PERIPHERAL VASCULAR DISEASE CONSENSUS STATEMENT
Abridged version

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The opinions, standards or guidelines comprised in this Consensus have been designed and conceived in generic terms from the description of situations considered as a theoretical model. Various alternative hypotheses are described to arrive to a diagnosis, to the definition of a treatment and/or the prevention of a given disease. Under no circumstances can it be interpreted as a specific instruction and/or as a practical recommendation. The specific application in the individual patient of any of the general descriptions present in this Consensus Statement will depend on the medical judgment of the intervening professional and on the characteristics and circumstances that arise regarding the case in question, considering the patient's medical history and specific pathological conditions to be treated and/or the means and resources available, and/or the need for additional and/or supplementary measures, etc. The assessment of these background factors and final clinical decision to be adopted are under the criteria and responsibility of the attending physician.

The present edition is an abridged version of the Peripheral Vascular Disease Consensus Statement. The complete version is available in: http://www.sac.org.ar/area-de-consensos-y-normas/

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Abbreviations

AAA	Abdominal aortic aneurysm
ABI	Ankle-brachial index
ACEI	Angiotensin converting enzyme inhibitors
ARA II	Angiotensin II receptor antagonists
CS	Carotid stenosis
CTA	Computed tomography angiography
CT	Computed tomography
DA	Digital angiography
HTN	Hypertension
IS	Ischemic stroke
LL	Lower limbs
LLAD	Lower limb arterial disease
LLCI	Lower limb critical ischemia
LLPVD	Lower limb peripheral vascular disease
NMR	Nuclear magnetic resonance
MRA	Magnetic resonance angiography
PTAS	Percutaneous transluminal angioplasty and stenting
PVD	Peripheral vascular disease
SSS	Subclavian steal syndrome
TIA	Transient ischemic attack
VRF	Vascular risk factors

1. INTRODUCTION

Peripheral vascular disease epidemiology in Argentina

According to the 1999-2000 NHANES survey, 4.3% of adults over 40 years of age in the United States are diagnosed with asymptomatic peripheral vascular disease (PVD). (1) Similarly, a Swedish study (2) revealed a prevalence of 18% PVD and 7% intermittent claudication in the population of aged 60-90 years. Since the development of PVD is associated to the prevalence and severity of risk factors, it is possible that the estimation for that age group in Argentina is higher. In this sense, we are also facing the problem of underdiagnosing this disease. One example is that only 4.3% of a cohort of 417 elderly patients (age >75 years) routinely assisted in outpatient clinics in three cities of our country had diagnosis of PVD (performed by any imaging method or by the presence of intermittent claudication). (3) However, this value was 32.8% in systematically examined subjects over 60 years of age, who were admitted with acute coronary syndromes in a community hospital in Buenos Aires. A registry of 9,500 patient visits with a diagnosis of peripheral artery disease (performed in centers with representatives of the Colegio Argentino de Cirujanos Cardiovasculares y Endovasculares [Argentine College of Cardiovascular and Endovascular Surgeons]) showed a prevalence of hypertension (HTN) and over 90% smoking, and of type 2 diabetes and dyslipidemia close to 50%. (4)

Although one of the most disabling consequences of PVD is amputation, its prevalence due to vascular causes is unknown in our country. A study that analyzed lower limb (LL) amputations in the provinces of Corrientes and Buenos Aires revealed that 75% of these procedures were performed in diabetic subjects. In conclusion, although we do not have exact figures, we can infer rom the published literature that PVD is not an uncommon disease in our country.

Risk factors and peripheral vascular disease

Risk factors related to the development of atherosclerotic PVD are similar to those described for ischemic heart disease. Classically, HTN, smoking, diabetes and high cholesterol have been the associated risk factors. However, there are differences in the prevalence of these risk factors according to the vascular bed studied. Prevalence of smoking is higher in patients with lower limb arterial disease (LLAD) compared to other vascular territories. Diabetes is another distinctive risk factor in LLAD not only associated with the presence of obstructions, but also with amputation and ulceration susceptibility.

Risk stratification

In subjects with atherosclerotic disease in any vascular territory the use of scales (Framingham, SCORE, WHO) for cardiovascular risk stratification is not necessary. These patients are at high risk and are equivalent to those with coronary heart disease. It is important to emphasize that in individuals with arterial diseases unrelated to atherosclerosis, such as renal artery angiodysplasia or radiation-induced vascular disease, overall risk stratification should be performed.

Indications for risk stratification

Recommendation	Class	Level of evidence
- Patients with symptomatic peripheral vascular disease should be considered at high risk for vascular events.	I	A
- Patients with obstructive arterial disease not attributable to atherosclerosis should undergo overall cardiovascular risk stratification as a prevention measure.	I	C

VASCULAR DISEASE IN MULTIPLE TERRITORIES: CORONARY, CAROTID AND RENAL (SCREENING AND MANAGEMENT)

Prognosis of peripheral vascular disease in multiple territories

In patients with atherosclerotic disease in a vascular territory, presence of coexisting disease in different vascular beds is associated with increased risk of symptom and complication recurrence.

Screening and management of patients with vascular disease in multiple territories

Carotid stenosis in coronary artery disease patients (with no planned revascularization strategy)

Although the association between both vascular beds is evident, the prevalence of significant carotid stenosis (CS) is relatively low; therefore, routine color Doppler screening of significant CS has limited value.

Carotid stenosis screening in patients with planned coronary artery bypass graft surgery (CABG)

Prevalence of CS in patients with planned CABG varies from 25% when CS is greater than 50% to 8-13% when CS is greater than 80%. (5).

Management of patients with carotid stenosis and planned CABG

Considering the type of presentation in patients with symptomatic CS, it is reasonable to first perform carotid revascularization in patients with planned CABG. Among asymptomatic patients (the majority) those who may benefit from prophylactic revascularization would be those with severe CS, particularly bilateral severe stenosis, or contralateral occlusion. However, in the absence of randomized studies and clear evidence demonstrating the benefits of prophylactic carotid revascularization, all patients should be assessed individually by a multidisciplinary team that includes a neurologist.

Renovascular disease management in patients with coronary disease

Renal artery stenosis should be suspected in patients with recurrent episodes of heart failure, refractory angina, recurrent pulmonary edema or impaired renal function with the use of angiotensin-converting enzyme inhibitors (ACEI) or angiotensin II receptor antagonists (ARA II). Color Doppler ultrasound is the first-line screening tool for the detection of renal artery stenosis. Furthermore, the presence of renal artery stenosis does not affect the management of patients with coronary heart disease, except for renal failure due to ACEI inhibitors.

Lower limb arterial disease in patients with coronary artery disease

At any stage of coronary artery disease presentation, the presence of LLAD worsens the prognosis. In the GRACE registry, in-hospital mortality in patients with acute coronary syndrome was significantly higher in patients with LLAD.

In summary, patients with LLAD and associated coronary artery disease have twice the risk of death than patients with isolated coronary disease; hence, preventive treatment should be strict and aggressive.

