Chapter 13
Popliteal Artery Aneurysm Repair Primary and Recurrent

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Clinical Presentation and Indications for Repair

Popliteal artery aneurysms (PAA) are the most frequently encountered true peripheral artery aneurysm that a vascular surgeon repairs. PAA are most commonly seen in older men and are associated with aneurysms at other locations, specifically the contra lateral popliteal artery and the abdominal aorta. While less frequently encountered in clinical practice, iatrogenic and traumatic popliteal artery pseudoaneurysms do occur.

PAA may have an asymptomatic presentation such as a pulsatile mass behind the knee, noted on physical exam, or as an incidental finding on an imaging study. Symptomatic presentations include acute limb-threatening ischemia secondary to sudden thrombosis of the aneurysm or distal embolization of PAA mural thrombus, or more rarely as rupture. Chronic symptoms of ischemia may also occur leading to claudication or tissue loss, which may have an insidious onset due to chronic silent embolization. Local compression of the nerve or vein may lead to pain, paresthesia, or limb swelling.

In general, a PAA that is causing symptoms has indication for repair. For asymptomatic PAA, a size of 2 cm has been a traditionally accepted size to consider elective repair in good risk patients. Other considerations beyond size include degree of thrombus within aneurysm, status of tibial vessel runoff, and ambulatory status, along with consideration of comorbidities and overall health status of the patient.

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Significant PPA mural thrombus in a good risk patient would make the argument for earlier repair, whereas lack of thrombus in a poorer surgical risk patient would advocate for a watchful waiting approach.

Preoperative Evaluation

Several imaging modalities including duplex ultrasound, computed tomography angiography (CTA), magnetic resonance angiogram (MRA), and catheter-based digital subtraction angiography, are available and may be of use in the diagnosis and management of PAA. Duplex ultrasound is a good screening tool for identifying PAA and is also useful for surveillance of asymptomatic PAA that have not reached criteria for repair. Duplex ultrasound is also valuable in identifying the vein preoperatively that will be used as conduit for bypass during repair of PAA. In planning PAA repair, imaging studies must define the extent of the aneurysm and identify any arterial disease proximal or distal to the PAA. CTA is the author's preferred imaging modality for this. Catheter-based digital subtraction angiography is typically reserved for cases of acute PAA occlusion, where catheter-directed thrombolysis is initiated to recover outflow vessels. Catheter-based digital subtraction angiography is also employed when other imaging studies are unable to define the tibial vessel runoff well enough to plan the arterial reconstruction. Ankle brachial index (ABI) along with digital photoplethysmography (PPG) is obtained to objectively document the preoperative physiologic limb perfusion status.

Anatomy

The popliteal artery runs deep within the popliteal fossa and is a continuation of the superficial femoral artery beginning at the level of the adductor hiatus in the adductor magnus muscle of the thigh. The popliteal artery gives off several geniculate branches, and ends at the inferior border of the popliteus muscle where it branches into the anterior tibial artery and the timiperone trunk, which shortly branches into the peroneal and posterior tibial arteries.

Operative Approach

The standard approaches for repair of PAA include posterior approach and medial approach. Advantages of the medial approach include its familiarity to most surgeons and the versatility it allows for proximal and distal exposure such as in cases of superficial femoral artery involvement or a tibial artery being the distal arterial target for bypass. The medial approach also allows ready access to the great

saphenous vein. Advantages of the posterior approach include the option for complete excision of the aneurysm in cases of nerve or vein compression. However, this approach is only useful for focal aneurysms as exposure is limited proximally to the adductor canal and to the anterior tibial artery takeoff distally. This approach also limits ready access to an appropriately sized vein to be used as bypass conduit.

Posterior Approach

The posterior approach is performed through and S or step incision (Fig. 13.1). This incision avoids a perpendicular incision across the knee crease, staying medial to the major nerves and veins in approaching the artery. The incision for posterior exposure starts on the posterior medial aspect of the thigh within 1 to 2 cm posterior to the course of the great saphenous vein and is carried down to just below the

