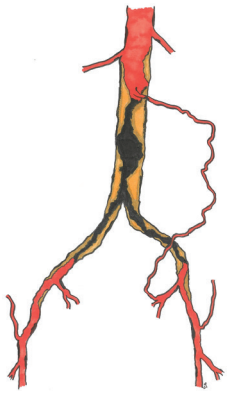

FROM RENÉ LERICHE TO OUR DAYS: DEFINITION, EPIDEMIOLOGY, AND CLINICAL PRESENTATION OF AORTO ILIAC STENO-OCCLUSIVE DISEASE

Antonino Giordano, Massimo Lenti

Among the peripheral artery disease (PAD), a well-known pathology is the so called Leriche Syndrome which is characterized by an aortoiliac occlusive disease (AIOD).

It is a chronic syndrome, and it can progressively spread proximally or distally depending on the onset time and the collateralization. The latter influences the clinical presentation which can be from an asymptomatic phase to intermittent claudication and critical limb ischemia (CLI) (Figure 1.1).

In the 18th century, British surgeon J. Hunter described occlusive arterial pathology,[1] in 1914 Robert Grahman reported the AIOD, but only in 1947 the French physiologist and surgeon Henri Leriche linked the AIOD to the clinical presentation, noticing the recurrence of three symptoms: claudication, erectile dysfunction and lack of distal pulses.

The surgical reconstruction of the aortoiliac (AI) occlusive disease dates to 1947 when the Portuguese surgeon Dos Santos successfully performed an endarterectomy of a heavily calcified common femoral artery (CFA).[2] It took almost an additional fifteen years to firstly use a synthetic graft for an aortic bypass. A step forward possible thanks to Wylie's experience who extended the endarterectomy to the AI region.[3] The surgical experience we have is a heritage of the last fifty years of the 20th century. The rapid improvements brought Gross to use an arterial homograft in 1948, Voorhees to implant a synthetic prosthesis in 1952, Gruntzig to perform the first angioplasty and Puel and Sigwart the first stenting in 1986.

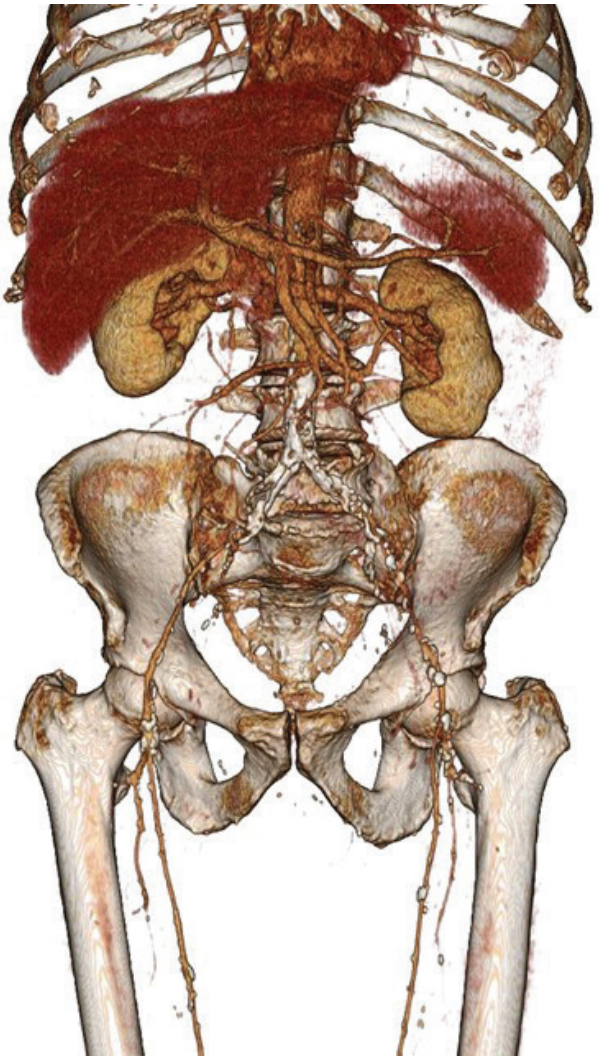

Figure 1.1. CT scan of an 80-year-old male patient who suffers of chronic limb ischemia of the left lower limb caused by AI occlusive disease. Infrarenal aorta is highly calcified.

