Noninvasive Diagnostic Options for Peripheral Artery Disease and Chronic Venous Insufficiency

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DISCLOSURE

Dr. Bongiovanni discloses that she has no financial or personal benefit relationship with any medical products distributor or manufacturer.
NON-INVASIVE EVALUATION OF PAD
VASCULAR ABNORMALITIES IN PERIPHERAL ARTERY DISEASE

MACROVASCULAR PROBLEMS
(Upstream flow obstructions)

MICROVASCULAR PROBLEMS
MACROVASCULAR PROBLEMS
ANKLE/BRACHIAL SYSTOLIC PRESSURE INDEX (ABI)

• Takes minutes to perform anywhere

• Equipment is very inexpensive

• Not user dependent

• Not reimbursed *per se*

• Very valuable community screening tool

• Diagnostically unreliable IN DIABETICS
Diagnosis of PAD, continued

- Sequential, segmental pressure measurement
- Arterial air plethysmography
  1. segmental pressure measurements
  2. arterial pressure pulse waveforms
  3. segmental/brachial systolic pressure indices
  4. forefoot and digital artery assessments
MACROVASCULAR PROBLEMS
MACROVASCULAR PROBLEMS, continued
PLANTAR ULCERS
Macrovascular problems, continued

All of the above foot ulcers occurred in patients in whom ABI > 0.80

This phenomenon is consistent with the presence of severe arterial medial calcification
PVR vs ABI

ABI = 1.14
ARTERIAL ULTRASONOGRAPHY
ARterial ultrasonography

Pros

• Allows for both insonation and visualization of the arterial lumen in real time

• Permits “mapping” of sites of arterial flow restriction

• Permits estimation of the degree of stenosis caused by visible lesions, both physically and hemodynamically
ARTERIAL ULTRASONOGRAPHY

Cons

• Equipment is expensive
• Very User Dependent
• Mapping is very time consuming
• Testing is only reimbursed when performed by certified personnel
IDENTIFYING MICROVASCULAR PROBLEMS
IDENTIFYING MICROVASCULAR PROBLEMS

- CAPILLARY REFILL TIMES > 2 sec
- PALE SKIN COLORATION THAT IS NOT POSTURE RELATED
- TcPO2 ratio < 0.9
TcPO$_2$

- TcPO$_2$ reference level @ mid- sternum
- TcPO$_2$ periwound measured <5 mm from wound bed
- Results reported as indices, i.e. $\text{TcPO}_2@\text{wound} / \text{referenceTcPO}_2 = \text{index}$
TCpO$_2$

- ABI = 0.90
- ABI = 0.86
- ABI = 0.89
- ABI = 0.94
Differential Dx of PAD

NONVASCULAR CAUSES

- Arthritic hips
- Restless Leg Syndrome
- Peripheral neuropathy
- Spinal stenosis
- Prolapsed intervertebral disc
- Popliteal artery entrapment
VASCULAR CAUSES

Diabetes mellitus
Arterial embolus
Thromboangiitis obliterans (Buerger’s Disease)
Deep venous thrombosis
Signs/Symptoms of PAD

Limb Examination and Contralateral Comparison

- Hair loss
- Poor nail growth (brittle nails)
- Anhydrous skin
- Dependent rubor/elevation pallor
Signs/Symptoms of PAD, continued

- Ischemic tissue/ulceration
- Absent/diminished pulses
- Arterial bruits
Diagnosis of PAD, continued

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CONCLUSIONS

• Noninvasive diagnostic tools are available, some are inexpensive, some are extremely accurate

• ABI measurements are valuable screening tools

• TCpO$_2$ and similar measurements can predict healing potential or define amputation level

• Ultrasonography can specifically identify flow-restricting lesions in both location and severity
Noninvasive Diagnostic Options for Chronic Venous Insufficiency
What is Chronic Venous Insufficiency (CVI)?

• AKA “venous reflux”

• Pooling (stasis) of blood in the lower extremities that occurs when vein walls weaken and venous valves do not close properly
CVI Manifestations
CVI Manifestations, cont.
CVI Manifestations, cont.
CVI CAUSES

• Damage to venous valves allows blood to leak backward resulting in elevated venous blood pressure

• Valve damage is caused by aging, extended sitting or standing, reduced mobility
CVI causes, cont.

- Thrombophlebitis affecting the deep veins in the legs (DVT)
- Pelvic tumors
- Vascular malformations
- Platelet aggregation
- Endothelial damage
- Intracellular edema
Symptoms of CVI

- Lower extremity edema, especially following extended periods of standing
- Aching or tiredness of the legs
- New varicose veins
- Induration and lipodermatosclerosis
- Stasis ulcers (venous ulcers, varicose ulcers)
CVI symptoms, cont.

- Increased capillary pressure causes rupture and leakage of blood into the skin. This results in red-brown discoloration known as stasis dermatitis. This is extremely prone to breaking down in response to scratching or blunt trauma.
Noninvasive Diagnostic Method of Choice:

Colorflow Duplex Ultrasonography
Diagnostic Advantages

- Venous segment evaluation occurs in real time
- Response to evocative maneuvers (e.g., augmentation, valsava) is visualized directly and documented in direction of flow change
- Painless testing
Diagnostic Advantages, cont.

- Specific areas of insufficiency are defined by the presence of reflux that occurs in response to augmentation and is visualized by directional flow changes.

- The number and location of incompetent valves, penetrating veins and varices are precisely defined.
DISADVANTAGES

• Expensive equipment
• Testing is extremely user dependent
• Testing is not reimbursed unless performed by certified technologists
• Can require extended periods of standing and/or upright sitting
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• Noninvasive diagnostic tools are available, some are inexpensive, some are extremely accurate.

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• Ultrasonography can specifically identify flow-restricting lesions in both location and severity.
CONCLUSIONS, cont.

- Colorflow duplex ultrasonography provides specific, real time visualization and insonation of extremity veins.

- Venous insufficiency is determined by the presence of venous reflux in response to evocative, augmentation maneuvers.
CONCLUSIONS, cont.

• Both arterial and venous ultrasonographic tests are highly user dependent and must be performed by credentialed personnel.

• Testing is painless but may require lengthy periods in order to provide specific and detailed information.
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