Interventional Radiology
GRAND ROUNDS

Topic: Interventional Treatment Options for Peripheral Arterial Disease

Patients with chronic arterial occlusion of the lower extremities often present with the pain of exercise-induced intermittent claudication in the calf, buttocks or thighs. In a previous issue of *Interventional Radiology Grand Rounds,* we presented a general overview of peripheral arterial disease (PAD) including prevalence, risk factors, diagnosis and treatment options. In this issue, we describe various percutaneous endovascular therapies used by interventional radiologists to treat patients with lower extremity PAD.

Features of Intermittent Claudication

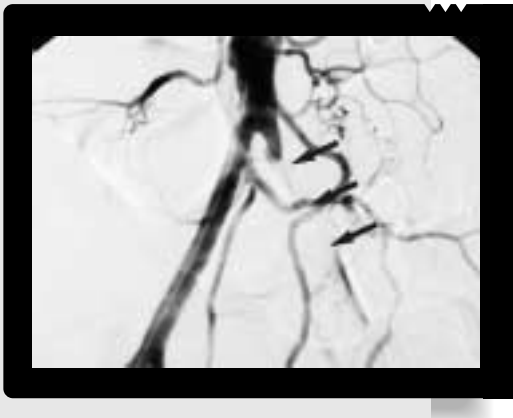
- Occurs in the hips and thighs (aortoiliac disease) or calves (aortoiliac or femoropopliteal disease)
- Is reproducible with consistent level of activity from one day to the next
- Becomes worse, not better, with further exercise
- Completely resolves within a few minutes after the exercise is discontinued

Most patients who are candidates for nonsurgical, interventional radiology therapies can be treated on a 23-hour admission basis. The procedures generally are one to two hours in duration and are performed using local anesthesia and conscious sedation. Patients usually experience little discomfort and often can ambulate within eight hours of the procedure.

Case History

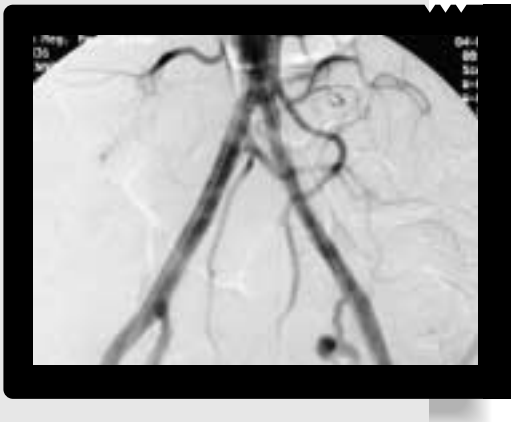
A 58-year-old male smoker presented with a one-year history of severe, incapacitating left thigh and buttock claudication after ambulating a distance of approximately one block. He also had a history of hypertension and coronary artery disease. The ankle-brachial index (ABI) on the left was 0.58. On physical exam there was no left femoral pulse. The patient was referred for arteriography which demonstrated occlusion of the left common iliac artery **(Fig. 1)**. The left external iliac artery was seen filling on later images, and runoff arteries in the legs were normal. The chronic occlusion was successfully crossed with a guidewire and an endovascular stent was placed **(Fig. 2)**. Following the procedure, the claudication symptoms were resolved and the ABI was normalized to 0.98.

Figure 1



Initial subtraction pelvic arteriogram demonstrates complete occlusion of the left common iliac artery (arrows). The left external iliac and common femoral arteries were seen to be patent on later images.

Figure 2



Final pelvic arteriogram after endovascular stenting reveals good flow of contrast through the stented area and into the left leg. The stent is difficult to visualize on subtracted angiographic images.

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Indications

Many patients with lower extremity PAD will respond to conservative measures including cessation of smoking, graded exercise regimens, and lowering of serum cholesterol levels. Currently, the main indications for an interventional procedure in PAD patients include:

- claudication interfering with work or lifestyle refractory to conservative measures such as exercise therapy.
- limb salvage in patients with severe ischemia manifested by pain at rest, nonhealing ulcers, infection or gangrene.[1]

Nonsurgical Treatment Options

Angioplasty

Percutaneous transluminal angioplasty (PTA) improves blood flow by creating a controlled injury to the vessel wall. It was first described in 1964 by Dotter and Judkins and advanced in 1974 by Gruntzig, who developed a balloon catheter which could be introduced coaxially over a guidewire.

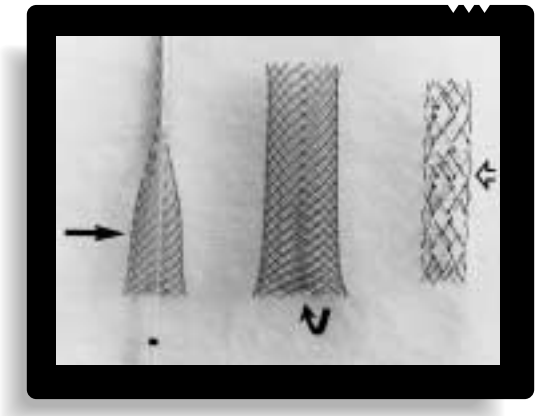

Figure 3

Examples of endovascular metallic stents. The self-expanding Wallstent is shown partially (straight arrow), and fully deployed (curved arrow). The balloon-expandable Palmaz stent is shown after expansion (open arrow).

