2D Perfusion Angiography To Assess The Effectiveness Of Treatments On Foot Perfusion: How To Do It And Quantitate Its Results

Jos C. van den Berg, MD PhD
Ospedale Regionale di Lugano, sede Civico, Lugano
University of Bern
Switzerland

VEITH symposium 2017
New York, November 14-18 2017

Disclosures
• None

Functional imaging
• Indocyanine green fluorescence imaging/tissue oxygen saturation foot-mapping etc.
  – Difficult to implement during procedure
• Angiography based
  – ‘Wound-blush’ (difficult to quantify)
  – 2D perfusion angiography
  – 3D CB-CT perfusion angiography

2D-perfusion angiography technique
• Standard angiography (DSA 3 fps)
• Standardized contrast injection
• Immobilized limb/foot
• Software elaboration of DSA

2D-perfusion angiography
• Measures volume flow in the whole foot
  – Macro-circulation
  – Micro-circulation

Application 2D-perfusion angiography
• Determine endpoint for revascularization
  – Evaluation macro-circulation
  – Increase in volume flow
• Test the functionality of the micro-circulation
2D-perfusion angiography - macrocirculation

- Increase in volume flow after revascularization
  - Time to peak (TTP)
  - Area under the curve (AUC)

Murray T et al, JET 2016;23:58-64

DSA

2D-perfusion angiography

- DSA

Time to peak and area under the curve
Micro-circulation

• AV-shunting reduced ('foot wants to keep the blood')

Reekers JA, CIRSE 2015

Micro-circulation

• Tolazoline opens capillaries (vasodilation), increases AV-shunting

Reekers JA, CIRSE 2015

Capillary resistance index (CRI)

• Maximal peak density post-tolazoline divided by maximal peak density pre-tolazoline

• Measures functionality of micro-circulation

Reekers JA, CIRSE 2015

CRI

• 21 patients with CLI
  – Group A n=10 revascularization (2 bypass)
  – Group B n=11 no treatment
• 7 early amputations (30%)
  – Group A n=4
  – Group B n=3

Reekers JA, CIRSE 2015
CRI

- Patient selection? Cf. FFR (cardiology)
- Patients with CRI <0.9 may have better outcome

Reekers JA, CIRSE 2015

2D-perfusion angiography-macrocirculation

- 89 patients
  - N=9 imaging not adequate
  - N=12 no BTK intervention
  - N=68 available for analysis
- Increase in maximal peak density 21%, area under the curve 48% (NB changes, no absolute measures)
- 9/68 no increase
- No relationship to clinical outcome investigated (PALI study will address this)

Reekers JA et al, CVIR 2016;39:183-189

2D-perfusion angiography-macrocirculation

- Statistically significant improvement in AUC after PTA (29.4%) and no significant change in TTP or PDV
- No statistical difference in perfusion values between above- and below-knee angioplasty

Murray T et al, JET 2016;23:58-64

2D perfusion angiography-drawbacks

- Angiosomes typically overlap on any single (2D) projection
- Patient motion

2D perfusion angiography-drawbacks

- Angiosomes typically overlap on any single (2D) projection
- Patient motion

Conclusion

- 2D-perfusion angiography allows functional imaging that may help in selecting patients that will benefit from revascularization
- 2D-perfusion angiography can help to determine an endpoint for revascularization with potential benefit for treatment planning and outcome analysis