Lower-Extremity Thrombectomy With Retrograde Distal Balloon Occlusion: The TReDBO Technique

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Abstract: Purpose. To describe a novel technique designed to prevent distal thromboembolism when treating thrombotic superficial femoral artery (SFA) occlusion with thrombolysis and mechanical thrombectomy. Technique. After antegrade crossing of the thrombotic SFA occlusion, retrograde tibiopedal access is obtained. An appropriately sized short balloon is then inflated at low pressure in the patent mid-distal popliteal artery from the retrograde access, with the antegrade guidewire “trapped” against the popliteal vessel wall. The guidewire is removed from the retrograde balloon and a stopcock is applied to the guidewire port to prevent backflow of blood and to allow for contrast injections through the balloon catheter lumen if desired. Thrombolysis with mechanical, rheolytic thrombectomy is then performed as usual from the antegrade access. Additional intervention of the SFA, as required for obstructive disease, is also performed. When antegrade and retrograde contrast injections demonstrate good results without evidence of residual thrombus or debris, the retrograde balloon is deflated and removed. Results. This technique was successfully applied in 5 patients with good results and without evidence of distal embolization or other complication. Conclusion. Thrombolysis with mechanical thrombectomy can be safely performed using retrograde distal balloon occlusion without occurrence of distal embolization or other complications. Prolonged balloon occlusion appears to be well tolerated due to geniculate collaterals.

Key words: distal embolization, mechanical thrombectomy, superficial femoral artery total occlusion, tibiopedal access

T hrombotic occlusion of the superficial femoral artery (SFA) is a not uncommon presentation of peripheral arterial disease of the lower extremities, although the true incidence is not known. If not promptly treated, it can lead to amputation or death.\(^1\)\(^-\)\(^5\) The clinical presentation is usually one of acute or subacute onset (days to weeks) of severe lower-extremity claudication, sometimes accompanied by ischemic pain of the foot. Many of these patients have had previous endovascular therapy for obstructive SFA disease, often with stent or stent-graft placement. Previous stenting of the SFA is associated with higher rates of distal embolization when compared to non-stented restenosis, possibly because of the presence of thrombotic material.\(^5\) When performing angiography on such patients, there is often a total occlusion of the femoropopliteal vascular segment, with little indication of the pathology underlying the occlusion itself. Relatively easy passage of the guidewire through the occlusion within the clinical setting noted above is often a clue to the presence of thrombus. Beyond the occlusion, there may be evidence of distal embolization involving one or more tibial vessels. In these cases, the clinical syndrome may be quite severe. If the thrombotic occlusion is more than a week or so in duration, thrombus organization may have occurred and thrombolysis can be more challenging. Attempts to perform plain old balloon angioplasty, with or without stenting, will prove unsuccessful without clot dissolution and removal. One of the biggest clinical risks in performing thrombolysis and thrombectomy in this vascular territory is the risk of distal embolization. If the thrombus is relatively fresh, this can usually be relatively easily remedied; however, if the thrombus is well organized, the ensuing tibial obstruction can be more difficult to manage. Therefore, great effort must be made to avoid distal embolization to the below-the-knee vessels in these cases.

While it is beyond the scope of this article to discuss the various methods of thrombolysis and thrombectomy, distal embolic

![Figure 1](https://example.com/figure1.png)

Figure 1. (A) Total occlusion of the proximal superficial femoral artery (SFA). (B) Multiple overlapping stents in the SFA from a prior intervention. (C) Angiography at the popliteal level demonstrating total occlusion of the anterior tibial artery.
Protection is often employed in appropriate cases. This protection is frequently in the form of a filter deployed distal to the occlusion, usually in the popliteal artery, when treating this vascular segment. Depending upon the volume and degree of organization of the thrombus, the filter can become overwhelmed. Despite efforts to mitigate this by aspirating proximal to the filter prior to retrieval, it is not uncommon for some thrombus to escape, or spill, and embolize to the tibial vessels, particularly during filter retrieval. The operator is then confronted with deciding whether—and how—to alleviate this new problem, which can be more difficult than the initial one and may be potentially catastrophic in patients with already compromised run-off vessels.

In this paper, we describe the new thrombectomy with retrograde distal balloon occlusion (TReDBO) technique used in 5 cases of thrombolysis with rheolytic thrombectomy and distal embolic protection using distal balloon occlusion of the popliteal artery from a retrograde tibiopedal access. Thrombolysis and mechanical thrombectomy were performed in each case with the Angiojet thrombectomy device (Boston Scientific) and tissue plasminogen activator (TPA) was administered using the pulsed spray technique. In our limited experience, this method has provided excellent protection from distal thrombus embolization while allowing the TPA to be more effective by partially trapping it within the thrombotic segment.

**TECHNIQUE**

Contralateral common femoral artery (CFA) access is first obtained with a 5 or 6 Fr x 10 cm sheath. Lower-extremity arteriography is then performed using a 5 Fr crossover catheter, with the catheter positioned in the CFA of the treatment limb, after iliac artery angiography, with imaging down to the foot. The short contralateral sheath is then exchanged for a 6 Fr x 45 cm sheath, with the distal end of the sheath positioned within the CFA of the treatment limb. The patient is then anticoagulated with an intravenous heparin bolus of 70 U/kg. A 4 Fr angled catheter is next used to facilitate passage of the guidewire through the SFA.
occlusion. A straight, stiff Glidewire (Terumo) is usually chosen first. If there is significant thrombus in the occluded SFA, the wire and support catheter usually pass easily through the occlusion due to the relative softness of the thrombus. Frequently, one or two regions of resistance are encountered; they are usually the root cause of the occlusion and will ultimately require therapy after thrombolysis and thrombectomy. When reaching the reconstituted segment of the popliteal artery (guided by the diagnostic imaging), the guidewire is removed and angiography is performed to better delineate the tibial arterial outflow. The guidewire is then reintroduced through the catheter and down into a tibial artery. The tibial artery chosen is typically not the tibial artery to be used for retrograde access.

