- Contralateral femoral artery access is used most often for diagnostic studies and therapeutic interventions.
- Ipsilateral antegrade common femoral artery access provides maximum control and can be used in situations when contralateral access is challenging (eg, steep aortic bifurcations or hostile groin).
- Upper-extremity access is less frequently used, but is essential when faced with hostile femoral access sites or when simultaneous infrainguinal interventions are planned. Some endovascular interventions may not be tenable due to device length limitations.

DIAGNOSTIC DEVICES USED

INTRODUCER SHEATHS

4 F or 5 F.

FLUSH DIAGNOSTIC CATHETERS

4-F or 5-F Sos Omni or pigtail catheter placed in the infrarenal aorta for a nonselective flush aortogram/pelvic arteriogram (20 mL at 10 mL per second).

SELECTIVE DIAGNOSTIC CATHETERS

After crossing the aortic bifurcation with standard techniques, a 4-F or 5-F, 135-cm, angled Glide catheter should be advanced into the popliteal artery. The runoff vessels are best imaged in a 10° to15° ipsilateral oblique projection. Small volumes of dilute contrast (6 mL at 3 mL per second) are injected though the end-hole catheter using digital subtraction angiography.

DIAGNOSTIC GUIDEWIRES

A .035-inch exchange length steerable floppy tip guidewire is used to advance the diagnostic catheter into the popliteal artery. Small-caliber PTCA guidewires (.014-inch) readily access the tibial vessels once a crossover sheath has been advanced.

DIAGNOSTIC NOTES

- Ultrasound guidance aids percutaneous antegrade common femoral artery access by locating the bifurcation and thus avoiding low punctures, which are accompanied by more frequent complications.
- Selective catheter placement in the popliteal artery will provide optimal anatomic information and minimize contrast volumes.
- Once the selective diagnostic catheter is positioned in the popliteal artery, small injections of dilute contrast (66% strength) will provide adequate visualization of the tibial vessels. In cases of advanced atherosclerotic disease, strength contrast may be necessary. It is very important to see the entire lower-extremity runoff before and after the interventional procedure. Microembolization during tibial interventions is not uncommon.
- The tibial peroneal vessels are best imaged in an ipsilateral oblique projection (10° to 15°).
- A lateral projection of the foot will identify inframalleolar outflow vessels.
- Measurement of pressure gradients across the tibial peroneal vessels is unreliable because the diagnostic catheter obstructs flow and dampens waveforms in these small arteries.

sheath) is placed for the interventional procedure. Advancement of the guiding sheath across the aortic bifurcation into the contralateral femoral artery is aided by using a sturdy .035-inch exchange-length guidewire.

INTERVENTIONAL GUIDEWIRES

A steerable 300-cm, .014-inch PTCA guidewire is recommended for tibial interventions. A guidewire that provides stability with a flexible tip for crossing complex tibial lesions is recommended. If additional guidewire support is needed to cross chronic occlusions, a 5-F Berenstein glide catheter can be advanced to the diseased vessel. Through this 5-F catheter, a 3-F, 150-cm microcatheter can be advanced over the .014-inch guidewire. The additional support provided by this platform will allow guidewire passage across most chronic occlusions. Before proceeding to the intervention, intraluminal position should be confirmed by advancing the 3-F microcatheter across the lesion and injecting a small amount of contrast.

PTA BALLOONS

The normal tibial artery diameter (2 mm to 4 mm) favors the application of standard coronary artery interventional techniques. This includes the use of low-profile balloon catheters with hydrophilic coatings that are advanced over a .014-inch guidewire. These low-profile balloons are available as over-the-wire and monorail systems.

Noncomplex short focal stenoses (TASC A) and multiple sequential focal stenoses (TASC B) with mild disease proximal and distal are ideal for balloon angioplasty (PTA). A residual waist may be present during balloon insufflation of heavily calcified vessels. Although tempting, avoid overinflating the angioplasty balloon. Longer inflation times (30 seconds to 60 seconds) are more beneficial for eliminating the waist.

Cutting balloons can be used for the challenges of recalcitrant lesions that are often resistant to conventional angioplasty (eg, ostial lesions, calcified stenoses, and in-stent restenosis). The inflation diameter (2 mm to 4 mm) of these cutting balloons should approximate a 1.1:1 ratio with the native vessel. Oversizing increases the risk of vessel perforation and should be avoided.

cally and biologically. The Cryoplasty balloon is advanced over the .014-inch guidewire and placed across the lesion using roadmapping techniques. The Cryoplasty balloon is rapidly inflated with a canister of nitrous oxide, which dilates and cools the vessel. Potentially, this will limit dissections and vessel recoil and increase cellular apoptosis.

