Case report

Minimally Invasive Revascularization in CLTI: A case of Long In-Stent occlusion revascularization with BYCROSS System

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CLINICAL CASE

A 75-year-old female patient presented with left Chronic Limb-Threatening Ischemia (CLTI) and was referred to our Vascular & Endovascular Surgery unit.

MEDICAL HISTORY

Her medical history includes arterial hypertension, chronic myeloid leukemia, dyslipidemia, and mild chronic renal insufficiency (stage IIIb KDOQI), along with a history of congestive heart failure. Her specific vascular history revealed three previous revascularizations of the left superficial femoral artery (SFA): angioplasty in May 2021, angioplasty in August 2022, and PTA/stenting in July 2023, complicated by a right iliac-femoral pseudoaneurysm that underwent hybrid correction.

RECENT FINDINGS

On admission, she reported rest pain for at least 30 days, associated with a kissing ulcer between the second and third toes of the left foot with a poor ankle-brachial-index (ABI- 0.4, GLASS stage IV, WIFI score 121). Duplex ultrasound showed SFA occlusion with proximal endpoint of mimetic BMS (Supera, Abbott Vascular, Santa Clara, CA) at level of common femoral artery (CFA), with biphasic Doppler Flowmetry in distal popliteal artery (P2). The deep femoral artery (DFA) was patent. The SFA occlusion was morphologically confirmed by CT angiography (CTA). Preoperative CTA scans were imported into a 3D workstation and processed using dedicated software (Aquarius, Terarecon, San Mateo, Calif). (Fig.1)

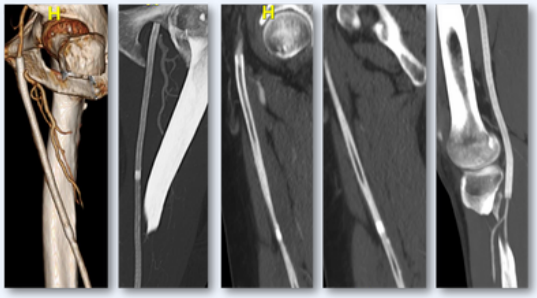

Figure 1: Preoperative CTA scans processed using dedicated software.

INTERVENTION

Written consent was obtained from the patient for the anonymous use of data and images for scientific purposes. Surgery was performed under general anesthesia and systemic heparinization in a hybrid operating theater.

The first step involved surgical exposure of the left CFA, SFA, and DFA at their origin. The CFA arteriotomy at the bifurcation revealed significant fibrotic proliferation stenosing the common femoral vessel and obstructing the previous bare metal stent. (Fig.2)

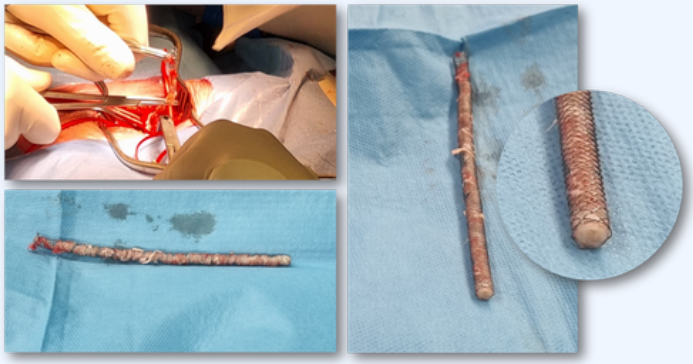

Figure 2: Surgical exposure of the left CFA, SFA, DFA at their origin and BMS explantation.

The second step involved the removal of the proximal portion of the BMS, CFA endarterectomy, and the placement of an expansion patch (8 mm Dacron). (Fig.3)

The third step consisted of an endovascular approach with direct antegrade puncture of the newly made patch using a 9 Fr introducer sheath. Digital subtraction angiography revealed patency of the CFA and DFA, SFA dissection at its origin, and in-stent occlusion in the middle third, with distal popliteal artery revascularization. (Fig.4)

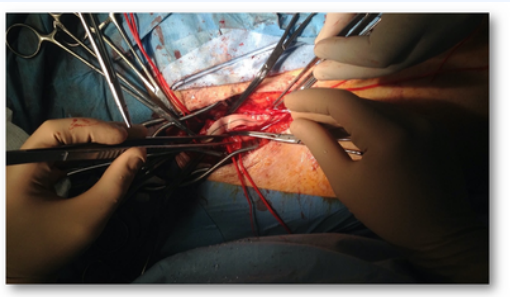

Figure 3. Placement of an expansion patch (8 mm Dacron)

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After successful in-stent recanalization using a Command ST .018'' guide wire (Abbott, Chicago, Illinois, Stati Uniti) and a Berenstein catheter, the SFA was pre-dilated with a Passeo 4-80 mm balloon catheter (Biotronik, Lake Oswego, OR, USA) (Fig.4).

