FRONTLINE VASCULAR CARE 2025

SPECTRUM VASCULAR & GENERAL SURGERY 光谱外科与血管专科

FARRER PARK HOSPITAL

Peripheral Arterial Disease: Diagnosis and Management

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2019

CLINICAL PRACTICE GUIDELINE DOCUMENT

Global Vascular Guidelines on the Management of Chronic Limb-Threatening Ischemia

2017

Editor's Choice — 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with the European Society for Vascular Surgery (ESVS)

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2023

The intersocietal IWGDF, ESVS, SVS guidelines on peripheral artery disease in people with diabetes mellitus and a foot ulcer

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CLINICAL PRACTICE GUIDELINE DOCUMENT

Editor's Choice – European Society for Vascular Surgery (ESVS) 2024 Clinical Practice Guidelines on the Management of Asymptomatic Lower Limb Peripheral Arterial Disease and Intermittent Claudication ☆

CLINICAL PRACTICE GUIDELINE

2024 ACC/AHA/AACVPR/APMA/ABC/SCAI/SVM/SVN/SVS/SIR/VESS Guideline for the Management of Lower Extremity Peripheral Artery Disease

2024

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2024

ESC European Society of Cardiology

European Heart Journal (2024) **45**, 3538–3700
https://doi.org/10.1093/eurheartj/ehae179

ESC GUIDELINES

2024 ESC Guidelines for the management of peripheral arterial and aortic diseases

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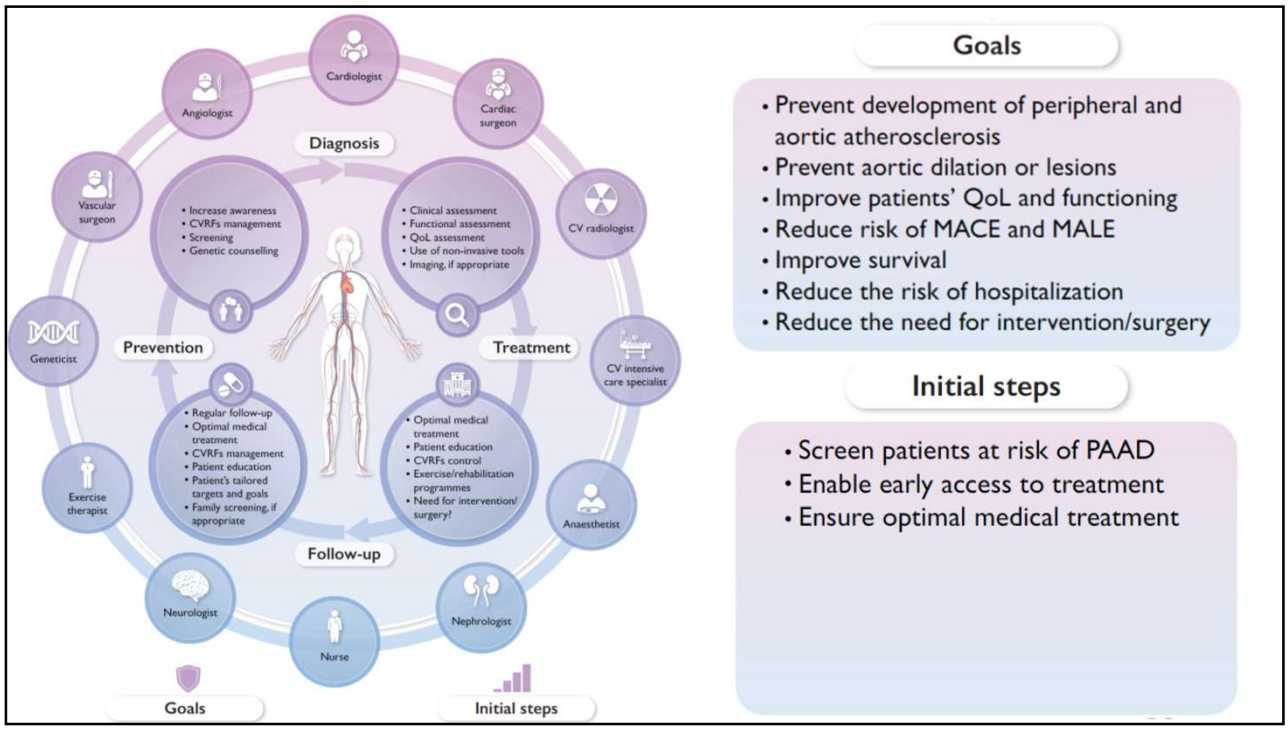
Cardiologist
Cardiac surgeon
CV radiologist
CV intensive care specialist
Anaesthetist
Nephrologist
Nurse
Neurologist
Exercise therapist
Geneticist
Vascular surgeon
Angiologist
Diagnosis
Treatment
Follow-up
Prevention
• Increase awareness
• CVRFs management
• Screening
• Genetic counselling
• Clinical assessment
• Functional assessment
• QoL assessment
• Use of non-invasive tools
• Imaging, if appropriate
• Optimal medical treatment
• Patient education
• CVRFs control
• Exercise/rehabilitation programmes
• Need for intervention/surgery?
• Regular follow-up
• Optimal medical treatment
• CVRFs management
• Patient education
• Patient's tailored targets and goals
• Family screening, if appropriate
Goals
Initial steps
Goals
• Prevent development of peripheral and aortic atherosclerosis
• Prevent aortic dilation or lesions
• Improve patients' QoL and functioning
• Reduce risk of MACE and MALE
• Improve survival
• Reduce the risk of hospitalization
• Reduce the need for intervention/surgery
Initial steps
• Screen patients at risk of PAAD
• Enable early access to treatment
• Ensure optimal medical treatment

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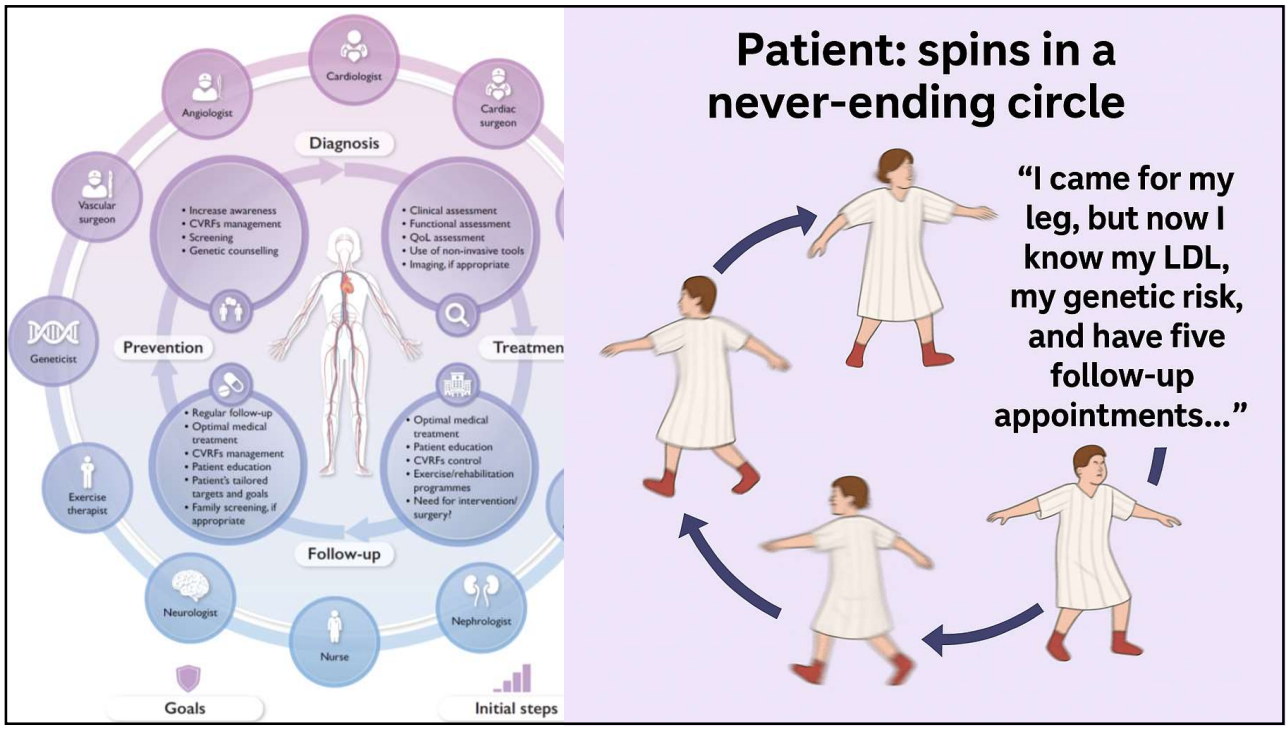
Cardiologist
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Exercise therapist
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Vascular surgeon
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• Imaging, if appropriate
• Optimal medical treatment
• Patient education
• CVRFs control
• Exercise/rehabilitation programmes
• Need for intervention/surgery?
• Regular follow-up
• Optimal medical treatment
• CVRFs management
• Patient education
• Patient's tailored targets and goals
• Family screening, if appropriate
Goals
Initial steps
Patient: spins in a never-ending circle
"I came for my leg, but now I know my LDL, my genetic risk, and have five follow-up appointments..."

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HANDOUTS ON WEBSITE
https://spectrum-surgery.com

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PERIPHERAL ARTERIAL DISEASE

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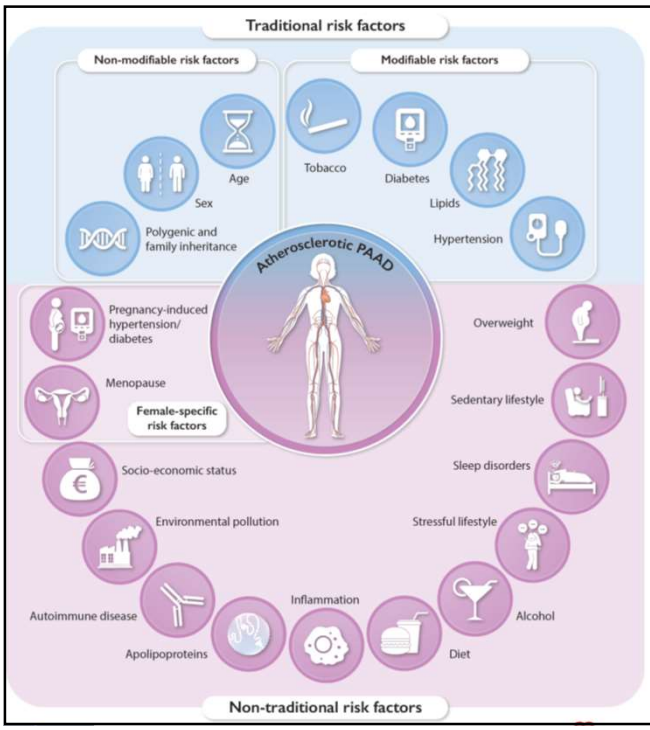

PAD Risk factors

Guideline Directed Medical Therapy (GDMT) / Best Medical Therapy

- Antithrombotic therapy
  - Single Antiplatelet
  - Dual Pathway Inhibition (DPI)
    - Aspirin + Rivaroxaban 2.5 mg bd
- Lipid targets LDL < 1.4 mmol/L or 55 mg/dL
  - Statins / Ezetimbe
  - PCSK9 inhibitors
  - siRNA
- Manage modifiable CV risk factors
  - OHGAs/Insulin/CGM
  - BP meds (ARB)
- Lifestyle modification
  - Smoking cessation
  - Diet (Mediterranean)
  - Exercise

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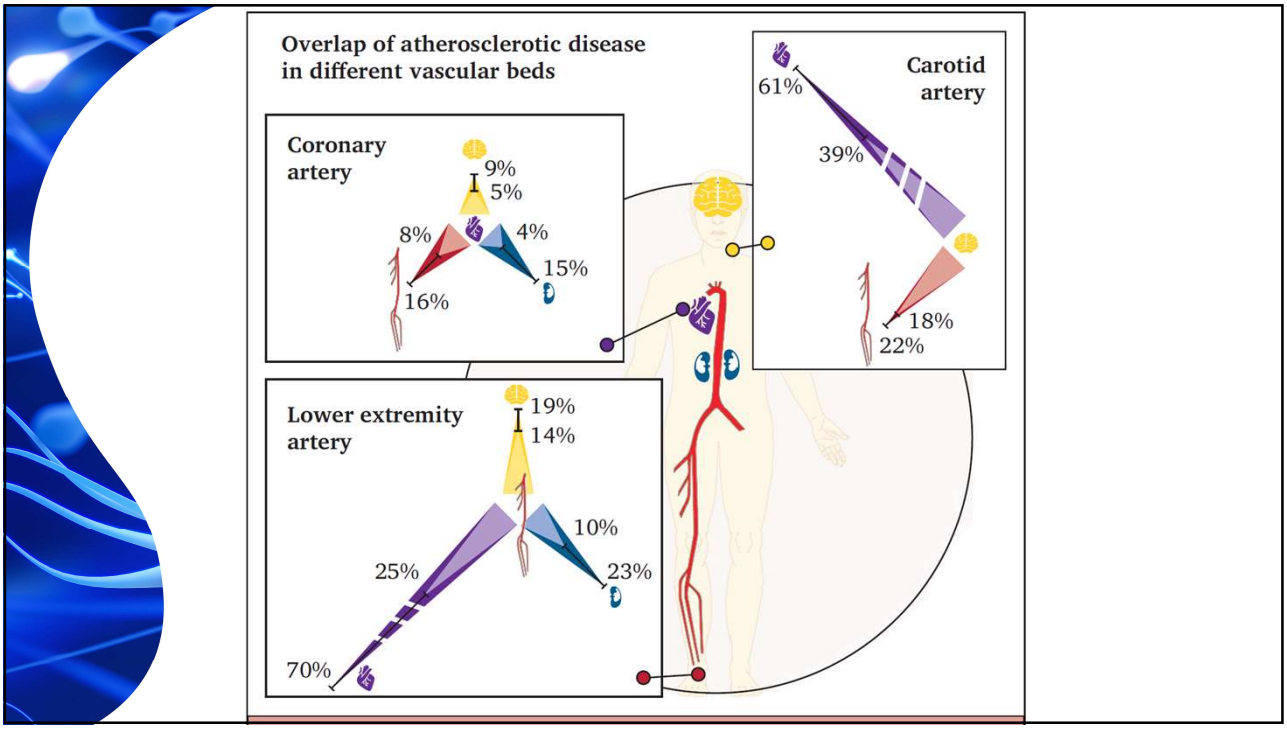

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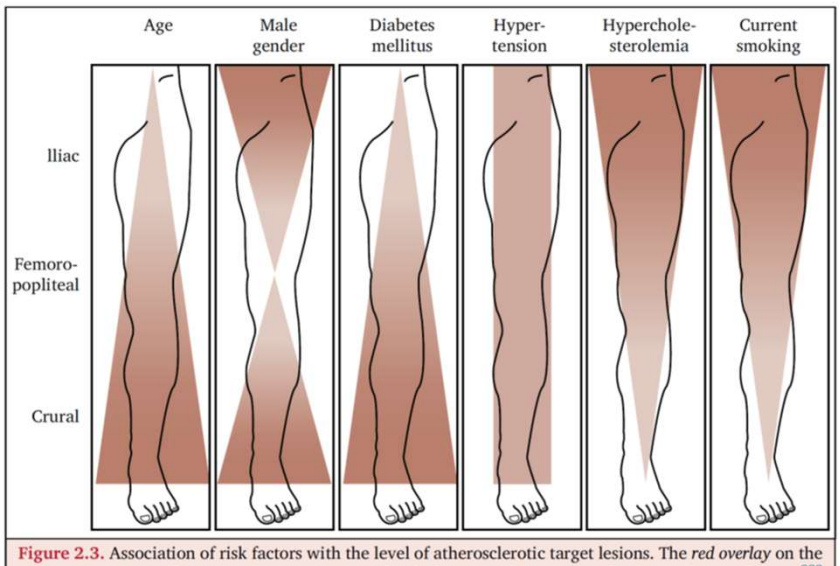

Figure 2.3. Association of risk factors with the level of atherosclerotic target lesions. The *red overlay* on the anatomic cartoon illustrates the association of risk factor with patterns of atherosclerotic disease.[223] (Reprinted from Diehm N, Shang A, Silvestro A, Do DD, Dick F, Schmidli J, et al. Association of cardiovascular risk factors with pattern of lower limb atherosclerosis in 2659 patients undergoing angioplasty. Eur J Vasc Endovasc Surg 2006;31:59-63.)