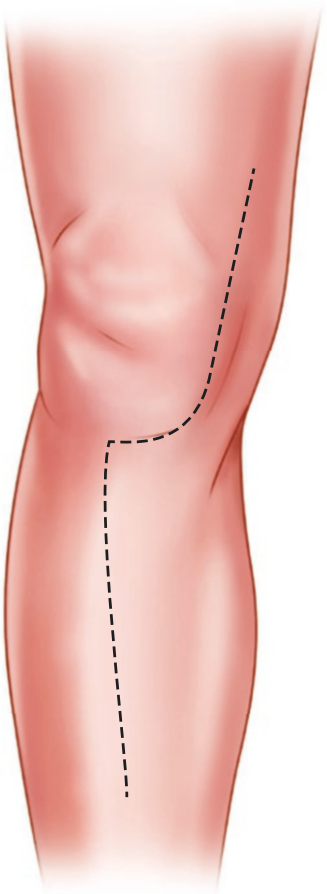

Fig. 13.1 Image demonstrating S or step incision for posterior to popliteal artery, which avoids a perpendicular incision across the knee crease

popliteal crease at which point the incision is sharply curved laterally to the middle of the leg at which point the incision is sharply curved downward. Below the knee, the incision and dissection remain just medial to the small saphenous vein and sural nerve. This incision theoretically provides access to harvest the great or small saphenous vein to be used as autogenous bypass graft. The author's preference is to use the saphenous vein as conduit for arterial reconstruction and typically uses the most proximal great saphenous vein, which tends to offer the best size match. This is performed with the patient in the supine position after which the patient is placed in a prone position for the posterior exposure.

The route to the neurovascular structure in the popliteal fossa is direct, with the popliteal artery the deepest of these structures (Fig. 13.2a, b). Dissection proceeds between the heads of the gastrocnemius muscle, staying medial and avoiding injury to the small saphenous vein and sural nerve. As the gastrocnemius muscle heads are retracted apart, a nerve to the medial head of the gastrocnemius muscle will be encountered and may be difficult to preserve in more distal exposures. In these

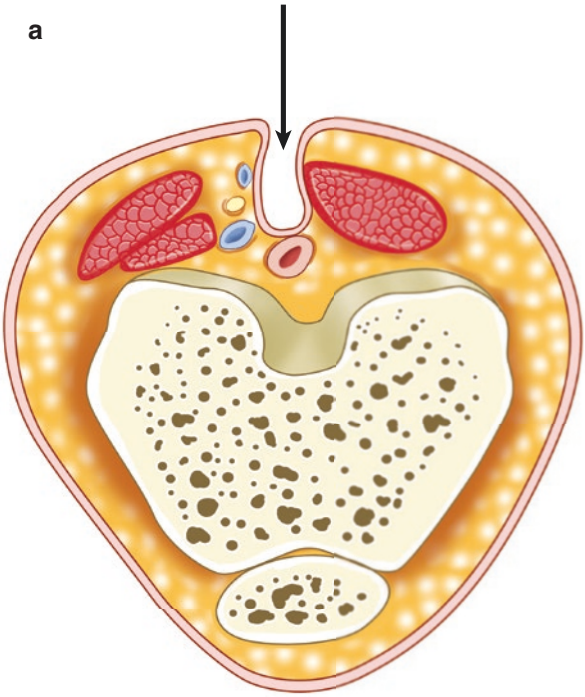

Fig. 13.2 (**a**) Image demonstrating course of dissection for posterior approach to popliteal artery, staying medial to the major nerves and veins in approaching the artery. (**b**) Image demonstrating posterior exposure of the popliteal artery

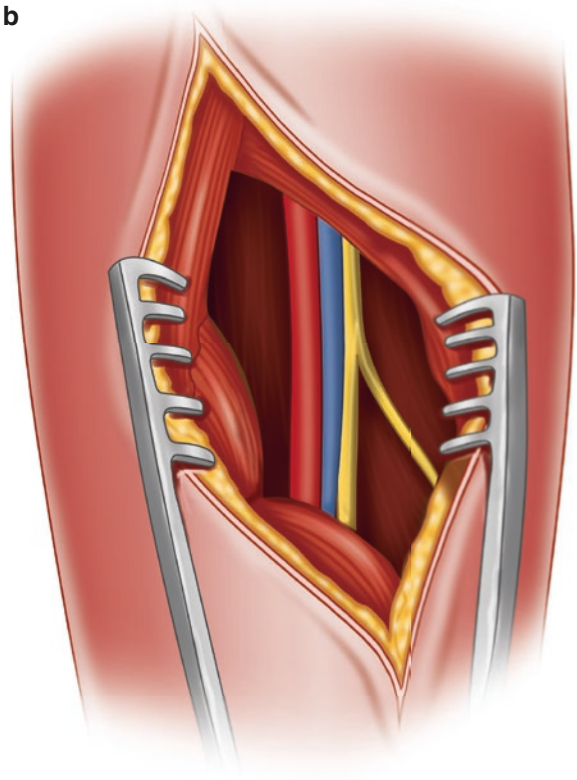

Fig. 13.2 (continued)

typically elderly patients, if a nerve is divided, it does not result in discernable disability. Dissection continues medial to the popliteal vein and usually requires ligation of a few small branches to the vein. Venae comitantes around the artery will require division as well. This exposure usually allows access of the popliteal artery proximally at the level of the adductor hiatus and distally to the origin of the anterior tibial artery.