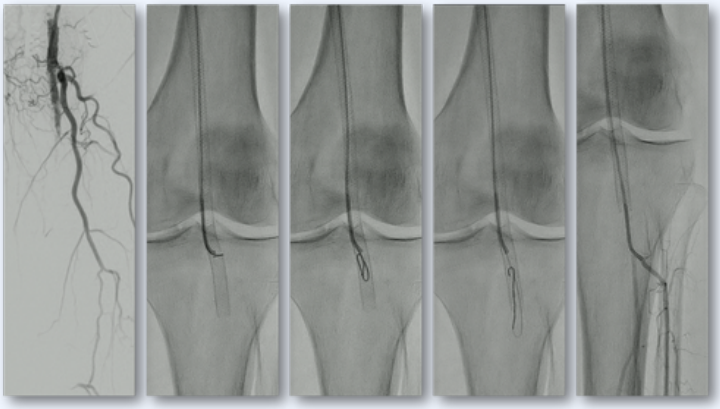

Figure 4. Diagnostic DSA and femoro-popliteal recanalization

The 6Fr-70 cm BYCROSS® system was selected for the procedure, requiring a 6/8 Fr-65 cm introducer sheath. A Terumo Destination 7 Fr-65 cm introducer sheath was then positioned into the SFA through the 9 Fr introducer sheath using a coaxial technique. Under fluoroscopic guidance, the BYCROSS® atherectomy device was introduced over the guide wire into the 7 Fr introducer sheath and connected.

In-stent atherectomy was first performed with slow rotation speed and closed wings (Stage 1), followed by faster rotation (Stage 2). At this stage, utilizing the elastic properties of the Nitinol wing, which can bend asymmetrically and increase the tip diameter from 1.9 mm to 4.7 mm, we achieved further lumen gain. The device operates on the Archimedes screw principle for debris transport in addition to a pump in the handle. (Fig.5).

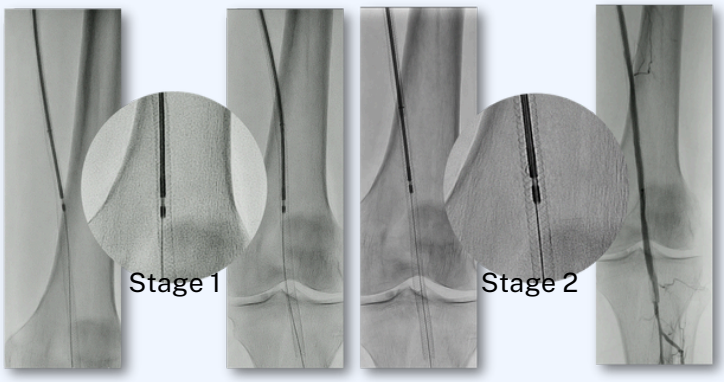

Figure 5. In-stent atherectomy: first performed with slow rotation speed and closed wings (Stage 1), followed by faster rotation and open wings (Stage 2).

Control DSA demonstrated a good morphological result with SFA-popliteal recanalization. The procedure concluded with prolonged

SFA-popliteal angioplasty using drug eluting balloons (DEB) IN. PACT (Medtronic) 6-120 mm, 5-120 mm, and 5-120 mm (Fig.6). Completion DSA showed full patency of the femoro-popliteal axis with below-the-knee (BTK) circulation supplied by all three tibio-peroneal arteries (Fig.7). At the end of the procedure, the left dorsalis pedis pulse was palpable. Duplex ultrasound confirmed patency of the treated femoro-popliteal axis with excellent lumen gain and triphasic Doppler flow at the distal popliteal artery.

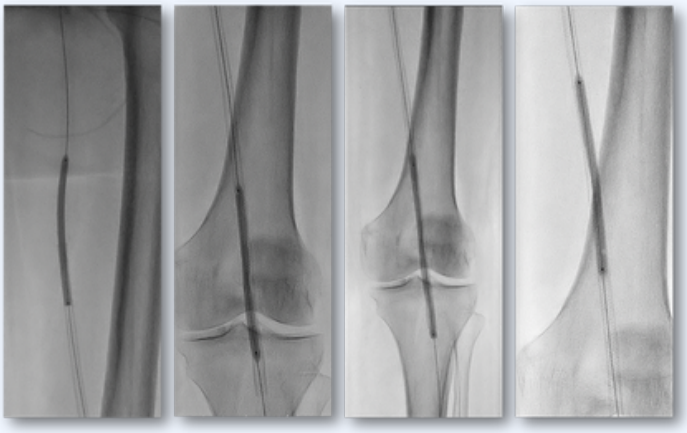

Figure 6. Prolonged SFA-popliteal angioplasty using drug eluting balloons (DEB)

DISCUSSION

Recent developments of dedicated devices, such as the BYCROSS system, have expanded treatment options for patients with CLTI, allowing for effective minimally invasive interventions and overcoming the limitations of open surgical procedures, which have been the only viable alternatives for many years.

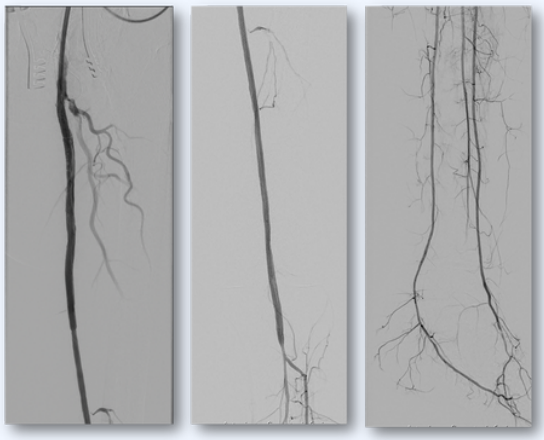

Figure 7. Completition DSA