



ASSESSMENT AND EVALUATION OF LOWER LIMB ARTERIAL DISEASE

Mr Mark E. O'Donnell Consultant Vascular and Endovascular Surgeon

DipSEM(GB&I) MB BCh BAO(Dist) MFSEM(UK) MFSEM(RCSI&RCPI) MFSTEd MMedSc(Dist) MD ECFMG RPVI(ARDMS) FRCSEd(Gen&Vasc Surg) FEBVS(Hon)

ASiT MRCS Part B (OSCE) Course – 7th September 2016



Learning Outcomes

- Describe the clinical presentation for patients with lower limb peripheral arterial disease (PAD).
- Revise cardiovascular risk factors.
- Describe clinical examination.
- Explore investigative modalities.
- Evaluate and classify treatment modalities for PAD.





Atherosclerosis – A Systemic Process

Cerebrovascular disease

- Ischaemic stroke.
- Transient Ischaemic Attack (TIA).

Cardiovascular disease

- Myocardial Infarction (MI).
- Angina (stable/unstable).

Peripheral arterial disease (PAD)

- \rightarrow Intermittent claudication
 - Pain on walking.
- \rightarrow Severe limb ischaemia
 - Rest pain.
- Gangrene, necrosis.
 Safe Personal Effective



Atherosclerosis – A Systemic Process





Hankey GJ, JAMA 2006

Hankey GJ, JAMA 2006

Peripheral Arterial Disease

- 20% of people over 55 years of age.
 - 27 million people affected in Europe and USA.
- Only 10-30% of patients will have symptoms.
 - McDermott MM, Cleve J Clin Med 2006
- Symptoms deteriorate in 25% of patients.
- 2% to 4% will require amputation.
- Dormandy J, Semin Vasc Surg 1995

Schmieder FA, Am J Cardiol 2001

The Epidemiology of PAD



0.1% Critical limb ischaemia

East Lancashire Hospitals NHS

NHS Trust

5% Intermittent claudication

10% Asymptomatic (ABPI<0.9)

50% Asymptomatic (2D USS)



Natural History of PAD

East Lancashire Hospitals

NHS Trust



Natural History of PAD

East Lancashire Hospitals

NHS Trust



Natural History of PAD

East Lancashire Hospitals

NHS Trust





Relative 5-Year Mortality Rates



Safe Personal Effective

Diabetes

- 15% of diabetics are affected by PAD at 10 years following diagnosis, rising to 45% at 20 years.
- 20% of patients with PAD have diabetes.
- PAD disease distribution different in diabetes.
- Strandness *Diabetes* 1961.

Muribato *Circulation* 1997.

- PAD more aggressive in diabetics with an 11-times higher rate of major lower limb amputation and a doubling of the five-year mortality.
 Elhadd Pract Diabetes Int 1999
- Diabetic ulcers heal more slowly and are the main cause of non-traumatic lower limb amputation in developed countries.

Caputo N Engl J Med 1994

• Kreines *Diabetes Care* 1985.





Clinical History





Pain

- Site.
- Radiation.
- Intensity.
- Duration.
- Onset.
- Character.





Pain

- Site Calf, thigh or buttock.
- Radiation Generally radiates proximally.
- Intensity Increasing intensity as walking progresses. Causes walking to cease.
- Duration Fairly constant duration.
- Onset Fairly constant onset time.







Medical History

- Precipitating Factors.
- Alleviating Factors.
- Deterioration.
- Co-existing disease.
- Other causes.





Medical History

- Precipitating Factors:
 - Walking / exertion.
- Alleviating Factors:
 - Rest.
- Deterioration:
 - Can vary.
- Co-existing disease:
 - Cardiovascular disease.
- Other causes:
 - Back pain, arthritis or other orthopaedic pathology.



Additional Information

- How far ?
- What exactly stops walking ?
- Can you walk through the pain ?
- Flat or inclines better ?
- Timescale of progress ?
- Comparison of date-lines ?





