Back to Basics: Arterial Sheath Management

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Abstract: Appropriate vascular access techniques are a cornerstone of any percutaneous vascular intervention to decrease periprocedural complications, and proper management of the vascular access site during a procedure plays a role in reducing complications that is just as important. The common femoral artery followed by the radial artery remain the predominant access sites for peripheral vascular interventions. Potential complications include bleeding, hematoma, pseudoaneurysm, arteriovenous fistula, retroperitoneal hemorrhage, arterial dissection, thromboembolism, infection, vessel rupture/perforation, and limb ischemia. Operators must quickly recognize these complications and provide management options for each one. We present the case of a clotted femoral arterial sheath that was promptly recognized and corrected prior to the development of potentially catastrophic complications.

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Introduction

Appropriate vascular access techniques are a cornerstone of any percutaneous vascular intervention to decrease periprocedural complications. Proper management of the vascular access site during a procedure plays just as important a role to reduce the incidence of complications. The common femoral artery followed by the radial artery remain the predominant access sites for peripheral vascular interventions.[1] Sheath sizes typically range from 4F to 7F, depending on the access site and type of intervention.[2] Potential vascular complications include bleeding, hematoma, pseudoaneurysm, arteriovenous fistula, retroperitoneal hemorrhage, arterial dissection, thromboembolism, infection, vessel rupture/perforation, and limb ischemia.[3] It is imperative for operators to quickly recognize these complications and be knowledgeable of various management options for each one. We present the case of a clotted femoral arterial sheath that was promptly recognized and corrected prior to the development of potentially catastrophic complications.

Case Presentation

A 70-year-old man was referred for consideration of right lower extremity (RLE) intervention after initially presenting with resting ischemic pain and early tissue necrosis of the metatarsals, consistent with critical RLE ischemia. The patient was taken to the catheterization lab, where contralateral left common femoral artery (CFA) access was gained using a Micropuncture needle (Cook Medical) under ultrasound guidance. A 6F, 11 cm arterial sheath was placed into the artery over a guidewire. The right common iliac artery was engaged using a 5F internal mammary artery catheter; a 0.035" stiff-angled

Figure 1. Digital subtraction angiography demonstrating total occlusion of the proximal right superficial femoral artery.

Figure 2. Digital subtraction angiography image demonstrating total occlusion of the right popliteal artery, proximal occlusion of the right anterior tibial artery with distal reconstitution via collaterals, and occluded peroneal and posterior tibial arteries.

Glidewire (Terumo Interventional Systems) was then advanced to the right CFA. Peripheral angiography of the RLE was performed, demonstrating a total occlusion of the superficial femoral artery (SFA) as well as total occlusion of the popliteal artery and all three infrapopliteal vessels (**Figure 1** and **Figure 2**). The 6F sheath was then exchanged over the Glidewire for a 6F, 45 cm sheath. At this time, anticoagulation was initiated with intravenous unfractionated heparin at 80 units/kg to achieve an activated clotting time (ACT) > 250 seconds.

Maintaining an intraluminal course throughout, the SFA and popliteal arteries were successfully traversed using a stiff-angled Glidewire inside of a 0.035" Crosswalk braided peripheral microcatheter (Asahi Intecc Medical) for additional support. After advancing the microcatheter to the distal popliteal artery, the Glidewire was exchanged for a 0.014" pre-curved Mongo ES wire (Asahi Intecc Medical). The occluded anterior tibial artery was successfully navigated with the Mongo wire, after which intravascular ultrasound was performed from the anterior tibial artery proximally to the SFA. Next, laser atherectomy of the SFA, popliteal, and anterior tibial arteries was performed with a 1.7 mm Turbo-Elite laser atherectomy catheter (Philips) (**Figure 3** and **Figure 4**). Following atherectomy, the anterior tibial artery was dilated with an Ultraverse 3.5 x 100 mm balloon (Bard). In preparation for percutaneous transluminal angioplasty of the SFA and popliteal arteries, the Mongo 0.014" wire was exchanged for a 0.035" stiff-angled Glidewire.