Amongst the years the surgical technique has been constantly stimulated by the inspiration of lively minds and newly discovered materials and technologies as better perioperative management, including infection control and intensive care monitoring.

When open surgery reached the best setting, with satisfying results in procedural complication and patency rate, the progress let the surgeon to look towards the mini-invasive endovascular approach. The latter is still the one which is constantly renewed.

Etiology

The most common cause is atherosclerosis which usually affects the aortoiliac segment and the lower limb vascular tree with a multilevel pathology.

Atherosclerosis causes Leriche Syndrome, therefore all the risk factors (RF) that lead to that are shared. Non-modifiable RF are gender, age, race and familiar history; modifiable RF are diabetes mellitus, smoke, hypertension, hyperlipemia, hypertriglyceridemia and homocysteine.[4]

Epidemiology

The exact incidence and prevalence are underestimated because of the rate of asymptomatic type which reaches almost 10% and they are surely increasing in our aging population.

The archetypical patient is an elderly male, smoker, with a story of high blood pressure, diabetes mellitus type II, stoke and myocardial infarction. These groups usually present a multiple level pathology.

The one with isolated AI pathology are usually younger and heavy smokers. The more widespread is the atherosclerosis is throughout the body (coronary and visceral arteries), the higher the likelihood of presenting a CLI instead of the claudication.[5]

Sometimes it affects young women who smoke. In these cases, imaging can show narrowing and diffuse atherosclerosis with focal stenosis of aortic bifurcation. This pathology is called small aortic syndrome or hypoplastic aortic syndrome.[6] Smoke is always present even though other atherosclerosis risk factor could be absent.

Pathology and clinical presentation

AI pathology usually arises in the aortic bifurcation and the origin of the common iliac artery and progressively extends proximally and distally over the years.

The patient reports a progressive increased handicap in walking until it affects his quality of life. The worsening of the symptoms is related to the collateralization (lumbars, hypogastric, circumflex iliac, internal mammary-epigastric, superior and inferior mesenteric arteries (SMA and IMA)[7] and the spread to the femoral arteries: 40% with a symptomatic form of AI occlusive disease have a severe stenosis of profunda femoral artery's ostium and more than 40% of the superficial femoral artery (SFA). Although some reports described a renal thrombosis in one third of patient with AI occlusion.[8]

If the bad habits are put aside and pharmacological therapy is initiated, the pathology can reach a steady state, hence the patient reports a stability in his claudication with the pain usually located in the calf or sometimes spread to the thigh, the buttock and the hip.

Often sexual disorders can be described: a 30% of males report difficulty in achieving and maintaining an erection as a result of the lower blood flow through the internal pudenda arteries.[9] Recovery of normal internal pudenda arteries, both with open surgery and endovascular, does not always lead to improvements in erection as a result of the possible iatrogenic damage to the autonomic plexus and the aim of restoring a satisfying blood flow to the lower limb despite the pelvic circulation.[10] Thus, not only the sexual function is hardly restored completely, more often a deficit in ejaculation persists, but it can be lost after surgery.

Anatomy: abdominal aorta and collateralization

Abdominal aorta begins after the diaphragmatic hiatus (T12 vertebra) and ends at the bifurcation (L4 vertebra). In their study, Shakeri *et al.*[11] showed with a logistic regression analysis that the bifurcation angle, but not its asymmetry, gender or age of the patients, was a significant independent risk factor for aortoiliac atherosclerosis. This is probably related to his intrinsic function to split the high-pressure blood stream into the lower limbs and pelvis. Moore *et al.*[12] demonstrated that the oscillating wall stress increases the buildup of the atherosclerotic plaques in the infrarenal aorta and low value of wall shear stress in this aortic section (Figure 1.2).

