/basilar aneurysms
- *Key feature*: Use of axillary roll to prevent brachial plexus injury or pressure on dependent shoulder
- *Rolls themselves can cause harm*; prevented by placement under the upper part of the chest rather than the axilla

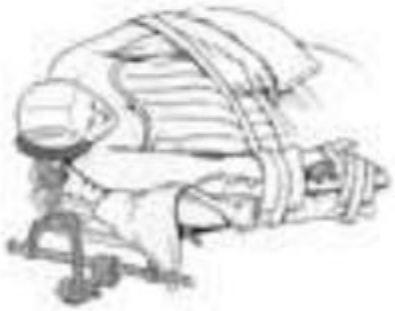


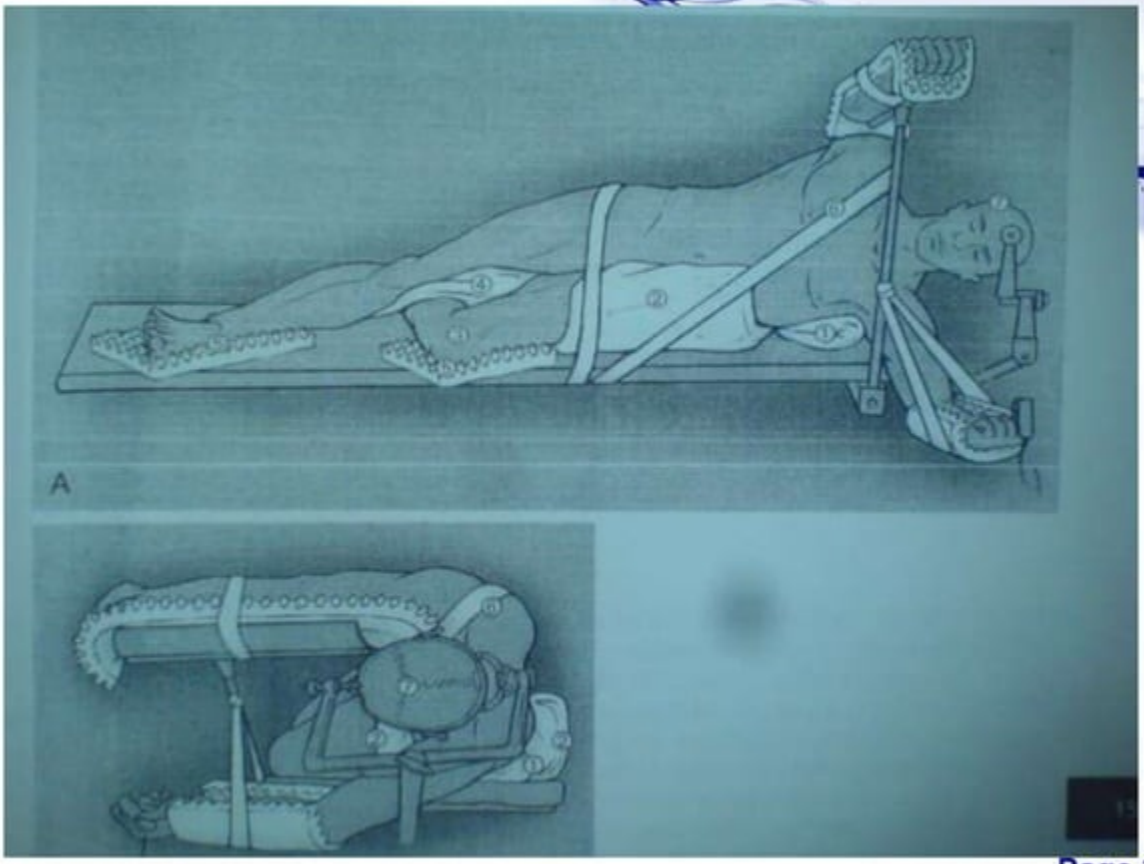
LATERAL POSTION

- To maintain the lateral position a support placed along the patients back and abdomen

- Knees flexed with paddings between the knees to avoid pressure over the fibular head and peroneal nerve






