Peripheral Arterial Disease for the PCP

Hani Turkmani, M.D.

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Disclosures

- None

Overview

- Definition and epidemiology
- Risk factors
- Clinical assessment: symptoms, exam, testing
- Medical management
- Revascularization

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DEFINITION & EPIDEMIOLOGY

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Definition

- Peripheral vascular disease (PVD) encompasses both arterial and venous disease
- Peripheral arterial disease (PAD) includes atherosclerotic and non-atherosclerotic disease, such as vasculitis and fibromuscular dysplasia
- The focus of this talk is atherosclerotic arterial disease affecting the lower extremities

Epidemiology

- PAD presents medical, social and economic challenges
- The prevalence of PAD depends on method of detection
- By ankle-brachial index, PAD affects about 15-20% of people > 65 y of age
- By symptoms, about 2-5% of people > 65y of age have PAD
- About 8-10 million individuals in the US have PAD and about 200 million suffer from it world-wide
- 5-y survival of pts with claudication is 70% (75% deaths due to CVD)

Zipes, Douglas P., et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Elsevier, 2019.
Criqui, M. H., & Aboyans, V. (2015). Epidemiology of peripheral artery disease. Circulation Research, 116(9), 1509–1526. https://doi.org/10.1161/CIRCRESAHA.116.303849

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Legend:
NHW: Non-Hispanic whites
AA: African American
HS: Hispanic
AS: Asian
AI: American Indian

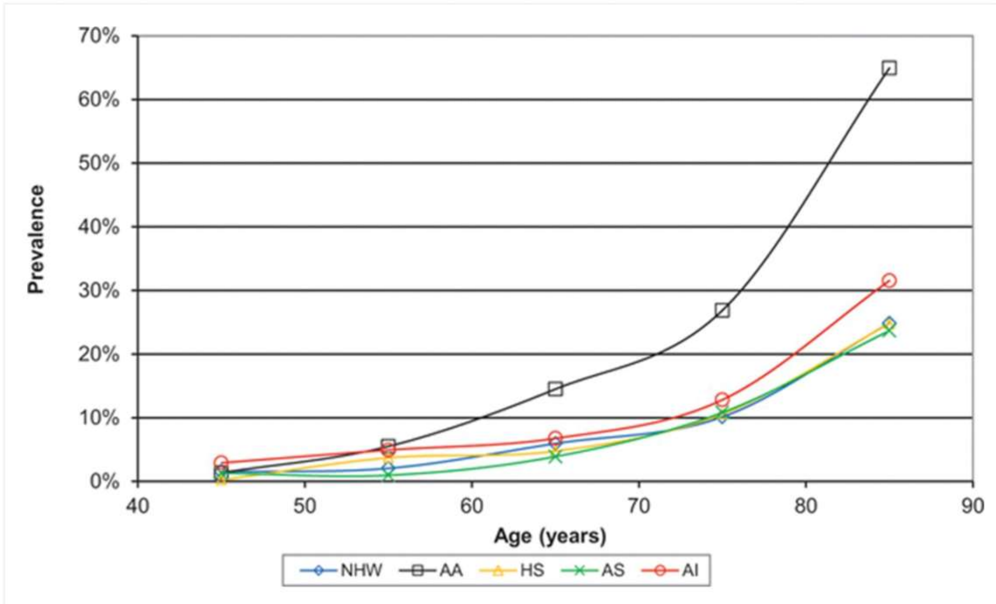

Figure 1. *Prevalence of PAD among men in the US. Adapted from "Epidemiology of Peripheral Artery Disease" by M. Criqui, 2015, Circulation Research, retrieved from: https://www.ahajournals.org/doi/10.1161/circresaha.116.303849*

