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Iatrogenic vessel perforation during below-the-knee percutaneous revascularisation for critical limb ischaemia: successful management with deep catheter intubation and prolonged balloon inflations

Massimiliano Fusaro, Giuseppe G.L. Biondi-Zoccai, Dace Sondore, Massimo Medda, Nadia Mollichelli, Davide Abbiati, Graziella De Giacobbi and Luigi Inglese

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Division of Catheterisation and Cardiovascular Radiology, 'E. Malan' Cardiovascular Centre, Policlinico San Donato, San Donato Milanese (MI), Italy

Correspondence to Dr Giuseppe G.L. Biondi-Zoccai, Servizio di Emodinamica e Interventistica Cardiovascolare, Casa di Cura Abano Terme, Piazza C. Colombo, 1, 35031 Abano Terme (PD), Italy
Tel: +39 04 98221381; fax: +39 04 98221378;
e-mail: gbiondizoccai@gmail.com

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Since its introduction, percutaneous transluminal angioplasty (PTA) has widely been employed for the management of peripheral arterial disease. Thanks to major technological advances, such as subintimal angioplasty [1], PTA has recently been applied in ever more challenging patients and lesions, including those typical of critical limb ischaemia (CLI). An evidence-based appraisal of the role of PTA in patients with CLI has just demonstrated [2] that contemporary PTA techniques can now achieve effective and complete revascularisation even in critically ischaemic limbs [3], albeit at the expense of a potential increase in procedural complications.

We report the case of a patient with CLI who underwent PTA of the right anterior tibial artery. Despite the occurrence of iatrogenic vessel perforation due to aggressive wire introduction, this complication could be successfully managed by means of deep catheter intubation and prolonged balloon inflations.

A 74-year-old diabetic female, symptomatic for rest leg pain and non-healing ulcers on the dorsum of the right foot, was referred to our division for peripheral arteriography and potential percutaneous revascularisation. Two months previously, the patient had already been treated with PTA for CLI of the right leg, achieving successful recanalisation of the occluded peroneal and posterior tibial arteries, while leaving the occluded anterior tibial artery untreated. Despite successful revascularisation, the long-standing right foot ulcer had not healed, and the patient was thus referred for angiography and completion of revascularisation.

Antegrade common femoral artery puncture was performed using a 19 G needle (Cordis, Milan, Italy), and a slow flow injection was performed through the needle to confirm the good position in the common femoral artery and favour wiring of the superficial femoral artery. A 6 F sheath was then inserted (Terumo, Rome, Italy) and diagnostic angiography was carried out using the side arm of the introducer sheath. Lower limb arteriography showed a persistently good angiographic result in the peroneal and posterior tibial arteries as well as a long occlusion of the anterior tibial artery (Fig. 1a and b). In order to achieve complete revascularisation, PTA of the anterior tibial artery was planned.

The lesion was approached at first with a 0.014″ hydrophilic wire (PT Graphix Super Support, Boston Scientific, Genoa, Italy) and a 2.0 × 30 mm over-the-wire balloon catheter (Savvy, Cordis), i.e. with a 'small system'. Because of the inability to cross the occluded lesion, several wiring attempts were then made using 0.018″ and 0.035″ stiff wires (V18 and Starter, Boston Scientific; Radifocus Glidewire, Terumo), with the possibility of controlling the back end of such wires with use of a 4 F Berenstein catheter (Cordis) as a guiding catheter. The lesion could be crossed with the back end of the V18 wire but, due to the inability to track even the smallest balloon (1.5 × 20 mm Bijou, Boston Scientific), subintimal angioplasty was then attempted using the 0.035″ hydrophilic wire (Radifocus Glidewire) (Fig. 1c). While succeeding in crossing the lesion, angiography disclosed vessel perforation at the proximal site of the occlusion due to the exceedingly large loop of the wire (Fig. 2a). By positioning the Berenstein catheter deeply (thus engaging the catheter close to the ostium and limiting blood flow through the perforation), the perforation was temporarily sealed. The proximal occlusion was then wired with the back of the 0.035″ stiff wire (Starter, Boston Scientific). After dottering the 0.035″ stiff wire through the

