Brigham and Women's Hospital
Founding Member, Mass General Brigham

Peripheral Artery Disease (including Carotid and Aortic Disease)

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- Clinical focus: Thrombosis and Vascular Medicine
- Research focus: Thrombosis

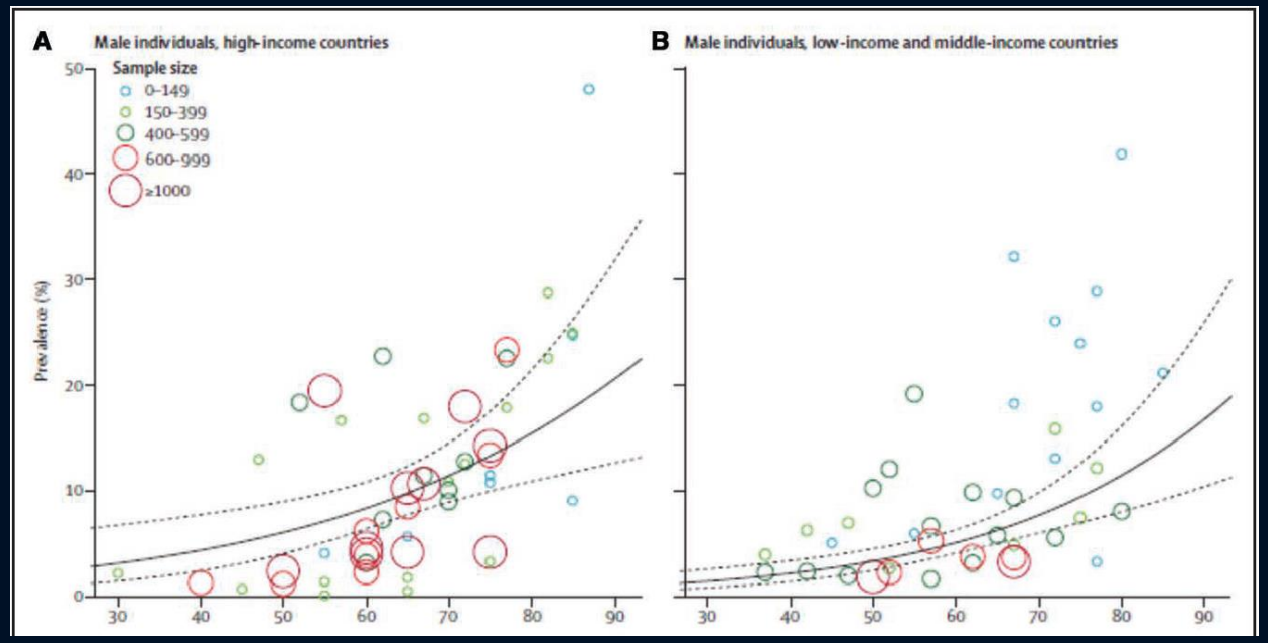
Disclosures

- **Research Grants:** BMS/Pfizer, Janssen, Alexion, Bayer, Amgen, BSC, Esperion, 1R01HL164717-01
- **Advisory Role:** BSC, Amgen, BCRI, PERC, NAMSA, BMS, Janssen, Regeneron

Objectives

- Use case vignettes to:
  1. Understand the natural history and pathophysiology of peripheral artery disease (PAD)
  2. Describe the evaluation and management of intermittent claudication
  3. Highlight the assessment and treatment of patients with chronic limb-threatening ischemia

Prevalence of PAD: Global Patterns



Criqui MH, et al. Circulation. 2021;144:e171–e191

Racial and Ethnic Disparities in Peripheral Artery Disease

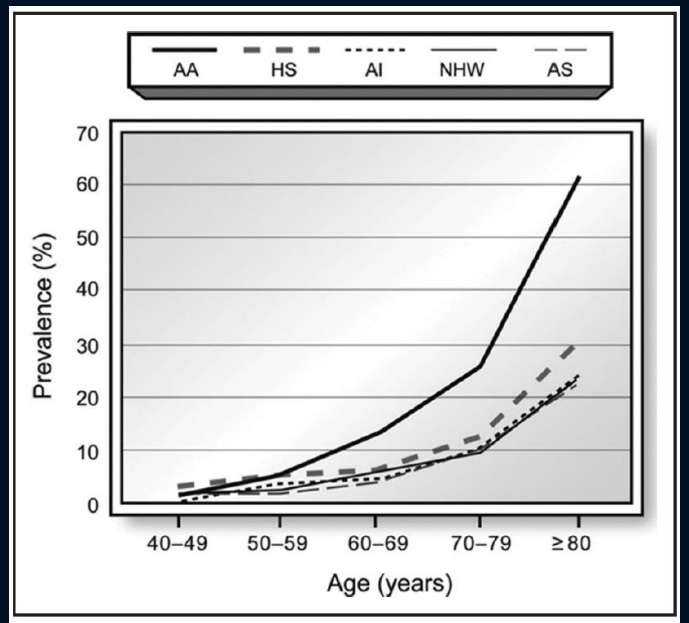


Figure 1. Ethnic-specific prevalence of peripheral artery disease in men.

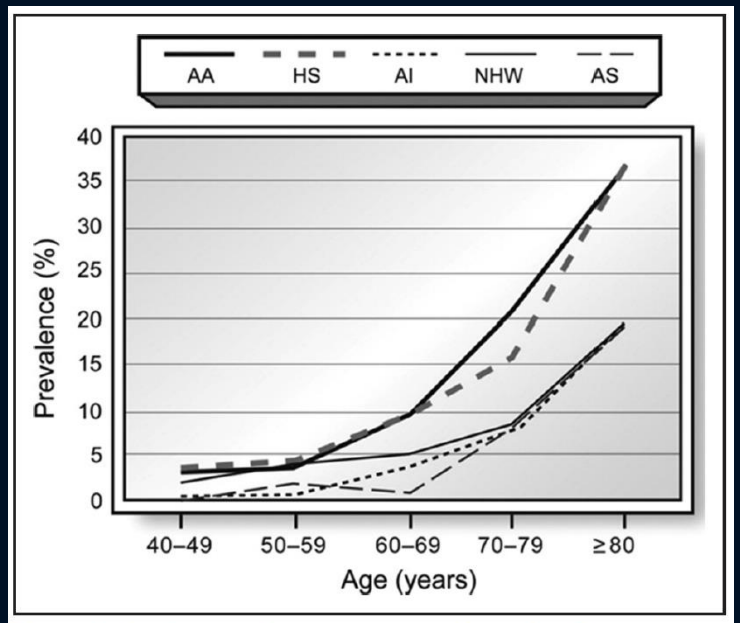
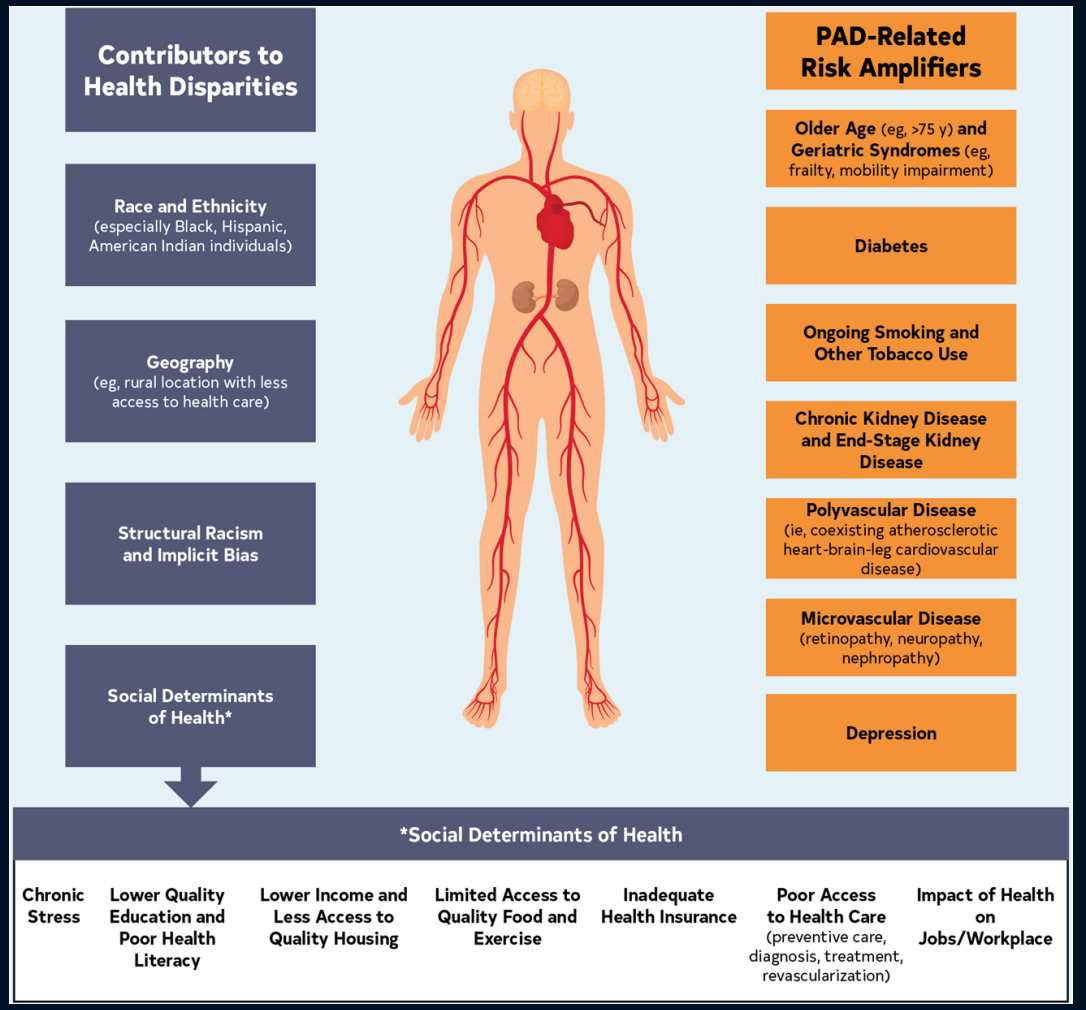
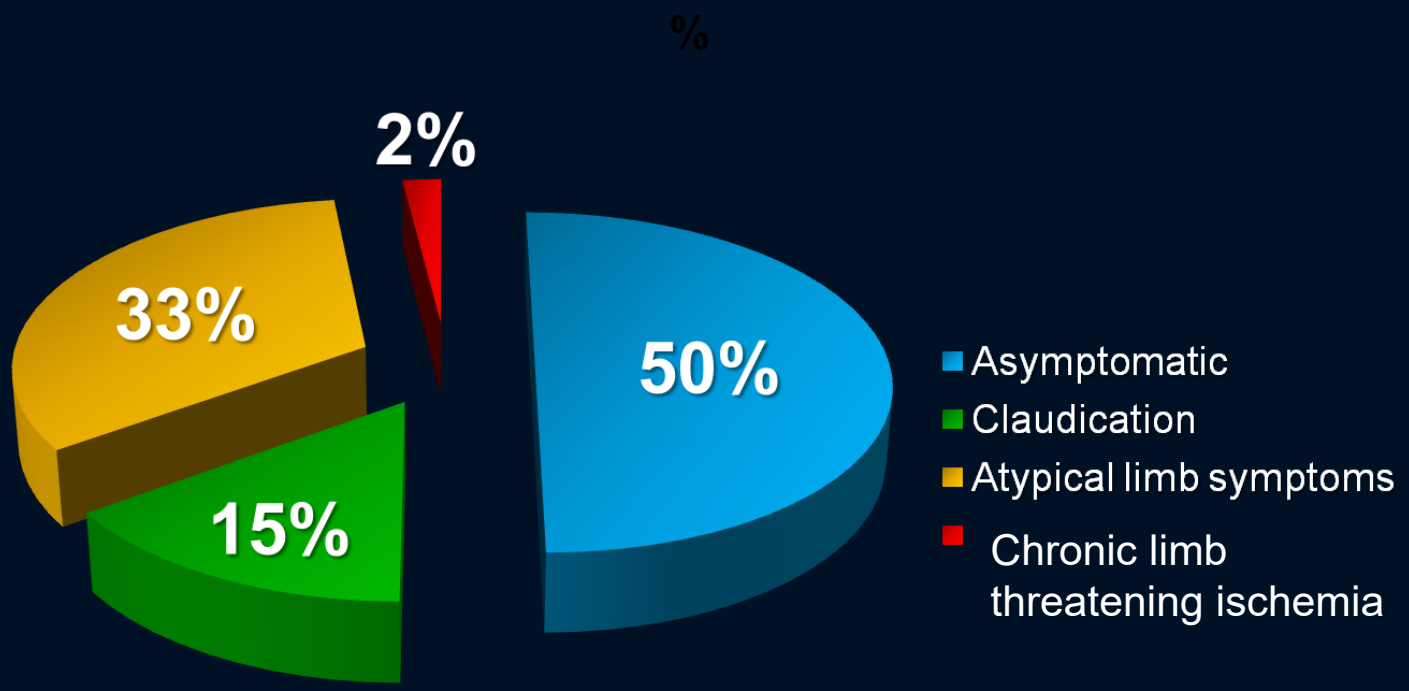


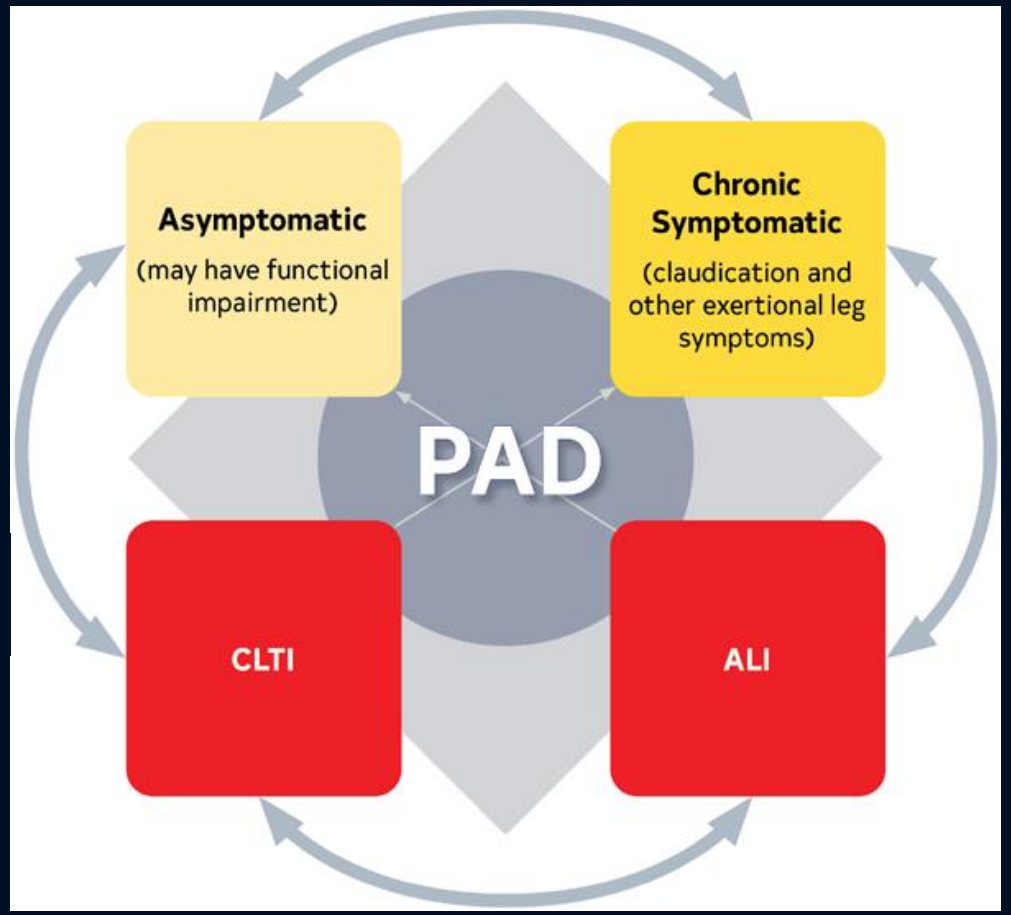
Figure 2. Ethnic-specific prevalence of peripheral artery disease in women.



Hackler EL, et al. Circulation Research. 2021;128:1913
Gornik HL, et al. Circulation. 2024;149:e1313

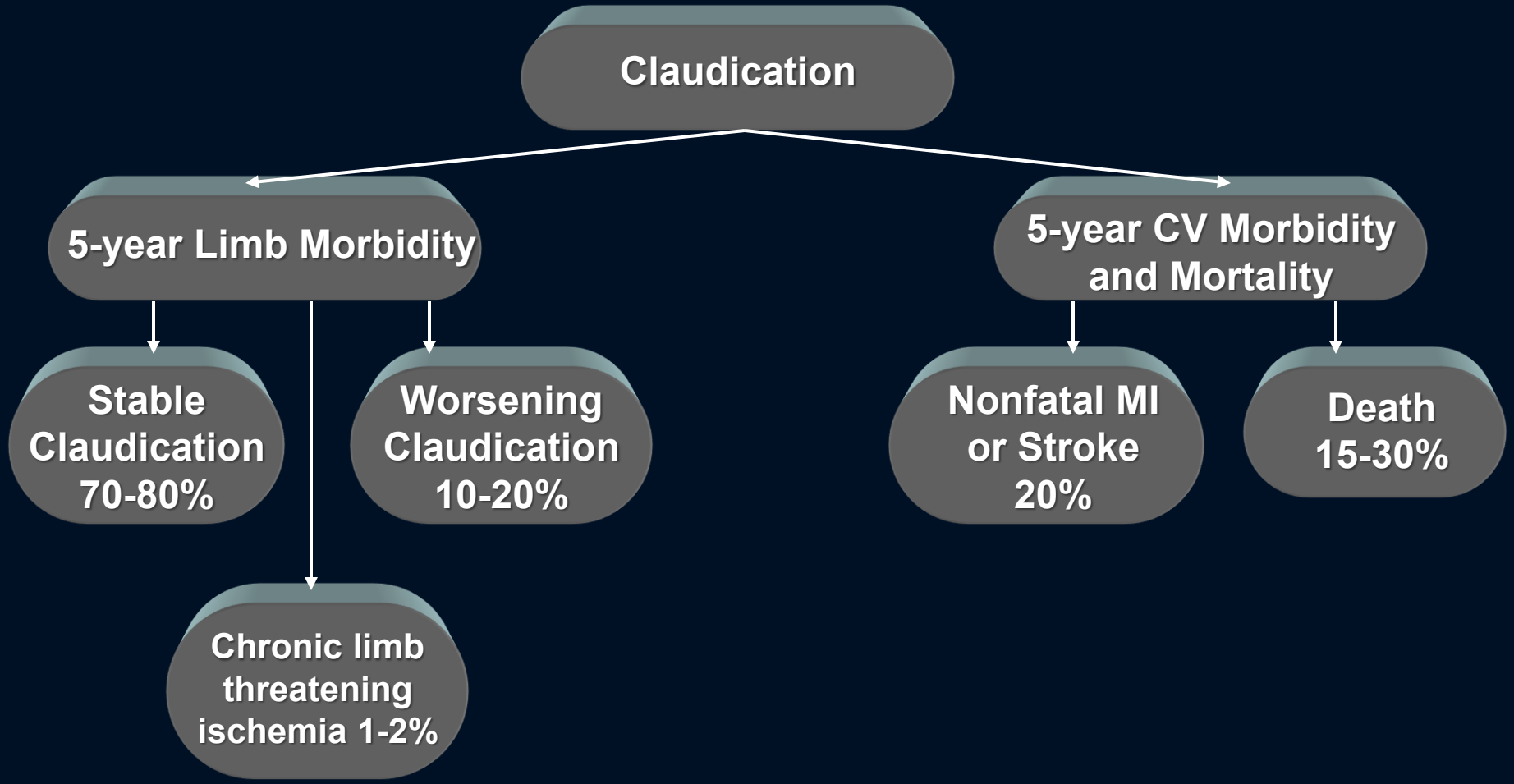
Clinical Presentation of PAD





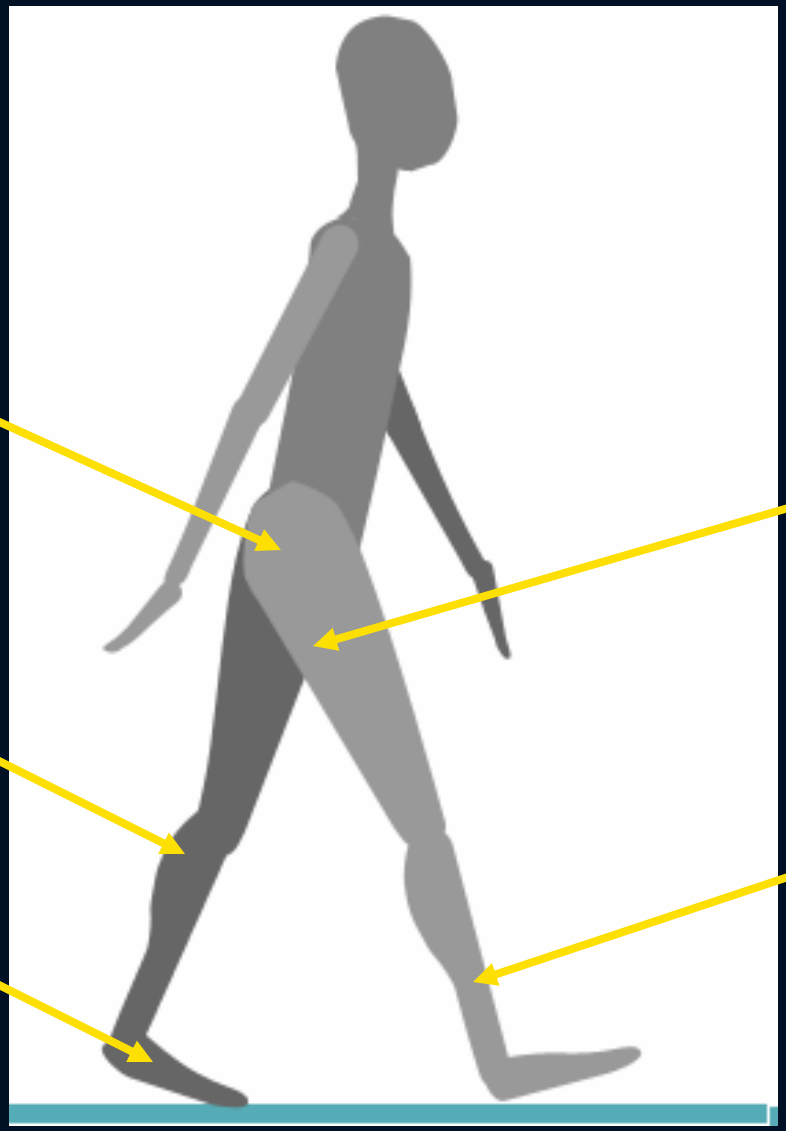
Gornik HL, et al. Circulation. 2024;149:e1313

