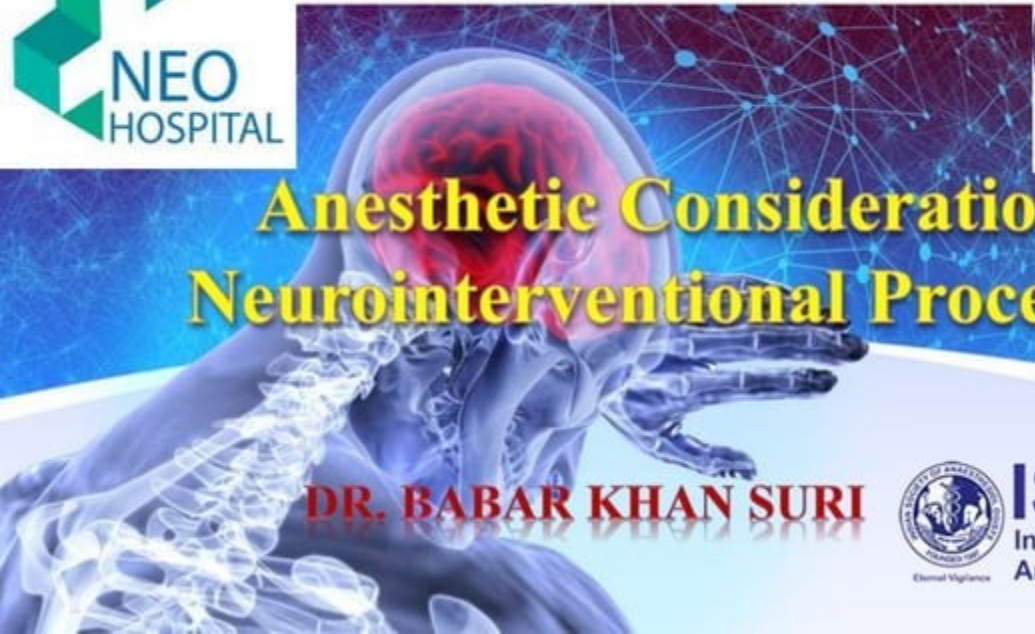
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INDIAN SOCIETY OF ANAESTHESIOLOGISTS · FOUNDED 1947 ·

Anesthetic Consideration in Neurointerventional Procedures



DR. BABAR KHAN SURI

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Welcomes you all
for
for ISA monthly academic meet on

Anesthetic Consideration in Neurointerventional Procedures



Venue- Board Room
Basement -2
4pm onwards

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Interventional Neuroradiology (INR)

- Interventional Neuroradiology (INR) is the discipline that uses endovascular procedures to treat vascular condition of the central nervous system.





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INDICATIONS

- Diagnostic
- Therapeutic

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Diagnostic procedure

- CT HEAD
- MRI Brain
- CT angio
- MR Angio
- DSA

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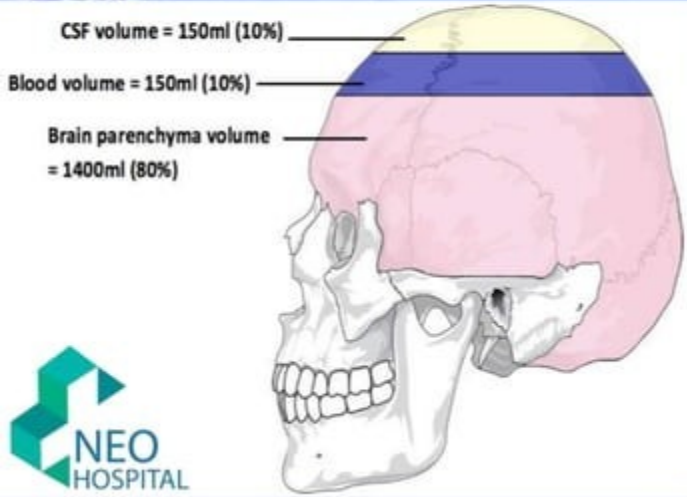
Therapeutic Indication of INR