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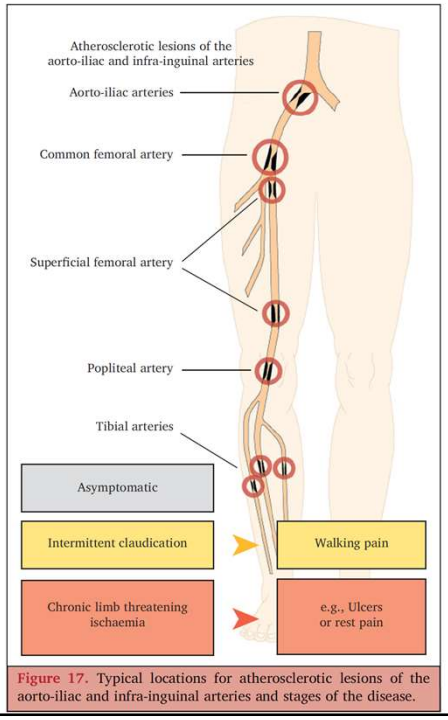

Figure 17. Typical locations for atherosclerotic lesions of the aorto-iliac and infra-inguinal arteries and stages of the disease.

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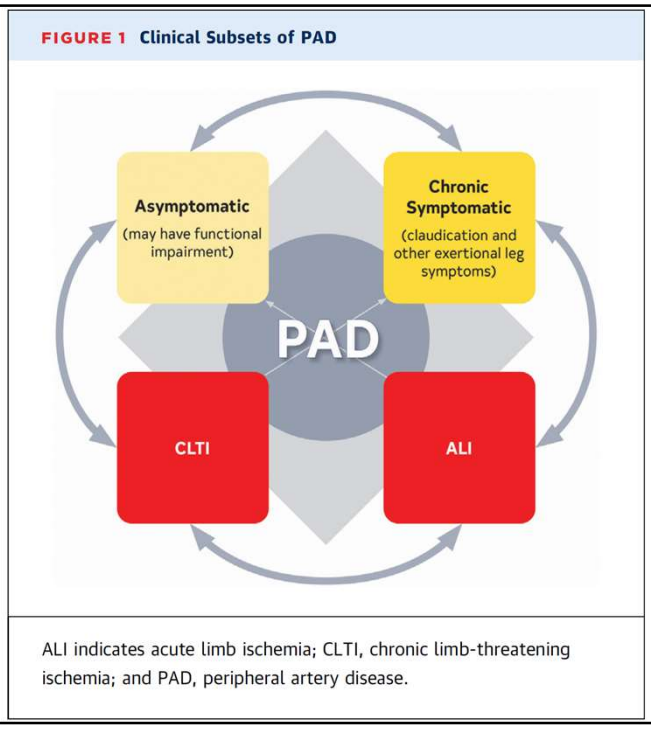

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Asymptomatic PAD

- May self-limit activity to remain below ischemic threshold to avoid leg pain.
- Majority of asymptomatic PAD develop symptoms during an objective walking test despite not reporting any exertional leg symptoms
- Functional impairment comparable to patients with claudication (chronic symptomatic)
- Associated with increased risk of major adverse cardiac events, including mortality

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What is intermittent claudication?

Table 4. Classical symptoms of intermittent claudication, modified from Rose.[81]

Exertional leg pain that:
Does not begin at rest
Involves the calf, thigh and or buttock
Causes the patient to reduce their walking speed or stop walking
Resolves within 10 minutes of rest

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HISTORY

Family history of CVD (coronary artery disease, cerebrovascular disease, aortic aneurysm, LEAD), and premature CVD (fatal or non-fatal CVD event or/and established diagnosis of CVD in first degree male relatives before 55 years or female relatives before 65 years).
Personal history of: • Hypertension • Diabetes • Dyslipidaemia • Smoking (present and/or past), passive smoking exposure • Prior CVD • Chronic kidney disease • Sedentary life • Dietary habits • History of cancer radiation therapy • Psycho-social factors
Transient or permanent neurological symptoms
Arm exertion pain, particularly if associated with dizziness or vertigo
Symptoms suggesting angina, dyspnoea
Abdominal pain, particularly if related to eating and associated with weight loss
Walking impairment/claudication: • type: fatigue, aching, cramping, discomfort, burning • location: buttock, thigh, calf, or foot • timing: triggered by exercise, uphill rather than downhill, quickly relieved with rest; chronic • distance
Lower limb pain (including foot) at rest, and evolution at upright or recumbent position
Poorly healing wounds of the extremities
Physical activity assessment: • Functional capacity and causes of impairment
Erectile dysfunction

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CVD = cardiovascular disease; LEAD = lower extremity artery disease.

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TABLE 7 Alternative Diagnosis for Leg Pain or Claudication Not Related to PAD (Normal Physiological Testing)

Condition	Location	Characteristic	Effect of Exercise	Effect of Rest	Effect of Position	Other Characteristics
Hip arthritis	Lateral hip, thigh	Aching discomfort	After variable degree of exercise	Not quickly relieved	Improved when not bearing weight	Symptoms variable; history of degenerative arthritis
Foot/ankle arthritis	Ankle, foot, arch	Aching pain	After variable degree of exercise; may also be present at rest	Not quickly relieved	May be relieved by not bearing weight	Symptoms variable
Nerve root compression	Radiates down leg	Sharp lancinating pain	Induced by sitting, standing, or walking (variable)	Often present at rest	Improved by change in position	History of back problems; worse with sitting; relief when supine or standing
Spinal stenosis (eg, degenerative disc disease or tumor)	Often bilateral buttocks, posterior leg	Pain and weakness	May mimic claudication	Variable relief but can take a long time to recover	Relief by lumbar spine flexion	Worse with standing and extending spine
Symptomatic popliteal (Baker's) cyst	Behind knee, down calf	Swelling, tenderness	With exercise	Also present at rest	None	Not intermittent
Venous claudication	Entire leg, worse in calf	Tight, bursting pain	After walking	Subsides slowly	Relief speeded by leg elevation	History of iliofemoral deep vein thrombosis; edema; signs of venous stasis
Chronic compartment syndrome	Calf muscles	Tight, bursting pain	After strenuous exercise (jogging)	Subsides very slowly	Relief with rest	Typically heavy muscled athletes

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Table 5. Potential differential diagnostic alternatives causing lower limb pain, that may either present with intermittent claudication symptoms or be misclassified as intermittent claudication.

Condition	Location	Characteristics	Effect of exercise	Effect of rest	Effect of position
Baker's cyst	Behind knee	Swelling behind knee and distally. When ruptured, tenderness and calf pain	Worsening of symptoms	None	None
Deep vein thrombosis and venous claudication caused by chronic venous obstruction	Entire lower limb	Ipsilateral oedema, tightness, worse in calf	Worsening of symptoms	Subsides slowly	Relief by elevation
Thromboangiitis obliterans – Buerger's disease	Often bilateral	Young age smokers, pain (most commonly) located in the foot	Worsening of symptoms	Relief with rest	Worse with elevation
Spinal cord stenosis	Often bilateral buttock and lower limbs	Pain, weakness, numbness	May mimic claudication	Variable relief and may take a long time to recover	Relief with lumbar spine flexion
Nerve root compression	Radiates down along the posterior aspect of the lower limb	Sharp pain	Induced mainly by standing and walking	Present at rest and on sitting	Improved by change in position
Hip arthritis	Ipsilateral lower limb – thigh	Pain and discomfort	Worse with exercise	Relief but it takes time	Less symptoms when not weight bearing
Foot or ankle arthritis	Ankle or foot	Pain and discomfort	Worse with exercise	Relief but it takes time	Fewer symptoms when not weight bearing or related to activity level
Chronic exertional compartment syndrome	Lower limb	Pain, swelling, disability	Worse with exercise	Pain even at rest, relief takes time	Worsening or improvement according to position
Popliteal artery entrapment syndrome	Lower limb	Cold feet after exercise Tingling or burning in calf Numbness in the calf area	Worse with exercise	Relief with rest	Flexion of foot results in worsening of symptoms
Cystic adventitial degeneration of the popliteal artery	Calf, always unilateral	Exercise induced pain and discomfort, most common in younger patients	Worse with exercise	Relief with rest	None
Lymphangitis or cellulitis	Entire lower limb, mostly in calf	Ipsilateral pitting oedema, worse in calf	Heaviness	None	None

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Table 2.2 • Rutherford classification of the severity of PAD

Grade	Category	Description
0	0	Asymptomatic
I	1	Mild claudication
I	2	Moderate claudication
I	3	Severe claudication
II	4	Ischaemic rest pain
II	5	Minor tissue loss
III	6	Major tissue loss

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Rutherford classification for chronic limb ischaemia 1997

is preferred. Walking for 5 minutes at a treadmill speed of 2 mph (176 ft/min) is roughly equivalent to walking three blocks (900 ft) at average speed.

	3	Se
II*	4	Isc
III*	5	M
	6	M

AP, Ankle pressure; *PVR*, pul
*Grades II and III, categories
†Five minutes at 2 mph on a

Convert units

Length

900 = 274.32

Foot Meter

FORMULA for an approximate result, divide the length value by 3.2808399

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Table 8. The Fontaine and the revised Rutherford peripheral arterial disease classifications.

Fontaine		Rutherford			
Class	**Symptoms**	**Grade**	**Category**	**Symptoms**	**Objective criteria**
Stage I	Asymptomatic	0	0	Asymptomatic	Normal treadmill or reactive hyperaemia test
Stage II	Claudication pain in limb IIA: Claudication at a distance ≥ 200 m	I	1	Mild claudication	Completes treadmill exercise; AP after exercise > 50 mmHg but at least 20 mmHg lower than resting value
	IIB: Claudication at a distance < 200 m		2	Moderate claudication	Between categories 1 and 3
			3	Severe claudication	Cannot complete standard treadmill exercise, and AP after exercise < 50 mmHg
Stage III	Rest pain, mostly in the feet	II	4	Ischaemic rest pain	Resting AP < 40 mmHg, flat or barely pulsatile ankle or metatarsal PVR; TP <30 mmHg
Stage IV	Ulceration and or gangrene of the limb	III	5	Minor tissue loss – non-healing ulcer, focal gangrene with diffuse pedal ischaemia	Resting AP < 60 mmHg, ankle or metatarsal PVR flat or barely pulsatile; TP < 40 mmHg
			6	Major tissue loss – extending above transmetatarsal level, functional foot no longer salvageable	Same as category 5

AP = ankle pressure; PVR = pulse volume recordings; TP = toe pressure.

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Physical examination

- T – active infection?
- BP
- HR – ? AF ? PPM/AICD/CRTD
- LL
  - Tissue loss: Ulcer, Gangrene (wet/dry), New amputation wound
  - Cold, Trophic skin changes
  - Mottling / Paraesthesia / Paralysis
- Peripheral pulses
  - LL
  - UL
- AAA
- Renal bruit
- Carotid pulses/bruit

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	Perf co
1. Wash your hands	
2. Introduce yourself to the patient and explain what you are about to do	
3. Palpate carotid pulse for rate and rhythm	
4. Listen for carotid bruit	
5. Check bilateral arm blood pressure	
6. Inspect upper limbs for muscle atrophy, tissue loss, embolic phenomenon, capillary refill	
7. Palpate bilateral brachial and radial pulses	
8. Cardiac auscultation for arrhythmias and murmurs	
9. Expose abdomen	
10. Palpate for pulsatile abdominal mass	
11. Auscultate abdomen for renal and other bruits	
12. Inspect lower limbs for gangrene/ tissue loss/ pallor	
13. Palpate feet for difference in skin temperature	
14. Elevate limb and check for elevation pallor and dependent rubor	
15. Palpate for bilateral femoral, popliteal, posterior tibial and dorsalis pedis pulses	
16. Ascultate femoral arteries for bruits	
17. Suggest using Doppler to check for pulses and ABI	

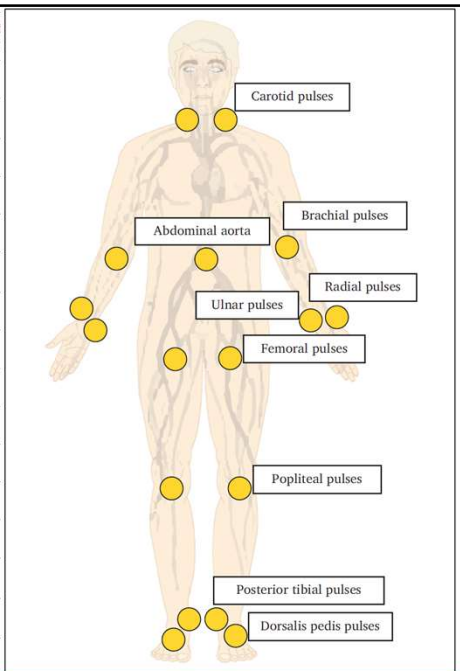

Figure 5. Pulse examination of patients with lower extremity peripheral arterial disease.

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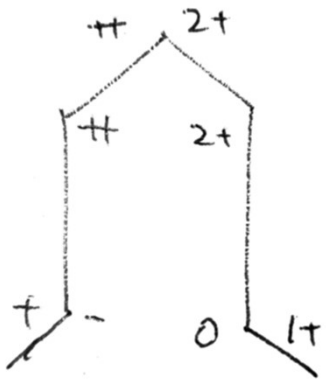
Rating of LL extremity pulses?



Rating of Pulses	Clinical Finding
0	Absent
1	Diminished
2	Normal
3	Bounding

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Investigations

- FBC – infection, anaemia, ?polycythaemia
- RP – renal impairment
- LFT / Lipid panel – dyslipidaemia requiring high intensity statins
- PT/PTT GXM → transfusion required?
- CXR
- ECG, CE/TnT
- TTE
- ABPI/TBI
- Toe pressure
- US Arterial Duplex LL
  - Confirm diagnosis, determine anatomical location and degree of stenosis
  - Routine surveillance after lower limb bypass, stenting
- US LL / UL vein mapping
- CT peripheral angiogram for aortoiliac / CFA disease
- MRA – beware nephrogenic systemic fibrosis in CRF patients
- Laser Doppler/TCOM
- ? XR/MRI tro OM

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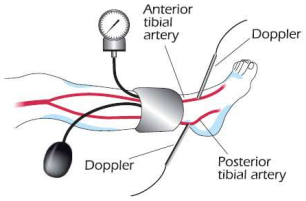
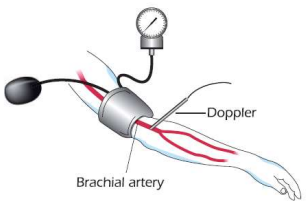
ABPI

2. How to measure the ABI?
In supine position, with cuff placed just above the ankle, avoiding wounded zones. After a 5–10 minute rest, the SBP is measured by a Doppler probe (5–10 MHz) on the posterior and the anterior tibial (or dorsal pedis) arteries of each foot and on the brachial artery of each arm. Automated BP cuffs are mostly not valid for ankle pressure and may display overestimated results in case of low ankle pressure. The ABI of each leg is calculated by dividing the highest ankle SBP by the highest arm SBP.





