Diagnosing Peripheral Arterial Disease, Critical Limb Ischemia and Non-healing Wounds

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• Diagnosing Peripheral Arterial Disease (PAD), Critical Limb Ischemia (CLI) and Non-healing Wounds

• Hands on, Tips and Tricks
• Maintenance and Calibration
• Interpreting Curves and Results
Introduction

The aim of this document is to describe Peripheral Arterial Disease (PAD), its complications and how to diagnose PAD with objective vascular tests.
Facts...

Worldwide there is:

- An increasing number of diabetics
- An aging population
Resulting in…

More patients with:

- Peripheral Arterial Disease (PAD)
- Critical Limb Ischemia (CLI)
- Complicated chronic wounds
- Amputations
Peripheral Arterial Disease (PAD)

What is PAD?
• Occlusions in the peripheral arteries causing ischemia in the lower extremities

Risk factors:
• Smoking, diabetes, high blood pressure, obesity, increasing age …

Prevalence:
• 3-10% in general, 15-20% people aged > 70

Problem: 2/3 of all patients with PAD show no symptoms!

Underestimation of disease!

Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASCII). Eur J Vasc and Endovasc Surgery, Vol 33, suppl 1 2007
Peripheral Arterial Disease PAD

Symptoms:

- **Walking pain - Intermittent Claudication (IC)**
  - Pain upon walking which disappear at rest
  - Cold legs and feet
  - Discoloration

- **Critical Leg Ischemia (CLI)**
  - Severe form of PAD
  - Rest pain
  - Ischemic ulcers and gangrene
  - High incidence of amputation and mortality

- **Non-healing wounds**
  - Often caused by Ischemia (PAD/CLI)
  - 15% of all diabetics develop ulcers
  - 14-24% with a foot ulcer require amputation, 85% of these amputations could be prevented with early diagnosis

“Ischemia should not be excluded as a cause of a diabetic foot ulcer unless proven absent.”

Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASCII). Eur J Vasc and Endovasc Surgery, Vol 33, suppl 1 2007
ESVS Guidelines for Critical Limb Ischaemia and Diabetic Foot, 2011
Objective Vascular Tests

It is recommended to confirm PAD/CLI with objective vascular tests:

- Ankle pressure – ABI
- Toe pressure - TBI
- tcpO₂
- PVR
- Segmental pressure
- Imaging techniques (Duplex, angiogram)

Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASCII). Eur J Vasc and Endovasc Surgery, Vol 33, suppl 1 2007
Why is objective diagnosis useful?
Crucial to Make the Right Decision

Objective vascular tests support clinical decisions

- Suspected ischemia, e.g. ulcer or pain
  - Confirm disease: ABI, toe pressure and tcpO₂
    - Conservative
      - Follow up: ABI, toe pressure and tcpO₂
    - Intervention
      - Assess severity: Toe pressure and tcpO₂
        - PTA
        - Bypass surgery
        - Amputation
          - Amputation level: Correct amputation with tcpO₂ avoiding re-amputations
Diagnosing PAD/CLI

- Diagnose if a patient is suffering from PAD/CLI
- Assess severity of disease
- Predict wound healing potential
- Decide treatment plan
  - Prioritize between patients
- Define optimal amputation level
- Qualify for Hyperbaric Oxygen Therapy (HBOT)
  - Better “success rate” for the doctor
- Evaluate treatment success
  - Follow up on treatment, plan for next step
Complications with diabetes

- Peripheral Arterial Disease (PAD) is more aggressive
- Increased prevalence for Critical Limb Ischemia (CLI)
- Neuropathy – reduces pain perception, feet are "warm"
- Calcified vessels – falsely elevated ABI
- Non-healing, diabetic foot ulcers
- Impaired microvascular functions
- High risk for amputations

More complex diagnosis
Common Objective Vascular Tests
Ankle Pressure, Ankle Brachial Index

• Most commonly used vascular test
• Simple and cheap
• ABI = Ankle pressure/Brachial pressure

Is ABI accurate enough?

• Risk for falsely high ABI values due to calcified vessels
  – Common in diabetics and end-stage renal disease patients
  – May result in underestimation of PAD/CLI

• Macrocirculatory measurement only
  – Skin microcirculation important factor for wound healing, macrocirculation is not enough
"Trust ABI when low but not when high."

- Toe pressures have proven to be an excellent option for the diagnosis of PAD in patients at risk for falsely elevated ABI values (ABI > 1.4)
- Toe arteries are smaller and more easy to occlude
- Accurate toe pressures require sensitive techniques such as laser Doppler

**PeriFlux 6000 solution**

- Laser Doppler used for detection
  - Sensitive at low pressures
  - Solution for cold ischemic feet – in-built local heating
  - Small probes easy to affix on all digits

Transcutaneous oxygen (tcpO₂ / TCOM)

Measures the local oxygen tension in the skin deriving from the local capillary (nutritive) blood perfusion.