A

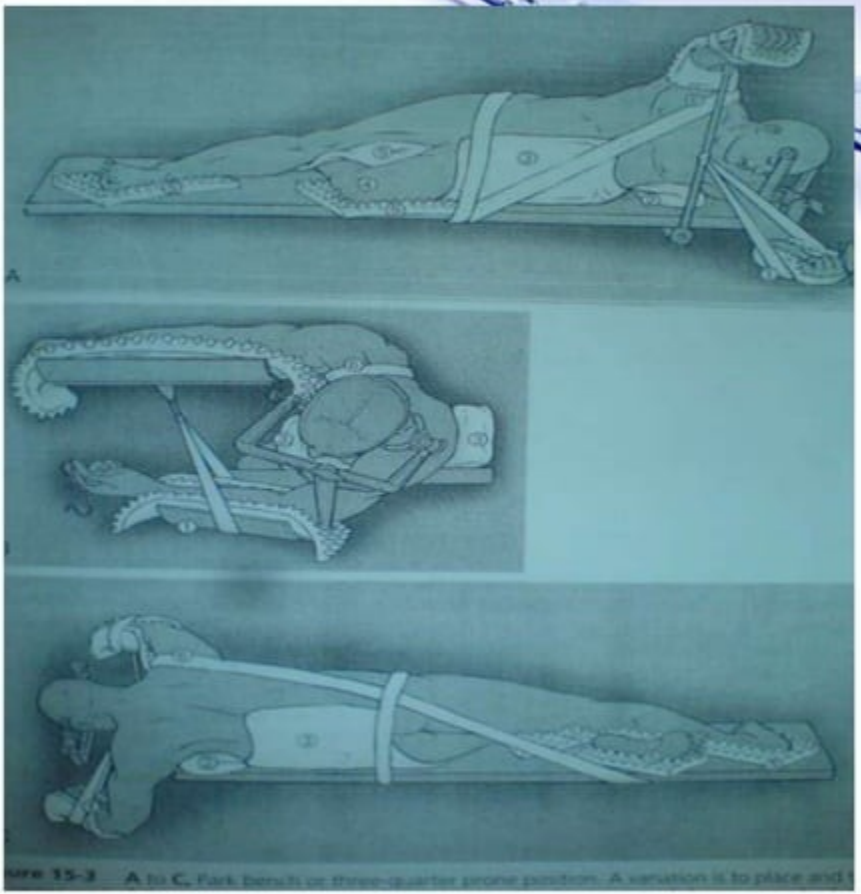
LATERAL POSTION
physiology

- RESPIRATORY SYSTEM: non dependent lung is well ventilated, but poorly perfused and dependent lung is well perfused but poorly ventilated→ V/Q mismatch

- CVS: minimal decrease in MAP ; HR unchanged

PARK-BENCH OR THREE QUARTER PRONE POSITION

- Used in far lateral approaches
- placing the patient sufficiently superiorly on the operating table such that the dependent arm is hanging over the edge of the table & secured with a sling
- Trunk is rotated 15° from lateral position into a semiprone position & supported with pillows.
- I/L shoulder is pulled inferiorly



PARK BENCH POSITION

- Head is flexed @ the neck and then rotated to look toward the floor [120° from vertical & laterally flexed 20°]





PARK BENCH POSITION

- Support the dependent arm
- Pad all pressure points
- Axillary roll placed under dependent chest
- Avoid too much tension on shoulder[Brachial plexus]
- Considerable rotation & flexion of the neck→kinking of ETT, IJV (use Flexometallic ETT)
- Excessive flexion prees mandible onto clavicle

PRONE POSITION

- For spinal cord, suboccipital approach/occipital lobe, craniosynostosis and posterior fossa procedures

- Can cause hemodynamic changes, impairement of ventilation and spinal cord injury

- Anaesthesiologist should have a plan for detaching and reattaching monitors in an orderly manner to prevent excessive monitoring 'window'.
Needs coordination of members.



PRONE POSITION

The prone position also has been referred to, aptly, as the Concorde position because, for cervical spine and posterior fossa procedures, the final position commonly entails neck flexion, reverse Trendelenburg, and elevation of the legs. This orientation brings the surgical field to a horizontal position.