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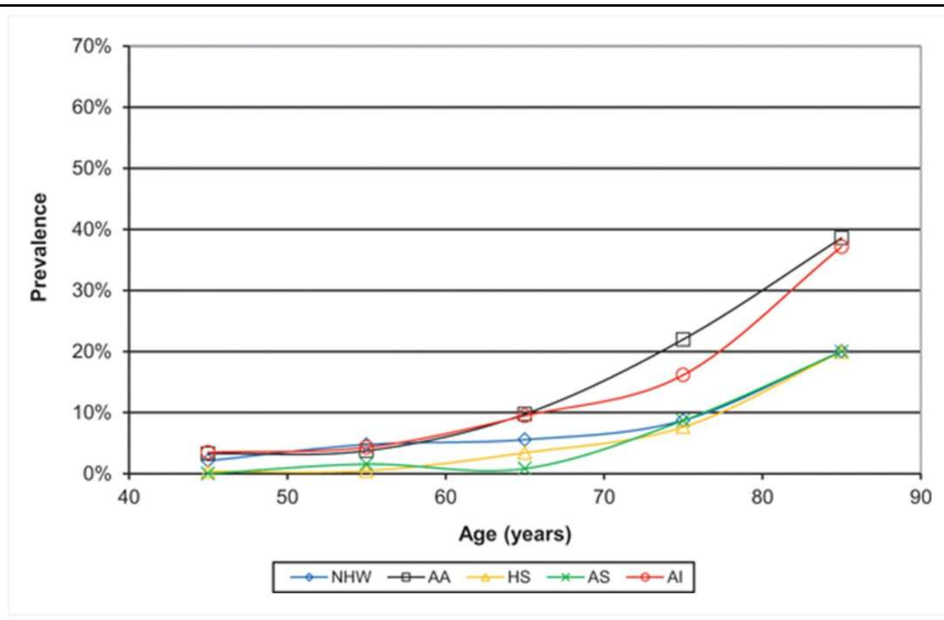

Figure 2. *Prevalence of PAD among women in the US. Adapted from "Epidemiology of Peripheral Artery Disease" by M. Criqui, 2015, Circulation Research, retrieved from: https://www.ahajournals.org/doi/10.1161/circresaha.116.303849*

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RISK FACTORS

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Risk Factors

- Similar to that of other atherosclerotic conditions
- Smoking: The most impactful of risk factors with a 4-fold increase in PAD risk in a dose-dependent manner
- Diabetes mellitus: About 3-fold increase in PAD risk, with tendency for extensive calcification and small vessel disease; increases risk for amputation
- Hypertension, hyperlipidemia, and inflammation also pose significant risk for the development of PAD

Zipes, Douglas P., et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Elsevier, 2019.
Criqui, M. H., & Aboyans, V. (2015). Epidemiology of peripheral artery disease. Circulation Research, 116(9), 1509–1526. https://doi.org/10.1161/CIRCRESAHA.116.303849

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CLINICAL ASSESSMENT

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Symptoms

- The primary symptom of PAD is intermittent claudication
- Comes from the Latin word “claudicare” -> “to limp” (Merriam-Webster)
- Caused by the demand-supply mismatch with exertion
- Usually described as cramping, the location of which correlates with level of stenosis
- Calf cramps are the most frequent because the gastrocnemius muscle is the most active during walking
- A non-atherosclerotic cause of LE pain is lumbago

Zipes, Douglas P., et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Elsevier, 2019.

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Symptoms

- Severe PAD causes symptoms at rest, such as pain and paresthesia
- Called critical limb ischemia or chronic limb-threatening ischemia
- Worse with leg elevation and improves with leg dependency (increased perfusion pressure)
- Patients with neuropathy can have minimal symptoms

Zipes, Douglas P., et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Elsevier, 2019.

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Physical Exam

- Palpation of femoral and pedal pulses is an essential part of exam in patients with LE symptoms
- Diminished pulse indicates a stenosis proximal to site of palpation
- Other signs include LE muscle atrophy, hair loss, smooth and shiny skin, foot ulcers

Zipes, Douglas P., et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Elsevier, 2019.

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Ulcers

Fig. 2.1 Neuropathic ulcer

Fig. 2.2 Ischemic ulcer

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Madassery, S., & Patel, A. (Eds.). (2023). Limb preservation for the vascular specialist: From wound care to wound closure (2023rd ed.). Springer International Publishing.