Intermittent Claudication

- Claudication means to limp.
 - (Latin: Claudicare)
- Defined as the presence of ;
 - reproducible crampy lower limb pain.
 - precipitated by walking.
 - relieved by rest.
 - with an ankle brachial-pressure index less than 0.9.





Clinical Presentation

- No pain at rest or during the 1st few steps.
- A relatively consistent walking distance.
- Relief on standing for 1-3 minutes.
- No need to sit or lie.
- Recurrence on walking a similar distance.
- Worse on walking quickly or uphill.





Critical Ischaemia

- Defined as;
 - Rest pain with tissue loss +/- gangrene.
 - Requiring regular analgesia for a period greater than 2 weeks.
 - ABPI <0.3 or ankle pressure less <30mmHg (40mmHg in Diabetics).
- Indicates significant threat of limb loss.





Clinical Presentation

- Rest pain is defined as;
 - Characteristically boring, gnawing and severe pain.
 - Worse at night.
 - Present in the foot or toes and not the calf or thigh.
- True rest pain will wake the patient from sleep and requires strong opioid analgesia.
- Lying the limb in a dependant position may relieve the pain.





- Sciatica / Spinal Stenosis:
 - History of disc or back trouble.
 - Pain felt in back, down buttock and thigh.
 - No characteristic relationship to exercise.
 - Limited straight leg raising.
 - Neurological signs muscle wasting, loss of power, reflexes and sensation.





- Osteoarthritis of the Hip:
 - Difficult to distinguish as pain is exacerbated by exercise.
 - Pain felt in hip joint and may be referred to the knee.
 - Varies from day to day.
 - Worse at the end of the day.





- Cauda Equina Claudication.
 - Two distinct pathologies.
 - Very difficult to distinguish.
 - Disc Pathology partial compression cauda equina by a prolapsed disc.
 - Aorto-iliac disease on exercise, a drop in blood pressure leads to ischaemia of the cauda equina.





- Anterior Tibial Compartment Syndrome:
 - Occurs in younger people.
 - More likely after unaccustomed exercise.
 - Pain felt in the anterior part of the lower leg.



East Lancashire Hospitals NHS

NHS Trust

Condition	Prevalence	Anatomical Distribution	Character of Pain	Effect of Exercise	Effect of Rest	Effect of Position	Additional Factors
Thigh and Buttock Claudication	Rare	Buttock, hip and thigh	Crampy, aching discomfort	Reproducible onset (same distance for each episode)	Quickly relieved	None	Proximal pulses may be reduced combined with normal distal pulses
Calf Claudication	3% - 5% of the adult population	Calf muscles	Crampy, aching discomfort	Reproducible onset	Quickly relieved	None	May have atypical symptoms on exercise
Foot Claudication	Rare	Foot arch	Severe pain on exercise	Reproducible onset	Quickly relieved	None	Numbness can also be associated with pain
Venous Claudication	Rare	Entire lower limb affected. Worse in calf.	Tight, bursting pain	Occurs after walking	Slow to settle	Elevation enhances recovery	Signs of deep venous congestion and oedema present. May have history of iliofemoral thrombosis
Chronic Compartment Syndrome	Rare	Calf muscles	Tight, bursting pain	Occurs after walking	Very slow to settle	Elevation enhances recovery	Tends to affect heavily muscled athletes
Spinal Stenosis	Common	Buttocks and posterior aspects of lower limb. Often bilateral	Pain and weakness	Occurs with exercise and can mimic claudication	Varies but can have a prolonged recovery time	Lumbar spine flexion eases discomfort	Exacerbated by standing and extending spine
Nerve Root Compression	Common	Radiation of pain down lower limb	Sharp	May be induced by sitting, standing or walking	Often present at rest	Positional change can improve symptoms	History of back pain
Bakers Cyst	Rare	Behind knee down calf	Tenderness and associated swelling	Occurs with exercise	Present at rest	None	Usually a constant discomfort
Hip Arthritis	Common	Lateral aspect hip and thigh	Dull to severe ache	Can occur following a period of exercise	Not relieved quickly	Rest and minimal weight bearing helps	Symptoms can vary. Increased in patients with high BMI
Foot or Ankle Arthritis	Common	Ankle and foot arch	Aching pain	Variable onset following exercise	Not quickly relieved	Rest and minimal weight bearing helps	Variable. Can relate to exercise but present at rest

Differential diagnoses for lower limb exertional symptomatology.

