ACC/AHA Guidelines for the Management of Patients with Peripheral Arterial Disease (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic)

A Collaborative Report from the American Associations for Vascular Surgery/Society for Vascular Surgery,* Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, Society of Interventional Radiology, and the ACC/AHA Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients with Peripheral Arterial Disease)—Summary of Recommendations

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PREAMBLE

THE following is recommendation-only summary of the recently published Guidelines for the Management of Patients with Peripheral Arterial Disease (PAD), developed by the ACC/AHA Task Force on Practice Guidelines. Readers are referred to the full-text version (1) as well as the executive summary (2) of the original document that, due to length considerations, could not be presented in their entirety in this journal. The authors of the original full document are included following the title. Appendixes detail the relationship with industry of the writing committee (Appendix I) and the peer reviewers (Appendix II).

It is important that the medical profession play a significant role in critically evaluating the use of diagnostic procedures and therapies as they are introduced and tested in the detection, management, or prevention of disease states. Rigorous and expert analysis of the available data documenting absolute and relative benefits and risks of those procedures and therapies can produce helpful guidelines that improve the effectiveness of care, optimize patient outcomes, and favorably affect the overall cost of care by focusing resources on the most effective strategies.

The American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) have jointly engaged in the production of such guidelines in the area of cardiovascular disease since 1980. The

ACC/AHA Task Force on Practice Guidelines, whose charge is to develop, update, or revise practice guidelines for important cardiovascular diseases and procedures, directs this effort. Writing committees are charged with the task of performing an assessment of the evidence and acting as an independent group of authors to develop or update written recommendations for clinical practice.

Experts in the subject under consideration have been selected from both organizations to examine subject-specific data and write guidelines. The process includes additional representatives from other medical practitioner and specialty groups when appropriate. Writing committees are specifically charged to perform a formal literature review, weigh the strength of evidence for or against a particular treatment or procedure, and include estimates of expected health outcomes where data exist. Patient-specific modifiers, comorbidities and issues of patient preference that might influence the choice of particular tests or therapies are considered as well as frequency of follow-up and cost effectiveness. When available, information from studies on cost will be considered; however, review of data on efficacy and clinical outcomes will constitute the primary basis for preparing recommendations in these guidelines.

The ACC/AHA Task Force on Practice Guidelines makes every effort to avoid any actual, potential, or perceived conflict of interest that might arise as a result of an industry relationship or personal interest of the writing committee. Specifically, all members of the writing committee, as well as peer reviewers of the document, were asked to provide disclosure statements of all such relationships that might be perceived as real or potential conflicts of interest. Writing committee members are also strongly encouraged to declare a previous relationship with industry that might be perceived as relevant to guideline development. If a writing committee member develops a new relationship with industry during their tenure, they are required to notify guideline staff in writing. The continued participation of the writing committee member will be reviewed. These statements are reviewed by the parent task force, reported orally to all members of the writing committee at each meeting, and updated and reviewed by the writing committee as changes occur. Please refer to the methodology manual for ACC/AHA guideline writing committees for further description of the relationships with industry policy, available on ACC and AHA World Wide Web sites (*http://www.acc.org/clinical/manual/manual_introltr.htm* and *http://circ.ahajournals.org/manual/*). Please see Appendix I for author relationships with industry and Appendix II for peer reviewer relationships with industry that are pertinent to these guidelines.

These practice guidelines are intended to assist health care providers in clinical decision making by describing a range of generally acceptable approaches for the diagnosis, management and prevention of specific diseases or conditions. These guidelines attempt to define practices that meet the needs of most patients in most circumstances. These guideline recommendations reflect a consensus of expert opinion after a thorough review of the available, current scientific evidence and are intended to improve patient care. If these guidelines are used as the basis for regulatory/payer decisions, the ultimate goal is quality of care and serving the patient's best interests. The ultimate judgment regarding care of a particular patient must be made by the health care provider and the patient in light of all of the circumstances presented by that patient. There are circumstances in which deviations from these guidelines are appropriate.

The guidelines will be reviewed annually by the ACC/AHA Task Force on Practice Guidelines and will be considered current unless they are updated, revised, or sunsetted and withdrawn from distribution. The executive summary and recommendations are published in the March 21, 2006, issue of the *Journal of the American College of Cardiology* and March 21, 2006, issue of *Circulation*. The full-text guidelines are e-published in the same issue of the journals noted above, as well as posted on the ACC (*www.acc.org*) and AHA (*www.americanheart.org*) World Wide Web sites. Copies of the full text and the executive summary are available from both organizations.

—Sidney C. Smith, Jr, MD, FACC, FAHA, Chair, ACC/AHA Task Force on Practice Guidelines

1. INTRODUCTION: DEFINITIONS

A. Classification of Recommendations

Class I: Conditions for which there is evidence for and/or general agreement that a given procedure or treatment is beneficial, useful, and effective.

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the useful-

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* AAVS/SVS when Guideline initiated, now merged into SVS.

† Society for Vascular Medicine and Biology official representative.

‡ Society of Interventional Radiology official representative.

§ Society for Vascular Surgery official representative.

¶ Society for Cardiovascular Angiography and Interventions official representative.

** Former Task Force member during this effort.

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This document is available on the World Wide Web sites of the American College of Cardiology (*www.acc.org*) and the American Heart Association (*www.americanheart.org*). Single copies of this document are available by calling 1-800-253-4636 or writing the American College of Cardiology Foundation, Resource Center, at 9111 Old Georgetown Road, Bethesda, MD 20814-1699. Ask for reprint number 71-0349. To obtain a copy of the Executive Summary published in the March 21, 2006, issue of the *Journal of the American College of Cardiology* and the March 21, 2006, issue of *Circulation*; ask for reprint number 71-0348. To purchase bulk reprints (specify version and reprint number): Up to 999 copies, call 1-800-611-6083 (US only) or fax 413-665-2671; 1,000 or more copies, call 214-706-1789, fax 214-691-6342, or e-mail pubauth@heart.org

This document can also be found on the World Wide Web sites of the Society for Cardiovascular Angiography and Interventions (*www.scai.org*), Society for Vascular Medicine and Biology (*www.svmb.org*), Society of Interventional Radiology (*www.sirweb.org*), and Vascular Disease Foundation (*www.vdf.org*). Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. This document was approved by the American College of Cardiology Foundation Board of Trustees in October 2005 and by the American Heart Association Science Advisory and Coordinating Committee in October 2005. These recommendations have been compiled with permission of the American College of Cardiology Foundation.

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ness/efficacy of a procedure or treatment.

Class IIA: weight of evidence/opinion is in favor of usefulness/efficacy.

Class IIB: usefulness/efficacy is less well established by evidence/opinion.

Class III: Conditions for which there is evidence and/or general agreement that a procedure/treatment is not useful/effective and in some cases may be harmful.

B. Level of Evidence

- Level of evidence A: data derived from multiple randomized clinical trials or meta-analyses.
- Level of evidence B: data derived from a single randomized trial or nonrandomized studies.
- Level of evidence C: only consensus opinion of experts, case studies, or standard of care.