Screening and management of coronary artery disease in patients with carotid disease

Patients with CS have a high prevalence of coronary artery disease and risk of cardiovascular events. However, coronary angiography screening for coronary artery disease and eventual revascularization before vascular surgery showed no benefit. (6)

Screening and management of coronary artery disease in patients with lower limb arterial disease

Patients with LLAD who will undergo elective surgery require a short-term purpose assessment consisting in surgical risk stratification to employ strategies in order to reduce it, and another one to identify patients with long-term poor prognosis in whom drug treatment may or may not improve their morbidity and mortality. As in carotid endarterectomy, patients with LLAD requiring surgery do not benefit from prophylactic CABG.

Screening recommendations

Recommendation	Class	Level of evidence
- Use of carotid Doppler ultrasound for CS screening is not routinely recommended in patients with coronary artery disease who are not on revascularization plan.	III	C
- Although the coexistence of coronary artery disease and renal artery stenosis is frequent, systematic screening for renal artery stenosis does not seem reasonable.	III	C
- Systematic coronary artery disease screening with cineangiography is not recommended prior to vascular surgery (carotid or lower limb).	III	B

Diagnosis

Lower limb arterial disease
Ankle-brachial index
Ankle-brachial index (ABI) assessment is a noninvasive, safe, reproducible, validated method, which is also cost-effective: using a cutoff value of 0.9 its sensitivity and specificity exceed 95%. It is able to diagnose the disease and also stratify patients and add prognostic value, as 5-year survival decreases concomitantly with ABI reduction.

Ultrasound
Arterial Doppler ultrasound of the LL is the recommended assessment study in the initial management of most patients with LLAD.

Magnetic resonance imaging
Nuclear magnetic resonance (NMR) may assess the LL arterial tree completely, even the most distal parts. It has 93-100% sensitivity and 93-100% specificity.

Computed tomography angiography
Computed tomography angiography (CTA) is more sensitive to evaluate the aortoiliac territory; it has 96% sensitivity and 98% specificity. At the femoropopliteal level, the sensitivity is 97% and the specificity 94%, while it is lower at the infrapatelar level.

Digital Angiography
Digital angiography (DA), considered the standard method for decades, is today intended for patients with elective therapeutic interventions.

Screening recommendations

Recommendation	Class	Level of evidence
- The anatomical data obtained from imaging studies should always be assessed together with studies evaluating hemodynamic variables at the moment of deciding the therapeutic behavior.	I	C

Cerebrovascular disease

Color Doppler ultrasound is commonly used as the first step to detect internal carotid artery stenosis and to assess its severity.
Computed tomography angiography and NMR have the advantage of providing simultaneous images of the aortic arch, complete common and internal carotid arteries and intracranial circulation, as well as the brain parenchyma. In a systematic review and meta-analysis no major differences among Doppler ultrasound, NMR and computed tomography (CT) were found for the detection of a significant CS. Angiography may be required for diagnostic purposes only in selected cases (e.g. when there are discordant results among noninvasive diagnostic methods, or to seek additional intracranial vascular disease). (7)

Renovascular stenosis

It is usually diagnosed in the following situations:
1. HTN: It is the most common cause of secondary HTN and is detected in 0.5% to 5% of cases.
2. Renal failure: It is the third most common etiology (10-15% of cases).
3. Heart failure: Usually acute and secondary to a sudden increase in blood pressure.

Severe renal artery stenosis should be strongly suspected in the presence of:
1. Rapidly worsening HTN.
2. Diastolic blood pressure ≥ 110 mm Hg.
3. Hypokalemia.
4. HTN refractory to treatment.
5. Abdominal murmurs.
6. Progressive creatinine increase and renal function worsening. (8)

Abdominal aortic aneurysm

Physical examination has low sensitivity, since only 50% of 3.5 to 6 cm diameter aneurysms are detected. A complete physical examination may provide other useful indications: in patients with femoral artery aneurysms, abdominal aortic aneurysm (AAA) is present in up to 85% of cases, and in those with popliteal aneurysm, concomitant AAA may be expected in up to 60% of cases.

Conversely, approximately 15% of patients with AAA may have a popliteal or femoral aneurysm; it is therefore recommended not to omit its exploration on physical examination.

SURGICAL RISK ASSESSMENT IN VASCULAR SURGERY

Assessment of cardiovascular risk in noncardiac surgery is a very common debate in routine practice. Despite advances in surgical procedures, constant development of new techniques and perfection of anesthetic perioperative care in general, complications remain a significant problem, ranging from 1.4% to 4% of major postoperative cardiac complications in unselected surgeries and rising from 5% to 9% in vascular surgeries.

A detailed analysis of this issue may be seen in the full version of this Consensus statement in: http://www.sac.org.ar/area-de-consensos-y-normas/

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2. CAROTID AND VERTEBROBASILAR DISEASE

PHYSIOPATHOLOGICAL, EPIDEMIOLOGICAL AND CLINICAL MANIFESTATIONS OF EXTRACRANIAL ATHEROMATOSIS

The natural risk of symptomatic CS stroke after recent transient ischemic attacks (TIA) is 5.5% at 2 days and 20.1% at 90 days, while that of asymptomatic stenosis >75% is 2-3% per year, similar to the risk of stroke subsequent to endarterectomy performed for asymptomatic stenosis.

VASCULAR RISK FACTORS AND MEDICAL TREATMENT

Treatment recommendations and treatment goals for risk factors do not differ from those contained in this Consensus statement for any patient at high vascular risk.

Hypertension. Treatment recommendations

Recommendation	Class	Level of evidence
- In patients with asymptomatic CS, antihypertensive treatment is recommended to maintain blood pressure <140/90 mmHg. (1)	I	A

Dyslipidemia. Treatment recommendations

Recommendation	Class	Level of evidence
- Treatment with statins is recommended in all patients at high vascular risk (coronary artery disease or diabetes) and dyslipidemia.	I	A
- Treatment with statins is recommended in patients with asymptomatic CS to reduce LDL-C below 100 mg/dL.	I	B
- Treatment with statins is recommended in patients with symptomatic CS to reduce LDL-C below 70 mg/dL.	IIa	B
- In patients in whom the desired LDL-C levels are not achieved with statins, it is reasonable to intensify treatment with other drugs.	IIa	B
- In patients who cannot tolerate statins it is reasonable to use other lipid-lowering drugs.	IIa	B

LDL-C: Low density lipoprotein cholesterol. CS: Carotid stenosis

Diabetes. Treatment recommendations

Recommendation	Class	Level of evidence
- Treatment of blood glucose levels, both with healthy lifestyle recommendations as with hypoglycemic drugs may be useful in patients with CS and diabetes. It is reasonable to maintain a target HbA1c ≤ 7%, although the benefit for stroke prevention has not been fully established.	IIa	A
- Treatment with statins to keep LDL-C values ≤ 70 mg/dL in patients with CS and diabetes could be useful to reduce the risk of vascular events.	IIa	B
- Antihypertensive treatment reduces stroke risk in patients with CS and diabetes.	I	A

LDL-C: Low density lipoprotein cholesterol. CS: Carotid stenosis

Smoking. Treatment recommendations

Recommendation	Class	Level of evidence
- Patients should be questioned on their smoking habits recommending its cessation in case of CS, and non-pharmacological or pharmacological therapeutic interventions should be performed in order to reduce the risk of vascular disease.	I	A