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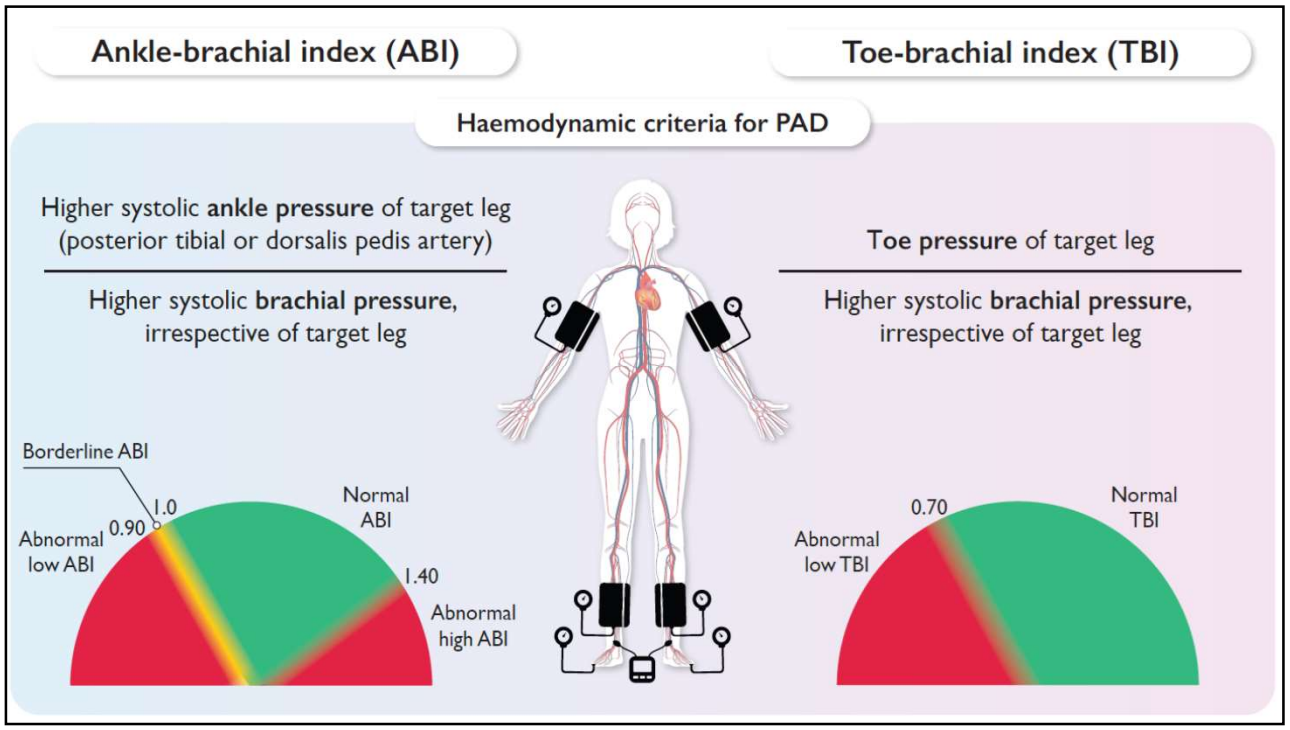
Ankle-brachial index (ABI)
Toe-brachial index (TBI)
Haemodynamic criteria for PAD
Higher systolic ankle pressure of target leg (posterior tibial or dorsalis pedis artery)
Higher systolic brachial pressure, irrespective of target leg
Toe pressure of target leg
Higher systolic brachial pressure, irrespective of target leg
Borderline ABI
1.0
0.90
Abnormal low ABI
Normal ABI
1.40
Abnormal high ABI
0.70
Abnormal low TBI
Normal TBI

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Management

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Guideline Based Medical Therapy

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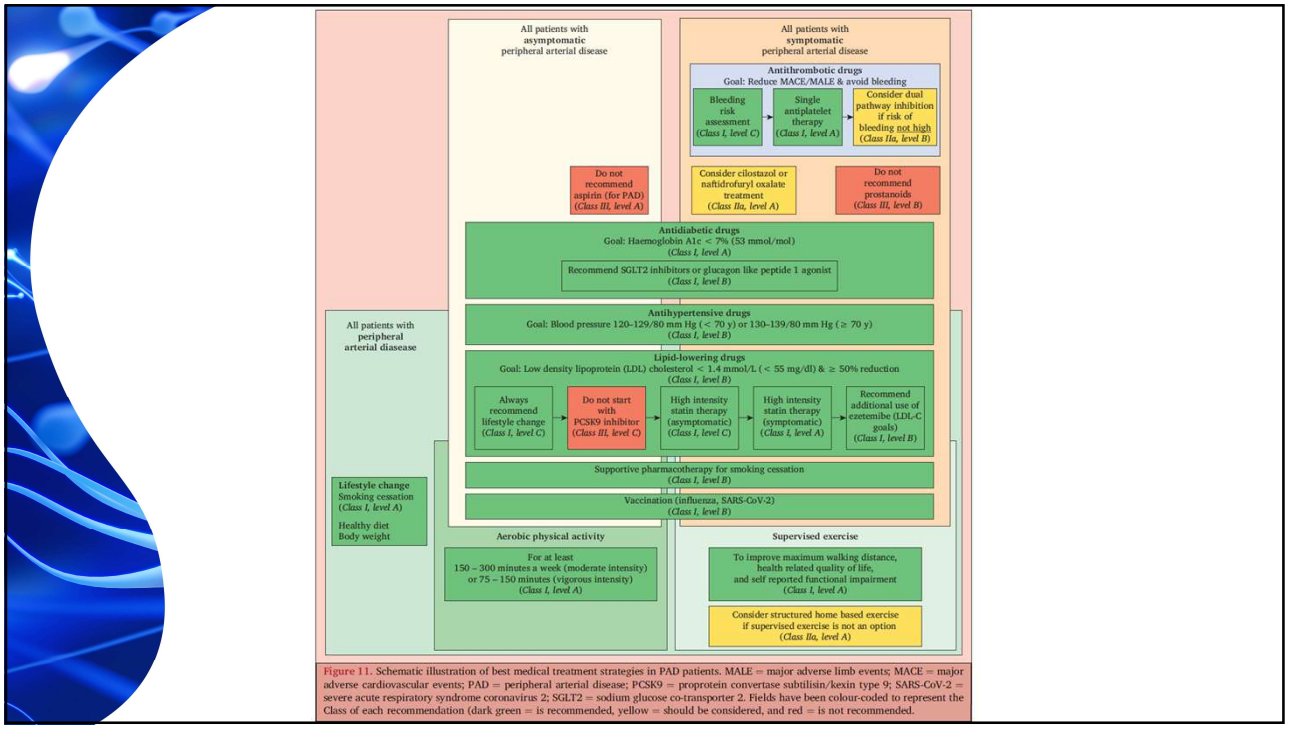
All patients with asymptomatic peripheral arterial disease
All patients with symptomatic peripheral arterial disease
Antithrombotic drugs
Goal: Reduce MACE/MALE & avoid bleeding
Bleeding risk assessment (Class I, level C)
Single antiplatelet therapy (Class I, level A)
Consider dual pathway inhibition if risk of bleeding not high (Class IIa, level B)
Do not recommend aspirin (for PAD) (Class III, level A)
Consider cilostazol or naftidrofuryl oxalate treatment (Class IIa, level A)
Do not recommend prostanoids (Class III, level B)
Antidiabetic drugs
Goal: Haemoglobin A1c < 7% (53 mmol/mol) (Class I, level A)
Recommend SGLT2 inhibitors or glucagon like peptide 1 agonist (Class I, level B)
All patients with peripheral arterial disease
Antihypertensive drugs
Goal: Blood pressure 120–129/80 mm Hg (< 70 y) or 130–139/80 mm Hg (≥ 70 y) (Class I, level B)
Lipid-lowering drugs
Goal: Low density lipoprotein (LDL) cholesterol < 1.4 mmol/L (< 55 mg/dl) & ≥ 50% reduction (Class I, level B)
Always recommend lifestyle change (Class I, level C)
Do not start with PCSK9 inhibitor (Class III, level C)
High intensity statin therapy (asymptomatic) (Class I, level C)
High intensity statin therapy (symptomatic) (Class I, level A)
Recommend additional use of ezetemibe (LDL-C goals) (Class I, level B)
Supportive pharmacotherapy for smoking cessation (Class I, level B)
Vaccination (influenza, SARS-CoV-2) (Class I, level B)
Lifestyle change
Smoking cessation (Class I, level A)
Healthy diet
Body weight
Aerobic physical activity
For at least 150 – 300 minutes a week (moderate intensity) or 75 – 150 minutes (vigorous intensity) (Class I, level A)
Supervised exercise
To improve maximum walking distance, health related quality of life, and self reported functional impairment (Class I, level A)
Consider structured home based exercise if supervised exercise is not an option (Class IIa, level A)
Figure 11. Schematic illustration of best medical treatment strategies in PAD patients. MALE = major adverse limb events; MACE = major adverse cardiovascular events; PAD = peripheral arterial disease; PCSK9 = proprotein convertase subtilisin/kexin type 9; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; SGLT2 = sodium glucose co-transporter 2. Fields have been colour-coded to represent the Class of each recommendation (dark green = is recommended, yellow = should be considered, and red = is not recommended.

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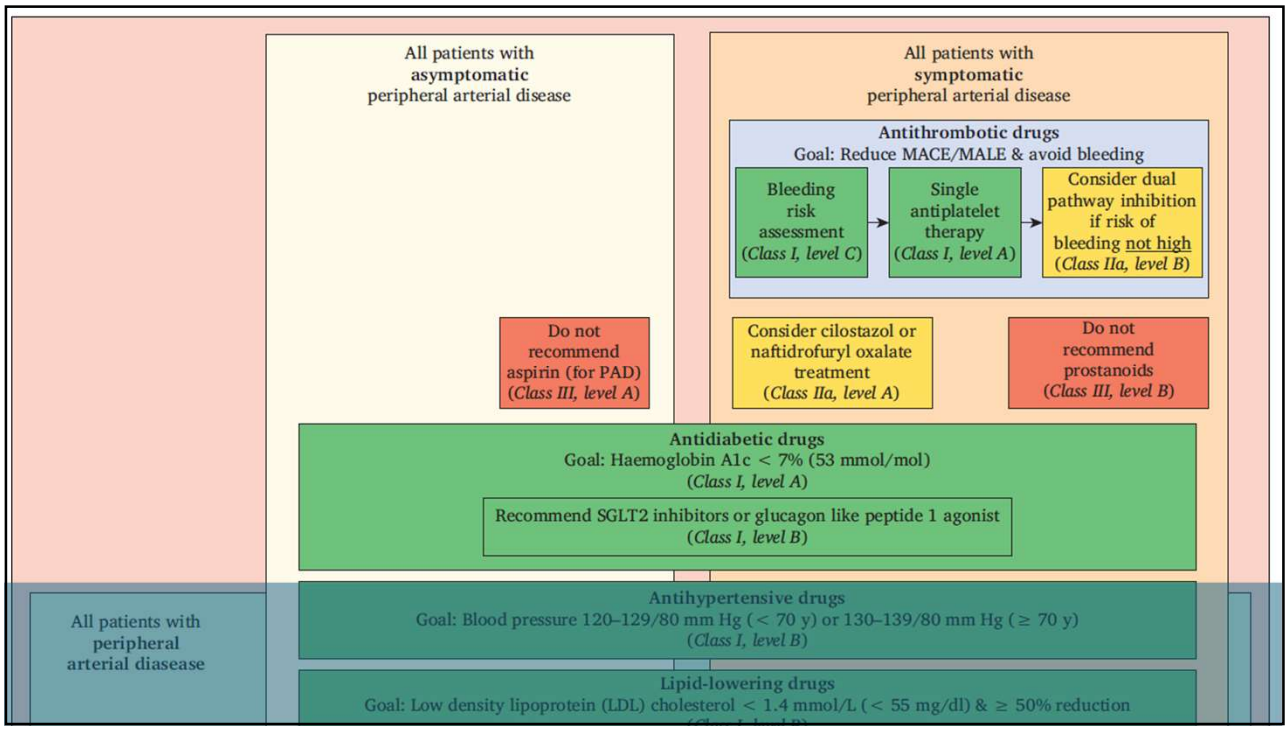

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Semaglutide and walking capacity in people with symptomatic peripheral artery disease and type 2 diabetes (STRIDE): a phase 3b, double-blind, randomised, placebo-controlled trial

Marc P Bonaca, MD [a] · Andrei-Mircea Catarig, MD [b] · Prof Kim Houlind, MD [c,d] · Prof Bernhard Ludvik, MD [e] · Prof Joakim Nordanstig, MD PhD [f] · Chethana Kalmady Ramesh, MSc [g] · et al. Show more

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Press Releases

Novo Nordisk A/S: Ozempic® receives EU recommendation in peripheral arterial disease, cementing the broad benefits of semaglutide for people with type 2 diabetes and comorbidities

June 24, 2025 10 min read

STRIDE trial achieved its primary endpoint, with semaglutide 1.0 mg demonstrating a superior and clinically meaningful improvement of 13% in maximum walking distance and a mean treatment difference of 39.9 meters on a steep (12%) incline, compared to placebo at Week 52[1].

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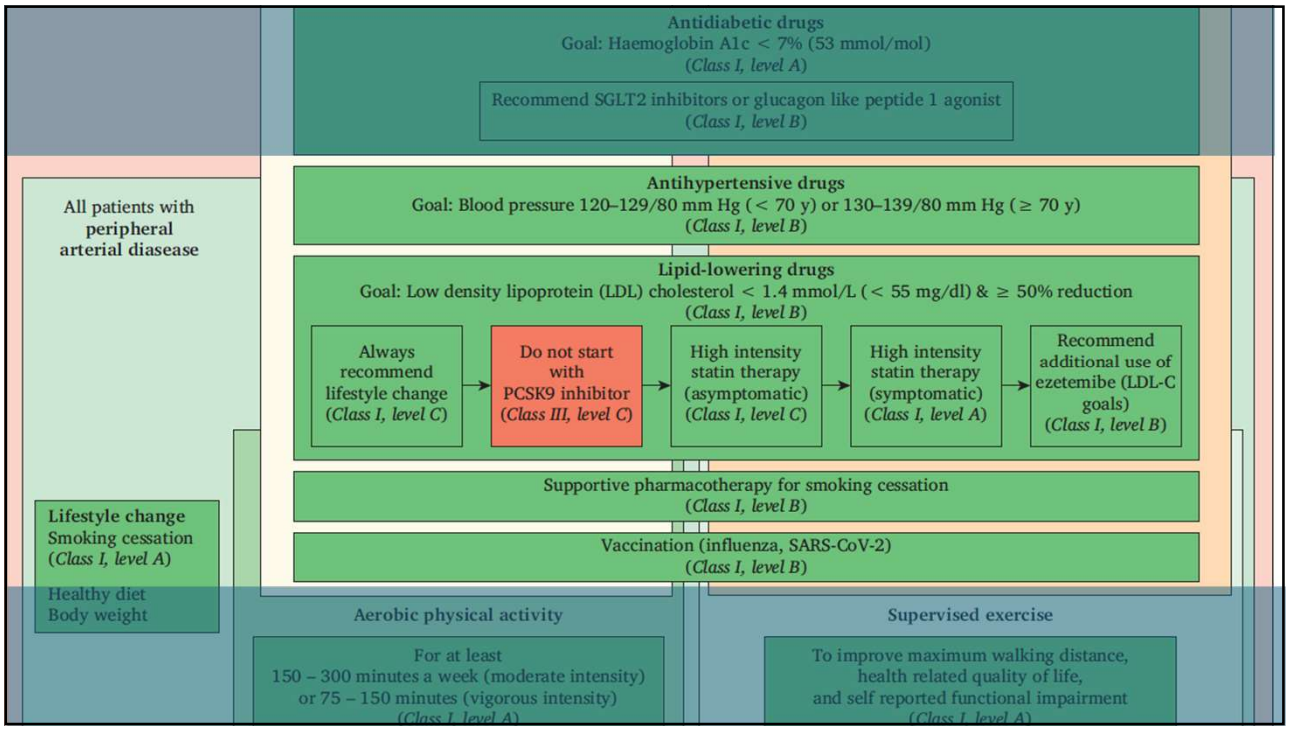

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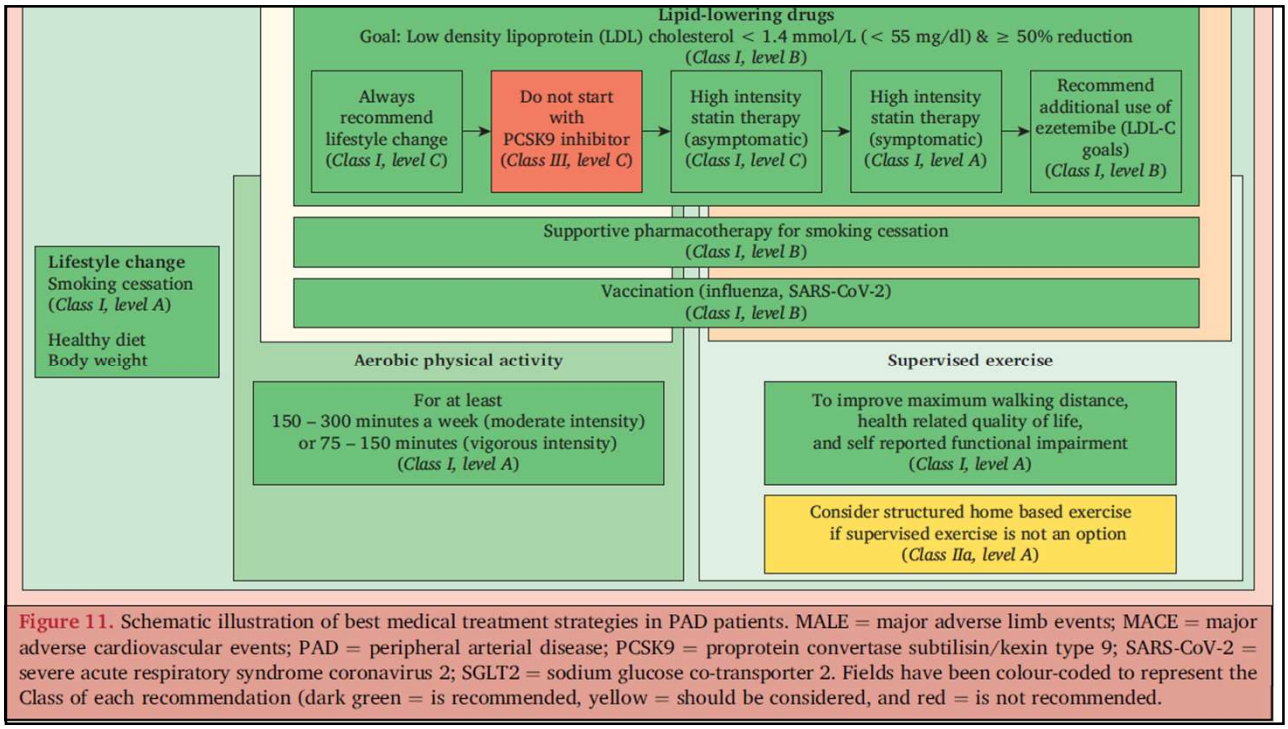

Figure 11. Schematic illustration of best medical treatment strategies in PAD patients. MALE = major adverse limb events; MACE = major adverse cardiovascular events; PAD = peripheral arterial disease; PCSK9 = proprotein convertase subtilisin/kexin type 9; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; SGLT2 = sodium glucose co-transporter 2. Fields have been colour-coded to represent the Class of each recommendation (dark green = is recommended, yellow = should be considered, and red = is not recommended.

