Paraplegia 2017: How Does it Relate to Thoracic Endovascular Aortic Aneurysm Repair (TEVAR)?

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Disclosures

I have no conflicts of interest.
Paraplegia After TEVAR

- Paraplegia
- Crawford reported a 30% incidence of paraplegia following open repair of Type II aneurysms with no intercostal reimplantation
Paraplegia after TEVAR

• Paraplegia

➢ Since extensive endografting of the thoracic aorta necessarily covers multiple intercostal arteries, one might expect to see paraplegia with a similarly high frequency
Paraplegia after TEVAR

• Paraplegia

➢ Our experience, and that of others, does not reflect the same high incidence of paralysis as reported by Crawford, despite extensive coverage of the thoracic aorta with endografts
Paraplegia after TEVAR

Hypogastric arteries

SPINAL CORD BLOOD SUPPLY

Human Anatomy

Vertebral A.
Anterior Spinal A.

Basilar A.

Artery of Adamkiewicz

Radicular Spinal Arteries
Paraplegia after TEVAR

• Etiology
  ➢ Acute paraplegia
    • Coverage of critical intercostal or collateral artery
      • Left subclavian
      • Intercostals
      • Hypogastric
    • Embolization
Intercostal reimplantation
Paraplegia after TEVAR

Acute Onset

Embolization
Paraplegia after TEVAR

Delayed onset paraplegia

➢ Decreased perfusion
  • Hypotension intra-op or post-op
  • Marginal collaterals
  • Delayed closure of endoleak

➢ Cytokine activation with secondary neuronal injury
Paraplegia after TEVAR

- 127 patients
- 3 of 127 pts (2.4%) developed spinal cord ischemia
  - No acute paraplegia
  - All delayed onset – PO day 1, 3 days, 6 weeks
Paraplegia after TEVAR

Patient #1

- Etiology - Hypoperfusion
  - Excessive anti-hypertensive medication
Paraplegia after TEVAR

Patient #1

- 76 y/o male with previous AAA repair
  - Underwent TEVAR
  - 32 cm length covered
- Neurologically normal post-op
- 6 weeks later developed paraplegia
  - CSF Drainage, BP elevation
  - Return of neurologic function
Paraplegia after TEVAR

**Patient #1**

- Returned again 6 weeks later, but 3 days after onset of paraplegia
- No response to CSF drainage
- Remained with permanent paraplegia
Paraplegia after TEVAR

Patient #2

- Etiology - Delayed occlusion of critical intercostal artery
  - Closure of endoleak with thrombosis of a critical collateral artery
Paraplegia after TEVAR

Patient #2

- 72 y/o male with previous AAA repair underwent TEVAR
  - Type II endoleak noted on completion angiography
  - Discharged PO day #1 with normal neurologic exam
Paraplegia after TEVAR

Patient #2 – Post-op

Type II endoleak
Paraplegia after TEVAR

Patient #2

- 3 days post-op had sudden onset of back pain
- Presented to ER and CT scan obtained
- No endoleak
- No expansion of aneurysm
- TEVAR intact without migration
- Discharged from ER
- Developed paralysis as he walked away
Paraplegia after TEVAR

Patient #2

CT Scan after emergency room visit

Endoleak has closed
Paraplegia after TEVAR

Patient #2

Interpretation:

• Endoleak maintained collateral flow to cord
• Back pain due to paraspinous myalgia when endoleak closed caused muscle ischemia
• Collateral flow insufficient to maintain adequate spinal cord perfusion
Paraplegia after TEVAR

Patient #3

- Etiology – Reperfusion injury from activated cytokines
Paraplegia after TEVAR

Patient #3

- 78 y/o female
- TAA: 8cm diameter, 16 cm length
- Coexisting 4cm AAA
- Comorbidity: COPD
- 2 devices needed for TAA exclusion
Paraplegia after TEVAR

Gore Thoracic Excluder

Deployment Knob
(unscrew / steady pull)
Paraplegia after TEVAR

Patient #3

Misdeployment of the 2\textsuperscript{nd} device across the visceral segment of aorta
Paraplegia after TEVAR

Patient #3

- Device extracted via infra-renal aorta (40 minute visceral ischemia time)
- Tube graft repair of AAA
- Deployment of 2nd TEVAR in appropriate location
Paraplegia after TEVAR

Patient #3

• After awakening from anesthesia, neurological examination was normal
Paraplegia after TEVAR

Patient #3

- Day after operation, left leg paralysis, right leg weakness noted
- Lumbar CSF drain inserted
- Dexamethasone IV
Paraplegia after TEVAR

Patient #3

• Complete resolution of neurologic sequellae by POD #3
• Discharged home POD #8, asymptomatic
• Normal examination at 18 mo follow-up
Paraplegia after TEVAR

Patient #3

➢ Delayed-onset Paraplegia

• Prolonged gut ischemia with intra-operative activation of cytokines can result in secondary spinal cord injury (cord edema, apoptosis, direct cytokine injury, non-reflow phenomenon)
Paraplegia after TEVAR
SMA

RABBIT PARAGLEIA MODEL UTILIZING DUNN OCCLUDER

Valve- Stabilized in Transcutaneous Position

Wire- Truncutaneous Flow Probe

CSF Catheter

Pressure Monitor Line

SMA snare

SMA
Thoracic Endografts

Tarlov Scores

- Aorta 12 mins.: 3.6 +/- .84, p=.003
- Aorta 12 mins. SMA 10 mins.: 1.7 +/- 1.3, p=.001
- Aorta 12 mins. + SMA 12 mins: .67 +/- 1.4, p=.0009

- Aorta 12 mins. + SMA 18
Paraplegia after TEVAR

➢ Etiology
  − Acute paraplegia
    • Coverage of critical intercostal artery
    • Embolization
  − Delayed onset paraplegia
    • Decreased perfusion (hypotension)
    • Delayed closure of endoleak
    • Cytokine activation with secondary neuronal injury
Paraplegia after TEVAR

Summary

➢ The use of CSF drainage is helpful in reversing neurologic symptoms in some patients

➢ We recommend routine CSF drainage as a precaution in patients with prior thoracic or abdominal aortic replacement
Paraplegia after TEVAR

Summary

➢ Since gut ischemia can increase the risk of paraplegia, we recommend against simultaneous “debranching” procedures at the time of TEVAR
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