

Questions and answers on diagnosis and management of patients with Peripheral Arterial Diseases: a companion document of the 2017 ESC Guidelines for the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS)

Endorsed by: the European Stroke Organisation (ESO)

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Keywords

Guidelines • Questions and answers • Peripheral arterial diseases • Carotid artery disease • Vertebral artery disease • Upper extremity artery disease • Mesenteric artery disease • Renal artery disease • Lower extremity artery disease • Multisite artery disease

Case 1

A 76-year-old male is referred 48 hours after a transient ischaemic attack in the territory of the left carotid artery. He presented a recurrent episode of transient aphasia two hours prior to admission. He is not currently taking any medication. The duplex ultrasound scan (DUS) reveals a 60% stenosis of the left internal carotid artery (ICA) and non-stenotic plaques in the right ICA.

Q1. Do you plan any further carotid imaging?

If carotid artery stenting (CAS) is considered as the treatment approach, magnetic resonance angiography (MRA) or computed tomography angiography (CTA) is necessary for visualizing the aortic arch. If carotid endarterectomy (CEA) is the chosen treatment strategy, the DUS scan should be corroborated either by CTA or MRA or alternatively DUS should be repeated in an expert centre for confirmation prior to intervention.

Q2. How would you manage the patient?

There is consistent evidence that this patient will benefit from a carotid intervention, given his clinical presentation with recurrent symptoms within a short time

delay, and that he is a male aged > 75 year with a > 50% stenosis. The highest risk period for recurrent stroke is within the first 7 – 14 days after symptom onset. Accordingly, carotid intervention should be performed as soon as possible. CEA is associated with lower procedural risk in this early time period and is currently the preferred option. Age > 75 years is also associated with a significantly higher procedural risk after CAS. In experienced centres, however, with documented procedural risks < 6%, CAS may be an alternative to CEA, especially if there are comorbidities or other high-risk anatomical features.

Single antiplatelet therapy should be started as soon as possible, along with statin therapy and angiotensin-converting enzyme (ACE) inhibitors as appropriate. Dual antiplatelet therapy (DAPT) combining aspirin and clopidogrel is indicated in case of CAS. Prior to discharge the patient should receive lifestyle advice regarding smoking cessation, exercise and diet.

Q3. Is further cardiac work-up required?

It is reasonable to perform echocardiography and a 24-hour electrocardiogram (ECG) recording to rule out concomitant cardio-embolic disease, although this should not postpone the planned carotid intervention. If there is likely to be any delay, the carotid procedure should not be deferred unless there is a history of symptomatic cardiac disease warranting further investigation.

Case 2

A 76-year-old woman who underwent mechanical mitral valve replacement 15 years ago is referred for an asymptomatic 80% ICA stenosis, which was identified on a DUS following detection of a carotid bruit at a systematic clinical check-up.

Q4. Do you plan any other carotid imaging?

Beyond carotid stenosis estimation, other plaque characteristics can also be studied by DUS such as plaque extent, echolucence, and intraplaque haemorrhage. CTA can be proposed to confirm lesion severity. Likewise, brain CT may help for tracking any silent cerebral embolism, either recent or old (ipsilateral stroke), which may have a direct impact both on the indication and the timing of intervention.

Q5. DUS showed no high-risk lesion features and brain CT found no ipsilateral brain ischaemic lesion. How would you treat this carotid stenosis?

In this low-risk asymptomatic ICA patient, best medical therapy is the most frequent option, given the uncertain benefits of revascularization. Optimal risk factor control is recommended according to the ESC prevention guidelines, including use of statins. No additional antiplatelet therapy is recommended on top of vitamin K antagonist (VKA) in this elderly lady with a mechanical mitral valve, given the lack of proven ischaemic benefit and the established bleeding risk of such a combination.

Case 3

A 62-year-old man is referred for a left carotid bruit. He is asymptomatic and smokes tobacco regularly. DUS found a 70% left ICA stenosis. His medical history includes a transient ischaemic aphasia seven years earlier and a thyroidectomy complicated by right recurrent laryngeal nerve (RLN) palsy. Further investigations reveal that the left carotid lesion is predominantly echolucent and there is evidence of an old 'silent' infarction in the left parietal hemisphere.

Q6. Should the 70% asymptomatic left ICA stenosis be treated?

It is important to ensure that the patient is taking optimal medical therapy. Smoking cessation should be strongly encouraged and assistance should be proposed. Despite proven benefit of medical therapy to prevent stroke, a prior silent ipsilateral infarction, and a history of contralateral transient ischaemic attack (TIA) and echolucent plaque are high risk criteria for recurrent ipsilateral stroke. Carotid revascularization may be therefore considered in this particular case.