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Revasc for Asymptomatic PAD?

COR	LOE	RECOMMENDATIONS
2a	B-NR	1. In patients with asymptomatic PAD, it is reasonable to perform revascularization procedures (endovascular or surgical) to reconstruct diseased arteries if needed for the safety, feasibility, or effectiveness of other procedures (eg, transfemoral aortic valve replacement, mechanical circulatory support, endovascular aortic aneurysm repair).[1-8]
3: Harm	B-NR	2. In patients with asymptomatic PAD, revascularization procedures (endovascular or surgical) should not be performed solely to prevent progression of disease.[9-16]

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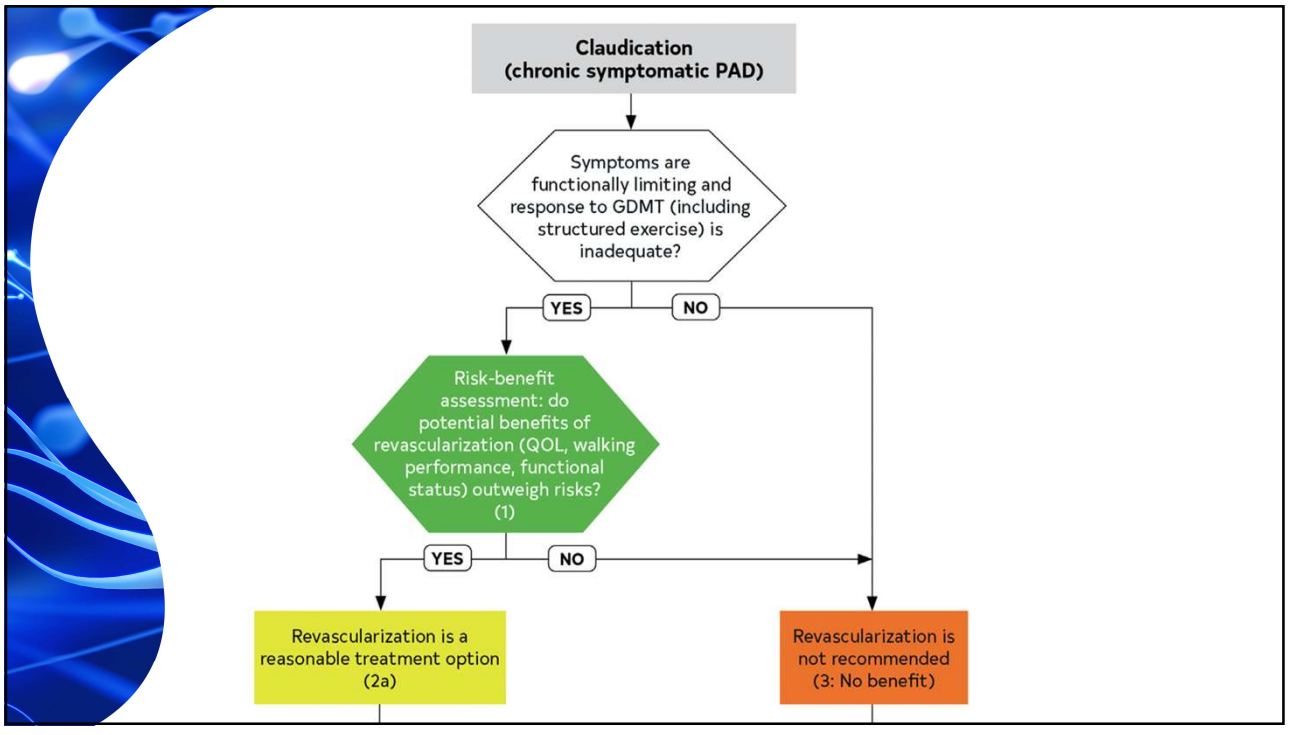

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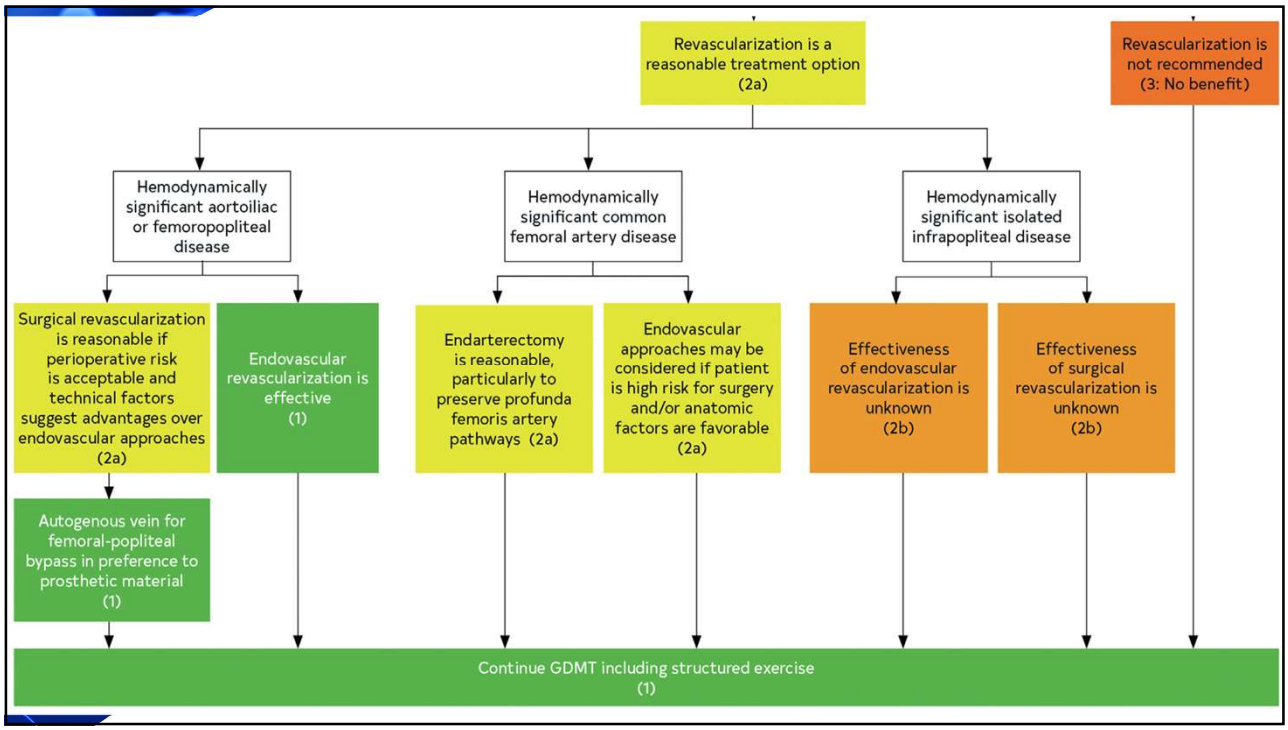
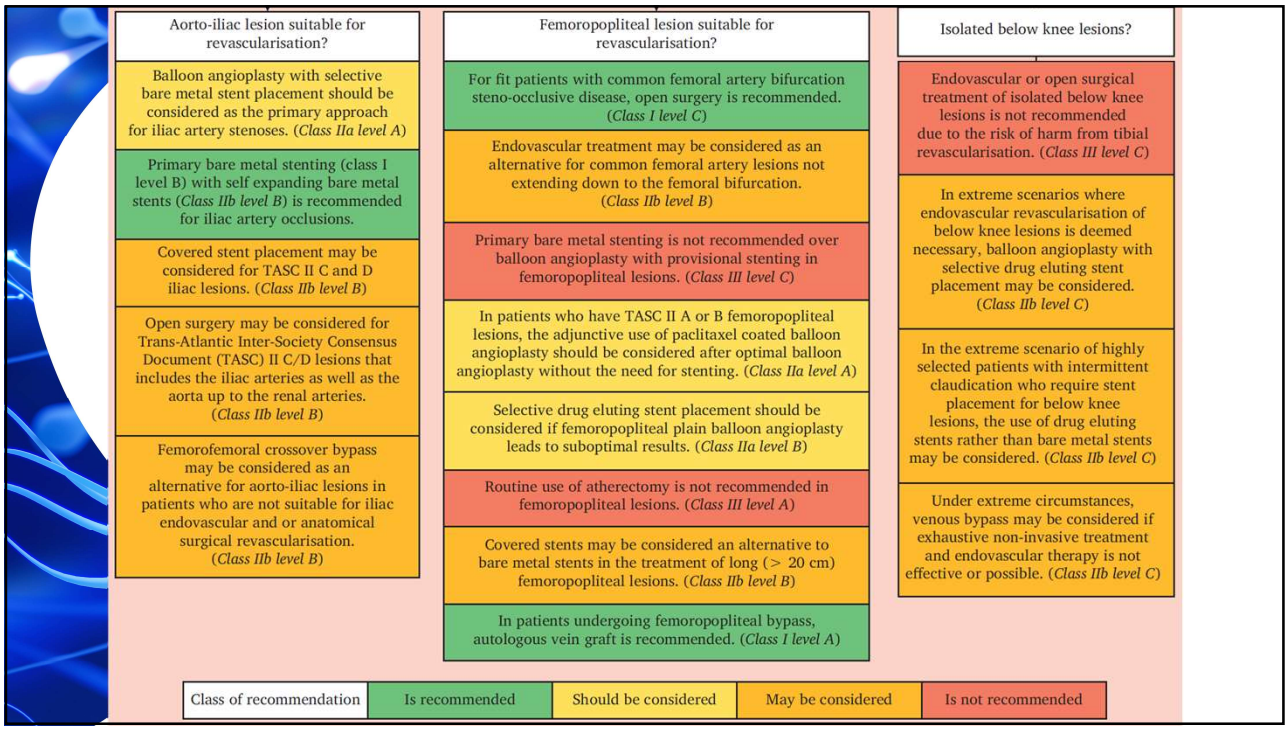

Revascularization is a reasonable treatment option (2a)
Revascularization is not recommended (3: No benefit)
Hemodynamically significant aortoiliac or femoropopliteal disease
Hemodynamically significant common femoral artery disease
Hemodynamically significant isolated infrapopliteal disease
Surgical revascularization is reasonable if perioperative risk is acceptable and technical factors suggest advantages over endovascular approaches (2a)
Endovascular revascularization is effective (1)
Endarterectomy is reasonable, particularly to preserve profunda femoris artery pathways (2a)
Endovascular approaches may be considered if patient is high risk for surgery and/or anatomic factors are favorable (2a)
Effectiveness of endovascular revascularization is unknown (2b)
Effectiveness of surgical revascularization is unknown (2b)
Autogenous vein for femoral-popliteal bypass in preference to prosthetic material (1)
Continue GDMT including structured exercise (1)

45


Aorto-iliac lesion suitable for revascularisation?
Balloon angioplasty with selective bare metal stent placement should be considered as the primary approach for iliac artery stenoses. (Class IIa level A)
Primary bare metal stenting (class I level B) with self expanding bare metal stents (Class IIb level B) is recommended for iliac artery occlusions.
Covered stent placement may be considered for TASC II C and D iliac lesions. (Class IIb level B)
Open surgery may be considered for Trans-Atlantic Inter-Society Consensus Document (TASC) II C/D lesions that includes the iliac arteries as well as the aorta up to the renal arteries. (Class IIb level B)
Femorofemoral crossover bypass may be considered as an alternative for aorto-iliac lesions in patients who are not suitable for iliac endovascular and or anatomical surgical revascularisation. (Class IIb level B)
Femoropopliteal lesion suitable for revascularisation?
For fit patients with common femoral artery bifurcation steno-occlusive disease, open surgery is recommended. (Class I level C)
Endovascular treatment may be considered as an alternative for common femoral artery lesions not extending down to the femoral bifurcation. (Class IIb level B)
Primary bare metal stenting is not recommended over balloon angioplasty with provisional stenting in femoropopliteal lesions. (Class III level C)
In patients who have TASC II A or B femoropopliteal lesions, the adjunctive use of paclitaxel coated balloon angioplasty should be considered after optimal balloon angioplasty without the need for stenting. (Class IIa level A)
Selective drug eluting stent placement should be considered if femoropopliteal plain balloon angioplasty leads to suboptimal results. (Class IIa level B)
Routine use of atherectomy is not recommended in femoropopliteal lesions. (Class III level A)
Covered stents may be considered an alternative to bare metal stents in the treatment of long (> 20 cm) femoropopliteal lesions. (Class IIb level B)
In patients undergoing femoropopliteal bypass, autologous vein graft is recommended. (Class I level A)
Isolated below knee lesions?
Endovascular or open surgical treatment of isolated below knee lesions is not recommended due to the risk of harm from tibial revascularisation. (Class III level C)
In extreme scenarios where endovascular revascularisation of below knee lesions is deemed necessary, balloon angioplasty with selective drug eluting stent placement may be considered. (Class IIb level C)
In the extreme scenario of highly selected patients with intermittent claudication who require stent placement for below knee lesions, the use of drug eluting stents rather than bare metal stents may be considered. (Class IIb level C)
Under extreme circumstances, venous bypass may be considered if exhaustive non-invasive treatment and endovascular therapy is not effective or possible. (Class IIb level C)
Class of recommendation
Is recommended
Should be considered
May be considered
Is not recommended

49

CLTI
CHRONIC LIMB THREATENING ISCHAEMIA

50

CRITICAL LIMB ISCHAEMIA

- Critical limb ischaemia
  - >= 2 weeks duration
  - Ischemic rest pain, ulceration or gangrene
  - AND
    - Ankle pressure < 50mmHg or toe pressure < 30mmHg
    - ABPI < 0.40
    - $TcPO_2$ < 30 mr
- Fails to encompass the full spectrum of patients who are evaluated and treated in modern practice

OUTDATED

51

CHRONIC LIMB THREATENING ISCHAEMIA

- CLTI = clinical syndrome / wide spectrum of disease
  - >= 2 weeks duration
  - Ischemic rest pain, ulceration or gangrene
  - Objectively documented PAD on haemodynamic testing
- Stage severity of limb threat → risk of major amputation using Wounds, Ischemia, and foot Infection (WIfI) classification

Very low = VL = clinical stage 1
Low = L = clinical stage 2
Moderate = M = clinical stage 3
High = H = clinical stage 4
Clinical stage 5 would signify an unsalvageable foot

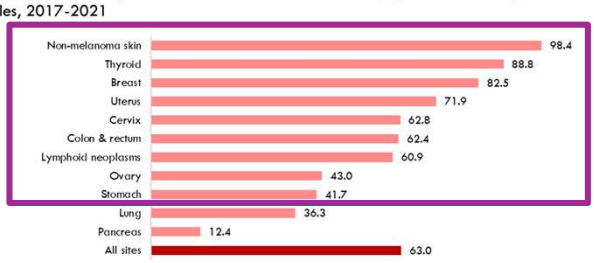
52

CLTI "Arterial cancer"