Safe Personal Effective

O'Donnell, Ulster Med J 2011







- Constitutional:
 - Male Sex.
 - Age.
 - Family History.
 - ACE II Gene Deletion Polymorphism.





- Hard Risk Factors:
 - Blood Pressure.
 - Cholesterol.
 - Cigarettes.
 - Diabetes.





- Soft Risk Factors:
 - Lack of Exercise.
 - Obesity.
 - Stress.





The "At-Risk" Population

- Age < 50 years with diabetes, and one additional risk factor (e.g., smoking, dyslipidemia, hypertension, or hyperhomocysteinemia).
- Age 50 to 69 years *and* history of smoking or diabetes.
- Age \geq 70 years.
- Leg symptoms with exertion (suggestive of claudication) or ischaemic rest pain.
- Abnormal lower extremity pulse examination.
- Known atherosclerotic coronary, carotid or renal artery disease.



Clinical Examination





Clinical Examination

- Inspection.
- Palpation.
- Auscultation.
- Traditional Tests.
- Complete Cardiovascular Assessment.





Inspection

- Colour:
- Pink.
- Red.
- White.
- Blue.
- Black.




























Inspection

Colour:

Pink, Red, White, Blue, Black.

- Trophic Changes:
 - Shiny skin.
 - Hair loss.
 - Loss of subcutaneous tissue.





Inspection

- Colour:
- Pink, Red, White, Blue, Black.
- Trophic Changes:
 - Shiny skin, hair loss, loss of subcutaneous tissue,
- Ulceration at Pressure Points:
 - Lateral side of foot, head of 1st metatarsal, heel, malleoli.
 - Tips and between the toes.







































Palpation

• Temperature of skin.

• Capillary Refill.





Pulses

- Femoral.
- Popliteal.
- Posterior Tibial.
- Dorsalis Pedis.





Femoral Artery

 Feel for the mid-inguinal point which is mid-way between the symphysis pubis and anterior superior iliac spine.





Popliteal Artery

 Ask the patient to bend their knee. Place the thumbs on the tibial tuberosity and feel the pulse behind the knee with 8 finger tips.





Posterior Tibial Artery

 Palpate the artery mid-way between the medial malleolus and the prominence of the heel.







Dorsalis Pedis Artery

 Look for the mid-line between the medial and lateral malleoli. Palpate down a line extending from this point to the web space between the 1st two toes just lateral to extensor hallucis longus.







Traditional Bedside Evaluation

Arterial Insufficiency

- Elevate leg to about 15°
- Look for venous guttering.





Traditional Bedside Evaluation

Buerger's Angle:



- Elevate leg.
- Continue with leg elevation until the limb becomes pale.
- Note the angle from the horizontal baseline at which this occurs.
- This is Buerger's Angle.











Traditional Bedside Evaluation

Buerger's Test:



- Next, ask the patient to hang the leg over the side of the bed.
- Note the time of venous filling.
- Assess for the presence of reactive hyperaemia on dependency.
- If the foot goes crimson Buerger's +ve Test.



East Lancashire Hospitals





Systemic Examination

- Blood Pressure.
- Auscultation of the Heart.





Systemic Examination

Palpation of the Abdomen.







Haematological Analyses





Full blood picture

- Haemoglobin:
 - Anaemia Acute vs. Chronic.
- White Cell Count:
 - Inflammation / Infection.
- Platelets:
 - Clotting potential.
- Indices:
 - Mean Cell Volume.
 - Packed Cell Volume.





Urea and electrolytes

- Sodium.
- Potassium.
- Urea.
- Creatinine / eGFR:
 - CTA / MRA scanning.
 - Angiogram.
- Other electrolytes:
 - Calcium.
 - Magnesium.





