Methods of preventing spinal cord ischemia during TAA open and endovascular surgery

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Critical Issues
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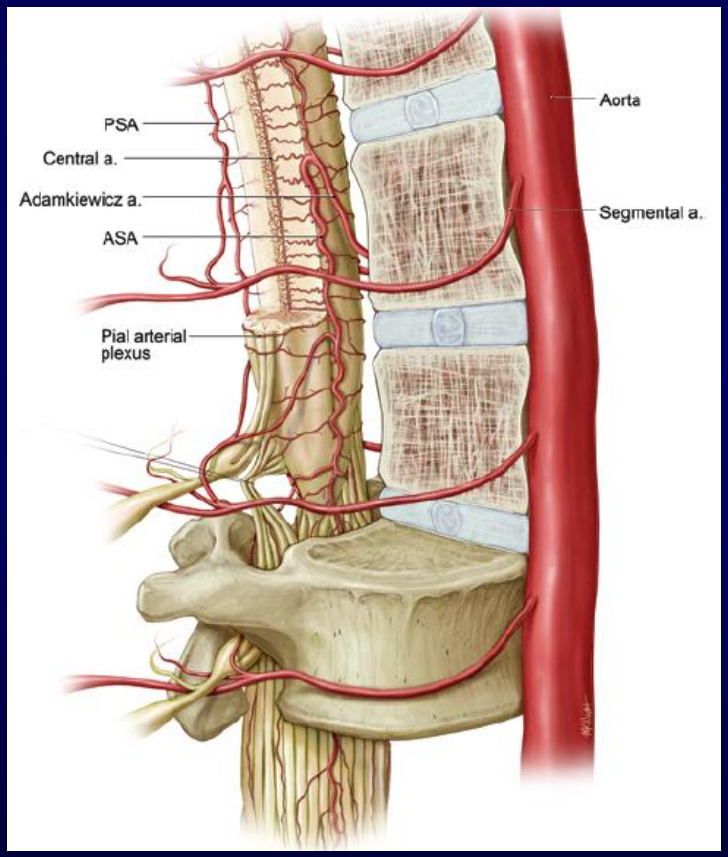
Disclosures

- none

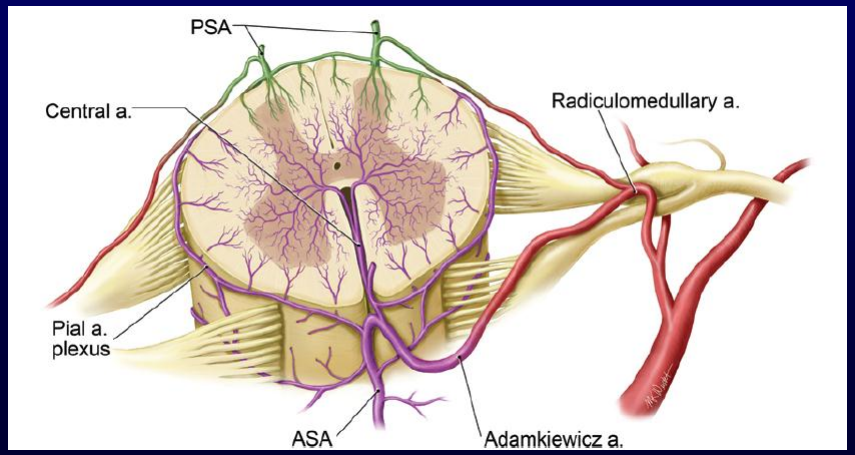
Monitoring

1. Identification of critical segmental arteries (pre-op)



Nr. ant rad. arteries 2-17
Art. Adamkiewicz T8-L2 (90%)

Profound collateral network (lumbar / pelvic)



Advances in Imaging of the Spinal Cord Vascular Supply and its Relationship with Paraplegia after Aortic Interventions. A Review