C. Vascular History and Physical Examination

Class I

1. Individuals at risk for lower-extremity PAD (see Section 2.1.1, Table 2 in reference 1) should undergo a vascular review of symptoms to assess walking impairment, claudication, ischemic rest pain, and/or the presence of nonhealing wounds. (Level of evidence: C)

2. Individuals at risk for lower-extremity PAD (see Section 2.1.1) should undergo comprehensive pulse examination and inspection of the feet. (Level of evidence: C)

3. Individuals over 50 years of age should be asked if they have a family history of a first-order relative with an abdominal aortic aneurysm (AAA). (Level of evidence: C)

2. LOWER-EXTREMITY PAD

A. Lower-extremity PAD: General Recommendations for Diagnosis and Therapy by Clinical Presentation

(1) Asymptomatic

Class I

1. A history of walking impairment, claudication, ischemic rest pain, and/or nonhealing wounds is recommended as a required component of a standard ROS for adults 50 years and older who have atherosclerosis risk factors and for adults 70 years and older. (Level of evidence: C)

2. Individuals with asymptomatic lower-extremity PAD should be identified by examination and/or measurement of the ABI so that therapeutic interventions known to diminish their increased risk of myocardial infarction (MI), stroke, and death may be offered. (Level of evidence: B)

3. Smoking cessation, lipid lowering, and diabetes and hypertension treatment according to current national treatment guidelines are recommended for individuals with asymptomatic lower-extremity PAD. (Level of evidence: B)

4. Antiplatelet therapy is indicated for individuals with asymptomatic lower-extremity PAD to reduce the risk of adverse cardiovascular ischemic events. (Level of evidence: C)

Class IIa

1. An exercise ABI measurement can be useful to diagnose lower-extremity PAD in individuals who are at risk for lower-extremity PAD (Table 2 in reference 1) who have a normal ABI (0.91–1.30), are without classic claudication symptoms, and have no other clinical evidence of atherosclerosis. (Level of evidence: C)

2. A toe-brachial index or pulse volume recording measurement can be useful to diagnose lower-extremity PAD in individuals who are at risk for lower-extremity PAD who have an ABI greater than 1.30 and no other clinical evidence of atherosclerosis. (Level of evidence: C)

Class IIb

Angiotensin-converting enzyme (ACE) inhibition may be considered for individuals with asymptomatic lower-extremity PAD for cardiovascular risk reduction. (Level of evidence: C)

(2) Claudication

Class I

1. Patients with symptoms of intermittent claudication should undergo a vascular physical examination, including measurement of the ABI. (Level of evidence: B)

2. In patients with symptoms of intermittent claudication, the ABI should be measured after exercise if the resting index is normal. (Level of evidence: B)

3. Patients with intermittent claudication should have significant functional impairment with a reasonable likelihood of symptomatic improvement and absence of other disease that would comparably limit exercise even if the claudication was improved (eg, angina, heart failure, chronic respiratory disease, or orthopedic limitations) before undergoing an evaluation for revascularization. (Level of evidence: C)

4. Individuals with intermittent claudication who are offered the option of endovascular or surgical therapies should: (a) be provided information regarding supervised claudication exercise therapy and pharmacotherapy; (b) receive comprehensive risk factor modification and antiplatelet therapy; (c) have a significant disability, either being unable to perform normal work or having serious impairment of other activities important to the patient; and (d) have lower-extremity PAD lesion anatomy such that the revascularization procedure would have low risk and a high probability of initial and long-term success. (Level of evidence: C)

Class III

Arterial imaging is not indicated for patients with a normal postexercise ABI. This does not apply if other atherosclerotic causes (eg, entrapment syndromes or isolated internal iliac artery occlusive disease) are suspected. (Level of evidence: C)

(3) Critical Limb Ischemia

Class I

1. Patients with critical limb ischemia (CLI) should undergo expedited evaluation and treatment of factors that are known to increase the risk of amputation (see text). (Level of evidence: C)

2. Patients with CLI in whom open surgical repair is anticipated should undergo assessment of cardiovascular risk. (Level of evidence: B)

3. Patients with a prior history of CLI or who have undergone successful treatment for CLI should be evaluated at least twice annually by a vascular specialist owing to the relatively high incidence of recurrence. (Level of evidence: C)

4. Patients at risk of CLI (ABI less than 0.4 in a nondiabetic individual, or any diabetic individual with known lower-extremity PAD) should undergo regular inspection of the feet to detect objective signs of CLI. (Level of evidence: B)

5. The feet should be examined di-

rectly, with shoes and socks removed, at regular intervals after successful treatment of CLI. (Level of evidence: C)

6. Patients with CLI and features to suggest atheroembolization should be evaluated for aneurysmal disease (eg, abdominal aortic, popliteal, or common femoral aneurysms). (Level of evidence: B)

7. Systemic antibiotics should be initiated promptly in patients with CLI, skin ulcerations, and evidence of limb infection. (Level of evidence: B)

8. Patients with CLI and skin breakdown should be referred to health care providers with specialized expertise in wound care. (Level of evidence: B)

9. Patients at risk for CLI (those with diabetes, neuropathy, chronic renal failure, or infection) who develop acute limb symptoms represent potential vascular emergencies and should be assessed immediately and treated by a specialist competent in treating vascular disease. (Level of evidence: C)

10. Patients at risk for or who have been treated for CLI should receive verbal and written instructions regarding self-surveillance for potential recurrence. (Level of evidence: C)

(4) Acute Limb Ischemia

Class I

Patients with acute limb ischemia and a salvageable extremity should undergo an emergent evaluation that defines the anatomic level of occlusion and that leads to prompt endovascular or surgical revascularization. (Level of evidence: B)

Class III

Patients with acute limb ischemia and a nonviable extremity should not undergo an evaluation to define vascular anatomy or efforts to attempt revascularization. (Level of evidence: B)

(5) Prior Limb Arterial Revascularization

Class I

Long-term patency of infrainguinal bypass grafts should be evaluated in a surveillance program, which should include an interval vascular history, resting ABIs, physical examination, and a duplex ultrasound (US) at regular intervals if a venous conduit has been used. (Level of evidence: B)

Class IIa

1. Long-term patency of infrainguinal bypass grafts may be considered for evaluation in a surveillance program, which may include conducting exercise ABIs and other arterial imaging studies at regular intervals (see duplex US recommendations, Section 2.5.5). (Level of evidence: B)

2. Long-term patency of endovascular sites may be evaluated in a surveillance program, which may include conducting exercise ABIs and other arterial imaging studies at regular intervals (see duplex US recommendations, Section 2.5.5). (Level of evidence: B)

B. Lower-extremity PAD: Diagnostic Methods

(1) Ankle- and Toe-Brachial Indexes, Segmental Pressure Examination

Class I

1. The resting ABI should be used to establish the lower-extremity PAD diagnosis in patients with suspected lower-extremity PAD, defined as individuals with exertional leg symptoms, with nonhealing wounds, who are 70 years and older or who are 50 years and older with a history of smoking or diabetes. (Level of evidence: C)

2. The ABI should be measured in both legs in all new patients with PAD of any severity to confirm the diagnosis of lower-extremity PAD and establish a baseline. (Level of evidence: B)

3. The toe-brachial index should be used to establish the lower-extremity PAD diagnosis in patients in whom lower-extremity PAD is clinically suspected but in whom the ABI test is not reliable due to noncompressible vessels (usually patients with long-standing diabetes or advanced age). (Level of evidence: B)

4. Leg segmental pressure measurements are useful to establish the lower-extremity PAD diagnosis when anatomic localization of lower-extremity PAD is required to create a therapeutic plan. (Level of evidence: B)

(2) Pulse Volume Recording

Class IIa

Pulse volume recordings are reasonable to establish the initial lower-extremity PAD diagnosis, assess localization and severity, and follow the status of lower extremity revascularization procedures. (Level of evidence: B)

(3) Continuous-wave Doppler US

Class I

Continuous-wave Doppler US blood flow measurements are useful to provide an accurate assessment of lower-extremity PAD location and severity, to follow lower-extremity PAD progression, and to provide quantitative follow-up after revascularization procedures. (Level of evidence: B)

(4) Treadmill Exercise Testing with and without ABI Assessments and 6-Minute Walk Test

Class I

1. Exercise treadmill tests are recommended to provide the most objective evidence of the magnitude of the functional limitation of claudication and to measure the response to therapy. (Level of evidence: B)

2. A standardized exercise protocol (either fixed or graded) with a motorized treadmill should be used to ensure reproducibility of measurements of pain-free walking distance and maximal walking distance. (Level of evidence: B)

3. Exercise treadmill tests with measurement of preexercise and postexercise ABI values are recommended to provide diagnostic data useful in differentiating arterial claudication from nonarterial claudication ("pseudoclaudication"). (Level of evidence: B)

