CEREBRAL ANEURYSMS IN THE ENDOVASCULAR SUITE

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Interventional neuroradiology

Major challenge

- Anesthesia
- Lengthy/Complex procedures
- Outside operating room
- Aging population
Anesthesia

Outside the operating room

Challenging

RISKY

Adverse respiratory events

Careful monitoring by experienced anesthesiologist

Operating room monitoring

Operating room standard of care

Personal with knowledge of emergency protocols
Recommendation from international commission on radiological protection

Total body dose < 20mSv/year

Protective measures

- Lead aprons of > 0.5mm thickness
- Thyroid collars
- Glass lead screens
- 4 feet away from radiation source
- Scattered radiation
- New evidence of high ocular radiation
  → Protective eyewear
Neurological Imaging

High speed digital subtraction angiography + Fluoroscopic technology

1. Injection of contrast agent into circulation
   - Insertion of catheter into vascular circulation (Internal carotid/Vertebral artery)
   - Vascular “Road-mapping”

2. Visualization of catheter tip with real time high resolution fluoroscopy
   - SUPERIMPOSITION
   - Image
   - Degradation of quality with patient movement
   - General anesthesia with less artifacts
Coiling Techniques: Direct Coiling
Coiling Techniques: Stent Assisted Coiling
Coiling Techniques: Balloon Assisted Coiling
Anesthetic considerations

Central nervous system

Full neurological exam

Before any interventional procedure

Level of consciousness

Presence of focal neurological deficits
Anesthetic considerations

Cardiovascular system

Subarachnoid hemorrhage → Hyperactivity of sympathetic system → Massive release of catecholamines

- Significant ECG changes
- Arrhythmias
- Left ventricular systolic dysfunction

Optimization of preoperative hypertension/arrhythmias → Appropriate invasive hemodynamic monitoring → Procedure
Anesthetic considerations

Respiratory system

Unconscious patients

Aspiration
Pneumonia
Respiratory associated comorbidities
Neurogenic pulmonary edema

COPD
Respiratory infections
Anesthetic considerations

Airway assessment

Routine

Electrolytes

Hyponatremia

10% - 34%

SIADH

Cerebral salt wasting syndrome
Cerebral Angiography

Majority of workload in the neuroradiology suite

Majority of awake patients

Guideline to differentiate patients to be sedated or given GA

Importance or laying still

Possibility of hot sensation in head/face during injection

Possibility of headache during catheter manipulation
Endovascular coiling

- Safely undertaken within hours of aneurysm rupture
- Dependent on size and configuration of aneurysm

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Complete thrombosis (%)</th>
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<tbody>
<tr>
<td>&lt;4</td>
<td>54 - 87</td>
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<tr>
<td>&gt;4</td>
<td>15 - 35</td>
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Monitoring and Equipment

Standard Monitoring
- Pulse oximetry
- ECG
- Capnography

Arterial cannulation
- Controlling BP
- ACT

Cold Radiological suites
- ↑ Risk of hypothermia
  - Temperature monitoring
    - Warming devices

Extra long tubing/leads
- Away from radiologists’ view

Urinary catheter
- Large flush volumes
- Large contrast volumes

Long procedures
Intravenous access

Two large bore intravenous cannulas

- Extra long extensions
- Easily accessible injection port
- CHECKING prior to procedure
Anesthesia

General anesthesia

Immobile patient

Improved imaging

Improved outcome

Induction

Hemodynamic stability

Adequate muscle relaxation

Adequate fixation of ET tube

Prevention of BP surge
Anesthesia

Maintenance

Propofol/Remifentanil target controlled infusions

- Cardiac stability
- Rapid emergence

Nitrous oxide → Expansion of microair emboli → Avoidance

Sevoflurane → Volatile agent of choice

Coupling of CBF and CMRO₂ up to 1 MAC

AIM

- Motionless patient
- Optimal cerebral perfusion
- Cardiovascular stability
- ICP control
Anesthesia

Maintenance

AIM

BLOOD PRESSURE MANIPULATION

SAH

Impaired autoregulation

BUT

Avoidance of hypotension

Maintenance of CPP

BP > 160mmHg

Aneurysm rupture

Labetalol

Minimal effect on cerebral circulation

Esmolol

Short acting and titratable
Prevention of thromboembolic complications during and after procedure

Baseline ACT

ACT > 2ACT\textsubscript{b} – 3ACT\textsubscript{b}

Heparin infusion

Bolus of heparin: 70 IU/Kg
Anesthesia

Recovery

AIM

SMOOTH

RAPID

Immediate assessment of neurological status
Complications

- Acute complications
  - Hemorrhagic
    - Intracranial vessel injury
  - Occlusive
    - Intracranial vessel dissection
    - Aneurysm perforation
- CNS complications
  - Displacement of coil into parent vessel
  - Coil fracture
  - Vasospasm
- Thromboembolic complications
- Contrast reactions
  - Hemorrhage at puncture site
- Non CNS complications
  - Retroperitoneal hematoma
  - Groin hematoma
Complications

Hemorrhagic complications

Sudden Rise in MAP

- Immediate lowering of systemic arterial pressure
- Immediate reversal of heparin
  - 1mg Protamine for each 100u of heparin
- ↓ Cerebral edema
  - $\text{PaCO}_2 = 30$
  - Mannitol 0.25g/kg – 0.5g/kg
- Aneurysm perforation
  - Packing of defect with coils
    - FAILURE
    - EMERGENCY CRANIOTOMY
  - Embolization with glue
- Hemorrhage
  - New SAH
  - Acute hydrocephalus
    - Ventricular drainage
Occlusive complications

- Thrombolytic agents
- Antiplatelet agents

OCCLUSION

- ↑ Arterial pressure
- ↑ Collaterals’ flow
- Maintenance of normocarbia
Complications

Occlusive complications

VASOSPASM

Papaverine

Intra-arterial injection

Transient effect

Systemic side effect

Triple therapy

Angioplasty

Most effective

Hypertension, Hemodilution, Hypervolemia

Risks

Pulmonary edema

Cerebral edema

Myocardial ischemia

Electrolyte imbalance

Risks

Vessel rupture

Rebleed
Complications

Contrast reactions

Contrast

Iodinated

ACUTE REACTION

Injection of contrast

20 min

Hypertonicity

Direct cardiac depression

Idiosyncratic reactions

Anaphylactoid reactions

Non Iodinated

DELAYED REACTION

Skin rash

Hx of contrast allergy

Antihistramines

Steroids
THANK YOU