

Post–Total-Knee-Arthroplasty Popliteal Artery Intimal Tear Repaired With Endoluminal Balloon Angioplasty

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Arterial vascular injury after total knee arthroplasty (TKA) is rare; its rate of occurrence is 0.03% to 0.17%.^{1,2} Post-TKA arterial occlusion can be caused by thrombosis, fascial obstruction, plaque embolization, or direct trauma to the vessel.^{3,4} Optimal treatment options for popliteal artery occlusion are primary repair of the vessel and saphenous vein bypass.⁵

In this article, we report a case of post-TKA popliteal artery occlusion with suspected intimal flap disruption treated endovascularly with percutaneous transluminal angioplasty (PTA). We obtained the patient's written informed consent to document her case for publication.

CASE REPORT

A woman in her early 60s presented to our office with bilateral knee pain, left more than right. She had previously been treated with anti-inflammatory medications, viscosupplementation, and corticosteroid injections. Nevertheless, she had significant activity-related pain, which improved only with rest.

Physical examination revealed a full-extension mild valgus deformity that was correctable with varus stress. There was tenderness on the medial and lateral joint lines, and range of motion (ROM) was 0° to 95°. Skin examination was unremarkable, and there were palpable pulses with no sensory deficit. Radiographs showed tricompartmental degenerative changes with a slight valgus deformity and no soft-tissue abnormalities.

After medical clearance was obtained, the patient underwent left TKA with a posterior stabilized design. The

surgery was completed through a standard midline incision and a median parapatellar arthrotomy. The tourniquet was elevated to 350 mm Hg for a total of 63 minutes and was let down after the cement had polymerized. The unremarkable wound, which had no significant bleeding, was closed in standard fashion. In the recovery room, the patient was found to be in stable condition, but pulses were not palpable in the left leg. The extremity itself was felt to be slightly cold. A vascular consultation was requested immediately.

Vascular evaluation revealed a normal pulse on the right and a palpable left femoral pulse but no palpable pulse in the left popliteal, posterior tibial, and dorsalis pedis arteries. Doppler examination revealed no signals in the left popliteal, dorsalis pedis, and posterior tibial arteries. Sensation and movement to the left lower extremity remained intact. The vascular consultant recommended immediate evaluation in the angiography suite. The patient underwent emergency arteriography, which showed short segmental occlusion of the popliteal artery with a tapering appearance (Figures 1A–1C). After discussing multiple options for revascularization of the extremity, we recommended endoluminal balloon angioplasty because we thought it offered a reasonable chance for success and had the lowest risk for surgical and postsurgical complications.

A guide wire was advanced across the occlusion, and the angioplasty was performed with a balloon measuring 5 mm × 2 cm (Figures 2A, 2B). Follow-up imaging showed excellent blood flow (Figures 2C, 2D). Clinical results were a return of palpable pulses and a normal ankle-brachial index. Overall time in the angiography suite was 45 minutes, and overall time from tourniquet compression to limb reperfusion was less than 2 hours.

Aspirin 325 mg/d was started immediately, enoxaparin 30 mg subcutaneous 2 times a day was started 12 hours after surgery, and warfarin was started at 5 mg the evening after surgery. Enoxaparin was discontinued when the international normalized ratio exceeded 2 (postoperative day 5), and warfarin was continued for 3 weeks with the international normalized ratio kept between 2 and 3.

