Angio-Perfusion Imaging in CLI Patients with Pharmacological and Catheter-Based Interventions. Can we predict Outcome?

Peter Huppert
Dpt. of Radiology, Neuroradiology and Nuclear Medicine
Klinikum Darmstadt, Germany
Disclosure

Speaker name: Peter Huppert, M.D.

I have the following potential conflicts of interest to report:

☐ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)
X Nothing to disclose
Background

- Limb salvage in CLI patients is 80-85% over 3-5 years independent of revascularization methods used*.
- Amputation cannot be prevented in 5-10% of patients despite technical success of recanalization.
- Evaluation of microcirculation may show irreversible damage causing lack of clinical benefit*.

Technical Option for Evaluation of Microcirculation during DSA

- C-Arm CT (Dyna-CT) Perfusion-Imaging
- 2D Imaging: flow dynamics
- 3D Imaging: blood volume/tissue volume
C-Arm-CT („Dyna-CT“)

- Based on FP-technology
- Digital 3d Image acquisition
- 270-dgr rotation (8 sec)
- Reconstr. of CT images
- 3 D images and MPR
- Perfusion imaging with CM

Applications:
- interv. oncol.
- interv. neuro.
Peripheral Dyna-CT Perfusion Imaging

- 3D Perfusion Imaging using C-arm-CT of the foot is possible
- Variable reconstructions in all planes
- Tissue imaging and artery imaging can be matched
- High resolution imaging of small arteries
Semiquantitative Mapping of Tissue Perfusion

- Colour-coded semiquantification of perfusion possible
- Correlation of perfusion deficit and related artery is visualized
2D Imaging: Flow Dynamic

- Time-contrast intensity curves of target arteries
- Time to peak
- Area under the curve
- syngo iFlow® protocol (Siemens)
3D Imaging: Peripheral Blood Volume (PBV)

- Voxel based measurement of blood volume / tissue volume
- Colour coding
- Analysis of Max/Min and mean +/- SD within ROI
- *syngo* DynaPBV® protocol (Siemens)
- Sensitive to motion artefacts
Potential use of Perfusion Imaging

• Endpoint of BTK intervention:
  Evaluation of perfusion benefit within target area after revascularization (1 vs. 2 arteries)

• Prediction of revascularization benefit:
  Evaluation of tissue perfusion reserve by pharmacological stimulation (vasodilatation)
Endpoint of BTK Intervention

target: Rutherford V lesion D1-3

recanalization of posterior tibial artery + anterior tibial artery?
Increased Tissue Perfusion after Recanalization of Posterior Tibial Artery
Positive Perfusion Reserve

native

<table>
<thead>
<tr>
<th>ROI</th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 60 HU</td>
<td>12.459 Px.</td>
<td>68.789 Px.</td>
</tr>
</tbody>
</table>
Negative Perfusion Reserve

<table>
<thead>
<tr>
<th>ROI</th>
<th>before</th>
<th>after</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 60 HU</td>
<td>26.748 Px.</td>
<td>43.766 Px.</td>
</tr>
</tbody>
</table>

after 75 mg i.a. Papaverin-Hydrochlorid
Prediction of Revascularization Benefit

TTP (target: plantar artery): 13 sec

2D Syngo i Pilot
Prediction of Revascularization Benefit

**Imaging protocol**
- 5 sec run time / 270 degr.
- *syngo iFlow®* 13 sec TTP of target artery
- Run delay 13-2=11 sec
- *syngoBodyPBV®*

**Contrast injection protocol**
- Volume 12 cc
- Flow 3 cc/sec
- Catheter position Pop.II

**Values**
- **Native run**
  - PBV: 60 cc/1.000 cc
- **Post stimulation run (Papaverin i.a.)**
  - PBV: 120 cc/1.000 cc
- **Post intervention run**
  - PBV: 145 cc/1.000 cc
# Protocol of Peripheral Blood Volume Evaluation (Syngo PBV®)

<table>
<thead>
<tr>
<th>Inflow</th>
<th>Completely recanalised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catheter position</td>
<td>2nd popliteal segment</td>
</tr>
<tr>
<td>Contrast volume</td>
<td>12 cc</td>
</tr>
<tr>
<td>Contrast flow</td>
<td>3 cc/sec</td>
</tr>
<tr>
<td>Scan delay</td>
<td>Time to peak of target artery (syngo iFlow®) minus 2.5 sec</td>
</tr>
<tr>
<td>Scan time (270 degrees)</td>
<td>5 sec</td>
</tr>
<tr>
<td>i.a. vasodilator</td>
<td>75 mg Papaverin Hydrochlorid</td>
</tr>
<tr>
<td>Delay after drug injection</td>
<td>120 sec</td>
</tr>
</tbody>
</table>
Prediction of Perfusion Benefit

baseline

Papaverin

post recanalisation
**Uongoing Work in Progress**

<table>
<thead>
<tr>
<th>Done</th>
<th>To do</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Optimization of contrast injection protocol</td>
<td>• Optimization of positioning (soft cast fixation)</td>
</tr>
<tr>
<td>• Definition of vasodilator injection protocol</td>
<td>• Standardisation of PBV measurements</td>
</tr>
<tr>
<td>• Definition of run delay</td>
<td>• Correlation of tissue perfusion reserve and healing of tissue defects</td>
</tr>
</tbody>
</table>
Thank You for Attention!
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