Beyond the iliac vessel from the abdominal aorta originate many vessels that can be grouped into anterior, lateral and posterior. The anterior group consists of celiac trunk, SMA and IMA. The lateral includes the middle suprarenal, renal and gonadal arteries. The posterior group includes inferior phrenic and lumbar arteries and median sacral artery (Figure 1.3).[7, 13]

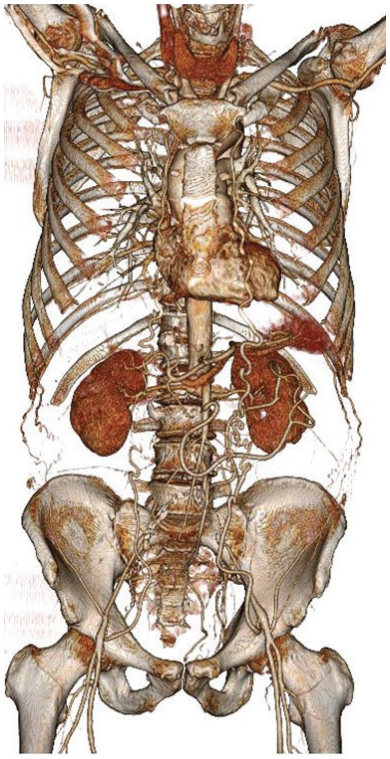

Figure 1.2. 75-year-old male patient with a wide collateralization.

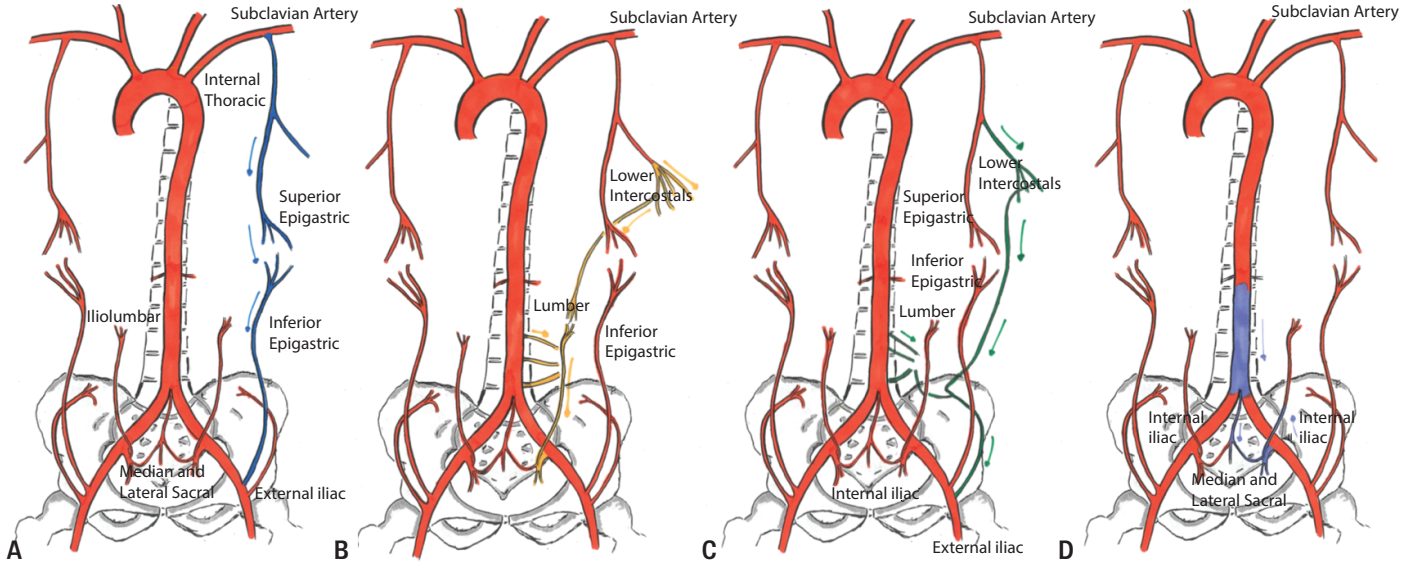

Figure 1.3. Systemic collateral pathways in aortoiliac occlusive disease. A) The Winslow pathways allows blood to flow from the subclavian artery to the distal external iliac artery via the internal thoracic, superior epigastric, and inferior epigastric arteries; B) the deep circumflex artery originates from the lateral aspect of the distal external iliac artery and anastomoses with lumbar arteries arising from the abdominal aorta and the lower intercostal arteries; C) the iliolumbar artery arises from the internal iliac artery and forms collateral pathways with lumbar and lower intercostal arteries; D) the median sacral artery arises near the bifurcation of the abdominal aorta and connects with the lateral sacral artery, which arises from the posterior division of the internal iliac artery.[7]