4. Exercise treadmill tests should be performed in individuals with claudication who are to undergo exercise training (lower-extremity PAD rehabilitation) so as to determine functional capacity, assess nonvascular exercise limitations, and demonstrate the safety of exercise. (Level of evidence: B)

Class IIb

A 6-minute walk test may be reasonable to provide an objective assessment of the functional limitation of claudication and response to therapy in elderly individuals or others not amenable to treadmill testing. (Level of evidence: B)

(5) Duplex US

Class I

1. Duplex US of the extremities is useful to diagnose anatomic location and degree of stenosis of PAD. (Level of evidence: A)

2. Duplex US is recommended for routine surveillance after femoral-popliteal or femoral-tibialpedal bypass with a venous conduit. Minimum surveillance intervals are approximately 3, 6, and 12 months, and then yearly after graft placement. (Level of evidence: A)

Class II

1. Duplex US of the extremities can

be useful to select patients as candidates for endovascular intervention. (Level of evidence: B)

2. Duplex US can be useful to select patients as candidates for surgical bypass and to select the sites of surgical anastomosis. (Level of evidence: B)

Class IIb

1. The use of duplex US is not well established to assess long-term patency of percutaneous transluminal angioplasty. (Level of evidence: B)

2. Duplex US may be considered for routine surveillance after femoral-popliteal bypass with a synthetic conduit. (Level of evidence: B)

(6) Computed Tomographic Angiography

Class IIb

1. Computed tomographic (CT) angiography of the extremities may be considered to diagnose anatomic location and presence of significant stenosis in patients with lower-extremity PAD. (Level of evidence: B)

2. CT angiography of the extremities may be considered as a substitute for magnetic resonance (MR) angiography for those patients with contraindications to MR angiography. (Level of evidence: B)

(7) MR Angiography

Class I

1. MR angiography of the extremities is useful to diagnose anatomic location and degree of stenosis of PAD. (Level of evidence: A)

2. MR angiography of the extremities should be performed with gadolinium enhancement. (Level of evidence: B)

3. MR angiography of the extremities is useful in selecting patients with lower-extremity PAD as candidates for endovascular intervention. (Level of evidence: A)

Class IIb

1. MR angiography of the extremities may be considered to select patients with lower-extremity PAD as candidates for surgical bypass and to select the sites of surgical anastomosis. (Level of evidence: B)

2. MR angiography of the extremities may be considered for postrevascularization (endovascular and surgical bypass) surveillance in patients with lower-extremity PAD. (Level of evidence: B)

(8) Contrast Angiography

Class I

1. Contrast angiography provides detailed information about arterial anatomy and is recommended for evaluation of patients with lower-extremity PAD when revascularization is contemplated. (Level of evidence: B)

2. A history of contrast reaction should be documented before the performance of contrast angiography and appropriate pretreatment administered before contrast is given. (Level of evidence: B)

3. Decisions regarding the potential utility of invasive therapeutic interventions (percutaneous or surgical) in patients with lower-extremity PAD should be made with a complete anatomic assessment of the affected arterial territory, including imaging of the occlusive lesion, as well as arterial inflow and outflow with angiography or a combination of angiography and noninvasive vascular techniques. (Level of evidence: B)

4. Digital subtraction angiography is recommended for contrast angiographic studies because this technique allows for enhanced imaging capabilities compared with conventional unsubtracted contrast angiography. (Level of evidence: A)

5. Before performance of contrast angiography, a full history and complete vascular examination should be performed to optimize decisions regarding the access site, as well as to minimize contrast dose and catheter manipulation. (Level of evidence: C)

6. Selective or superselective catheter placement during lower-extremity angiography is indicated because this can enhance imaging, reduce contrast dose, and improve sensitivity and specificity of the procedure. (Level of evidence: C)

7. The diagnostic lower-extremity arteriogram should image the iliac, femoral, and tibial bifurcations in profile without vessel overlap. (Level of evidence: B)

8. When conducting a diagnostic lower-extremity arteriogram in which the significance of an obstructive lesion is ambiguous, transstenotic pressure gradients and supplementary angulated views should be obtained. (Level of evidence: B)

9. Patients with baseline renal insufficiency should receive hydration before undergoing contrast angiography. (Level of evidence: B)

10. Follow-up clinical evaluation, including a physical examination and measurement of renal function, is recommended within 2 weeks after contrast angiography to detect the presence of delayed adverse effects, such as atheroembolism, deterioration in renal function, or access site injury (eg, pseudoaneurysm or arteriovenous fistula). (Level of evidence: C)

Class IIa

1. Noninvasive imaging modalities, including MR angiography, CT angiography, and color flow duplex imaging, may be used in advance of invasive imaging to develop an individualized diagnostic strategic plan, including assistance in selection of access sites, identification of significant lesions, and determination of the need for invasive evaluation. (Level of evidence: B)

2. Treatment with n-acetylcysteine in advance of contrast angiography is suggested for patients with baseline renal insufficiency (creatinine greater than 2.0 mg/dL). (Level of evidence: B)

C. Lower-extremity PAD: Treatment

(1) Cardiovascular Risk Reduction

(a) Lipid-lowering Drugs

Class I

Treatment with a hydroxymethyl glutaryl (HMG) coenzyme-A reductase inhibitor (statin) medication is indicated for all patients with PAD to achieve a target LDL cholesterol level of less than 100 mg/dL. (Level of evidence: B)

Class IIa

1. Treatment with an HMG coenzyme-A reductase inhibitor (statin) medication to achieve a target LDL cholesterol level of less than 70 mg/dL is reasonable for patients with lower-extremity PAD at very high risk of ischemic events. (Level of evidence: B)

2. Treatment with a fibric acid derivative can be useful for patients with PAD and low HDL cholesterol, normal LDL cholesterol, and elevated triglycerides. (Level of evidence: C)

(b) Antihypertensive Drugs

Class I

1. Antihypertensive therapy should be administered to hypertensive patients with lower-extremity PAD to achieve a goal of less than 140 mm Hg systolic over 90 mm Hg diastolic (nondiabetics) or less than 130 mm Hg sys-

tolic over 80 mm Hg diastolic (diabetics and individuals with chronic renal disease) to reduce the risk of MI, stroke, congestive heart failure, and cardiovascular death. (Level of evidence: A)

2. β-adrenergic blocking drugs are effective antihypertensive agents and are not contraindicated in patients with PAD. (Level of evidence: A)

Class IIa

The use of angiotensin-converting enzyme inhibitors is reasonable for symptomatic patients with lower-extremity PAD to reduce the risk of adverse cardiovascular events. (Level of evidence: B)

Class IIb

Angiotensin-converting enzyme inhibitors may be considered for patients with asymptomatic lower-extremity PAD to reduce the risk of adverse cardiovascular events. (Level of evidence: C)

(c) Diabetes Therapies

Class I

Proper foot care, including use of appropriate footwear, chiropody/podiatric medicine, daily foot inspection, skin cleansing, and use of topical moisturizing creams, should be encouraged and skin lesions and ulcerations should be addressed urgently in all diabetic patients with lower-extremity PAD. (Level of evidence: B)

Class IIa

Treatment of diabetes in individuals with lower-extremity PAD by administration of glucose control therapies to reduce the hemoglobin A1C to less than 7% can be effective to reduce microvascular complications and potentially improve cardiovascular outcomes. (Level of evidence: C)

(d) Smoking Cessation

Class I

Individuals with lower-extremity PAD who smoke cigarettes or use other forms of tobacco should be advised by each of their clinicians to stop smoking and should be offered comprehensive smoking cessation interventions, including behavior modification therapy, nicotine replacement therapy, or bupropion. (Level of evidence: B)

(e) Homocysteine-Lowering Drugs

Class IIb

The effectiveness of the therapeutic use of folic acid and B12 vitamin supplements in individuals with lower-extremity PAD and homocysteine levels greater than 14 mol/L is not well established. (Level of evidence: C)