AWAKE PRONATION

- For patients with compromised spinal canal and when there is possibility of worsening of neurologic function with handling



- Patient can indicate pain
- Progression of Neurological deficit: YES / NO



- If progression, can correct the faulty position



- Needs adequate sedation and topical anaesthesia

PRONATION AFTER INDUCTION

ANESTHESIA
- Should blunt autonomic reflexes
- Shouldn't cause hypotension

NARCOTICS RELAXANTS
- Give a loading dose prior to pronation
- Adequate neuromuscular blockade

IVF
- Fluid bolus of 500 ml
- .

PRONE POSITION
How to achieve

- Patient placed on two bolsters or a support device with arms to the side of the body

- bolsters should be sufficiently far apart;

To avoid compressing abdominal & femoral venous return

To allow adequate diaphragmatic excursion

PRONE POSITION
How to achieve

- Move the trolley parallel & adjacent to operating table
- All lines:ensure length & secure
- 2 assistants stand on free side of table & another 2 on free side of trolley. One manage feet
- If cx spine is stable; anesthetist manage head & coordinate turn; if unstable→ neurosurgeon
- Keep arms of the patient alongside the body



PRONE POSITION
How to achieve

- disconnect lines / monitoring leads and secure
- @ the signal from the person managing head, disconnect patient from anaesthesia machine
- turn him gradually onto the outstretched arms of the receiving assistants
- hold the arms alongside the body & head in the sagittal plane during turn
- Reconnect , auscultate the chest and confirm ETT position

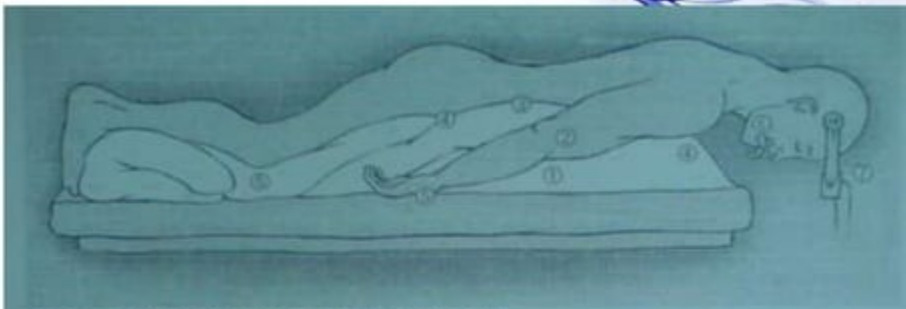


PRONE POSITION

How to achieve

- patient remains supported by appropriate chest rolls
- rolls should support the lateral edge of the torso from head to foot
- Rotate head toward the anaesthesia machine & place it on a headrest
- Take care of the downside eye and ear
- Arms alongside / in front of the patient





Prone position-B (suboccipital approach)
Head on face pillow

① Bolsters
② Arms alongside the head
③ Avoid pressure on abdomen
④ Avoid pressure on male genitals and breasts
⑤ Arm and knee padding
⑥ Face pillow with eyes and nose free of compression

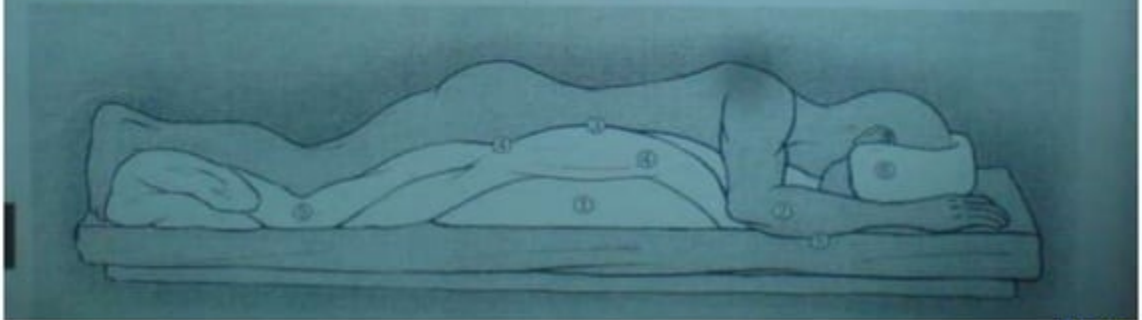




Figure 36-18 Prone position with Mayfield head pins. Rigid fixation is provided for cervical spine and posterior intracranial surgeries.