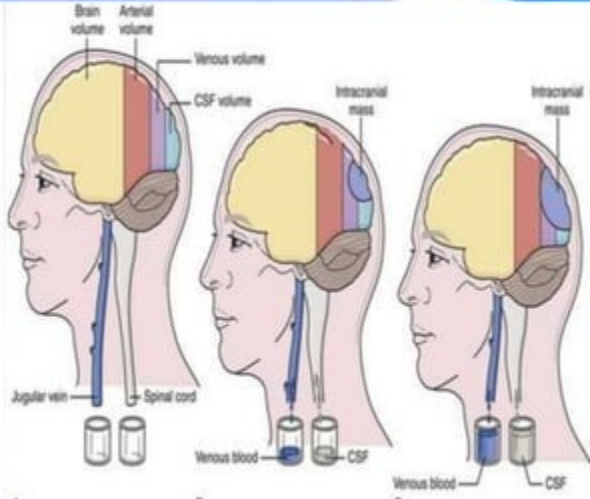
- Endovascular treatment of cerebral aneurysms (coiling / embolisation)
- Endovascular treatment of AV malformations / fistulae (intracranial, dural, spinal)
- Pre-operative embolisation of cerebral and spinal tumours.
- Embolisation for epistaxis.
- Investigation and treatment (venous angioplasty/venous stenting) of Idiopathic Intracranial Hypertension (IIH).
- Sclerotherapy for venous angioma.
- Balloon angioplasty for carotid stenosis and vasospasm.
- Intra-arterial chemotherapy.
- Treatment of acute thromboembolic stroke.
- Stereotactic surgery.

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Principle of cerebral perfusion





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Principle of cerebral perfusion

- The normal cerebral blood flow (CBF) is approximately 50 ml/100g/min or 700 ml/min, which is roughly 14 % of the cardiac output.

1.CBF = Cerebral Perfusion Pressure (CPP) /Cerebrovascular resistance (CVR)

2.CPP = MAP – ICP

- Pressure autoregulation maintains CBF at a constant level in normal brain.

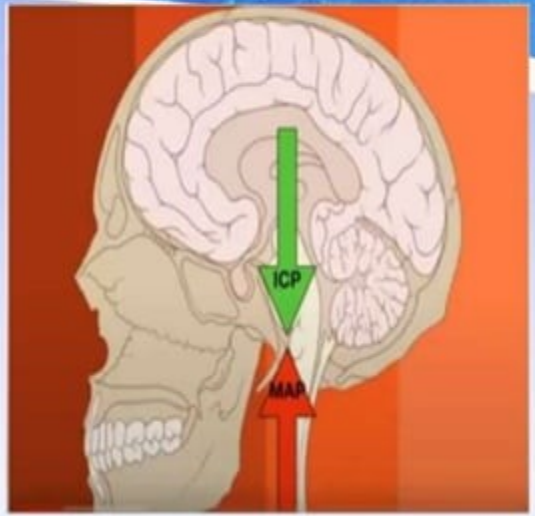
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Cerebro - Vascular Resistance (CVR) KWJ et Al

- Metabolic Factors ($CMRO_2$).
- Chemical Factors (O_2 and CO_2 tensions).
- Body temperature.

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- Pressure driving the flow of blood through the brain
- CPP = MAP – ICP or Cerebral venous pressure (CVP) in the jugular bulb (which one is higher)
- Normal CPP = 60-70 mmHg
- Effects of CPP to the brain:
  - < 50 mmHg (cerebral ischaemia)
  - > 150 mmHg (cerebral oedema)
- Factors affecting CPP:
  - Changes of MAP
  - Changes of ICP
  - Changes of CVP



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Special Consideration

- Radiation Protection
- Contrast and Flush
- Anticoagulation
- Position of the patient

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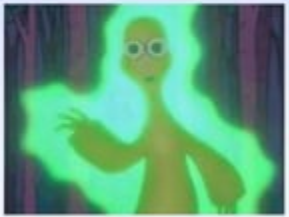
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Radiation Hazard

- Direct Radiation
- Leakage
- Scatter Radiation







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Keep detector close to patient.