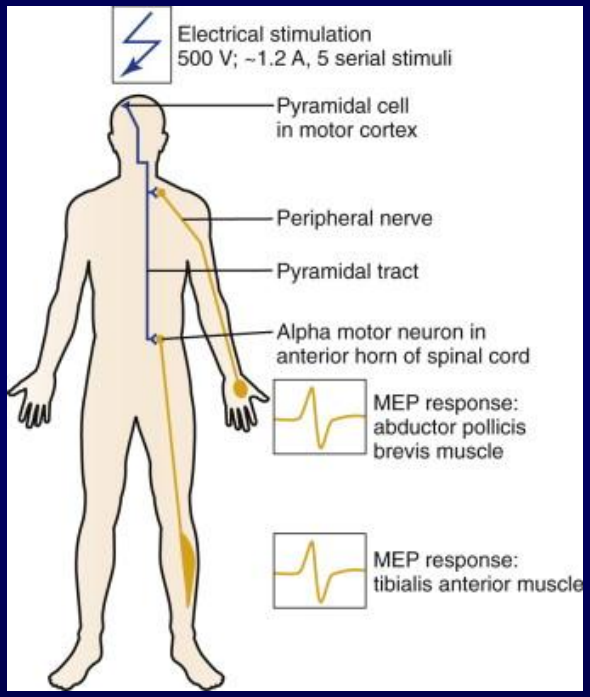
Eur J Vasc Endovasc Surg (2009) 38, 567–577

G. Melissano*, R. Chiesa

- 1196 patients, detection great radicular artery
  - Detection rates 81% (MRA) and 72% (CT-a)

- Clinical benefits:
  - Selective intercostal / lumbar re-implantation (open surgery)
  - Avoidance of unnecessary coverage intercostal feeders of ARM (TEVAR)
  - Selective revascularisation of left subclavian or hypogastric artery
  - Selective use of CSF drainage

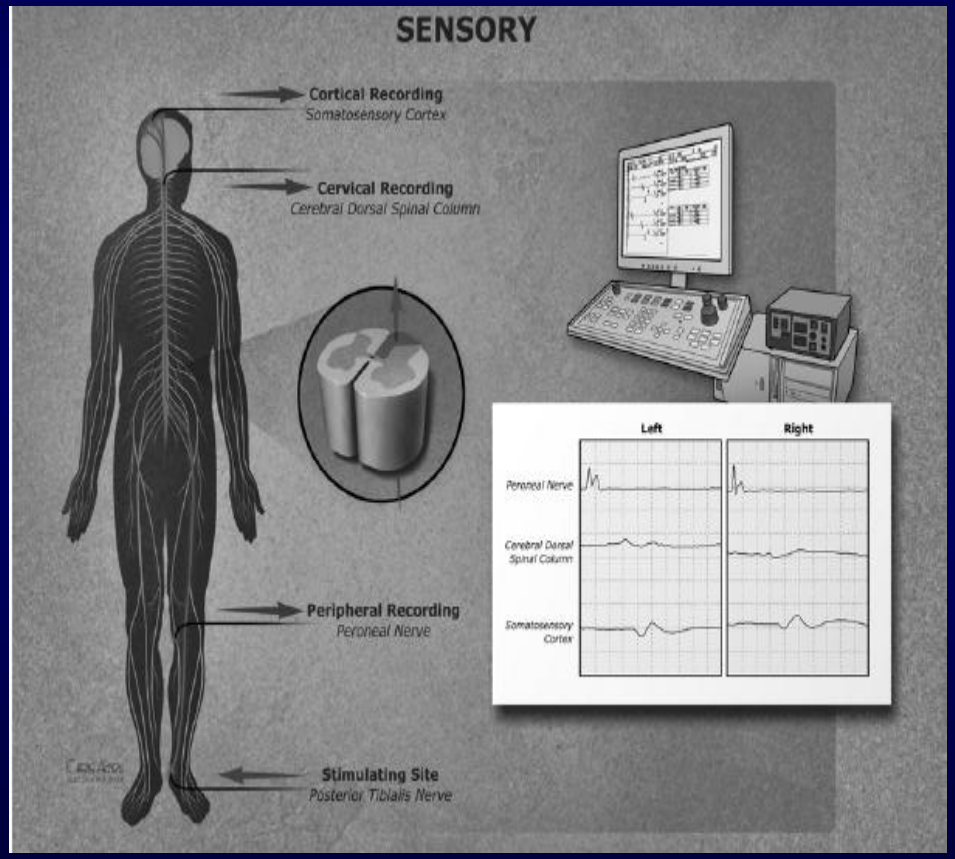
Monitoring
2. Intra-operative MEP



1.Reflects ά motor neurons
2.MEP ratio ↓ >50% significant
3.Irreversible MEP ↓ ~ SCI