Natural History



Hirsch AT, et al. Circulation 2006;113:e463

Clinical Evaluation



Buttock and hip- aortoiliac

Upper 2/3 of calf- superficial femoral

Foot- infrapopliteal

Thigh- aortoiliac or common femoral

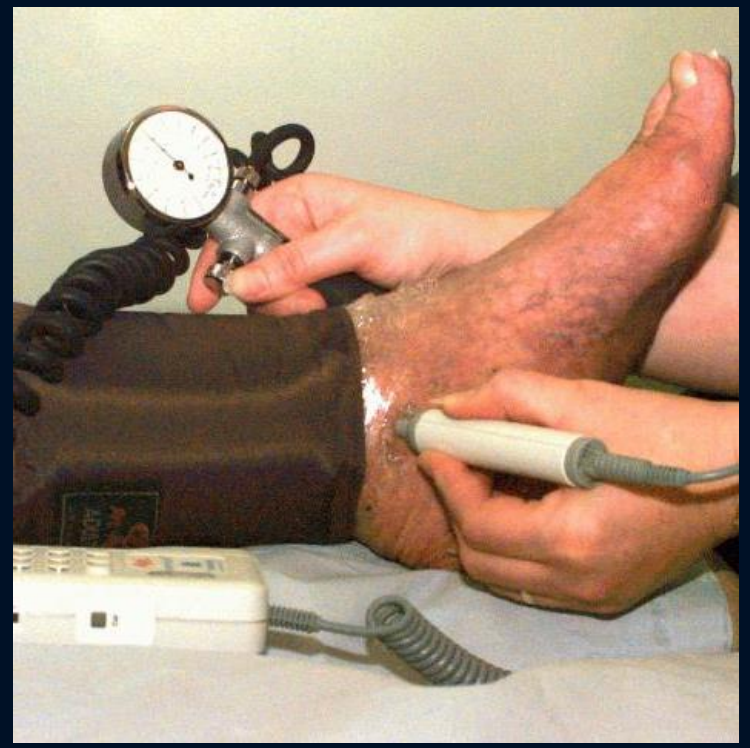
Lower 1/3 of calf- popliteal

Case No. 1

- A 67-year-old man with diabetes, prior smoking, hypertension, and high cholesterol presents with calf cramping when walking.
- He first noted the cramping when climbing hills on the golf course but now experiences it even walking on level ground.
- The discomfort resolves with rest.
- His symptoms are worse on the left.

Case No. 1

- The patient has a blood pressure of 172/82 in the right arm and 166/80 in the left arm.
- Femoral pulses are 2+ without bruits, and popliteal pulses are 1+ bilaterally.
- Distal pulses are 1+ at the DP and PT bilaterally.
- Ankle brachial index (ABI) is 1.1 on the right and 1.0 on the left.



Board-Style Q&A #1

- In a patient with exertional limb symptoms but normal resting ABIs, which is the best initial diagnostic study?
  1. Invasive angiogram
  2. CT angiogram
  3. MR angiogram
  4. Exercise ABIs
  5. Vascular PET scan

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Case No. 1

Exercise ABIs

Stage	ABI	
	Right	Left
Rest	1.1	1.0
Immediate post	0.7	0.6
5 minutes post	1.0	1.0

Definition: Claudication

- **Intermittent claudication:** (n) reproducible discomfort in a defined muscle group provoked by exercise and relieved with rest.

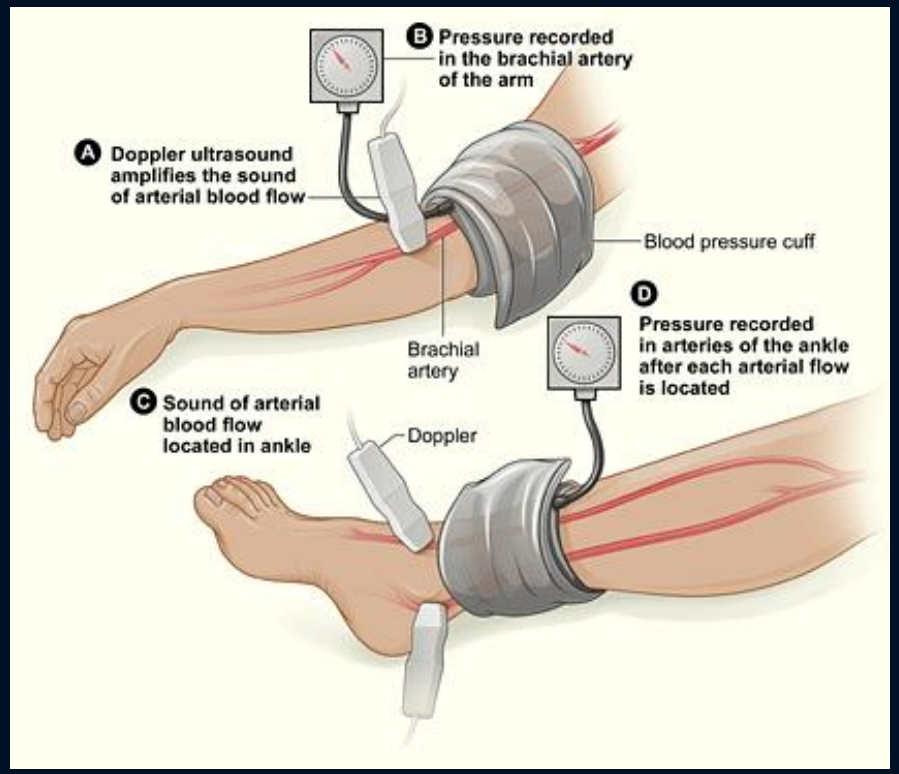
Clinical Evaluation

Condition	Location of pain	Quality of symptoms	Effect of exercise and rest	Other
Intermittent claudication	Buttock, thigh, and calf	Crampy, achy, fatigue	Onset after same degree of exercise, quick relief with rest	Reproducible
Spinal stenosis	Hip, buttocks, thigh (dermatomal)	Weakness, pain	Onset with walking or standing, relieved with position change	History of back problems
Venous claudication	Whole leg	Tightness	Onset with walking, slow relief with rest	History of DVT, edema on exam

Dormandy JA, Rutherford RB. J Vasc Surg 2000;31:S1

Ankle:Brachial Index

- The ankle:brachial index (ABI) is calculated by dividing each of the systolic pressures in the ankle (DP and PT) by the highest brachial pressure.
- 95% sensitive and 99% specific for PAD
- Identifies a population at high risk of CV events



http://www.nhlbi.nih.gov/health/dci/images/pad_abi.gif

Variation in the Calculation of ABIs

- If you want to assess for perfusion-related disease (claudication or critical limb ischemia):
  - ABI = $\frac{\text{highest ankle pressure}}{\text{highest arm pressure}}$

- If you want to assess for cardiovascular risk (atherosclerosis):
  - ABI = $\frac{\text{lowest ankle pressure}}{\text{highest arm pressure}}$

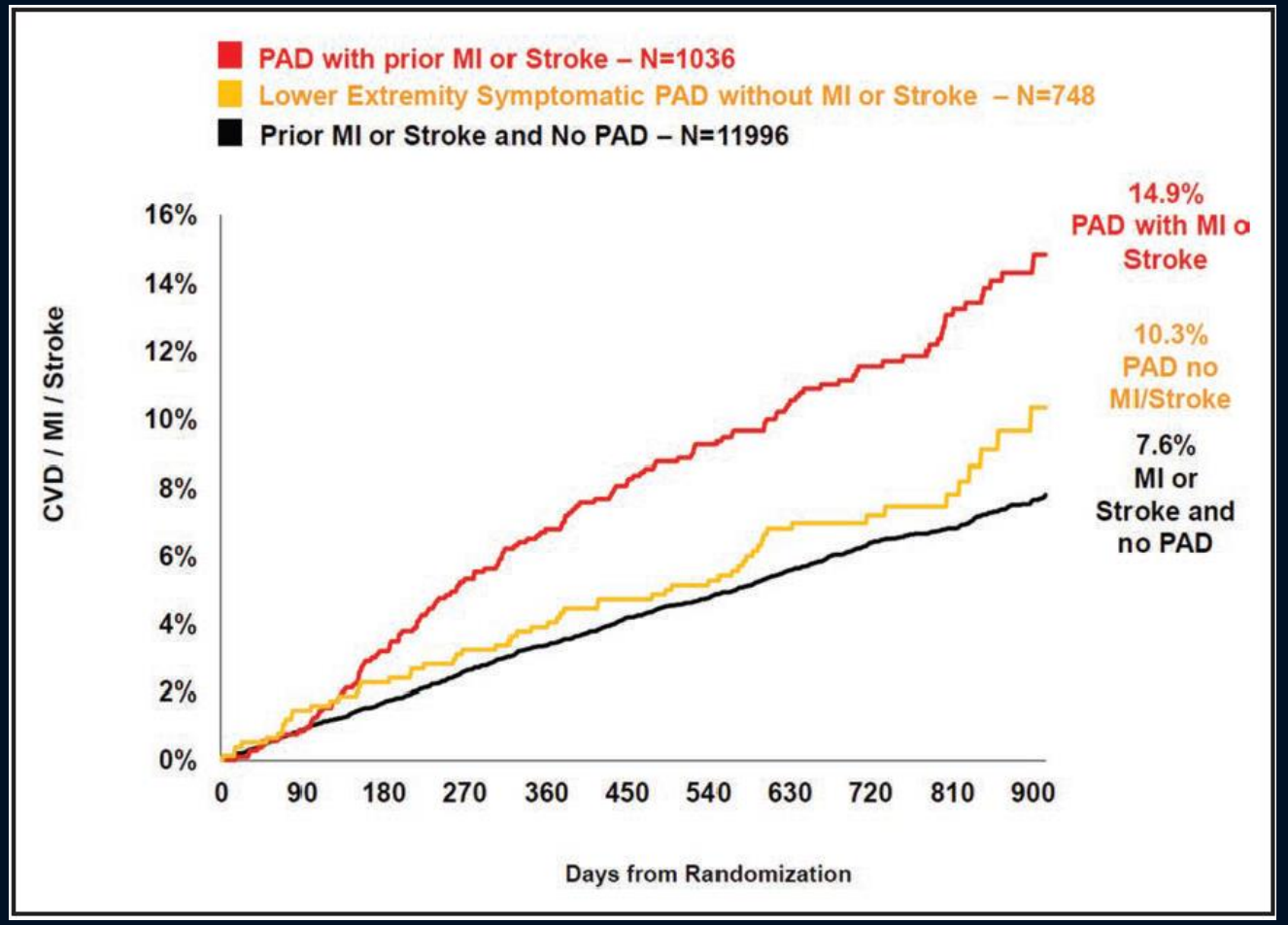
Espinola-Klein C, et al. Circulation 2008;118:961

Correlation of ABI to Severity of PAD

ABI	Clinical Syndrome
0.80 – 1.0	Usually asymptomatic. Associated with future risk of heart attack and/or stroke.
0.40 – 0.80	Claudication or atypical leg discomfort. Associated with future risk of heart attack and/or stroke.
< 0.40	Associated with increased risk of critical limb ischemia (rest pain, tissue loss). Associated with future risk of heart attack and/or stroke.

www.vdf.org/diseaseinfo/pad/anklebrachial.php

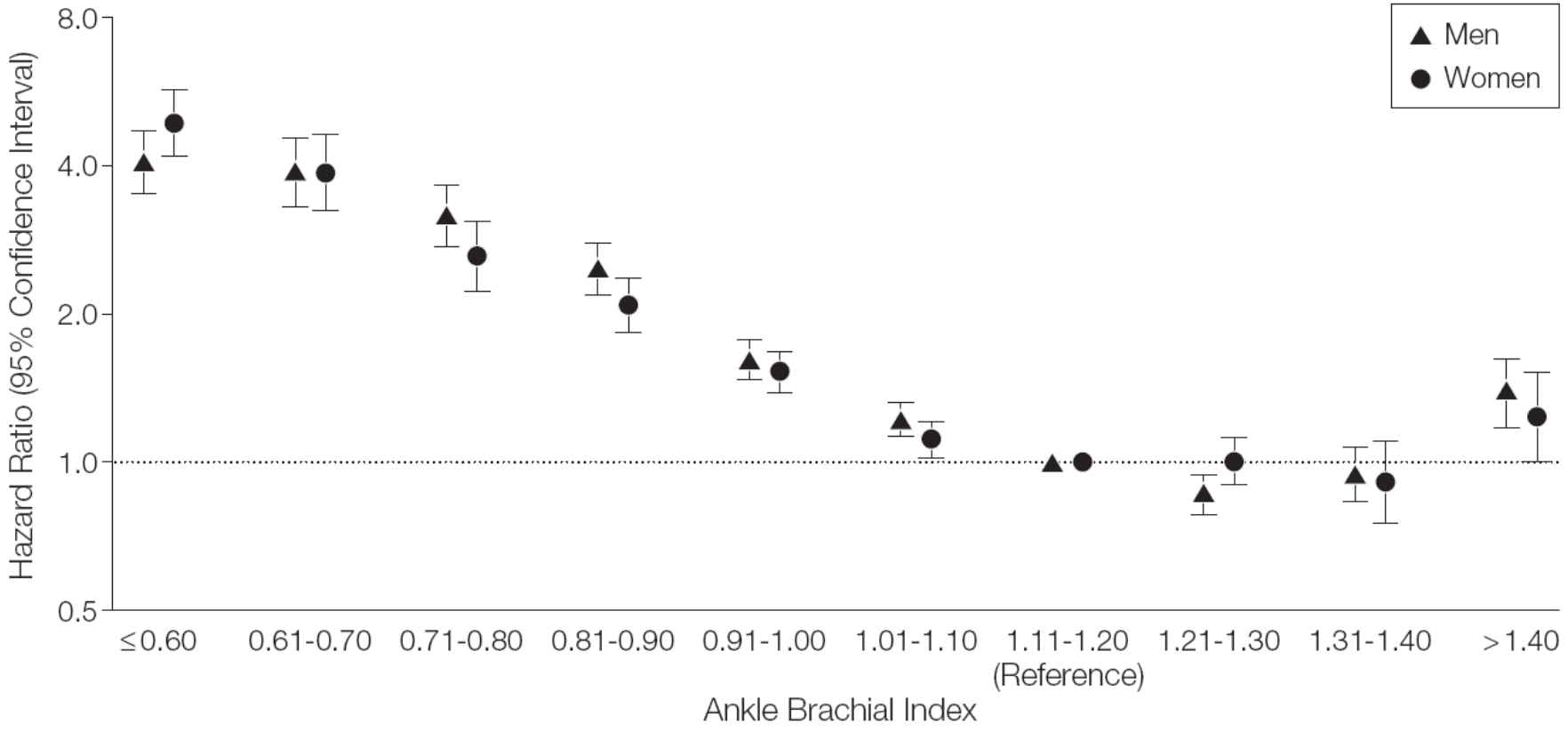
Major Adverse CV Event Risk Increases with Diagnosis of PAD



Criqui MH, et al. Circulation. 2021;144:e171–e191

ABI and Mortality

Figure 2. Hazard Ratios for Total Mortality in Men and Women by Ankle Brachial Index at Baseline for All Studies Combined in the ABI Collaboration



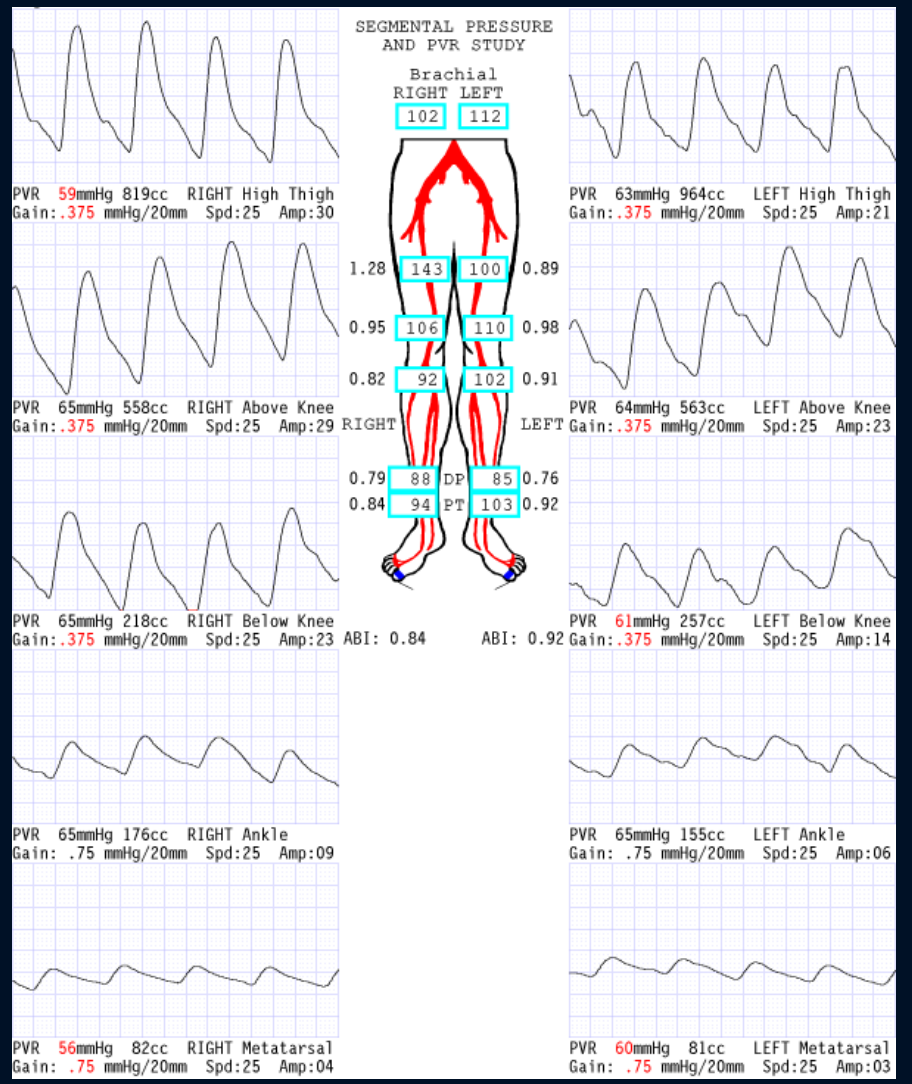
Hazard ratios are not adjusted for age or cardiovascular risk factors.