Collimate.

Position shield in between patient and operator.

Radiation safety cap



Radiation safety glasses (with side panels).

Lead skirt and vest with thyroid collar.

Movable lead skirt.

Disposable shielding.



Contrast and Flush

- Up to 2 litters of Flush and 300ml of contrast used in these procedures.
- Patient are at risk of development of Acute Contrast induced Nephropathy and Hyponatremia.
- Limited use of contrast and good hydration practices can lower the risk.
- Post Op KFT and Urine output should be closely monitor up to 72 hrs.

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Anticogulation



- Heparin
- Direct Thrombin Inhibitors
- Antiplatelet agents
- Reversal of Anticogaulation

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Anti Coagulation

- IV Heparin and other dugs are also used in these procedures to avoid Thromboembolic complications and vessel occlusions.
- Base line Activated Clotting Time (ACT) should be obtained and 70-100 units /kg IV Heparin needs to be given.
- Post Procedural ACT should be targeted around 2-3 times of the base line.
- Post procedural reversal of Heparin done by 1mg protamin= each 100 units of initial Heparin.

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Position

- Position in these procedure is one another difficulty due to inability to access air way and IV line.
- Extra care should be given by using long infusion lines and Armoured/ RAE ET tubes can be used for intubation or a Routine PVC tube with adequate fixing tape.

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Anaesthetic Goals

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- Patient immobility
- Maintenance of adequate CPP
- Hemodynamic stability
- Rapid Identification and management of complications
- Smooth, rapid emergence to ameliorate undesirable effects on intracranial and central venous pressure .
- Management of anticoagulation.
- Analgesia.

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• WHEN A CASE IS POSTED

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PATIENT ASSESSMENT

History

- Background history and chronology of recent events.
- Neurological deficits and current GCS
- Symptoms of raised ICP
- Previous neurosurgical procedures (and review of anaesthetic chart where possible)
- Allergy history and medication review
- Relatives should be informed about
  Invasive monitoring
  Prolong elective ventilation and ICU stay.

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PATIENT ASSESSMENT

- **Examination**
- All general and Airway examination
- Establishment of baseline BP
- Neurological examination and assessment of GCS
- Cardio respiratory assessment.

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PATIENT ASSESSMENT

- **Investigations**
- Full blood count and coagulation testing
- Kidney function test and electrolytes.
- Glucose
- ECG
- Imaging

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PRE-OPERATIVE PREPRATION AND MONITORS

- NIBP
- SpO2
- ECG
- Temperature Probe
- Urinary Catheterization
- Arterial lines
- Standard and difficult airway equipment and long breathing circuits.
- Wide bore IV access and long extension lines.
- Central access may be considered but is not always necessary.
- Management of EVD.

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PRE-OPERATIVE PREPRATION AND MONITORS

- Special Drugs and Medications

1. Sodabicarb Infusion
2. Nimodipine inusion
3. Dexmedetomidine infusion

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Choice of Anesthesia

- IV Sedation/ MAC
- General Anethesia

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MAC

- ***Pros.***
  * Patient can remain conciuos and oriented , secure his airway.
  * Any allergic reaction or adverse event can be traced rapidly
  * Early Discharge.
- ***Cons***
  * Only possible in awake, cooperative patient
  * Best for elective diagnostic purpose only.
  * Image Quality may be compromised due to motion artifacs.

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IV Sedation

- ***Pros.***

  * Alleviate pain, anxiety, and discomfort, and allow rapid recovery.
  * No need for any specific Air way device.

- ***Cons***

  * Motion artifacts
  * Cerebral metabolics.