Q7. What should be the revascularization strategy: CEA or CAS?

This patient has an asymptomatic left ICA stenosis that meets current criteria for intervention, but he also has a right RLN palsy following a previous thyroidectomy. Given the potential risk of left RLN palsy and therefore the need for emergency tracheostomy, left carotid artery stenting should be considered if performed in an experienced centre with a 30-day death/stroke risk of < 3%.

Case 4

A 72-year-old man with a history of diabetes and asymptomatic lower extremity artery disease (LEAD) presents with atypical chest pain. Following a positive ischaemic test, coronary angiography reveals three-vessel coronary artery disease and the Heart Team decides to perform coronary artery bypass grafting (CABG).

Q8. Is a carotid duplex scan needed prior to CABG?

Yes. Diabetic patients aged > 70 years with three-vessel coronary artery disease and/or LEAD are significantly more likely to have concurrent carotid stenoses. Patients undergoing CABG with concomitant carotid disease display a higher risk of peri-operative stroke/death. Such information should be integrated into the decision-making process and the patient's information.

Q9. The carotid duplex scan reveals an asymptomatic 70% right ICA stenosis and an occluded left ICA. A CT scan also reveals an area of silent infarction in the left hemisphere. Should the patient undergo carotid revascularization in addition to CABG?

CABG patients with bilateral severe asymptomatic ICA stenoses (or contralateral occlusion) may be considered for staged or synchronous carotid revascularization, given the significantly higher risk of post-CABG stroke.

Q10. What should be the timing of carotid intervention?

In the case of TIA or stroke within the 6 months prior to CABG surgery, staged or synchronous CEA would have been the preferred option. This patient is asymptomatic and evidence suggests that the rates of 30-day death/stroke following staged/same day CAS are broadly similar to those observed after staged/synchronous CEA, although no randomized trials have been undertaken. The decision of whether to undertake staged vs. same day and CEA vs. CAS should be made according to the local experience, the urgency of the cardiac intervention and the peri-procedural antiplatelet strategy. If CAS is chosen, 'same-day' CAS + CABG would be the preferred timing as this would avoid deferring CABG because of the increased bleeding risk associated with DAPT required after CAS.

Case 5

A 75-year-old woman presented with a vertebrobasilar TIA that occurred four weeks earlier leading to bilateral lower limb weakness and dysarthria. CT angiography reveals an 80% stenosis of the V2 segment of the left vertebral artery (VA). The right VA and the circle of Willis are intact and all other investigations are normal.

Q11. Is there any indication for revascularization of the VA stenosis?

There is currently no compelling evidence that angioplasty ± stenting of the VA stenosis will reduce the risk of recurrent vertebrobasilar stroke more than best medical therapy alone. Management consists of risk factor control, statin therapy and antiplatelet monotherapy (either aspirin or clopidogrel).

Q12. Four months later the patient suffers a recurrent vertebral stroke while on aspirin and statins. There is no change in the extracranial VA stenosis and the clinical course is favourable with full recovery. How should she be managed?

It is important to ensure the patient actually adheres to her medical therapy. VA stenting is a reasonable approach in case of recurrent symptoms on optimal medical therapy. Saphenous bypass from the carotid artery to the VA is another option in a few expert centres. Evidence suggests that the use of drug-eluting stents may be associated with lower rates of restenosis. After stenting, DAPT (aspirin and clopidogrel) should be prescribed for at least one month.

Case 6

A 73-year-old male smoker presents with uncontrolled hypertension (home blood pressure 160/95 mmHg) despite taking an ACE inhibitor, a calcium-channel blocker, a thiazide diuretic and a beta-blocker. He is asymptomatic. Serum creatinine level is 97 µmol/L and urinalysis shows 1+ protein. Echocardiography reveals left ventricular hypertrophy and left ventricular diastolic dysfunction with preserved ejection fraction. Renal DUS finds a slightly smaller left kidney (90 mm vs. 100 mm on the right), with high velocity and turbulent flow (peak systolic velocity > 4 m/s) in the left renal artery near its ostium. CTA reveals no adrenal abnormalities but 80% left renal artery stenosis (RAS).

Q13. Should revascularization be performed?

