Peripheral Arterial Disease: the growing role of endovascular management

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Learning objectives

- To be able to classify stenotic lesions of PAD in the lower limbs.
- To recognize which lesions should be treated by endovascular techniques and which lesions should be treated with surgery.
- To acknowledge technical advances in chronic total occlusion (CTO) revascularization.

Background

Peripheral arterial disease (PAD) is estimated to afflict 3 to 10% of the world population, increasing to 15-20% in people aged over 70 years old. Between Europe and North America, this disease accounts for a prevalence of 27 million people, and given the aging population of the developed countries, the situation is likely to dramatically increase over the next 20 years.

It is most often caused by atherosclerosis, even though other causes such as inflammation, trauma, unusual anatomy or radiation treatments may also be implied. Patients with PAD have an increase mortality risk from myocardial infarction and cerebrovascular disease.

Several risk factors have long been identified falling in two broad categories: the modifiable and the non-modifiable.

The care of these patients is divided between several different medical specialties, with a great importance resting on the primary care physician. Part of the difficulty of diagnosing and managing PAD is the fact that an asymptomatic patient can have severe and long standing disease. Of the 27 million patients between Europe and North America, 10.5 million have symptomatic disease (39%) while 16.5% are asymptomatic (61%), of which one third (5.5 million) have complete occlusion of a major artery of the lower limbs.

Several clinical studies have demonstrated an identical progression of the disease unrelated to the presence or absence of symptoms. This means that the development of symptoms reflects more of the subject's activity level than the disease severity or prognosis.

The main symptom of PAD is intermittent claudication (IC). The location of pain grossly reflects the level of the lesion.

Only 1 - 3% of patients with IC will require an amputation over a 5 year period.

Critical limb ischemia (CLI) is defined as chronic ischemic symptoms during rest. About 20% of patients with CLI die within one year after presentation.

Acute limb ischemia is a sudden cut in the blood supply to the limb, resulting in a 10-30% risk of amputation over a 30 day period.
There is a clear association between PAD and coronary artery disease (CAD) and cerebral artery disease, reflecting atherosclerosis as the basis of the three conditions. The most common cause of death in these patients is CAD (63%).

In 2000, the Inter-Society Consensus for the Management of Peripheral Arterial Disease published their first guidelines for the Diagnosis and Management of PAD, a text accused of being too long and too detailed, and that did not receive a wide acceptance in the international community.

In 2005, the ACC/AHA Joint Guidelines were published, but their focus was on the North American situation and it was also considered too long. Two years later, the TASC II guidelines were published and the text largely revised, being turned into a more concise and directed set of clear guidelines and recommendations, oriented to the diagnosis and management of lower limb disease. The classification of some lesions was changed so that longer stenosis were now included in the realm of endovascular intervention.

According to the TASC guidelines, lesions are classified from A to D, being lesion type A an indication for endovascular treatment and lesion type D an indication for surgical treatment. Lesion type B states a preference for endovascular techniques and lesion type C suggest primary surgical treatment.

In 2011, a focused update to the 2005 guidelines was published by the ACCF/AHA. Perhaps more important than the changes introduced with this update, is what has remained unchanged. In fact no new recommendations regarding therapeutic procedures were introduced. Concerning noninvasive testing, the ankle-brachial index (ABI) was uniformed, taking special attention to its interpretation which now clearly states a new group, with results ranging from 0.91 to 0.99, considered 'borderline'. This is important because it recognizes that these patients have a worst prognosis than those that fall clearly in the normal group.

None of the guidelines so far acknowledge the advances in chronic total occlusion.

**Images for this section:**

<table>
<thead>
<tr>
<th>Modifiable risk factors</th>
<th>Non-modifiable risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cigarette smoking, diabetes, dyslipidemia, hypertension, hyperhomocysteinemia, obesity (BMI &gt; 30),</td>
<td>Race, age and gender, family history of PAD, heart disease or stroke</td>
</tr>
</tbody>
</table>

**Fig. 1:** Modifiable and non-modifiable risk factors for peripheral arterial disease.
**Fig. 2:** Relation between the location of the pain in intermittent claudication and the location of the stenotic lesion

<table>
<thead>
<tr>
<th>Location of pain</th>
<th>Location of the lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hips and buttocks</td>
<td>Aortoiliac lesion</td>
</tr>
<tr>
<td>Thigh</td>
<td>Common Femoral Artery</td>
</tr>
<tr>
<td>Upper two thirds of the calf</td>
<td>Superficial Femoral Artery</td>
</tr>
<tr>
<td>Lower two-thirds of the calf</td>
<td>Popliteal artery</td>
</tr>
</tbody>
</table>