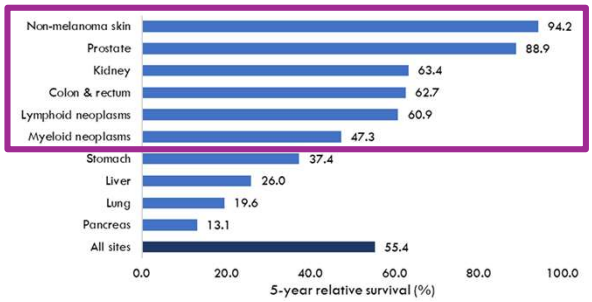
- End-stage manifestation of systemic atherosclerosis
- Mortality
  - 1 year 24%
  - 5 year 60% ~ 40% survival
  - Stage 3 Colon cancer 28% ~ 72% survival

Charts extracted from
Singapore Cancer Registry Annual Report 2021
Published August 2023

Figure 2.2.2 Five-year age-standardised relative survival rate (%) for ten most frequent incident cancers in females, 2017-2021



igure 2.2.1 Five-year age-standardised relative survival rate (%) for ten most frequent incident cc n males, 2017-2021



53

Component	Score	Description		
W (Wound)	0	No ulcer (ischaemic rest pain)		
	1	Small, shallow ulcer on distal leg or foot without gangrene		
	2	Deeper ulcer with exposed bone, joint or tendon ± gangrenous changes limited to toes		
	3	Extensive deep ulcer, full thickness heel ulcer ± calcaneal involvement ± extensive gangrene		
I (Ischaemia)		ABI	Ankle pressure (mmHg)	Toe pressure or $TcPO_2$
	0	≥0.80	> 100	≥60
	1	0.60–0.79	70–100	40–59
	2	0.40–0.59	50–70	30–39
	3	<0.40	<50	<30
fI (foot Infection)	0	No symptoms/signs of infection		
	1	Local infection involving only skin and subcutaneous tissue		
	2	Local infection involving deeper than skin/subcutaneous tissue		
	3	Systemic inflammatory response syndrome		

Estimate risk of amputation at 1 year for each combination[2]																
	Ischaemia – 0				Ischaemia – 1				Ischaemia – 2				Ischaemia – 3			
W-0	VL	VL	L	M	VL	L	M	H	L	L	M	M	L	M	M	H
W-1	VL	VL	L	M	VL	L	M	H	L	M	H	H	M	M	H	H
W-2	L	L	M	H	M	M	H	H	M	H	H	H	H	H	H	H
W-3	M	M	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3

54

55

56

57

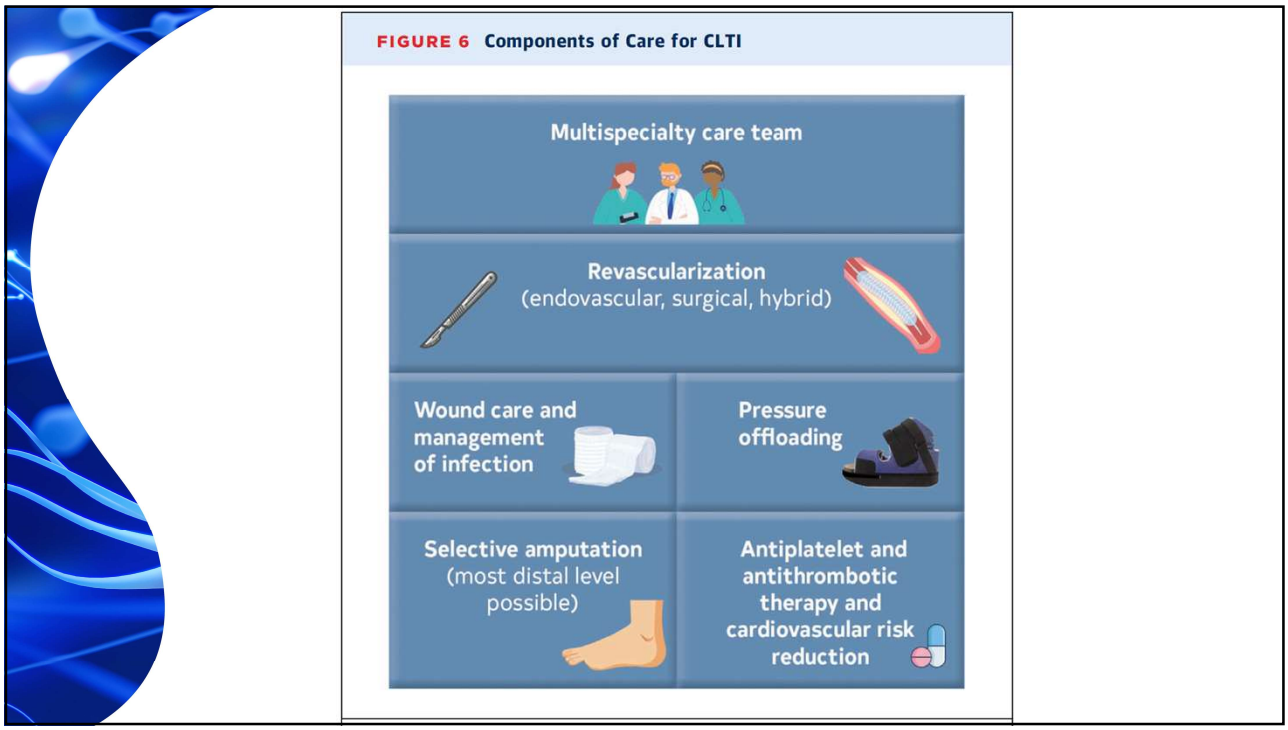
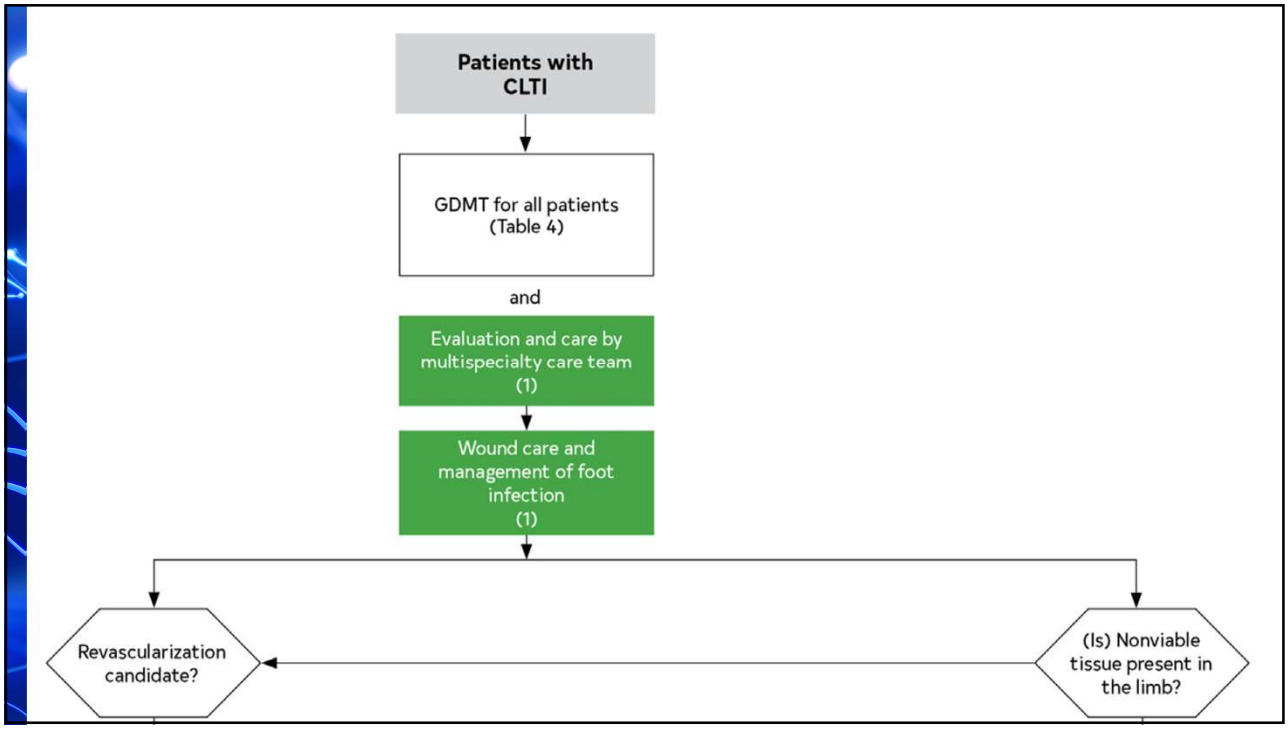
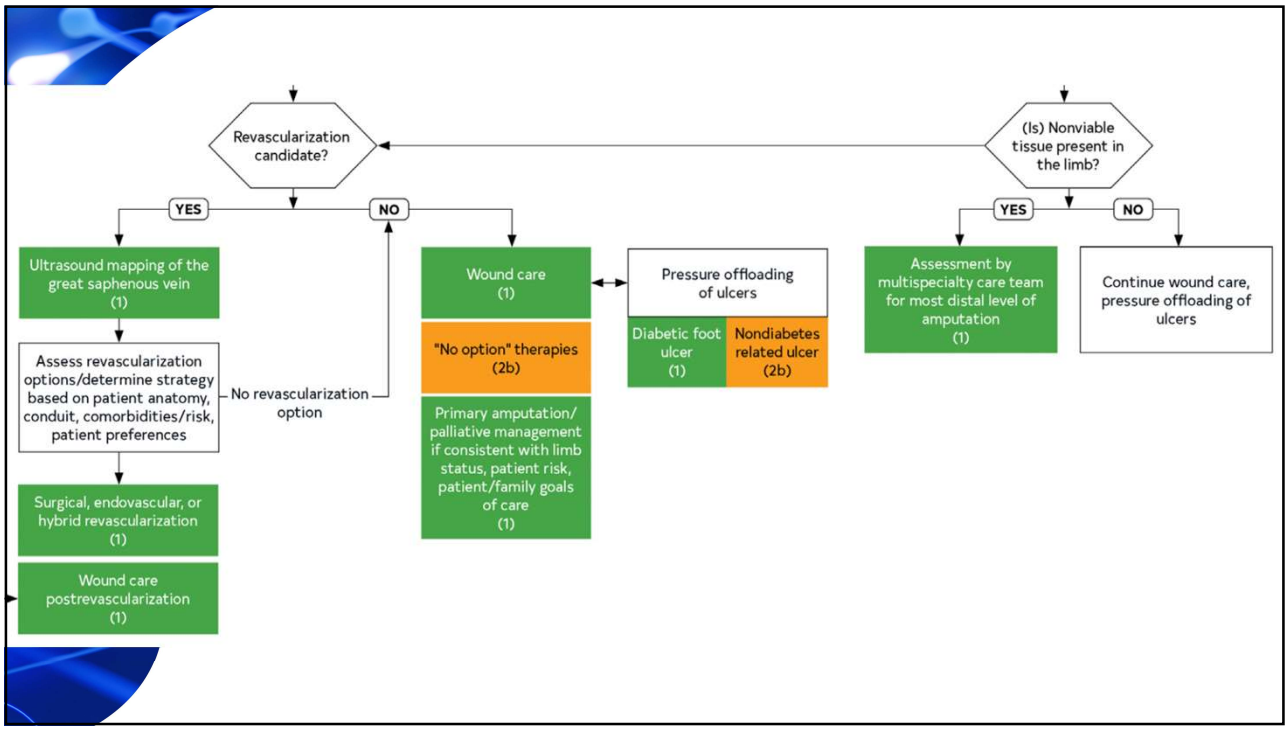


FIGURE 6 Components of Care for CLTI
Multispecialty care team
Revascularization
(endovascular, surgical, hybrid)
Wound care and management of infection
Pressure offloading
Selective amputation
(most distal level possible)
Antiplatelet and antithrombotic therapy and cardiovascular risk reduction

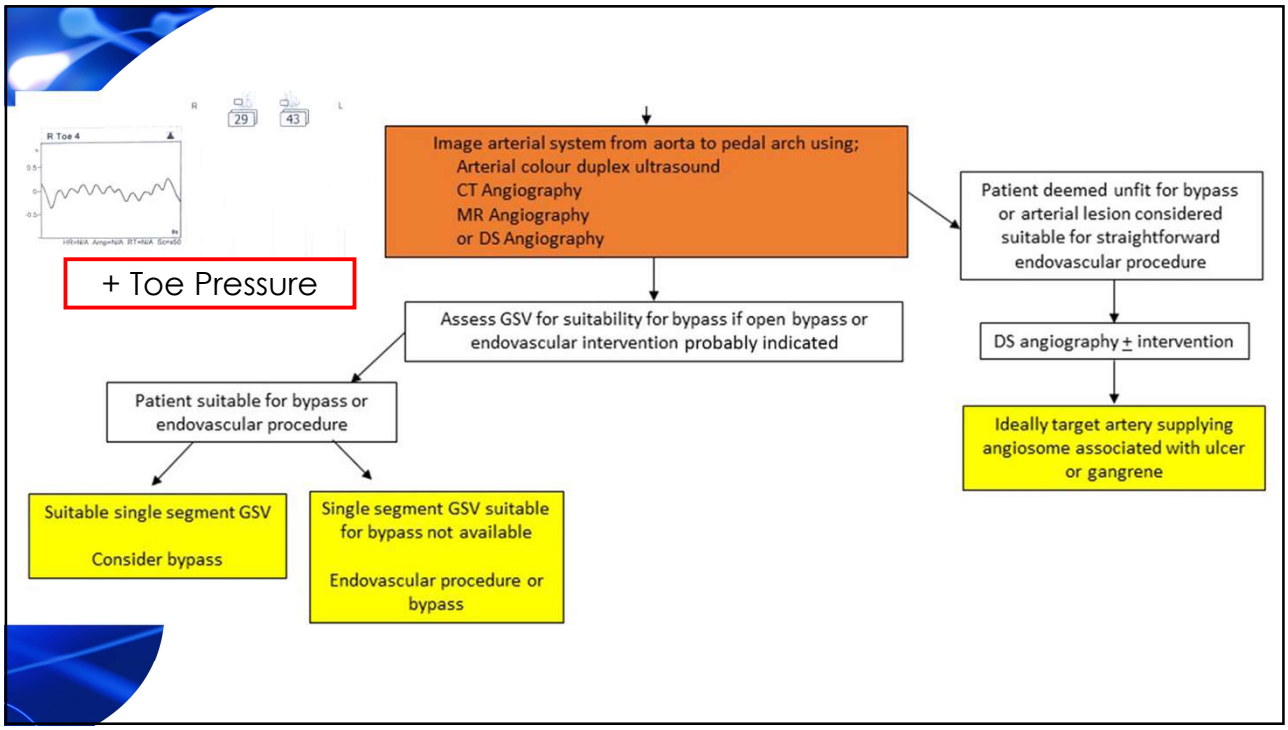
58


Patients with CLTI
GDMT for all patients (Table 4)
and
Evaluation and care by multispecialty care team (1)
Wound care and management of foot infection (1)
Revascularization candidate?
(Is) Nonviable tissue present in the limb?