Randomized clinical trials and meta-analyses have shown no benefit of renal artery stenting over best medical therapy in terms of blood pressure control or cardiovascular outcomes. In this patient, it is recommended to add spironolactone, antiplatelet therapy, statins and intensified lifestyle modifications, and to ensure optimal drug adherence.

Q14. Should ACE inhibitors be withdrawn?

ACE inhibitors should not be withdrawn, given the improved prognosis in patients with renal artery disease. However, patients should be monitored due to possible adverse events such as hyperkalaemia and acute kidney injury.

Q15. Two years later the patient is admitted to the hospital on two occasions within one month for acute pulmonary oedema with high blood pressure (180/100 mmHg), which rapidly resolves following treatment with intravenous diuretics and nitrates. He is compliant with his medications and lifestyle changes. Echocardiography shows unchanged findings. The estimated glomerular filtration rate is 32 mL/min with no improvement at hospital discharge. DUS and MRA reveal 90% ostial left RAS and 60% right mid-segment RAS. The left kidney is smaller (80 mm) than the right (100 mm). How should he be treated?

This patient may now be a candidate for percutaneous renal artery revascularization based on the “flash” pulmonary oedema, decreased size of the left kidney, bilateral RAS, and worsening renal function. The decision should be made within a multidisciplinary team.

Case 7

Your expert opinion is requested for a 74-year-old lady who presents with a deep ulcer on the first toe of her left foot with signs of local infection confined to the skin and an ankle-brachial index (ABI) of 0.49. She has had diabetes for > 10 years with mild renal impairment.

Q16. What is your diagnostic workup?

Based on the description of the wound and the degree of foot ischaemia and infection, the patient has a Wifl score of 2-2-1, which corresponds to chronic limb-threatening ischaemia (CLTI) clinical stage 4 (high risk of amputation). The benefit of revascularization (if feasible) is high depending on infection control. DUS is proposed as the first line imaging test. However, extensive below-the-knee disease is common in CLTI diabetic patients and full-leg digital subtraction angiography down to the plantar arch is recommended to explore all revascularization options.

Q17. Angiography demonstrates no significant lesion above the knees and long occlusions of the anterior and posterior tibial arteries. The peroneal artery is the only vessel supplying the foot. The patient has extended varicose saphenous veins bilaterally. Which revascularization strategy would you propose?

In long chronic total occlusion of the crural arteries, bypass with an autologous vein gives superior long-term patency and leg survival as compared with endovascular revascularization. However, given the poor condition of the saphenous veins, endovascular therapy may be the preferred choice. Based on the angiome concept, revascularisation should target at best the ischaemic tissues.

Q18. Recanalization of the posterior tibial artery is successfully performed with implantation of a bare-metal stent to the ostium. DAPT with aspirin and clopidogrel is administered for three months. Two weeks later the patient develops atrial fibrillation. What is your antithrombotic strategy?

The patient requires oral anticoagulants (OAC) because of a CHA₂DS₂-VASc score of 4. Her bleeding risk is low (HAS-BLED score 1) and allows for dual antithrombotic therapy combining OAC plus either aspirin 75–100 mg/day or clopidogrel 75 mg/day for at least one month after stent implantation. Beyond the dual antithrombotic period and because of the need for long-term anticoagulation, OAC alone would be proposed.

Case 8

An 86-year-old man presents with an acute onset of left foot pain that started 1.5 hours ago. He has a history of hypertension, paroxysmal atrial fibrillation treated with non-vitamin K oral anticoagulation (NOAC), and repeat left superficial femoral artery (SFA) balloon angioplasty procedures. The patient underwent bilateral saphenous vein stripping 25 years ago. He acknowledges not taking his medications in recent days. At physical examination, his left foot is pale, cold, with partial loss of motor function and an absence of left popliteal and distal pulses. Laboratory work up shows myoglobin levels 3 x upper limit of normal and an impaired renal function with a glomerular filtration rate of 48 mL/min.

Q19. What is your management strategy?

Since the patient shows a neurological deficit, urgent revascularization is mandatory for limb salvage. DUS can be performed in the emergency unit if available, but should not delay management. In this case, the availability of angiography must be balanced against the urgency for revascularization, and to save time, angiography can be performed in the operating room, during thrombectomy.

Q20. After successful thrombectomy of an occluded SFA, a 5 cm long stenosis of the distal SFA is unmasked. This arterial segment has already been treated twice with balloon angioplasty. What is your strategy?

The presence of a short SFA lesion relapsing twice after plain balloon angioplasty is an indication for drug-coated balloon angioplasty or bypass surgery. In this case, the endovascular option is preferable because of age, risk factors and the absence of a saphenous vein available for a bypass.