Obesity. Treatment recommendations

Recommendation	Class	Level of evidence
- Weight reduction is recommended in obese or overweight subjects with the aim of reducing blood pressure.	I	A
- Weight reduction is recommended in obese or overweight subjects with the aim of reducing stroke risk.	IIa	B
- A potassium-rich diet (fruits and vegetables) may lower stroke risk.	I	B

LDL-C: Low density lipoprotein cholesterol

Physical activity. Treatment recommendations

Recommendation	Class	Level of evidence
- Physical activity is recommended to reduce stroke risk.	I	B
- At least 150 minutes of moderate physical activity or 75 minutes of vigorous aerobic activity per week are recommended.	I	B

Antiplatelet therapy. Treatment recommendations

Recommendation	Class	Level of evidence
- Aspirin antiplatelet therapy (75-325 mg/day) is recommended in patients with asymptomatic or symptomatic CS for the prevention of stroke and other vascular events.	I	A
- Antiplatelet therapy with aspirin or clopidogrel 75 mg/day or a combination of aspirin 50 mg and extended release dipyridamole 400 mg is recommended in patients with symptomatic CS to prevent recurrence.	I	B
- Anticoagulation in patients with asymptomatic CS is not recommended unless there is an urgent anticoagulation cause (e.g., atrial fibrillation, pulmonary embolism, etc.).	I	C
- Anticoagulation in patients with symptomatic CS is not recommended unless there is an urgent anticoagulation cause (e.g., atrial fibrillation, pulmonary embolism, etc.).	I	B
- The combination of aspirin and clopidogrel in patients with symptomatic CS is not recommended unless there are specific indications (unstable angina, non-Q myocardial infarction or recent stent implantation).	III	B

CS: Carotid stenosis

COMPLEMENTARY DIAGNOSTIC METHODS

Echo-Doppler of neck vessels

Ultrasound is the first most commonly used method for the diagnosis of CS.

Recommendations for echo-Doppler of neck vessels

Recommendation	Class	Level of evidence
- Echo-Doppler of neck vessels should be performed in patients with signs and symptoms of ischemic stroke or TIA.	I	A
- In patients with ischemic stroke or TIA and carotid or vertebral stenosis with significant hemodynamic obstruction diagnosed by ultrasound, its confirmation should be made by a second method, which may be CTA, MRA or DA.	I	A
- In a population with intermediate cardiovascular risk, measurement of carotid intima media thickness and fundamentally the presence of carotid plaque provide minimal additional information in the first case and substantial in the second case over traditional VRF.	IIa	A
- It is reasonable to repeat the ultrasound examination annually to determine the progression or regression of the disease and response to medical therapeutic interventions in patients with stenosis previously greater than 50%.	IIa	C
- Ultrasound of the carotid arteries may be considered in asymptomatic patients without evidence of vascular disease presenting two or more of the following risk factors: hypertension, dyslipidemia, smoking, and family history of early vascular disease, in order to detect the presence of subclinical atherosclerosis. It is uncertain whether the detection of disease with this study could determine actions with clinical significance.	IIa	C
- Carotid ultrasound is not recommended as routine assessment in asymptomatic patients without atherosclerotic evidence or risk factors.	III	C
- Carotid ultrasound is not recommended as routine assessment in patients with neurological or psychiatric diseases unrelated to focal cerebral ischemia, tumors, epilepsy, and degenerative and infectious diseases.	III	C

TIA: Transient ischemic attack. CTA: Computed tomography angiography. MRA: Magnetic resonance angiography. DA: Digital angiography. VRF: Vascular risk factors.

Extracranial vertebral and subclavian artery echo-Doppler

Recommendations for echo-Doppler of vertebral arteries

Recommendation	Class	Level of evidence
- In patients with symptoms suggestive of subclavian steal syndrome it is advisable to perform a Doppler ultrasound of both subclavian and vertebral arteries to identify the steal phenomenon.	I	B
- In patients with lesions of the spinal territory, Doppler ultrasound sensitivity and specificity is lower compared to that of the carotid territory; therefore, CTA, MRA or DA are recommended to confirm the findings.	I	B

CTA: computed tomography angiography. MRA: Magnetic resonance angiography. DA: digital angiography.

Magnetic resonance angiography and computed tomography angiography

Recommendations

Recommendation	Class	Level of evidence
- CTA and MRA are indicated in the evaluation of patients with symptoms of ischemic stroke or TIA of the carotid and vertebral territory in order to rule out large vessel disease.	I	C
- If echo-Doppler and MRA and/or CTA findings are concordant for carotid circulation, it is not necessary to perform DA.	I	B
- In patients with ferromagnetic devices MRA is contraindicated.	III	C

CTA: computed tomography angiography. MRA: Magnetic resonance angiography. TIA: Transient ischemic attack.

Digital Angiography

Digital angiography remains as the benchmark diagnostic method against which other studies are compared.

Recommendations

Recommendation	Class	Level of evidence
- In patients with ischemic stroke or TIA of carotid or vertebral territory in which an extracranial source of ischemia is not identified CTA, MRA or DA may be useful to investigate cerebrovascular disease.	IIa	C
- When endarterectomy is planned in a significant CS detected by Doppler ultrasound, it may be useful to perform CTA, MRA or DA to assess the severity of the injury and identify intrathoracic and intracranial lesions, and the development of collateral circulation not adequately evaluated by Doppler ultrasound.	IIa	C
- It is reasonable to perform DA to detect and characterize extracranial and/or intracranial cerebrovascular disease in patients with stroke or TIA when noninvasive tests are inconclusive, or if they are impracticable for technical or medical contraindications. It is also reasonable to conduct DA when there is no correlation among the results of noninvasive imaging studies.	IIa	C
- When Doppler ultrasound, CTA or MRA suggest a complete carotid occlusion (100%) in a patient with neurological symptoms, DA should be considered in order to determine the existence of minimal arterial lumen that allows carotid revascularization.	IIa	C
- In patients with renal failure it is reasonable to conduct a limited DA to assess (permanently) one vascular bed in order to decrease the nephrotoxicity of iodinated contrast material.	IIa	C

TIA: Transient ischemic attack. CTA: Computed tomography angiography. MRA: Magnetic resonance angiography. DA: Digital angiography. CS: Carotid stenosis

CAROTID SURGICAL TREATMENT

Symptomatic patients

Three prospective, randomized studies with a similar design concluded that surgical treatment is superior to medical treatment, reducing the risk of ischemic stroke and TIA in patients with symptomatic CS greater than 50%.