At this point, the aneurysm is isolated as well as normal artery proximally and distally to the aneurysm. Geniculate branches are ligated. Arterial control is accomplished with application of vascular clamps to the arteries proximal and distal to the aneurysm or alternatively with inflation of a tourniquet in the thigh proximal to the incision after exsanguination of the distal limb with an Esmarch wrap. Then, the aneurysm may be excised or open longitudinally similar to open infrarenal aortic aneurysm repair, and then, the chosen bypass conduit is sewn in place with end-to-end anastomosis proximally and distally in the standard fashion with running polypropylene suture.

Medial Approach

The concept of PAA repair via a medial approach is proximal and distal ligation of the aneurysm with interval bypass (Fig. 13.3). During which attempt is made to ligate side branches of PAA as there is a risk of continued aneurysm growth if it remains pressurized from patent-preserved side branches. Exposure is via above and below knee incisions (Fig. 13.4).

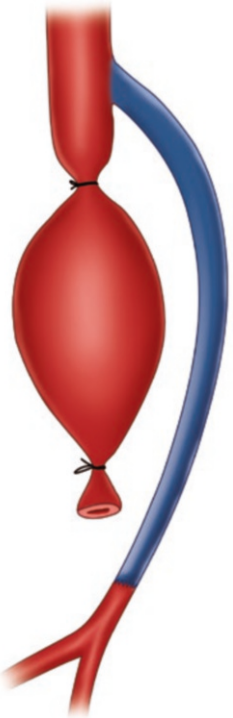

Fig. 13.3 Image demonstrating proximal and distal ligation of popliteal artery aneurysm with interval bypass

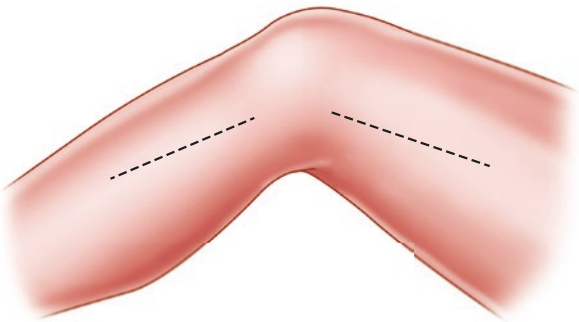

Fig. 13.4 Image demonstrating medial aspect of the lower limb with the knee slightly bent with the site of incisions for medial exposure of the above and below knee popliteal artery

The medial incision to expose the popliteal artery above the knee is made longitudinally over the palpable depression between the vastus medialis above and the sartorius muscle below. If the greater saphenous vein will be needed, the incision can be made closer to it. Once the skin and superficial fascia are opened, the deep fascia will be seen as well as the more opaque outline of its junction with the medial intermuscular septum and the fascia is incised below/posterior to this junction. After incising the fascia just below the intermuscular septum and above the sartorius muscle, the popliteal space is entered (Fig. 13.5a, b). The proximal popliteal artery is surrounded by venae comitantes with the popliteal vein behind it. Exposure of the popliteal artery requires dividing and dissection away these venae comitantes. It should be noted during this dissection that the saphenous nerve exits the adductor hiatus and travels superficially and distally, usually joining the great saphenous vein at or just below the knee. It should be identified and protected. If the nerve is injured, dividing the nerve and leaving the patient with an area of numbness is often better tolerated than ongoing causalgic pain of a partially injured or entrapped nerve.

The medial exposure of the below knee popliteal artery is performed via an incision placed just posterior to the edge of the tibia and in front of the great saphenous vein. Again, if the great saphenous vein is being harvested to use as conduit, the incision may be made closer to the vein. The course to the below knee neurovascular structures is direct (Fig. 13.6a, b), by first incising the fascia into the deep posterior compartment and then taking down fibers of the soleus muscle with electric cautery. Having divided the fibers of the soleus muscle and providing retraction the popliteal vein will come into view. The tibial nerve will be found adjacent to it superiorly and slightly deeper in the incision. The artery will be found deeper between these two structures. For exposure of the more proximal below knee popliteal artery to the anterior tibial artery, the popliteal vein is retracted posteriorly. Exposure including the anterior tibial artery and tibioperoneal trunk requires a greater mobilization of the vein including ligation and division of the anterior tibial vein and possibly other small tributaries.

