Near-Infrared Spectroscopy To Non-Invasively Monitor Spinal Cord Perfusion: How Does it Work and Early Experience

Christian D. Etz

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ONSET TIME OF POSTOPERATIVE PARAPLEGIA

Mean: 36.8 ± 38.9 hrs (1st Episode)
Median: 21.6 hrs (1st Episode)
7.3 Days or 176 hrs (2nd episode)

paraspinal cnNIRS

How does it work?
Collateral Network Near-infrared spectroscopy (cnNIRS)

Non-invasive real-time collateral network NIRS

Paraspinal cnNIRS VALIDATION

Experimental Sequence A
- Baseline
- X-clamping (ischemia: 8 min.)
- Clamp release (recovery)

2. Etz et al., Eur J Vasc Endovasc Surg. 2013 Dec;46(6):651-6
Experimental setup

Non-invasive cnNIRS

Regional lumbar cnNIRS reflects spinal cord oxygenation

Experimental MIS²ACE lumbar cnNIRS monitoring

Lumbar cnNIRS and neurological outcome

paraspinal cnNIRS VALIDATION (B)
Serial segmental artery occlusion (MIS²ACE)
Lumbar cnNIRS significantly correlates with neurological outcome after experimental consecutive segmental artery occlusion (R = 0.7, P<0.001).

Experimental validation lumbar cnNIRS

1. Reflects lumbar spinal cord oxygenation
2. Reacts to occlusion of segmental arteries in real-time
3. Correlates with neurological outcome after MIS²ACE

Paraspinal cnNIRS

First clinical results

Concept validation open TAAA repair

Clinical study – preliminary results –

1. Endovascular aortic repair (EVAR) &
2. Minimally invasive staged segmental artery coil-embolization (MIS²ACE)
cnNIRS during EVAR

N= 11
Age 72-83
Indication for branched EVAR:
• 6 Crawford II
• 4 Crawford III
• 1 Crawford IV
7 patients with prior MISACE (!)

Example measurement of lumbar cnNIRS

EVAR

Anesthesia
Stent in
Stent deployed
Branches
Balloon dilatation
Sheath in
Sheath out

Example measurement of lumbar cnNIRS

cnNIRS during EVAR

(N=11)

Example measurement of lumbar cnNIRS

cnNIRS during MISACE

N=13
Age 65-82
Indication:
• 8 Crawford II
• 3 Crawford III
• 2 Crawford IV
SA occluded = 5 ± 2
Inferior mesenteric artery occluded in 8 patients

Example measurement of lumbar cnNIRS

cnNIRS during first stage MISACE

Example measurement of lumbar cnNIRS
Conclusions & interpretation

1. minor changes in CN oxygenation during EVAR
   (most pronounced during aortic balloon expansion)
   - previous MISACE sessions
   - aneurysm-related native SA occlusion
   - no immediate / complete occlusion of covered SAs
   - ongoing study: heterogeneous patient group

2. no relevant changes with MIS²ACE of 4 to 6 SAs
   - MIS²ACE of few SAs leads to no relevant alterations in CN perfusion/ oxygenation
   - influence of lumbar optode-positioning

→ small pt numbers, no neurologic deficits encountered