(f) Antiplatelet and Antithrombotic Drugs

Class I

1. Antiplatelet therapy is indicated to reduce the risk of MI, stroke, or vascular death in individuals with atherosclerotic lower-extremity PAD. (Level of evidence: A)

2. Aspirin, in daily doses of 75–325 mg, is recommended as safe and effective antiplatelet therapy to reduce the risk of MI, stroke, or vascular death in individuals with atherosclerotic lower-extremity PAD. (Level of evidence: A)

3. Clopidogrel (75 mg/d) is recommended as an effective alternative antiplatelet therapy to aspirin to reduce the risk of MI, stroke, or vascular death in individuals with atherosclerotic lower-extremity PAD. (Level of evidence: B)

Class III

Oral anticoagulation therapy with warfarin is not indicated to reduce the risk of adverse cardiovascular ischemic events in individuals with atherosclerotic lower-extremity PAD. (Level of evidence: C)

(2) Claudication

(a) Exercise and Lower-extremity PAD Rehabilitation

Class I

1. A program of supervised exercise training is recommended as an initial treatment modality for patients with intermittent claudication. (Level of evidence: A)

2. Supervised exercise training should be performed for a minimum of 30–45 minutes, in sessions performed at least three times per week for a minimum of 12 weeks. (Level of evidence: A)

Class IIb

The usefulness of unsupervised exercise programs is not well established as an effective initial treatment modality for patients with intermittent claudication. (Level of evidence: B)

(b) Medical and Pharmacologic Treatment for Claudication

1. CILOSTAZOL

Class I

1. Cilostazol (100 mg orally two times per day) is indicated as an effective therapy to improve symptoms and increase walking distance in patients with lower-extremity PAD and intermittent claudication (in the absence of heart failure). (Level of evidence: A)

2. A therapeutic trial of cilostazol should be considered in all patients with lifestyle-limiting claudication (in the absence of heart failure). (Level of evidence: A)

2. PENTOXIFYLLINE

Class IIb

1. Pentoxifylline (400 mg three times per day) may be considered as second-line alternative therapy to cilostazol to improve walking distance in patients with intermittent claudication. (Level of evidence: A)

2. The clinical effectiveness of pentoxifylline as therapy for claudication is marginal and not well established. (Level of evidence: C)

3. OTHER PROPOSED MEDICAL THERAPIES

Class IIb

1. The effectiveness of L-arginine for patients with intermittent claudication is not well established. (Level of evidence: B)

2. The effectiveness of propionyl-L-carnitine as a therapy to improve walking distance in patients with intermittent claudication is not well established. (Level of evidence: B)

3. The effectiveness of ginkgo biloba to improve walking distance for patients with intermittent claudication is marginal and not well established. (Level of evidence: B)

Class III

1. Oral vasodilator prostaglandins such as beraprost and iloprost are not effective medications to improve walking distance in patients with intermittent claudication. (Level of evidence: A)

2. Vitamin E is not recommended as a treatment for patients with intermittent claudication. (Level of evidence: C)

3. Chelation (eg, ethylenediaminetetraacetic acid) is not indicated for treatment of intermittent claudication and may have harmful adverse effects. (Level of evidence: A)

(c) Endovascular Treatment for Claudication

Class I

1. Endovascular procedures are indicated for individuals with a vocational or lifestyle-limiting disability due to intermittent claudication when clinical features suggest a reasonable likelihood of symptomatic improvement with endovascular intervention and (a) there has been an inadequate response to exercise or pharmacological therapy and/or (b) there is a very favorable risk-benefit ratio (eg, focal aortoiliac occlusive disease). (Level of evidence: A)

2. Endovascular intervention is recommended as the preferred revascularization technique for TASC type A (see Tables 20 and 21 and Fig 8 in reference 1) iliac and femoropopliteal arterial lesions. (Level of evidence: B)

3. Translesional pressure gradients (with and without vasodilation) should be obtained to evaluate the significance of angiographic iliac arterial stenoses of 50%–75% diameter before intervention. (Level of evidence: C)

4. Provisional stent placement is indicated for use in the iliac arteries as salvage therapy for a suboptimal or failed result from balloon dilation (eg, persistent translesional gradient, residual diameter stenosis greater than 50%, or flow-limiting dissection). (Level of evidence: B)

5. Stenting is effective as primary therapy for common iliac artery stenosis and occlusions. (Level of evidence: B)

6. Stenting is effective as primary therapy in external iliac artery stenoses and occlusions. (Level of evidence: C)

Class IIa

Stents (and other adjunctive techniques such as lasers, cutting balloons, atherectomy devices, and thermal devices) can be useful in the femoral, popliteal, and tibial arteries as salvage therapy for a suboptimal or failed result from balloon dilation (eg, persistent translesional gradient, residual diameter stenosis greater than 50%, or flow-limiting dissection). (Level of evidence: C)

Class IIb

1. The effectiveness of stents, atherectomy, cutting balloons, thermal devices, and lasers for the treatment of femoral-popliteal arterial lesions (except to salvage a suboptimal result from balloon dilation) is not well established. (Level of evidence: A)

2. The effectiveness of uncoated/uncovered stents, atherectomy, cutting balloons, thermal devices, and lasers for the treatment of infrapopliteal lesions (except to salvage a suboptimal result from balloon dilation) is not well established. (Level of evidence: C)

Class III

1. Endovascular intervention is not indicated if there is no significant pressure gradient across a stenosis despite flow augmentation with vasodilators. (Level of evidence: C)

2. Primary stent placement is not recommended in the femoral, popliteal, or tibial arteries. (Level of evidence: C)

3. Endovascular intervention is not indicated as prophylactic therapy in an asymptomatic patient with lower-extremity PAD. (Level of evidence: C)

(d) Surgery for Claudication

1. Indications

Class I

Surgical interventions are indicated for individuals with claudication symptoms who have a significant functional disability that is vocational or lifestyle limiting, who are unresponsive to exercise or pharmacotherapy, and who have a reasonable likelihood of symptomatic improvement. (Level of evidence: B)

Class IIb

Because the presence of more aggressive atherosclerotic occlusive disease is associated with less durable results in patients younger than 50 years of age, the effectiveness of surgical intervention in this population for intermittent claudication is unclear. (Level of evidence: B)

Class III

Surgical intervention is not indicated to prevent progression to limb-threatening ischemia in patients with intermittent claudication. (Level of evidence: B)

2. Preoperative Evaluation

Class I

A preoperative cardiovascular risk evaluation should be undertaken in those patients with lower-extremity PAD in whom a major vascular surgical intervention is planned. (Level of evidence: B)

3. Inflow Procedures: Aortoiliac Occlusive Disease

Class I

1. Aortobifemoral bypass is beneficial for patients with vocational- or lifestyle-disabling symptoms and hemodynamically significant aortoiliac disease who are acceptable surgical candidates and who are unresponsive to or unsuitable for exercise, pharmacotherapy, or endovascular repair. (Level of evidence: B)

2. Iliac endarterectomy and aortoiliac or iliofemoral bypass in the setting of acceptable aortic inflow should be used for the surgical treatment of unilateral disease or in conjunction with femoral-femoral bypass for the treatment of a patient with bilateral iliac artery occlusive disease if the patient is not a suitable candidate for aortobifemoral bypass grafting. (Level of evidence: B)

Class IIb

Axillofemoral-femoral bypass may be considered for the surgical treatment of patients with intermittent claudication in very limited settings, such as chronic infrarenal aortic occlusion associated with symptoms of severe claudication in patients who are not candidates for aortobifemoral bypass. (Level of evidence: B)

Class III

Axillofemoral-femoral bypass should not be used for the surgical treatment of patients with intermittent claudication except in very limited settings (see Class IIb recommendation above). (Level of evidence: B)