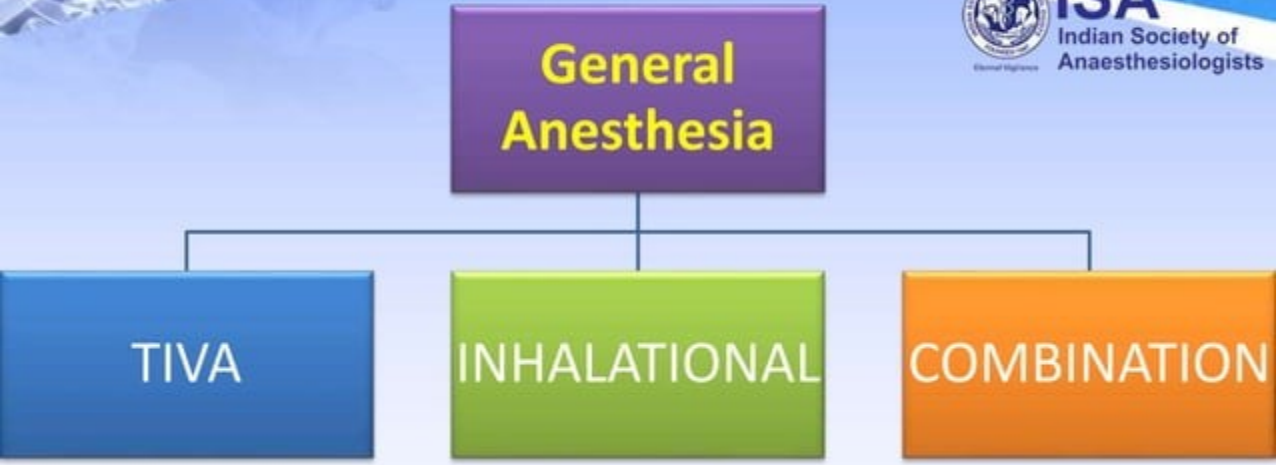
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General Anesthesia

- ***Pros.***
  * Minimize motion artefacts , to improve the quality of the image and to reduce catheter-induced complications.
  *Normocapnia or modest Hypocapnia can be easily managed
  * Juggling of hemodynamics is comparatively easy
- ***Cons***
  *Reversal of anesthesia
  *Anesthesist need to have a hawk eye for complication.
  *Real time Neurological assesment not possible.

General Anesthesia

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Induction

Maintenance

Emergence

Recovery

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INTRA-OPERATIVE MANGEMENT

- **INDUCTION :-**

*Aim is to maintain haemodynamic stability, CPP and avoid blood pressure surges.

*Opioid, Intravenous lidocaine, labetalol, Esmolol to attenuate pressor response.

*choice of intravenous agent is at the discretion of the anaesthetists.

*choice of muscle relaxant will also depend on the need for rapid sequence induction.

*Following intubation, the endotracheal tube must be secured carefully because of restricted airway access as discussed.

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INTRA-OPERATIVE MANGEMENT

- **Maintenance**
  *Both total intravenous anaesthesia (TIVA) and volatile anaesthesia maintenance are considered appropriate.

  *TIVA technique – usually a **Propofol/Remifentanil** target controlled infusion - include haemodynamic stability and the avoidance of the potential for volatile-mediated uncoupling of cerebral metabolism and cerebral blood flow.

  ***Atracurium** (by intermittent boluses or infusion) can also be used for guaranteed immobility.

  ***Sevoflurane** is the volatile agent of choice as cerebral blood flow and metabolism coupling is maintained up to 1 MAC.

  *Post-operative analgesia- infusion of remifentanil or boluses of other opioids such as fentanyl or alfentanil.

INTRA-OPERATIVE MANGEMENT

- ***Emergence***

  ***A**im is to wake the patient up in a smooth, rapid manner that allows for early neurological assessment.

  *An ETT to LMA exchange or wake patients with a background remifentanil infusion in progress.

- ***Recovery***

  *Patients often require ongoing haemodynamic monitoring and BP management, and so may be managed post-operatively in a critical care area.