Once exposure and control of normal artery proximal and distal to the popliteal artery aneurysm have been obtained, working through both incisions, further dissection of the aneurysm is performed to identify and ligate branches. The artery just proximal and distal to the aneurysm is ligated. Arterial reconstruction is then performed, typically with greater saphenous vein graft. Considerations for tunneling of the graft include anatomically or subcutaneously. If the decision is made to tunnel the graft anatomically, one must make certain that it will not be compressed by the residual aneurysm. If the graft is tunneled subcutaneously, it is often advantageous to divide the distal below knee popliteal artery and perform the distal anastomosis end to end. This is done to provide a better course for the graft to follow, as end-to-side anastomoses often result with the graft coming to meet the artery at a right angle and leads to kinking and graft failure.

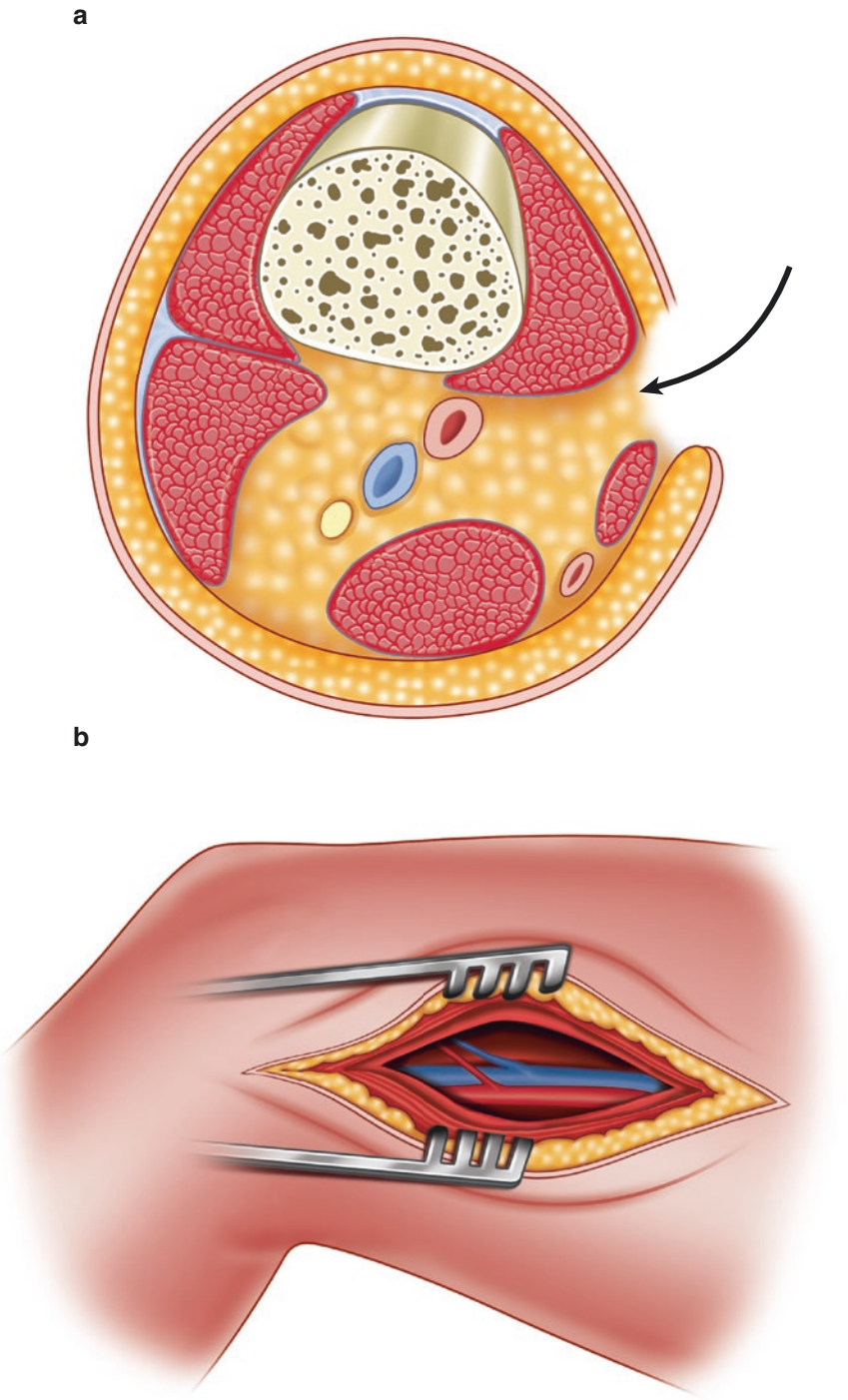

Fig. 13.5 (**a**) Cross-sectional image demonstrating course to the above knee popliteal artery via medial approach. (**b**) Image demonstrating exposure of the above knee popliteal artery via a medial approach