4. Helpful to identify post-op MAP

Monitoring
3. Intra-operative SSEP

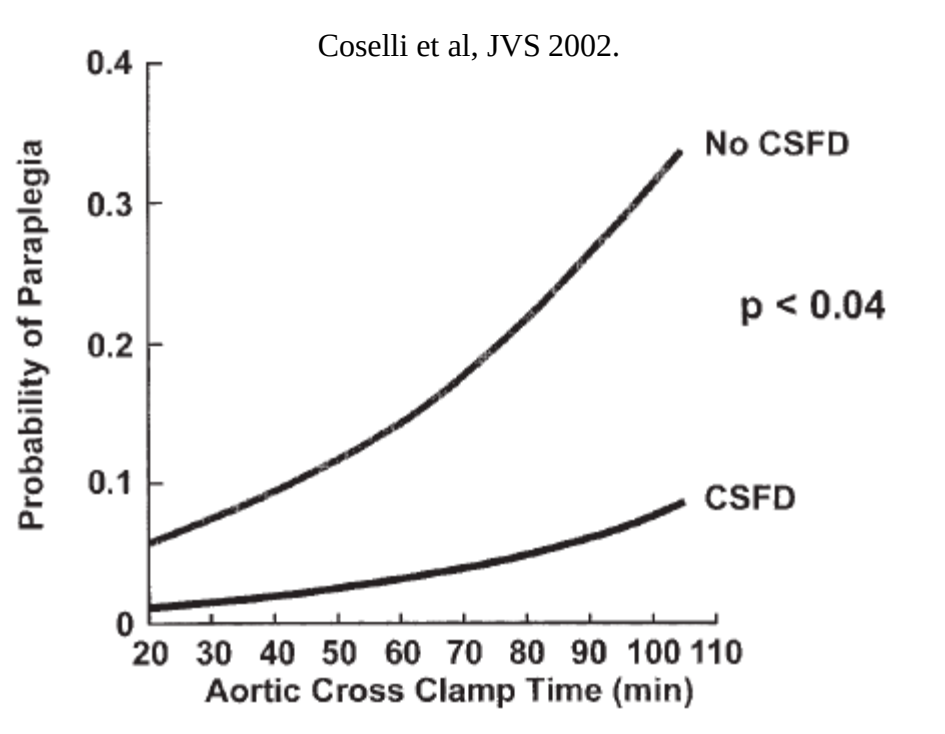


1. Only reflects posterior column (delayed ischemia detection)
2. High rate false positive and negative tests*

*Meylaerts SA et al. Ann Surg 1999.

1. Reduce duration of ischemia

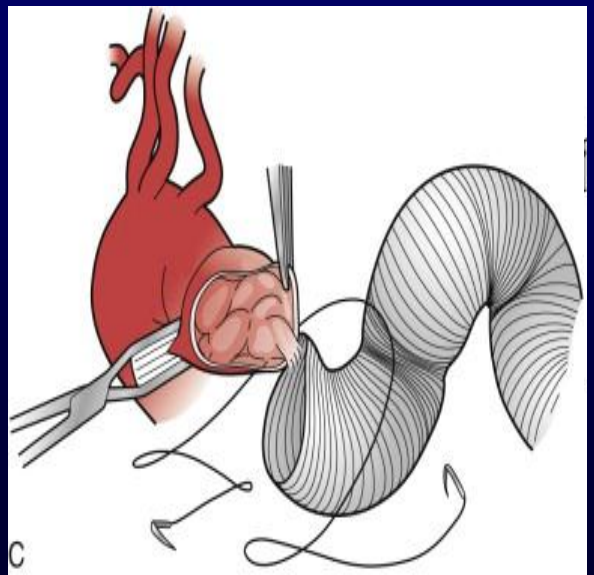
- Sequential aortic clamping
- Experienced multidisciplinary vascular teams*