PRONE POSITION

- breast & genitalia placed medially between chest rolls
- Eyes taped; head supports should be spaced wide enough ; pin based holder better
- Down side ear kept flat and unfolded
- Chin is tucked in the suboccipital approach
  2 FB distance between chin-mandible,sternum-clavicle
- no pressure over pre auricular area; VII n superficial

PRONE POSITION

- Ensure even pressure over face / Intermittently check for orbital compression
- Arms and knees padded
- Ankles elevated so that toes are hanging freely
- **A rolled gauze bite block instead of an oral airway can avoid compression ischemia while preventing trapping of tongue in between teeth**

PRONE POSITION
CARDIOVASCULAR SYSTEM

- CVS adapts well



- Venous pooling may reduce cardiac filling pressures and cardiac output

- Improper position- obstruct femoral vein / IVC ; ↓BP/venous return

- wrapping legs with elastic / pneumatic stockings can maintain the filling pressures

PRONE POSITION
RESPIRATORY SYSTEM

- If allowed to breathe spontaneously, has to move the entire thoracic mass off sternum to expand pleural cavity ; also weight of dorsal trunk push abdominal contents cephalad ,which push diaphragm→↑ WOB

- If rolls correctly placed, chest and abdomen hang free; ventilation accoplished with normal pressures

- FRC decrement seen in supine position is not seen with prone position



PRONE POSITION
CENTRAL NERVOUS SYSTEM

- Vertebral venous plexus have anastomotic connections with IVC & femoral vein

- Compression of IVC→ diversion of blood to vertebral venous plexus → ↑ bleeding, ↓visibility in spine surgery

IF PROPERLY POSITIONED ON CHEST ROLL



TAKE CARE OF BRACHIAL PLEXUS

- In 'stick-em up' position arms shouldnt be abducted >90⁰; elbows shouldnt be extended>90⁰ [90-90 position]

- Elbow should be anterior to the shoulder to prevent wrapping of brachial plexus around head of humerus

- Pronation makes ulnar nerve very vulnerable, while supination keeps it in a more protected position

DONT *loose* YOUR TAPE TO SALIVA...

- Ensure fixity of ETT tape



@When a thing ceases to be a subject of controversy, it ceases to be a subject of interest... William Hazzlit



....SITTING POSITION

SITTING POSITION

- Several reviews of large experiences concluded that the sitting position can be employed with acceptable rates of morbidity and mortality

- Access to midline structures like floor of 4th ventricle, pontomedullary junction and vermis better; for supracerebelar infratentorial approach

- Better anatomic orientation, better visualization for the assistant, drier field

- Sitting Vs Alternatives ←→risk Vs no risk



not like that!

Will you prefer....in...?

- Patient with poor cardiac reserve
- Patient with ventriculoatrial shunt
- Known intracardiac defects
- Pulmonary A-V malformations
- Severe hypovolemia / cachexia
- Severe hydrocephalus
- Lesion vascularity ……..NO… NO

HOW TO ACHIEVE..

- Skull secured in three pin head holder [applied while on supine]
- Infiltration of scalp & periosteum @ pin sites [↓hypertesive response]
- Arterial pressure transducer zeroed @ the interaural plane[1] /skull base[2] [CPP maintenance become easier]



- Bony prominences well padded
- Legs placed in thigh-high compression stockings [limit pooling of blood] ***But it's not a tourniquet….understood?!***

HOW TO ACHIEVE

- Elbows supported by pad/pillows to avoid contact with table or U-frame or stretch on brachial plexus
- Legs freed of pressure [@ the level of common peroneal nerve just distal & lateral to head of fibula;Pillow under knees]
- At least 1 inch / 2 fingerbreadth space between chin & chest

  [to prevent cervical cord stretching & venous obstruction]
- Avoid large airways & biteblock in the pharynx
- Avoid excessive neck rotation, especially in elderly