4. Outflow Procedures: Infrainguinal Disease.

Class I

1. Bypasses to the popliteal artery above the knee should be constructed with autogenous vein when possible. (Level of evidence: A)

2. Bypasses to the popliteal artery below the knee should be constructed with autogenous vein when possible. (Level of evidence: B)

Class IIa

The use of synthetic grafts to the popliteal artery below the knee is reasonable only when no autogenous vein from ipsilateral or contralateral leg or arms is available. (Level of evidence: A)

Class IIb

1. Femoral-tibial artery bypasses constructed with autogenous vein may be considered for the treatment of claudication in rare instances for cer-

tain patients (see text). (Level of evidence: B)

2. Because their use is associated with reduced patency rates, the effectiveness of the use of synthetic grafts to the popliteal artery above the knee is not well established. (Level of evidence: B)

Class III

Femoral-tibial artery bypasses with synthetic graft material should not be used for the treatment of claudication. (Level of evidence: C)

5. Follow-up after Vascular Surgical Procedures

Class I

1. Patients who have undergone placement of aortobifemoral bypass grafts should be followed up with periodic evaluations that record any return or progression of claudication symptoms, the presence of femoral pulses, and ABIs at rest and after exercise. (Level of evidence: C)

2. Patients who have undergone placement of a lower-extremity bypass with autogenous vein should undergo periodic evaluations for at least 2 years that record any claudication symptoms; a physical examination and pulse examination of the proximal, graft, and out flow vessels; and duplex imaging of the entire length of the graft, with measurement of peak systolic velocities and calculation of velocity ratios across all lesions. (Level of evidence: C)

3. Patients who have undergone placement of a synthetic lower extremity bypass graft should, for at least 2 years after implantation, undergo periodic evaluations that record any return or progression of claudication symptoms; a pulse examination of the proximal, graft, and outflow vessels; and assessment of ABIs at rest and after exercise. (Level of evidence: C)

(3) CLI and Treatment for Limb Salvage

(a) Medical and Pharmacologic Treatment for CLI

1. Pentoxifylline

Class III

Parenteral administration of pentoxifylline is not useful for this treatment of CLI. (Level of evidence: B)

2. Prostaglandins

Class IIb

Parenteral administration of prostaglandin E-1 or iloprost for 7–28 days may be considered to reduce ischemic pain and facilitate ulcer healing in patients with CLI, but its efficacy is likely to be limited to a small percentage of patients. (Level of evidence: A)

Class III

Oral iloprost is not an effective therapy to reduce the risk of amputation or death in patients with CLI. (Level of evidence: B)

3. Angiogenic Growth Factors

Class IIb

The efficacy of angiogenic growth factor therapy for treatment of CLI is not well established and is best investigated in the context of a placebo-controlled trial. (Level of evidence: C)

(b) Endovascular Treatments for CLI

Class I

1. For individuals with combined inflow and outflow disease with CLI, inflow lesions should be addressed first. (Level of evidence: C)

2. For individuals with combined inflow and outflow disease in whom symptoms of CLI or infection persist after inflow revascularization, an outflow revascularization procedure should be performed. (Level of evidence: B)

3. If it is unclear whether hemodynamically significant inflow disease exists, intraarterial pressure measurements across suprainguinal lesions should be measured before and after the administration of a vasodilator. (Level of evidence: C)

(c) Thrombolysis for Acute and CLI

Class I

Catheter-based thrombolysis is an effective and beneficial therapy and is indicated for patients with acute limb ischemia (Rutherford categories I and IIa) of less than 14 days' duration. (Level of evidence: A)

Class IIa

Mechanical thrombectomy devices can be used as adjunctive therapy for acute limb ischemia due to peripheral arterial occlusion. (Level of evidence: B)

Class IIb

Catheter-based thrombolysis or thrombectomy may be considered for patients with acute limb ischemia (Rutherford category IIb) of more than 14 days' duration. (Level of evidence: B)

(d) Surgery for CLI

1. General Recommendations

Class I

1. For individuals with combined inflow and outflow disease with CLI, inflow lesions should be addressed first. (Level of evidence: B)

2. For individuals with combined inflow and outflow disease in whom symptoms of CLI or infection persist after inflow revascularization, an outflow revascularization procedure should be performed. (Level of evidence: B)

3. Patients who have significant necrosis of the weightbearing portions of the foot (in ambulatory patients), an uncorrectable flexion contracture, paresis of the extremity, refractory ischemic rest pain, sepsis, or a very limited life expectancy due to comorbid conditions should be evaluated for primary amputation of the leg. (Level of evidence: C)

Class III

Surgical and endovascular intervention is not indicated in patients with severe decrements in limb perfusion (eg, ABI less than 0.4) in the absence of clinical symptoms of CLI. (Level of evidence: C)

2. Inflow Procedures: Aortoiliac Occlusive Disease

Class I

1. When surgery is to be undertaken, aortobifemoral bypass is recommended for patients with symptomatic, hemodynamically significant, aortobiiliac disease requiring intervention. (Level of evidence: A)

2. Iliac endarterectomy, patch angioplasty, or aortoiliac or iliofemoral bypass in the setting of acceptable aortic inflow should be used for the treatment of unilateral disease or in conjunction with femoral-femoral bypass for the treatment of a patient with bilateral iliac artery occlusive disease if the patient is not a suitable candidate for aortobifemoral bypass grafting. (Level of evidence: B)

3. Axillofemoral-femoral bypass is indicated for the treatment of patients with CLI who have extensive aortoiliac disease and are not candidates for other types of intervention. (Level of evidence: B)

3. Outflow Procedures: Infrainguinal Disease

Class I

1. Bypasses to the above-knee popliteal artery should be constructed

with autogenous saphenous vein when possible. (Level of evidence: A)

2. Bypasses to the below-knee popliteal artery should be constructed with autogenous vein when possible. (Level of evidence: A)

3. The most distal artery with continuous flow from above and without a stenosis greater than 20% should be used as the point of origin for a distal bypass. (Level of evidence: B)

4. The tibial or pedal artery that is capable of providing continuous and uncompromised outflow to the foot should be used as the site of distal anastomosis. (Level of evidence: B)

5. Femoral-tibial artery bypasses should be constructed with autogenous vein, including the ipsilateral greater saphenous vein, or if unavailable, other sources of vein from the leg or arm. (Level of evidence: B)

6. Composite sequential femoropopliteal-tibial bypass and bypass to an isolated popliteal arterial segment that has collateral outflow to the foot are both acceptable methods of revascularization and should be considered when no other form of bypass with adequate autogenous conduit is possible. (Level of evidence: B)

7. If no autogenous vein is available, a prosthetic femoral-tibial bypass, and possibly an adjunctive procedure, such as arteriovenous fistula or vein interposition or cuff, should be used when amputation is imminent. (Level of evidence: B)

Class IIa

Prosthetic material can be used effectively for bypasses to the below-knee popliteal artery when no autogenous vein from ipsilateral or contralateral leg or arms is available. (Level of evidence: B)

4. Postsurgical Care

Class I

1. Unless contraindicated, all patients undergoing revascularization for CLI should be placed on antiplatelet therapy (see Sections 2.4.2 and 2.6.1.6), and this treatment should be continued indefinitely. (Level of evidence: A)

2. Patients who have undergone placement of aortobifemoral bypass grafts should be followed up with periodic evaluations that record any return or progression of ischemic symptoms, the presence of femoral pulses, and ABIs. (Level of evidence: B)

3. If infection, ischemic ulcers, or gangrenous lesions persist and the ABI is less than 0.8 after correction of inflow, an outflow procedure should be performed that bypasses all major distal stenoses and occlusions. (Level of evidence: A)

4. Patients who have undergone placement of a lower extremity bypass with autogenous vein should undergo for at least 2 years periodic examinations that record any return or progression of ischemic symptoms; a physical examination, with concentration on pulse examination of the proximal, graft, and outflow vessels; and duplex imaging of the entire length of the graft, with measurement of peak systolic velocities and calculation of velocity ratios across all lesions. (Level of evidence: A)