Cryoplasty can safely be performed in tibial vessels utilizing the longer 135-cm balloon catheters (diameters 2.5 mm to 4 mm), a 6-F guiding sheath, and .014-inch guidewires. Routinely, two inflations per lesion are necessary to maximize cellular apoptosis. Cryoplasty is ideal for TASC A, B, and C lesions, as well as recalcitrant lesions.

STENTS

Failed PTA with major flow-limiting dissections may require the use of a balloon-expandable stent to improve flow hemodynamics. The similar size of coronary and tibial interventions allows the use of low-profile coronary stents for tibial vessels. Drug-eluting stents (DESs) have changed the landscape of interventional cardiology. Potentially, DESs placed in the tibial vessels will have the same antiproliferative effect and limit in-stent restenosis. If a flow-limiting dissection is present after tibial artery angioplasty, the .014-inch guidewire is left in place, an activated clotting time is checked to confirm therapeutic anticoagulation, and the DES is deployed across the lesion.

PLAQUE EXCISION

Complex tibial lesions, chronic occlusions, and trifurcation lesions (TASC C and D) tend to have a better result if treated with plaque excision and recanalization. The SilverHawk Plaque Excision System consists of a low-profile atherectomy catheter with a motor drive unit. A tiny blade spins at 8,000 rpm and excises plaque from the arterial wall without inducing barotrauma. After each pass, the plaque is packed in the nose cone to avoid distal embolization. The SilverHawk SS (small vessel standard tip) and ES (extra small vessel standard tip) systems are advanced through the 6-F sheath and over the stiff .014-inch PTCA guidewire. The ES SilverHawk Peripheral Catheter maintains a low crossing profile (1.9 mm) and is well suited for plaque excision in extremely small vessels (2 mm). Larger tibial vessels will require the SS SilverHawk catheter 2 mm X 20 mm is used to predilate the tract. This maneuver facilitates passage of the low-profile SilverHawk atherectomy device. This monorail atherectomy catheter is advanced forward, and the excised plaque is collected in the nose cone. Most tibial lesions require two catheter passes with the directional blade rotated 180°. A completion angiogram is obtained through the guiding sheath. Any residual stenoses can be touched up with additional passes of the atherectomy catheter. Rarely is adjunctive angioplasty and stenting necessary after plaque excision.

INTERVENTIONAL NOTES

- IVUS offers an adjunctive means to assess tibial vessels before and after intervention. The IVUS system uses advanced spectral analysis techniques to simplify interpretation of ultrasound images and provide detailed information of atherosclerotic plaques. A .018-inch catheter can be placed through the 6-F guiding sheath and over the .014-inch guidewire. This catheter is specifically designed to visualize peripheral vessels 10 mm to 24 mm in diameter.
- The Balkin Guiding Sheath has a Check-Flo valve that limits blood loss during frequent catheter manipulations.
- The ideal imaging system for lower-extremity vessels incorporates digital subtraction angiography with bolus chase techniques.
- Digital road mapping of the tibial arteries can be used to facilitate catheter advancement and guide interventions.
- Concomitant iliac, femoral, or popliteal flow-limiting lesions should be fixed after addressing the tibial lesions.
- Ultrasound-guided distal tibial artery percutaneous retrograde access can be used if antegrade access is unsuccessful.
- Occasionally, tibial vessel thrombolysis may be necessary. Therefore, experience with thrombolytic agents and catheters is a relative asset for those contemplating tibial interventions.
- Vessel perforation is a known complication and can be addressed with prolonged balloon inflations. If free perforation is not controlled by this means, a covered stent may be beneficial if the vessel diameter is 2.75 mm or
- Arteriovenous fistulae occurring after intervention are best managed conservatively.

CONTRAST RECOMMENDATIONS

Dilute to nonionic, iso-osmolar.

PHARMACEUTICALS

- During interventional procedures, liberal use of unfractionated heparin (60 to 80 units/kg) is administered intravenously to increase the activated clotting time to 250 to 300 seconds.
- Catheter-directed, intra-arterial nitroglycerin is administered at doses of 100 to 300 µg during the procedure. This minimizes tibial vasospasm.
- After the intervention, all patients receive a loading dose of 300 mg of clopidogrel. This is continued for 3 to 6 months at 75 mg daily.

OTHER EQUIPMENT USED

Thrombectomy devices, laser atherectomy.

TESTS USED

An activated clotting time is checked 1 hour after the initial heparin bolus; if the value is less than 250 seconds, additional heparin (20 to 40 units/kg) is administered. ■