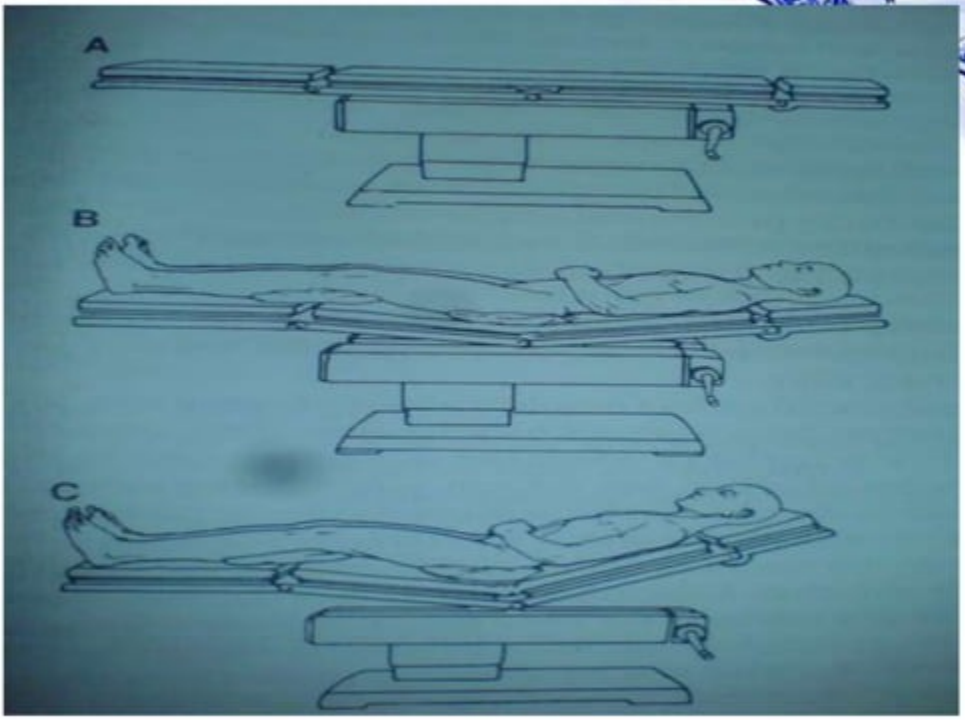
HOW TO ACHIEVE

- Avoid excessive flexion of knees towards the chest [prevent abdominal compression,lower extremity ischemia and sciatic nerve injury]

- Head holder should be attached to the back portion of the table, rather than to the thigh portion
- [makes lowering of head and closed chest massage if necessary, easier]

SEQUENCE

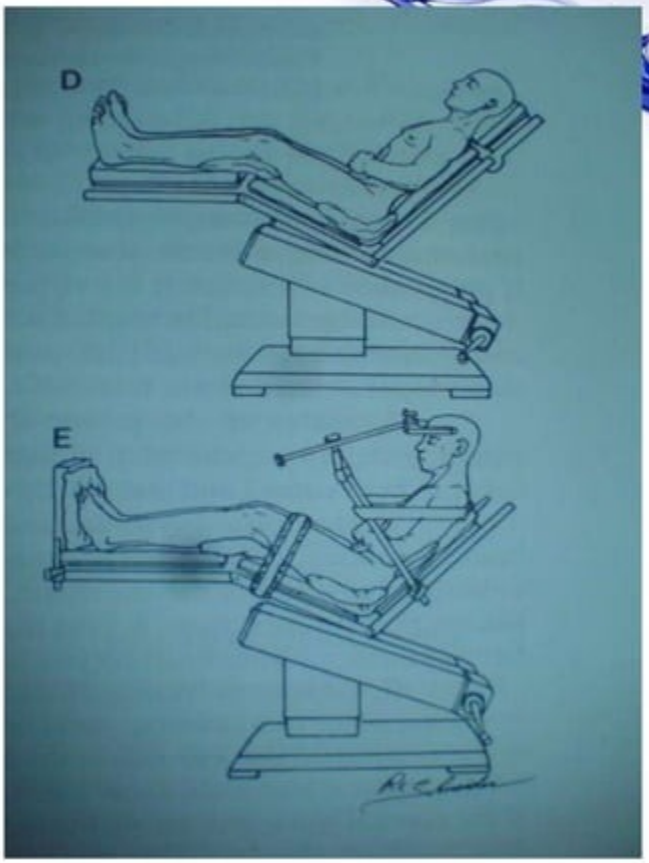
- While monitoring BP, adjust the operating table
- Flex the table fully & lower the foot section 45°
- Slowly elevate back section while placing the chassis in the Trendelenberg position