5. Patients who have undergone placement of a synthetic lower extremity bypass graft should undergo periodic examinations that record any return of ischemic symptoms; a pulse examination of the proximal, graft, and outflow vessels; and assessment of ABIs at rest and after exercise for at least 2 years after implantation. (Level of evidence: A)

3. RENAL ARTERIAL DISEASE

A. Clinical Clues to the Diagnosis of Renal Artery Stenosis

Class I

1. The performance of diagnostic studies to identify clinically significant renal artery stenosis (RAS) is indicated in patients with the onset of hypertension before the age of 30 years. (Level of evidence: B)

2. The performance of diagnostic studies to identify clinically significant RAS is indicated in patients with the onset of severe hypertension (as defined in The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC-7 report [294]) after the age of 55 years. (Level of evidence: B)

3. The performance of diagnostic studies to identify clinically significant RAS is indicated in patients with the following characteristics: (a) accelerated hypertension (sudden and persistent worsening of previously controlled hypertension); (b) resistant hypertension (defined as the failure to achieve goal blood pressure in patients who are adhering to full doses of an appropriate three-drug regimen that includes a diuretic); or (c) malignant hypertension (hypertension with coexistent evidence of acute end-organ damage, ie, acute renal failure, acutely decompensated congestive heart failure, new visual or neurological disturbance, and/or advanced [grade III/IV] retinopathy). (Level of evidence: C)

4. The performance of diagnostic studies to identify clinically significant RAS is indicated in patients with new azotemia or worsening renal function after the administration of an ACE inhibitor or an angiotensin receptor blocking agent (see text). (Level of evidence: B)

5. The performance of diagnostic studies to identify clinically significant RAS is indicated in patients with an unexplained atrophic kidney or a discrepancy in size between the two kidneys of greater than 1.5 cm. (Level of evidence: B)

6. The performance of diagnostic studies to identify clinically significant RAS is indicated in patients with sudden, unexplained pulmonary edema (especially in azotemic patients). (Level of evidence: B)

Class IIa

The performance of diagnostic studies to identify clinically significant RAS is reasonable in patients with unexplained renal failure, including individuals starting renal replacement therapy (dialysis or renal transplantation). (Level of evidence: B)

Class IIb

1. The performance of arteriography to identify significant RAS may be reasonable in patients with multivessel coronary artery disease and none of the clinical clues (Fig 17 in reference 1) or PAD at the time of arteriography. (Level of evidence: B)

2. The performance of diagnostic studies to identify clinically significant RAS may be reasonable in patients with unexplained congestive heart failure or refractory angina (see Section 3.5.2.4). (Level of evidence: C)

B. RAS: Diagnostic Methods

Class I

1. Duplex US is recommended as a screening test to establish the diagnosis of RAS. (Level of evidence: B)

2. CT angiography (in individuals with normal renal function) is recom-

mended as a screening test to establish the diagnosis of RAS. (Level of evidence: B)

3. MR angiography is recommended as a screening test to establish the diagnosis of RAS. (Level of evidence: B)

4. When the clinical index of suspicion is high and the results of noninvasive tests are inconclusive, catheter angiography is recommended as a diagnostic test to establish the diagnosis of RAS. (Level of evidence: B)

Class III

1. Captopril renal scintigraphy is not recommended as a screening test to establish the diagnosis of RAS. (Level of evidence: C)

2. Selective renal vein renin measurements are not recommended as a useful screening test to establish the diagnosis of RAS. (Level of evidence: B)

3. Plasma renin activity is not recommended as a useful screening test to establish the diagnosis of RAS. (Level of evidence: B)

4. The captopril test (measurement of plasma renin activity after captopril administration) is not recommended as a useful screening test to establish the diagnosis of RAS. (Level of evidence: B)

C. Treatment of Renovascular Disease: RAS

(1) Medical Treatment

Class I

1. Angiotensin-converting enzyme inhibitors are effective medications for treatment of hypertension associated with unilateral RAS. (Level of evidence: A)

2. Angiotensin receptor blockers are effective medications for treatment of hypertension associated with unilateral RAS. (Level of evidence: B)

3. Calcium-channel blockers are effective medications for treatment of hypertension associated with unilateral RAS. (Level of evidence: A)

4. β-blockers are effective medications for treatment of hypertension associated with RAS. (Level of evidence: A)

(2) Indications for Revascularization

(a) Asymptoatic Stenosis

Class IIb

1. Percutaneous revascularization may be considered for treatment of an asymptomatic bilateral or solitary viable kidney with a hemodynamically significant RAS. (Level of evidence: C)

2. The usefulness of percutaneous revascularization of an asymptomatic unilateral hemodynamically significant RAS in a viable kidney is not well established and is presently clinically unproven. (Level of evidence: C)

(b) Hypertension

Class IIa

Percutaneous revascularization is reasonable for patients with hemodynamically significant RAS and accelerated hypertension, resistant hypertension, malignant hypertension, hypertension with an unexplained unilateral small kidney, and hypertension with intolerance to medication. (Level of evidence: B)

(c) Preservation of Renal Function

Class IIa

Percutaneous revascularization is reasonable for patients with RAS and progressive chronic kidney disease with bilateral RAS or a RAS to a solitary functioning kidney. (Level of evidence: B)

Class IIb

Percutaneous revascularization may be considered for patients with RAS and chronic renal insufficiency with unilateral RAS. (Level of evidence: C)

(d) Impact of RAS on Congestive Heart Failure and Unstable Angina

Class I

Percutaneous revascularization is indicated for patients with hemodynamically significant RAS and recurrent, unexplained congestive heart failure or sudden, unexplained pulmonary edema (see text). (Level of evidence: B)

Class IIa

Percutaneous revascularization is reasonable for patients with hemodynamically significant RAS and unstable angina (see text). (Level of evidence: B)

(3) Catheter-based Interventions for RAS

Class I

1. Renal stent placement is indicated for ostial atherosclerotic RAS lesions that meet the clinical criteria for intervention. (Level of evidence: B)

2. Balloon angioplasty with bailout stent placement if necessary is recommended for FMD lesions. (Level of evidence: B)

(4) Surgery for RAS

Class I

1. Vascular surgical reconstruction is indicated for patients with fibromuscular dysplastic RAS with clinical indications for interventions (same as for PTA), especially those exhibiting complex disease that extends into the segmental arteries and those having macroaneurysms. (Level of evidence: B)

2. Vascular surgical reconstruction is indicated for patients with atherosclerotic RAS and clinical indications for intervention, especially those with multiple small renal arteries or early primary branching of the main renal artery. (Level of evidence: B)

3. Vascular surgical reconstruction is indicated for patients with atherosclerotic RAS in combination with pararenal aortic reconstructions (in treatment of aortic aneurysms or severe aortoiliac occlusive disease). (Level of evidence: C)

4. MESENTERIC ARTERIAL DISEASE

A. Acute Intestinal Ischemia

(1) Acute Intestinal Ischemia Caused by Arterial Obstruction

(a) Diagnosis

Class I

1. Patients with acute abdominal pain out of proportion to physical findings and who have a history of cardiovascular disease should be suspected of having acute intestinal ischemia. (Level of evidence: B)

2. Patients who develop acute abdominal pain after arterial interventions in which catheters traverse the visceral aorta or any proximal arteries or who have arrhythmias (such as atrial fibrillation) or recent MI should be suspected of having acute intestinal ischemia. (Level of evidence: C)

Class III

In contrast to chronic intestinal ischemia, duplex sonography of the

abdomen is not an appropriate diagnostic tool for suspected acute intestinal ischemia. (Level of evidence: C)

(b) Surgical Treatment

Class I

Surgical treatment of acute obstructive intestinal ischemia includes revascularization, resection of necrotic bowel, and, when appropriate, a "second look" operation 24–48 hours after the revascularization. (Level of evidence: B)