JAMA 2008;300:197

Exercise ABIs

- Confirms the PAD diagnosis
- Establishes PAD as the cause of symptoms
- Assesses the functional severity of claudication
- May “unmask” PAD when the resting ABI is normal

Segmental Doppler Pressures and Pulse Volume Recordings



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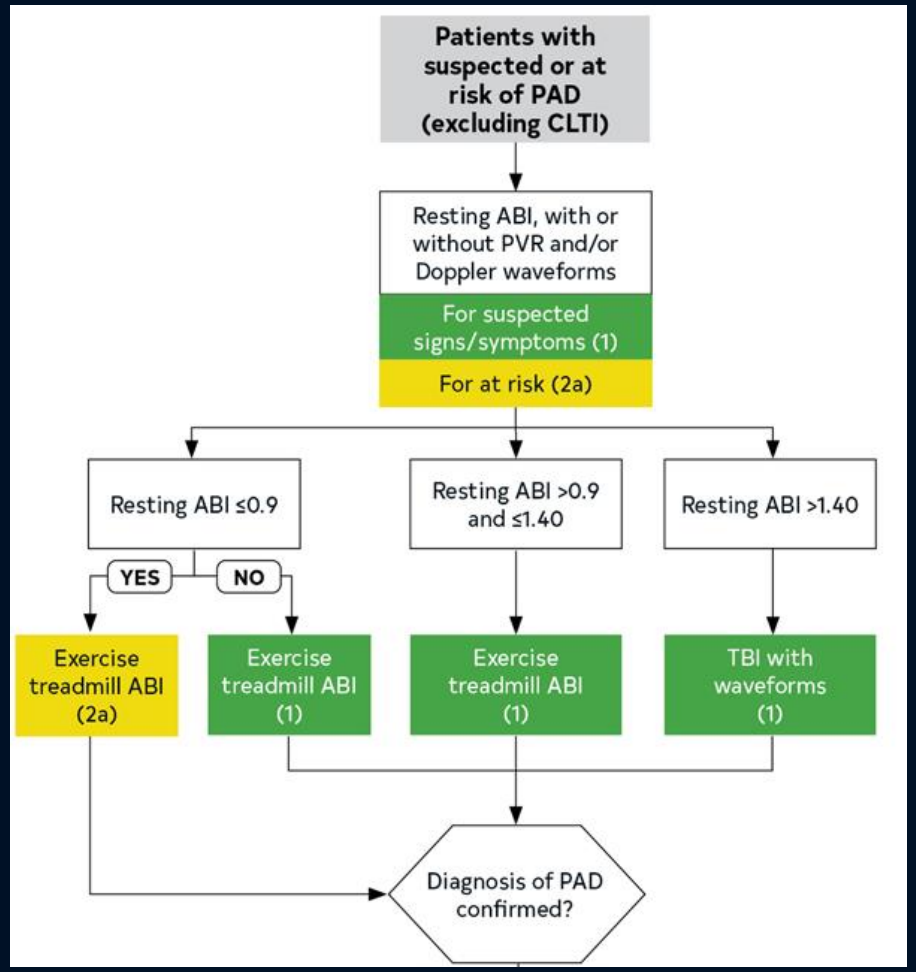
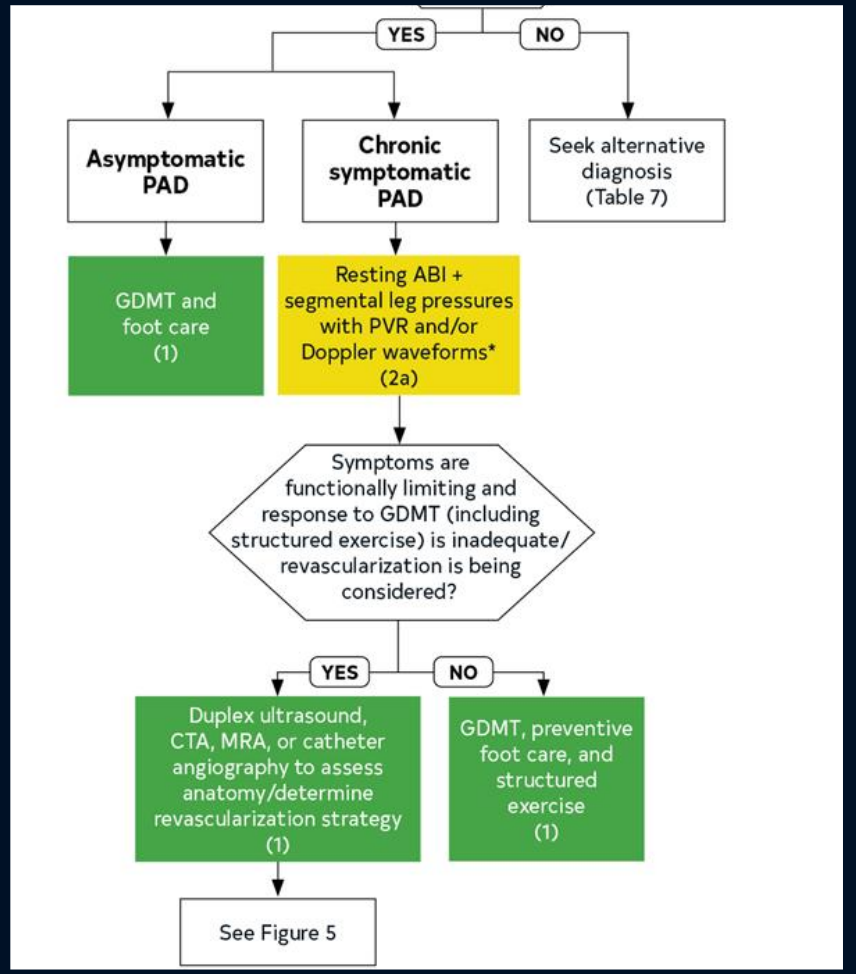
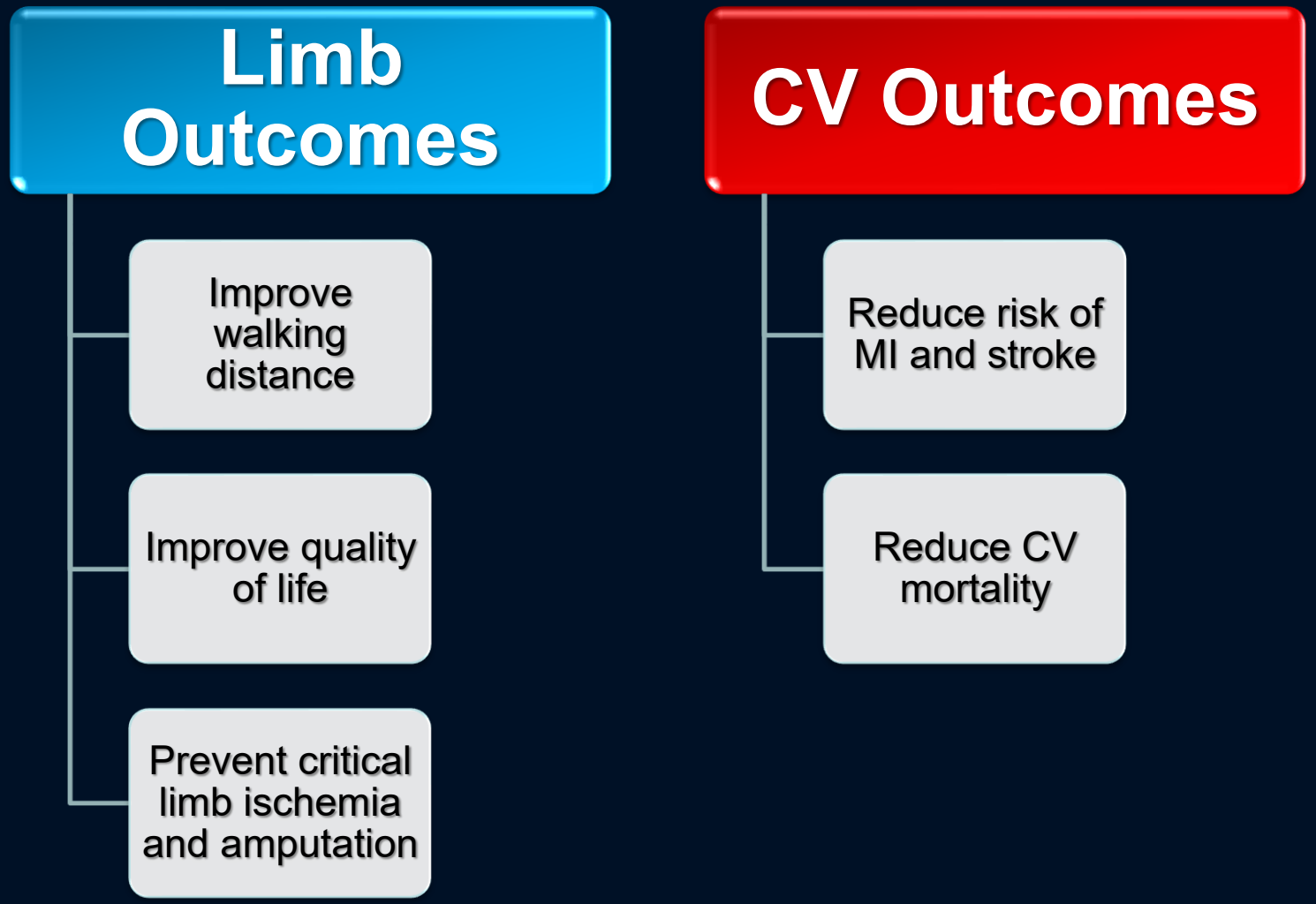




Gornik HL, et al. Circulation. 2024;149:e1313

PAD: Goals of Therapy



Board-Style Q&A #2

- A 64-year-old woman with COPD, prior DVT no longer on anticoagulation, cigarette smoking, hypertension, and right leg claudication has a right ABI of 0.6.
- Which of the following is the most important intervention?
  1. Cilostazol
  2. Rivaroxaban and aspirin
  3. Smoking cessation
  4. Lower extremity bypass surgery

Board-Style Q&A #2

- A 64-year-old woman with COPD, prior DVT no longer on anticoagulation, cigarette smoking, hypertension, and right leg claudication has a right ABI of 0.6.
- Which of the following is the most important intervention?
  1. Cilostazol
  2. Rivaroxaban and aspirin
  3. Smoking cessation
  4. Lower extremity bypass surgery

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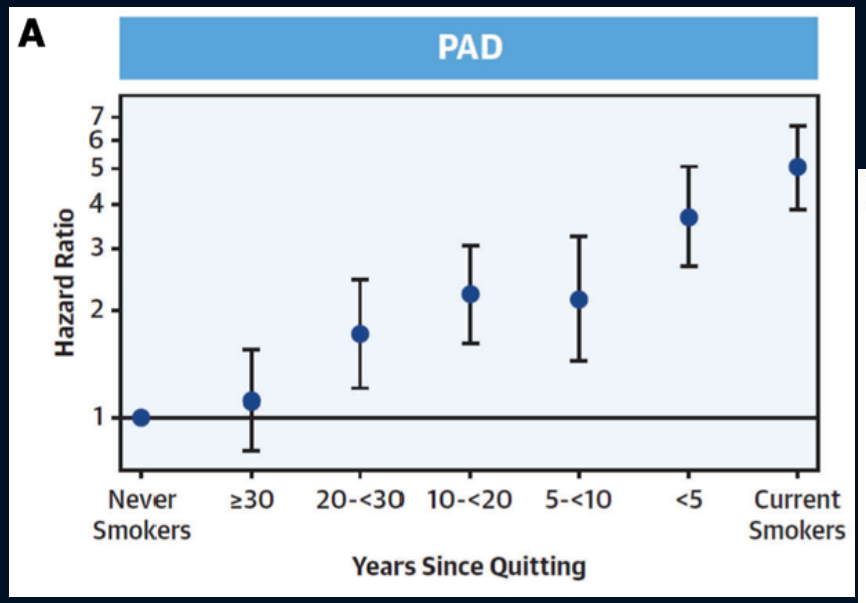
5.4. Smoking Cessation for PAD

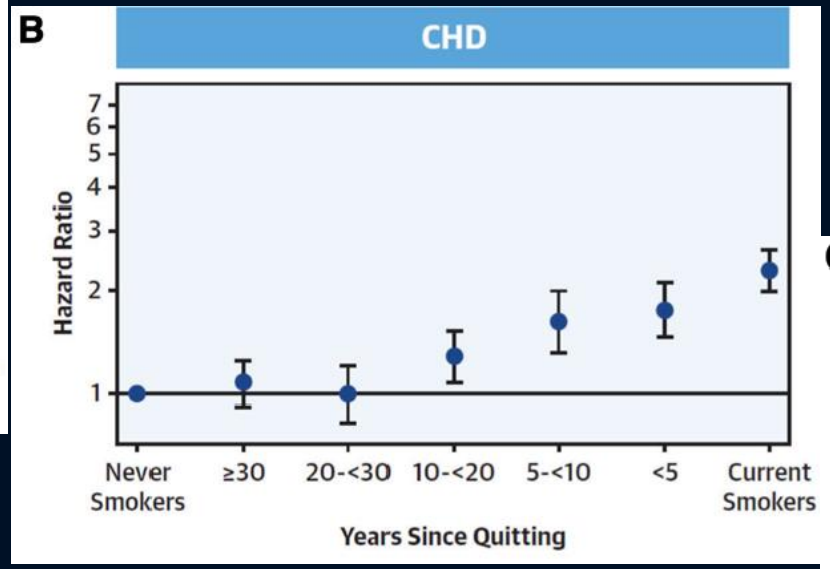
Recommendations for Smoking Cessation for PAD
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

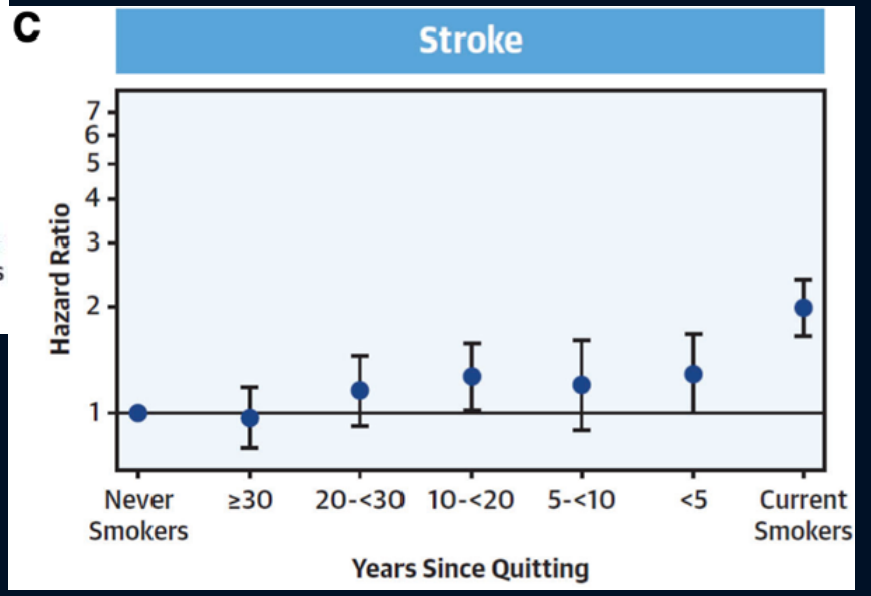
COR	LOE	Recommendations
1	A	1. Patients with PAD who smoke cigarettes or use any other forms of tobacco should be advised at every visit to quit or encouraged to maintain cessation.[1–3]
1	A	2. Patients with PAD who smoke cigarettes or use any other forms of tobacco should be assisted in developing a 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, et al. Circulation. 2024;149:e1313

Smoking Cessation Saves Limbs and Reduces CV Events







Criqui MH, et al. Circulation. 2021;144:e171–e191

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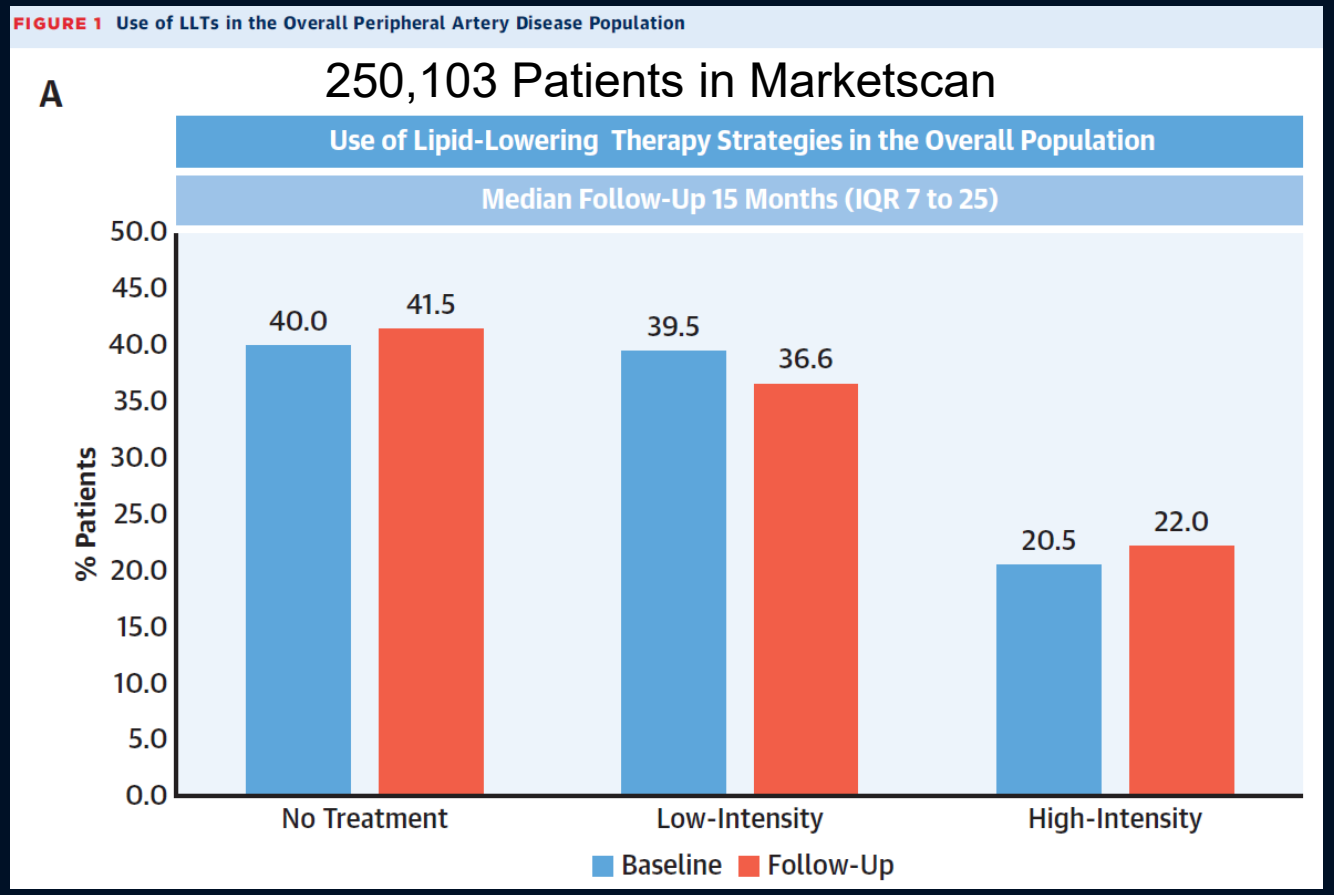
5.1. Antiplatelet and Antithrombotic Therapy for PAD

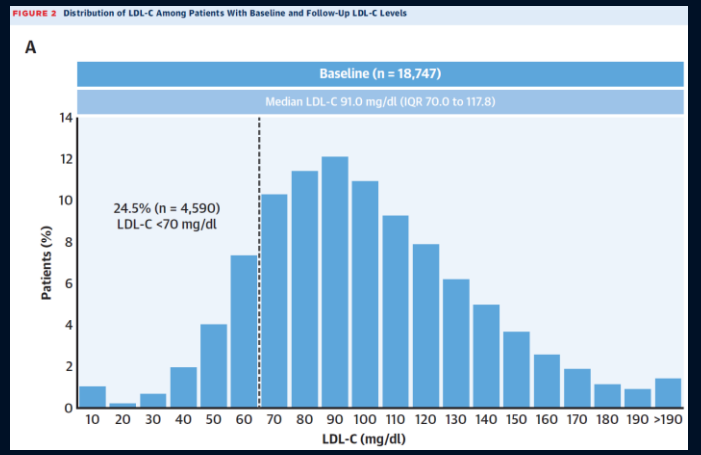
Recommendations for Antiplatelet and Antithrombotic Therapy for PAD Referenced studies that support the recommendations are summarized in the Online Data Supplement.

