

Vascular Surgery Workbook

University of Leicester Medical School

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Contributors

Mr Nikesh Dattani

Dr Michaelis Patsalides

Mr Sufyan Azam

Mr Dimitri Vlastos

Introduction

Welcome to your Vascular Surgery block!

This workbook has been created to introduce students on their surgical block to the basic concepts of vascular surgery, which are mapped to the phase 2 curriculum.

The workbook is split into 5 sections, each covering a different area of vascular surgery.

Within each section, case-based scenarios and questions are used to guide the student's learning around the topic. The content covered within the workbook is by no means exhaustive and should be used by students to spark further reading around the topic.

Students should ideally aim to complete the workbook before the mid-point of their time in vascular surgery so that there is adequate time for discussion about confusing topics with clinical teachers and mentors.

The Vascular Society of Great Britain & Ireland has produced a short textbook aimed at medical students and early years doctors. I would recommend using this as a starting point for further reading when required.

It can be download free of charge from:

<https://jvsgbi.com/all-you-need-to-know-about-vascular-surgery/>

I hope you enjoy your time in vascular surgery.

Mr Nikesh Dattani
Consultant Vascular & Endovascular Surgeon
Block Lead for Vascular Surgery, University of Leicester

Session 1 – Arterial disease

Case 1

Timothy Harris, a 71-year-old retired builder, presents to vascular clinic with a 10-month history of gradually worsening left calf pain on walking. He can walk around 80 metres on the flat before developing cramping pain in the calf, which is relieved by resting for 2-3 minutes.

Over the last month, he has also noticed very occasional pain in his left foot at night.

He has a history of hypertension, hypercholesterolaemia and type 2 diabetes mellitus. He takes atorvastatin 20mg OD, ramipril 10mg ON and metformin 500mg BD. He has smoked 25 cigarettes a day since the age of 18.

On examination, the left foot is cool with reduced capillary refill. There is loss of hair over the shin and foot. No ulcer is seen. Both femoral pulses are palpable. No popliteal or distal pulses can be felt in either leg.

1. State the most likely diagnosis?

2. State which features in the presenting complaint make this diagnosis most likely? Justify your answers.

The vascular team suspect intermittent claudication secondary to peripheral arterial disease.

3. Which risk factors for peripheral artery disease are present in this patient's history?

4. Which initial bedside tests should be performed to determine the severity of this patient's peripheral vascular disease?

ABPI is performed as below

Ankle Brachial Pressure Index Report				
Resting ABPI Measurement				
Side:	DP	PT	Brachial	ABPI
Right				
Left	70 mmHg	70 mmHg	140	0.5
Comments: monophasic, painful calf/foot				

5. Interpret this ABPI result. Does this confirm the diagnosis?

6. State 4 initial conservative management steps for this patient.

The vascular team commence Mr Harris on 75mg clopidogrel, give him firm advice to stop smoking and decide to review him back in clinic in 6 weeks' time to check on symptoms.

Six weeks later in clinic he has not stopped smoking but now reports that the foot pain is present every night and he is struggling to sleep. On examination his foot now has a red hue.

7. On the current history and clinical signs present, state the current severity of this patient's peripheral arterial disease. Justify your answer.

8. What is the significance of the red discolouration of the foot?

The vascular team decide that the patient needs intervention to help with these symptoms.

9. State a first line, non-ionising test to define the level of this patient's peripheral vascular disease.
Who usually performs this test?

An arterial duplex scan is performed and reported as below:

VASCULAR STUDIES UNIT

Level 1
Glenfield Hospital
Tel: 0116 258 5440

NHS
University Hospitals
of Leicester
NHS Trust

LOWER LIMB ARTERIAL DUPLEX SCAN REPORT

Resting ankle pressures

	Right DP	PT	Per	BP	Index
Left	DP	PT	Per		

Post-exercise pressures

	Right DP	PT	Per	BP	Index
Left	DP	PT	Per		

Time walked _____ mph

Comment:

Scan comment:

Image Quality: GOOD ☒ POOR ☐

SIGNED: *[Signature]*
CLINICAL VASCULAR SCIENTIST

PRINT NAME: *L SPENCE*

DATE: *7/1/23*

Diagram of Lower Limb Arterial Duplex Scan:

The diagram shows the arterial system of the lower limb. Handwritten notes indicate the following findings:

- Right Femoral Artery:** triphasic & 97cm/s
- Right Popliteal Artery:** 20cm/s
- Right Tibial Artery:** > 6x velocity increase very heavily calcified stenosis - very narrow channel of flow through stenosis
- Right Ankle Artery:** monophasic & 14cm/s
- Left Femoral Artery:** monophasic & 13cm/s
- Left Popliteal Artery:** > 6x velocity increase damped flow & 15cm/s
- Left Tibial Artery:** 3 vessel run off all appear patent damped flow 13-20cm/s

Surgery is considered to treat this patients' symptoms.

10. State two possible procedures for the revascularisation of this patient's left leg. Which would be the preferable option? Justify your answer.

Case 2

Saima Khan, a 76-year-old woman, presents to the emergency department with sudden severe pain in her left leg that started 2 hours ago while she was sitting at home. The pain was immediate, intense, and has become worse. She now reports numbness in the foot and inability to move her toes properly.

She has a past medical history of atrial fibrillation, hypertension, and a previous transient ischaemic attack. Her medications are amlodipine 5mg OD, apixaban 5mg BD and bisoprolol 10mg OD. The patient states that she stopped taking her anticoagulation 3 weeks ago after running out of tablets.

On examination, the left leg is pale and cold below the knee. Capillary refill is absent in the toes. No dorsalis pedis, posterior tibial, or popliteal pulses are palpable on the left. Bedside doppler signals are absent.

The right leg is warm and well perfused with all pulses present.

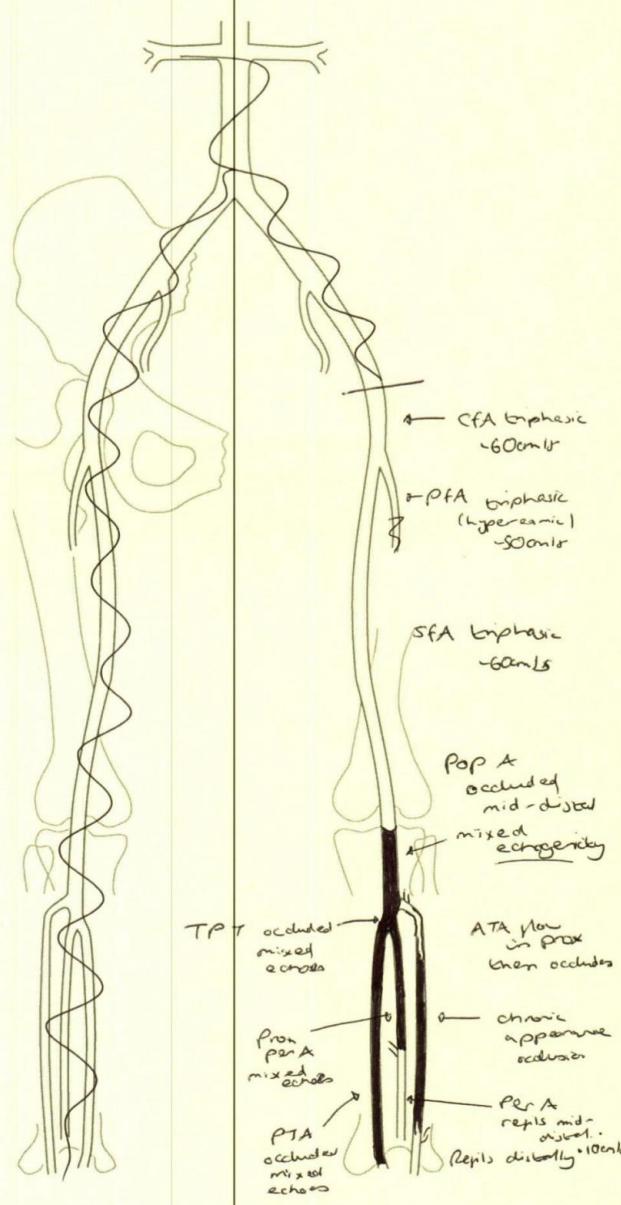
Questions

1. State the most likely diagnosis?
2. State the 6 common findings in acute limb ischaemia (the “6 Ps”).

Acute limb ischaemia is suspected.

