Vascular Anaesthesia: Thoracic EVAR

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Session Summary

• Morbidity case – Thoracic EVAR
  • SBAR as per SALG morbidity and mortality tool

• Practical guide for complex EVARs

• A success story
Situation: Case 1

- **Admitting diagnosis:** Collapse and profound hypotension
- **Procedure performed:** Renal artery embolisation
- **Complication:** Paraplegia secondary to spinal cord ischaemia
Background

- 65 year old gentleman
- Elective thoracic EVAR – 08/10/2015

PMHx

- Previous repair of ruptured infra-renal AAA (2006)
- Renal stones
- Hypertension
- Ex-smoker
2008

- **CT Scan**: Persistent shadowing of left base of lung? Neoplasm

*Lost to follow-up!!!*
2014

- Admitted with: fall, SOB and rib pain
- CXR showed a possible pneumothorax
- CT scan requested
Stable penetrating atherosclerotic ulcer

Increase in size of aneurysm
April 2015

• Follow-up CT
  • Penetrating ulcer stable at 3.7cm
  • Size of thoraco-abdominal aneurysm increased to 7cm!
RISK OF RUPTURE!

- Major challenge of thoracic EVAR
  - Optimize proximal landing zone due to close proximity of supra-aortic branches
  - Preserve supra-aortic branches
  - Need a 2cm healthy segment of aorta for landing zone
  - Distal landing zone – compromise mesenteric arteries

SMA = Artery of Death
Option 1: De-branching Arch Vessels
Option 2: Abdominal Branch
Other Options

• Surgical repair (considered high risk)
• Do nothing!

• Decision: Best option = Abdominal branch
Procedure: 8/10/15

- 7.5 hr procedure (uneventful)
- SBP maintained > 120mmHg throughout with Metaraminol
- Post-op instructions:
  - Maintain MAP >75mmHg & SBP >100mmHg
Post Stent
Re-admission: 16/10/2015

- Developed abdominal pain
- 5hrs later – found collapsed at home
- Paramedic arrival – profoundly hypotensive and unable to move lower limbs
- On admission SBP < 80mmHg despite fluid resuscitation
Peri-renal haematoma

Re-admission: 16/10/2015
Re-admission: 16/10/2015

- Interventional radiology: renal artery embolisation
- Prior to induction started on vasopressors
- Central line inserted and started on inotropic support
- MAP maintained > 85mmHg
- 3 Units blood transfusion
- Spinal drain inserted – high opening pressure (not measured)
- Transferred to ICU as level 3
- Extubated 6hrs later
Re-admission: 16/10/2015

• Remained paraplegic despite spinal drain

• **MRI scan**
  • Cord expansion and diffusely increased T2 signal below T8 down to apex of conus medullaris
  • Secondary to acute ischaemia after occlusion of artery of Adamkievix

• Spinal rehabilitation at Pinderfields
Assessment & Analysis
Error Analysis

• No CT post procedure
• Damage to renal artery → Peri-renal haematoma
Root Cause Analysis

**Human Error**
- Failure on re-admission to treat profound hypotension adequately whilst awaiting diagnosis

**Patient Related Factors**
- Multiple risk factors for development of spinal cord ischaemia
  - ? Prophylactic spinal drain at original procedure
Root Cause Analysis

**System Error**
- No system in place to ensure follow-up post procedure
- No protocols in place for detection and monitoring of neurological deficit
- No protocols for management of spinal drains
Spinal Cord Perfusion

• Mainly by greater radicular artery of Adamkiewicz
  • Originates from the aorta at level T9 - T12
  • 11% origin L1 –L2; level of renal arteries

• Importance of collateral network plays a role in maintaining spinal perfusion
Spinal Cord Perfusion

Perfusion pressure = MAP – CSF pressure

- Maintain low CSF pressure < 10mmHg
- MAP manipulated by anaesthetist
Spinal Cord Ischaemia (SCI)

• Incidence: 1-4% for endovascular
  2-11% for open repair

• Perioperative mortality 46%

• Mechanism:
  • Critical interruption of spinal cord blood supply – coverage of collateral/feeder vessels
  • Thromboembolic
  • Perioperative hypotension
SCI Risk Factors

- Previous open or endovascular aortic surgery
- Length of aortic graft coverage > 50%
- Duration of surgery
- Perioperative hypotension
- Perioperative blood loss
- COPD
- Cutaneous atheroembolisation
- Post-operative requirement of inotropic support
Spinal Drain

• Performed following anaesthesia and insertion of arterial and venous lines
• Inserted at L4/5 level
• Transducer placed at mid atrial level
• CSF drained manually by gravity: maintain CSF pressure <15 mmHg
• Drained in 5-10ml aliquots
• Volume removed should be recorded
• CSF drained for 48-72hrs
Contra-indications: Spinal Drain

- Acute trauma
- Active infection
- Aortic rupture
- Prior paraplegia
- Previous spinal surgery
Complications: Spinal Drains

• Intra-spinal/subdural haematoma
• Subarachnoid haemorrhage
• Meningitis
• CSF fistula formation
• Catheter retention
Literature Review
Neuroprotective Strategies Can Prevent Permanent Paraplegia in the Majority of Patients Who Develop Spinal Cord Ischaemia After Endovascular Repair of Thoracoabdominal Aortic Aneurysms

S.H. Rossi a, A. Patel a, P. Saha a, A. Gwozdz a, R. Salter b, P. Gkoutzios b, T. Carrell a, S. Abisi a, B. Modarai a,*