(c) Endovascular Treatment

Class IIb

Percutaneous interventions (including transcatheter lytic therapy, balloon angioplasty, and stenting) are appropriate in selected patients with acute intestinal ischemia caused by arterial obstructions. Patients so treated may still require laparotomy. (Level of evidence: C)

(2) Acute Nonocclusive Intestinal Ischemia

(a) Etiology and Clinical Clues

Class I

1. Nonocclusive intestinal ischemia should be suspected in patients with low flow states or shock, especially cardiogenic shock, who develop abdominal pain. (Level of evidence: B)

2. Nonocclusive intestinal ischemia should be suspected in patients receiving vasoconstrictor substances and medications (eg, cocaine, ergots, vasopressin, or norepinephrine) who develop abdominal pain. (Level of evidence: B)

3. Nonocclusive intestinal ischemia should be suspected in patients who develop abdominal pain after coarctation repair or after surgical revascularization for intestinal ischemia caused by arterial obstruction. (Level of evidence: B)

(b) Diagnosis

Class I

Arteriography is indicated in patients suspected of having nonocclusive intestinal ischemia whose condition does not improve rapidly with treatment of their underlying disease. (Level of evidence: B)

(c) Treatment

Class I

1. Treatment of the underlying shock state is the most important initial step in treatment of nonocclusive intestinal ischemia. (Level of evidence: C)

2. Laparotomy and resection of nonviable bowel is indicated in patients with nonocclusive intestinal ischemia who have persistent symptoms despite treatment. (Level of evidence: B)

Class IIa

Transcatheter administration of vasodilator medications into the area of vasospasm is indicated in patients with nonocclusive intestinal ischemia who do not respond to systemic supportive treatment and in patients with intestinal ischemia due to cocaine or ergot poisoning. (Level of evidence: B)

B. Chronic Intestinal Ischemia

(1) Diagnosis

Class I

1. Chronic intestinal ischemia should be suspected in patients with abdominal pain and weight loss without other explanation, especially those with cardiovascular disease. (Level of evidence: B)

2. Duplex US, CT angiography, and gadolinium-enhanced MR angiography are useful initial tests for supporting the clinical diagnosis of chronic intestinal ischemia. (Level of evidence: B)

3. Diagnostic angiography, including lateral aortography, should be obtained in patients suspected of having chronic intestinal ischemia for whom noninvasive imaging is unavailable or indeterminate. (Level of evidence: B)

(2) Interventional Treatment

Class I

Percutaneous endovascular treatment of intestinal arterial stenosis is indicated in patients with chronic intestinal ischemia. (Level of evidence: B)

(3) Surgical Treatment

Class I

Surgical treatment of chronic intestinal ischemia is indicated in patients with chronic intestinal ischemia. (Level of evidence: B)

Class IIb

Revascularization of asymptomatic intestinal arterial obstructions may be considered for patients undergoing aortic/renal artery surgery for other indications. (Level of evidence: B)

Class III

Surgical revascularization is not indicated for patients with asymptomatic intestinal arterial obstructions, except in patients undergoing aortic/renal artery surgery for other indications. (Level of evidence: B)

5. ANEURYSMS OF THE ABDOMINAL AORTA, ITS BRANCH VESSELS, AND THE LOWER EXTREMITIES

A. Abdominal Aortic and Iliac Aneurysms

(1) Risk Factors

Class I

1. In patients with AAAs, blood pressure and fasting serum lipid values should be monitored and controlled as recommended for patients with atherosclerotic disease. (Level of evidence: C)

2. Patients with aneurysms or a family history of aneurysms should be advised to stop smoking and be offered smoking cessation interventions, including behavior modification, nicotine replacement, or bupropion. (Level of evidence: B)

(2) Aortic Aneurysm Rupture: General Recommendations

Class I

1. Patients with infrarenal or juxtarenal AAAs measuring 5.5 cm or larger should undergo repair to eliminate the risk of rupture. (Level of evidence: B)

2. Patients with infrarenal or juxtarenal AAAs measuring 4.0–5.4 cm in diameter should be monitored by US or CT scans every 6–12 months to detect expansion. (Level of evidence: A)

Class IIa

1. Repair can be beneficial in patients with infrarenal or juxtarenal AAAs 5.0–5.4 cm in diameter. (Level of evidence: B)

2. Repair is probably indicated in patients with suprarenal or type IV thoracoabdominal aortic aneurysms larger than 5.5–6.0 cm. (Level of evidence: B)

3. In patients with AAAs smaller than 4.0 cm in diameter, monitoring by US examination every 2–3 years is reasonable. (Level of evidence: B)

Class III

Intervention is not recommended

for asymptomatic infrarenal or juxtarenal AAAs if they measure less than 5.0 cm in diameter in men or less than 4.5 cm in diameter in women. (Level of evidence: A)

(3) Diagnosis of Aortic and Iliac Aneurysms

(a) Symptomatic Aortic or Iliac Aneurysms

Class I

1. In patients with the clinical triad or of abdominal and/or back pain, a pulsatile abdominal mass, and hypotension, immediate surgical evaluation is indicated. (Level of evidence: B)

2. In patients with symptomatic aortic aneurysms, repair is indicated regardless of diameter. (Level of evidence: C)

(b) Screening High-risk Populations

Class 1

Men 60 years of age or older who are either the siblings or offspring of patients with AAAs should undergo physical examination and US screening for detection of aortic aneurysms. (Level of evidence: B)

Class IIa

Men who are 65–75 years of age who have ever smoked should undergo a physical examination and one-time US screening for detection of AAAs. (Level of evidence: B)

(4) Observational Management or Aortic and Iliac Aneurysms

(a) Blood Pressure Control and β-Blockade

Class I

Perioperative administration of β-adrenergic blocking agents, in the absence of contraindications, is indicated to reduce the risk of adverse cardiac events and mortality in patients with coronary artery disease undergoing surgical repair of atherosclerotic aortic aneurysms. (Level of evidence: A)

Class IIb

β-adrenergic blocking agents may be considered to reduce the rate of aneurysm expansion in patients with aortic aneurysms. (Level of evidence: B)

(5) Prevention of Aortic Aneurysm Rupture: Management Overview

Class I

1. Open repair of infrarenal AAAs and/or common iliac aneurysms is indicated in patients who are good or average surgical candidates. (Level of evidence: B)

2. Periodic long-term surveillance imaging should be performed to monitor for an endoleak, to document shrinkage or stability of the excluded aneurysm sac, and to determine the need for further intervention in patients who have undergone endovascular repair of infrarenal aortic and/or iliac aneurysms. (Level of evidence: B)

Class IIa

Endovascular repair of infrarenal aortic and/or common iliac aneurysms is reasonable in patients at high risk of complications from open operations because of cardiopulmonary or other associated diseases. (Level of evidence: B)

Class IIb

Endovascular repair of infrarenal aortic and/or common iliac aneurysms may be considered in patients at low or average surgical risk. (Level of evidence: B)

B. Visceral Artery Aneurysms

Class I

Open repair or catheter-based intervention is indicated for visceral aneurysms measuring 2.0 cm in diameter or larger in women of childbearing age who are not pregnant and in patients of either gender undergoing liver transplantation. (Level of evidence: B)

Class IIa

Open repair or catheter-based intervention is probably indicated for visceral aneurysms 2.0 cm in diameter or larger in women beyond childbearing age and in men. (Level of evidence: B)

C. Lower-extremity Aneurysms

(1) Natural History of Lower-extremity Aneurysms

Class I

In patients with femoral or popliteal aneurysms, US (or CR or MR) imaging is recommended to exclude contralateral femoral or popliteal aneurysms and AAA. (Level of evidence: B)

(2) Management of Lower-extremity Aneurysms

(a) Femoral and Popliteal Aneurysms

Class I

1. Patients with a palpable popliteal mass should undergo an US examination to exclude popliteal aneurysm. (Level of evidence: B)