*Cowan et al. JVS 2003;37:1169-74

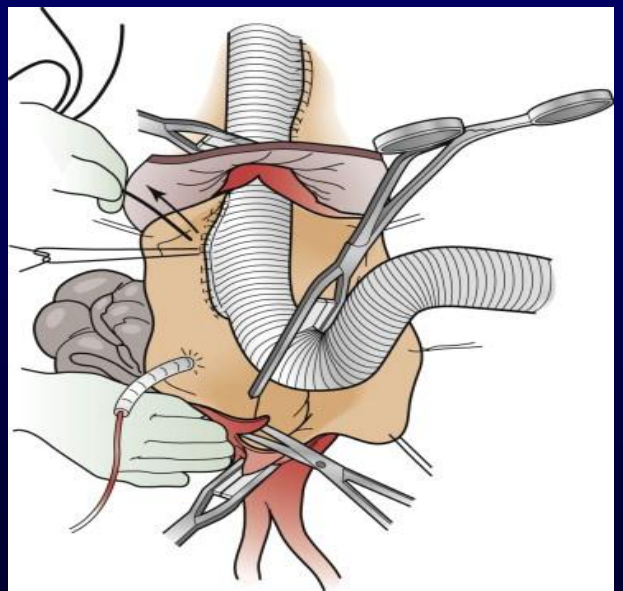
2. Reduce severity of ischemia

- Distal aortic perfusion techniques
  - Left atrial (pulm.vein) – femoral artery bypass
  - Distal aortic perfusion pressure 70 mmHg
- Sequential aortic cross-clamping (Jacobs, JVS 2006)



2. Reduce severity of ischemia

- Distal aortic perfusion techniques
  - Left atrial (pulm.vein) – femoral artery bypass
  - Distal aortic perfusion pressure 70 mmHg
- Sequential aortic cross-clamping
- Selective perfusion/ reattachment critical segmental arteries
- Endarterectomy aortic segment/ revasc. back-bleeding arteries
  - MEP (SSEP) guided



2. Reduce severity of ischemia

- Minimize blood steal from the spinal cord
  - 2F balloon-tipped catheters into intercostal arteries
  - Ligation of intercostal arteries before opening the aneurysm

3. Cerebro spinal fluid drainage

- Tuohy needle into subarachnoid space
- Spinal drain inserted
- CSF pressure 10 mmHg
  - 13 cm above ext. auditory meatus
- Continue for 72 hrs post-op.

Cerebrospinal fluid drainage reduces paraplegia after thoracoabdominal aortic aneurysm repair: Results of a randomized clinical trial

JOURNAL OF VASCULAR SURGERY
Volume 35, Number 4

Joseph S. Coselli, MD, Scott A. LeMaire, MD, Cüneyt Köksoy, MD, Zachary C. Schmittling, MD, and Patrick E. Curling, MD, *Houston, Tex*

145 patients, SCI: 2.6% (drainage) vs 13% (control), P < .05

4. Hypothermia

- Increases tolerance of neural tissue to ischemia
  - ↓ oxygen demand and metabolic rate
  - ↓ reperfusion syndrome

- Cardiopulmonary bypass
  - Full heparinization, coagulopathy, intrabronchial bleeding
- Spontaneous lowering core temperature 32˚

5. Post-op care

- CSF drainage first 72 hrs.
- MAP according to per-operative MEP
- Avoid hypotension, renal insuffiency
- Pharmagological agents
  - Free radical scavangers (in vitro experiments)