Q21. Following angioplasty, a dissection of the SFA is observed and a bare-metal stent is successfully deployed. After bailout stent placement and with documented non-compliance to oral anticoagulation treatment, how would you choose your antithrombotic strategy?

The recommended antithrombotic therapy after endovascular SFA intervention is DAPT for at least one month irrespective of stent type. This patient also has an indication for anticoagulation because of atrial fibrillation with a CHA₂DS₂-VASc score of 4. In this case, the combination of NOAC + aspirin 75 mg/day for one month is the best option. The patient should be specifically educated to improve treatment adherence.

Case 9

A 75-year-old diabetic woman attends her scheduled consultation for dilated cardiomyopathy with reduced left ventricular ejection fraction (last LVEF at 40%). She is clinically stable and in New York Heart Association (NYHA) functional class II. She has a regular pulse but the posterior tibial and pedal pulses are missing bilaterally. She has no complaints about her legs or feet despite walking up to 1 km on level ground. She avoids walking uphill because of shortness of breath. You measure the ABI, estimated at 0.70 at right and 0.85 at left.

Q22. Do you propose any test for her LEAD?

In the absence of symptoms, no intervention is indicated. Hence vascular imaging is not mandatory. A treadmill walking test can be proposed for an objective estimation of her walking distance, as a reference during follow-up. Heart failure and diabetes are two conditions favouring “masked LEAD”.

Q23. She is on ramipril and bisoprolol. You add clopidogrel 75 mg. Would you stop her beta-blocker?

No. Beta-blockers can be prescribed in most patients and there is no reason for stopping the beta-blockers in this asymptomatic lady, given the established prognosis in heart failure patients.

Q24. Four months later she complains of asthenia, worsening of shortness of breath and palpitations. Her heart rhythm is irregular and an ECG confirms atrial fibrillation. You prescribe an OAC. Do you stop antiplatelet therapy?

Clopidogrel should be stopped. The addition of antiplatelet therapy to OACs has no proven beneficial effect for LEAD over OAC alone. This combination should only be given in patients with recent peripheral or coronary stenting.

Case 10

A 71-year-old diabetic man is referred for the management of intermittent claudication of the right leg (pain-free walking distance 150 m). He has hypertension and chronic atrial fibrillation with prior stroke and gastrointestinal bleeding. He also has a moderate aortic stenosis. He is on oral anticoagulation and ACE inhibitors. Duplex ultrasound reveals a short tight stenosis of the right common iliac artery, amenable to an endovascular approach.

Q25. How would you treat claudication due to iliac disease?

In all patients with claudication, exercise therapy is recommended for better symptom control and improvement in walking distance and quality of life; supervised exercise should be preferred over home-based exercise because it is more effective and safer. A three-month trial is generally warranted. On the other hand, our patient has an isolated short iliac stenosis and first-line endovascular revascularization can be considered, given the good long-term patency and low risk of complications. However, considering the high bleeding risk (HAS-BLED score 3) and concomitant OAC, endovascular revascularization should not be the first choice because it might require the addition of antiplatelet therapy on top of OAC. Best medical therapy is the preferred option.

Q26. Three months later, the patient has had minimal benefit from supervised exercise therapy and claudication is affecting his daily life severely. What would you do?

After failure of supervised exercise training, revascularization should be considered. An endovascular-first approach is recommended for short iliac lesions and primary stenting should be preferred. In our patient, an optimal result after balloon angioplasty may be accepted in order to avoid the addition of antiplatelet therapy after stent implantation, with the entailed increase in bleeding risk.

Q27. Balloon angioplasty caused a dissection and stent implantation was required. Would you add antiplatelet therapy on top of OAC?

Adding antiplatelet therapy will increase the bleeding risk by at least 50% (from HAS-BLED score 3 to 4). Therefore, we may prefer not to add antiplatelet therapy if the angiographic result is optimal. Alternatively, either aspirin 75 – 100 mg/day or clopidogrel 75 mg/day may be added for one month after stent implantation.

Case 11

A 65-year-old man is addressed for daily life incapacitating claudication. A right SFA occlusion was diagnosed

6 months earlier. He received clopidogrel and atorvastatin and quit smoking. A supervised exercise programme was attempted, but the symptoms persisted with a walking distance ≤ 100 metres. Right and left ABIs were respectively 0.50 and 1.03. At DUS you confirm a 15 cm long occlusion of the distal right SFA, no iliac disease, patent popliteal artery but stenoses of the crural arteries. DUS also shows great saphenous veins of 4 mm diameter, usable for bypass.