Surgical treatment recommendations in symptomatic patients

Recommendation	Class	Level of evidence
- Carotid endarterectomy is indicated in patients with TIA or ischemic stroke and 70% to 99% CS provided less than 6% perioperative complications are estimated. (2-6)	I	A
- Carotid endarterectomy is indicated in patients with TIA or ischemic stroke and 50% to 69% CS, depending on selected patients' age, sex and comorbidities.	IIa	A
- It is reasonable to choose carotid endarterectomy over angioplasty and stenting in patients over 70 years of age or with unfavorable anatomy for endovascular treatment.	IIa	B
- It is advisable to perform carotid endarterectomy within the first 2 weeks of a cerebrovascular event to prevent event recurrence.	IIa	B
- Carotid endarterectomy is not recommended in stenosis <50%.	III	A

TIA: Transient ischemic attack. CS: Carotid stenosis

Asymptomatic patients

Surgery recommendation in asymptomatic patients

Recommendation	Class	Level of evidence
- Carotid endarterectomy may be indicated in selected asymptomatic patients with stenosis >80%, if less than 3% perioperative complications are estimated. (7-9)	IIa	A

ENDOVASCULAR TREATMENT

Endovascular treatment is a therapeutic alternative which has demonstrated increased risk of ischemic stroke with percutaneous transluminal angioplasty and stenting (PTAS) and myocardial infarction with endarterectomy in subgroup analyases of clinical trials.. Young subjects had fewer events with PTAS and elderly patients had fewer events with endarterectomy. (10-12)

Endovascular treatment recommendations

Recommendation	Class	Level of evidence
- PTAS is an alternative to carotid endarterectomy in symptomatic patients <75 years of age with low risk of procedure-related complications (less than 6%) and a level of obstruction higher than 70% by noninvasive methods or greater than 50% by DA. (1-3)	IIa	A
- It is reasonable to choose PTAS over carotid endarterectomy in patients with history of surgery or radiation therapy to the neck or post carotid endarterectomy stenosis.	IIa	B
- PTAS is recommended within the first 2 weeks of a cerebrovascular event to prevent its recurrence.	IIa	B
- PTAS is not recommended in patients with stenosis <70% by noninvasive methods or <60% by DA.	III	A
- PTAS in asymptomatic patients should only be performed in selected patients with stenosis >80%, evidence of progression or plaque instability under adequate medical treatment and low risk of complications (less than 3%).	IIa	B

PTAS: Percutaneous transluminal angioplasty and stenting. DA: Digital angiography.

RISK ASSESSMENT PRIOR TO REVASCULARIZATION

Preprocedural risk assessment recommendations for carotid revascularization

Recommendation	Class	Level of evidence
- Preoperative assessment in patients undergoing carotid endarterectomy or PTAS should include a complete clinical evaluation, routine laboratory coagulation studies, electrocardiogram and echocardiogram.	I	C
- In patients with symptomatic CS by ischemic stroke it is necessary to perform a control brain imaging study to rule out hemorrhagic transformation or edema of the ischemic area.	I	B
- Asymptomatic patients should have low surgical risk prior to carotid endarterectomy or PTAS, since the benefit of the intervention is marginal.	I	A
- In patients with suspected severe or symptomatic coronary artery disease due to unstable angina or myocardial infarction, cardiac assessment and management should be performed according to the corresponding clinical practice guidelines.	I	B

PTAS: Percutaneous transluminal angioplasty and stenting. CS: Carotid stenosis.

POSTSURGICAL TREATMENT OF CAROTID ARTERY DISEASE

Postsurgical carotid artery endarterectomy or PTAS have specific characteristics that should be known to reduce post-procedure morbidity and mortality.

Recommendations of postsurgical carotid revascularization care

Recommendation	Class	Level of evidence
- Postsurgical carotid endarterectomy and PTAS care should be done in an intensive care unit.	I	C
- Continuous electrocardiographic, blood pressure and neurological monitoring, as well as neck and carotid endarterectomy drains and PTAS puncture site control, should be performed to detect possible complications.	I	C
- Hypertension and hypotension should be avoided since both are associated with complications.	I	C
- Post-carotid endarterectomy patients should receive antiplatelet therapy with aspirin and statins.	I	A
- Post-PTAS patients should receive antiplatelet therapy with clopidogrel for 1-3 months and aspirin and statins indefinitely.	I	A

PTAS: Percutaneous transluminal angioplasty and stenting

SUBCLAVIAN STEAL SYNDROME AND VERTEBROBASILAR DISEASE

Vertebrobasilar disease

It is mostly an asymptomatic entity that requires no treatment. In case of symptom onset, revascularization should be considered.

Recommendations for subclavian steal syndrome and vertebral pathology

Recommendation	Class	Level of evidence
- In patients with atheromatous lesions of the subclavian, vertebral or basilar artery control of VRF is indicated.	I	C
- In symptomatic SSS patients, extra-anatomic carotid-subclavian bypass or endovascular treatment with PTAS is indicated to prevent neurologic or claudication symptoms.	IIa	B
- Asymptomatic patients with SSS should not receive invasive treatment by any of the above two methods.	III	C
- In patients with SSS and planned CABG requiring use of ipsilateral mammary artery, it is reasonable to perform treatment prior to cardiac surgery.	IIa	C
- In patients with vertebral dissection, it is reasonable to use antiplatelet therapy with aspirin and/or anticoagulation for 3 to 6 months.	I	C

VRF: Vascular risk factors. SSS: Subclavian steal syndrome. PTAS: Percutaneous transluminal angioplasty and stenting.

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3. LOWER LIMB ARTERIAL DISEASE

INTRODUCTION

Epidemiology

The prevalence of lower limb arterial disease (LLAD) increases with age, affecting up to 15-20% of elderly patients over 65 years of age.

CLINICAL PRESENTATION

Most patients with LLAD are asymptomatic during several years. Once symptoms are present, three different syndromes can be identified:

- **Intermittent claudication:** It is sudden pain in the LL manifested while walking and relieved by rest.
- **Critical ischemia:** It is manifested by pain at rest or by presence of vascular trophic lesions.
- **Acute ischemia:** It is tissue perfusion deficit of less than 14 days evolution.

CLINICAL PRESENTATION

Measurement of ankle-brachial index

Recommendation	Class	Level of evidence
- Measurement of ankle-brachial index is indicated as first-line non-invasive test to detect and diagnose lower limb arterial disease.	I	B
- Another diagnostic test should be used in case of ABI >1.4 in diabetic or elderly patients.	I	B
- Exercise ankle-brachial index should be considered in case of patients with atypical symptoms suggestive of LLPVD to confirm the diagnosis and quantify seriousness.	IIa	B

ABI: Ankle-brachial index. LLPVD: Lower limb peripheral vascular disease.

Other diagnostic methods

Recommendation	Class	Level of evidence
- Color Doppler echography is recommended as first-line diagnostic method to confirm and localize LLAD.	I	B
- Ultrasound and CAT or MNR are recommended to localize LL arterial lesions and define revascularization strategy.	I	B
- Indication of angiography is preserved for patients with planned revascularization procedure.	IIa	C

LLAD: Lower limb arterial disease. CAT: Computed axial tomography. MNR: Nuclear magnetic resonance. LL: Lower limbs.

INTERMITTENT CLAUDICATION TREATMENT

Intermittent claudication treatment is aimed to relieve symptoms, increase walking distance and reduce overall cardiovascular risk.

Physical exercise

Recommendation	Class	Level of evidence
- Supervised exercise therapy is recommended in all patients with LLPVD having no contraindication for its performance.(1)	I	A
- In case supervised exercise therapy is not available unsupervised exercise therapy is recommended.	I	C

LLPVD: Lower limb peripheral arterial disease.

