Clinical case report¹

Endovascular treatment of peripheral artery disease within an Angio-CT suite

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¹ Results from case studies are not predictive of results in other cases. Results in other cases may vary.
A 60 year old male patient who suffered an ischemic stroke a year ago presented with a complaint of claudication on the left leg (<100 meters), which had expanded to the right leg before he arrived at our hospital. The ankle-brachial index\textsuperscript{1} was measured as 0.70/0.54 (right/left).

In the diagnostic IV-CTA images (Figure 1–3 (a,b)) from the outpatient CT scan, multiple severe stenosis was observed at the mid superficial femoral artery (SFA) (1), midpopliteal artery (2), tibial-peroneal trunk (3, 5), and anterior tibial artery (4) on both the left leg and the right leg.

It was diagnosed as peripheral artery disease, Rutherford III, Fontaine II, TASC A.

The physicians decided to start with endovascular treatment (EVT) on the left leg first. The right leg was treated several weeks later. The reasons for performing EVT on only one side per day were:

- Long procedure time
- X-ray exposure dose and contrast medium
- Reimbursement

After the catheter is positioned in the left external iliac artery under angio guidance, the patient is switched to CT for a periprocedural CTA with intra-arterial injection.

Compared to IV-CTA, which was performed before the procedure as an initial diagnostic scan, the vasculature on the IA-CTA images can be visualized with higher density and more details thanks to the nature of selective injection (Figures 1–3 (c,d)).

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\textsuperscript{1} The normal range for the ankle-brachial index is between 0.90 and 1.30. An index under 0.90 means that blood is having a hard time getting to the legs and feet: 0.41 to 0.90 indicates mild to moderate peripheral artery disease; 0.40 and below indicates severe disease.
Lead minimally invasive procedures with multi-modal image guidance

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CTA images above the knee – Improved contrast enhancement with intra-arterial injection

Figure 1
(A) MIP and (B) volume rendering of pre-procedural CTA of the whole leg on both sides with intravenous injection.
(C) MIP and (D) volume rendering of peri-procedural CTA of the whole left leg with intra-arterial injection.

1. superficial femoral artery; 2. mid popliteal artery; 3. tibial-peroneal trunk; 4. anterior tibial artery; 5. tibial-peroneal trunk

IVUS images

(E) IVUS image showing the complete occlusion of the SFA.
(F) IVUS image showing 95% stenosis of popliteal artery. Red indicates blood flow.

Figure 1 (continued)
CTA images below the knee – Enhanced vessel visibility with intra-arterial injection

Figure 2
(A) MIP and (B) volume rendering of preprocedural CTA of the whole leg on both sides with intravenous injection.
(C) MIP and (D) volume rendering of peri-procedural CTA of the whole left leg with intra-arterial injection.

CTA images of the foot – Enabled vessel visibility in distal branches with intra-arterial injection

Figure 3
(A) MIP and (B) volume rendering of preprocedural CTA of the whole leg on both sides with intravenous injection.
(C) MIP and (D) volume rendering of peri-procedural CTA of the whole left leg with intra-arterial injection.
Axial MPR images from intra-arterial CTA

Figure 4
Axial images from IA-CTA also support endovascular treatment. SFA is clearly enhanced in the healthy regions (A, C), on the other side, the thrombus was observed with positive remodeling of the vessel wall at the occluded lesion (B). Collateral flow is confirmed in all axial images.
Slab MIP images from intra-arterial CTA

Figure 5
Multiple slab MIP images are utilized to investigate morphological changes of the vessels. Subtracted images are useful for vessel examination in various directions.
Treatment

It was concluded that thrombi had accumulated at the mid SFA and a 13 cm occlusion had developed within a month. Aspiration thrombectomy (Thrombuster, Kaneka) was attempted several times, but with little success. A stent graft (VIABAHN 6 mm x 150 mm, Gore) was placed at the distal end of the lesion followed by another of the same type to cover the occluded lesion, based entirely on the information from the IA-CTA (Figure 6).

Stent graft deployment to treat SFA occlusion

Figure 6
Pre-DSA
DSA image acquired after passing through the occluded lesion with a basket catheter (PARACHUTE, Goodcare) and postdilation balloon (SABER 5 mm x 60 mm).

Deployment of stent graft
VIABAHN (6 mm x 150 mm) was deployed starting at the distal end of the occluded lesion, followed by another VIABAHN (6 mm x 50 mm) at the proximal area.

Post-angiogram
Final 2D angiogram after the completion of SFA treatment, showing recovered blood flow of SFA.

Subsequently, percutaneous transluminal angioplasty (PTA) was applied to the left popliteal artery as originally planned (Figure 7). The patient had complained of no further symptoms at the time of writing this report.
Figure 7
(A–C) 95% stenosis was observed in the left popliteal artery before PTA. DSA image (A) is compared with MIP (B) and VR images (C) derived from intra-arterial CTA. Orange arrows indicate the segment treated with the stent graft. White/black arrows show the 95% stenosis treated with a balloon.

(D) Plain old balloon angioplasty (POBA) was applied to the left popliteal artery.
Injection protocol

With Angio-CT, it is possible to perform CT angiography with selective intra-arterial injection. This allows the use of highly diluted contrast medium. In this case, which is part of a feasibility study, only 18.5 ml contrast medium was used to perform the IA-CTA, while 110 ml contrast agent was needed for the IV-CTA. This is especially beneficial for patients with renal insufficiency. Additionally, the arteries can be visualized with higher density and more detail. This helps to guide the procedure with higher precision.

The Angio-CT is designed for complex IO procedures, but it also opens up new possibilities in a routine case like the endo-vascular treatment for PAD.

It is also worthy mentioning that IV-CTA remains an important tool for evaluating vessel conditions in CLI patients due to its wide availability and non-invasive nature.

Conclusion

Intravenous CTA  Intra-arterial CTA

<table>
<thead>
<tr>
<th>Scanner</th>
<th>Diagnostic CT</th>
<th>Angio-CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection Location</td>
<td>Elbow vein</td>
<td>External iliac artery</td>
</tr>
<tr>
<td>Contrast medium (mgI/mL)</td>
<td>370</td>
<td>270 (diluted to 20%)</td>
</tr>
<tr>
<td>Injection rate (mL/sec)</td>
<td>3.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Amount (mL)</td>
<td>110</td>
<td>18.5</td>
</tr>
<tr>
<td>Total Iodine (g)</td>
<td>40.7</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Injection protocol

Figure 8
IV-CTA
IA-CTA
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