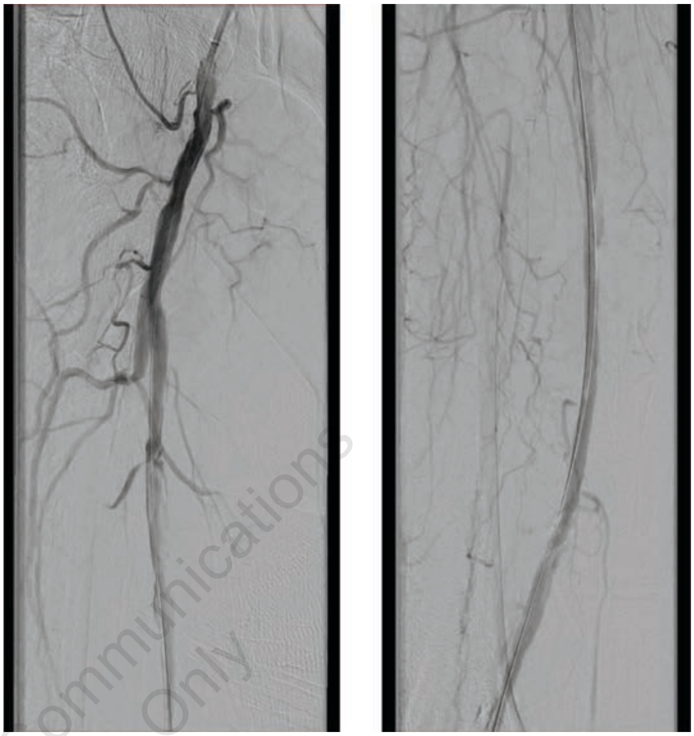

Figure 3. Digital subtraction angiography images of the right superficial femoral artery after laser atherectomy.

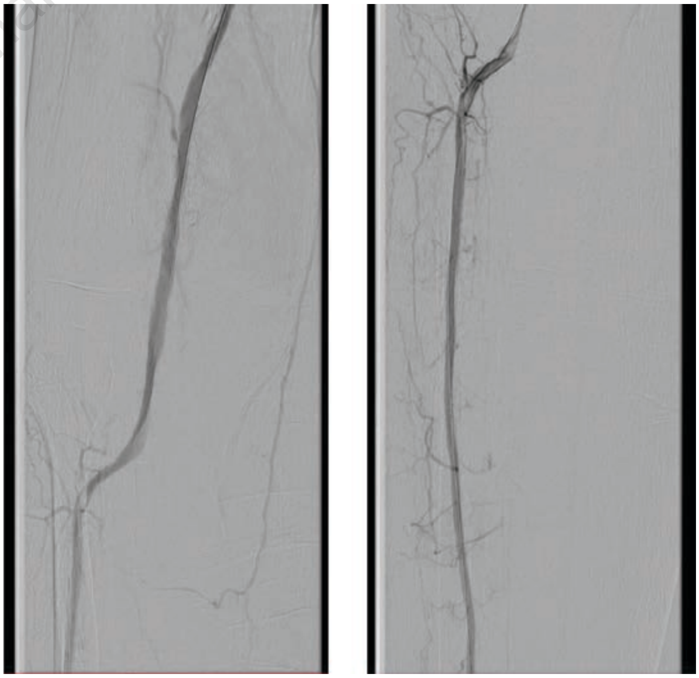

Figure 4. Digital subtraction angiography images of the right popliteal (left) and anterior tibial (right) arteries after laser atherectomy.

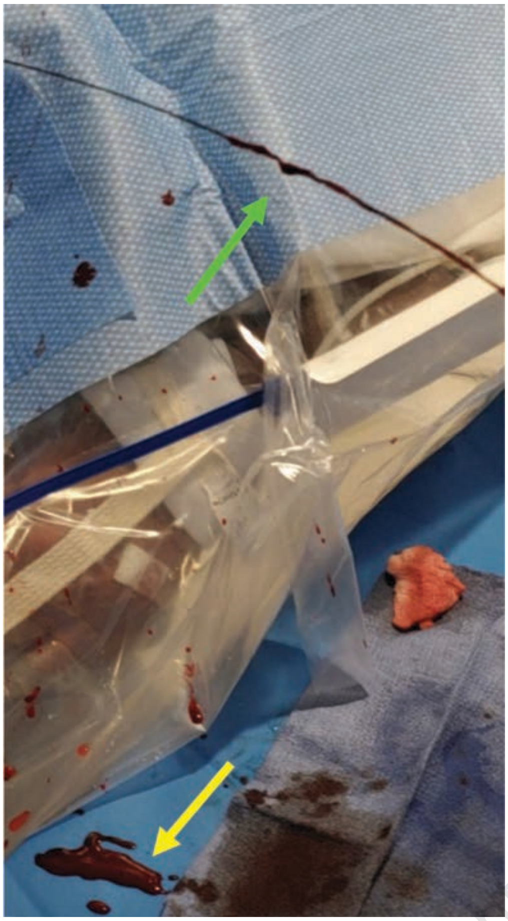

Figure 5. Extensive clot burden involving the long 6F sheath (yellow arrow) and stiff-angled Glidewire (green arrow).

Figure 6. Deployment of two BioMimics 6 x 150 mm stents to the right superficial femoral artery.

After the wire exchange, we attempted to aspirate, then flush, the 6F sheath with heparinized saline. After multiple failed attempts at sheath aspiration, we suspected a clotted arterial sheath and immediately proceeded to sheath exchange with a new 6F 45 cm sheath. Cautious to maintain wire position, the sheath was successfully exchanged. Saline flushing of the removed sheath resulted in expulsion of extensive clot burden (**Figure 5**). Repeat ACT confirmed therapeutic anticoagulation. The procedure concluded with percutaneous transluminal angioplasty followed by stenting of the SFA with BioMimics 6 x 150 mm stents (**Figure 6**). Final angiography demonstrated brisk flow through the SFA, popliteal, and anterior tibial arteries with no evidence of distal embolization (**Figure 7** and **Figure 8**).

