Percutaneous balloon fenestration of flow-limiting iatrogenic dissection of the common femoral artery: report of two cases

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Abstract

Acute iatrogenic arterial dissection is a known complication of endovascular techniques and can be treated with prolonged ballooning, stent placement, or balloon fenestration. Treatment of common femoral artery (CFA) dissection needs special attention because of the potential compromise of either the deep or superficial femoral artery origin and the enhanced mechanical stress to arteries in the groin. The authors report two cases with percutaneous balloon fenestration of flow-limiting localized iatrogenic dissection of the CFA with initial technical success in both cases and favorable short- to midterm outcomes.
Introduction

In spontaneous acute aortic dissection ischemia is due to compromise of its branches by the aortic intimal flap (dynamic type), by extension of the dissection into the branch-vessels (static type) or some combination of the two mechanisms (1). In these complicated dissections aortic branch reperfusion can be restored either by stentgraft sealing of the entry tear, by creation of a re-entry, a procedure known as fenestration of the dissecting membrane, or by stenting the true lumen of the dissected branch.

For several reasons the common femoral artery (CFA) deserves a different interventional approach. First, its dissection may compromise either the deep or the superficial femoral artery origin. An acute iatrogenic obstruction leading to occlusion of a patent superficial femoral artery (SFA) may lead to tissue ischemia with possible limb loss unless treated, while the acute deep femoral artery (DFA) occlusion will be well tolerated if the SFA is patent. On the other hand, when treating chronic SFA occlusions, preservation of DFA patency is essential because of the substantial early and late SFA reocclusion rate with its potentially severe limb ischemia when both the SFA and DFA are occluded.

Second, as opposed to the pelvis or the thigh arteries stents are exposed to higher mechanical stress in the inguinal region.

We report transluminal balloon fenestration of the CFA in two patients with flow-limiting iatrogenic dissection following PTA.

Case Reports

Institutional Review Board approval is not required at our hospital for retrospective clinical reviews such as the two cases presented herein.

Case 1: A 70-year old female patient was referred to our institution presenting
with acute onset of rest pain on the left lower extremity. PTA with stenting of the left external iliac artery (EIA) was performed elsewhere 12 months prior to her visit. The ankle-brachial systolic pressure index (ABI) was 0.5 on the left and 0.93 on the right. Angiography of the abdominal aorta, pelvic and the lower extremity arteries showed a short occlusion of the most distal EIA and collateral filling of the CFA via internal iliac artery (Fig. 1a). Furthermore, angiography demonstrated a proximal segmental occlusion of the left SFA. The distal SFA, the popliteal artery as well as all calf vessels were patent.

A 6 Fr cross-over sheath (Destination, Terumo, Leuven, BE) was then introduced via the right CFA followed by 5’000 IU heparin. As the distal external iliac and proximal SFA could easily be traversed by the guidewire (V18 Control Wire, Boston Scientific, Natick, MA, USA), pharmaco-mechanical thrombolysis with 400’000 IU of urokinase was performed. Thereafter a chronic dissection of the CFA and a short stenosis of the proximal SFA were noted (Fig. 1b). The SFA was perfused via the presumed true lumen. Attempts to advance a 0.018-inch guidewire (V18 Control Wire, Boston Scientific, Natick, MA, USA) into the false CFA lumen supplying the DFA via the cross-over antegrade approach failed. At this point a retrograde, fluoroscopy-guided, percutaneous puncture of the DFA 2 cm distally to the CFA bifurcation was performed. A 4 Fr sheath (Radifocus Introducer II, Terumo, Leuven, BE) was placed into the DFA. Retrograde probing with a guidewire of a potential communication between the two CFA lumina via the DFA failed too. After bending the back end of the same guidewire, it was used to puncture the CFA septum at the femoral bifurcation via the DFA access under fluoroscopic guidance (Fig. 1c). A 4 Fr catheter (Lindh, Cordis, Roden, NL) was passed over this wire and its course traversing into the
true lumen confirmed by contrast injection. Then, the wire was advanced with its leading soft end into the external iliac artery. A 6mm balloon was used to enlarge the punctured intimal flap in order to achieve a fenestration of the intimal flap (Fig. 1d). Finally we performed a cross-over PTA of the proximal SFA stenosis using a 5mm balloon, followed by stenting (Smart®, 8x40mm, Cordis, Roden, NL) of the local dissection. Control angiography of the left lower extremity demonstrated patent EIA, CFA as well as SFA and no distal embolization (Fig. 1e).