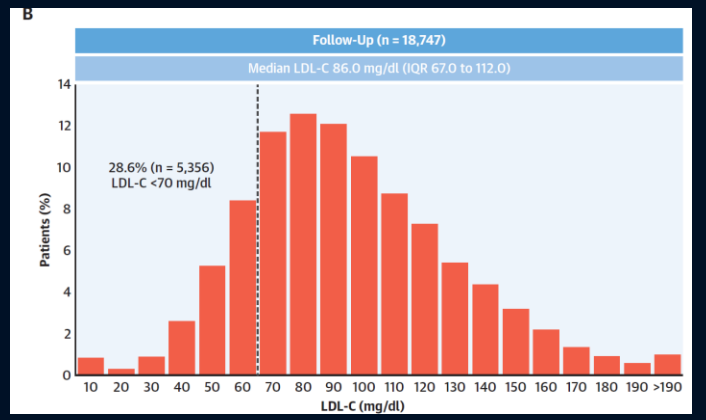
COR	LOE	Recommendations
1	A	1. In patients with symptomatic PAD, single antiplatelet therapy is recommended to reduce the risk of MACE.[1–4]
1	B-R	2. In patients with symptomatic PAD, single antiplatelet therapy with clopidogrel alone (75 mg daily) is recommended to reduce the risk of MACE.[4]
1	C-LD	3. In patients with symptomatic PAD, single antiplatelet therapy with aspirin alone (range, 75-325 mg daily) is recommended to reduce the risk of MACE.[1–3]
1	A	4. In patients with symptomatic PAD, low-dose rivaroxaban (2.5 mg twice daily) combined with low-dose aspirin is effective to reduce the risk of MACE and MALE.[5,6]
1	B-R	5. After endovascular or surgical revascularization for PAD, antiplatelet therapy is recommended.[1,7–9]
1	A	6. After endovascular or surgical revascularization for PAD, low-dose rivaroxaban (2.5 mg twice daily) combined with low-dose aspirin is recommended to reduce the risk of MACE and MALE.[7]
2a	C-LD	7. After endovascular revascularization for PAD, dual antiplatelet therapy with a P2Y12 antagonist and low-dose aspirin is reasonable for at least 1 to 6 months.[8–11]
2a	C-LD	8. After endovascular or surgical revascularization in patients with PAD who require full-intensity anticoagulation for another indication and are not at high risk of bleeding, adding single antiplatelet therapy is reasonable.[12,13]

Gornik HL, et al. Circulation. 2024;149:e1313

Effectiveness of Blood Lipid Management in Patients With Peripheral Artery Disease







Hess CN, et al. J Am Coll Cardiol 2021;77:3016

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5.2. Lipid-Lowering Therapy for PAD

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]

5.5. Diabetes Management for PAD

Recommendations for Diabetes Management for PAD
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

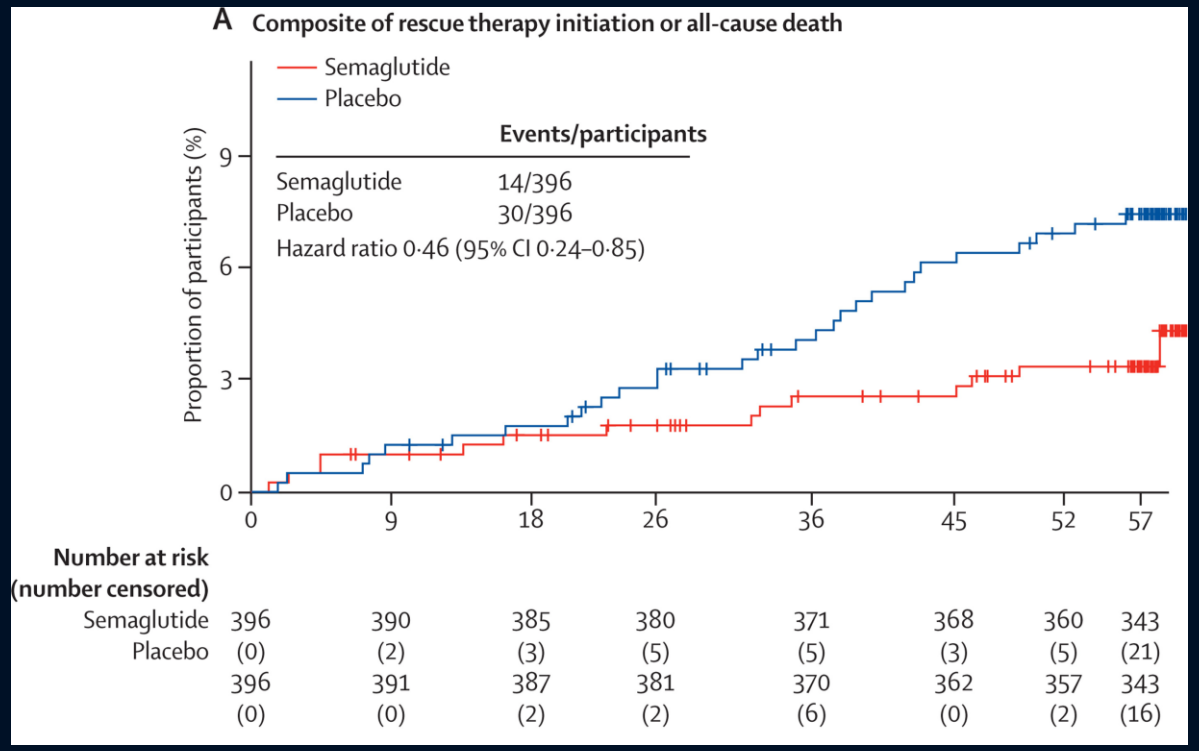
COR	LOE	Recommendations
1	A	1. In patients with PAD and type 2 diabetes, use of glucagon-like peptide–1 agonists (liraglutide and semaglutide) and sodium-glucose cotransporter-2 (SGLT-2) inhibitors (canagliflozin, dapagliflozin, and empagliflozin) are effective to reduce the risk of MACE.[1–12]
1	C-EO	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]

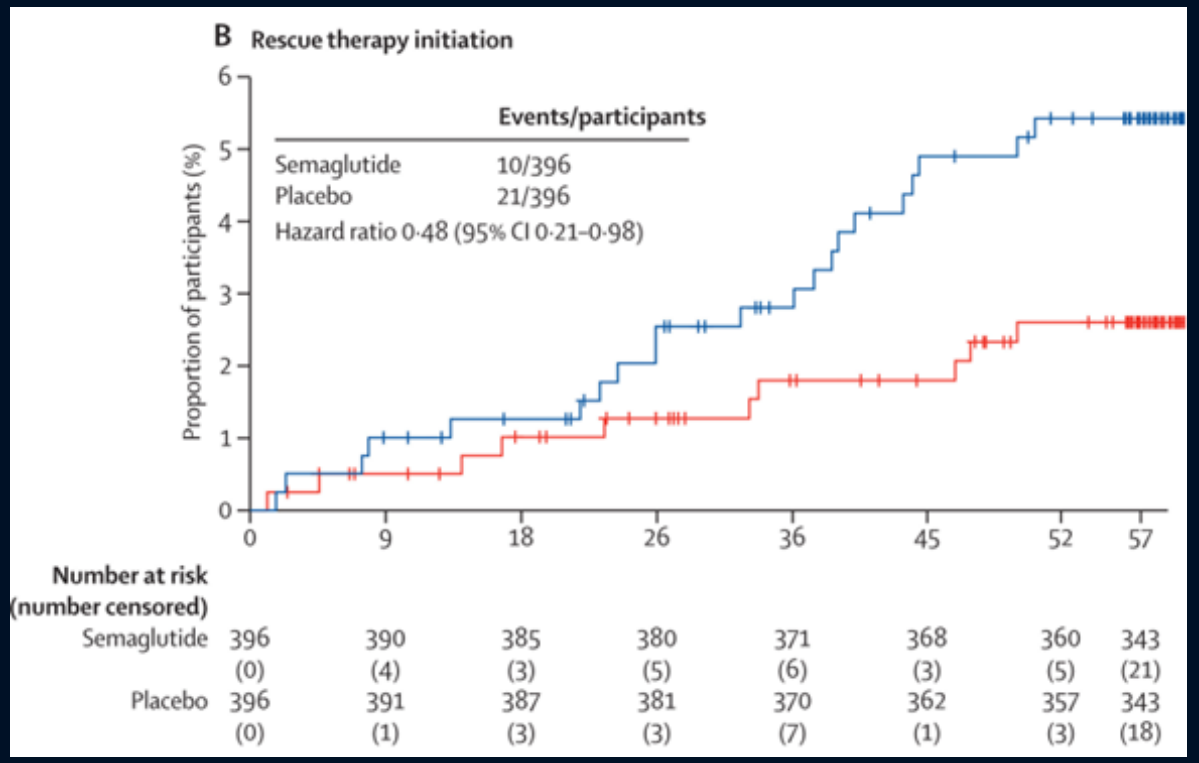
Gornik HL, et al. Circulation. 2024;149:e1313

Semaglutide and Walking Capacity in People with Symptomatic PAD and Type 2 Diabetes: STRIDE **Trial**

Bonaca MP, et al. Lancet. 2025:S0140-6736(25)00509-4. Online ahead of print.

Semaglutide and Walking Capacity in People with Symptomatic PAD and Type 2 Diabetes: STRIDE **Trial**





Bonaca MP, et al. Lancet. 2025:S0140-6736(25)00509-4. Online ahead of print.

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Recommendations for Exercise 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 chronic symptomatic PAD, SET is recommended to improve walking performance, functional status, and QOL.[7,16–28]
1	A	2. In patients with chronic symptomatic PAD, a structured community-based exercise program with behavioral change techniques is effective to improve walking performance, functional status, and QOL.[5–15]
1	A	3. In patients who have undergone revascularization for chronic symptomatic PAD, SET after revascularization is effective to improve walking performance, functional status, and QOL.[29–39]
1	B-R	4. In patients with functionally limiting claudication, SET or a structured community-based exercise program should be offered as an initial treatment option.[17,18,25,40]

Gornik HL, et al. Circulation. 2024;149:e1313

CLEVER: Supervised Exercise vs. Stenting for Claudication Resulting From Aortoiliac Disease

Table 3. Six-Month End Points and Risk Factors

	OMC (n=20)	SE+OMC (n=38)	ST+OMC (n=41)	SE vs OMC [95% CI] (*P*)	ST vs OMC [95% CI] (*P*)	SE vs ST [95% CI] (*P*)
Primary end point						
Change of PWT from baseline to 6 mo, mins	1.2±2.6 (−4.1, 8.6)	5.8±4.6 (−0.4, 16.9)	3.7±4.9 (−4.7, 14.6)	4.6 [2.7–6.5] (<0.0001)*	2.5 [0.6–4.4] (0.021)*	2.1 [0.0–4.2] (0.042)
P, nonparametric analysis				<0.001*	0.019*	0.002
Multiple imputation analysis	1.0±2.8 (−9.5, 8.60)	6.1±4.6 (−0.4, 16.9)	3.6±4.9 (−4.7, 14.6)	5.1 [4.5–5.7] (<0.001)*	2.6 [2.0–3.2] (0.017)*	2.5 [1.9–3.1] (0.028)
Secondary end points						
Change in COT from baseline to 6 mo, min	0.7±1.1 (−0.6, 3.3)	3.0±2.9 (−0.8, 10.7)	3.6±4.2 (−0.3, 17.9)	2.2 [1.2–3.3] (0.003)	2.9 [1.5–4.3] (0.006)	0.7 [0.9–2.3] (0.425)
Change in hourly free-living steps from baseline to 6 mo, n†	−5.6±109.4 (−268.2, 168.9)	72.6±138.7 (−185.2, 425.7)	114.3±273.9 (−192.6, 976.4)	78.3 [0.7–157.2] (0.0625)	120.0 [3.5–236.5] (0.1024)	41.7 [73.4–156.8] (0.4661)
Change in ABI from baseline to 6 mo	0.01±0.10 (19) (−0.24, 0.12)	0.03±0.11 (36) (−0.23, 0.37)	0.29±0.33 (40) (−0.12,1.59)	0.0 [0.0–0.1] (0.578)	0.3 [0.2–0.4] (<0.001)	0.3 [0.2–0.4] (<0.001)
Risk factors (change from baseline)						
LDL cholesterol, mg/dL	−4.4±42.3	−3.6±17.4	−9.3±24.7	*P*=0.813	*P*=0.686	*P*=0.474
HDL cholesterol, mg/dL	7.9±15.4	5.6±8.4	0.4±8.5	*P*=0.551	*P*=0.061	*P*=0.013
Hemoglobin A_{1C}, %	−0.09±0.27	0.01±0.50	0.01±0.35	*P*=0.344	*P*=0.303	*P*=0.977
Fibrinogen, g/dL	31.7±64.1	−15.0±84.5	−2.0±89.1	*P*=0.043	*P*=0.151	*P*=0.541
Systolic blood pressure, mm Hg	−5.8±20.7	−0.95±19.1	−5.6±21.9	*P*=0.381	*P*=0.974	*P*=0.323

OMC indicates optimal medical care; SE, supervised exercise; ST, stent revascularization; CI, confidence interval; PWT, peak walking time; COT, claudication onset time; ABI, ankle-brachial index; LDL, low-density lipoprotein; and HDL, high-density lipoprotein. Values are mean±SD (minimum, maximum) when appropriate. *P* values are based on ANCOVA with adjustment for study center, baseline cilostazol use, and baseline value of the end point.

*One-sided *P* value.

†Adjusted with pedometer logs.

Murphy TP, et al. Circulation 2012;125:130

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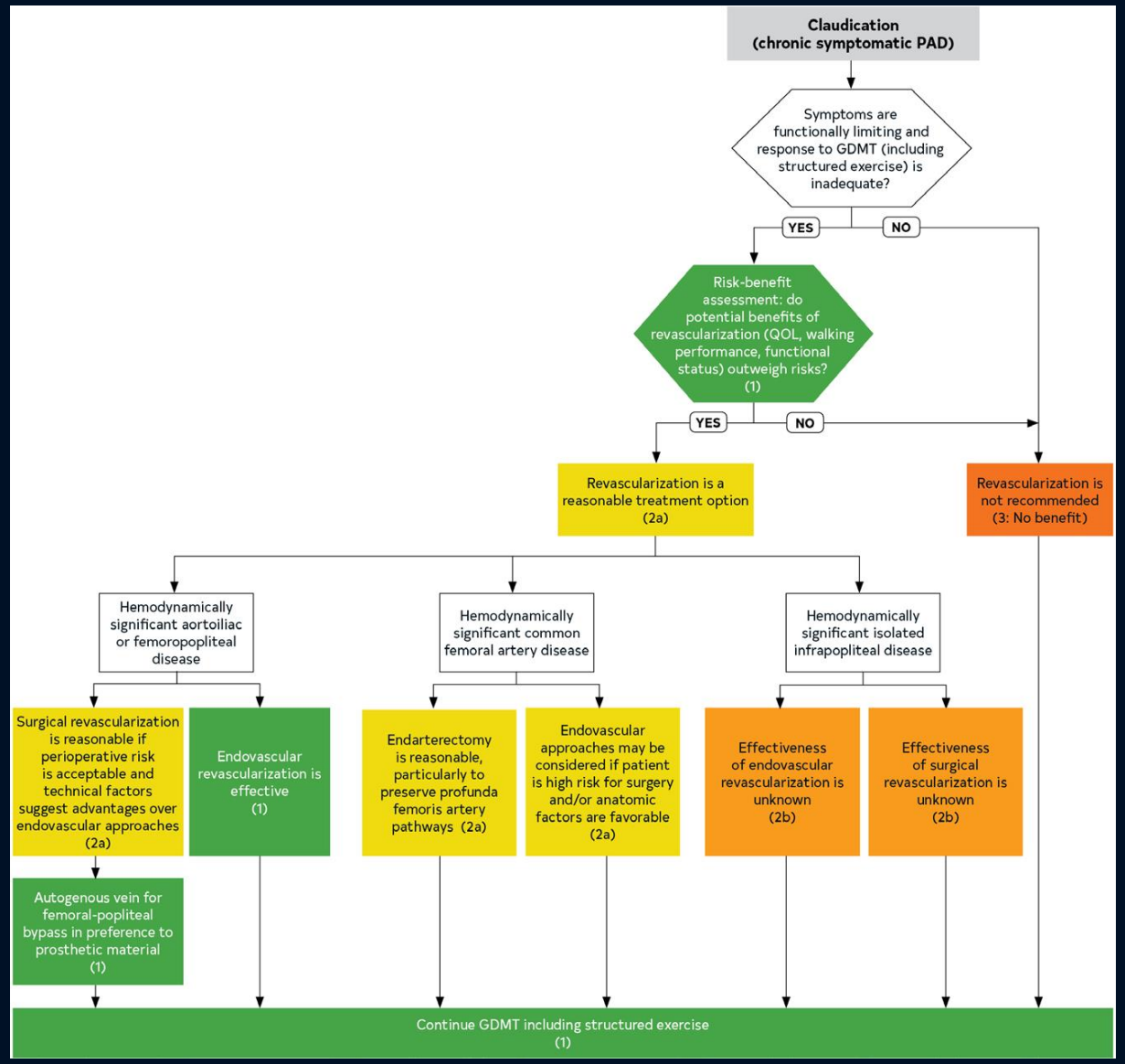


COR	LOE	Recommendations
Revascularization for Claudication: Initial Decision-Making		
1	B-NR	1. In patients with functionally limiting claudication who are being considered for revascularization, potential benefits with respect to QOL, walking performance, and overall functional status should be weighed against the risks and durability of intervention and possible need for repeated procedures.[1–6]
2a	B-R	2. In patients with functionally limiting claudication and an inadequate response to GDMT (including structured exercise), revascularization is a reasonable treatment option to improve walking function and QOL.[7–14]
3: No Benefit	C-EO	3. In patients with claudication who have had adequate clinical response to GDMT (inclu… structured exercise), revascularization is no… recommended.
Revascularization for Claudication: Aortoiliac Disease and Femoropopliteal Disease (Excluding Common Femoral Artery Disease)		
1	A	4. In patients with functionally limiting claudication and hemodynamically significant aortoiliac or femoropopliteal disease with inadequate response to GDMT (including structured exercise), endovascular revascularization is effective to improve walking performance and QOL.[7–28]
2a	B-NR	5. In patients with functionally limiting claudication and hemodynamically significant aortoiliac or femoropopliteal disease with inadequate response to GDMT (including structured exercise), surgical revascularization is reasonable if perioperative risk is acceptable and technical factors suggest advantages over endovascular approaches.[29–31]
Revascularization for Claudication: Common Femoral Artery Disease		
2a	B-R	6. In patients with functionally limiting claudication and hemodynamically significant common femoral artery disease with inadequate response to GDMT (including structured exercise), surgical endarterectomy is reasonable, especially if endovascular approaches adversely affect profunda femoris artery pathways.[32,33]

Gornik HL, et al. Circulation. 2024;149:e1313

Indications for Intervention

Lifestyle-limiting claudication

- Despite optimal medical therapy

Rest pain

Non-healing ulcer

Gangrene

Board-Style Q&A #3

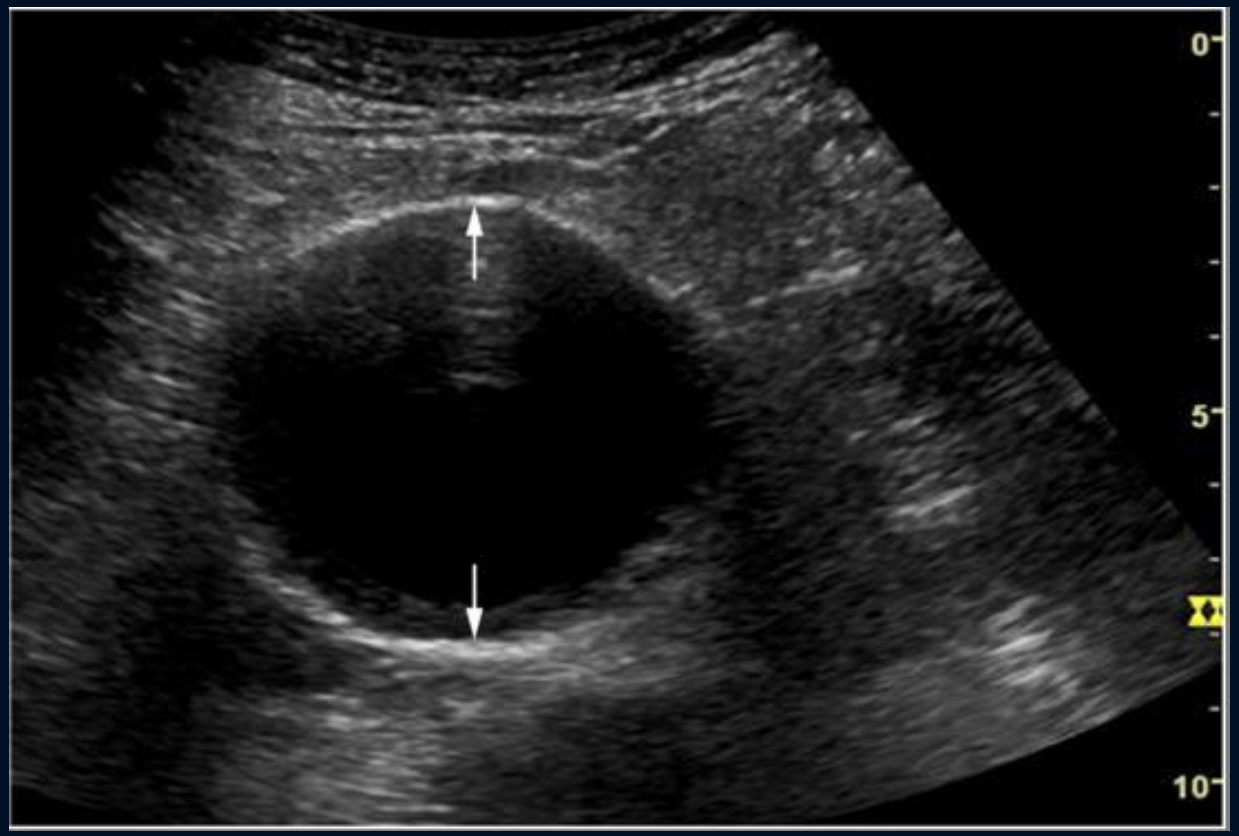
- In our patient with claudication walking the golf course and abnormal exercise ABIs, which additional screening test should be performed?
  1. Stress echocardiogram
  2. Stress nuclear perfusion scan
  3. Abdominal ultrasound
  4. CT calcium score
  5. Carotid ultrasound

Board-Style Q&A #3

- In our patient with claudication walking the golf course and abnormal exercise ABIs, which additional screening test should be performed?
  1. Stress echocardiogram
  2. Stress nuclear perfusion scan
  3. Abdominal ultrasound
  4. CT calcium score
  5. Carotid ultrasound

Screening for Aortic Aneurysm

- The USPSTF recommends one-time screening for abdominal aortic aneurysm (AAA) with ultrasonography in men ages 65 to 75 years who have ever smoked.
- The USPSTF recommends that clinicians selectively offer screening for AAA in men ages 65 to 75 years who have never smoked rather than routinely screening all men in this group.