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POST-OPERATIVE MANAGEMENT

- Maintenance of blood pressure depends on each procedure; slightly low blood pressure is maintained after CAS and AVM embolization and hypertension is maintained after coil embolization for ruptured aneurysms.
- Contrast-induced nephropathy is another problem presenting during the post-procedural period

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DELIBERATE HYPERTENSION

- During acute arterial occlusion or vasospasm, the only practical way to increase collateral blood flow may be an augmentation of the collateral perfusion pressure by raising the systemic blood pressure.
- Systemic blood pressure is raised by 30% to 40% above baseline.
- **Phenylephrine**, usually the first-line agent for deliberate hypertension.
- Norepinephrine (noradrenaline) and vasopressin are used occasionally when phenylephrine is not sufficient.
- The electrocardiogram and ST segment monitor should be carefully inspected for signs of myocardial ischemia
- There is also a risk of rupturing an aneurysm or arteriovenous malformation (AVM) with induction of hypertension.



DELIBERATE HYPOTENSION

- Two primary indications for induced hypotension are
  (1) to test cerebrovascular reserve in patients undergoing carotid test occlusion.
  (2) to slow flow in a feeding artery of a brain AVM before injecting glue **("flow arrest")**
- nicardipine or sodium nitroprusside infusions to induce hypotension.
- Intravenous adenosine has been used during aneurysm surgery to induce transient cardiac pause.
- Invasive Blood pressure should be monitor with utmost care.

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Management of Intracranial Catastrophes

- **Initial Resuscitation**
  Communicate with endovascular therapy team.
  Assess the need for assistance; call for assistance.
  Secure the airway and ventilate with 100% O2.
  Determine whether the problem is hemorrhagic or occlusive:
  Hemorrhagic:
  Immediate heparin reversal (1mg protamine for each 100 units of heparin given) and low normal mean arterial pressure.
  Occlusive:
  Deliberate hypertension, titrated to findings of neurologic examination, angiography, or physiologic imaging studies or to clinical context.
- **Further Resuscitation**
  PaCO2 manipulation consistent with clinical setting; otherwise normocapnia.
  Mannitol 0.5g/kg, rapid IV infusion.
  Titrate IV agent to electroencephalographic burst suppression.
  Consider ventriculostomy for treatment or monitoring of increased intracranial pressure.
  Consider anticonvulsant.

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Procedure	Possible Anesthetic Considerations
Therapeutic embolization of vascular malformation	
1. Intracranial AVM	Deliberate hypotension, postprocedure NPPB
2. Dural arteriovenous fistula	Existence of venous hypertension; deliberate hypercapnia
3. Extracranial AVM	Deliberate hypercapnia
4.Carotid cavernous fistula	Deliberate hypercapnia, postprocedure NPPB
5.Cerebral aneurysms	Aneurysmal rupture, blood pressure control[*]
6.Ethanol sclerotherapy of arteriovenous or venous malformations	Brain swelling, airway swelling, hypoxemia, hypoglycemia, intoxication from ethanol, cardiorespiratory arrest
7.Balloon angioplasty and stenting of occlusive cerebrovascular disease	Cerebral ischemia, deliberate hypertension, concomitant coronary artery disease, bradycardia, hypotension

Procedure	Possible Anesthetic Considerations
8. Balloon angioplasty of cerebral vasospasm secondary to aneurysmal subarachnoid hemorrhage	Cerebral ischemia, blood pressure control[*]
9. Therapeutic carotid occlusion for giant aneurysms and skull base tumors	Cerebral ischemia, blood pressure control[*]
10. Thrombolysis of acute thromboembolic stroke	Postprocedure intracranial hemorrhage (NPPB), concomitant coronary artery disease, blood pressure control[*]
11. Intra-arterial chemotherapy of head and neck tumors	Airway swelling, intracranial hypertension
12. Embolization for epistaxis	Airway control



Thankyou