The patient wore a knee immobilizer for 24 hours and then only while out of bed during the rest of her inpatient stay (ie, until postoperative day 5). Once an outpatient, she began standard physical therapy. Serial pulse checks, conducted every hour the first 24 hours, remained normal. The extremity remained soft and nontender. An arterial

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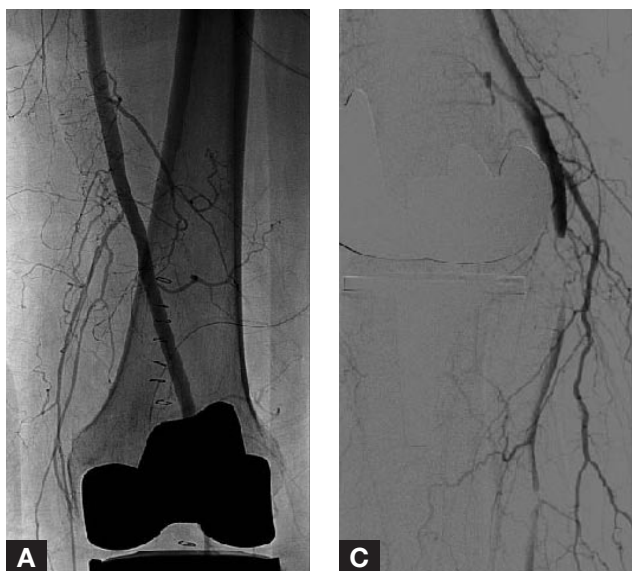


Figure 1. (A) Anteroposterior nonsubtracted angiogram with minimal blood flow through popliteal artery. (B) Lateral angiogram shows tapering of popliteal artery. (C) Subtracted angiogram shows occlusion of popliteal artery.

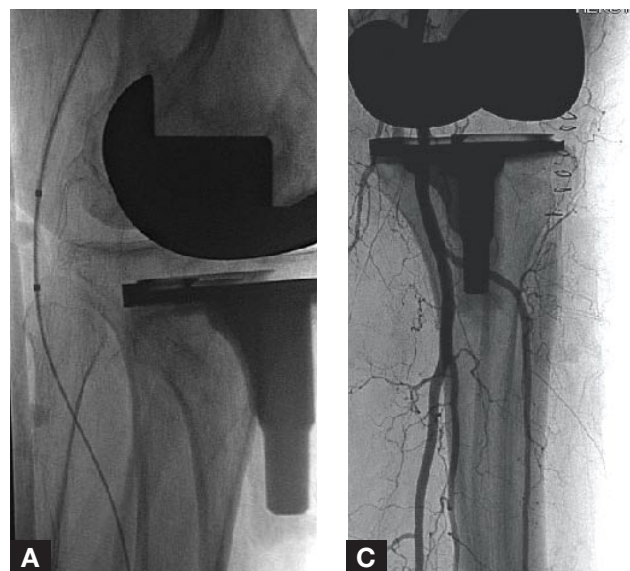
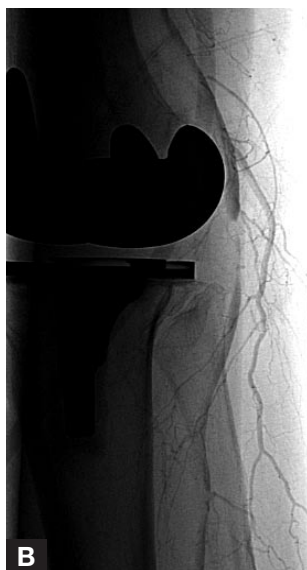
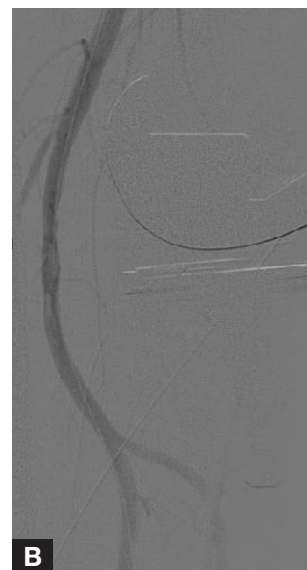


Figure 2. (A) Lateral nonsubtracted angiogram shows endoluminal balloon ready to be deployed. (B) Lateral subtraction angiogram with deployed endoluminal balloon. (C) Anteroposterior angiogram shows blood flow restored through popliteal artery. (D) Lateral angiogram shows blood flow restored through popliteal artery.



duplex scan performed on postoperative day 3 showed normal velocities without stenosis. The patient was discharged home on postoperative day 5.