www.uspreventiveservicestaskforce.org

Screening for Aortic Aneurysm: Society of Vascular Surgery Perspective

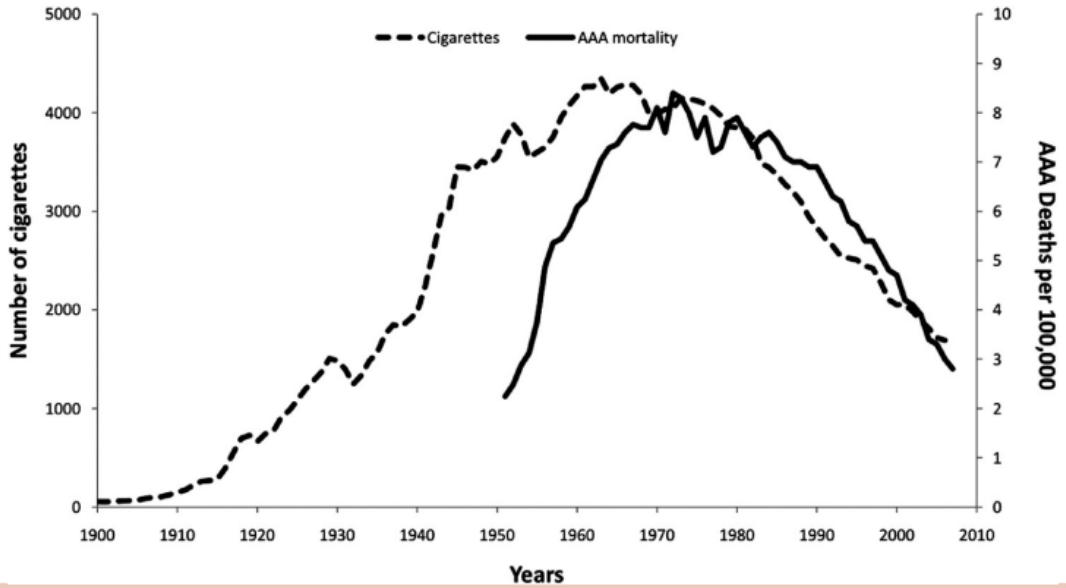


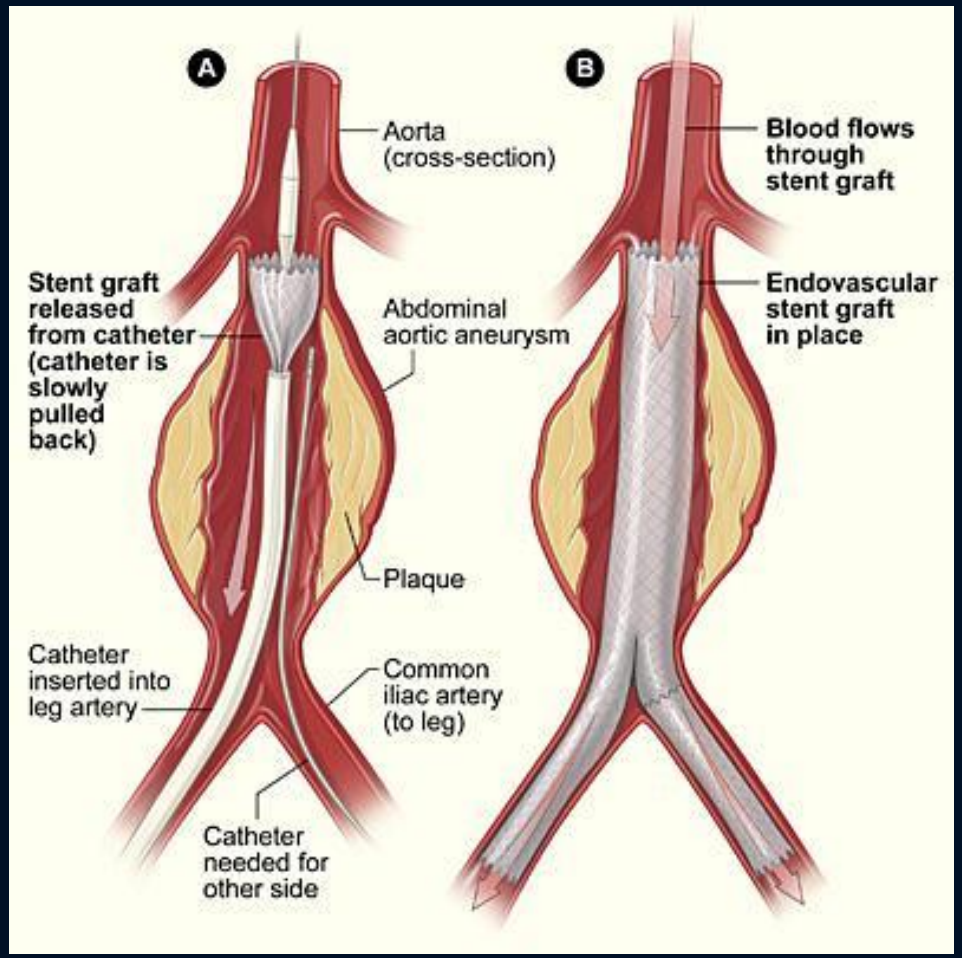
Fig 1. The annual adult per capita cigarette consumption and age-adjusted abdominal aortic aneurysm (*AAA*) deaths per 100,000 white men by year in the United States. (From Lederle FA. The rise and fall of abdominal aortic aneurysm. Circulation 2011;124:1097-9.).

We recommend a one-time ultrasound screening for AAAs in men or women 65 to 75 years of age with a history of tobacco use.	
Level of recommendation	1 (Strong)
Quality of evidence	A (High)
We suggest ultrasound screening for AAA in first-degree relatives of patients who present with an AAA. Screening should be performed in first-degree relatives who are between 65 and 75 years of age or in those older than 75 years and in good health.	
Level of recommendation	2 (Weak)
Quality of evidence	C (Low)
We suggest a one-time ultrasound screening for AAAs in men or women older than 75 years with a history of tobacco use and in otherwise good health who have not previously received a screening ultrasound.	
Level of recommendation	2 (Weak)
Quality of evidence	C (Low)
If initial ultrasound screening identified an aortic diameter >2.5 cm but <3 cm, we suggest rescreening after 10 years.	
Level of recommendation	2 (Weak)
Quality of evidence	C (Low)

Chaikof E, et al. J Vasc Surg. 2018;67: P2-77.E2

Screening for Aortic Aneurysm: Society of Vascular Surgery Perspective

We suggest referral to a vascular surgeon at the time of initial diagnosis of an aortic aneurysm.	
Level of recommendation	Good Practice Statement
Quality of evidence	Ungraded
We recommend repair for the patient who presents with an AAA and abdominal or back pain that is likely to be attributed to the aneurysm.	
Level of recommendation	1 (Strong)
Quality of evidence	C (Low)
We recommend elective repair for the patient at low or acceptable surgical risk with a fusiform AAA that is ≥5.5 cm.	
Level of recommendation	1 (Strong)
Quality of evidence	A (High)
We suggest elective repair for the patient who presents with a saccular aneurysm.	
Level of recommendation	2 (Weak)
Quality of evidence	C (Low)
We suggest repair in women with AAA between 5.0 cm and 5.4 cm in maximum diameter.	
Level of recommendation	2 (Weak)



Chaikof E, et al. J Vasc Surg. 2018;67: P2-77.E2
https://vascular.org/

Case No. 2

- A 72-year-old woman with poorly controlled diabetes, chronic kidney disease, hypertension, and coronary artery disease presents with a painful right foot and nonhealing ulcers.
- She notes that her leg feels better when hanging off the bed.
- She describes multiple ulcers on both feet that have been present for months.

Color Atlas of Peripheral Vascular Disease, 1996

Case No. 2

- She has numerous ulcers of varying depth with erythema and scant discharge.
- She has 1+ femoral pulses bilaterally and nonpalpable popliteal pulses.
- Her distal pulses are faintly detected by Doppler and monophasic at the PT and nondetectable at the DP bilaterally.
- Her ankle brachial index is 0.3 on the left and 0.2 on the right.
- A note is also made of bilateral carotid bruits.

Color Atlas of Peripheral Vascular Disease, 1996

Chronic Limb-Threatening Ischemia

- Arterial ulceration is part of the spectrum of chronic limb-threatening ischemia that includes rest pain and gangrene.

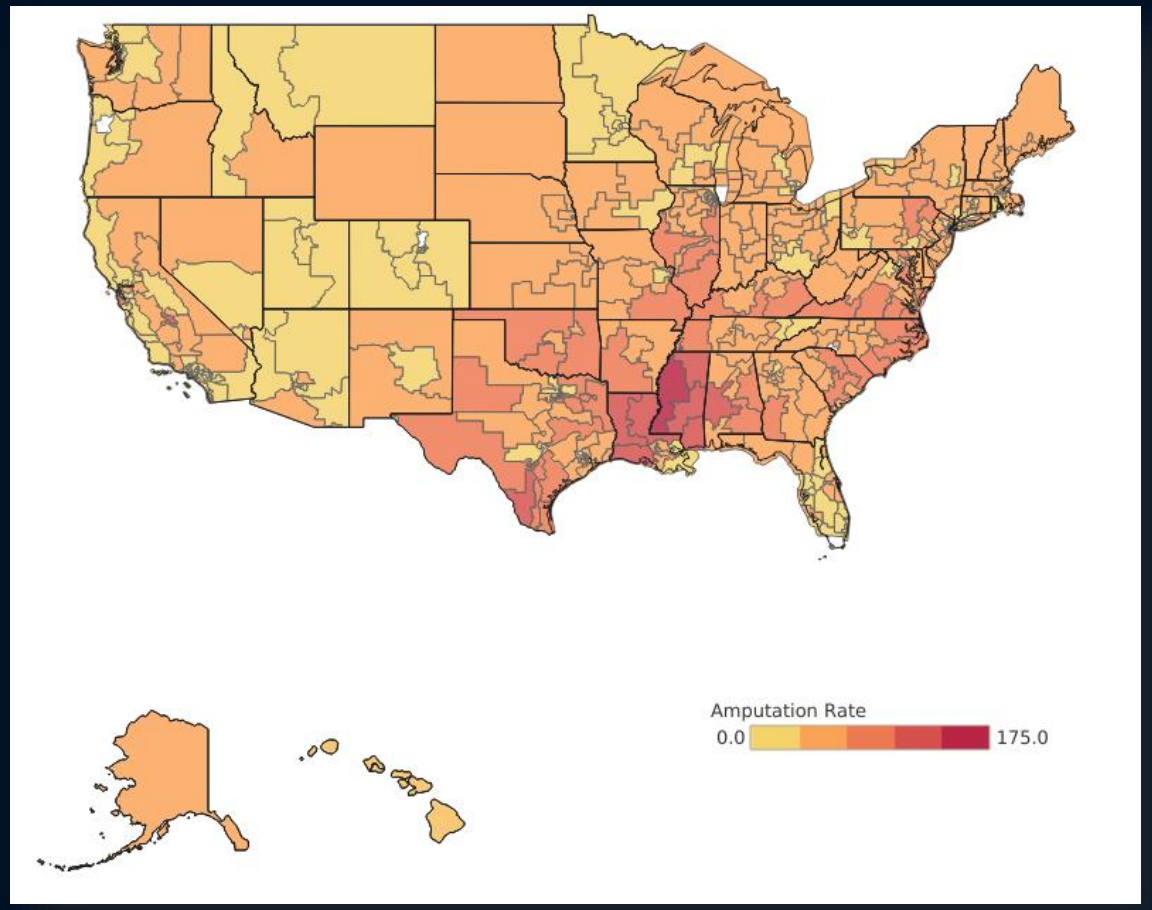
- Chronic limb-threatening ischemia usually results when two or more levels of the arterial tree have significant disease.

- **Chronic limb-threatening ischemia inevitably leads to tissue loss or amputation unless successful revascularization is performed.**

PAD Collaborative: Amputation Heat Map

National Amputation Rate 45.5

cases per 100,000 population



https://professional.heart.org/en/communities/vascular-disease-and-thrombosis/pad-collaborative/heat-map

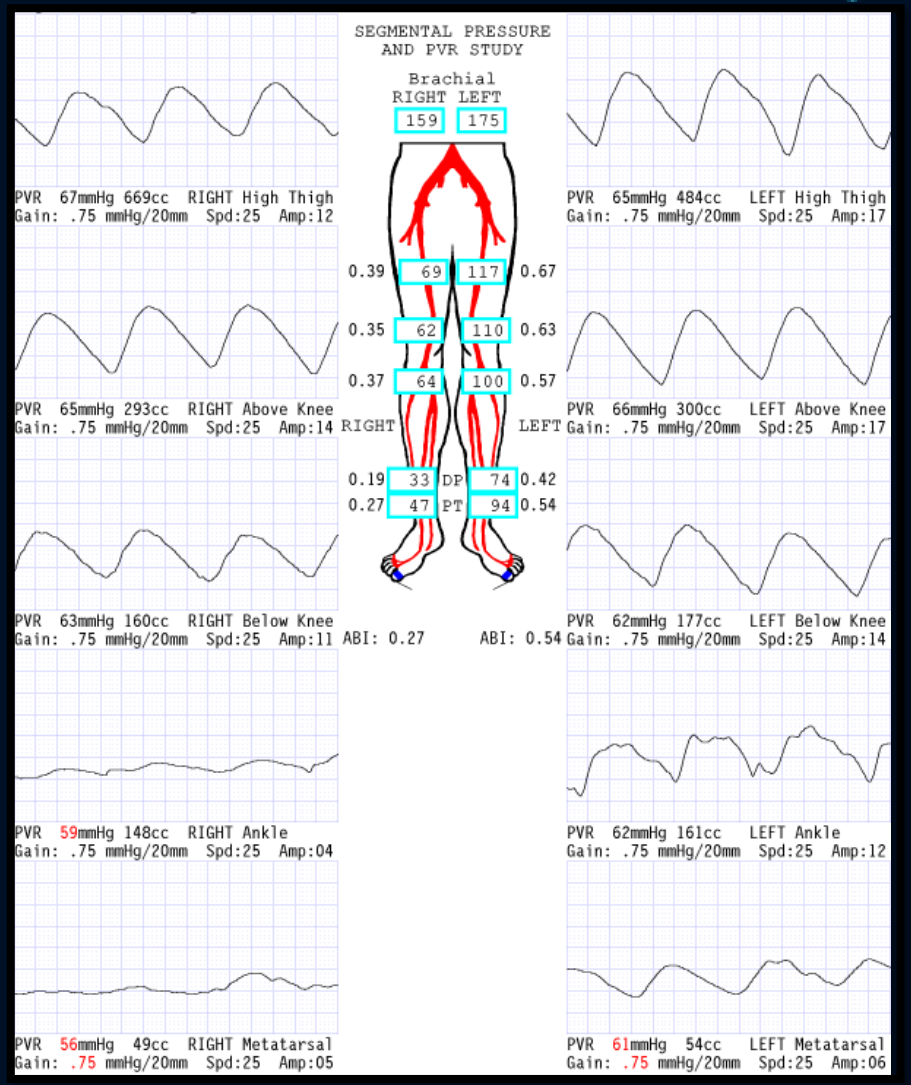
Clinical Evaluation

Type of ulcer	Location	Pain	Skin	Base	Edges
Venous	Perimalleolar	Rare	Stasis pigmentation with thickening	Wet, weepy, healthy granulation tissue	Clean
Arterial	Shins, toes, sites of injury/pressure	Yes	Shiny, pale, decreased hair, livedo	Dry, pale with eschar	Smooth
Neurotrophic	Plantar surface, pressure points	No	Callused	Healthy, pale	Trophic, callused

Hurst's The Heart 2007

Diagnostic Testing

- SDPs with PVRs help establish the level and severity of PAD.
- If SDP findings are not consistent with severe disease, an alternative etiology for the non-healing ulcer should be sought.
- Diagnostic imaging with MRA, CTA, or conventional angiography should be performed in planning for revascularization.

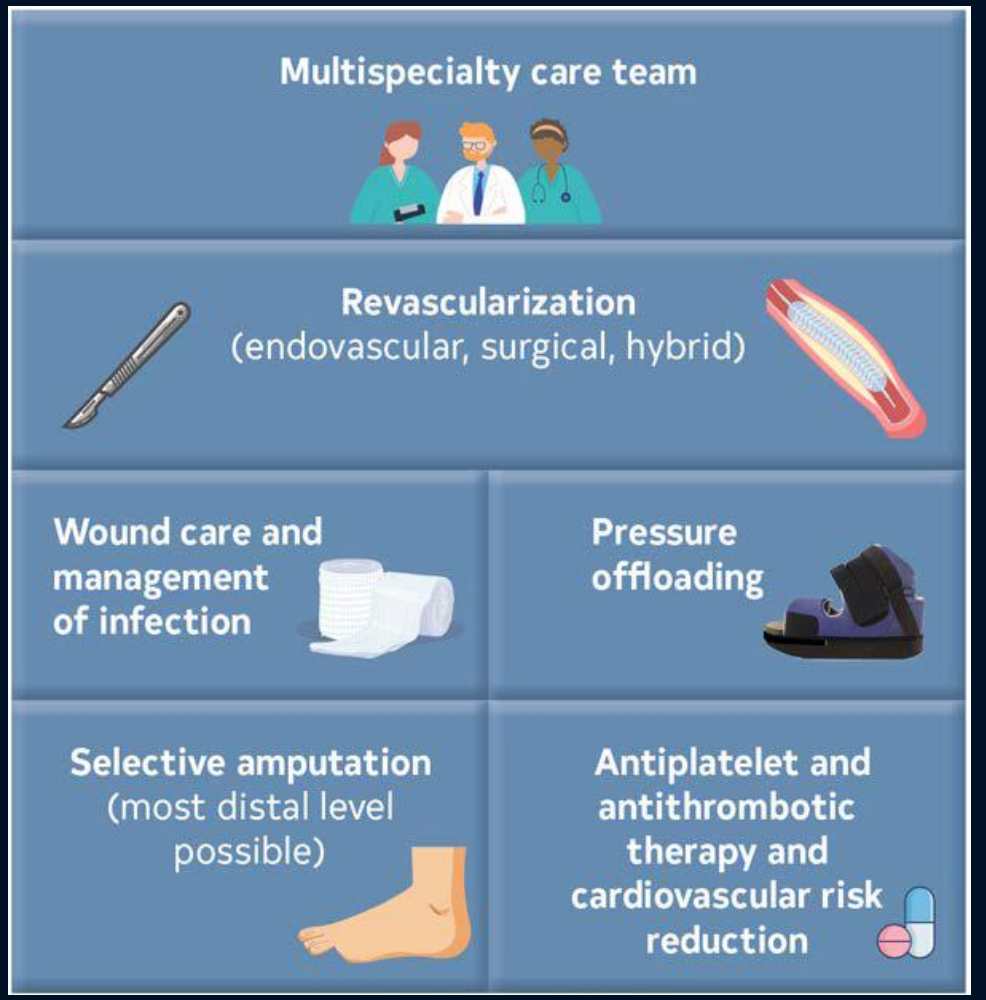


2024 AHA/ACC PAD Guidelines: CLTI

10.1. Team-Based Care for CLTI

Recommendation for Team-Based Care for CLTI
Referenced studies that support the recommendation are summarized in the Online Data Supplement.

