Use of Near Infrared Spectroscopy (NIRS) for Monitoring Spinal Cord Perfusion During Endovascular Repair of Complex Aortic Aneurysms

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February 16, 2018
Relevant Disclosures

W.L. Gore - research funding; consulting; medical advisory board
Cook - research funding
Medtronic - medical advisory board
Spinal Cord Perfusion

- Artery Radicular Magna
- Paraspinal musculature
- Anterior Spinal
- Vertebral
- Segmental arteries
- Internal iliac

Randal Griepp (multiple sources)
Blood Supply To Spinal Cord Collateral Network After Complex EVAR

Main supply to the spinal cord collateral network after EVAR:

» Subclavian
» Internal iliac
» External iliac

Shijo Eur J Cardiothorac Surg 2015
Segmental Arteries After Endovascular Aortic Repair

- CT scans showed no reduction in the number of segmental arteries
- Collaterals maintain arterial patency of segmental arteries

Chang et al. J Endovasc Ther 2008
Spinal Cord Protection

- CSF Drainage
- MAP > 90 mmHg
- Transfusion to Hct ≥ 30
- Early restoration of LE perfusion
- Staged Procedures
Staging and Temporary Aneurysm Sac Perfusion (TASP)
Evoked Potentials (MEP and SSEP) Monitoring

MEP monitoring has been successfully used to detect SCI during TAAA repair and to reduce the incidence of neurologic complications.

Collateral Network Concept

Paraspinal Muscles

Collateral Network Near-infrared spectroscopy (cnNIRS)
Potential Benefits of NIRS

- LE ischemia and anesthetics don’t interfere with measurements
- Widely available and inexpensive
- Non-invasive
- Minimal technical requirements
- Can be easily continued post-operatively
Question: lumbar cnNIRS = Spinal cord oxygenation? ✔
Lumbar cnNIRS and Spinal Cord Oxygenation
NIRS Monitoring of Spinal Cord Collateral Network Perfusion

Near-infrared Spectroscopy Monitoring of the Collateral Network Prior to, During, and After Thoracoabdominal Aortic Repair: A Pilot Study

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- Aortic cross clamp and CPB change lumbar CN perfusion
- SCI associated with greater reduction in saturations

Etz, et al.  Eur J Vasc Endovasc Surg 2013
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cN oxygenation (in % baseline)

* p < .01 (ThS vs. LbS)

Etz, et al. Eur J Vasc Endovasc Surg 2013
15 patients; open TAAA repair
All had NIRS + MEP monitoring
No patients suffered SCI

- NIRS changes correlated with MEP changes (p = 0.037)
Spinal Cord Protection – Role of NIRS?

CSF Drainage

- CSF Drainage
- MAP > 90 mmHg
- Transfusion to Hct ≥ 30
- Early restoration of LE perfusion
- Staged Procedures
- **NIRS monitoring**
Test Occlusion of Last Branch

Test Occlude for 10 min

NIRS no Δ

Complete repair

NIRS ↓ Lb sat

Leave branch open (TASP)
Cornell Experience: Complex EVAR and NIRS

- Physician-sponsored IDE study
- Endovascular TAAA repair with F/B-EVAR
- NIRS last 25 consecutive patients
- No cases SCI
- Study ongoing
Intraoperative NIRS Monitoring

Thoracic

Lumbar

Sheath In
Sheath Out
Final Branch

4 Hours 09-Nov-16 15:17

73 74

68
Impact of Early Pelvic & Extremity Reperfusion on SCI

- CSF drainage, MAP > 90, aggressive blood transfusion
- Early withdrawal of large femoral sheaths to reperfuse pelvis and LE
- > 10-fold drop in SCI incidence:
  - 14% prior to protocol (43 patients)
  - 1.2% after protocol (161 patients)

Warein Eur J Vasc Endovasc Surg 2016
Conclusions

Spinal cord perfusion monitoring with NIRS during complex EVAR remains investigational.

Preliminary clinical data suggests NIRS may be a useful adjunct to monitor spinal cord collateral network perfusion during open TAAA repair.

Study of NIRS during complex EVAR is ongoing.