Ulcers

Fig. 2.4 Venous leg ulcer

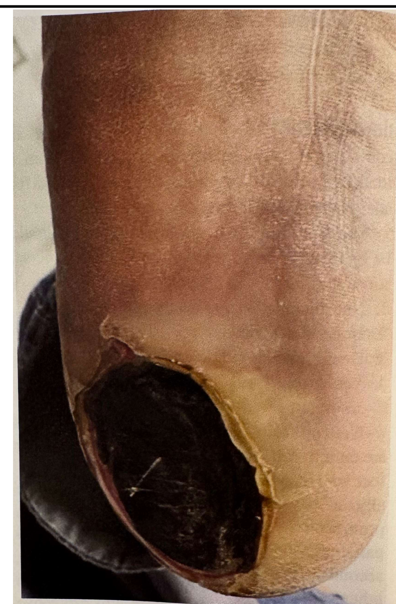

Fig. 2.3 Decubitus ulcer of heel

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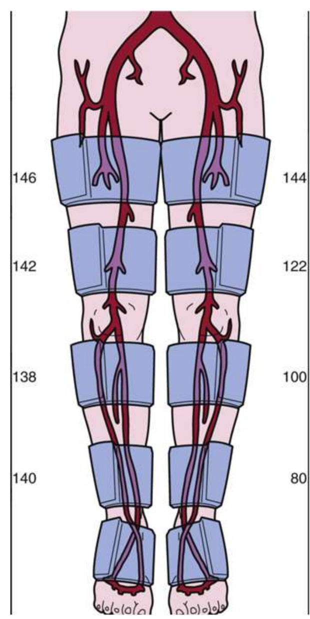
Madassery, S., & Patel, A. (Eds.). (2023). Limb preservation for the vascular specialist: From wound care to wound closure (2023rd ed.). Springer International Publishing.

TESTING

Non-Invasive Testing

Segmental BP measurement

- Systolic BP is measured along the LEs
- Amplification of BP waves leads to a higher SBPin the distal vessels compared to the aorta
- A drop of > 20 mmHg between 2 successive points indicates significant stenosis
- 90% aortic stenosis is needed for a resting gradient to exist
- 70% stenosis in the distal vessels is needed for a resting gradient to exist

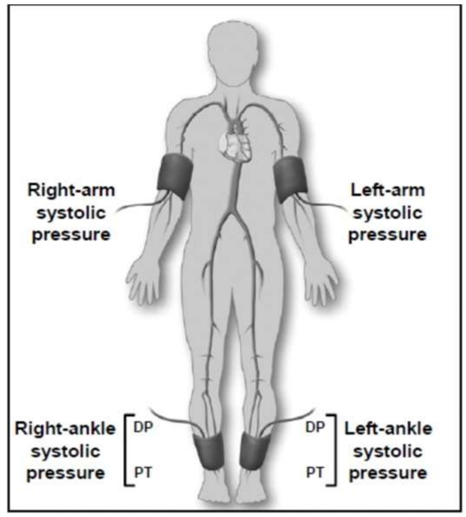


Zipes, Douglas P., et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Elsevier, 2019.
Mittleider D. Noninvasive arterial testing: what and when to use. Semin Intervent Radiol. 2018;35(5):384-392.

Non-Invasive Testing

Ankle-Brachial Index

- A highly specific and moderately sensitive test
- SBP at the ankle level is measured and compared to brachial SBP
- Results:
  - Normal 1-1.4
  - Borderline 0.9-0.99
  - Mild 0.7-0.89
  - Moderate 0.4-0.69
  - Severe <0.4
  - Non-compressible >1.4



Criqui. *NEJM*. 2004.

Zipes, Douglas P., et al. Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine. Elsevier, 2019.
Mittleider D. Noninvasive arterial testing: what and when to use. Semin Intervent Radiol. 2018;35(5):384-392.

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Non-Invasive Testing

Toe-Brachial Index

- Ratio of SBP in the great toe in comparison to brachial SBP
- A more reliable index in diabetic pts due to less medial wall calcification in the digital vessels
- Diabetics with an absolute toe SBP < 45 mmHg have poor wound healing without revascularization

Mittleider D. Noninvasive arterial testing: what and when to use. Semin Intervent Radiol. 2018;35(5):384-392.
Tehan P et al. Measurement of toe systolic pressures: a technique paper. Wound Practice and Research 2021; 29(3):148-153.