The next step is retrograde tibial access. If all tibial arteries are widely patent, then the posterior tibial artery is general chosen for access since it affords a straighter path to the popliteal artery. All tibial access is performed with ultrasound guidance using a 15 MHz “hockey stick” transducer and a 4 Fr sheath inserted using a micropuncture kit. One technical aspect of tibiopedal access where we may differ from traditional practice is that when both patent and occluded tibial arteries are present, we choose the occluded vessel, provided it is accessible. Our experience has shown that retrograde tibiopedal access for the purpose of performing suprapopliteal intervention (with inherently larger-profile catheters) sometimes leads to the development of obstructive – and even totally occlusive – disease in the accessed vessel over time. Therefore, accessing a severely diseased or occluded tibial artery minimizes this potential long-term downside. A .014˝ soft-tipped guidewire is then passed retrograde up the tibial artery into the popliteal artery, followed by positioning of an appropriately sized, 20 mm-long balloon in the P2 or P3 segment of the popliteal artery. We have found that a 5.5 mm balloon is satisfactory for most vessels. If a diseased or occluded tibial artery is chosen, balloon dilatation is first performed with a long, 3.0 mm balloon.

Prior to popliteal balloon inflation, the Angiojet device (Solent Omni) is prepared for delivery of 10 mg of TPA (alteplase) using the pulsed spray technique. The thrombectomy catheter is then positioned in the CFA of the treatment limb. At this point, the popliteal artery balloon is inflated to 4 atm. The low pressure is all that is required to occlude the vessel without causing significant barotrauma. The guidewire is then removed from the balloon catheter and a stopcock is attached to prevent backflow of blood. Angiography is then performed via the balloon lumen to assess geniculate collaterals. In addition, angiography is performed from both the CFA sheath and the tibial sheath. If the accessed tibial artery is diseased, we advance a soft .014˝ guidewire down the vessel from the CFA sheath, remove the tibiopedal sheath, and perform a 5-minute balloon inflation across the access site at low pressure while applying manual compression externally; this usually results in good hemostasis. Additional treatment of the access tibial artery may be performed at this time, including pedal branches, if needed.

**DISCUSSION**

Acute and/or organized thrombus is frequently present in total occlusions of the SFA. There are many ways to treat thrombus-containing SFA occlusions, but most involve some form of thrombolysis and/or thrombectomy. These procedures can be complicated by distal thromboembolism and so this must be addressed, often using distal embolic protection devices (EPDs), mostly with filters. EPDs, however, are not foolproof in their ability to prevent embolization because they sometimes move about during the procedure or spill some of their contents during EPD retrieval. In addition, EPDs add significant unreimbursed cost to the procedure. Tibiopedal access has become increasingly common in the performance of endovascular procedures and has been demonstrated to be quite safe. With the TRKeBO technique, we were able to prevent distal thrombotic embolization more effectively since the balloon is completely occlusive and it allows aspiration right up to the balloon itself. Furthermore,
we believe that thrombolysis is more efficient in these cases since much of the thrombolytic is “trapped” in the treatment segment. Of course, some will still run off through collateral vessels. We found the prolonged popliteal balloon inflations to be well tolerated. Mean popliteal balloon inflation time in these cases was 46.6 minutes (range, 38-53 minutes). There appears to have been adequate collateral (geniculate) flow to avoid severe ischemia; nevertheless, the foot is exposed because of the tibiopedal access and can be monitored for signs of ischemia. Finally, retrograde contrast injections through the occlusion balloon lumen can identify residual embolic debris requiring additional aspiration in a way that cannot be as accurately defined by antegrade injections.

STUDY LIMITATIONS
This is a limited observational study and our results cannot be generally extrapolated. There was no attempt to compare the outcomes using this technique versus filter use. In fact, use of filters for the prevention of distal embolization in conjunction with thrombolytic therapy and thrombectomy has been unequivocally shown to be safe and efficacious. Furthermore, in order to apply this technique, the status of the tibial vessels is of paramount importance. Despite the apparent safety of tibiopedal access, there is risk to the access vessel both acutely and for longer-term stenosis or occlusion, and this must be taken into consideration when deciding whether to utilize this technique. For our purpose, only a 4 Fr sheath is required (and not the larger 5 Fr and 6 Fr sheaths needed in many cases of SFA intervention performed via tibiopedal access that are associated with greater vessel injury). Furthermore, this technique would not be suitable in cases where prolonged thrombolysis is anticipated, but rather is intended for cases where thrombolysis-facilitated thrombectomy is planned so that occlusion balloon inflation time will be limited. Finally, evaluation of collaterals, particularly geniculate vessels, is important in establishing the likely tolerability of this technique.

CONCLUSION
Thrombectomy with retrograde distal balloon occlusion (TReDBO) is a safe and feasible technique, in appropriate patients, to prevent distal thromboembolization in the treatment of thrombotic occlusion of the superficial femoral artery.

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The author reports that patient consent was provided for publication of the images used herein.


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REFERENCES