Q28. How do you manage this patient?

The patient has severe claudication despite controlled risk factors, adherence to medical therapy and supervised exercise therapy over 6 months. Revascularization should be considered. Yet further preoperative imaging (in this case an angiography) is mandatory because of below-the-knee arterial stenoses.

Q29. Angiography shows a 15-cm occlusion of the SFA with minimal calcification and two large collaterals reconstituting the SFA at the adductor canal. The popliteal artery is patent with a 70% stenosis of the peroneal and posterior tibial arteries and a normal anterior tibial artery filling the dorsalis pedis with a complete pedal arch. What is your management strategy?

Primary stenting should be considered for SFA lesions $< 20 - 25$ cm in length. Considering the good antegrade flow, the absence of an occlusive lesion of the profunda and of the origin of the SFA with symptoms limited to claudication, an endovascular solution with a bare stent is preferred, without intervention on distal arteries. Drug-eluting balloons and drug-eluting stents may be considered as alternatives to bare-metal stents.

Q30. The SFA lesion is traversed with a 5-F catheter and straight hydrophilic guidewire and adequately stented. During follow-up, free walking distance improves significantly over 400 m. What kind of follow-up would you recommend?

Survey the patient frequently for symptoms, possibly after the postoperative exercise therapy programme, to ensure early detection of restenosis. Ultrasound imaging combined with ABI or toe-brachial index measurements is mandatory. DAPT may be useful for a short period of time.

Case 12

A 64-year-old woman seeks a consultation because of recurrent abdominal pain over the last several weeks, occurring mainly after eating. She has no weight loss, diarrhoea, constipation or loss of appetite. She has no chest pain on exertion. Her cardiovascular risk factors include hypertension and smoking (1 pack/day of cigarettes for the last 40 years). The clinical examination is unrevealing. Haemoglobin, electrolytes and plasma albumin levels are normal. Low-density lipoprotein cholesterol (LDL-C) is 155 mg/dL and high-density lipoprotein cholesterol (HDL-C) is 58 mg/dL. An abdominal CTA reveals diffuse moderate atherosclerosis of the abdominal aorta and 70% stenosis at the origin of the superior mesenteric artery (SMA), while the coeliac trunk

and inferior mesenteric artery show plaques with $< 30\%$ stenosis at their origin.

Q31. How would you manage this patient?

The presence of a significant stenosis of a single visceral artery to the bowel in a patient without weight loss makes the diagnosis of chronic mesenteric ischaemia unlikely, and an alternative diagnosis should be considered. In this case, an abdominal DUS with assessment of the mesenteric arteries and coeliac trunk is suitable to confirm the presence of a haemodynamically significant stenosis of the superior mesenteric arteries. The sensitivity can be improved by comparing pre- and post-prandial flows. Independent of the DUS findings, this patient is at high risk of cardiovascular events. Smoking cessation advice and support, single antiplatelet therapy (if not contraindicated) and statins (target LDL-C < 70 mg/dL) are indicated. Hypertension should be preferably managed by an ACE inhibitor or angiotensin receptor blocker (ARB).

Q32. The DUS confirms the 70% stenosis of the SMA with no other significant stenosis of the visceral arteries. After referring the patient to a gastroenterologist, the diagnosis of irritable bowel syndrome is made. Your resident challenges you by asking how you would manage the patient if she had weight loss and food aversion associated with severe SMA and coeliac trunk stenoses.

In this scenario, the ischaemic origin of the pain would be highly likely and revascularization should be considered in addition to best medical therapy. The SMA should be considered the primary target for revascularization and stenting which, if feasible, is preferred over surgery.

Case 13

A 75-year-old man is admitted to the emergency department because of acute and severe abdominal pain. The patient has a history of hypertension. Cardiac auscultation finds irregular beats, and the ECG confirms atrial fibrillation.

Q33. What is the typical clinical triad suggesting embolic occlusion of the SMA?

The clinical triad combines severe abdominal pain without peritonitis, bowel emptying, and often both vomiting and diarrhoea which are a potential source of embolism.

Q34. Is there any cardiovascular biomarker useful for this patient?

D-dimer is an excellent exclusion test, since virtually all patients with acute occlusion of the SMA have an elevated D-dimer level within the first 24 hours after the event.