Coagulation screen

- Prothrombin Time (PT).
- Activated Partial Thromboplastin Time (APTT):
 - Heparin.
- International Ratio (INR):
 - Warfarin.





C-reactive protein

- Inflammation / Infection.
- Trends / Progress.





Risk factor analysis

- Fasting Glucose.
- Fasting Lipid Profile.

- Vasculitis Screen.
- Thrombophilia screen.
- Thyroid Function Tests.





Wound Evaluation





Tissue Sample

- Tissue Sample / Biopsy.
- Bone.





Wound swabs no longer suggested.





Plain X-ray

- Evaluate for bony destruction.
- Surveillance.







Magnetic Resonance Imaging





Nuclear Imaging





Vascular Investigation





Vascular Investigation



Ankle-Brachial Pressure Index.






- Cuff was inflated to 10mmHg above systolic pressure and deflated at 2 mmHg/s.
- The first reappearance of the pulse was taken as the systolic pressure.

Systolic ankle pressure (mm Hg)

Systolic brachial pressure (mm Hg)

East Lancashire Hospitals



- Resting ABI of < 0.90 indicates a haemodynamically significant arterial stenosis.
- An ABI < 0.90 is also 95% sensitive in detecting arteriogram-positive lesions in symptomatic individuals.
- Calcification and inability to compress the arteries can occur in patients with diabetes or renal insufficiency resulting in a false elevation of ankle pressures, leading to an ABI <u>></u> 1.4.

ABPL as a Predictor of Risk East Lancashire Hospitals





ABPI – Prediction of Mortality





Segmental Waveforms



Index









Exercise ABPI

Confirms the PAD diagnosis.

 Assesses the functional severity of claudication.

May "unmask" PAD when resting the ABI is normal.



Vascular Investigation



- Ankle-Brachial Pressure Index.
- Arterial Duplex.





Arterial Duplex

- Duplex ultrasound of the extremities is useful to diagnose anatomic location and degree of stenosis of peripheral arterial disease.
- Duplex ultrasound is useful to provide surveillance following femoralpopliteal bypass using venous conduit (but not prosthetic grafts).
- Duplex ultrasound of the extremities can be used to select candidates for:
 - endovascular intervention.
 - surgical bypass.
 - select the sites of surgical anastomosis.





Arterial Duplex





Vascular Investigation



- Ankle-Brachial Pressure Index.
- Arterial Duplex.
- Magnetic Resonance Angiography.





NHS Trust

Magnetic Resonance Angiogram





Vascular Investigation



- Ankle-Brachial Pressure Index.
- Arterial Duplex.
- Magnetic Resonance Angiography.
- Computerised Tomography Angiology.





Computerised Tomography Angiogram





Vascular Investigation



- Ankle-Brachial Pressure Index.
- Arterial Duplex.
- Magnetic Resonance Angiography.
- Computerised Tomography Angiology.
- Transfemoral Angiography.





Transfemoral Angiography





Vascular Investigation



- Ankle-Brachial Pressure Index.
- Arterial Duplex.
- Magnetic Resonance Angiography.
- Computerised Tomography Angiology.
- Transfemoral Angiography.





Treatment Goals





Treatment Goals





Why have PAD Guidelines ?

- To enhance the quality of patient care.
- Increasing recognition of the importance of atherosclerotic lower extremity PAD:
 - High prevalence.
 - High cardiovascular risk.
 - Poor quality of life.
- The evidence base has become increasingly robust, data-driven care guidelines are now possible.







Editors: Lars Norgren and William R Hiatt Associate Editors: John A Dormandy and Mark R Nehler Contributing Editors: Kenneth A Harris and F Gerry R Fowkes Consulting Editor: Robert B Rutherford

Journal of Vascular Surgery 2007;45:1S-67S, European Journal Vascular & Endovascular Surgery 2007;33:S1-S75

East Lancashire Hospitals

TASC II Guidelines

- Epidemiology of PAD.
- Management of CV risk factors and co-existing disease.
- Intermittent claudication.
- Chronic critical limb ischemia.
- Acute limb ischemia.
- Revascularisation.
- Non-invasive vascular laboratory and imaging.