**Fig. 4:** Rutherford classification of PAD.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>1</td>
<td>Mild claudication</td>
</tr>
<tr>
<td>2</td>
<td>Moderate claudication</td>
</tr>
<tr>
<td>3</td>
<td>Severe claudication</td>
</tr>
<tr>
<td>4</td>
<td>Rest pain</td>
</tr>
<tr>
<td>5</td>
<td>Ischemic ulceration not exceeding ulcer of the digits of the foot</td>
</tr>
<tr>
<td>6</td>
<td>Severe ischemic ulcers or frank gangrene</td>
</tr>
<tr>
<td>Lesion type</td>
<td>Aortoiliac lesions</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>Unilateral or bilateral stenoses of CIA Unilateral or bilateral single short (≤3 cm) stenosis of EIA</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Short (3 cm) stenosis of infrarenal aorta Unilateral CIA occlusion Single or multiple stenosis totaling 3–10 cm involving the EIA not extending into the CFA Unilateral EIA occlusion not involving the origins of internal iliac or CFA</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Bilateral CIA occlusions Bilateral EIA stenoses 3–10 cm long not extending into the CFA Unilateral EIA stenosis extending into the CFA Unilateral EIA occlusion that involves the origins of internal iliac and/or CFA Heavily calcified unilateral EIA occlusion with or without involvement of origins of internal iliac and/or CFA</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Infrarenal aortoiliac occlusion Diffuse disease involving the aorta and both iliac arteries requiring treatment Diffuse multiple stenoses involving the unilateral CIA, EIA and CFA Unilateral occlusions of both CIA and EIA Bilateral occlusions of EIA Iliac stenoses in patients with AAA requiring treatment and not amenable to endograft placement or other lesions requiring open aortic or iliac surgery</td>
</tr>
</tbody>
</table>

**Fig. 3:** TASC II classification of stenotic lesions in the aortoiliac and femoral-popliteal segments.
An increasing number of patients with chronic total occlusions (CTO) are being treated through a primary percutaneous approach (especially those deemed to be high surgical-risk patients), based on recent reports of low morbidity and mortality with intra-lumen and sub-intimal endovascular procedures, associated with lower costs and shorter hospital stay. The BASIL trial showed no difference in long-term outcomes between endovascular and surgical revascularization approaches in patients suitable for either techniques, and current evidence shows that even extensive TASC II D type lesions can be approached percutaneously with reasonable technical success and limb salvage. Patients with symptomatic infra-inguinal atherosclerosis on hemodialysis were identified as a high-risk subset for procedural failure and subsequent limb amputation.

Often the indication for endovascular treatment of aortoiliac and femoral popliteal stenosis is based on the belief that the patient will benefit from the procedure.

This benefit is often limited in case of extensive disease below the knee.

Endovascular treatment of CTO and below the knee intervention has been increasingly used in lesions that were previously only approached with surgical revascularization techniques.

There is increasing evidence indicating that at least one tibial vessel needs to be patent to the ankle for long-term procedural success.

Two lines of thought now prevail concerning CTO endovascular management, the intra-luminal and the sub-intimal approaches. There is, however, very few data reports comparing these to techniques, and the choice of one over the other reflects mostly personal preference and experience. The success of the intraluminal approach depends on the characteristics of the occluded segment. A soft thrombus allows for easy intraluminal progression, but hard calcific intraluminal atheromatous plaques will inadvertently convert the technique to a subintimal channel creation.

**Images for this section:**
Fig. 5: Multiple plaques in diffuse arterial atheromatous disease.
Fig. 6
Fig. 7: The same patient after below-the-knee balloon PTA.
Fig. 8: After the endovascular treatment, blood flow reaches the foot.
Fig. 9: Sub-occlusive stenotic lesion in the distal third of the femoral artery.
Fig. 10: The same patient being treated with balloon and stent placement.
Fig. 11: The final result was satisfactory after stent placement.
**Fig. 12:** Total occlusion of the proximal segment of the femoral artery.
Fig. 13: After stent placement, the patient observed significant symptomatic relief and amputation was avoided.
Conclusion

Revision of the TASC guidelines for the management of PAD have included slightly longer stenosis in the realm of endovascular procedures, but none of the current consensus take into account recent reports of CTO endovascular treatment. These procedures have gained hype over the international community, as can be acknowledged by the contents presented in meetings like LINC.

Stenotic lesions of TASC II type C and D, currently indicated for primary surgical management, could soon be treated primarily with endovascular techniques.

Personal Information

References

3. Intraluminal Versus Subintimal Approach to Chronic Total Occlusions Endovascular Today, October 2001