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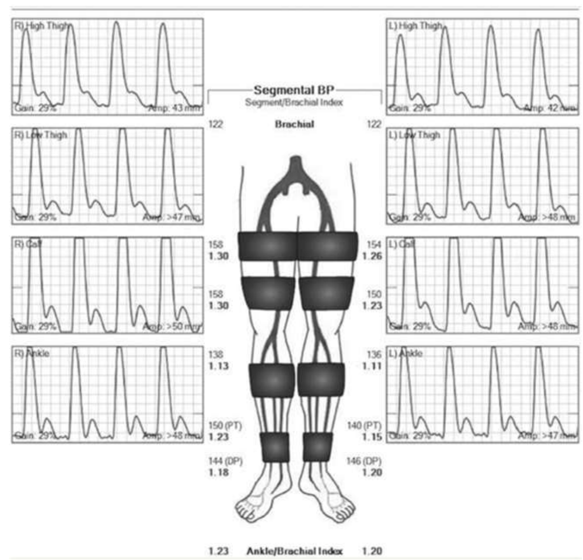
Non-Invasive Testing

Pulse Volume Recording

- Measures the change in volume of blood at the site of the inflated cuff
- Provides further insight into presence and degree of disease



Mittleider D. Noninvasive arterial testing: what and when to use. Semin Intervent Radiol. 2018;35(5):384-392.

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Non-Invasive Testing

Arterial Duplex Ultrasound

- Allows for direct visualization and physiologic assessment of lesions
- Assessment of blood flow velocity at the site of stenosis correlates with degree of stenosis
- Waveform morphology also allows better characterization of stenosis

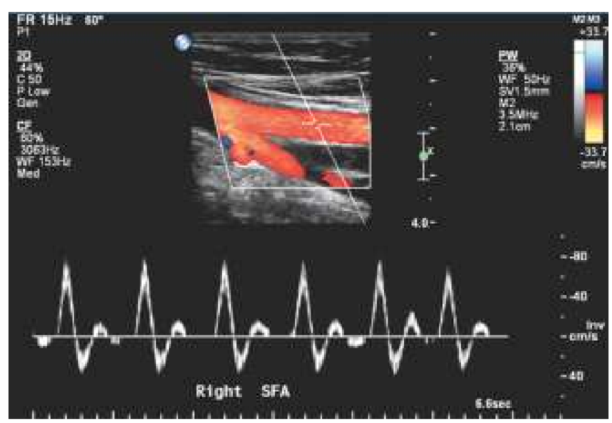

Figure: Ultrasound assessment of lower extremity arteries. Radiology Key. URL: https://radiologykey.com/ultrasound-assessment-of-lower-extremity-arteries-2/
Kim ES, Sharma AM, Scissons R, et al. Interpretation of peripheral arterial and venous doppler waveforms: a consensus statement from the society for vascular medicine and society for vascular ultrasound. Vasc Med. 2020;25(5):484-506.

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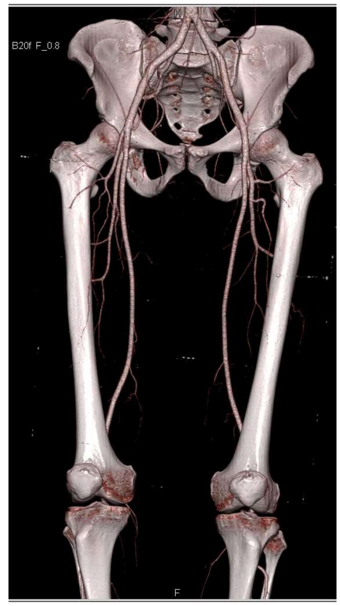
Non-Invasive Testing

CT Angiography

- A great tool that is readily available
- High sensitivity and specificity
- Does not provide physiologic information
- Limited by heavy arterial wall calcification (bloom artifact)



Figures: Cta runoff without vascular injury - trauma case studies - ctisus ct scanning. CTisus. URL: https://ctisus.com/teachingfiles/cases/trauma/341785

Mittleider D. Noninvasive arterial testing: what and when to use. Semin Intervent Radiol. 2018;35(5):384-392.