PTA of the iliac arteries is associated with better long-term success rates than femoral angioplasty. Published results vary, with five-year patency rates of iliac angioplasty ranging from 53 percent to 88 percent,[1] compared with less than 60 percent five-year patency rate for femoropopliteal PTA in most series. Small vessels below the knee also may be successfully treated, but this is usually reserved for patients with limb-threatening ischemia. Focal lesions respond best to PTA, while long stenoses, tandem lesions, and chronic occlusions respond less favorably.

In experienced hands, PTA has a high technical success rate, with approximately 90 percent of patients experiencing improvement in symptoms.[2] Immediate causes of PTA failure include intimal dissection, elastic recoil of the vessel wall, and arterial rupture. Restenosis due to intimal hyperplasia and progression of atherosclerosis are the most common causes of late PTA failures.

Etiology of PTA Failures

- Immediate
  - intimal dissection
  - elastic recoil
  - incomplete dilatation
  - rupture
- Late
  - intimal hyperplasia
  - progression of atherosclerosis

Stents

The introduction of metallic endovascular stents has revolutionized the interventional treatment of lower extremity PAD, mainly in the aortoiliac arteries. Currently available stents are either balloon-expandable or self-expandable (**Fig. 3**). Initially, stents were primarily used in cases of PTA failure due to elastic recoil or dissection. They have since become increasingly popular. Technical

success and patency rates after iliac stent placement are better than after angioplasty alone, with no increase in complication rates.[3]

The availability of stents allows for endovascular treatment of chronic arterial occlusions **(Figs. 1 & 2)** and disease of more extensive distribution than that amenable to angioplasty alone. The excellent clinical results and low complication rate of aortoiliac stent placement justifies its use in patients with intermittent claudication and severe obstruction,[4] who in the past were not felt to warrant surgical bypass.[5]

Stent-Grafts

Metallic stents covered with prosthetic material, or stent-grafts, represent a new development in interventional radiology. Such devices are able to exclude blood flow from the diseased vessel and have potential in treating thoracic, abdominal, and iliac artery aneurysms.[6] Mycotic and pseudoaneurysms have also been treated, as well as cases of iliac artery rupture caused by angioplasty. While the standard of treatment of aortoiliac aneurysms has been surgical repair, stent-grafts provide a less invasive alternative. Various investigational designs have been evaluated, but an FDA-approved device is not yet available.

Thrombolysis

Thrombolytic therapy, usually with the plasminogen activator urokinase, is often used by the interventional radiologist in the treatment of PAD patients. The percutaneous management of acute thrombosis and limb ischemia in the peripheral arteries is well established, and thrombolytic therapy is a common treatment for thrombosed bypass grafts.[7] Chronic arterial occlusions in the legs are usually treated surgically or, in the iliac arteries, with primary stent placement. To minimize the risk of hemorrhagic complications, patient selection and management, as well as method of delivery, are critical when thrombolytic therapy is contemplated.

Patient Preparation

The interventional radiologist performs a directed history and physical examination, including a review of comorbid conditions, current medications and allergies. Preprocedure BUN and creatinine are lab tests routinely needed, although the interventionalist may also order a CBC and coagulation profile. Patients may have clear liquids after midnight the day of the procedure and generally are instructed to take their usual medications. Diabetics are usually instructed to take one-half of their morning insulin dose and to stop taking metformin.

An arteriogram is performed to define the disease distribution. Patients with renal insufficiency often can be treated with little risk. In some cases, alternative contrast, such as carbon dioxide, is used. Significant lesions are usually identified by the use of intravascular pressure readings obtained above and below the obstruction.

Contraindications to Thrombolysis

- Absolute
  - recent neurologic, thoracic, or abdominal surgery
  - recent stroke
  - evidence of active gastrointestinal or genitourinary bleeding
  - central nervous systems metastatic disease
  - bleeding diathesis
- Relative
  - recent extremity surgery
  - occult blood in stool

References:

1. Weitz J, Byrne J, et al. Diagnosis and treatment of chronic arterial insufficiency of the lower extremities: A critical review. Circulation 1996;94:3026-3049.
2. Wildus D, Osterman F. Evaluation and percutaneous management of atherosclerotic peripheral vascular disease. JAMA 1989; 261:3148-3154.
3. Bosch J, Hunink M. Meta-analysis of the results of percutaneous transluminal angioplasty and stent placement for aortoiliac occlusive disease. Radiology 1997; 204:87-96.
4. Murphy T, Khwaja A, et al. Aortoiliac stent placement in patients treated for intermittent claudication. JVIR 1998;9:421-428.
5. Hertzer N. The natural history of peripheral vascular disease: Implications for its management. Circulation 1991;83(suppl I):I-12-I-19.
6. Blum U, Voshage G, et al. Endoluminal stent-grafts for infrarenal abdominal aortic aneurysms. N Engl J Med 1997;336:13-20.
7. Ouriel K, Shortell C, et al. A comparison of thrombolytic therapy with operative revascularization in the initial treatment of acute peripheral arterial ischemia. J Vasc Surg 1994;19:1021-1030.

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