64


Revascularization candidate?
(Is) Nonviable tissue present in the limb?
YES
NO
YES
NO
Ultrasound mapping of the great saphenous vein (1)
Assess revascularization options/determine strategy based on patient anatomy, conduit, comorbidities/risk, patient preferences
Surgical, endovascular, or hybrid revascularization (1)
Wound care postrevascularization (1)
No revascularization option
Wound care (1)
"No option" therapies (2b)
Primary amputation/ palliative management if consistent with limb status, patient risk, patient/family goals of care (1)
Pressure offloading of ulcers
Diabetic foot ulcer (1)
Nondiabetes related ulcer (2b)
Assessment by multispecialty care team for most distal level of amputation (1)
Continue wound care, pressure offloading of ulcers

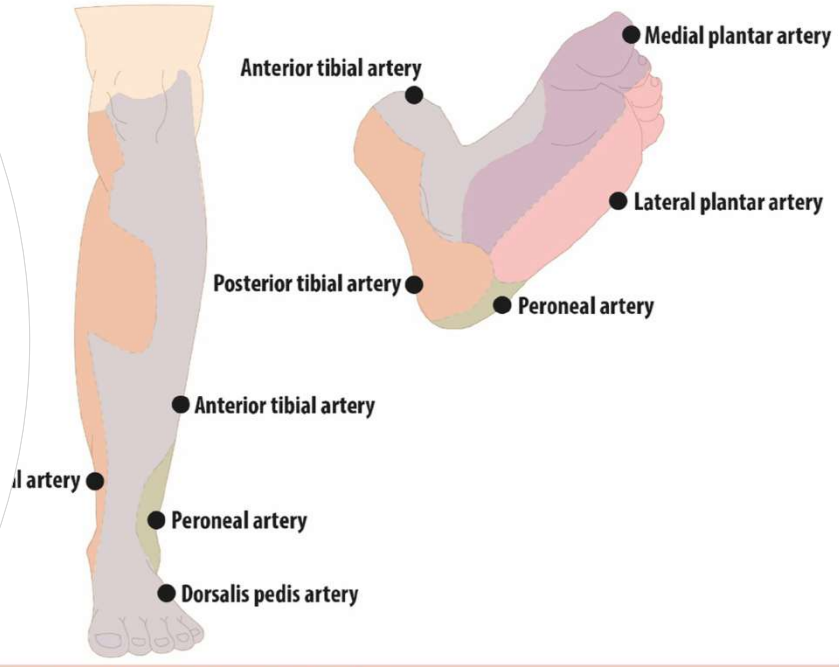
65


R Toe 4
+ Toe Pressure
Image arterial system from aorta to pedal arch using;
Arterial colour duplex ultrasound
CT Angiography
MR Angiography
or DS Angiography
Patient deemed unfit for bypass or arterial lesion considered suitable for straightforward endovascular procedure
Assess GSV for suitability for bypass if open bypass or endovascular intervention probably indicated
DS angiography ± intervention
Patient suitable for bypass or endovascular procedure
Ideally target artery supplying angiosome associated with ulcer or gangrene
Suitable single segment GSV
Consider bypass
Single segment GSV suitable for bypass not available
Endovascular procedure or bypass

66

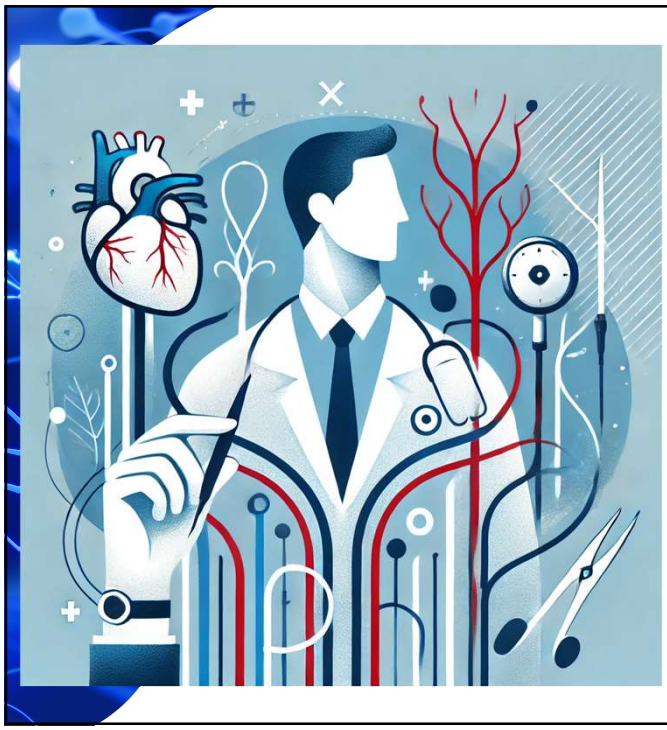
Goals of endovascular revascularisation

- Pulsatile inline arterial flow to the foot via
  - Direct revascularisation Angiosome / Woundosome
  - Indirect collaterals



ure 3. Angiosome distribution in the lower leg and foot.

67



How to figure out the arterial plumbing like a vascular surgeon

ASSUMING COSTS WERE NOT AN ISSUE

68

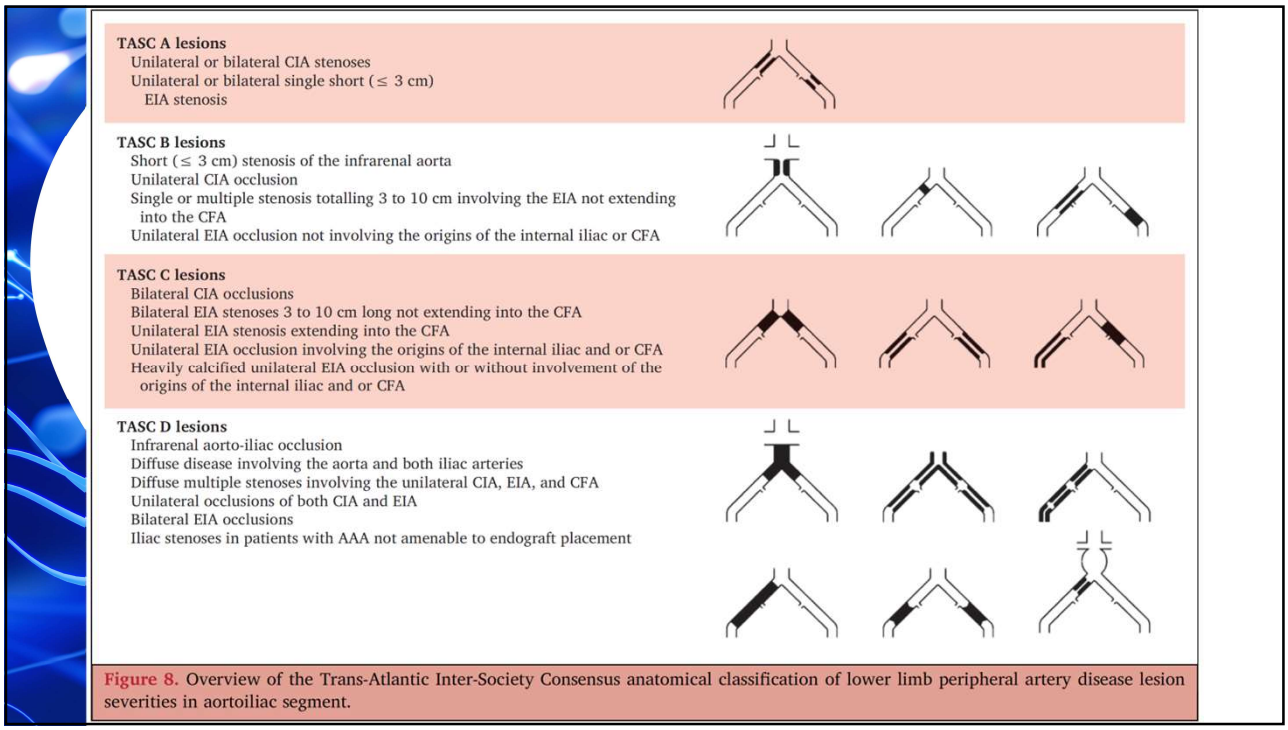


Figure 8. Overview of the Trans-Atlantic Inter-Society Consensus anatomical classification of lower limb peripheral artery disease lesion severities in aortoiliac segment.

69

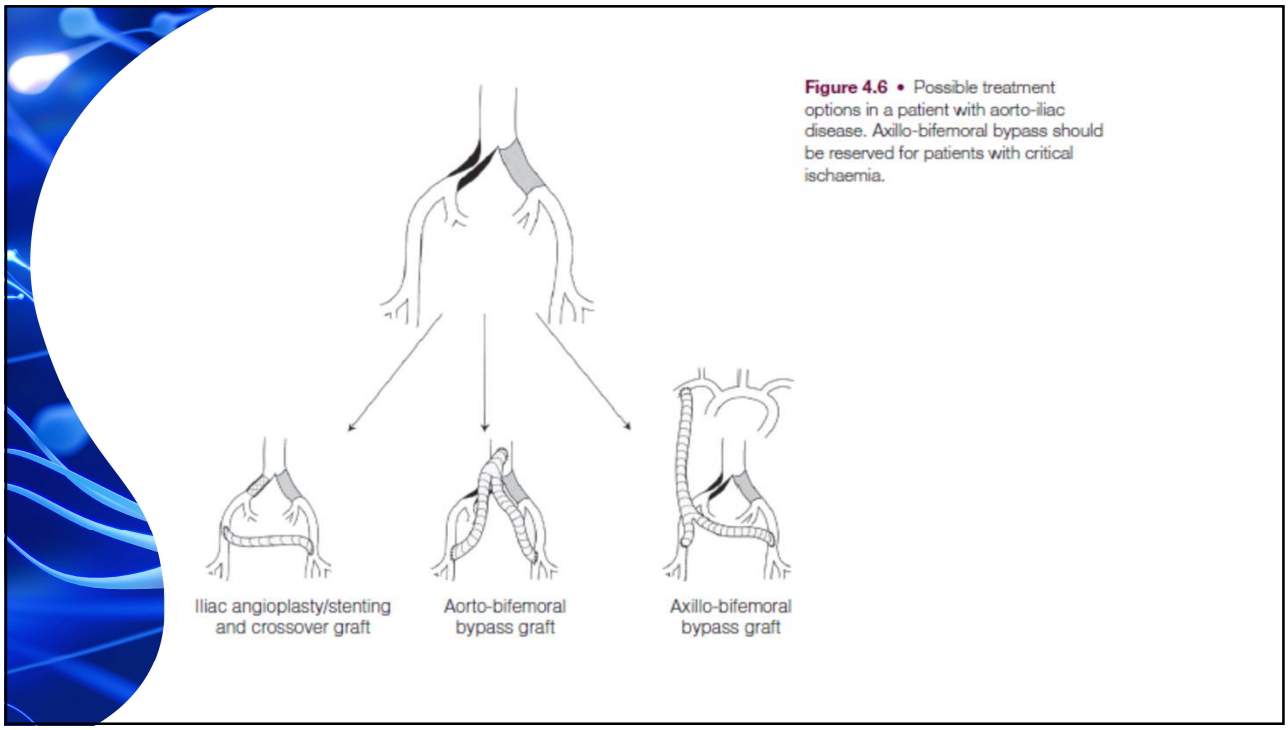


Figure 4.6 • Possible treatment options in a patient with aorto-iliac disease. Axillo-bifemoral bypass should be reserved for patients with critical ischaemia.

70

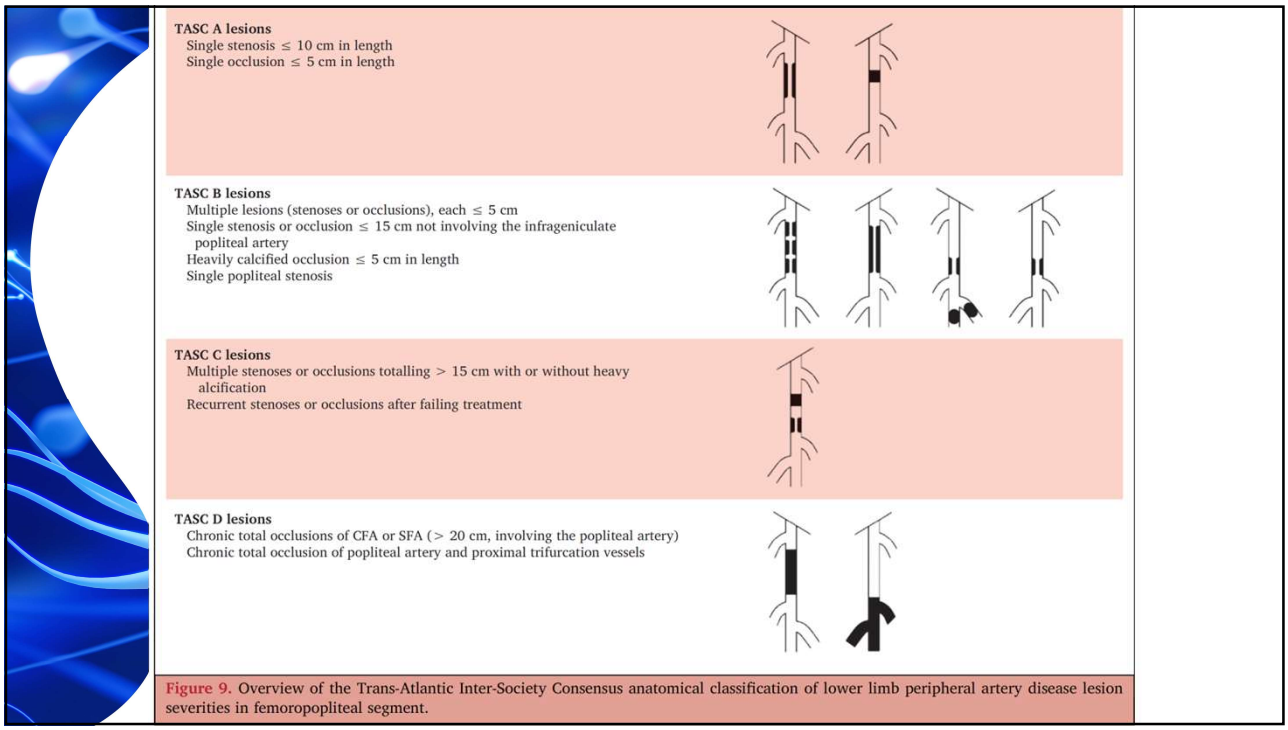


Figure 9. Overview of the Trans-Atlantic Inter-Society Consensus anatomical classification of lower limb peripheral artery disease lesion severities in femoropopliteal segment.

71

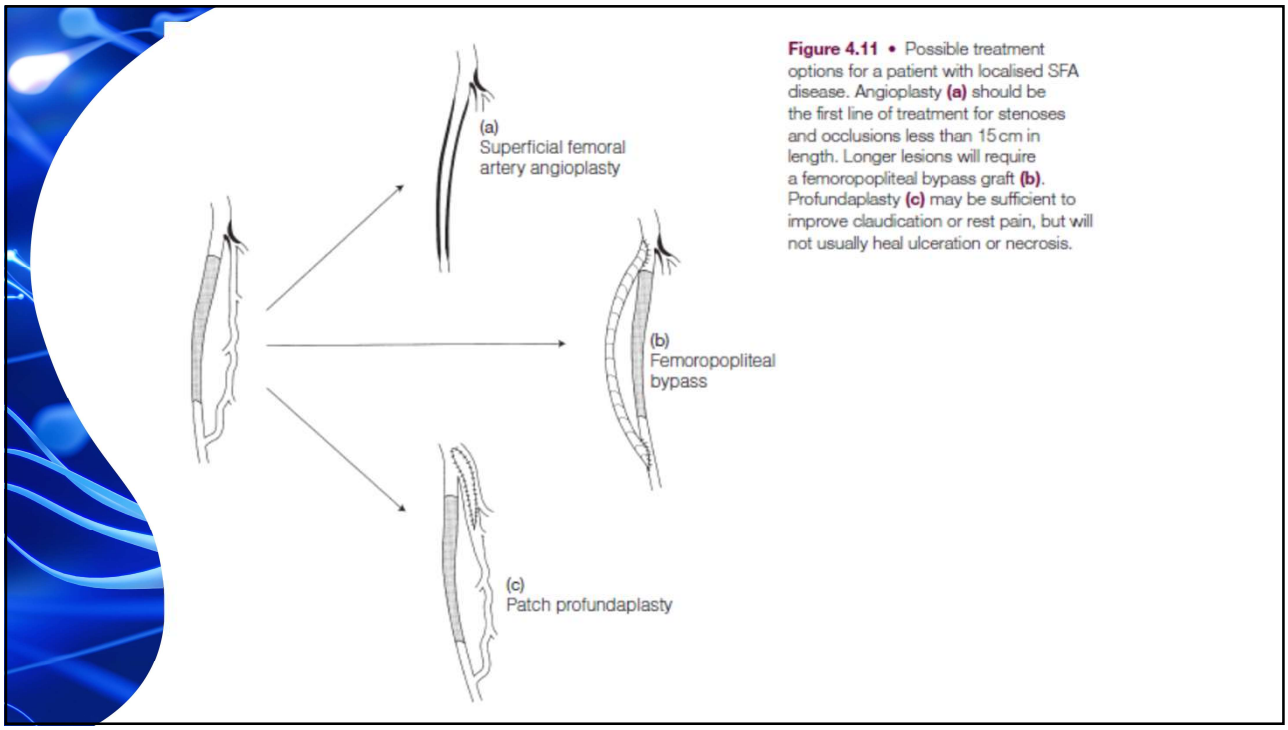
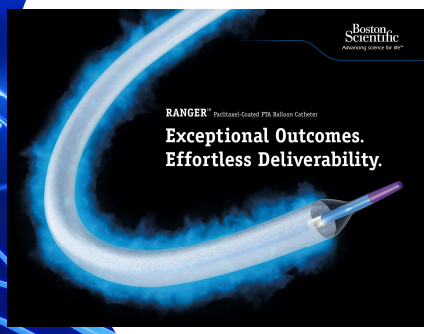
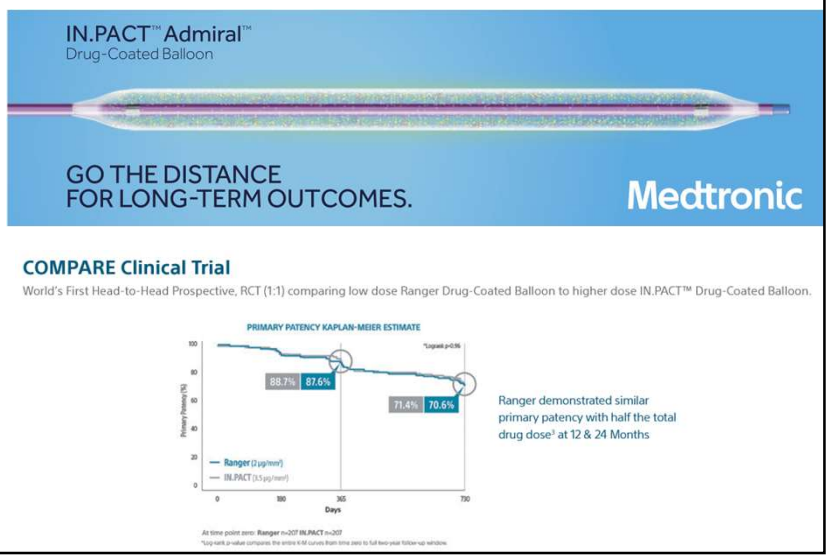


Figure 4.11 • Possible treatment options for a patient with localised SFA disease. Angioplasty **(a)** should be the first line of treatment for stenoses and occlusions less than 15 cm in length. Longer lesions will require a femoropopliteal bypass graft **(b)**. Profundaplasty **(c)** may be sufficient to improve claudication or rest pain, but will not usually heal ulceration or necrosis.