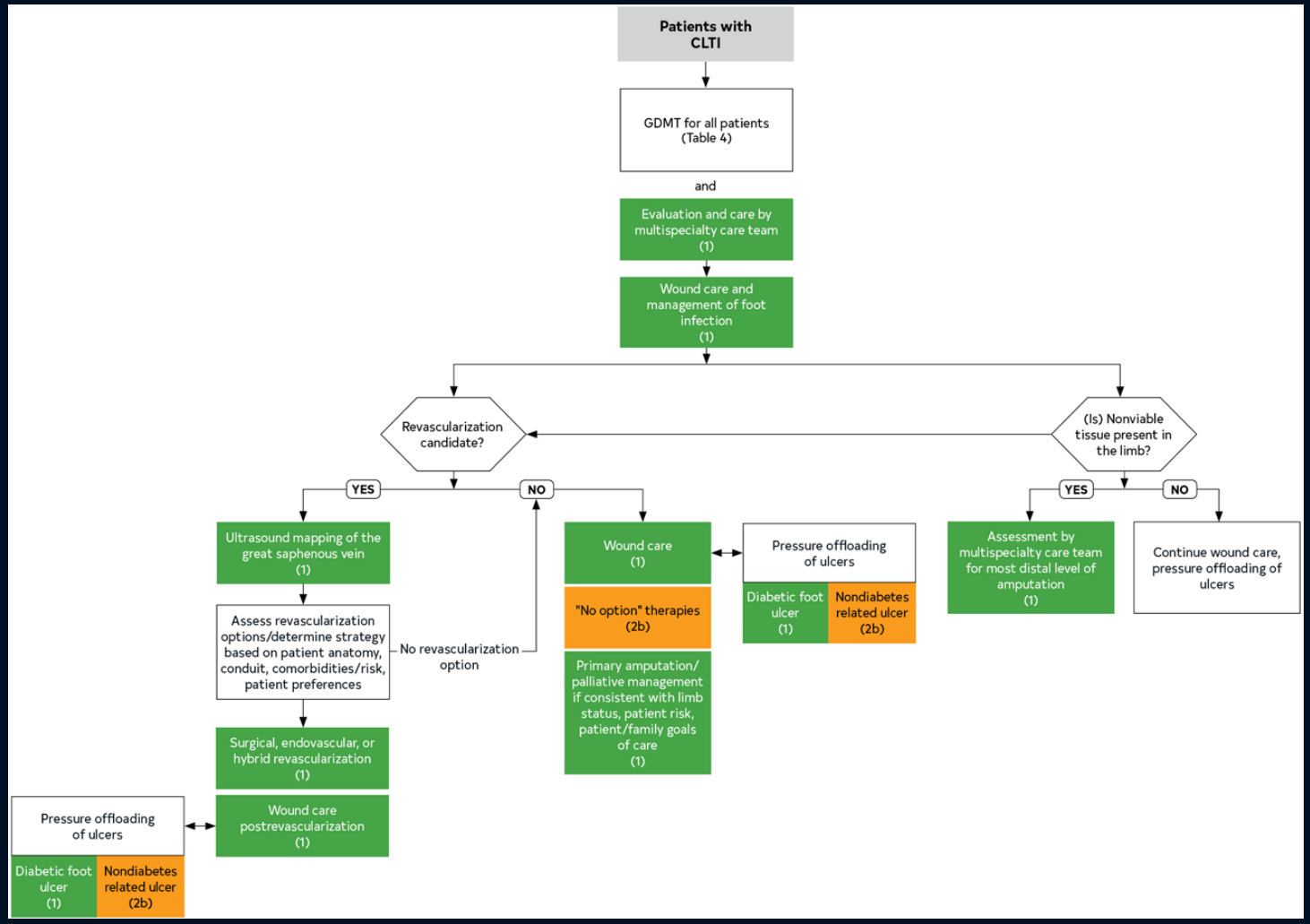
COR	LOE	Recommendation
1	B-NR	1. In patients with CLTI, a multispecialty care team should evaluate and provide comprehensive care with goals of complete wound healing, minimizing tissue loss, and preservation of ambulatory status.[1,2]



Gornik HL, et al. Circulation. 2024;149:e1313

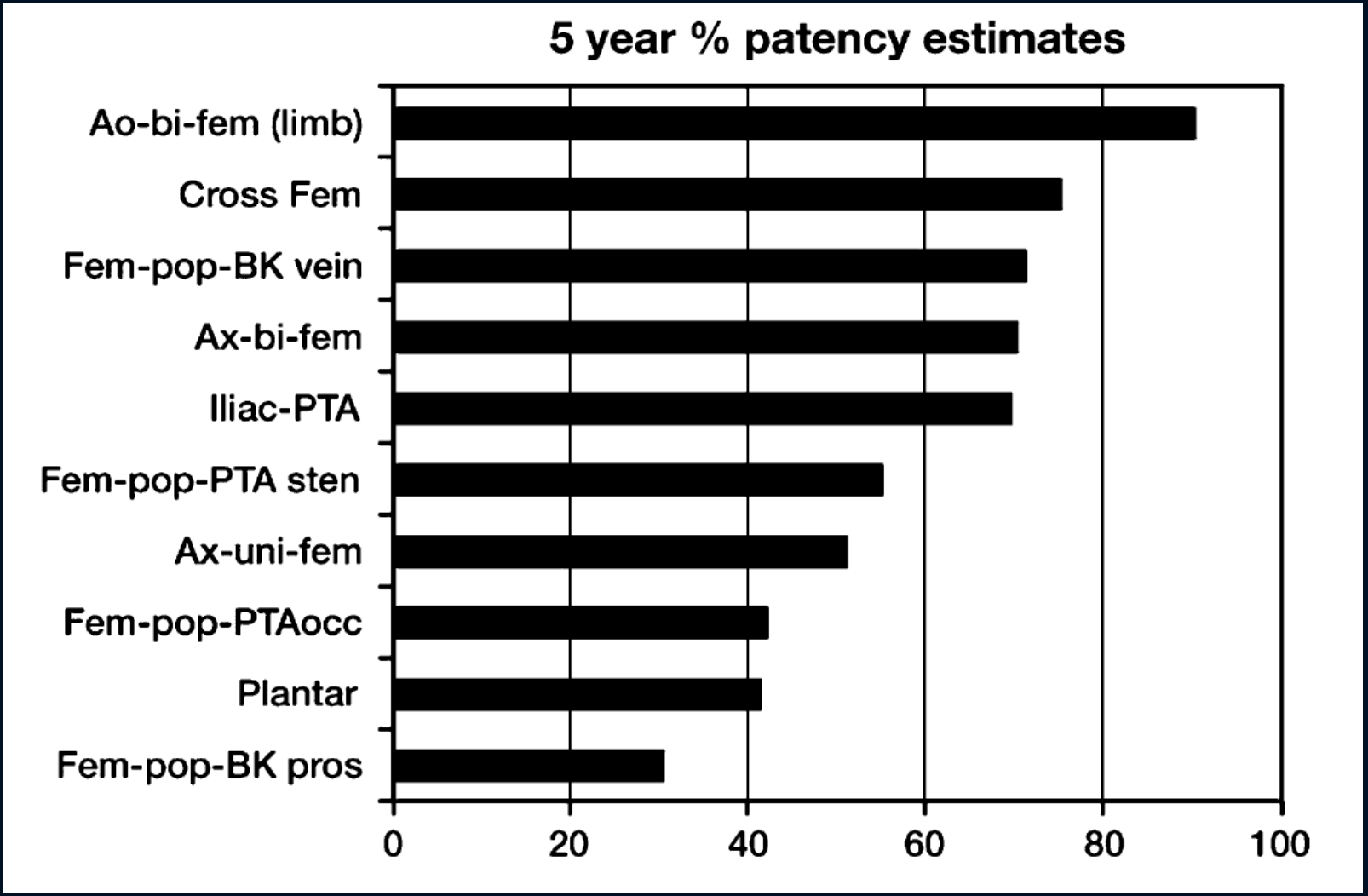
2024 AHA/ACC PAD Guidelines: CLTI

1	A	3. In patients undergoing surgical revascularization for CLTI, bypass to the popliteal or infrapopliteal arteries (ie, tibial, pedal) should be constructed with autogenous vein if available.[14–20]
1	B-R	4. In patients with CLTI due to infrainguinal disease, anatomy, available conduit, patient comorbidities, and patient preferences should be considered in selecting the optimal first revascularization strategy (surgical bypass or endovascular revascularization) (Table 16).[3,13]
1	B-R	5. In patients with CLTI who are candidates for surgical bypass and endovascular revascularization, ultrasound mapping of the great saphenous vein is recommended.[3,13]
2a	B-NR	6. In patients with CLTI for whom a surgical approach is selected and a suitable autogenous vein is unavailable, alternative conduits such as prosthetic or cadaveric grafts can be effective for bypass to the popliteal and tibial arteries.[21–26]
2a	B-NR	7. In patients with CLTI and nonhealing wounds or gangrene, revascularization in a manner that achieves in-line blood flow or maximizes perfusion to the wound bed can be beneficial.[27–33]
2a	C-LD	8. In patients with CLTI with ischemic rest pain (ie, without nonhealing wounds or gangrene) attributable to multilevel arterial disease, a revascularization strategy addressing inflow disease first is reasonable.[34,35]



Gornik HL, et al. Circulation. 2024;149:e1313

Revascularization: 5-year Patency



Norgren L, et al. Eur J Vasc Endovasc Surg. 2007;33 Suppl 1:S1

Ticagrelor vs. Clopidogrel for PAD: EUCLID

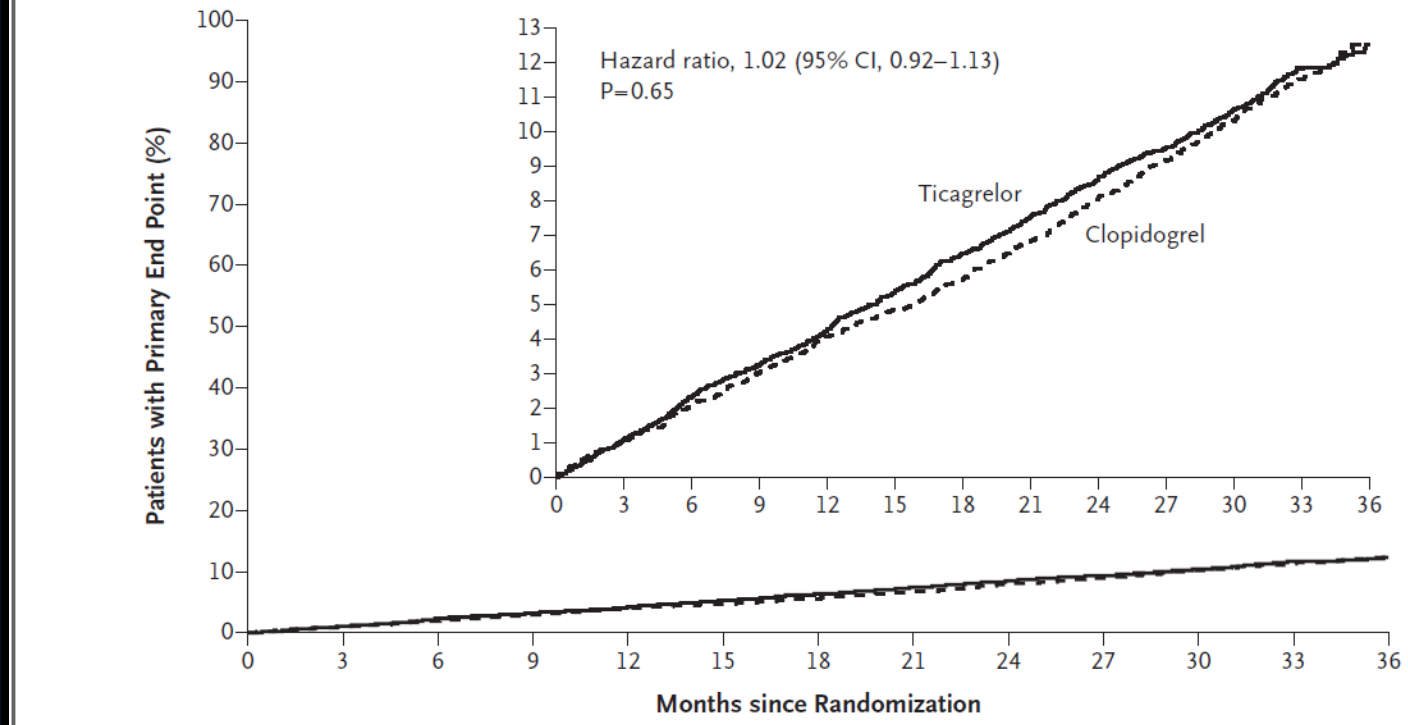
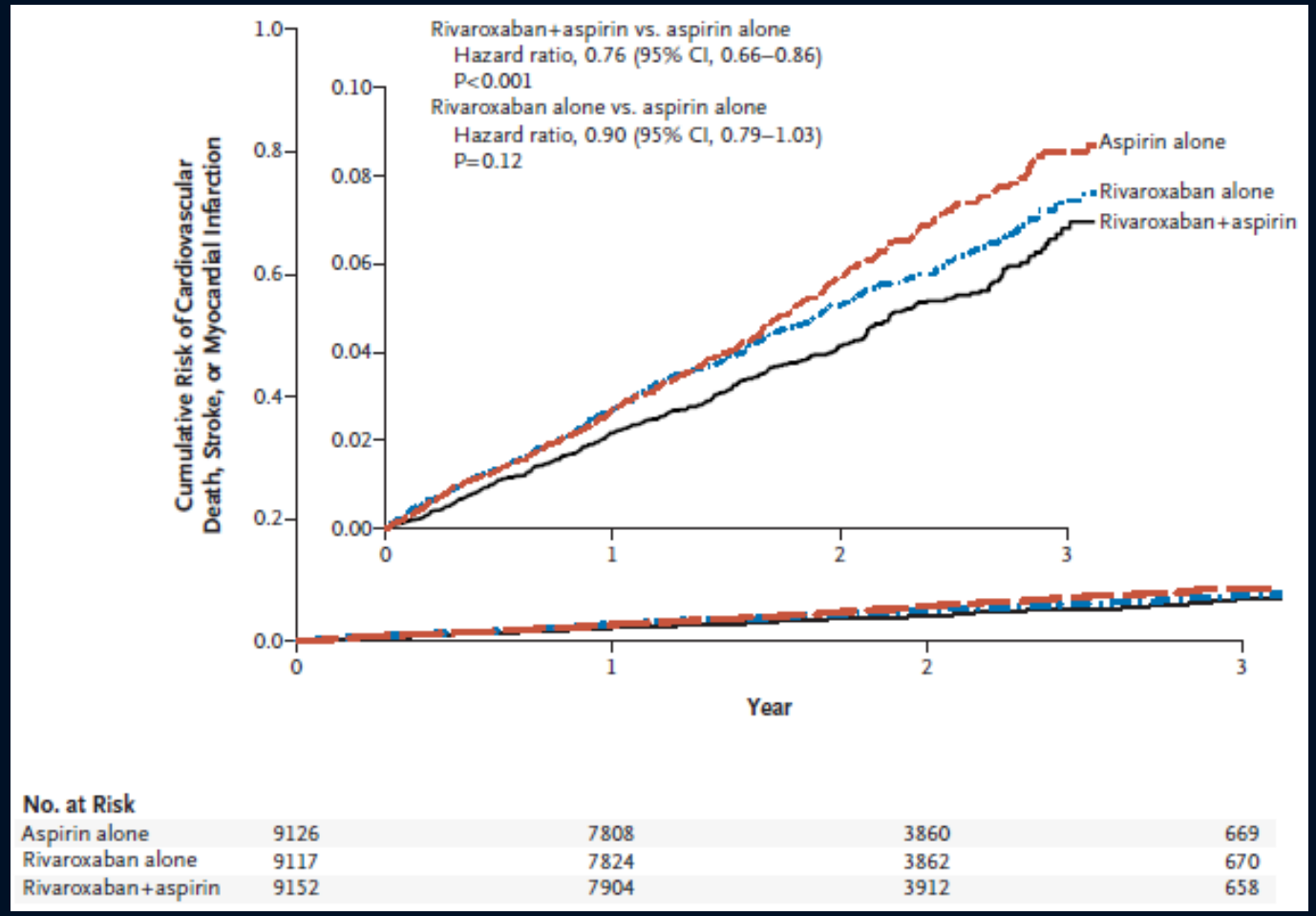


Figure 2. Kaplan–Meier Analysis of the Primary End Point.

Shown is the percentage of patients in whom the primary end point — a composite of cardiovascular death, myocardial infarction, or ischemic stroke — was reported. The inset shows the same data on an expanded y axis.

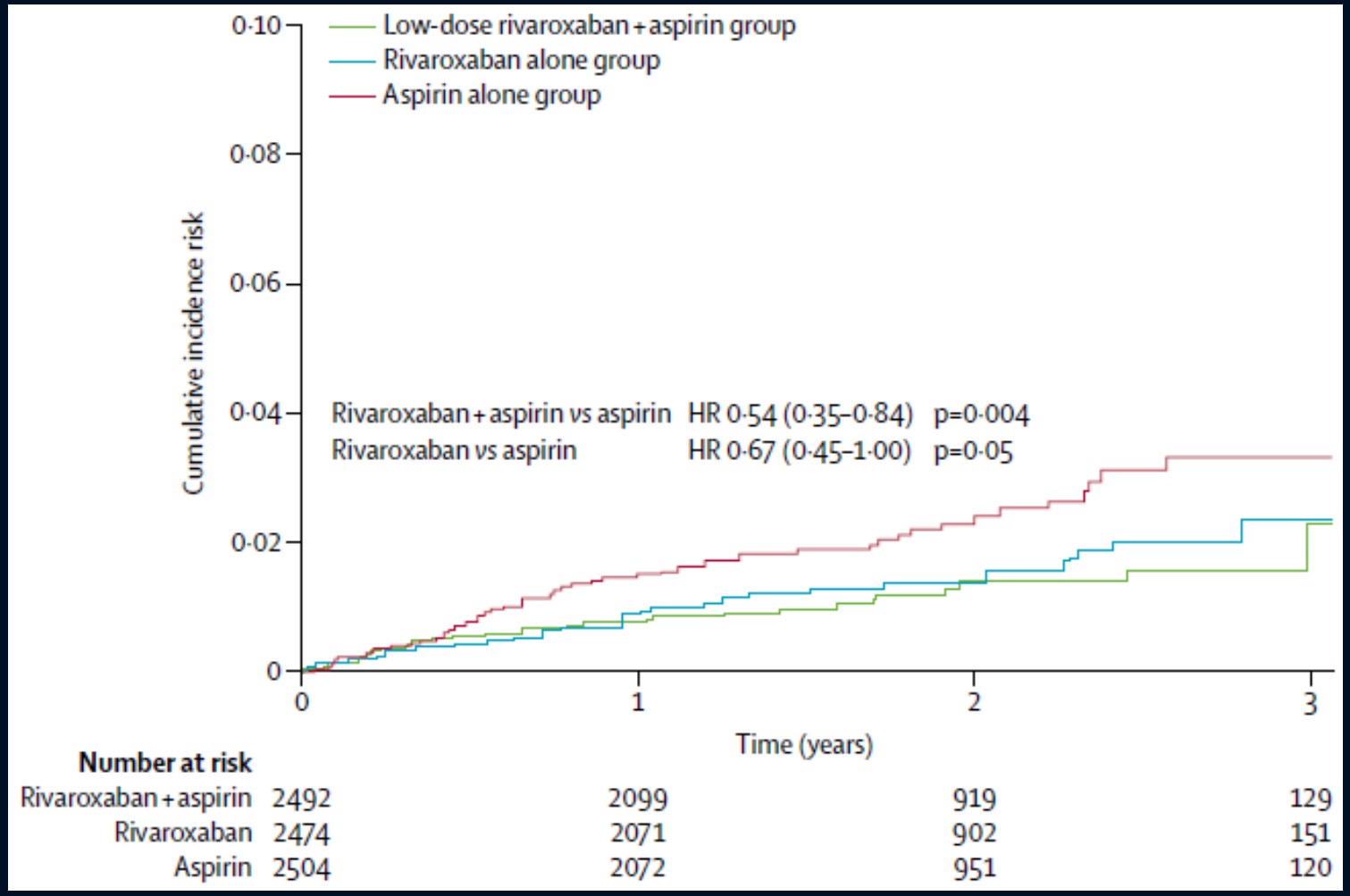
Hiatt WR, et al. N Engl J Med 2017;376:32

COMPASS: Combination Therapy Works Better Than Monotherapy



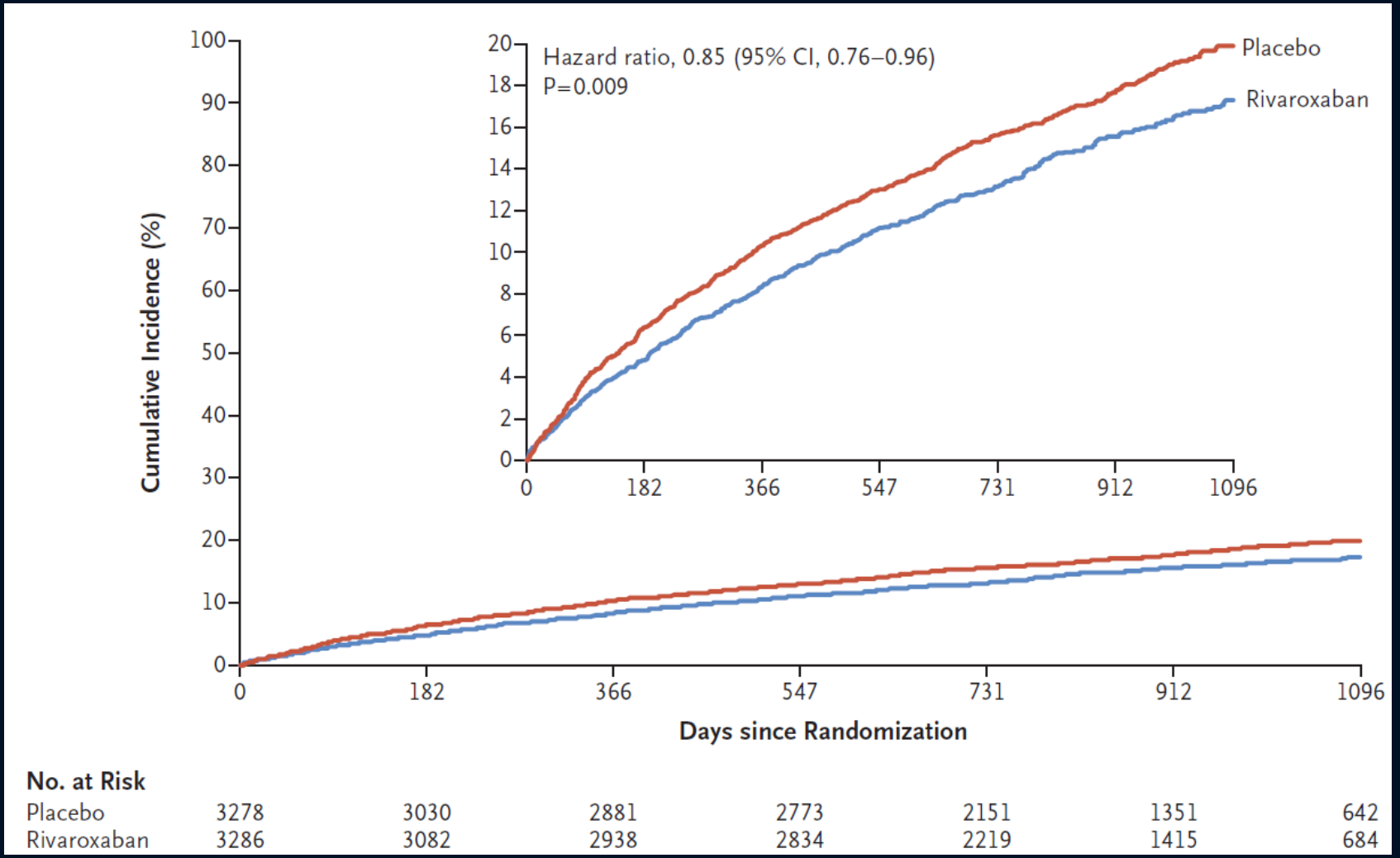
Eikelboom AW, et al. N Engl J Med 2017; 377:1319