Pharmacological treatment

Recommendation	Class	Level of evidence
- Cilostazol is the drug of choice for the treatment of intermittent claudication. (2)	I	A
- Intermittent claudication is not a contraindication for the use of betablockers if the patient requires this type of medications for a specific reason (e.g. ischemic heart disease). (3)	I	A
- All patients with peripheral artery disease must have blood pressure values <140/90 mmHg; ACEI or angiotensin II antagonists will be preferentially used to achieve this goal.(4)	I	A
- All patients with peripheral artery disease should receive treatment with statins in case of no contraindications, independently of baseline cholesterol levels.(5)	I	B
- All patients with LL peripheral artery disease should receive antithrombotic therapy with aspirin at doses of 75 to 325 mg/dL. (6)	I	B
- Clopidogrel should be used in non-revascularized patients only in case of aspirin contraindication.	IIa	C
- Use of pentoxifylline can be considered in case cilostazol cannot be administered.	IIb	A
- Oral anticoagulation is not indicated in patients with intermittent claudication.	III	C

ACEI: Angiotensin converting enzyme inhibitors, LL: Lower limbs

Invasive treatment TASC II classification

In addition to the presence of comorbidities, center experience and patient preference, lesion anatomy is very important for the selection of the revascularization strategy. A group of experts developed a recommendation document known as TASC II (Inter-Society Consensus for the Management of Peripheral Arterial Disease, revised 2007) establishing four categories (A, B, C and D) according to disease morphology and extent. Summarizing this classification, it can be said that an endovascular strategy is recommended for the more simple lesions (A) and that a surgical strategy is the treatment of choice for the most advanced lesions (D).

Endovascular treatment

Intermittent claudication revascularization

Recommendation	Class	Level of evidence
- It is reasonable to consider a revascularization strategy in patients in whom intermittent claudication alters quality of life with inadequate response to conservative treatment.	IIa	C
- Dual-antiplatelet therapy with aspirin and clopidogrel is recommended during at least one month after stent revascularization followed by chronic aspirin treatment.	I	B
- An asymptomatic patient should not be revascularized independently of arterial disease severity.	III	C

Aorto-iliac segment

Endovascular revascularization of the aortoiliac segment

Recommendation	Class	Level of evidence
- When revascularization is indicated, endovascular treatment is recommended as first strategy in all TASC A-C aortoiliac lesions.	I	C
- An endovascular approach can be attempted in TASC D lesions in patients with severe comorbidities and by an experienced team.	IIb	C
- Stent implant is recommended for aortoiliac and external iliac lesions.	IIb	C

Femoropopliteal segment

Endovascular revascularization of the femoropopliteal segment

Recommendation	Class	Level of evidence
- Endovascular treatment is recommended as first revascularization option in TASC A-C lesions, whereas TASC D lesions should have an initial surgical solution.	I	C
- Use of stents should be considered for TASC B-C lesions. (7)	IIa	A
- An endovascular approach may be attempted for TASC D in patients with severe comorbidities and by an experienced therapeutic team.	IIb	C

Infrapopliteal segment

Endovascular revascularization of the infra-popliteal segment

Recommendation	Class	Level of evidence
- Endovascular treatment should be considered as first strategy for infra-popliteal revascularization.	IIa	C
- Use of stent is preserved for cases with suboptimal outcome of balloon angioplasty.	IIa	C

Surgical treatment

Aortoiliac disease

Recommendation	Class	Level of evidence
- Surgical treatment is recommended for TASC D aortoiliac disease in patients with disabling intermittent claudication without comorbidities.	I	C
- The saphenous vein should be considered as the conduit of choice when infrainguinal revascularization is contemplated. (8)	I	A
- Asymptomatic patients should not be submitted to prophylactic revascularization.	III	C

Antiplatelet and anticoagulation therapy after revascularization

Recommendation	Class	Level of evidence
- Dual antiplatelet therapy with aspirin and clopidogrel is recommended for at least one month after stent revascularization.	I	C
- The association of aspirin and vitamin K antagonists may be considered after infrainguinal revascularization with autologous vein, especially in conduits at high risk of occlusion.	IIb	B
- Dual antiplatelet therapy with aspirin and clopidogrel may be considered after infrapopliteal revascularization with prosthetic bypass.	IIb	B

LOWER LIMB CRITICAL ISCHEMIA

Lower limb critical ischemia (LLCI) is the most severe PVD manifestation.

Treatment

Whenever possible, treatment consists in the revascularization of the affected limb.

Medical treatment

Recommendation	Class	Level of evidence
- Use of hyperbaric chamber may be considered as a revascularization adjuvant treatment in patients with critical ischemia or as last therapeutic approach in patients without revascularization possibilities.	IIa	C
- Use of prostanoids may be considered when revascularization is not feasible.	IIb	B
- Fort the moment, gene or stem cell therapy should not be used for the treatment of LL peripheral artery disease.	III	C

Invasive treatment

Recommendation	Class	Level of evidence
- The proximal lesion should be treated in the first place.	I	C
- For patients with LLCI and proximal and distal occlusive disease in whom symptoms of ischemia or infection persist even after proximal revascularization, distal bed revascularization is also justified.	I	B

Endovascular treatment

Recommendation	Class	Level of evidence
- Endovascular treatment is a reasonable treatment of choice for critical ischemia with favorable anatomy. (9)	IIa	B

Surgical treatment

Recommendation	Class	Level of evidence
- Bypass surgery is reasonable as initial treatment for LLCI in patients with life expectancy above 2 years and with autologous vein as revascularization conduit. (10)	IIa	B

Recommendations for the aortoiliac segment

Surgical treatment of aortoiliac segment critical ischemia

Recommendation	Class	Level of evidence
- Aortoiliac/femoral bypass is the usual treatment of choice for diffuse aortoiliac occlusive disease in patients with normal surgical risk.	IIa	C
- In patients without other revascularization options, extra-anatomical bypass may be considered due to its lower long-term permeability rate.	IIb	C

Recommendations for the femoropopliteal segment

Surgical treatment of femoropopliteal segment critical ischemia

Recommendation	Class	Level of evidence
- Common femoral artery endarterectomy and patch arterioplasty provide excellent results with low morbidity and mortality, and are the standard treatment for this location.	IIa	B
- Hybrid endovascular treatment of aortoiliac/femoral occlusive disease may be considered an acceptable alternative treatment in patients with aortoiliac disease and concomitant common femoral artery disease requiring open surgery.	IIb	B
- Deep femoral artery revascularization may be considered in patients with critical ischemia, without options for reestablishing continuous blood flow from the aortoiliac segment to the popliteal artery, in relation to the hemodynamically significant stenosis of the deep femoral artery. Based on current available information, surgical deep plasty is preferred over endovascular revascularization.	IIb	B

Recommendations for the infrapopliteal segment

Surgical treatment of infrapopliteal segment critical ischemia

Recommendation	Class	Level of evidence
- The internal saphenous vein is superior to any other material and should be used as graft in infrapopliteal artery bypass.	IIa	B
- When the internal saphenous vein is not available or adequate, use of alternative vein grafts is preferable to preserved vein or PTFE bypass.	IIa	B

PTFE: Polytetrafluorethylene.

ACUTE ARTERIAL ISCHEMIA

Definition

Lower limb acute arterial ischemia is defined as sudden decrease in perfusion causing potential threat to the viability of the affected limb, of less than two weeks evolution.

Etiology and clinical presentation

The etiology of this condition includes acute artery or bypass thrombosis, embolism, and dissection or trauma; it may also occur in arterial aneurysms, especially at the popliteal level, and in bypass, either synthetic or of autologous veins.