3. State the most likely cause of this patient's acute limb ischaemia. Justify your answer.

Saima presented at 10am during a weekday. An urgent arterial duplex was possible and has been reported as below:

NHS University Hospitals of Leicester NHS Trust		LEICESTER VASCULAR INSTITUTE VASCULAR STUDIES UNIT	
Lower Limb Arterial Duplex Scan Report			
Patient Details:			
Surname: _____			
Forename: _____			
Date of Birth: _____			
ID Number: _____			
Referring Consultant: _____			
Scan & Report completed by:			
Name: <u>Hannah Lines</u>			
Clinical Vascular Scientist			
Signed: _____			
Date: <u>3/7/26</u>			
VSU Leg Arterial Duplex Report Form, V6, Ref 040, April 2023, Review April 2028		Image Quality: GOOD ●●● POOR	

Handwritten Notes on Diagram:

- CFA biphasic ~60cm/s
- PTA biphasic (hyper-convic) ~50cm/s
- SFA biphasic ~60cm/s
- Pop A occluded mid-distal mixed echogenicity
- ATA flow in prox then occludes
- TPT occluded mixed echogenicity
- chronic apparent occlusion
- Per A repts mid-distal 10cm/s
- PTA occluded mixed echogenicity
- Prox pop A mixed echogenicity

7. State three definitive treatment options for this patient.

An urgent femoral embolectomy is performed.

8. State 3 complications specific to femoral embolectomy.

Twelve hours later Saima complains of significant calf pain. The pain is exacerbated by passive movement of the foot.

9. What complication has this patient developed and what is the definitive treatment?

Session 2 – Venous disease

Case 1

Sejal Patel, a 52-year-old school teacher, attends clinic with aching and heaviness in both legs, worse at the end of the day and after prolonged standing. She has noticed visible dilated veins over the medial aspect of her calves for several years. More recently, she has developed ankle swelling and itchy, discoloured skin around the lower legs.

She has had three pregnancies and stands for long periods at work. There is no history of DVT. She is otherwise fit and well.

On examination, there are tortuous varicosities along the distribution of the great saphenous veins bilaterally. There is mild pitting oedema around the ankles and brown skin pigmentation in the gaiter region. No ulcer is present.



1. State the most likely diagnosis?

2. Describe the pathophysiology of this disease.

3. State 4 differential diagnoses in a patient with unilateral leg swelling.

Venous insufficiency is suspected.

4. State a definitive investigation to confirm venous reflux?
5. Consider the NICE guidance. State four conservative management steps in the management of symptomatic varicose veins.
 - [Scenario: Varicose veins | Management | Varicose veins | CKS | NICE](#)

6. What are the indications for interventional treatment?

7. State 3 operative or interventional treatment options.

8. State 4 skin changes may be visible on examination in long-standing venous disease?

Case 2

David Lewis, a 44-year-old sales executive, presents with a 2-day history of pain and swelling in his left calf after returning from a long-haul flight 5 days ago. He also reports mild shortness of breath when climbing stairs today, which is new. He has no history of trauma. He has a body mass index of 34 kg/m² and smokes 10 cigarettes per day. He takes no regular medication.

On examination, the left calf is swollen, warm and mildly erythematous. It is tender deep in the calf. There is no obvious cellulitis or wound. Temperature is 37.5 C, pulse 102/minute, blood pressure 132/84 mmHg, respiratory rate 18/minute, and oxygen saturations 96% on air.

Questions

1. State the most likely diagnosis causing the leg swelling. Justify your answer.
2. State six further differential diagnoses for a swollen painful leg.

Deep vein thrombosis is suspected.

3. What risk factors for venous thromboembolism are present in this patient's history? State 4 further risk factors for venous thromboembolism unrelated to this patient's history.

4. What criteria can be used to assess the pre-test probability of DVT?

5. What is the diagnostic value of D-dimer testing?

6. State a definitive initial imaging investigation to determine the cause of the leg swelling in this patient.

At USS venous doppler a deep vein thrombosis is confirmed in the left calf.

7. State an initial pharmacological management for this patient. When should it be commenced and what is the rationale for its use?

8. Referring to the NICE guidance what is the duration of the pharmacological treatment in this case?

9. The patient is breathless. State the most likely cause for this.

Six months later the patient presents to his GP with a chronic feeling of heaviness in the leg associated with cramping. On examination there are some dark patches on the leg with varicose veins.

