74-year-old man with diabetic nephropathy (chronic kidney disease stage G4) was admitted to our department with critical limb ischemia (CLI) of the left limb with gangrene of the digits (Rutherford class 5). A femoroperoneal bypass with autogenous vein was applied for the revascularization of the right limb 5 months prior to his admission. The patient's past medical history included coronary heart disease with ischemic cardiomyopathy and an ejection fraction of 20%. The preprocedural duplex ultrasound evaluation revealed a severe calcified stenotic lesion of the popliteal artery and a single-vessel run-off through the peroneal artery. As a result of the patient's medical state and the type of the lesion, an endovascular-first approach was indicated.

Under local anesthesia, left antegrade femoral arterial access was obtained using ultrasound guidance. After the insertion of a short 6 Fr arterial sheath (Terumo), a diagnostic angiogram was performed using the Angiodroid carbon dioxide (CO2) injector (San Lazzaro di Savena, Italy). This confirmed the preprocedural duplex ultrasound findings (Figure 1). A Choice PT 0.014 floppy wire (Boston Scientific) and a Quick-Cross support catheter (Phillips) were used to cross the lesion. After crossing the lesion, a vessel preparation with endovascular lithoplasty (Shockwave Medical, Fremont, US) was performed using a 5 × 60 mm catheter inflated to 4 atm and activated. After delivering 30 pulses, the balloon was inflated to the reference vessel diameter for an additional 120 seconds. The lithoplasty was activated an additional 6 times after repositioning of the catheter in order to treat the entire lesion from “healthy to healthy,” delivering a total of 180 pulses. An antirestenotic therapy with a drug coated balloon (DCB) (5 ×120 mm, In.Pact Admiral, Medtronic) was applied following the plaque modification. The final angiography did not show any residual stenosis, local dissection, or distal embolization. The procedure was completed with the use of 10 mL contrast medium, and the patient was discharged the following day.

DISCUSSION

Renal function impairment in patients with CLI carries an increased risk for 30-day readmission after both endovascular and surgical revascularization and is associated with diminished 12-month amputation-free survival rates. Chronic kidney disease (CKD) leads to an accelerated arterial wall calcification through a complex inflammatory response and an upregulation of osteoblastic differentiation. In the registry of First-Line Treatments in Patients with Critical Limb Ischemia (CRITISCH), endovascular therapy was preferred over bypass grafting in patients with CKD despite the need for nephrotoxic contrast agent. The increased comor-
bidity of the patient, the severe vessel wall calcification, and the poor run-off that are often present in these patients can probably explain the preferential use of endovascular therapy. Nonetheless, endovascular treatment is associated with greater loss of renal function compared with surgery in the long run.6 Thus, any care should be taken to reduce the risk for acute kidney injury following endovascular procedures.

The use of CO2 as a negative contrast agent can be a valuable alternative in high-risk patients for iodinated contrast-induced nephropathy.7 CO2 can reduce the volume of contrast medium needed and safely guide complex peripheral interventions in patients with CLI.8,9 Of note, the development of novel computerized CO2 injectors may further improve the visualization of the tibial and foot arteries and eliminate the risk of air contamination.7

In regard to popliteal artery disease, the unique anatomical environment of the knee joint and the dynamic stress within the vessel wall challenge the performance of endovascular treatment. Although bare metal stents improved the outcomes of endovascular therapy in popliteal lesions, important drawbacks of permanent scaffolding such as in-stent-restenosis, stent fractures, and the interference with future surgical options remain.10-14 Alternatively, promising results have been reported after atherectomy followed by DCB angioplasty, so-called “DAART” for isolated popliteal disease.15 Still, both modalities are subject to certain limitations. DCB angioplasty alone is associated with a higher risk of bailout stenting and dissections, while increased rates of late lumen loss are observed after the treatment of severely calcified lesions.15-18 Regarding DAART, despite the added benefit of vessel preparation prior to DCB angioplasty, the need for repeated angiograms can be a limiting factor for the use of directional atherectomy in CKD patients.15

At our institution, a primary “leave nothing behind” approach is favored for isolated popliteal lesions. In the aforementioned case, vessel preparation and plaque modification were considered mandatory prior to paclitaxel application, given the poor outcomes of DCBs in calcified lesions. Endovascular lithoplasty offers an alternative vessel preparation technique in patients with calcified arterial wall without the need for repeated contrast agent administration. The lithoplasty device allows at low pressure (4 atms) and activation mechanical waves that pass through the soft tissue but disrupt and fracture calcified plaque in situ without the risk of embolization, as the calcium is never removed as with atherectomy. This low-pressure angioplasty reduces the risk for flow-limiting dissections, while leading in a sufficient luminal gain and vessel preparation. In this context, the DISRUPT PAD I and II trials reported promising patency and acceptable adverse event rates after endovascular lithoplasty in calcified femoropopliteal disease. Additionally, the ongoing DISRUPT PAD III study will evaluate the efficacy of the combination therapy of lithoplasty and DCB angioplasty over DCB angioplasty alone in calcified vessels. Of note, as these studies enrolled mainly claudicants, the performance of this approach in CLI patients has to be determined.
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