Clinical assessment of limb vitality

Category		Prognosis	Findings		Doppler signal	
			Sensitivity	Muscular weakness	Arterial	Venous
I	No threat	No threat	No	No	Present	Present
IIa	Incipient threat	Recoverable if treated quickly	Mínimal (digital) or none	No	Normally present	Present
IIb	Imminent threat	Recoverable if treated immediately	Beyond the fingers; pain at rest	Mild or moderate	Occasionally present	Present
III	No vitality	Irrecoverable injury	Deep anesthesia	Paralysis, stiffness	Absent	Absent

Treatment

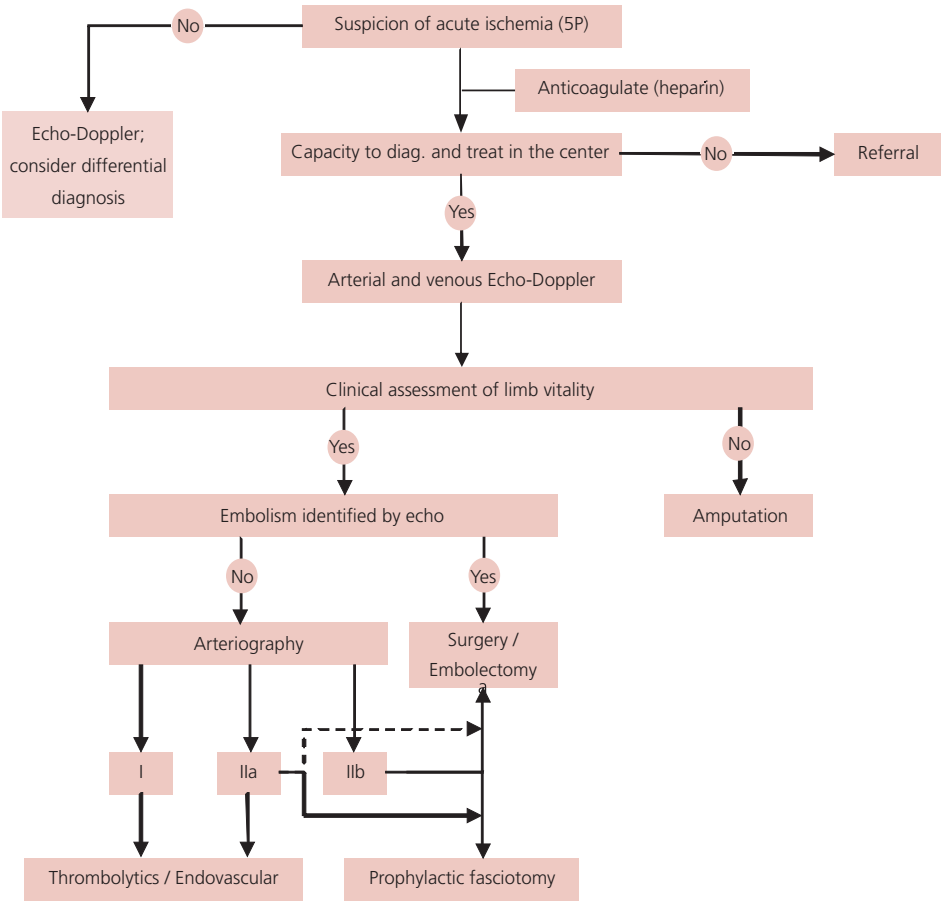
Initial medical management of acute ischemia

Recommendation	Class	Level of evidence
- All patients with acute lower limb arterial ischemia should receive heparin at treatment initiation.	I	B
- The patient should be immediately referred to another center in case of unavailable diagnostic or treatment resources.	I	C
- In the case of patients with severe limb ischemia and who progress with acute renal failure it is reasonable to start early hemodialysis therapy to decrease the risk of repercussion syndrome and hyperkalemia as a result of tissue injury and toxin release.	IIa	C

Acute ischemia reperfusion treatment

Recommendation	Class	Level of evidence
- Urgent revascularization is indicated in acute arterial ischemia with viable limb (stage II).	I	A
- In cases in which the limb presents with no vitality (stage III) no reperfusion strategy should be attempted and immediate limb amputation should be done, as it is considered a clinico-surgical emergency.	I	C
- Systemic thrombolytic therapy is not recommended in acute arterial ischemia.	III	B

ALGORITHM FOR THE MANAGEMENT OF ACUTE ARTERIAL ISCHEMIA OF THE LIMBS



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4. ABDOMINAL AORTIC AND ILIAC AORTIC ARTERY ANEURYSM

INTRODUCTION

Aneurysm is defined as the dilatation of an artery exceeding 50% of its normal diameter. In the case of the abdominal aorta there is general consensus in considering aneurysm when the artery reaches a transverse diameter >30 mm, >18 mm for the iliac artery and >15 mm for the popliteal artery.

NATURAL EVOLUTION

The probability of ruptured aneurysm is influenced by a number of factors, including aneurysm diameter, expansion rate and gender.
Aneurym size is the most important predictor of rupture risk, markedly increasing with aneurysm diameters greater than 5.5 cm.

EVALUATION AND DIAGNOSIS

Ultrasound

Echocardiography is the method of choice for AAA screening, diagnosis and surveillance.

Computed tomography

It is the method of choice for diagnosis and preoperative study, aortoiliac anatomy and aortic neck study (length, diameter, angulation, calcium, presence of thrombi) and wall characteristics.

Nuclear magnetic resonance

The improvements provided by helical CT scan have relegated NMR to a secondary place in the evaluation of AAA.

Angiography

It is not a precise technique to confirm the diagnosis of AAA or to measure its exact diameter.

ABDOMINAL AORTIC ANEURYSM SCREENING

Screening recommendations

Recommendation	Class	Level of evidence
- AAA screening is recommended in every man above 65 years of age who is a current or ex-smoker. (1)	I	A
- Every patient with known AAA without indication of intervention should have strict and programmed surveillance to assess its growth. (2, 3)	I	A
- Presence of AAA should be searched in every patient with popliteal, femoral or iliac aneurysm diagnosis.	I	C
- An echocardiographic control should be performed at least every 24, 12, 6 and 3 months for 30 to 39 mm, 40 to 44 mm, 45 to 49 mm and 50 to 54 mm aneurysms, respectively.	I	B
- It is reasonable to actively look for the presence of AAA in men and women above 60 years of age with first-degree relatives with history of AAA.	IIa	C

AAA: Abdominal aortic aneurysm.

MEDICAL TREATMENT

In patients with small aneurysms that have not reached the stage for surgical intervention, treatment should be focused both in reducing the occurrence of cardiovascular events as in delaying aneurysm growth and reducing rupture risk.

Acute ischemia reperfusion treatment

Recommendation	Class	Level of evidence
- All available therapeutic resources, both pharmacological and non-pharmacological, are recommended in patients with AAA who smoke to achieve smoking cessation.	I	B
- Patients with documented occlusive atherosclerotic disease and AAA should receive treatment with aspirin at doses of 81 to 100 mg/day.	I	A
- In patients with AAA without evidence of atherosclerotic disease it is reasonable to use aspirin at doses of 81 to 100 mg/day.	IIa	C
- In patients with AAA and either manifest or subclinical atherosclerotic disease, statin treatment is recommended to achieve a LDL-C level <70 mg/dl.	I	B
- In patients with AAA of family etiology not related to traditional CRF it would be reasonable to indicate statin treatment.	IIa	C
- There appears to be no systematic indication for the use of betablockers in patients with AAA. (4)	IIb	B
- In patients who must undergo AAA repair surgery it is reasonable to start betablocker titration 7 days prior to surgery. (5)	IIa	B

AAA: Abdominal aortic aneurysm. LDL-C: Low density lipoprotein cholesterol. CRF: Cardiovascular risk factors.