- IA Evidence from meta-analysis of randomized controlled trials.
- **IB** Evidence from at least one randomized controlled trial.





- IA Evidence from meta-analysis of randomized controlled trials.
- **IB** Evidence from at least one randomized controlled trial.
- IIA Evidence from at least one controlled study without randomisation.
- IIB Evidence from at least one other type of quasi-experimental study.





- IA Evidence from meta-analysis of randomized controlled trials.
- **IB** Evidence from at least one randomized controlled trial.
- IIA Evidence from at least one controlled study without randomisation.
- IIB Evidence from at least one other type of quasi-experimental study.
- III Evidence from non-experimental descriptive studies, such as comparative studies, correlation studies, and case-control studies.





- IA Evidence from meta-analysis of randomized controlled trials.
- **IB** Evidence from at least one randomized controlled trial.
- IIA Evidence from at least one controlled study without randomisation.
- IIB Evidence from at least one other type of quasi-experimental study.
- III Evidence from non-experimental descriptive studies, such as comparative studies, correlation studies, and case-control studies.
- IV Evidence from expert committee reports or opinions or clinical experience of respected authorities, or both.



Grades of Recommendation

- Grade A
 - Based on the criterion of a least one randomised, controlled clinical trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation.
- Grade B
 - Based on well-conducted clinical studies but no good quality randomised clinical trials on the topic of recommendation.
- Grade C
 - Based on evidence obtained from expert committee reports or opinions and / or clinical experiences of respected authorities.



Conservative





Modifiable Risk Factors



Gender reassignment



Stop smoking



Safe Personal Effective

Treat hypertension & stress



Smoking Cessation

 All patients who smoke should be strongly and repeatedly advised to stop smoking. A

All patients who smoke should receive a program of physician advice, group counselling sessions and nicotine replacement.
 A

 Cessation rates can be enhanced by the addition of antidepressant drug therapy (buproprion) and nicotine replacement. A



Exercise Rehabilitation

 Supervised exercise should be made available as part of the initial treatment for all patients with PAD. A

 The most effective programs employ treadmill or track walking that is of sufficient intensity to bring on claudication, followed by rest, over the course of a 30-60 minute session. A

 Exercise sessions should be typically conducted three times per week for three months. A



Medical



Antiplatelet Therapy

- All symptomatic PAD patients with or without a history of other cardiovascular disease should be prescribed an antiplatelet drug long term to reduce the risk of cardiovascular morbidity and mortality. A
- Aspirin is effective in patients with PAD who also have clinical evidence of other forms of cardiovascular disease (coronary or carotid). A
- Clopidogrel is effective in reducing cardiovascular events in a subgroup of patients with symptomatic PAD, with or without other clinical evidence of cardiovascular disease.
 B Safe Personal Effective



Hyperlipidaemia

- All symptomatic PAD patients should have their low-density lipoprotein (LDL) cholesterol lowered to <2.59mmol/l (<100mg/l). A
- A further reduction of LDL cholesterol down to <1.81mmol/l (<70mg/l) in patients with vascular disease in additional sites.
 B
- All asymptomatic patients with PAD should have their LDL cholesterol lowered to <2.59mmol/l (<100mg/l).



Hyperlipidaemia

- Dietary modification should be the initial intervention to control abnormal lipid levels.
- In symptomatic PAD patients, statins should be the primary agent to lower LDL cholesterol levels to reduce cardiovascular events. A
- Fibrates and / niacin should be considered in PAD patients with abnormal high density lipoprotein cholesterol and triglyceride levels.





Diabetes

 Patients with diabetes and PAD should have aggressive control of blood sugar levels with a haemoglobin A1c (HbA1c) goal of <7.0% or as close to 6% as possible.





PAD Specific Pharmacotherapy

A three to six month course of cilostazol should be first-line pharmacotherapy for the relief of claudication symptoms, as evidence shows both an improvement in treadmill exercise and quality of life. A

 Naftidrofuryl (Praxilene[®]) can also be considered for the treatment of claudication symptoms. A

No recommendation for the use of pentoxifylline.