Q35. The patient has all three symptoms and signs of an embolus to the SMA. He is in severe pain but the abdomen is not tense, there is no peritonitis, and two hours ago, when he fell ill, he had both vomiting and diarrhoea. The D-dimer level is a 1500 pg/mL. You consider an imaging technique to verify a possible occlusion of the SMA. Which is the preferred technique?

CTA is the preferred imaging technique. It should be performed first without contrast, then during the arterial phase (with slices ≤ 1 mm) and during the venous phase.

Q36. The patient has renal failure with an estimated glomerular filtration rate of 28 mL/min. The radiologist questions if it is reasonable to perform a CTA. How do you respond, and is there a less invasive method to rule out the diagnosis?

DUS is often not useful in the acute setting of a painful abdomen, since the embolus is often distal. MRA is often not available in the emergency setting. The patient should be referred for a CTA (along with a hydration protocol) since the management success is time dependent.

Q37. CTA shows an occlusion in the SMA, 5 cm distal from the origin of the aorta. It looks like an embolus with contrast around it, but no contrast distal to this occlusion. The intestines look normal during the venous phase, and no other pathology is seen. What are the therapeutic options? If an intervention is necessary, how urgent it is?

Urgent management is mandatory. The embolus can either be removed by an endovascular operation, such as an aspiration embolectomy, or through an open embolectomy of the SMA through a laparotomy. Both these methods are associated with similar outcomes.

Q38. You decide to perform an endovascular procedure in the hybrid operating room, and you remove the clot through an aspiration embolectomy under local anaesthesia. The patient is rapidly relieved with cessation of his abdominal pain. On examination, you find that the abdomen is a little painful, but not tense and without signs of peritonitis. Is an exploratory laparotomy necessary?

Systematic bowel inspection is not necessary, but if not performed, regular assessments of the patient and the abdomen are necessary within the first 48 – 72 hours.

Q39. This patient was discharged at day 4, without laparotomy. Pre-discharge ECG shows sinus rhythm. Would you prescribe any medication?

Given the embolic nature of the acute mesenteric ischaemia and the identification of atrial fibrillation at presentation, oral anticoagulation is indicated. Pending on renal function, NOACs or VKA antagonists are recommended.

Case 14

A 71-year-old diabetic male patient with a history of mild claudication presents with recurrent chest pain on light exertion. Systolic blood pressures in the left and right arm are 90 and 130 mmHg, respectively. Resting ECG is normal. LVEF is 40%. ABI is 0.70 on the left and 1.10 on the right. DUS shows > 90% proximal left subclavian artery stenosis. Coronary angiography reveals proximal triple-vessel disease. Aortic arch angiography confirms a 90% ostial left subclavian stenosis. The Heart Team considers CABG.

Q40. Which vascular conduits can be considered for CABG?

Arterial grafts should be preferred whenever possible. In the presence of LEAD, sparing the great saphenous vein should be considered, especially in the left leg, for potential future use for peripheral revascularization, and for avoidance of wound healing complications after harvesting.

Q41. How should the asymptomatic subclavian artery stenosis be managed?

The left internal mammary artery (LIMA) is the conduit of choice, especially for revascularization of the left anterior descending (LAD) artery. There are two options: (1) revascularization of the proximal subclavian artery stenosis prior to CABG (preferably stenting if the anatomy is favourable); or (2) LIMA can be used as a free graft conduit (aorta-LAD bypass) without prior intervention on the subclavian artery, depending on the number of calcific lesions of the ascending aorta in this patient with multisite artery disease.

Reference

Aboyans V, Ricco J-B, Bartelink M-LEL, Björck M, Brodmann M, Cohnert T, Collet J-P, Czerny M, De Carlo M, Debus S, Espinola-Klein C, Kahan T, Kownator S, Mazzolai L, Naylor AR, Roffi M, Röther J, Sprynger M, Tendera M, Tepe G, Venermo M, Vlachopoulos C, Desormais I. 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS). Document covering atherosclerotic disease of extracranial carotid and vertebral, mesenteric, renal, upper and lower extremity arteries. Endorsed by: the European Stroke Organization (ESO). The Task Force for the Diagnosis and Treatment of Peripheral Arterial Diseases of the European Society of Cardiology (ESC) and of the European Society for Vascular Surgery (ESVS). *Eur Heart J* 2017: <https://academic.oup.com/eurheartj/article-lookup/doi/10.1093/eurheartj/ehx095>

Appendix

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¹ Representing the European Society for Vascular Surgery (ESVS)

² Representing the European Stroke Organisation (ESO)

All other members represent the European Society of Cardiology (ESC)