Depending on the level and length of the aortoiliac segment involved in the occlusion, different natural collateral bypasses are activated becoming hypertrophic. These paths can be grouped in visceral and parietal and both help to maintain the blood flow to the lower limbs. The visceral derives from embryologic segment of the dorsal aorta.[14] It begins with branches of SMA and consist of the so-called Arc of Riolan (when present) and marginal artery of Drummond connecting via IMA, SMA to the hypogastric artery. The parietal anastomosis through parietal inferior intercostal along with lumbar and deep circumflex iliac artery connect external iliac to hypogastric. The longest pathway is Winslow's which connects subclavian artery to the external iliac through internal thoracic and superior epigastric to inferior epigastric. In addition, median sacral artery connects to hypogastric through lumbar branch of the iliolumbar.

During surgical dissection it is important to spare and save every collateral if possible.

Classification

Many classifications have been proposed since Leriche first described it.

Reddy and Shepard differentiated three types: type I is the most localized, involving the infrarenal aorta and common iliac arteries. Usually young patient, active smokers and females; type II: spreads to external iliac and common femoral arteries; type 3: multilevel pathology including lower limb arteries. In these three groups, a 5-6% extends proximally with a renal arteries involvement (Table 1.I).[15]

A second classification was published in 2007 by TranAtlantic Inter-Society Consensus and it is called TASC II and categorizes aortoiliac disease into four types (A-D).[16] Differently from the other classification, it does not focus only on the anatomy but classifies the shape, distribution and severity of the disease from A to D.

Diagnosis

The clinical presentation (claudication *vs.* CLI) combined with the anamnesis and the physical exam (Leriche's triad) should make the physician aware of an AI cause. Sometimes the femoral pulses can be felt owing to the strong collateralization network (see above).

Treatments

Surgical indication

Angioplasty and stenting are the first line treatment in most patients. In the past, this mini-invasive approach was used in short segment pathology graded A and B of the TASC classification (TransAtlantinc inter-Society Consensus), but lately it has been applied also in longer occlusion graded TASC C or D.

The traditional surgical approach, like the aortobifemoral bypass, is progressively less used and nowadays it is only a bail out strategy in cases in which the percutaneous transluminal angioplasty (PTA)/stenting fails or when there are contraindications in iodine contrast use, mainly CRF. Even if the pathology includes the common femoral artery, a hybrid approach can be planned. It consists in a first surgical phase (endarterectomy) and a second endovascular one (PTA/stenting).[17]

Table 1.I.—Classification on anatomical location.[15]

Classification system of aortoiliac occlusive disease based on anatomical location of the lesions	
Class	**Vessels of involvement**
Type I	Infrarenal abdominal aorta and common iliac arteries
Type II	Infrarenal abdominal aorta, common iliac arteries, external iliac arteries and femoral (common femoral) bifurcation
Type III	Infrarenal abdominal aorta, common iliac arteries, external iliac arteries, external iliac arteries, femoral (common femoral) bifurcation, popliteal, or tibial arteries

Surgery should always be considered when:

- claudication becomes a handicap in daily life forcing the patient to stop every few meters (10 to 20 meters). This is a grey area in which the subjectivity of the symptoms can overrule the signs. The experience of the vascular surgeon should let him to avoid the exaggeration of some patients who do not stand well with this chronic condition or when arthritis or root nerve disease have an important role in etiology. If the claudication is stable and the quality of life is not affected that much, a conservative therapy consisting of exercise should be considered;[18]
- rest pain, ulceration, gangrene, and tissue loss are poor prognosis outcome signs. CLI is not objectionable indication because of the high likelihood of major amputation.[19]

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Summary

In 1947 the French physiologist and surgeon Henri Leriche linked the aortoiliac occlusive disease to the clinical presentation, noticing the recurrence of three symptoms: claudication, erectile dysfunction and lack of distal pulses. The chronic syndrome can progressively spread proximally or distally depending on the onset time and the collateralization.