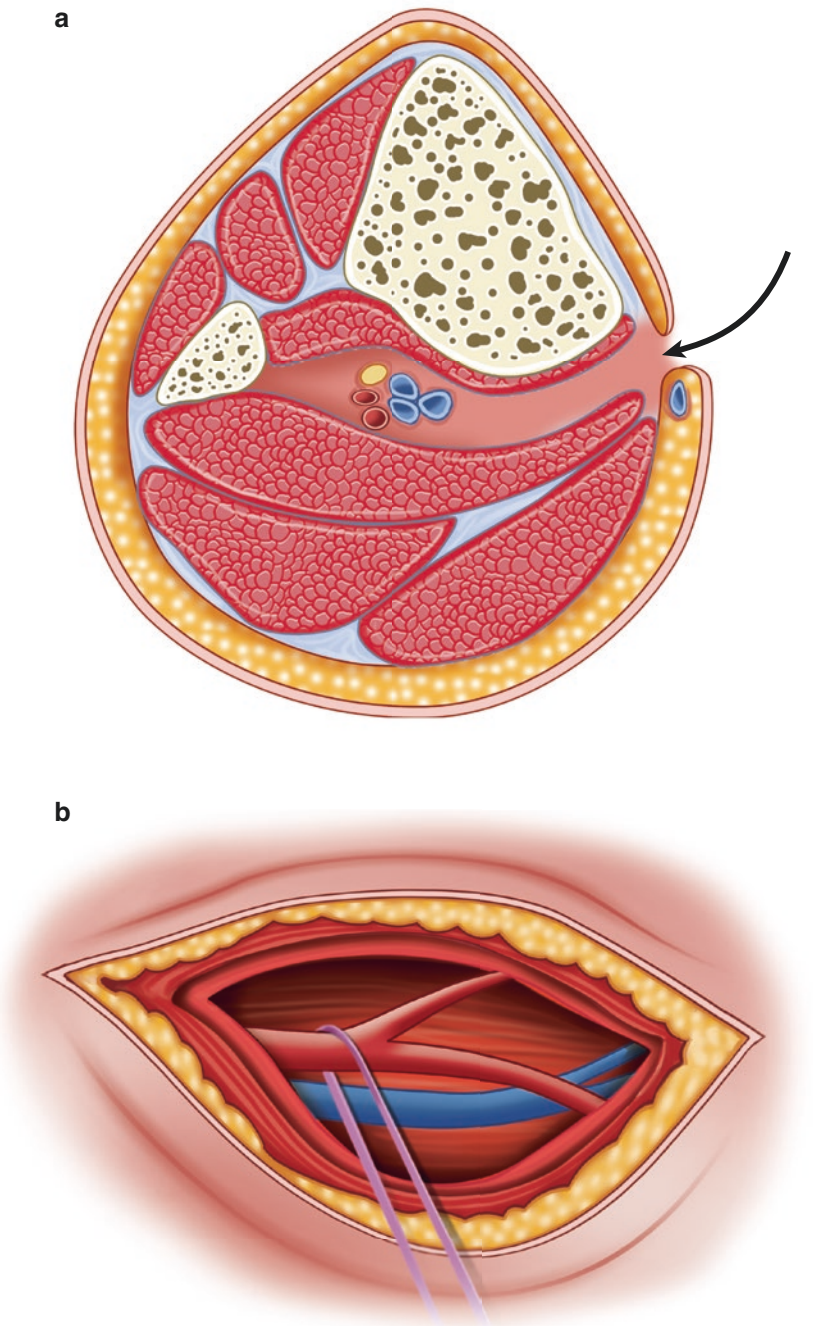

Fig. 13.6 (**a**) Cross-sectional image demonstrating course to the below knee popliteal artery via medial approach. (**b**) Image demonstrating exposure of the below knee popliteal artery via a medial approach

Recurrence and Remedial Interventions

While popliteal artery aneurysm repairs tend to be very durable, recurrent aneurysm may occur from progression of disease of the artery proximally or distally to the repair and, in such cases, require either bypass from a more proximal site or to a more distal site and exclusion of the aneurysmal artery. Also, aneurysms treated with ligation and interval bypass may also continue to grow if pressurized from non-ligated side branches, akin to type 2 endoleaks in endovascular aortic aneurysm repair. In such cases, if aneurysm is symptomatic, treatment requires occlusion of these branches via either open or endovascular techniques.