A
B
C

SEQUENCE

- Raise the back further untill the desired sitting position is achieved

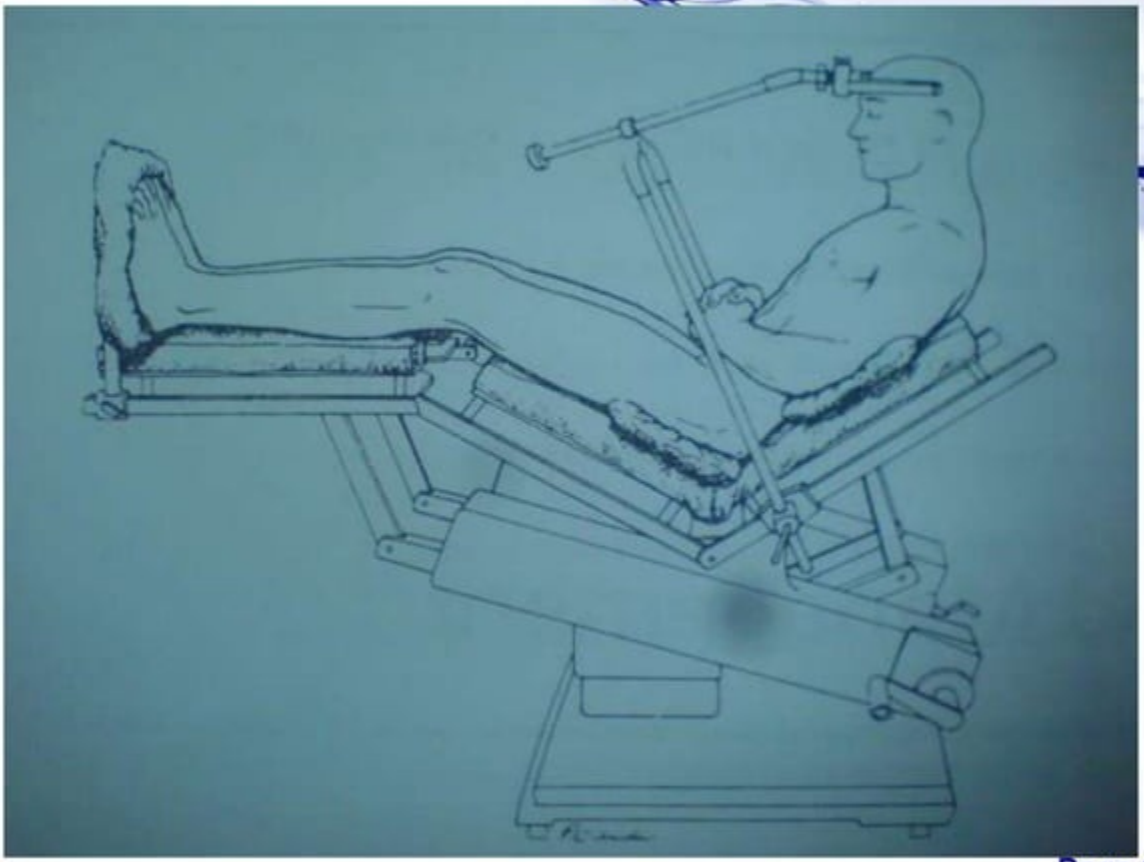
- Finally adjust foot section of the table to horizontal position


D
E

SEQUENCE

- Remove head rest and attach skull clamp to a U-shaped frame which has been attached to operating table

- Adjust U-frame & skull clamp to get the desired neck flexion and head position





HOW TO ACHIEVE

- its like a modified recumbent position rather than truly sitting

- Lateral lesions: a 'lounge chair' modification, with thoracic cage raised to 30-45°

- 'lateral sitting position' allows rapid head lowering to the left lateral decubitus & continiuation of the operation in the vent of hypotension or persistent VAE

- After positioning apply precordial doppler/ TEE with pediatric / small probe

The tense anaesthetist has some advantages...



- Lower airway pressures
- Ease of diaphragmatic excursion
- Improved ability for hyperventilation
- Better access to the ET tube & thorax for monitoring
- Easier access to extremities for monitoring/ fluid or blood administration / sampling
- Can see face during cranial nerve stimulation



NOTE....