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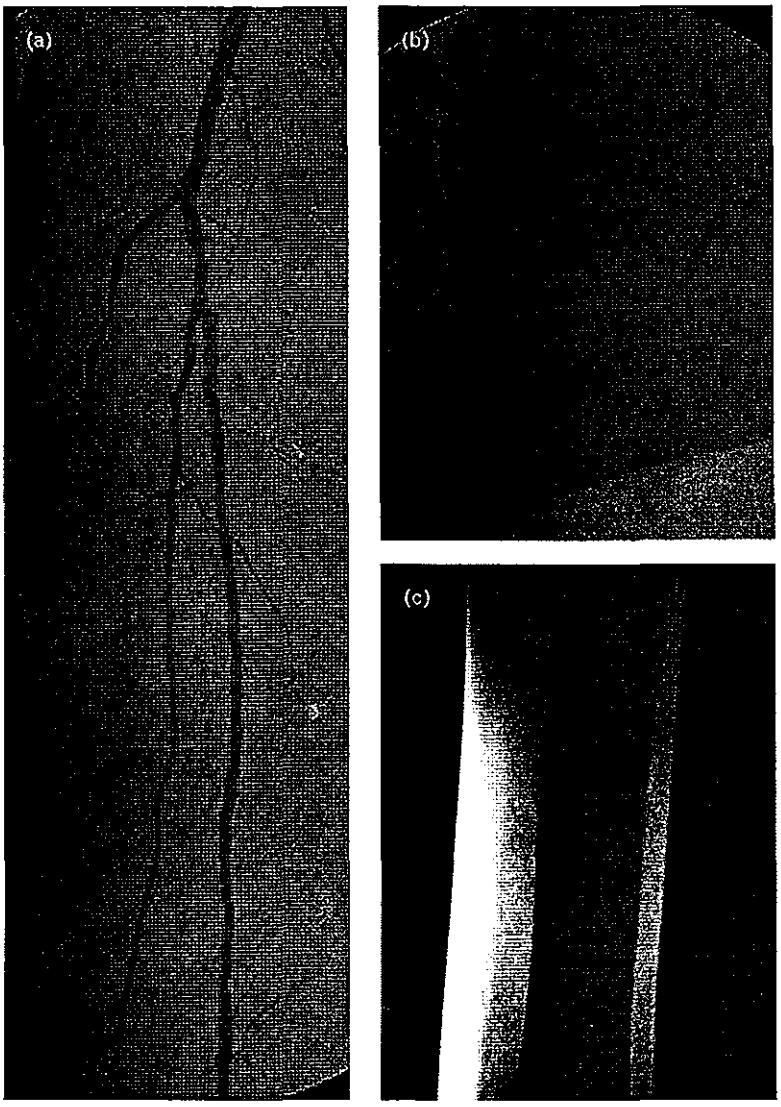
Fig. 1



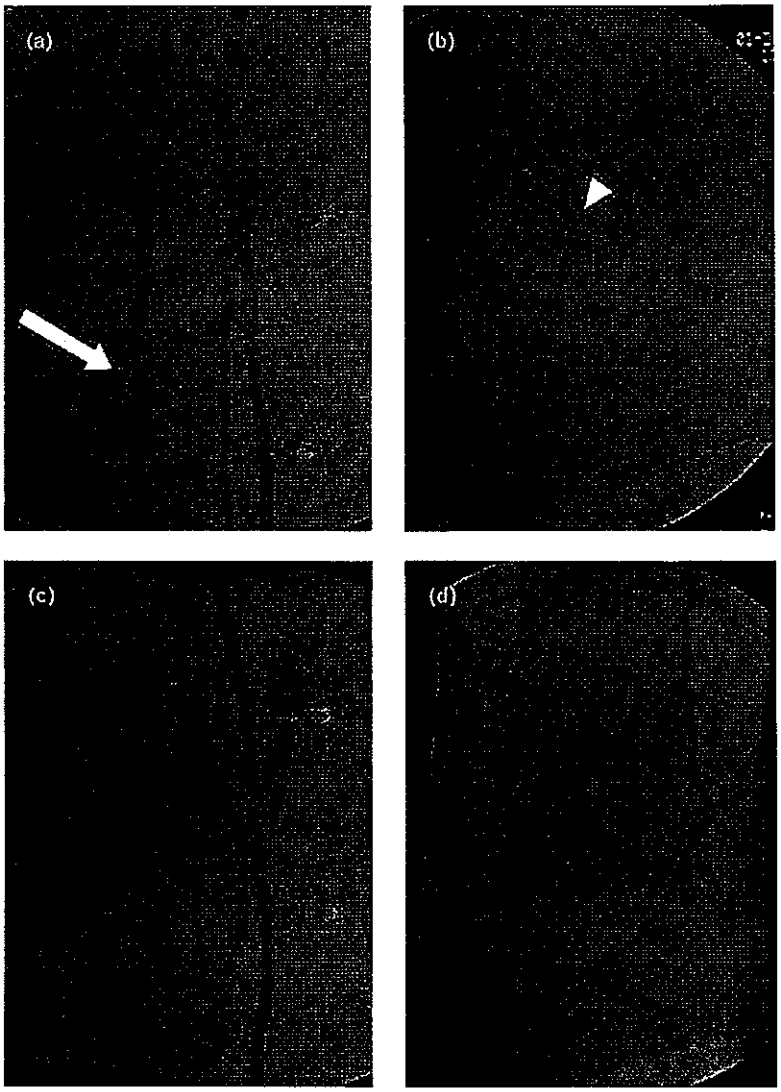
Lower limb arteriography in a 74-year-old female with right critical limb ischaemia. Two months prior to the index procedure, recanalisation of occluded peroneal and posterior tibial arteries had already been performed. Nonetheless, a right foot ulcer persisted and the patient was referred again for arteriography, which showed patency of the peroneal and posterior tibial arteries, with a long occlusion of the anterior tibial artery (a, b). In order to achieve complete revascularisation, percutaneous transluminal angioplasty of the anterior tibial artery was planned, with several wiring attempts with 0.014″, 0.018″ and 0.035″ stiff wires (with the possibility of controlling the back end of such wires). With use of a 4 F Berenstein diagnostic catheter as a guiding catheter, the lesion was successfully crossed (c).