COMPASS: Major Adverse Limb Events



Anand SS, et al. Lancet. 2018;391: 219

VOYAGER PAD: MI, Stroke, CV Death, and Major Adverse Limb Events



Bonaca MP, et al. N Engl J Med. 2020; 382:1994

Total Ischemic Event Reduction With Rivaroxaban After Peripheral Arterial Revascularization in the VOYAGER PAD Trial

CENTRAL ILLUSTRATION Mean Cumulative Functions for Total Primary Events and Total Vascular Events

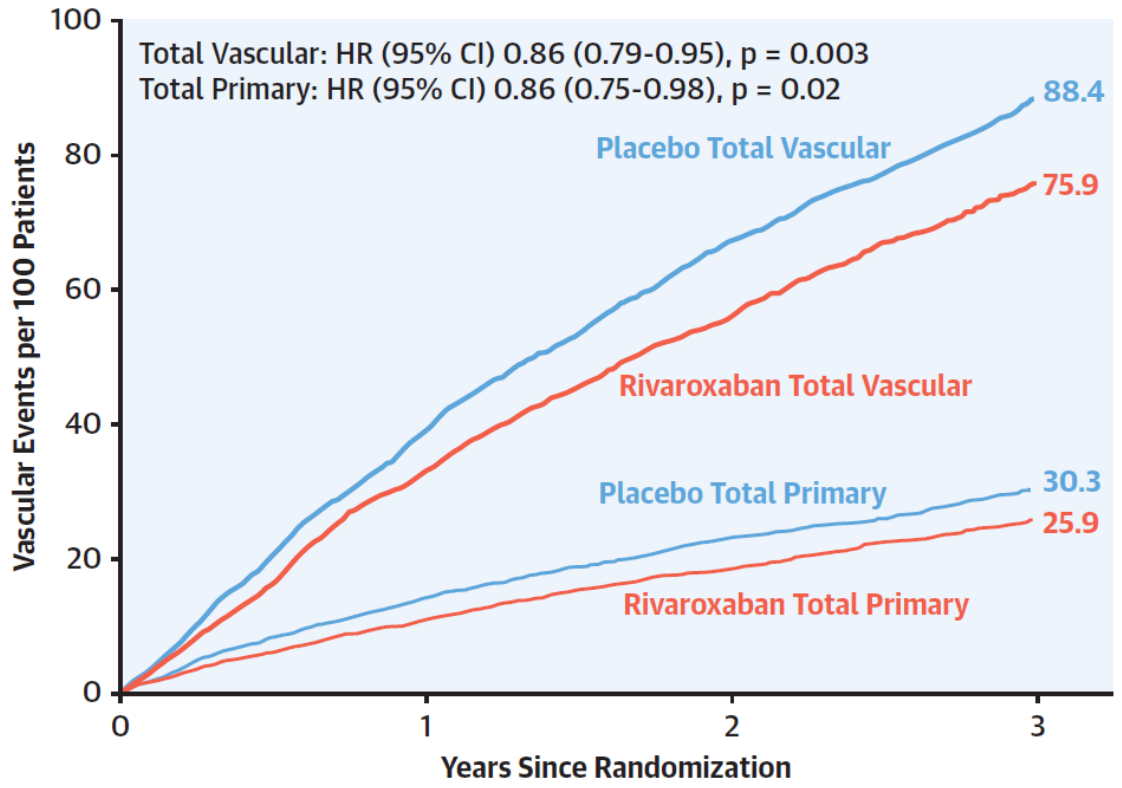
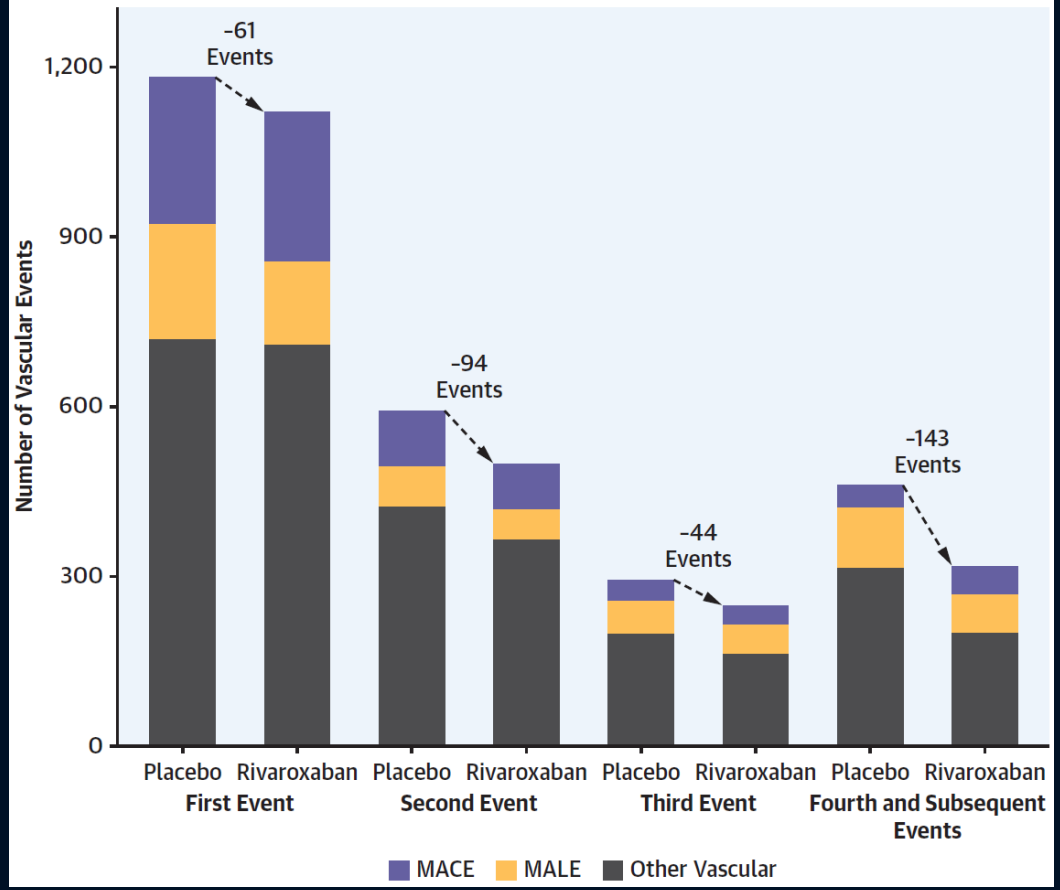
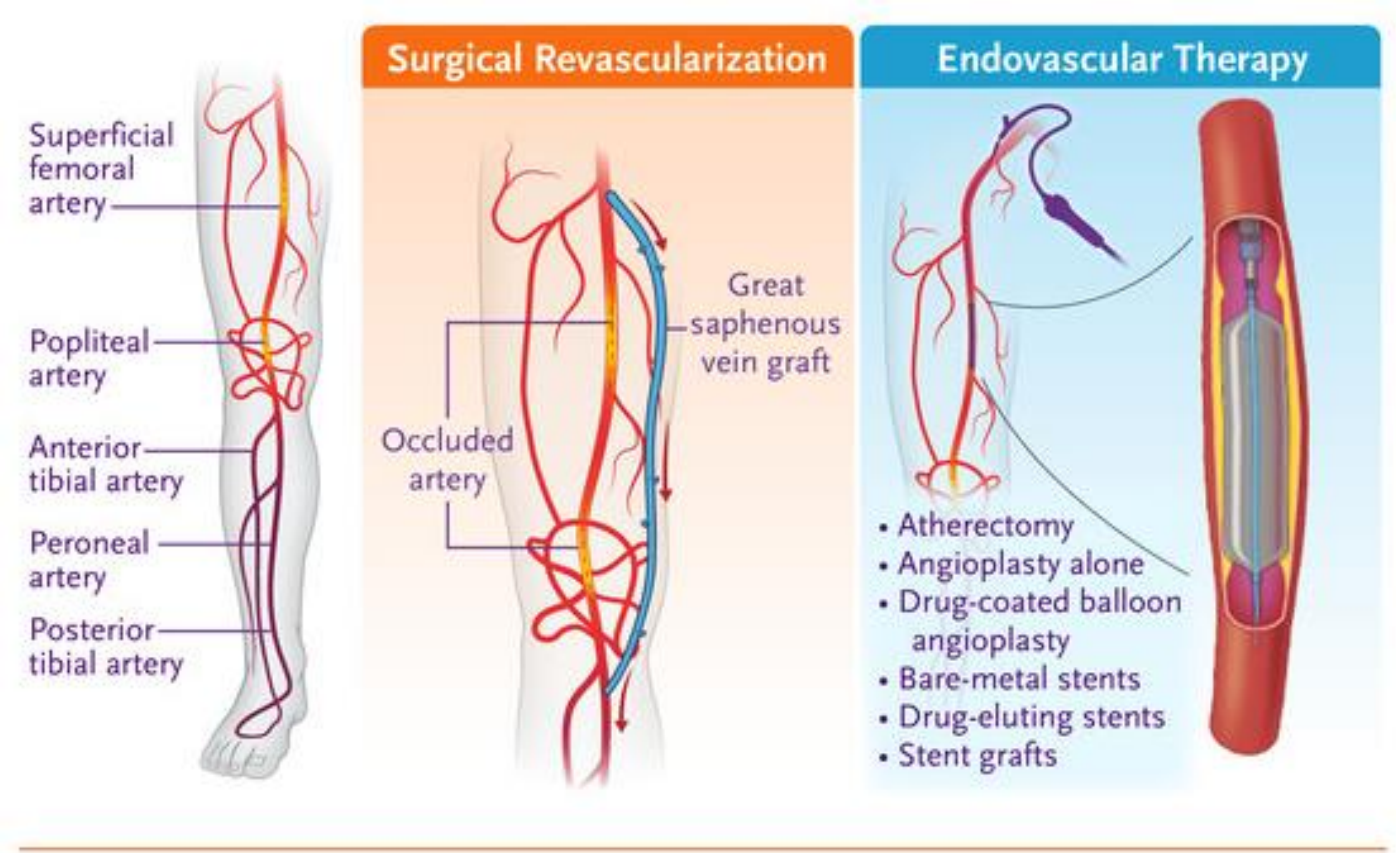


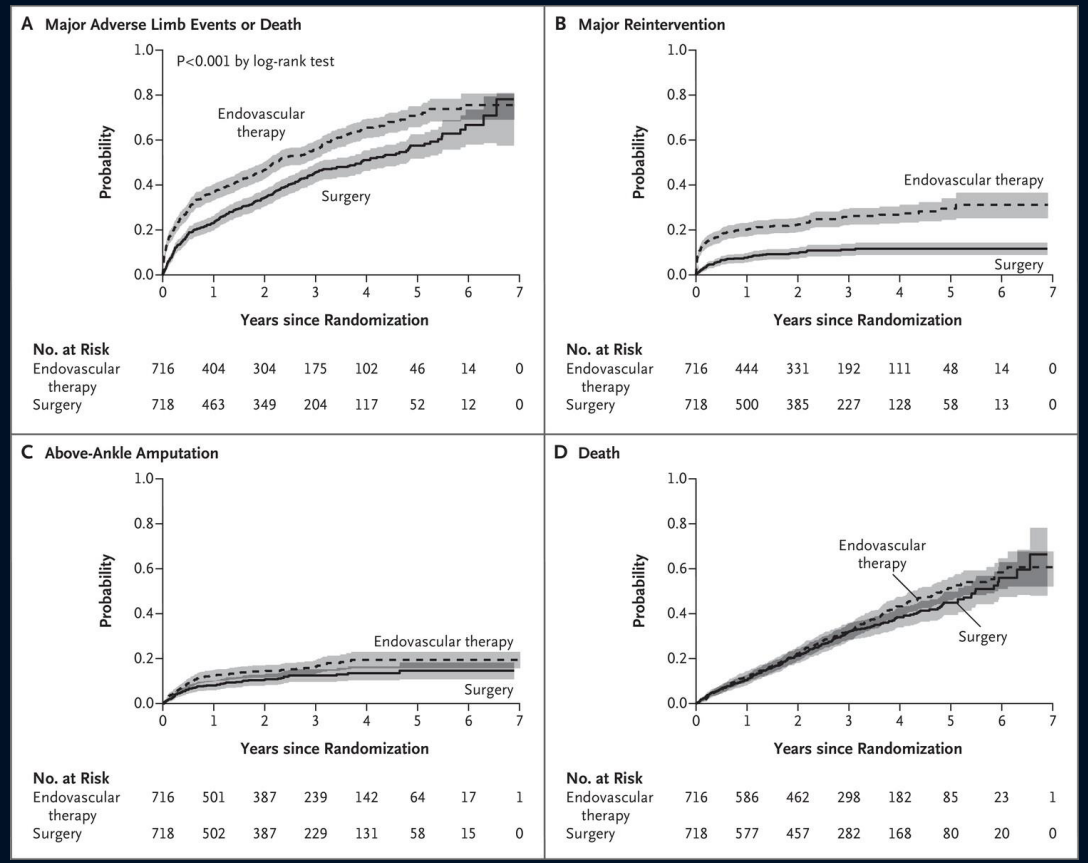
FIGURE 2 Distribution of First and Subsequent Vascular Events



Bauersachs R, et al. J Am Coll Cardiol 2021;78:317

BEST-CLI: Surgery or Endovascular Therapy for Chronic Limb-Threatening Ischemia





Farber A, et al. N Engl J Med 2022;387:2305

2024 AHA/ACC PAD Guidelines: Long-Term Care

12. LONGITUDINAL FOLLOW-UP OF PAD

Recommendations for Longitudinal Follow-Up of PAD
Referenced studies that support the recommendations are summarized in the Online Data Supplement.

COR	LOE	Recommendations
General Principles		
1	C-EO	1. In patients with PAD, with or without revascularization, longitudinal follow-up with routine clinical evaluation, including assessment of limb symptoms and functional status, lower extremity pulse and foot assessment, and progress of risk factor management, is recommended.
1	C-EO	2. In patients with PAD, coordination of care among clinicians to improve the management of PAD and comorbid conditions and to optimize patient outcomes is recommended.
Functional Status and QOL		
1	B-NR	3. In patients with PAD, with or without revascularization, periodic assessment of functional status as well as overall health-related QOL as a component of longitudinal follow-up is recommended.[1–6]
Medical Therapy		
1	A	4. In patients with PAD, long-term use of GDMT to prevent MACE and MALE is recommended.[7–12]
Postrevascularization Follow-Up		
1	C-LD	5. In patients with PAD who have undergone lower extremity revascularization (ie, surgical and/or endovascular), longitudinal follow-up that includes periodic clinical evaluation of lower extremity symptoms and pulse and foot assessment is recommended.[13–16]
1	C-LD	6. In patients with PAD who have undergone lower extremity revascularization (ie, surgical, endovascular, or both) with new lower extremity signs or symptoms, ABI and arterial duplex ultrasound is recommended.[14,17–20]
2a	B-R	7. In patients with PAD who have undergone infrainguinal, autogenous vein bypass graft(s) without new lower extremity signs or symptoms, it is reasonable to perform ABI and arterial duplex ultrasound surveillance within the first 1 to 3 months postprocedure, then repeat at 6 and 12 months, and then annually.[13,14,20–22]

Gornik HL, et al. Circulation. 2024;149:e1313

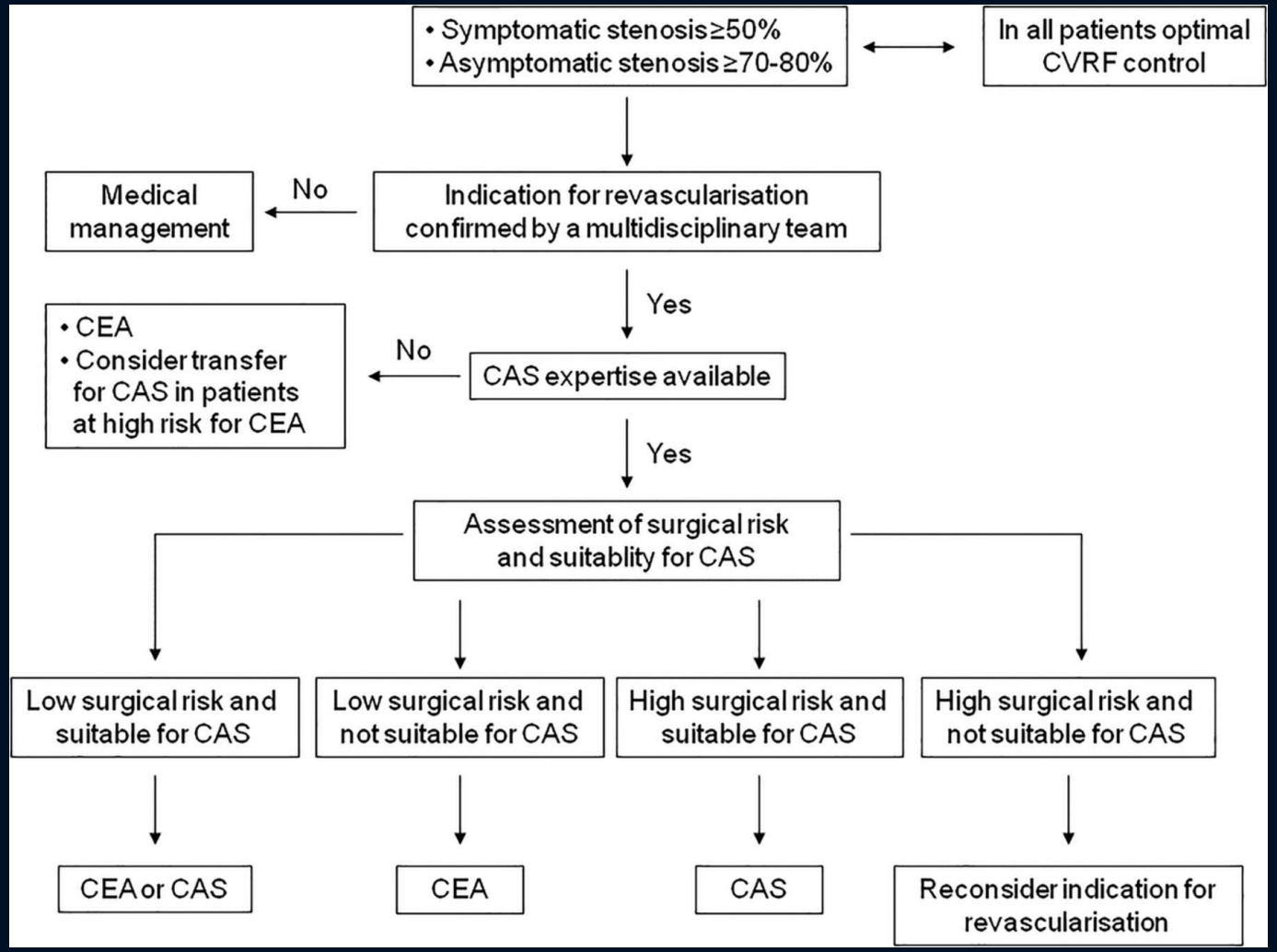
What About Her Carotid Bruits?

- An analysis of 28 prospective cohort articles and 17913 patients found that a carotid bruit was associated with:
  - 4-fold increase in TIA
  - 2.5-fold increase in stroke
  - 2.7-fold increase in fatal stroke

- The most appropriate next step in this patient would be a carotid ultrasound.