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INVASIVE ANGIOGRAPHY

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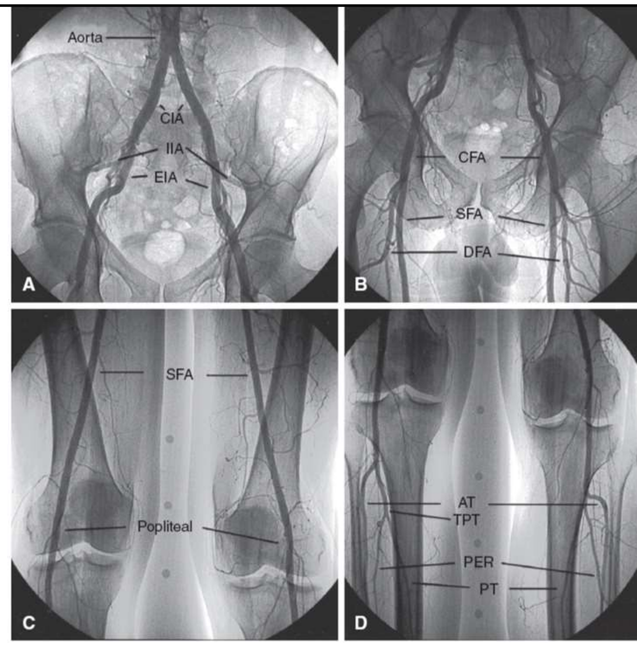
Invasive Angiography

- Gold standard test for PAD
- Reserved for pts with significant claudication or rest pain in who percutaneous or surgical treatment is indicated
- Access is usually femoral; however, there is a move towards radial access



Moscucci, M. (Ed.). (2020). Grossman & baim's cardiac catheterization, angiography, and intervention (9th ed.). Lippincott Williams and Wilkins.

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MEDICAL MANAGEMENT

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Goals of Management

- Symptomatic relief; rest pain and claudication
- Preserving limb viability
- Reducing total cardiovascular event risk

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Management

Risk Factor Modification

- Lipid-lowering therapy:
    - Moderate to high intensity statins are the mainstay agents
    - Goal is >50% reduction in LDL level
    - Statins reduced major adverse cardiac and limb events (MACE and MALE)
    - In a large meta-analysis including 138,000 PAD pts, statin therapy reduced risk of MLAE by 30%, amputation by 35% and MACE by 39%

Pastori D, Farcomeni A, Milanese A, et al. Statins and major adverse limb events in patients with peripheral artery disease: a systematic review and meta-analysis. Thromb Haemost. 2020;120(5):866-875.

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Management

Statin Intensity

	High Intensity	Moderate Intensity	Low Intensity
LDL-C lowering[†]	≥50%	30%–49%	<30%
Statins	**Atorvastatin (40 mg**[‡]**) 80 mg** **Rosuvastatin 20 mg (40 mg)**	**Atorvastatin 10 mg** (20 mg) **Rosuvastatin** (5 mg) **10 mg** **Simvastatin 20–40 mg**[§]	Simvastatin 10 mg
	...	**Pravastatin 40 mg** (80 mg) **Lovastatin 40 mg** (80 mg) Fluvastatin XL 80 mg **Fluvastatin 40 mg BID** Pitavastatin 1–4 mg	**Pravastatin 10–20 mg** **Lovastatin 20 mg** Fluvastatin 20–40 mg

Grundy SM, Stone NJ, Bailey AL, et al. 2018 aha/acc/aacvpr/aapa/abc/acpm/ada/ags/apha/aspc/nla/pcna guideline on the management of blood cholesterol: executive summary: a report of the american college of cardiology/american heart association task force on clinical practice guidelines. Circulation. 2019;139(25):e1046-e1081.