Results

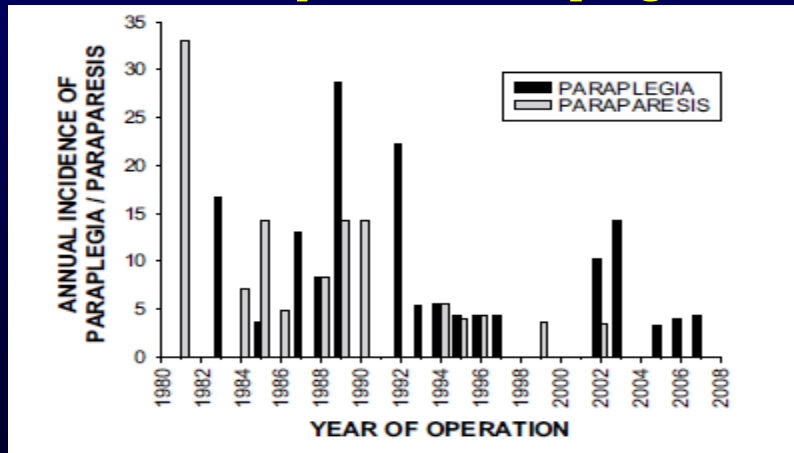
Thoracoabdominal Aortic Aneurysm Repair: Results of Conventional Open Surgery

Eur J Vasc Endovasc Surg (2009) 37, 640–645

M.A. Schepens*, R.H. Heijmen, W. Ranschaert [1], U. Sonker, W.J. Morshuis

571 patients TAAA repair (1981 – 2008)
30-day mortality 8.9%
Paraplegia / paraparesis 8.3%

Protecting factor SCI: use of CSF drainage and MEP/ sequential clamping



Results

The value of motor evoked potentials in reducing paraplegia during thoracoabdominal aneurysm repair

(J Vasc Surg 2006;43:239-46.)

Michael J. Jacobs, MD,[d] Werner Mess, MD,[b] Bas Mochtar, MD,[c] Robbert J. Nijenhuis, MD,[a] Randolph G. Statius van Eps, MD,[a] and Geert Willem H. Schurink, MD,[a] *Maastricht, The Netherlands*

- 112 consecutive TAAA repairs (42 type I, 70 type II)
- CSF drainage, hypothermia, MEP
- Reattachment of intercostal arteries in case of ↓↓ MEP

- No SCI in type I TAAA
- Early SCI 4.2%, delayed SCI 2.9% in type II TAAA

Results

Thoracic and Thoracoabdominal Aneurysm Repair: Is Reimplantation of Spinal Cord Arteries a Waste of Time?

(Ann Thorac Surg 2006;82:1670–8)

Christian D. Etz, MD, James C. Halstead, MA (Cantab), MRCS, David Spielvogel, MD, Rohit Shahani, MD, Ricardo Lazala, MD, Tobias M. Homann, MS, Donald J. Weisz, PhD, Konstadinos Plestis, MD, and Randall B. Griepp, MD

- 100 consecutive TAAA repairs (only 13 Crawford type II)
- MEP and SSEP monitoring
- Segmental ligation of intercostal/ lumbar arteries ***before*** aortotomy

- Mean 8 segmental artery pairs ligated
- Mean 4.5 segmental pairs ligated T7 – L1

- 2% SCI
  - Dissection
  - Delayed SCI

Conclusions

- Methods for preventing SCI during open TAAA
  - Reduction aortic clamp time / experienced teams
  - Sequential clamping with MEP (and SSEP) monitoring
  - Retrograde perfusion technique (70mmHg)
  - Moderate spinal cord hypothermia
  - CSF drainage (10 mmHg)

  - MEP ↓
    - Increase MAP / distal aortic perfusion
    - Reattachment segmental arteries
      - Endarterectomy excluded aortic segment , reattachment back bleeding intercostals

Conclusions

- Methods for preventing SCI during TEVAR
  - Pre-op MRA to evaluate segmental arteries / collaterals
  - Avoidance left subclavian / hypogastric coverage
  - CSF drainage (10 mmHg)
  - Hemodynamic stability

Conclusions

- Methods for preventing SCI post-TAAA repair
  - MAP based on per-op MEP values
  - Avoid hemodynamic instability
  - CSF drainage 72 hrs