- Case series: 12 patients over 7-year period
- **Key maneuvers**: elevating MAP and spinal CSF drainage
- Prophylactic drainage an essential adjunct
- Importance of an institutional protocol and adequate critical care support for facilitating prompt diagnosis and intervention
- Neurological deficit successfully reversed in over half of patients
Protocol - Aortic and aneurysmal

The safe use of spinal drains in thoracic aortic surgery

Mark Field*, Jim Doolan, Maria Safar, Manoj Kuduvalli, Aung Oo, Keith Mills, Jonathan Kendall, Michael Desmond

• Spinal drainage as part of a package of interventions contributes to a reduction in incidence of paraplegia

• Protocol developed for CSF drainage in conjunction with NPSA

• Care bundles developed:
  • Spinal drain insertion
  • Intra-operative management
  • Post-operative management
  • Management of neurological deficit
  • Trouble shooting of spinal drain
Postoperative Care Spinal Drain

ICP Monitoring
(Nurse led – immediate postoperative)

- Head up ≥ 30°
- Position zero at level of heart
- 3 Way tap
  - Turn drain bag off to patient
  - Mark as spinal/not for injection
- Flush
  - Turn off
  - Mark as spinal/not for flushing
- Monitor continuously
- 5000 U s/e heparin TDS (DVT prophylaxis)
- Do NOT use Hood CPAP (face CPAP to be d/w consultant)

Parameter and Pressures
(Fill in main observation chart)

- MAP > 85 mmHg
  - Maintain with fluids and noradrenalin infusion as necessary
- ICP < 15 mmHg
  - Intermittent drainage (anaesthetist only) maximum 20 ml/h (in 5-10 ml aliquots) slowly
  - If ICP still > 15 mmHg increase MAP till CPP (MAP-ICP) > 70 mmHg
- O₂ Saturation > 95%

Turn off sedation at
hours and assess (use assessment chart)

- Continue
  - Reassess every …… hours
  - At 72 h
    - Check clotting
    - Subcutaneous heparin (≥8 h before and after removal)
  - Remove Drain

- Medical Emergency
  - Contact anaesthetic Spr, consultant anaesthetist and consultant surgeon follow protocol
Neurological deficit

Medical Emergency
Contact on call anaesthetist and/or consultant anaesthetist

[Modified ‘COPS’ protocol (Estrella et al., 2009)]

<table>
<thead>
<tr>
<th>Individual elements</th>
<th>Interventions</th>
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<tbody>
<tr>
<td>Cerebrospinal fluid drainage</td>
<td>- Check drain function (if not working replace)</td>
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<tr>
<td></td>
<td>- Lie completely flat</td>
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<tr>
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<td>- ICP &lt;10 mmHg</td>
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<td>- Drainage in 10 ml increments (no more than 20 ml. Will need immediate review by consultant anaesthetist)</td>
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<td>- Keep in for 7 days</td>
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<tr>
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<td>- 5000 U sc heparin tds</td>
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<tr>
<td>Oxygen delivery</td>
<td>- O² Satuations &gt;95%</td>
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<tr>
<td></td>
<td>- Haemoglobin &gt;10 g/dl</td>
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<td></td>
<td>- Cardiac index &gt;205 l/min/BSA</td>
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<tr>
<td>Pressure management</td>
<td>- MAP &gt;90 mmHg</td>
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<tr>
<td></td>
<td>- SCPP &gt;80 mmHg (MAP-ICP)</td>
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<tr>
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<td>- Adequate right sided filling pressures</td>
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<tr>
<td>Status of patient</td>
<td>- Regular neurological observations</td>
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<td>- CT-scan head and spine if paraplegia</td>
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Bloodstained CSF

Medical Emergency
Contact on-call Anaesthetic and/or Anaesthetic Consultant

Stop draining
Correct coagulopathy
Consider Imaging
Altered mental status or focal deficit - immediate CT
• Preoperative placement of spinal drains
  • Efficacious in prevention and reversal of SCI in thoracic and thoraco-abdominal repairs where there is a much greater incidence of ischaemia
Practical Guide for Complex EVARs

• Team brief
• Right sided invasive monitoring lines
  • Often left axillary/left brachial for access
• Prolonged procedure
  • Heparin bolus at 100-150IU/kg
  • Heparin infusion 1000 units/hour
• Hourly ABGs
  • High index of suspicion for mesenteric ischaemia
  • Manifest as persistent metabolic acidosis
• Risk of contrast induced nephropathy
  • N-acetylcysteine 600 mg twice daily orally for 24 hours starting on the day before surgery
• Post-op HDU/ICU
Recommendations

• Post procedural CT prior to discharge

• Use of prophylactic spinal drain for complex TAAA and those with risk factors

• Prevention of hypotension in perioperative period
  • Maintaining systolic BP > 100mmHg
  • MAP 75-80mmHg
Recommendations

• Frequent neurovascular monitoring of lower extremities
  • If neurological deficit develops
    • Maintain MAP > 90mmHg
    • Insert spinal drain if one not already in place
    • Decrease CSF pressure < 10mmHg

• Infrequent use of spinal drains on ICU
  • Education of post-operative management
  • Development of protocol for management of spinal drains
  • Care bundles for spinal drain
Success Story – Case 2

• 79 year old gentleman
• Known 6cm thoracic aneurysm and 3.8cm infra-renal AAA

PMHx
• Hypertension
• AF
• Non-smoker
• Asbestos exposure
Success Story

- 11/12/2014: Transferred from Scunthorpe with a ruptured thoracic aneurysm out of hours
Success Story
Success Story
Success Story

- Follow-up CT scan
  2015
Suggested Action Points

• Development of protocol detailing indications for spinal drains and their management and care on ICU

• Develop a protocol for ‘Medical response to Neurological Impairment’ (similar to the COPS guide)
QUESTIONS?
References