Post thrombotic syndrome is suspected.

10. What is the pathophysiology of post thrombotic syndrome and state 3 conservative treatment steps.

Session 3 – Aortic disease

Case 1

Connor Doyle, a 74-year-old man, presents with sudden-onset central abdominal pain radiating to the back which began four hours ago at home. The pain is constant and severe. He feels faint and has vomited once. He has a past medical history of hypertension, hypercholesterolaemia and chronic obstructive pulmonary disease. He has a 50 pack year smoking history. He has no allergies, and takes amlodipine 5mg OD, atorvastatin 20mg OD and uses a Symbicort tubohaler BD.

On examination he looks pale and clammy but is alert. Observations are pulse 124/minute, blood pressure 92/58 mmHg, respiratory rate 24/minute, temperature 37.1°C.

Focussed abdominal examination reveals a tender, pulsatile expansile mass in the central abdomen.

Ruptured aortic aneurysm is suspected.

1. State 6 differential diagnoses for this patient's presentation.
2. State four risk factors for abdominal aortic aneurysm from this patient's history and state two additional risk factors.

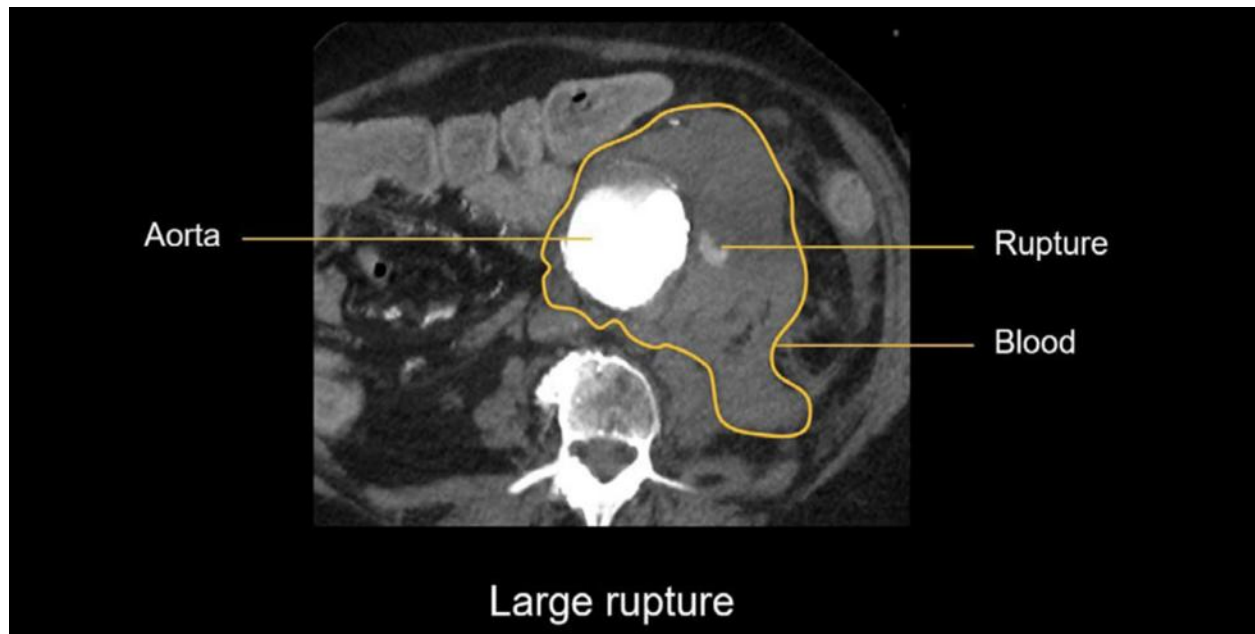
3. What form of shock is present in this patient?

4. State four immediate resuscitation measures for this patient.

Connor is resuscitated with IV fluids following the principles of permissive hypotension.

5. What is meant by permissive hypotension in this context?
6. State a definitive investigation to confirm the diagnosis in this context.

Immediate CT angiography of the aorta reveals a ruptured infra renal abdominal aortic aneurysm. A sample from this scan and can be seen below.