ELECTIVE TREATMENT OF NON-COMPLICATED INFRARENAL ABDOMINAL AORTIC ANEURYSMS

The United Kingdom Small Aneurysms Trial (UK-SAT) (2) and the Aneurysms Detection and Management Study (ADAM) (3) compared surgical treatment and clinical surveillance with ultrasound or CT scan in 4.0 to 5.4 cm diameter AAA. Follow-up for 4.6 to 4.8 years, respectively, showed no significant differences between studies. A meta-analysis of both studies confirmed methodological safety in follow-up strategy of AAA with less than 5.5 cm diameter. (6)

Recommendations

Recommendation	Class	Level of evidence
- Every patient with AAA diameter ≥5.5 cm or who develops symptoms attributable to the aneurysm or presents with growth greater than 1 cm/year has resolution indication. (2)	I	A
- It is reasonable to consider AAA repair in women and individuals with family history of AAA, when they reach 5.0 cm diameter.	IIa	B
- It is reasonable to consider saccular AAA intervention when the diameter exceeds 45 to 50 mm.	IIa	C

AAA: Abdominal aortic aneurysm.

Recommendation	Class	Level of evidence
- Physiotherapy and tobacco abstinence whenever possible is recommended 4 to 6 weeks prior to AAA surgical repair. (7)	I	A
- Every patient undergoing AAA intervention must have a formal preprocedural cardiological assessment. (8)	I	B
- Renal function should be evaluated with urea and creatinine tests prior to any AAA intervention.	I	B
- Surgical treatment would be recommended in young patients with normal surgical risk.	IIa	A
- Preoperative and operative measures should include antibiotic administration 30 minutes prior to surgery, avoid hypothermia, effective surgical resuscitation with crystaloids or coloidal substances, decrease blood loss and if possible the use of blood recovery and ultrafiltration devices.	IIa	B
- Presence of juxtarenal aortic aneurysms, horseshoe kidney, hostile abdomen or inflammatory aneurysms indicate use of retroperitoneal access.	IIb	C

AAA: Abdominal aortic aneurysm.

Endovascular treatment

The indication of endovascular treatment of aortic aneurysms should be considered regardless of the technique employed.

Recommendations for endovascular treatment of abdominal aortic aneurysm

Recommendation	Class	Level of evidence
- Endovascular approach would be preferable in high risk surgical patients or with technical contraindications for conventional surgery.	IIa	B
- Aortic endoprosthesis implantation is recommended in patients with comorbidities or diseases that increase the complexity of conventional surgery or in elderly patients.	IIa	C
- An aortic endoprosthesis should not be placed in the patient that cannot be adequately followed-up.	III	C

Patient surveillance with aortic endoprosthesis

Endoprosthesis implantation needs patient periodical and meticulous surveillance. Multi-slice intravenous contrast-enhanced CT scan is the study of choice to assess the presence of blood escapes or endoleaks.

Endoprosthesis surveillance recommendations

Recommendation	Class	Level of evidence
- Abdominal X-ray and intravenous contrast-enhanced CT scan should be performed within one month of endoprosthesis implantation, then at 6 and 12 months and thereafter once a year.	I	B

JUXTARENAL, PARARENAL AND SUPRARENAL ANEURYSMS

Risk of juxtarenal, pararenal and suprarenal rupture is similar to that of pure infrarenal aneurysm. The change is in the surgical risk due to the need of suprarenal aorta and/or visceral artery clampling.

Recommendations in juxtarenal, pararenal and suprarenal aneurysms

Recommendation	Class	Level of evidence
- Juxtarenal aneurysms not affecting the origin of renal arteries should have surgical treatment.	IIa	B
- Aneurysms involving de origin of renal arteries should have surgical treatment.	IIb	C
- Endoprosthesis may be an effective alternative in high surgical risk patients.	IIb	C

ILIAC ANEURYSMS

In the presence of an iliac aneurysm, contralateral aneurysms should be sought, since in 50% of cases they occur bilaterally.

Recommendation	Class	Level of evidence
- Any iliac aneurysm with diameter above 3.5 cm should be repaired.	IIa	C

COMPLICATED AORTIC ANEURYSM

Definition

This category includes two different clinical situations, ruptured aneurysm and symptomatic aneurysm. Ruptured aneurysm is that in which aortic wall rupture generates presence of blood outside the adventitia. Symptomatic aneurysm is the one presenting pain in the absence of ruptured wall.

Diagnosis

Diagnosis starts with clinical suspicion in the presence of the classical symptomatic triad (abdominal or lumbar pain, hypotension and pulsating mass) or else in any patient presenting with hypotension at the emergency department.

In general, in patients admitted with ruptured AAA who are hemodynamically stable, there is time to perform CT angiography.

Recommendations for the diagnosis of complicated abdominal aortic aneurysm

Recommendation	Class	Level of evidence
- If available, ultrasound is the complementary method to initially employ in the emergency department.	I	B
- If the patient has a known aortic aneurysm and is admitted with signs of hypovolemic shock and suggestive symptoms, he should be transferred to the operating room for its immediate resolution, unless ultrasound is available at the emergency department to confirm the suspected diagnosis.	IIa	C

Treatment

Initial medical management

Caution should be exerted on preoperative resuscitation of patients with ruptured aortic aneurysm. Aggressive resuscitation with crystaloids with the subsequent blood pressure elevation may generate re-bleeding favoring dilutional coagulopathy.

Surgical treatment

The decisive element in ruptured aortic aneurysm repair is the efficient, quick and safe proximal control.

Endovascular treatment

Immediate control of the aortic bleeding site is of vital importance in hemodynamically unstable patients with complicated AAA. In endovascular repair this is achieved by placing an elastomeric balloon in the aorta, above the ruptured site.