- Predicts wound healing potential
- Helps define degree of small vessel disease
- Accurately determines amputation level
- Monitors efficacy of patients ongoing therapy
- Establishes candidacy for HBO treatment

PeriFlux 6000 solution
- Clarke type electrodes for detection
- Possibility to combine with pressure measurements
Pulse Volume Recording (PVR)

- Measures changes in pressure, reflecting arterial pulsatility (air plethysmography)
- The shape of the signal is affected by calcification of the arteries as well as occlusions

**Pulse Wave grading** based on Rumwell & McParlin
Pulse Volume Recording (PVR)

PVR can be performed at different positions of the leg, localizing significant occlusive lesions in limbs.
Segmental Pressures

- Similar to toe and ankle pressure, but different positioning of the cuffs
- Provide an initial indication of anatomical location of arterial occlusive lesions (often replaced with imaging techniques)
- Often combined with segmental pulse volume recordings (PVR).
Combine test for best diagnosis!

PeriFlux 6000
All recommended vascular tests in one instrument!

- Ankle pressure – ABI
- Toe pressure - TBI
- tcpO₂
- PVR
- Segmental pressure
PeriFlux 6000 Solution

Adapt tests and workflow to patient

Claudicant, no diabetes — ABI — Treadmill

Diabetic — ABI — Toe pressure

Diabetic with wound — ABI — Toe pressure — tcpO₂

Critical Limb Ischemia — ABI — Toe pressure — tcpO₂
Combine Tests for Best Diagnosis

Example: Male with painful left foot and amputated toes.

**Right foot:**
- Ankle pressure = 146 mmHg
- ABI = 1.22
- Toe pressure = 42 mmHg
- Baseline tcpO₂ = 43 mmHg

**Left foot:**
- Ankle pressure = incompressible arteries
- Toe pressure = no toes
- Baseline tcpO₂ = 42 mmHg

Normal Ankle Pressure and ABI. *Is this really reliable* or the beginning of media sclerosis and falsely elevated ABIs?

Results from several tests will give a better overview of the limb circulation. Here: Patient with clear PAD but no CLI.

Falsely normal ABIs!
PeriFlux 6000 intelligence combined

A unique combination of simultaneous vascular tests to speed up your diagnosis
PeriFlux intelligence combined

- Accurate ABI and toe pressure
- Segmental pressure and PVR
- Microvascular tests – tcpO₂
- Adapt tests and workflow to patient
- Step-by-step instructions, operator independent
- Parallel testing to save time
Reference Values for Diagnosis
Reference Values PAD/CLI – TASC II

Peripheral Arterial Disease

Objective testing is recommended in all patients:
- Age 50-69 years diabetics and/or smokers
- Age > 70 years
- Leg symptoms with exertion or reduced physical function
- Abnormal leg vascular exam
- Assessment of cardiovascular risk

Critical Limb Ischemia

Diagnosis should be supported by objective tests:
- Ankle Pressure
  - Patients with ischemic ulcers < 70 mmHg
  - Patients with ischemic rest pain < 50 mmHg
- Toe Pressure
  - Patients with ischemic ulcers < 50 mmHg
  - Patients with diabetes < 50 mmHg
  - Patients with ischemic rest pain < 30 mmHg
- tcpO₂
  - < 30 mmHg

Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASCII). Eur J Vasc and Endovasc Surgery, Vol 33, suppl 1 2007
Clinical history:
History to identify symptoms of PAD.
Palpation of pulses in the lower limb.

Non-invasive screening tests:
Hand-held Doppler evaluation of flow signals from both foot arteries
Ankle-Brachial Index (ABI)
Toe-Brachial Index when ABI is uncertain

PAD is likely when:
The patient has claudication or rest pain.
Both foot pulses are absent to palpation.
Absent or monophasic Doppler signals from one or both foot arteries
  TBI < 0.7
  ABI < 0.9

Assess severity of PAD (wound healing potential)

Mild PAD:
Palpable foot pulses
Toe pressure > 55 mmHg
tcpO₂ > 50 mm Hg
ABI > 0.6*

Evaluate the effect of maximum 6 weeks optimal wound care. Reassess perfusion and consider duplex ultrasound or angiography when wound healing response is poor.

Severe PAD
Significant ischemia, severely impaired wound healing:
Toe pressure < 50 mmHg
tcpO₂ < 30 mm Hg
ABI < 0.6

Consider revascularization

*Note: ABI > 0.6 has less predictive value, and in these patients, tcpO₂ or toe pressure should be measured.
Reference Values $\text{tcpO}_2$ / TCOM

**Reference values**

- 50-70 mmHg  Normal
- < 40 mmHg  Impaired Wound Healing
- < 30 mmHg  Critical Limb Ischemia

For a more extensive summary of diagnostic guidelines, please visit:
http://www.perimed-instruments.com/guidelines-diagnosis-PAD

For more detailed information about tcpO$_2$, please visit:
Thank You!

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