Initial Claudication Distance





Absolute Claudication Distance





PAD Specific Medical Therapies

- Cilostazol.
- Naftidrofuryl.
- Pentoxifylline.
- Carnitine.
- Prostanoids.
- Ginkgo Biloba.
- Verapamil.
- Inositol Nicotinate.
- Buflomedil.
- Gene Therapy.
- Stem Cell Therapy.
- Other drugs not in active use.
- Venoactive Therapies.





Acute Limb Ischaemia

- Associated with significant morbidity and mortality.
- Clinical assessment is paramount.
- Remember;
 - Evaluate the contralateral limb.
 - Administer heparin early.
 - If you think about a fasciotomy DO IT !!!!





Consent

- General Local Complications;
 - Pain, Bruising, Bleeding, Wound infection.
- Systemic Complications;
 - Cardiovascular, Respiratory, Thromboembolic.

- Procedural Specific Complications;
 - Graft sepsis.
 - Graft occlusion and distal ischaemia.
 - Lim loss.
 - Nerve injury.
 - Failure to improve symptoms.





Endovascular Treatment







Endovascular Treatment









Surgical Intervention







Surgical Intervention







Arterial Anatomy of the Groin







Arterial Anatomy of the Thigh





Vein Harvest







Subfascial Tunnel Creation





Proximal Anatomosis





Distal Anastomosis





Completion





Important Literature







BASIL Trial

- Bypass versus Angioplasty in Severe Ischaemia of the Leg;
 - 452 patients with severe infra-inguinal arterial disease to receive surgery first (n=228) or angioplasty first (n=224).
- Similar amputation-free survival.
- Surgery more expensive.





BASIL 2 and 3

BASIL 2;

 Vein bypass first or best endovascular first revascularisation strategy for severe ischaemia due to infra-popliteal disease.

- BASIL 3;
 - Clinical and cost-effectiveness of drug-coated balloons, drug eluting stents and plain balloon angioplasty with bail-out bare metal stent revascularisation strategies for severe ischaemia secondary to femoro-popliteal disease.



Why Prescribe Aspirin?





Why Prescribe Aspirin?

- Antithrombotic Trialists' Collaboration reported that antiplatelet therapy was associated with a 23% reduction in non-fatal MI, non-fatal stroke and vascular death in patients with PAD.
- The clopidogrel versus aspirin in patients at high risk of ischaemic events trial (CAPRIE) showed that clopidogrel reduced the relative risk of major vascular events by 8.7% compared to aspirin.





Why Prescribe Aspirin?

- Antithrombotic Trialists' Collaboration reported that antiplatelet therapy was associated with a 23% reduction in non-fatal MI, non-fatal stroke and vascular death in patientswith PAD.
- The clopidogrel versus aspirin in patients at high risk of ischaemic events trial (CAPRIE) showed that clopidogrel reduced the relative risk of major vascular events by 8.7% compared to aspirin.
- Remember dual antiplatelet therapy in infrainguinal procedures, complex or redo surgeries.

Safe Personal Effective

Antitrombotic Trialists' Collaboration BMJ 2002; 324: 71-86.



Why Prescribe Statins ?





Why Prescribe Statins ?

- Medical Research Council (MRC) recommended statin therapy for all patients with PAD where simvastatin 40mg daily resulted in a 22% relative risk reduction in rates of MI, stroke and revascularisation in patients with PAD with a cholesterol level >3.5mmol/L.
- Walking performance improvements.
- Potential reduction in plaque volume.
 Heart Protection Study Lancet 2002; 360: 7-22.









Case 1

78 year old lady with atrial fibrillation presents with sudden inability to weight bear and states he foot feels "icy cold".





Case 2

 52 year old male diabetic smoker complains of severe reductions in walking distance. His podiatrist states he has an ulcer overlying his first metatarsal head.





Fasciotomy

https://www.youtube.com/watch?v=-1NDJkFH1vM





Questions ?