At routine clinical follow-up examinations the following day as well as after 3, 6, 12, 24 and 42 months the left ABI had improved to 1.05 and duplex imaging confirmed continuing patency of left EIA, CFA and SFA.

**Case 2:** A 70-year old male patient was referred to our institution for a non-healing ulceration of his right ankle after a complex talus fracture more than 10 years prior to referral. The ABI was 0.6 on the right and 1.0 on the left. Angiography of the right lower extremity showed a chronic proximal SFA occlusion with no stump at the origin of the SFA and with reconstitution at the level of the distal SFA through the DFA collaterals.

We therefore chose an ipsilateral retrograde transpopliteal approach to introduce a 4 Fr sheath (Radifocus Introducer II, Terumo, Leuven, BE) under sonographic guidance, followed by 5’000 IU heparin. A 0.018-inch guidewire (V18 Control Wire, Boston Scientific, Natick, MA, USA) was advanced to the level of the right EIA. We performed PTA of the proximal SFA occlusion using a 4mm balloon, followed by stenting (Protégé EverFlex 6x150mm, ev3, Minneapolis, MN, USA) for residual stenosis caused by elastic recoil. Completion angiography of the right lower extremity showed a patent CFA and
Surprisingly, the postinterventional hemodynamic evaluation on the following day showed no improvement, with right ABI measurement still at 0.6 and duplex sonography showing a high-grade stenosis at the right SFA ostium. The patient therefore was called for reintervention.

Choosing a contralateral transfemoral approach, a 6 Fr cross-over sheath (Destination, Terumo, Leuven, BE) was introduced via the left CFA, followed by 5’000 IU heparin. A steep oblique angiogram of the right femoral of the CFA revealed a localized dissection of the distal right CFA obstructing the SFA ostium (Fig. 2a). It was felt that at retrograde recanalization of the SFA, the guidewire had entered the CFA above its bifurcation, thus causing a short CFA dissection as the artery was balloon-dilated. This was not detected previously as the flap was hidden in the suboptimal angiographic projection. After several failed attempts to advance a 0.018-inch guidewire (V18 Control Wire, Boston Scientific, Natick, MA, USA) into the true SFA lumen via the cross-over sheath, a 4F retrograde sheath (Radifocus Introducer II, Terumo, Leuven, BE) was placed in the proximal right SFA approximately 3cm distal to the artery ostium using fluoroscopy for puncture guidance. This unusual femoral access was favoured over the popliteal one as torque-control of the bent guidewire was felt to be worse using that more remote access. In addition, a change of the patient’s position from supine to prone for popliteal puncture could be avoided.

The next steps were the same as in case 1 except that the septal puncture towards the true CFA lumen was from the SFA instead of the DFA and the larger balloon used for the fenestration (7mm, Fig. 2b). Completion angiography of the right lower extremity demonstrated patent CFA and SFA (Fig. 2c).
At routine clinical follow-up examinations the following day as well as after 1 and 3 months right ABI had improved to 0.9 and duplex imaging showed patent right CFA and SFA. As his wound had healed, the patient did not turn up to further follow-up examinations. He died 21 months after the CFA fenestration of cancer. According to his wife he did not suffer of any wound recurrence or walking disorder up to his death.

Both patients received a postinterventional dual antiaggregant therapy for 6 weeks with 100mg acetylsalicylic acid and 75mg clopidogrel daily.

Discussion

Acute iatrogenic arterial dissection is a known complication of endovascular techniques. Iatrogenic dissections of arteries can occur as a result of access artery puncture, mechanical intimal injury during manipulation with a guidewire or catheter and forceful contrast material injection. To some extent local dissection occurs in any balloon angioplasty. While acute arterial dissections of aortic branches or peripheral arteries may have a good chance of spontaneous recanalization, complete arterial occlusions leading to ischemia can be treated by surgical approaches or percutaneous techniques(2). The percutaneous techniques include prolonged ballooning, stenting or balloon fenestration (3, 4). Originally, percutaneous balloon fenestration was described for the treatment of true lumen collapse in spontaneous aortic dissection (5). Balloon fenestration aims at decreasing the inflow-to-outflow capacity ratio of the false lumen by widening an existing or artificially created re-entry tear, leading to reopening of the true lumen and reperfusion of compromised branch-vessels.