7. When should urgent surgery proceed without delay?

8. State two operative or interventional approaches for aneurysm repair in this patient.

9. State 6 complications specific to aortic aneurysm repair.

Case 2

Deepak Singh, a 65-year-old man, is found to have an infrarenal abdominal aortic aneurysm measuring 5.1 cm on ultrasound performed as part of the NHS screening programme in England. He has no abdominal or back pain. He has a past medical history of hypertension and is an ex-smoker. He takes amlodipine 10mg OD and has no allergies.

1. Define an abdominal aortic aneurysm.
2. What are the indications for repair in asymptomatic abdominal aortic aneurysms
3. What is the management of abdominal aortic aneurysms not meeting these indications?

4. What cardiovascular risk reduction measures should be addressed in this context?

The patient is provided with safety netting information regarding his aneurysm.

5. What advice should be given regarding symptoms that require urgent assessment?



Figure 2

CT scan showing an abdominal aortic aneurysm.

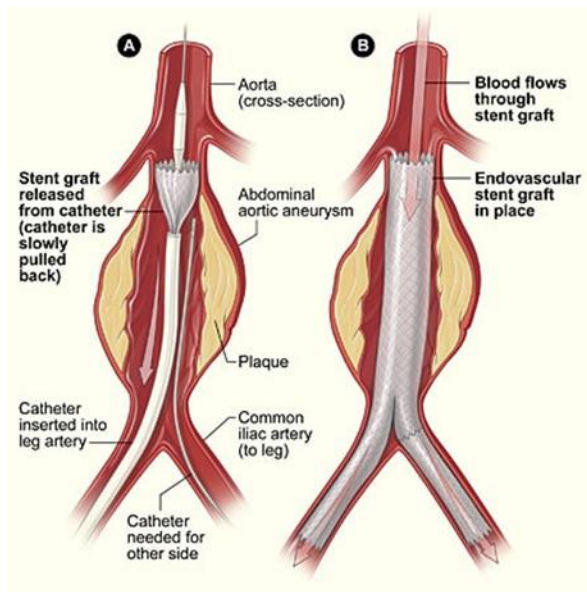


Figure 3
Endovascular repair of an abdominal aortic aneurysm

Session 4 – Ulcer assessment and management

Case 1

Ayleen Thompson, a 68-year-old woman, presents with a 3-month history of a non-healing painless leg ulcer. There is associated with ankle swelling and a dull ache in the leg that worsens during the day. She has had varicose veins for many years but no other medical problems and takes no regular medicines.

On examination there is a shallow irregular ulcer in the gaiter area, superio-medial to the medial malleolus of her left leg, with surrounding brown pigmentation and eczema. The leg is warm, and pedal pulses are palpable. A picture is taken and can be seen below.