Discussion

The incidence of femoral access site complications varies widely, from .7% to 9% in patients undergoing percutaneous peripheral vascular procedures.[4] Interventional procedures generally have a higher incidence of femoral access site complications compared with diagnostic procedures related to longer procedure times, requirement of therapeutic anticoagulation, larger sheath sizes, and the inherent complexity of the intervention. Thromboembolism can present at any time during the procedure, whether visibly on guidewires or quiescently formed in the lumens of catheters and sheaths. Additionally, peripheral vascular interventions often require the use of long (> 45 cm) arterial sheaths, which have been shown in small studies to have an increased risk of arterial thrombosis.[5] Although thromboembolic complications during percutaneous peripheral vascular interventions are rare, the consequences can be significant, including but not limited, to acute limb ischemia.[3]

Prevention is the most effective strategy in the management of thromboembolic complications.[4] Technological advancements, including heparin-coated catheters and the advent of hydrophilic-coated sheaths as well as guidewires, have been created to decrease the risk of thromboembolic complications. Despite these novel improvements, however, such equipment still retains varying inherent thrombogenicity.[6] The easiest method to prevent thrombus formation is frequent flushing of sheaths and catheters with heparinized saline. There is no definitive algorithm to the timing or frequency of sheath flushing. However, multiple resources have suggested the following criteria for when to flush a sheath: after initial insertion, with each catheter exchange, after prolonged idle procedural

Figure 7. Final angiographic result of right superficial femoral artery revascularization.

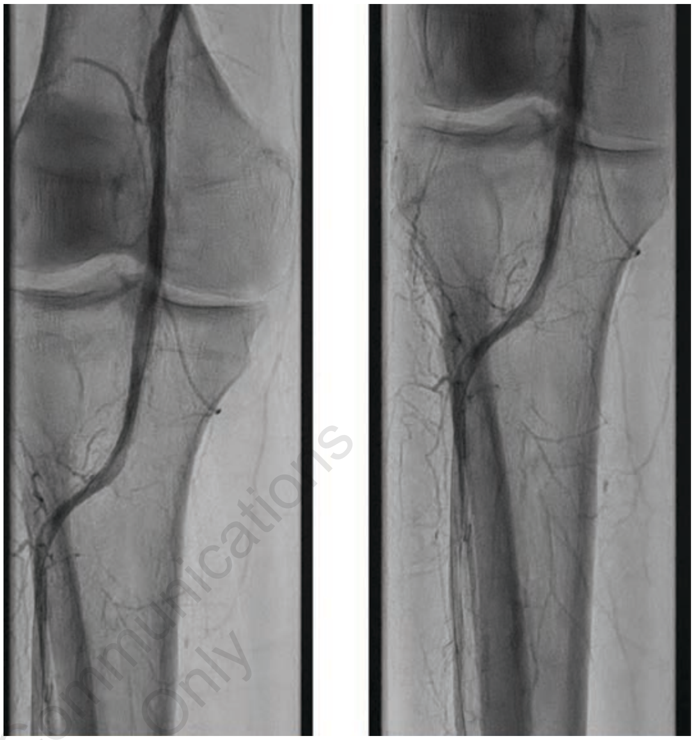

Figure 8. Final angiographic result of popliteal artery and anterior tibial artery revascularization.

time, and prior to sheath removal.[7-8] Additional management practices to decrease the risk of thrombus formation include ensuring appropriate anticoagulation status, frequent wiping of wires with gauze, or submerging hydrophilic wires in bowls or wire holders filled with heparinized saline.

Despite preventive measures, thromboembolic events can still occur, which necessitate prompt recognition as well as treatment. In our case, we discovered the sheath to be clotted when we were unable to aspirate blood following a routine wire exchange. Practicing frequent flushing techniques during the procedure allowed for prompt detection of the clotted sheath followed by appropriate treatment. The simplest and most effective technique to address the clotted sheath was to exchange the sheath over the existing guidewire for a new sheath of the same length and size. It must be noted that for this technique to be utilized, the guidewire should already be in place in the vasculature. Insertion of a guidewire into an already clotted arterial sheath is generally not recommended, as this could result in an increased risk of distal embolization. If a guidewire is not already in the vasculature, the operator can consider obtaining alternative vascular access followed by removal of the clotted sheath.

It should be noted that not all arterial sheaths that fail to aspirate are a result of thrombus, with alternative causes including arterial vasospasm, a kinked sheath, subintimal sheath placement in an arterial dissection, an arterial sidewall suction event, or a dislodged sheath. If a sheath fails to aspirate, one should never flush the sheath, as this could result in an avoidable complication.

Conclusion

Our case demonstrates the importance of remaining vigilant throughout percutaneous peripheral vascular interventions, thus resisting complacency during routine and often repetitive intraprocedural practices. Whether performing a diagnostic peripheral angiogram or a complex intervention, the operator has a responsibility to routinely perform practices to protect the patient from preventable complications. ■

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