The exact incidence and prevalence are underestimated because of the rate of asymptomatic type which reaches almost 10% and they are surely increasing in our aging population. The archetypical patient is an elderly male, smoker, with a story of high blood pressure, diabetes mellitus type II, stoke and myocardial infarction.

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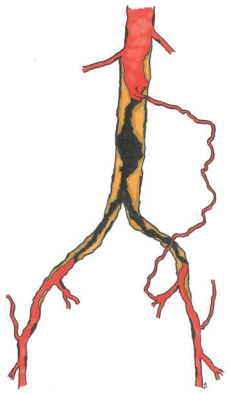

DIAGNOSTIC EVALUATION OF AORTO-ILIAC DISEASE

Maria Antonella Ruffino, Riccardo Faletti

A diagnostic evaluation in patients with symptoms suggesting for aortoiliac disease should be performed to confirm the diagnosis and to obtain an adequate topography of the vascular lesions in order to plan the best surgical treatment, by either open or endovascular techniques.

The aim of the preimaging evaluation is to localize the target lesion, evaluate the extension of the disease (*i.e.*, lesion extending above the aortic bifurcation or distally into the common femoral artery), the in-flow and the distal run-off (femoro-popliteal or infrapopliteal vessels).[1]

The primary imaging modality to be used in the screening of aortoiliac disease is duplex ultrasonography (DUS) due to its noninvasive nature, lower risks and costs, and strict dependence on operator skill and experience. DUS is also useful as a post-treatment imaging modality.

Despite the increasing evidence of duplex ultrasound as a preoperative arterial mapping test,[2, 3] in many centers, digital subtraction angiography, contrast-enhanced computed tomography angiography, or magnetic resonance angiography remains the diagnostic test of choice.

Digital subtraction angiography (DSA) is the "gold standard" for imaging of aortoiliac disease, but it is an invasive technique, and has a definite, although low, morbidity, with a 3-7% complication rate. The mortality rate of digital subtraction angiography as diagnostic imaging can be considered close to zero. As other less-invasive imaging techniques it requires contrast medium injection.[4]

Contrast-enhanced magnetic resonance angiography (CEMRA) and multidetector computed tomography angiography (MDCTA) are both accurate and reliable noninvasive imaging techniques to conventional DSA. They provide a noninvasive evaluation of the vascular anatomy as well as localization and extension of vascular lesions, thus facilitating the planning of interventional or surgical treatments in patients with aortoiliac disease.[5] The advantages of cross-sectional imaging compared with DSA are the noninvasive study of the wall and the ability to demonstrate pathological findings "outside" the vessels. Both imaging modalities are currently capable of depicting vascular lesions with a high degree of sensitivity and specificity.

Despite their value in identifying and mapping artery lesions, digital subtraction angiography, computed tomography angiography and magnetic resonance angiography carry a risk of potentially serious complications. To minimize the risk of these complications, many groups are exploring the possibility of mapping the arteries with DUS.[3]

The results from anatomical imaging should always be evaluated in conjunction with hemodynamic and clinical tests before therapeutic decisions.

Duplex ultrasound

Duplex ultrasound is a non-invasive arterial evaluation method. It is inexpensive, reproducible diagnostic test, with no risk of nephrotoxicity or systemic fibrosis compared with computed tomography angiography (CTA) and magnetic resonance angiography (MRA), and it is not based