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Recommendations for Lipid-Lowering Therapy for PAD
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
1	A	1. In patients with PAD, treatment with high-intensity statin therapy is indicated, with an aim of achieving a ≥50% reduction in low-density lipoprotein cholesterol (LDL-C) level.[1–3]
2a	B-R	2. In patients with PAD who are on maximally tolerated statin therapy and have an LDL-C level of ≥70 mg/dL, it is reasonable to add PCSK9 inhibitor therapy.[1,4–6]
2a	B-R	3. In patients with PAD who are on maximally tolerated statin therapy and have an LDL-C level of ≥70 mg/dL, it is reasonable to add ezetimibe therapy.[1,7]

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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Smoking Cessation

Recommendations for Smoking Cessation for PAD Referenced studies that support the recommendations are summarized in the Online Data Supplement.		
COR	**LOE**	**Recommendations**
1	A	1. Patients with PAD who smoke cigarettes or use any other forms of tobacco should be advised at every visit to quit or encouraged to maintain cessation.[1–3]
1	A	2. Patients with PAD who smoke cigarettes or use any other forms of tobacco should be assisted in developing a plan for quitting that includes pharmacotherapy (ie, varenicline, bupropion, and/or nicotine replacement therapies) combined with counseling, and/or referral to a smoking cessation program.[4–9]
1	B-NR	3. Patients with PAD should be advised to avoid exposure to secondhand tobacco smoke in all indoor or enclosed spaces, including work, home, transportation vehicles, and public places.[10–14]

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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HTN Management

Recommendations for Antihypertensive Therapy for PAD Referenced studies that support the recommendations are summarized in the Online Data Supplement.		
COR	**LOE**	**Recommendations**
1	A	1. In patients with PAD and hypertension, antihypertensive therapy should be administered to reduce the risk of MACE.[1–5]
1	B-R	2. In patients with PAD and hypertension, a systolic blood pressure (SBP) goal of <130 mm Hg and a diastolic blood pressure target of <80 mm Hg is recommended.[5–9]
1	B-R	3. In patients with PAD and hypertension, the selective use of angiotensin-converting enzyme (ACE) inhibitors or angiotensin-receptor blockers is recommended to reduce the risk of MACE.[10–12]

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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Diabetes Management

Recommendations for Diabetes Management for PAD Referenced studies that support the recommendations are summarized in the Online Data Supplement.		
COR	**LOE**	**Recommendations**
1	A	1. In patients with PAD and type 2 diabetes, use of glucagon-like peptide–1 agonists (liraglutide and semaglutide) and sodium-glucose cotransporter-2 (SGLT-2) inhibitors (canagliflozin, dapagliflozin, and empagliflozin) are effective to reduce the risk of MACE.[1–12]
1	C-EO	2. In patients with PAD, management of diabetes should be coordinated among members of the health care team.
2b	B-NR	3. In patients with PAD and diabetes, glycemic control may be beneficial to improve limb outcomes.[13–16]

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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Preventive Foot Care

- Foot ulcers and amputations are major morbidities in PAD pts
- It is essential to perform foot examination during office visits to determine risk of foot ulcers
- Improperly cut toenails, poor foot hygiene, ill-fitting shoes are signs of improper care
- Pt education is important
- Referral to podiatry is encouraged

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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Exercise Therapy

- Numerous benefits
- Mechanism not well understood; possibly through increasing muscle endurance, reducing inflammation and promoting angiogenesis
- Structured-Exercise Therapy (SET) has shown effectiveness in improving symptoms and increasing pain-free walking distance
- 30-45 min of intermittent walking in 1-hr sessions; performed 3 times weekly for 12 wks
- Unfortunately, referral to SET remains very low!

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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Anti-platelet and Anti-thrombotics

- Anti-platelet (AP) therapy is essential in the management of PAD
- AP in asymptomatic PAD is of uncertain benefit due to bleeding risk
- RCTs support the use of low-dose anticoagulant (rivaroxaban 2.5mg BID) along with ASA 81mg to lower risk of ischemic events (but higher risk of bleeding)
- DAPT is indicated for 6 months percutaneous revascularization
- SAPT is more appropriate for pts on full-dose AC for other clinical indications (e.g. AFIB)