72

- Drug / Paclitaxel coated balloon angioplasty for femoro-popliteal segment considered standard of care nowadays



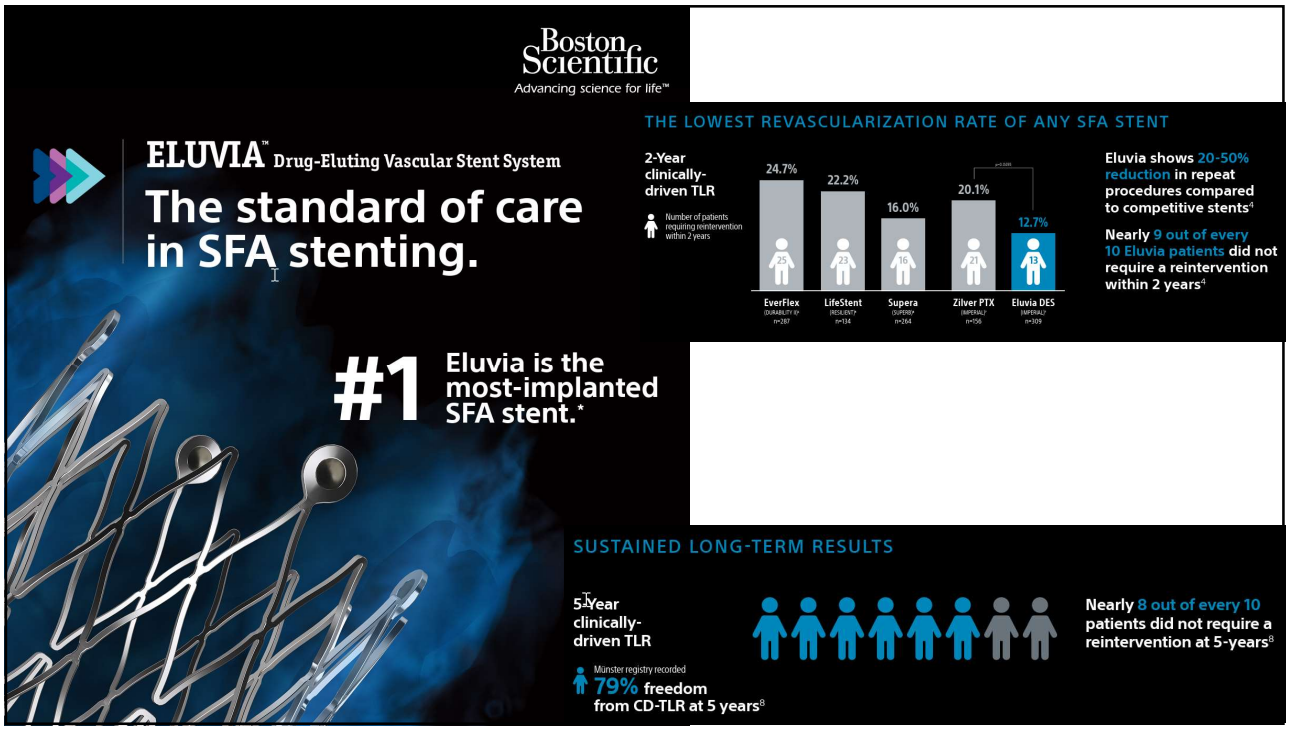


COMPARE Clinical Trial

World's First Head-to-Head Prospective, RCT (1:1) comparing low dose Ranger Drug-Coated Balloon to higher dose IN.PACT™ Drug-Coated Balloon.

Ranger demonstrated similar primary patency with half the total drug dose[3] at 12 & 24 Months

73



74

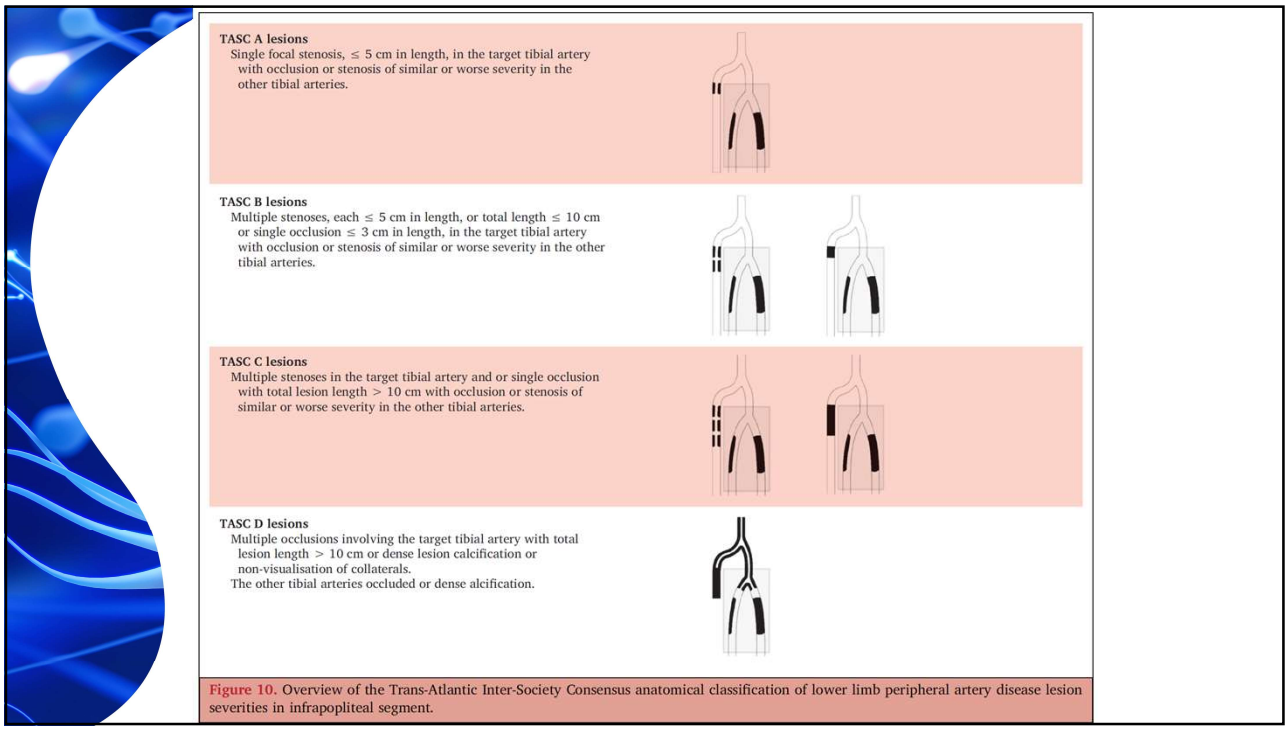


Figure 10. Overview of the Trans-Atlantic Inter-Society Consensus anatomical classification of lower limb peripheral artery disease lesion severities in infrapopliteal segment.

75

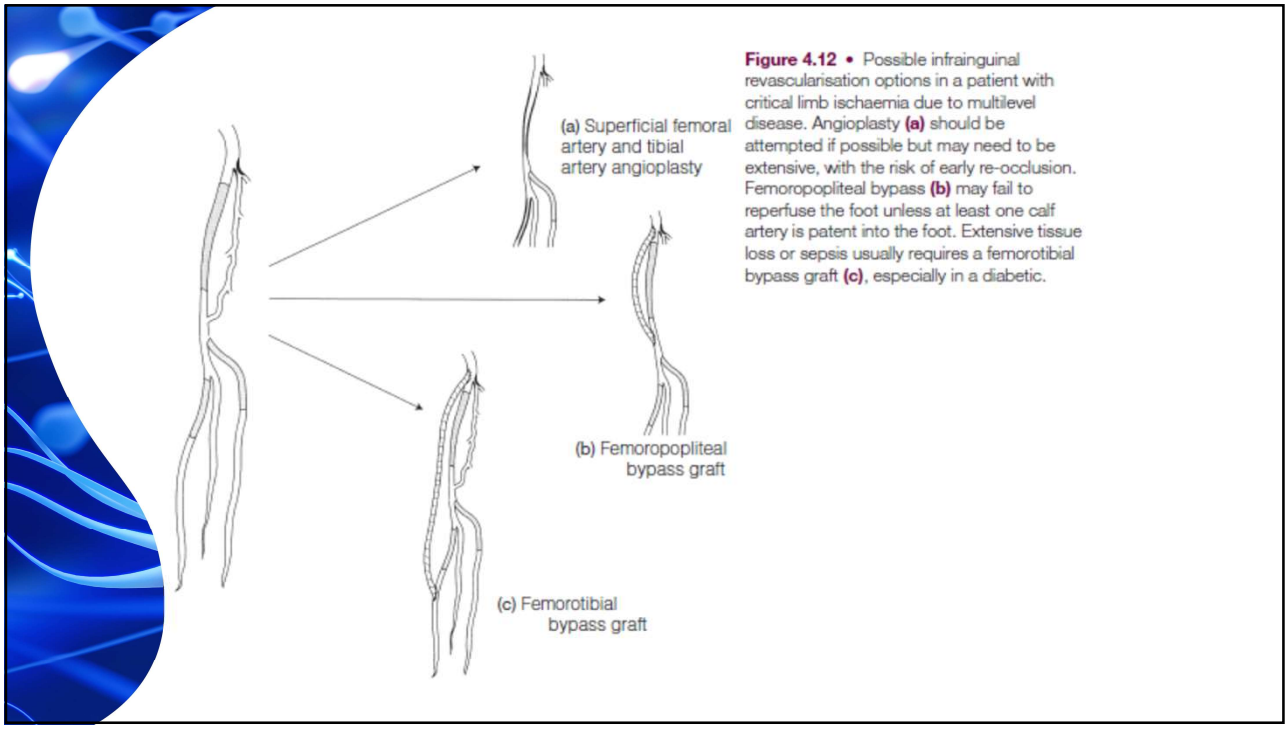
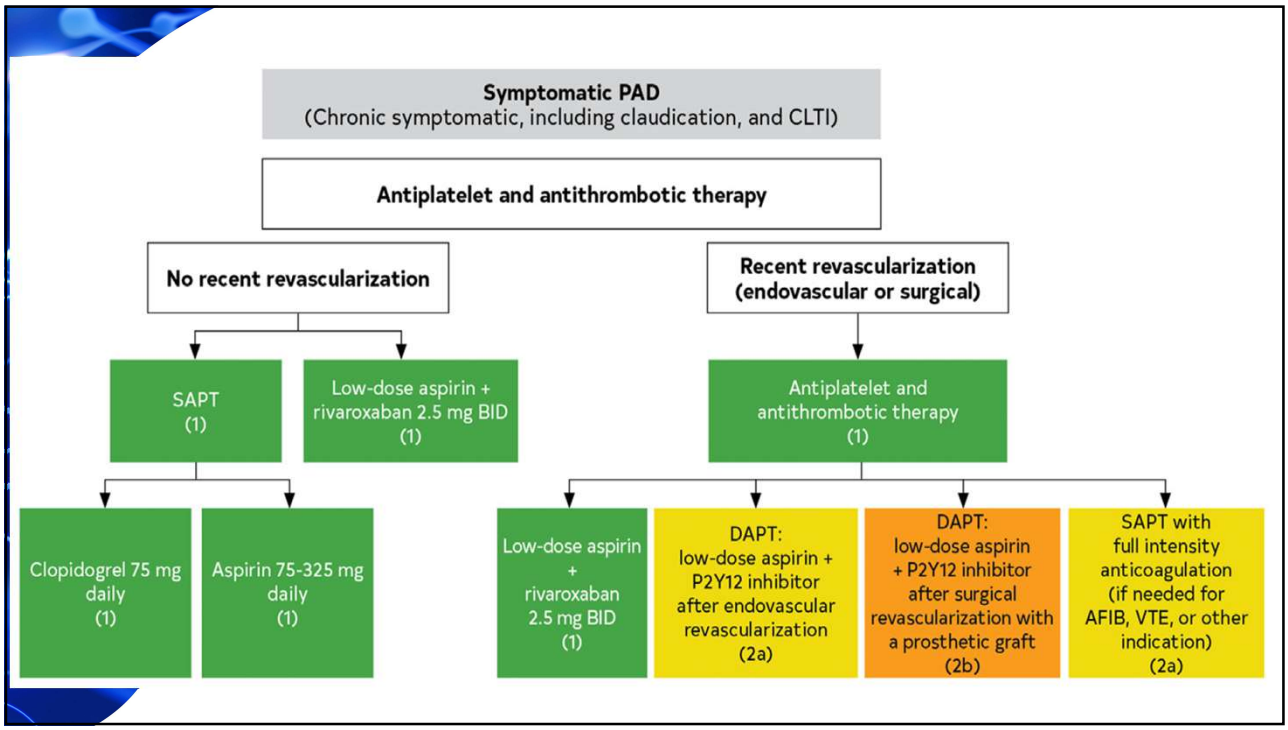


Figure 4.12 • Possible infrainguinal revascularisation options in a patient with critical limb ischaemia due to multilevel disease. Angioplasty **(a)** should be attempted if possible but may need to be extensive, with the risk of early re-occlusion. Femoropopliteal bypass **(b)** may fail to reperfuse the foot unless at least one calf artery is patent into the foot. Extensive tissue loss or sepsis usually requires a femorotibial bypass graft **(c)**, especially in a diabetic.