- Improved post operative cranial nerve function has been reported in patients undergoing acoustic neuroma resection in the sittin position, than in those operated in the horizontal position*

- *Black S, Ockert DB, Oliver WC Jr, et al. Outcome following posterior fossa craniectomy in patients in the sitting or horizontal positions. Anesthesiology 1988 69:49-56

PHYSIOLOGY

- Head elevation above RA→↓ dural sinus pressure[90°position cause a↓upto 10 mm of Hg]→ ↓ venous bleeding→ increase risk of VAE

- N.B. jugular bulb venous pressure is not a reliable indicator of dural sinus pressure

PHYSIOLOGY
CARDIOVASCULAR SYSTEM



>PVR

>SVR [50-80%]→↓RENAL BLOOD FLOW



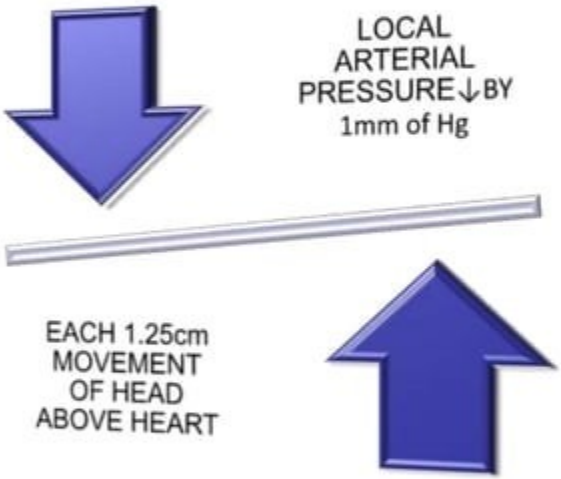
>C.O.[12-20%]

>VENOUS RETURN

>CBF[15%]CPP

>INTRATHORACIC→↓BLOOD VOLUME BY 500 ML [↓RA>LA PRESSURE]

PHYSIOLOGY
CARDIOVASCULAR SYSTEM



PHYSIOLOGY
CARDIOVASCULAR SYSTEM

MEASURES TO AVOID HYPOTENSION

PREPOSITIONING HYDRATION
WRAPPING OF LEGS WITH ELASTIC BANDAGES
SLOW INCREMENTAL ADJUSTMENT OF THE TABLE
?AGGRESSIVE VOLUME LOADING
?PNEUMATIC ANTISHOCK TROUSERS [G-SUIT]

PHYSIOLOGY
CARDIOVASCULAR SYSTEM

- Anaesthetic drugs and the sitting position act together so that the physiological insult is more pronounced… So watch B.P. closely.

- Adequate relaxation to prevent dangerous movement

- Depth titrated for optimal haemodynamic response

- Rx hypotension promptly by vasopressors, adjusting depth and IVFs

PHYSIOLOGY
CARDIOVASCULAR SYSTEM

- A pulmonary arterial catheter if h/o CAD,Valvular disease or >60 years

- all patients should be preoperatively imaged with an echo to R/O patent foramen ovale

- CPP should be maintained @ a minimum of 60 mm of Hg

PHYSIOLOGY
RESPIRATORY SYSTEM

- FRC & VC improved

- Hypovolemia→ may decrease upper lung perfusion → V-P mismatch / hypoxia

- Volatile agents may increase transpulmonary passage of air

- N_2O contraversial

References

✓Essentials of Neuroanaesthesia & Neurointensive Care; *Arun K. Gupta and Adrian W. Gelb (2008)*

✓*Neuroanaesthesia Handbook; David J Stone, Richard J Sperry,Joel O Johnson*

✓*Miller's Anaesthesia 7/e (2010) (1)P:2053*

✓Cottrell and Young's Neuroanaesthesia 5/e (2010) Patient positioning in anaesthesia (2)P:204

✓David JW Knight,Ravi P Mahajan,BJA,CEACCP vol 4,issue 5p:160-163

✓Practical Handbook of Neurosurgery: From Leading Neurosurgeons, Volume 3,By Marc Sindou

UNSTABLE POSITIONS ARE SOMETIMES UNAVOIDABLE



Thank You