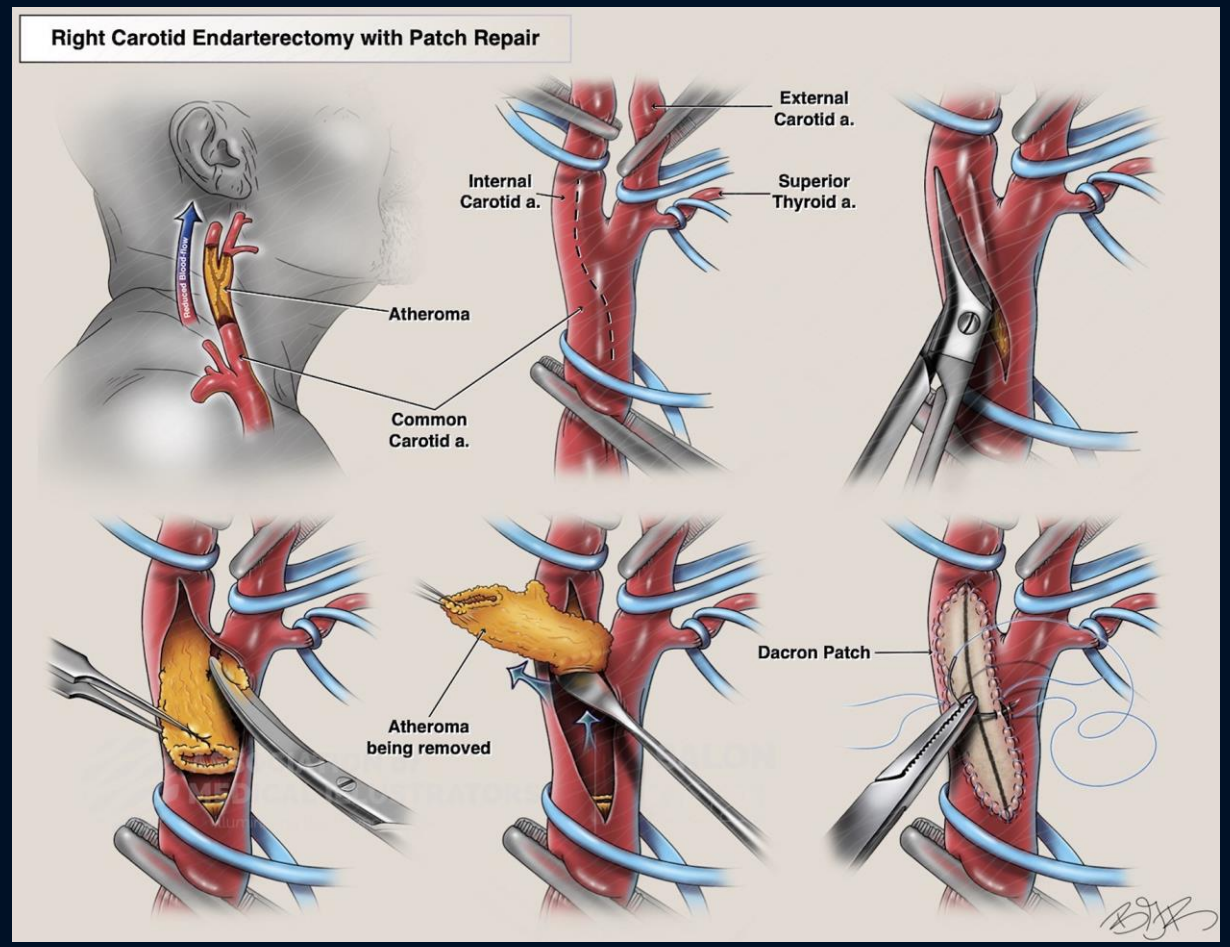
Pickett CA, et al. Stroke. 2010;41:229

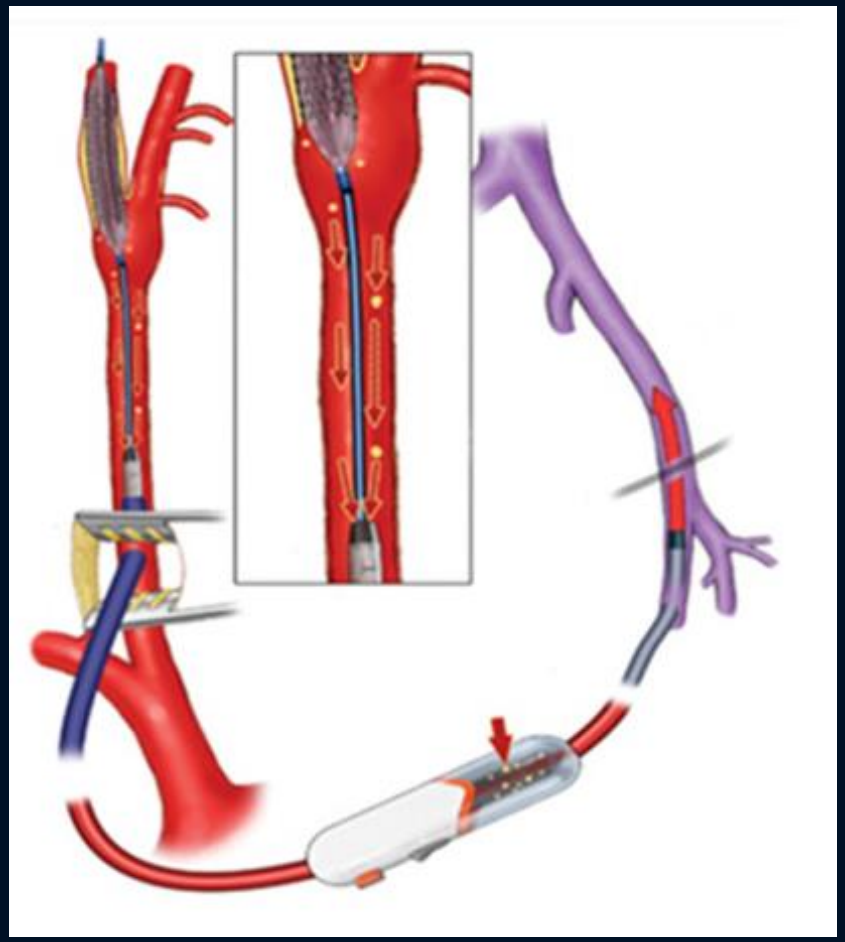
Management of Carotid Stenosis



heart.bmj.com/content/heartjnl/early/2016/03/04/heartjnl-2015-307638/

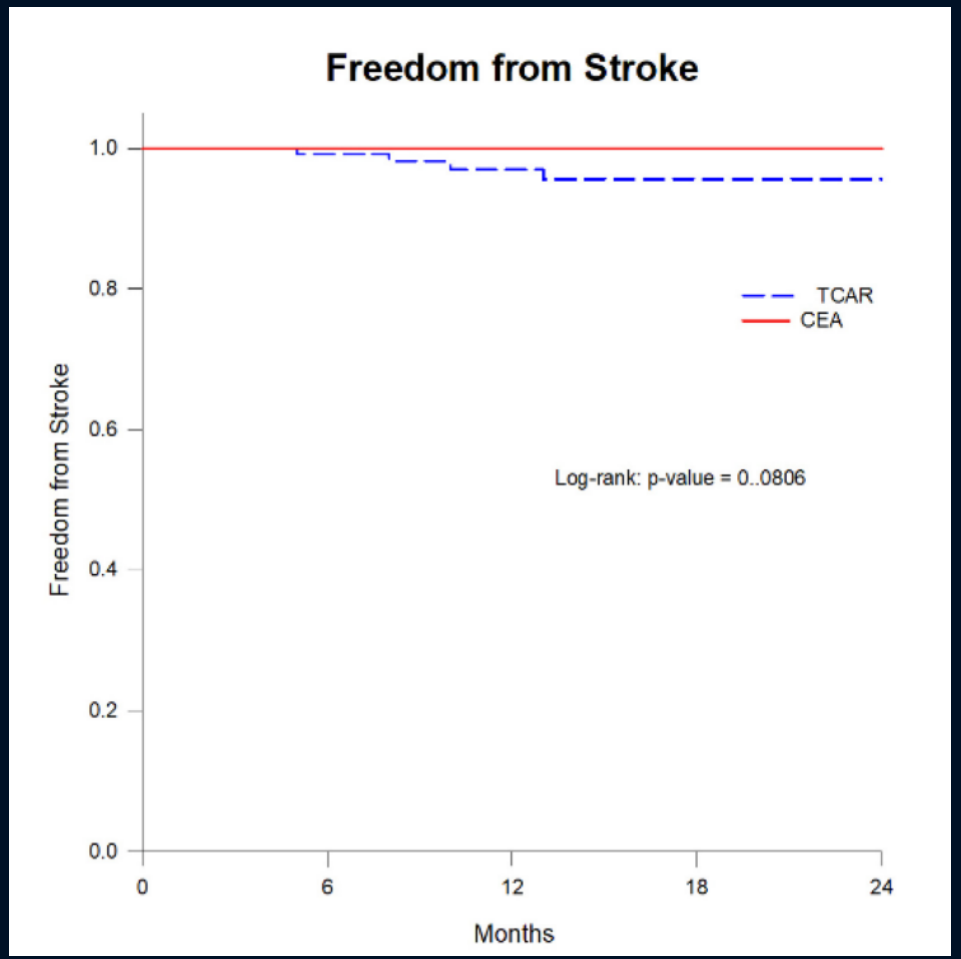
Carotid Endarterectomy and Transcarotid Artery Revascularization (TCAR)

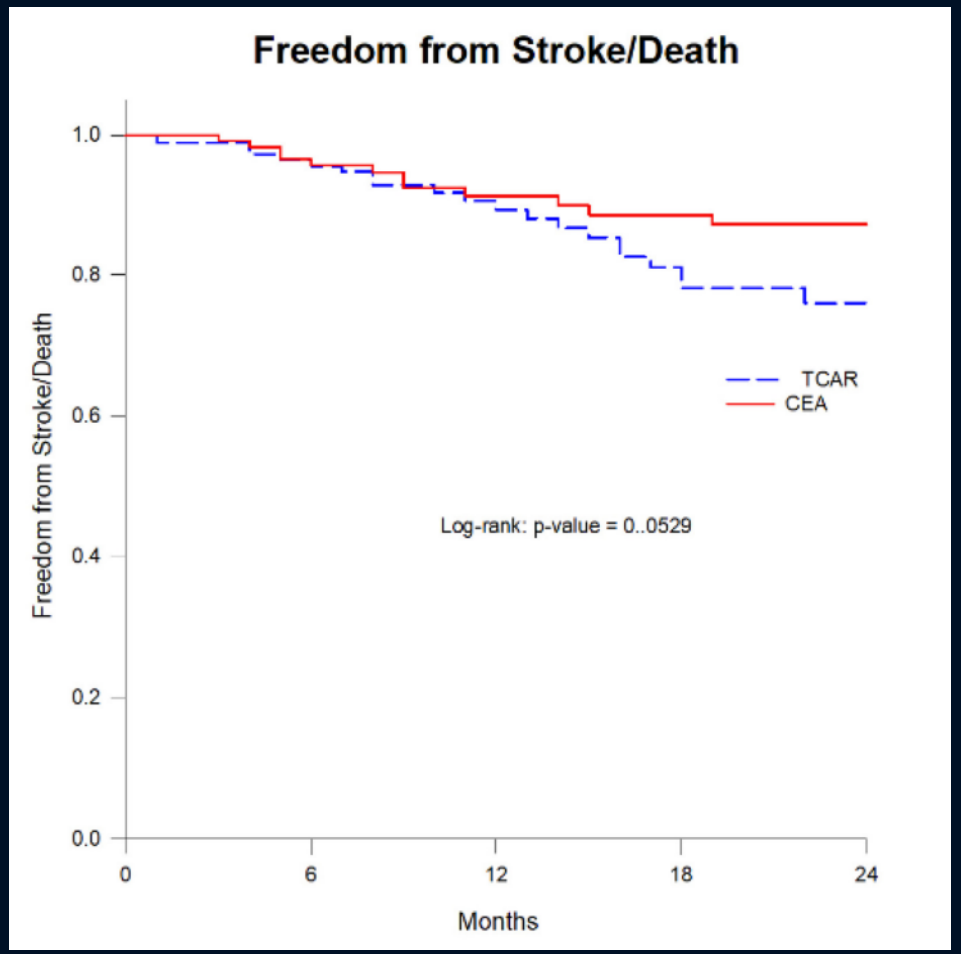




https://meetingarchive.ami.org/2021/project/right-carotid-endarterectomy-with-patch-repair/
Tanaka A, et al. J Vasc Surg. 2022;76:961

Transcarotid Artery Revascularization (TCAR) vs Carotid Endarterectomy





AbuRahma AF, et al. J Vasc Surg. 2024;79:1402

Transcarotid Artery Revascularization (TCAR) vs Carotid Endarterectomy

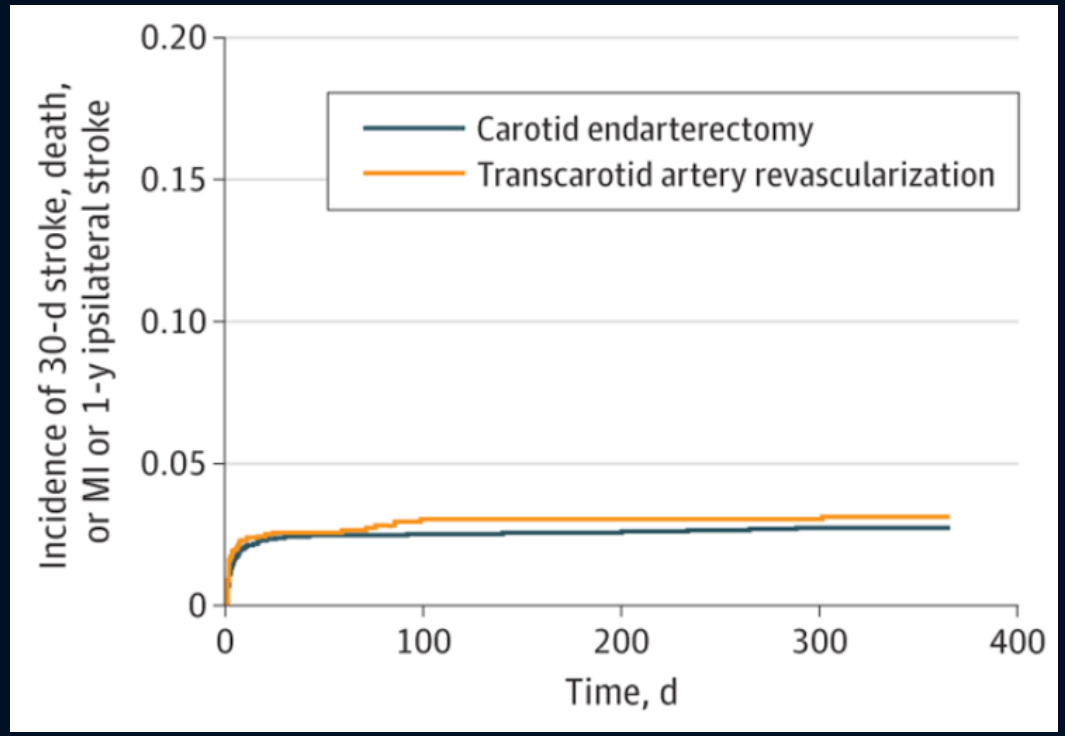
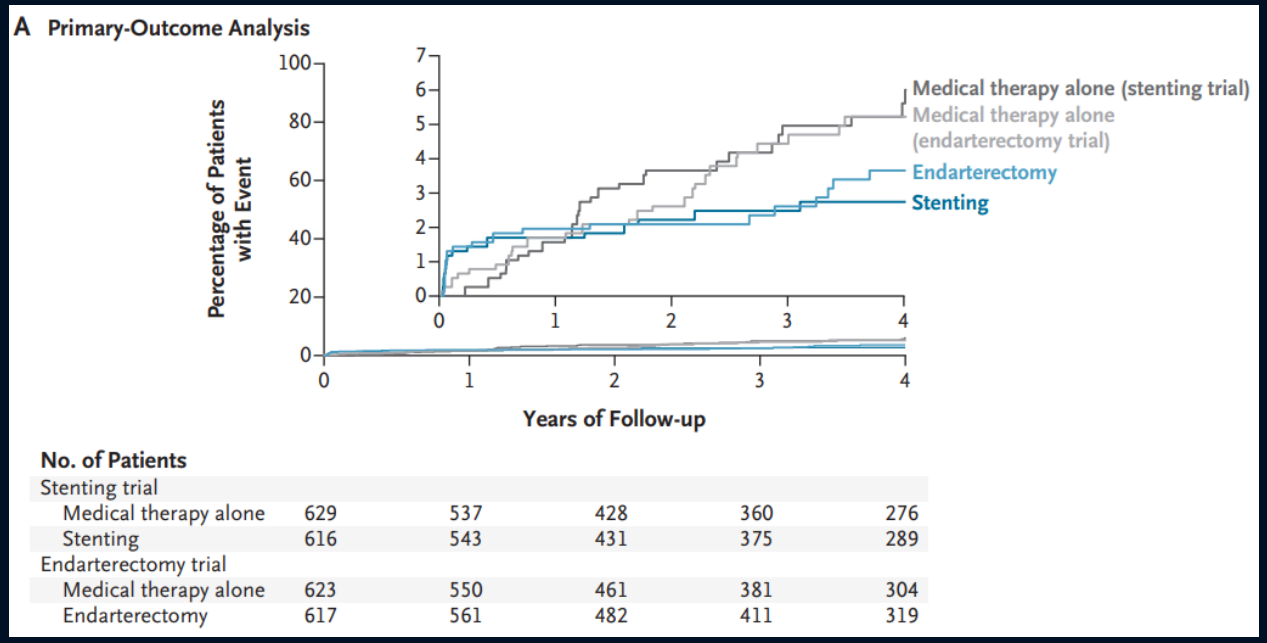


Table 2. In-Hospital Perioperative Outcomes After Transcarotid Artery Stenting or Carotid Endarterectomy Stenting in a Propensity Score–Matched Study Population

	No. (%)			
	Transcarotid artery stenting (n = 2962)	Carotid endarterectomy (n = 8886)	Absolute difference, % (95% CI)	*P* value
Stroke/death/myocardial infarction	58 (2.0)	151 (1.7)	0.26 (−0.31 to 0.82)	.35
Stroke	43 (1.5)	88 (1.0)	0.46 (0.01 to 0.94)	.04
Death	6 (0.2)	14 (0.2)	0.04 (−0.14 to 0.23)	.61
Myocardial infarction	14 (0.5)	63 (0.7)	−0.24 (−0.5 to 0.06)	.17
Cranial nerve injury	10 (0.3)	244 (2.7)	−2.4 (−2.8 to −2.0)	<.001
Total procedure time, mean (SD), min	72.2 (29.4)	117 (43.7)	−44.8 (−46.5 to −43.1)	<.001
Failed CMS discharge criteria	441 (14.9)	1439 (16.2)	−1.3 (−2.8 to 0.19)	.09
Failed discharge home	171 (5.8)	559 (6.3)	0.5 (−1.5 to 0.5)	.31
Length of stay >2 d	390 (13.2)	1263 (14.2)	−1.0 (−2.4 to 0.4)	.15

Liang P, et al. JAMA Neurol. 2023;80:437

Medical Management and Revascularization for Asymptomatic Carotid Stenosis



No. of Patients					
Stenting trial					
Medical therapy alone	629	537	428	360	276
Stenting	616	543	431	375	289
Endarterectomy trial					
Medical therapy alone	623	550	461	381	304
Endarterectomy	617	561	482	411	319

Table 2. Analysis of Primary Outcome and Components.

Variable	Stenting Trial		Endarterectomy Trial	
	Medical Therapy Alone	Stenting	Medical Therapy Alone	Endarterectomy
Primary 4-yr composite outcome*				
Event rate (95% CI) — %	6.0 (3.8 to 8.3)	2.8 (1.5 to 4.3)	5.3 (3.3 to 7.4)	3.7 (2.1 to 5.5)
Absolute difference (95% CI) — percentage points†	3.2 (0.6 to 5.9)		1.6 (−1.1 to 4.3)	
P value for difference	0.02		0.24	
Relative risk (95% CI)†	2.13 (1.15 to 4.39)		1.43 (0.78 to 2.72)	
Components of primary outcome				
Periprocedural period: stroke or death				
No. of events/no. of patients	0/629	8/616	3/623	9/617
Percent of patients with event (95% CI)	0.0 (0.0 to 0.6)	1.3 (0.6 to 2.5)	0.5 (0.1 to 1.4)	1.5 (0.7 to 2.8)
Difference (95% CI) — percentage points	−1.3 (−2.2 to 0.4)		−1.0 (−2.1 to 0.1)	
Postprocedural period: ipsilateral ischemic stroke				
No. of person-yr	1686	1714	1761	1823
No. of events/no. of patients	28/600	7/582	23/600	10/596
Annual event rate per person-yr (95% CI) — %	1.7 (1.1 to 2.4)	0.4 (0.2 to 0.9)	1.3 (0.9 to 2.0)	0.5 (0.3 to 1.0)
Relative risk (95% CI)	4.07 (1.78 to 9.31)		2.38 (1.13 to 5.00)	

Brott TG, et al .N Engl J Med 2026;394:219

Brief Take Home Notes

- Diagnosis of PAD identifies patients at risk for limb-associated morbidity and cardiovascular events.
- The approach to patients with PAD and claudication focuses on cardiovascular risk factor reduction, medical optimization, supervised exercise, and revascularization.
- Chronic limb threatening ischemia management emphasizes goal-directed medical therapy plus revascularization whenever possible.

References

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- Bonaca MP, et al. Rivaroxaban in Peripheral Artery Disease after Revascularization. N Engl J Med. 2020; 382:1994.

- Criqui MH, et al. Lower Extremity Peripheral Artery Disease: Contemporary Epidemiology, Management Gaps, and Future Directions: A Scientific Statement From the American Heart Association. Circulation. 2021;144:e171–e191.