So et al. reported an extra-aortic balloon fenestration of an iatrogenic dissection of the celiac artery during selective catheterization for transcatheter arterial
chemoembolization (4). We report on percutaneous balloon fenestration of localized iatrogenic dissection of the CFA related to PTA of a chronic SFA occlusion and respectively, of an external iliac occlusive lesion. In both instances the compromise of the CFA branches by the dissection membrane was – in analogy to the aortic classification- of the dynamic type (1). We opted for balloon fenestration of the intimal flap because of the perceived risk of possible vascular injury due to stent fracture in a critical location caused by repetitive flexion and extension. In the swine model placement of a Wallstent® in the CFA induced a more extensive neointimal hyperplasia than in other locations (6). In some early clinical series placement of woven stainless-steel or tantalum stents in periarticular arteries such as the CFA or the popliteal artery was not associated with significantly higher restenosis or reocclusion rates than in the SFA (7, 8). However, at the same time stenting of SFA lesions with these devices was questioned because of their comparable patency rates with regard to plain balloon angioplasty (9).

Current studies support the use of nitinol stents in primary SFA stenting of long lesions (10) and their use as a bail-out tool in failed angioplasty of short lesions. Fracture of nitinol devices has been reported to occur, depending on the manufacturer, in up to 53% in the SFA. Moreover, these events seem to be associated with a higher rate of in-stent restenosis or reocclusion (11). Experience with CFA stenting of arterioclerotic occlusive disease, or of access-related dissections, is limited and mid- or long-term follow-up has not been reported yet (12, 13)

In our cases the CFA stent would have to end distally either in the SFA or the DFA, thus compromising one or the other arterial orifice.
Another concern is that stenting of the CFA may prevent further endovascular procedures from an ipsilateral femoral approach or would render surgery in case of a failed intervention more difficult and risky. Further the fenestration procedure was, although more time-consuming, may be less expensive though a formal economic analysis was not part of this report.

In case 2, inadvertent localized dissection of the right CFA resulted from a re-entry above the CFA bifurcation in retrograde subintimal angioplasty of the SFA occlusion. This complication can be attributed to the limited accuracy of achieving true lumen re-entry at the desired point when using standard wire and catheter techniques in subintimal angioplasty. This is substantiated by the findings of Lipsitz et al. that 47% of the collaterals in a segment within 5cm distal to target lesions were lost following subintimal angioplasty (14). Yilmaz et al. reported two DFA occlusions caused by a high re-entry in 32 patients with otherwise technically successful subintimal recanalization of SFA occlusions through a transpopliteal approach (15). Devices for the purpose of efficient and accurate true lumen re-entry have been developed in the last decade. They facilitate wire passage back to the true lumen through a retractable curved needle using intravascular ultrasound guidance in the case of the Pioneer catheter (Medtronic, Santa Rosa, CA, USA) and fluoroscopic guidance in the case of the Outback catheter (LuMend Inc., Redwood City, CA, USA). Yet their use is limited by catheter expense, availability of an IVUS workstation in the case of the Pioneer catheter and the large-caliber access sheaths.

In conclusion, we reported on two cases with percutaneous balloon fenestration of flow-limiting localized iatrogenic dissection of the CFA with initial technical success in both cases and favorable short- to midterm outcome.
Figure 1:
Patient 1. a) Arteriography showing a membranous occlusion of the left CFA at its origin and a proximal segmental SFA occlusion. The CFA and DFA are opacified by collaterals. b) After thrombolysis there is evidence of a chronic dissection of the CFA and a proximal SFA stenosis. c) Puncture of the septum with an angled back-end of a 0.018-inch guidewire introduced through the DFA. d) Balloon fenestration of the septum. e) Completion arteriography after proximal SFA stenting showing no residual dissection or SFA stenosis.
Figure 2:
Patient 2. a) In the steep oblique magnified view the erroneously high CFA entry (Arrow) causes an obstructing dissection. Note the longitudinal dissection membrane running between that entry (Arrow) and the proximal SFA stent-edge at the original CFA bifurcation (Arrowhead) b) The inverted, bent guidewire has been advanced from the SFA into the true CFA lumen to create an entry at the original bifurcation. c) Completion angiography.