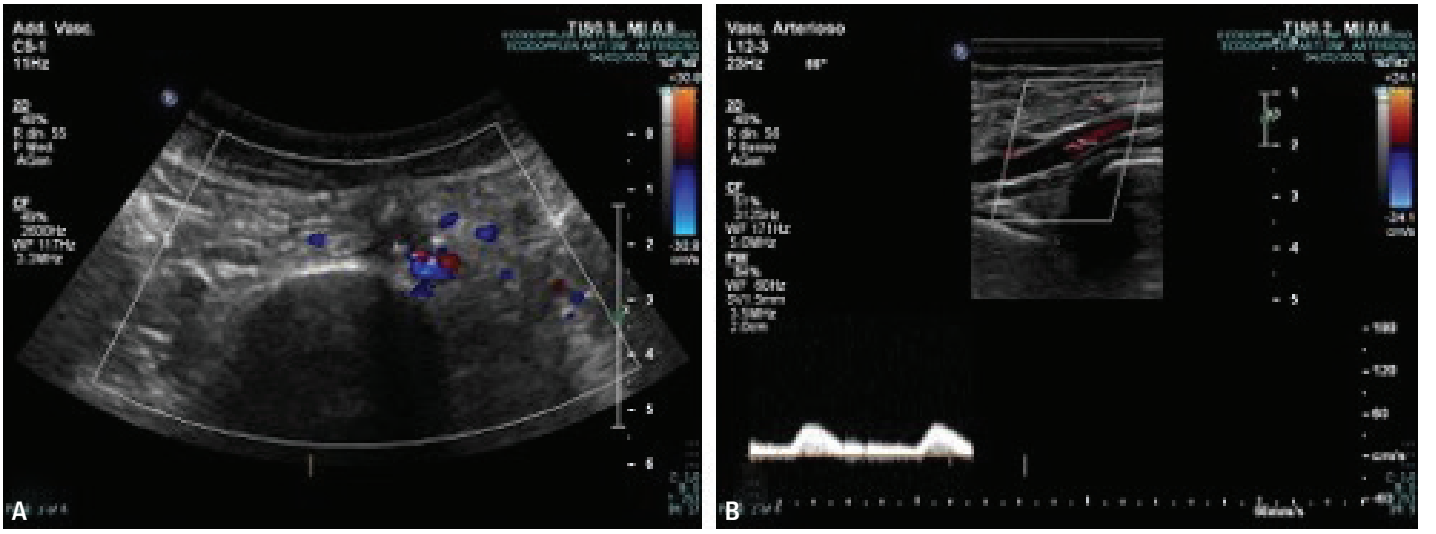

Figure 2.1. Duplex ultrasound: A) color mode axial view of common iliac arteries, patent; B) post-stenotic monophasic flow along the extermal iliac artery, just proximally the common femoral artery.

on ionizing radiation. This makes DUS a useful tool in the preoperative evaluation of patients with aortoiliac disease. The evaluation with DUS of aortoiliac disease can be very challenging since it can be limited in obese patients as well as in those patients with the presence of abdominal gas and severe arterial calcification.[6]

DUS mapping is performed mainly using a 2-5 MHz convex probe. A 3-12 MHz linear probe is used in case of very thin patients. DUS examination begins with the patient in the supine position, in B and duplex mode, observing the infrarenal aorta and both iliac axes, recording the Doppler wave-form morphology, peak systolic velocity (PSV), and end-diastolic velocity of each segment (infrarenal aorta and common iliac, external iliac, and common femoral arteries of both sides). A lesion is considered to be significant (stenosis >50%) when a plaque was observed, with acceleration of the Doppler flow (PSV>200 cm/s) and a ratio >2.4 (PSV in stenosis/PSV in the healthy proximal artery), lesions with PSV>300 cm/s and a ratio >3.5 were classified as severe (stenosis >70%).[7] If the examined artery segment did not have any Doppler flow or color filling of the vessel lumen (Figure 2.1A) and the distal wave morphology was monophasic (Figure 2.1B), the artery lesion is considered as occluded. Obesity, calcium, or abdominal gas limit the correct estimation of the patency and arterial Doppler flow could not be obtained.

The proximal part of the common iliac artery and the distal part of the external iliac artery can be visualized in 80% and 90 % of patients, respectively.[8] The middle part of the pelvic axis can sufficiently be examined by DUS in only 25% of patients. Alternative methods should be considered when the imaging is suboptimal.

A high sensitivity and specificity of DUS compared with the gold standard technique (digital subtraction angiography, CTA, or MRA, depending on the specific article) have been reported. Most of these studies show a DUS sensitivity above 85% and a specificity above 90% in referring to the evaluation of the aortoiliac territory.[9]

During daily clinical sessions in the vascular surgery department, the cases of patients requiring revascularization are discussed, and a surgical treatment plan is chosen on the basis of DUS mapping. In cases of inconclusive studies (mainly because of obesity and calcifications) and in those patients with an indication for open aortic surgery, the study was completed with CTA.

CTA

CTA with three-dimensional (3D) reconstruction is widespread used in clinical practice and is the first second level imaging modality for evaluating AIOD.