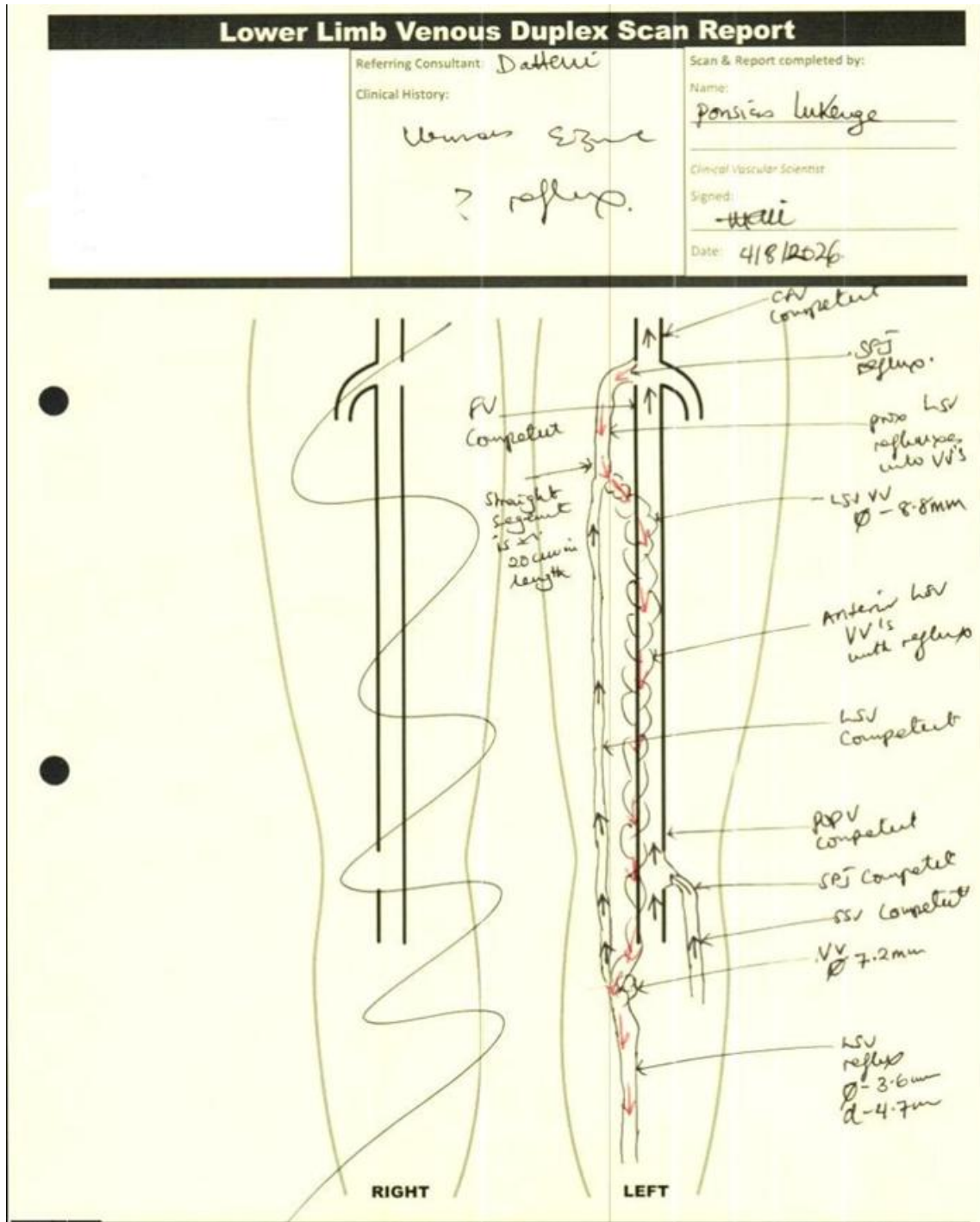


1. What type of leg ulcer is most likely?

2. State five clinical features from the history and examination that support this diagnosis?

3. State the definitive investigation to confirm the diagnosis.

A venous duplex scan confirms venous insufficiency with patent and competent deep veins with great saphenous vein reflux from the saphenofemoral junction down to the ulcer bed.



Compression therapy is considered.

4. When is this conservative intervention contraindicated? Justify your answer.
5. State three further conservative measures that may improve healing.
6. If conservative treatment options fail or are contraindicated, state two invasive treatment options for this patient's venous insufficiency.
7. What complications can arise from chronic venous ulceration?

Case 2

William Green, a 61-year-old man with a 20-year history of poorly controlled type 2 diabetes is referred to the vascular admission unit from his GP with a painless plantar ulcer under the right forefoot. He noticed it 3 weeks ago but sought help only when his wife saw discharge on his sock. He reports long standing, progressive numbness in both feet. The GP reports poor diabetic control.

On examination his observations are pulse 90 per minute, blood pressure 139/82, saturations 98% on room air, respiratory rate 18/minute, temperature 37.7 °C. There is a 2 cm ulcer under the first metatarsal head with surrounding callus and malodour. The foot is warmer than the contralateral foot. Sensation to monofilament testing is reduced. Pedal pulses are weakly palpable.



A diabetic foot ulcer is suspected.

1. State which complication of diabetes has contributed to development of this ulcer?
2. State four factors present in this patient's history and examination that indicate infection in the foot.
3. State four bedside assessments that should be performed on the foot?

4. Why must vascular status still be assessed even if the foot feels warm?

Osteomyelitis is suspected.