76



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No Option CLTI

Recommendations for Approach to the "No Option" Patient With CLTI
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	RECOMMENDATIONS
2b	B-R	1. In patients with CLTI for whom revascularization is not an option and a lack of outflow to the foot is observed, the usefulness of prostanoids is uncertain.[1-3]
2b	B-NR	2. In patients with CLTI for whom revascularization is not an option, arterial intermittent pneumatic compression devices may be considered to augment wound healing or ameliorate ischemic rest pain.[4-7]
2b	B-NR	3. In patients with CLTI for whom arterial revascularization is not an option and a lack of outflow to the foot is observed, venous arterialization may be considered for limb preservation.[8-12]

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COMPLICATIONS OF BYPASS

- Early
  - Bleeding
  - Thrombosis
  - Wound infection ~ 15-20% groin infection
  - Swelling (Ischaemia-Reperfusion / DVT)
- Late
  - Graft thrombosis/failure
  - Pseudoaneurysm
  - Graft infection
- Graft failure
  - Early (After 1 month) – commonly technical failure
  - Mid term (after 1 year) – Neointimal hyperplasia causing stenosis
  - Late (2-5 years) – atheromatous disease progression

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COMPLICATIONS OF ANGIOPLASTY

- Bleeding / Pseudoaneurysm / Retroperitoneal haematoma
- Vessel dissection/rupture
- Contrast-induced nephropathy
- Distal embolization → acute limb ischaemia
- Device/Stent-related
  - Failure to deploy
  - Misplacement
  - Migration
- Postop reocclusion

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CONTRAST INDUCED NEPHROPATHY

Box 2.1 • Risk factors for contrast-induced nephropathy (CIN) identified in multivariable analysis

- Chronic kidney disease (stage 3 or greater: eGFR <60 mL/min/1.73 m^2)
- Diabetes mellitus (type 1 or 2)
- Volume depletion
- Nephrotoxic drug use (NSAIDs, ciclosporin, aminoglycosides)
- Preprocedural haemodynamic instability
- Other comorbidities:
  - Anaemia
  - Congestive heart failure
  - Hypoalbuminaemia

eGFR, estimated glomerular filtration rate; NSAIDs, non-steroidal anti-inflammatory drugs.

- Intra-arterial administration of iodinated contrast poses greater risk of CIN than intravenous administration
- Withhold metformin
  - 2 days before and after
  - Recheck Cr 48hrs KIV restart if <25% increase compared to baseline
- Intravenous volume expansion
  - 1-1.5ml/kg/hr x 3-12 hours before and continue 6-24 hours afterwards
  - Insufficient data for oral fluids
- No role for N-acetylcysteine or sodium bicarbonate drip

82

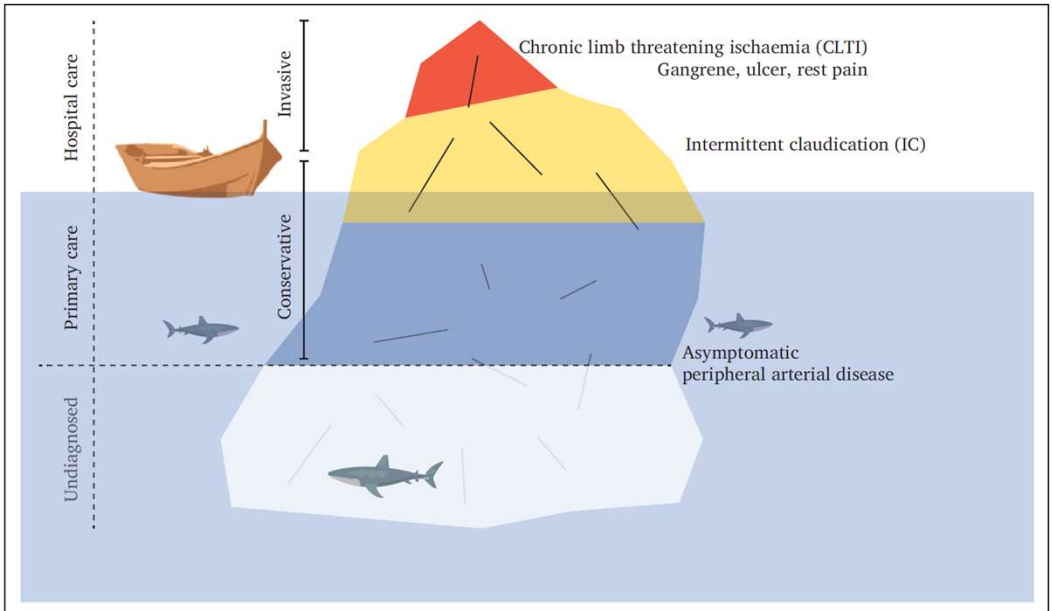


Figure 3. Schematic illustration of the lower limb peripheral arterial disease (PAD) iceberg epidemiology, indirectly illustrating the real challenges associated with reaching out to the entire patient population with any healthcare intervention. (Modified after Søgaard et al. Vasa. 2023;52:77-80.[72])

83

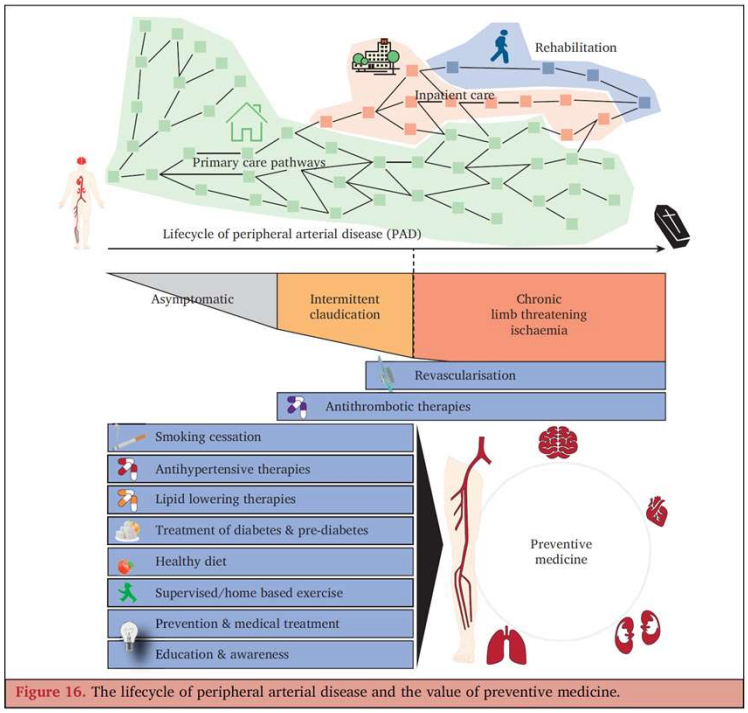


Figure 16. The lifecycle of peripheral arterial disease and the value of preventive medicine.

84

CLINICAL VIGNETTE

85

86

87

88

- Finally almost 100% pink granulation tissue!

89

Clinical Deterioration

- Staph aureus clusters
- Midfoot osteomyelitis

Due to

- Tibial artery reocclusions
  - Up to 70% reocclusion within 6 months
  - Repeat revascularisation
- Ultrasonic wound debridement + Wound care
- Antibiotics

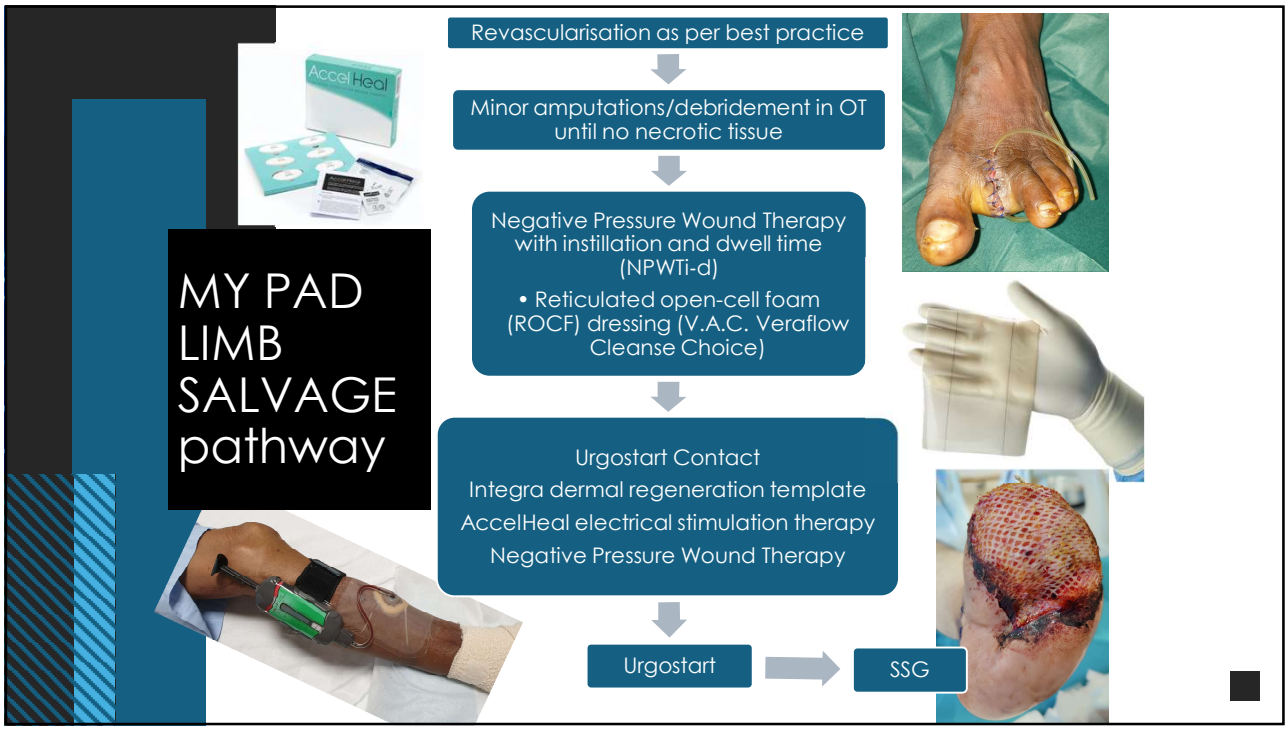
90

Veraflo Granudacyn Cleanse Choice (VGCC)

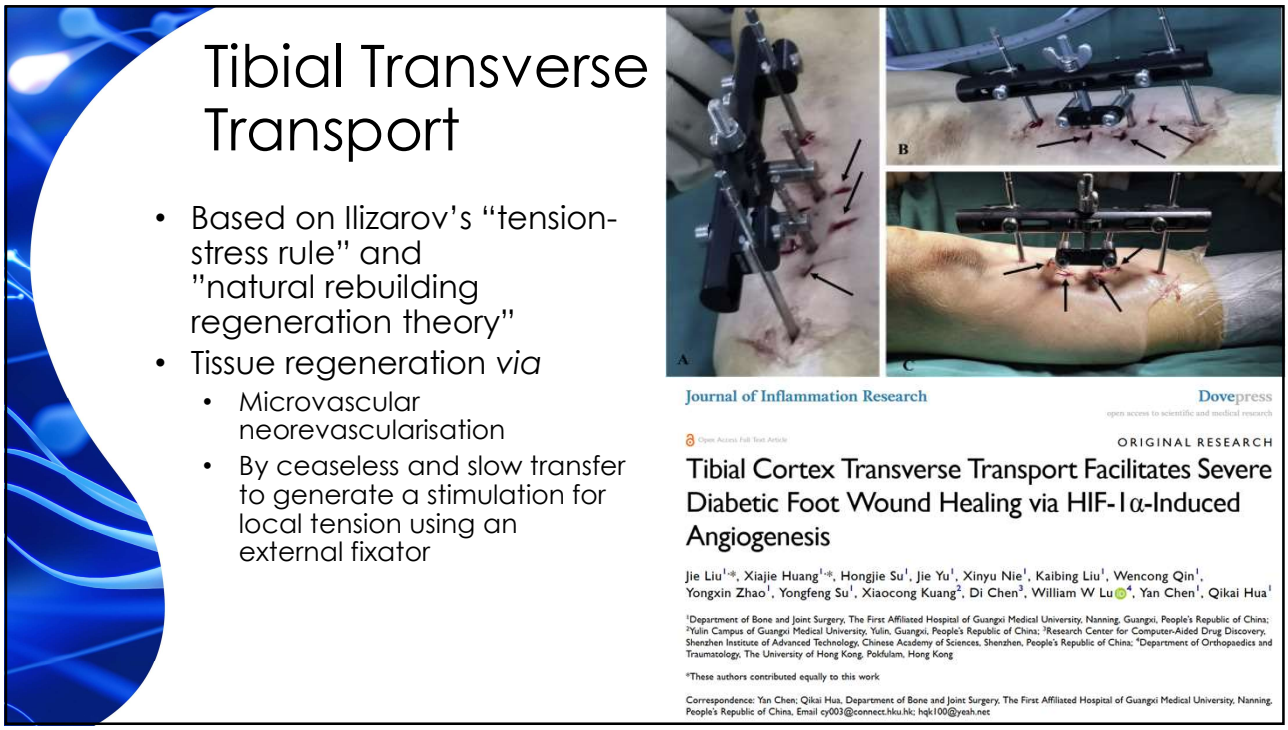
91

92

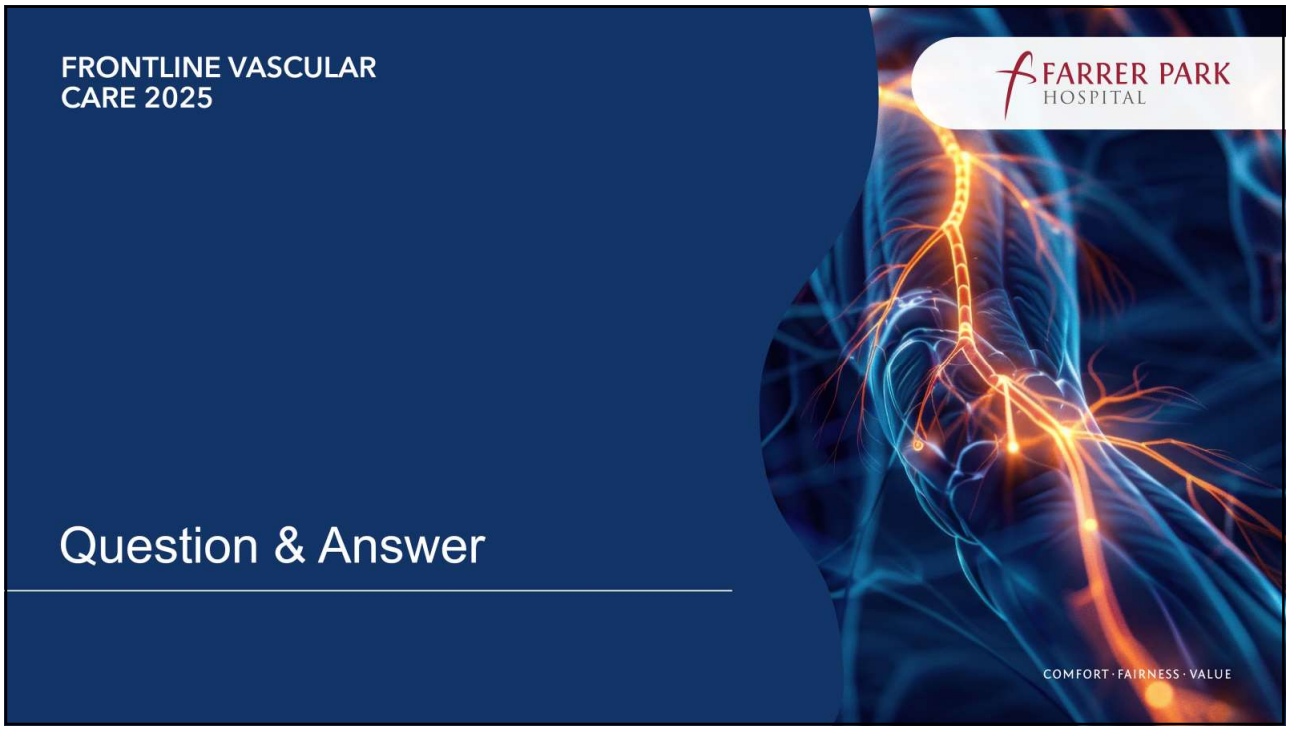
93


MY PAD LIMB SALVAGE pathway
Revascularisation as per best practice
Minor amputations/debridement in OT until no necrotic tissue
Negative Pressure Wound Therapy with instillation and dwell time (NPWTi-d)
• Reticulated open-cell foam (ROCF) dressing (V.A.C. Veraflow Cleanse Choice)
Urgostart Contact
Integra dermal regeneration template
AccelHeal electrical stimulation therapy
Negative Pressure Wound Therapy
Urgostart
SSG
AccelHeal

94


Tibial Transverse Transport
• Based on Ilizarov's "tension-stress rule" and "natural rebuilding regeneration theory"
• Tissue regeneration *via*
• Microvascular neorevascularisation
• By ceaseless and slow transfer to generate a stimulation for local tension using an external fixator
Journal of Inflammation Research
Dovepress
ORIGINAL RESEARCH
Tibial Cortex Transverse Transport Facilitates Severe Diabetic Foot Wound Healing via HIF-1α-Induced Angiogenesis

96


FRONTLINE VASCULAR
CARE 2025
FARRER PARK
HOSPITAL
Question & Answer
COMFORT · FAIRNESS · VALUE

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