At the first postoperative visit (2 weeks after surgery), the patient had excellent ROM (0°-115°) and an easily palpable dorsalis pedis pulse. The 3-month vascular follow-up examination revealed a normal arterial duplex of the popliteal artery without stenosis or pseudoaneurysm and a normal ankle-brachial index. At the most recent orthopedic follow-up (1 year after surgery), there were no orthopedic or vascular complaints. The patient had 0° to 125° ROM with excellent muscle strength and less than 5° of varus or valgus instability.

DISCUSSION

Popliteal vascular injury, a very rare complication of TKA, is estimated to occur in 0.03% to 0.17% of cases.^{1,2} Most of these vascular complications involve thrombosis, atherosclerotic occlusion, or direct sharp trauma. TKA-associated

arterial trauma can be a result of arterial occlusion from arterial manipulation or tourniquet use, trauma at the level of the superficial femoral artery, or compression of the artery between musculotendinous and osseous structures during correction of flexion contractures.^{2,6,7} Arterial intimal disruption is thought to result from extensive manipulation during the procedure.⁸ Tourniquet compression has been hypothesized as a cause of an intimal flap or of thrombosis of an atherosclerotic, stenotic femoral, or popliteal artery.^{4,7,9}

Treatment options for popliteal arterial occlusion secondary to arterial injury include emergency surgery with direct repair and popliteal bypass with contralateral saphenous vein bypass.⁵ However, Calligaro and colleagues¹⁰ stated that, in cases with underlying significant athero-

sclerotic disease, thrombectomy alone was inadequate for revascularization, and bypass procedures were often needed to reestablish blood flow. If blood flow cannot be reestablished, major knee amputation will be required.¹⁰

Repair of acute intimal flaps has involved balloon angioplasty combined with stents¹¹ as well as surgical bypass.² In our patient's case, use of a stent graft or a bare stent in the popliteal region would not have been appropriate because the large degree of flexion and extension would have left a stent exposed. Therefore, we used percutaneous transluminal angioplasty (PTA) for revascularization.

PTA is effective in improving blood flow in appropriate patients with occlusive disease of the femoral and popliteal arteries. The advantages of PTA over conventional methods of arterial revascularization include the ability to perform the procedure with the patient under local anesthesia, decreased hospital stay and costs, low rates of septic complications, and lack of a need to modify anticoagulant therapy.¹²

After reperfusion, compartment syndrome may result from indirect injury to the muscle during hypoxia and ischemia.¹³ The limb must be closely monitored for compartment syndrome. According to Perry,¹³ swelling, tightness, tenderness, and distal arterial pulses should be assessed. Our patient did not have any swelling, tightness, or tenderness, and her distal pulses were full throughout her hospital stay. Hofmeister and Shin¹⁴ stated that, when compartment syndrome occurs, early prophylactic fasciotomies should be performed. They also indicated that the optimal time for reperfusion and best recovery of the muscle is within 3 hours of occlusion. Our patient was reperfused within 2 hours of initial occlusion with the tourniquet. As she did not show any signs of reperfusion injury, prophylactic fasciotomies were not performed.

To our knowledge, this is the first report of using PTA to treat a post-TKA intimal flap tear of the popliteal artery. PTA was used to open the segmentally occluded popliteal artery. Given the relative shortness of the angiography procedure and our patient's quick recovery, we believe PTA should be considered a treatment option for popliteal arterial occlusion caused by intimal flaps.

CONCLUSIONS

The usual recommended treatment options for popliteal artery occlusion are primary repair of the vessel and saphenous vein bypass.⁵ As our patient's case demonstrates, endovascular treatment with balloon angioplasty for post-TKA popliteal artery injury secondary to intimal flap tears may be considered an alternative to open surgical revascularization procedures.

AUTHORS' DISCLOSURE STATEMENT

The authors report no actual or potential conflict of interest in relation to this article.

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