5. State two radiological investigations that can be performed to exclude osteomyelitis.

6. Refer to the NICE guidelines below. Outline the principles of management of a diabetic foot ulcer.

[Recommendations | Diabetic foot problems: prevention and management | Guidance | NICE](#)

7. What is meant by off-loading and why is it crucial to implement?

8. State three possible complications of inadequately assessed and treated diabetic foot infections?

Case 3

Martin Evans, a 73-year-old man, presents with a 2-month history of a painful ulcer on the medial aspect of his left foot. The pain is worse at night and when the leg is elevated. He has a past medical history of hypertension, chronic kidney disease stage 3, and hyperlipidaemia. He takes amlodipine 10mg OD and atorvastatin 10mg OD. He has a 40 pack-year smoking history.

On examination there is a 15mm punched-out ulcer over the medial aspect of the metatarsal head. The surrounding skin is shiny, hairless and cool. Capillary refill is delayed and foot pulses are absent.



An arterial ulcer is suspected.

1. Which features differentiate this ulcer from a venous ulcer?

2. Why is pain often severe in arterial ulceration?
3. ABPIs are requested. What further radiological investigations are required?
4. What are the conservative, medical and surgical principles of treatment?
5. When is urgent vascular referral indicated?

Case 4

Consider the following three ulcers:

Patient A: A shallow exudative ulcer in the gaiter area with oedema and hyperpigmentation

Patient B: A painful punched-out ulcer on the lateral malleolus, cold foot, absent pulses

Patient C: A plantar ulcer under the first metatarsal head, reduced sensation, surrounding callus



8. Match each patient to the most likely ulcer type, justifying your answers.

A:

B:

C:

9. Describe the typical site, appearance, and associated limb findings for venous ulcers, arterial ulcers, and diabetic neuropathic ulcers.

Ulcer type	Location	Appearance	Associated findings
Venous			
Arterial			
Diabetic neuropathic			

10. Why is pulse examination essential in every patient with a leg ulcer?

11. What is the role of ankle-brachial pressure index in ulcer assessment?

12. Outline the broad management principles for each ulcer type.

Venous ulcers:

Arterial ulcers:

Diabetic neuropathic ulcers:

Session 5

Case 1

A 58-year-old woman presents with a red, swollen, painful right lower leg that developed over 24 hours. She has mild fever and finds walking uncomfortable. She has recently completed treatment for breast cancer. Her calf is tender and larger than the opposite side.



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1. State 5 differential diagnoses for a swollen painful leg.
2. Which historical features help distinguish DVT, cellulitis, ruptured Baker's cyst, superficial thrombophlebitis, and lymphoedema?
3. Which examination findings are most useful?
4. What red flags suggest pulmonary embolism?
5. What initial investigations may be appropriate?

6. When should empirical anticoagulation be given before imaging?

7. Construct a safe initial management plan for this patient.

High-yield summary notes

Chronic arterial insufficiency

- Usually caused by atherosclerotic narrowing of limb arteries.
- Presents with intermittent claudication and, in severe disease, rest pain, ulceration, or gangrene.
- Examine for reduced pulses, cool limb, hair loss, shiny skin, and delayed capillary refill.
- First-line bedside test: ankle-brachial pressure index.
- Management includes smoking cessation, exercise therapy, antiplatelet therapy, statin, and risk-factor control.
- Critical limb-threatening ischaemia requires urgent vascular assessment.

Acute limb ischaemia

- Usually due to embolism or acute thrombosis.
- Think of the 6 Ps: pain, pallor, pulselessness, paraesthesia, paralysis, and perishingly cold.
- Urgent heparin is needed unless contraindicated.
- Rapid specialist involvement is essential.

Venous insufficiency and DVT

- Venous insufficiency causes aching, heaviness, oedema, skin pigmentation, and ulceration.
- DVT typically causes a swollen painful calf with warmth and tenderness.
- Duplex ultrasound is central to diagnosis in both reflux disease and DVT, but used for different purposes.
- Always consider pulmonary embolism.

Abdominal aortic aneurysm

- Often asymptomatic until found incidentally or until rupture.
- Rupture classically causes abdominal or back pain, shock, and a pulsatile mass.
- Stable patients usually undergo CT angiography.
- Unstable patients may need immediate operative management.

Leg ulcers

- Venous ulcers: gaiter area, shallow, exudative, associated with oedema and pigmentation.
- Arterial ulcers: distal, painful, punched out, associated with poor perfusion.
- Diabetic ulcers: pressure points, callus, neuropathy, often relatively painless.
- Always assess arterial supply before compression.