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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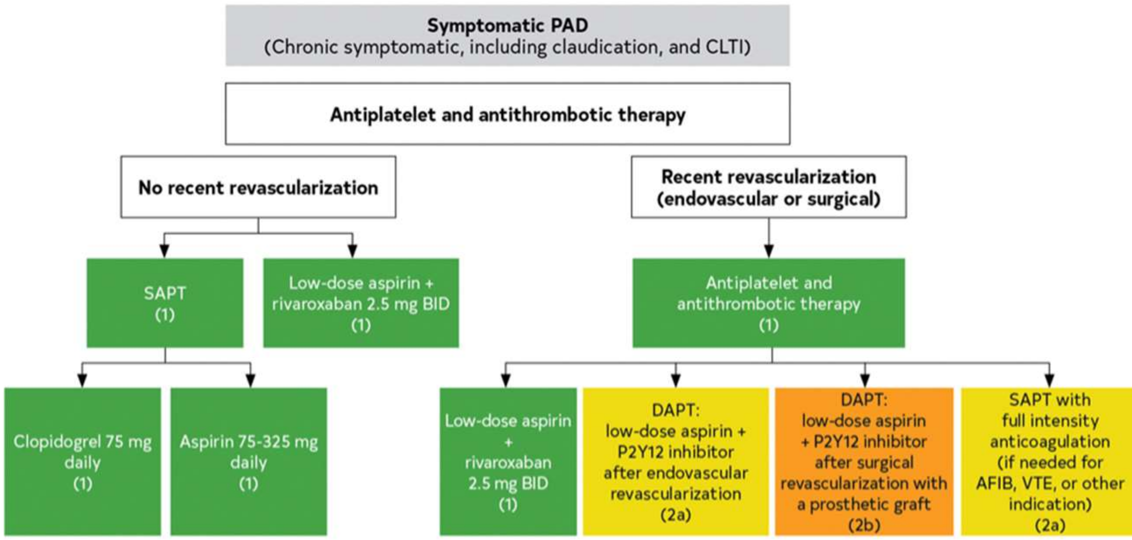

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REVASCULARIZATION

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Asymptomatic PAD

Recommendations for Revascularization for Asymptomatic PAD Referenced studies that support the recommendations are summarized in the Online Data Supplement.		
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]

Gornik HL, Aronow HD, Goodney PP, et al. 2024 acc/aha/aacvpr/apma/abc/scai/svm/svn/svs/sir/vess guideline for the management of lower extremity peripheral artery disease: a report of the american college of cardiology/american heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-e1410.

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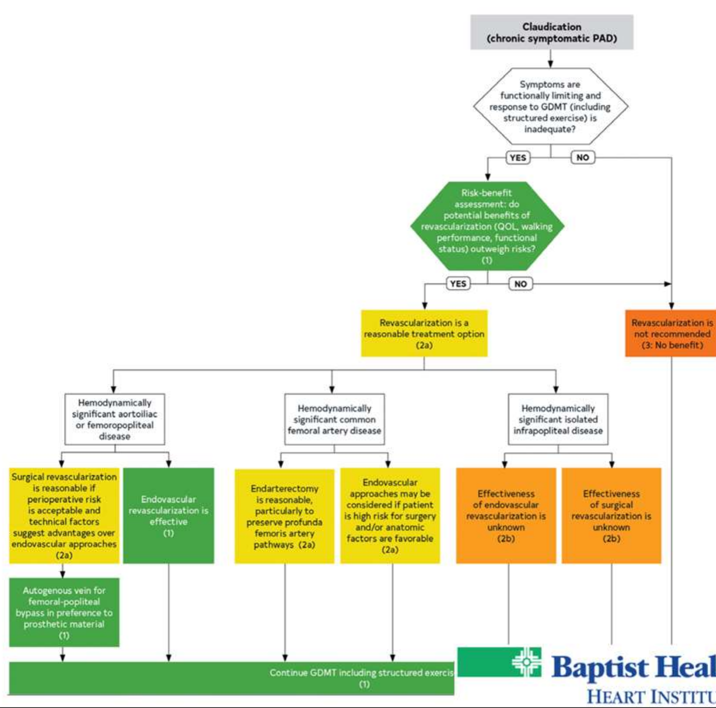
Revascularization in Symptomatic PAD



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Questions?

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