Recommendations for the treatment of complicated abdominal aortic aneurysm

Recommendation	Class	Level of evidence
- Aortic replacement should be done as fast as possible.	II	C
- If conditions to perform the diagnosis and treatment were not fulfilled at the center of origin, immediate activation should be implemented for referral to a center where the required treatment can be done without delay.	I	C
- Complementary studies to confirm the diagnosis or establish a therapeutic strategy should be done in the center where treatment will be carried out.	I	C
- Perform minimal resuscitation with permissive hypotension allowing preservation of patient consciousness and prevent ST-segment depression, usually by keeping systolic blood pressure between 70 and 80 mmHg.	IIa	C
- Use of surgical field blood recovery devices is recommended.	IIa	C
- It is reasonable to defer abdominal closure to reduce the incidence of compartmental syndrome.	IIa	C

POPLITEAL ANEURYSMS

Recommendations for popliteal aneurysms

Recommendation	Class	Level of evidence
- Echo-Doppler should be performed in every patient where a pulsatile mass is palpated at the popliteal cavity to rule out popliteal aneurysm.	I	C

Continue

(Continuation)

Recommendation	Class	Level of evidence
- In confirmed popliteal aneurysm diagnosis, its bilateral occurrence and the presence of aortic, iliac or femoral aneurysm should be ruled out.	I	C
- In every patient with popliteal aneurysm under 17 mm, annual echocardiographic surveillance should be performed, whereas if the popliteal aneurysm were above 17 mm, surveillance should be done every 6 months.	IIa	C
- It is recommended to repair every asymptomatic popliteal aneurysm above 2 cm.	IIa	C
- In the case of high surgical risk patients, the indication of intervention could be deferred until the aneurysm reaches 3 cm.	IIb	C
- No interventions should be performed on thrombosed popliteal aneurysms without acute or chronic ischemic symptoms.	III	C
- Urgent treatment is recommended in patients with acute ischemia and preserved viability secondary to thrombosis of popliteal aneurysm. (9)	I	A
- Patients with popliteal aneurysms who are not candidates to surgical resolution could be treated with oral anticoagulation with dicumarinic agents.	IIa	C

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5. RENAL VASCULAR DISEASE

INTRODUCTION

Atherosclerotic disease is the most frequent etiology of renal vascular disease (~ 90%), followed by fibromuscular dysplasia, whereas other causes are extremely rare. (1)

Renovascular disease is responsible for at least 1% of mild or moderate HTN, but its prevalence increases in patients with severe HTN, unresponsive to medical treatment and in those suffering from a sudden increase in blood pressure levels. (2)

Renovascular disease is defined as the presence of HTN and/or renal function impairment and/or development of heart failure attributed to the occurrence of renal stenosis.

DIAGNOSIS

Recommendations for the diagnosis of renovascular disease

Recommendation	Class	Level of evidence
- Diagnostic studies to screen for the presence of renal stenosis should be performed only with clinical suspicion of renovascular disease and the intention of proceeding with a specific treatment in case of confirming the occurrence of renal stenosis.	IIa	C

Continue

(Continuation)

Recommendation	Class	Level of evidence
- It would be reasonable to perform renal artery anatomy diagnostic imaging studies in patients with moderate and high suspicion of renovascular disease in whom specific interventional treatment is planned.	IIa	C
- Color echo-Doppler should be the first diagnostic method used to study patients with suspected renovascular disease.	I	B
- Patients with high suspicion of renovascular disease in whom echo-Doppler was not diagnostic should be submitted to a second non-invasive study or even a renal digital subtraction angiography.	I	C
- CTA and MRA may be used as diagnostic methods in patients with moderate or high clinical suspicion of renovascular disease of atherosclerotic origin and preserved renal function.	I	B
- Patients with high suspicion of renovascular disease in whom CTA or MRA were not diagnostic should be submitted to digital subtraction renal angiography.	I	C
- Renal arteriography is indicated in patients with moderate or high suspicion of renovascular disease in whom a non-invasive diagnostic study cannot be performed in the case studies have not been conclusive and a revascularization procedure is considered.	I	B
- In case iodine contrast substances are needed in patients with or at risk of renal function impairment, all necessary precautions should be adopted to avoid renal function impairment (Table 1).	I	A
- Arteriography would be the study of choice in the event of inconclusive echo-Doppler in patients with renal function impairment and suspected renovascular disease, in whom a revascularization procedure is planned in the case of renal stenosis.	IIa	C
- Gadolinium is not recommended in patients with creatinine clearance <30 ml/min.	III	B
- Patients with low probability of presenting with renovascular disease should not be submitted to additional diagnostic studies.	III	C
- Selective renin measurement at the level of the renal veins.	III	B
- Plasma renin activity.	III	B
- Baseline and postcaptopril or ACEI radiorenogram or renal scintigraphy.	III	B

CTA: Computed tomography angiography. MRA: Magnetic resonance angiography. ACEI: Angiotensin converting enzyme inhibitors.

Table 1. Measures to prevent renal failure due to contrast substance

Avoid use of nephrotoxic drugs.
Ensure isoosmolar saline hydration 1 ml/kg/h for at least 24 hours, starting 12 hours before and up to 12 hours after the procedure.
N-acetylcysteine 600 mg bid, 24 hours before and after the procedure.
Use isoosmolar, not ionic, contrast agentes.

TREATMENT OF RENAL VASCULAR STENOSIS

The different options to treat renal vascular stenosis consist in medical treatment and, in selected cases, percutaneous revascularization. Currently, the surgical option is reserved only for special situations (complex renal artery anatomy, need of aortic reconstruction or severe aortoiliac disease. (3)

Medical treatment

This approach includes the control of risk factors, such as smoking cessation, control of LDL-C, changes in lifestyle and use of antihypertensive agentes.

Recommendations for the medical treatment of renal vascular stenosis

Recommendation	Class	Level of evidence
- Use of ACEI, ARA II and calcium antagonists are recommended in the treatment of hypertension associated with unilateral renal stenosis.	I	B

Continue

(Continuation)

Recommendation	Class	Level of evidence
- Plasma urea, creatinine, sodium and potasssium levels should be closely monitored in every patient with known or suspected renal stenosis treated with ACEI or ARA II agents.	I	C
- The decrease in glomerular filtration rate greater than 30% or creatinine increase above 0.5 mg/dL may be indication for renal revascularization	IIb	C
- Use of ACEI and ARA II is not recommended in case of bilateral renal stenosis or in the case of renal stenosis with solitary functioning kidney..	III	B

ACEI. Angiotensin converting enzyme inhibitors. ARA II: Angiotensin II receptor antagonists.

Revascularization

Surgery

The concern with these procedures is the rate of morbidity and mortality.

Surgical Revascularization

Recommendation	Class	Level of evidence
- Surgical revascularization is recommended in patients who will undergo abdominal aortic surgery, or patients with complex renal anatomy or after a failed endovascular procedure.	IIb	C

Endovascular treatment

Endovascular revascularization

Recommendation	Class	Level of evidence
- Implant with stents is recommended in case of angioplasty of renal artery ostial lesions.	I	B
- Angioplasty, preferably with stent, is a strategy to be considered in patients with atherosclerotic renal artery stenosis >60% (gradient above 20 mmHg in angiography).	IIb	A
- Endovascular treatment of renal artery stenosis should be considered in patients with progressive renal function impairment.	IIb	B
- Renovascular stenosis treatment with balloon angioplasty, with or without stenting, may be considered in patients with renovascular disease and unresponsive HTN, recurrent congestive heart failure or in sudden pulmonary edema and preserved left ventricular systolic function, especially in bilateral renal stenosis or stenosis with solitary functioning kidney.	IIb	C

HTN: Hypertension.

FIBROMUSCULAR DYSPLASIA

There is no known treatment that may induce the regression of the arterial lesions produced by this non-atherosclerotic and non-inflammatory disease.

The only recommended treatment is that for HTN, without differences from the recommendation in other situations.

In the absence of randomized clinical trials, the main indications for revascularization are lesions > 60% lumen size, bilateral lesions, malignant or accelerated hypertension and in those with renal volume loss due to ischemic nephropathy.

Transluminal balloon angioplasty is the preferred revascularization technique. The possibilities of curing the hypertension with revascularization of fibromuscular dysplasia are higher than in atheromatous disease.

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