CT Scanning and Injection Protocols

More than 600 clinical cases have been processed using the AngioVis setup. The generation of MIPs, and various forms of Curved Planar Reformations has been used clinically at the Department of Cardiovascular and Interventional Radiology, Medical University of Vienna, Austria, using a 16-channel Multislice CT scanner. Recently, we have been using a 64-slice scanner at Medical University of Vienna, Austria and at Stanford University, USA.

The axial CT source images are transferred to the AngioVis workstation, where post-processing steps are performed by experienced CT technologists. The resulting images are sent to PACS (in DICOM format), and are then reviewed by the radiologist and vascular surgeons on any PACS viewing station.

Routine readout usually begins with looking at the MIP images, as they give an "angiography-like" overview. In the presence of vessel calcifications or endoluminal stents, the assessment of the flow channel requires the analysis of cross-sectional images. The most comprehensive tool to read cross sections is to use multi-path curved planar reformations. In many instances, these images provide the necessary clinical information. If necessary, the user can also read single-path CPRs through a vessel of interest. As all images are read on PACS workstations, all images can be magnified (zoom), and the viewing window settings can be altered interactively. This is crucial in the presence of calcifications/stents because too narrow window settings may cause –pseudo-stenosis due to the blooming artifact.

The following section describes our current scanning technique, the technique of contrast medium injection, and the routine post-processing steps for visualizing peripheral arterial occlusive disease for diagnosis and treatment planning, using the AngioVis programs.

Recent clinical examples with angiographic correlation will be available for practical testing at the exhibition booth.
Lower Extremities Runoff
Scanning Protocol – Siemens S 64

Scan protocol        RUNOFF (Vascular Folder)
Topogram            1500 mm AP; feet first, arms up; feet still and relaxed; support with cushions/tape;
Range 1+2          Bolus Tracking, ROI in abdominal aorta at celiac artery
Range 3             Runoff: from above the celiac trunk (D12 vertebral body) through toes
                                  120kV / Care dose 4D w. 250 ref-mAs)
                                  64x0.6mm, 0.5s gantry-rotation
                                  40s scantine for all patients! (NOTE: this will result in a pitch<1),
                                  ! Set scanrange first, then change scantime to 40s !
Range 4             Runoff: Pre-programmed optional second CTA acquisition to cover popliteal and crural territories. This range is only initiated, if there is no contrast medium opacification seen in the popliteal/crural vascular territories;
                                  If distal arterial opacification is adequate, just cut (delete) Range 4

Breathhold at inspiration
Scandirection cranio-caudal
Injection Protocol

Bolus tracking with ROI in Abdominal Aorta (beginning of scan range).
Minimum delay (3s including automated breath-hold-command)
Use a biphasic injection protocol with 35s injection duration

Injection Rates and Volumes
(adjusted to patient size)

<table>
<thead>
<tr>
<th>~BW (kg)</th>
<th>VOL1 (mL)</th>
<th>Flow1 (mL/s)</th>
<th>VOL2 (mL)</th>
<th>Flow2 (mL/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>XS &lt;55kg</td>
<td>20</td>
<td>4</td>
<td>96</td>
<td>3.2</td>
</tr>
<tr>
<td>S &lt;65kg</td>
<td>23</td>
<td>4.5</td>
<td>108</td>
<td>3.6</td>
</tr>
<tr>
<td>average 75kg</td>
<td>25</td>
<td>5</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>L &gt;85kg</td>
<td>28</td>
<td>5.5</td>
<td>132</td>
<td>4.4</td>
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<tr>
<td>XL &gt;95kg</td>
<td>30</td>
<td>6</td>
<td>144</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Saline flush: 40mL volume, flow-rate equal to 'Flow2'

Reconstruction (STh/RI)

Range 3: 2/1    B25f  (patients w. Fontain IIb) FoV: to greater trochanter
          1/0.7  B25f  (patients w. Fontain III/IV)
          5/5    B31f  Abd/Pelvis only !

Range 4: 1/0.7  B25f

Transfer Auto transfer of all data to PACS & Transfer to ANGIOVIS workstation
Lower Extremities Runoff
Scanning Protocol – Philips Brilliance 64

Indication Peripheral arterial occlusive disease
Scanprotocol (Vascular Folder)
Topogram 1500 mm AP; feet first, arms up; feet still and relaxed; support with cushions/tape;
Range 1+2 Bolus Tracking, ROI in abd. aorta at celiac artery
Range 3 Runoff: from above the celiac artery (D12 vertebral body) through toes
120kV / 180 eff.mAs
64 x 0.625mm
0.75s gantry-rotation
pitch 0.7 - 0.8
Range 4 Runoff: Pre-programmed optional second CTA acquisition to cover popliteal and crural territories. This range is only initiated, if there is no contrast medium opacification seen in the popliteal/crural vascular territories;
If distal arterial opacification is adequate, just cut (delete) Range4
Breathhold at inspiration
Scandirection cranio-caudal
Injection Protocol 17-20G IV line, Iomeron (iomeprol) 400
Bolus tracking with ROI in abdominal aorta (beginning of scan range);
minimum delay (4s including automated breath-hold-command).
Biphasic injection protocol
Volume 1 = 25 mL, injected at 4.5 mL/s
Volume 2 = 58 mL for PAOD II&III, 68mL for PAOD IV
Saline flush: 40mL volume, flow rate 2.3 mL/s
Reconstruction 1.5 / 0.75 mm
Transfer Auto transfer of all data to PACS & to ANGIOVIS workstation

Lower Extremities Runoff
Scanning Protocol – Siemens S16

Indication Peripheral arterial occlusive disease
Scanprotocol RUNOFF (Vascular Folder)
Topogram 1500 mm AP; feet first, arms up; feet still and relaxed; support with cushions/tape;
Range 1+2 Bolus Tracking, ROI in abd. aorta at celiac artery
Range 3 Runoff: from above the celiac artery (D12 vertebral body) through toes
120kV / 130 eff.mAs
16 x 0.75mm
0.5s gantry-rotation
Table-feed ~14mm/s (scantime is ~ 45–55s)
Breathhold at inspiration
**Scandirection**  cranio-caudal

**Injection**  17-20G IV line, **Iomeron (iomeprol) 400**

**Protocol**  Bolus tracking with ROI in abdominal aorta (beginning of scan range);
minimum delay (3s including automated breath-hold-command).
Biphasic injection protocol
Volume 1 = 25 mL, injected at 4.5 mL/s
Volume 2 = ___ mL* injected at 2.3 mL/s
Saline flush: 40mL volume, flow rate 2.3 mL/s

**Reconstruction**  1.5 / 0.75 mm

**Transfer**  Auto transfer of all data to PACS & to ANGIOVIS workstation