occlusion, this was quickly replaced with a 0.014″ hydrophilic wire (Pilot 200, Guidant, Segrate, Italy), which could be successfully tracked through the channel created by the 0.035″ wire. Subintimal angioplasty was then performed with the 0.014″ wire, achieving re-entry of the true arterial lumen (Fig. 2b). Once the correct position of the wire was confirmed and adequate distal flow in the foot was established, multiple balloon inflations were performed along the whole vessel, with prolonged (up to 3 min each) inflations at the perforation site in order to favour perforation sealing.

Following multiple balloon inflations, the angiogram showed brisk distal flow with non-flow-limiting dissection flaps in the presence of good pedal pulses (Fig. 2c and d). After local haemostasis with a 6 F Angioseal device (St Jude, Milan, Italy) and initiation of intravenous tirofiban, the patient was sent to the ward. The subsequent hospital stay was uneventful, with persistence of pedal pulses and subjective improvement in limb pain.

Given the increasing use of PTA for the treatment of CLI, it is important that intervetionists be aware of the

Fig. 2



As soon as the lesion was crossed, angiography disclosed vessel perforation at the proximal site of the anterior tibial artery ((a), contrast extravasation indicated by the arrow). By positioning the Berenstein catheter deeply, the perforation was temporarily sealed. The occlusion was then wired with a 0.035″ stiff wire and, after dottering the wire through the occlusion, this was replaced with a 0.014″ hydrophilic wire. Subintimal angioplasty was then performed with the 0.014″ wire achieving distal true lumen re-entry ((b), wire loop shown by the arrowhead). Afterwards, multiple balloon inflations were performed along the whole diseased vessel, with prolonged inflations at the perforation site in order to favour perforation sealing. The final angiogram showed brisk distal flow with non-flow-limiting dissection flaps in the presence of good pedal pulses (c, d). The patient was then sent to the ward on overnight intravenous tirofiban infusion, and the subsequent hospital stay was uneventful, with persistence of pedal pulses and subjective improvement in limb pain.

potential challenges and complications when facing such lesions. Complications of below-the-knee PTA may range from 6 to 30%, depending on several factors, including lesion characteristics, and the treatment strategy adopted [1,2,4]. This clinical picture emphasizes the challenges concerning both attempt at passing through a long chronic total occlusion of the tibial vessels and the risks of an aggressive wiring approach, which is indeed the only technique for successful revascularisation in similar difficult conditions. In this case of iatrogenic vessel perforation with contrast extravasation, it proved critical to safeguard lesion access and limit blood flow through the occlusion by means of deep catheter intubation. Prolonged balloon inflations allowed complete perforation sealing and enabled to achieve good final distal flow without the need for emergency surgery or the occurrence of compartment syndrome, which is actually the most feared complication of lower limb vessel rupture [4]. Vessel perforation may usually be managed conservatively as long as distal flow through

the true lumen can be achieved, given that preferential blood flow maximises endoluminal blood flow whereby limiting bleeding through the perforation. Thus, the occurrence of vessel rupture should not represent by itself a reason for interruption of the PTA procedure if successful revascularisation can be performed in a timely and effective manner.

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