2. Patients with popliteal aneurysms 2.0 cm in diameter or larger should undergo repair to reduce the risk of thromboembolic complications and limb loss. (Level of evidence: B)

3. Patients with anastomotic pseudoaneurysms or symptomatic femoral artery aneurysms should undergo repair. (Level of evidence: A)

Class IIa

1. Surveillance by annual US imaging is suggested for patients with asymptomatic femoral artery true aneurysms smaller than 3.0 cm in diameter. (Level of evidence: C)

2. In patients with acute ischemia and popliteal artery aneurysms and absent runoff, catheter-directed thrombolysis or mechanical thrombectomy (or both) is suggested to restore distal runoff and resolve emboli. (Level of evidence: B)

3. In patients with asymptomatic enlargement of the popliteal arteries twice the normal diameter for age and gender, annual US monitoring is reasonable. (Level of evidence: C)

4. In patients with femoral or popliteal artery aneurysms, administration of antiplatelet medication may be beneficial. (Level of evidence: C)

(b) Catheter-related Femoral Artery Pseudoaneurysms

Class I

1. Patients with suspected femoral pseudoaneurysms should be evaluated by duplex US. (Level of evidence: B)

2. Initial treatment with US-guided compression or thrombin injection is recommended in patients with large and/or symptomatic femoral artery pseudoaneurysms. (Level of evidence: B)

Class IIa

1. Surgical repair is reasonable in patients with femoral artery pseudoaneurysms 2.0 cm in diameter or larger that persist or recur after US-guided compression or thrombin injection. (Level of evidence: B)

2. Reevaluation by US 1 month after the original injury can be useful in patients with asymptomatic femoral artery pseudoaneurysms smaller than 2.0 cm in diameter. (Level of evidence: B)

References

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Appendix I
ACC/AHA Writing Committee to Develop Guidelines on PAD (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic)

Committee Member	Research Grant	Speakers Bureau/Honoraria	Stock Ownership	Consultant	Advisory Boards
Dr. Curtis W. Bakal	None	None	None	None	Berlex Labs Abbott Labs
Dr. Mark A. Creager	Eli Lilly Otsuka Pharmaceuticals Pfizer Vasogen	Bristol Meyers Squibb/Sanofi Partnership Otsuka Pharmaceuticals	Northport Domain	None	Bristol Meyers Squibb/Sanofi Genvec Geozyme Northport Domain Otsuka Pharmaceuticals Pfizer Vasogen
Dr Jonathan L. Halperin	None	AstraZeneca, LP Bristol Meyers Squibb/Sanofi Partnership	None	AstraZeneca, LP Bayer AG Boehringer Ingelheim Bristol Meyers Squibb/Sanofi Partnership	AstraZeneca, LP
Dr Ziv J. Haskal	Bard/Impra Boston Scientific Cook Cordis Endovascular Genentech IntraTherapeutics W. L. Gore	TransVascular W. L. Gore	None	Bard/Impra Endosurgery Ethicon Omnisonics TransVascular	TransVascular
Dr Norman R. Hertzer	None	None	None	None	None
Dr Loren F. Hiratzka	None	None	None	None	None
Dr Alan T. Hirsch	Alteon AstraZeneca Pharmaceuticals Bristol Meyers Squibb/Sanofi Partnership Kos Pharmaceuticals Otsuka America Pharmaceuticals	AstraZeneca Pharmaceuticals Bristol Meyers Squibb/Sanofi Partnership Otsuka America Pharmaceuticals Pfizer	None	Sonosite Vasogen	None
Dr William R. C. Murphy	None	None	None	None	None
Dr Jeffrey W. Olin	Bristol Meyers Squibb/Sanofi Partnership Vasogen	None	None	Aventis Bristol Meyers Squibb/Sanofi Partnership Genzyme Otsuka Vasogen	Abbott Aventis Bristol Meyers Squibb/Sanofi Partnership Genzyme
Dr Jules B. Puschett	None	None	None	None	None
Dr Kenneth A. Rosenfield	Abbott Boston Scientific Cordis Guidant	Eli Lilly	CryoVascular	Abbott Boston Scientific Cordis CryoVascular Guidant	Abbott Boston Scientific Cordis Guidant
Dr David Sacks	None	None	Angiotech	None	None
Dr James C. Stanley	None	None	None	None	None
Dr Lloyd M. Taylor, Jr.	None	None	None	None	None
Dr Christopher J. White	None	Eli Lilly	None	None	None
Dr John White	None	None	None	None	None
Dr Rodney A. White	AVE Bard Baxter Cordis J & J EndoLogix EndoSonics Medtronic	Multiple relationships with commercial entities that arise and are met as needed	Several biomedical companies	None	None

This table represents the relationships of committee members with industry that were disclosed at the initial writing committee meeting in November 2002 and that were updated in conjunction with all meetings and conference calls of the writing committee. It does not necessarily reflect relationships with industry at the time of publication.

Appendix II
External Peer Reviewers for the ACC/AHA 2005 Guideline Update for PAD (Lower Extremity, Renal, Mesenteric, and Abdominal Aortic)*

Peer Reviewer Name*	Representation	Research Grant	Speakers Bureau/ Honoraria	Stock Ownership	Consultant/ Advisory Board
Dr Joshua A. Beckman	Content Reviewer–ACC PVD Committee	None	Merck	None	None
Dr James F. Benenati	Official Reviewer–AHA	None	None	None	None
Dr Ralph G. Brindis	Official Reviewer–ACC BOT	None	None	None	None
Dr Alan S. Brown	Official Reviewer–ACC BOG	AstraZeneca Merck Merck Schering Plough Pfizer Smith Kline Beecham	Merck Merck Schering Plough Pfizer	None	AstraZeneca Merck Merck Schering Plough
Rita C. Clark	Organizational Reviewer–SVN	None	None	None	None
Dr John P. Cooke	Content Reviewer–Individual	None	None	None	None
Dr Robert T. Eberhardt	Official Reviewer–AHA	None	None	None	None
Dr Brian S. Funaki	Content Reviewer–AHA Committee on PV Imaging and Intervention	None	None	None	None
Dr Bruce Gray	Organizational Reviewer–SVMB	None	None	None	None
Karen Hayden, MSN	Organizational Reviewer–SVN	None	None	None	None
Dr William R. Hiatt	Organizational Reviewer–TASC	None	BMS/Sanofi Otsuka	None	BMS/Sanofi Signature
Dr David Holmes, Jr	Content Reviewer–ACC BOG	None	None	None	None
Dr Sharon A. Hunt	Organizational Reviewer–ACC/AHA TF on PGL	None	None	None	None
Dr Michael R. Jaff	Organizational Reviewer–SVMB	None	OtsukaBMS/Sanofi	None	Cordis Endovascular
Dr Matthew S. Johnson	Content Reviewer–AHA Committee on PV Imaging and Intervention	Bard Access Systems Boston Scientific	None	None	Boston Scientific
Dr John A. Kaufman	Content Reviewer–AHA Atherosclerosis PVD Steering Committee	None	None	None	None
Dr Morton Kern	Content Reviewer–AHA Diag and Interv Cardiac Cath Cmte	None	None	None	None
Dr Lloyd Klein	Content Reviewer–AHA Diag and Interv Cardiac Cath Cmte	TBD	TBD	TBD	TBD
Dr Frank Lederle	Content Reviewer–Individual Review	None	None	None	None
Dr Jonathan Lindner	Official Reviewer–ACCF TF on CECD	None	None	None	None
Dr Mary M. McDermott	Content Reviewer–AHA Athero PVD Steering Committee	None	None	None	None
Dr Alan Matsumoto	Content Reviewer–AHA Committee on PV Imaging and Intervention	None	Genentech	None	Cordis Endovascular Medtronic W. L. Gore
Dr Roxana Mehran	Content Reviewer–Individual Review	Boston Scientific Cordis Medtronic	The Medicines Company Tyco/Mallinckrodt	None	None
Dr Emile R. Mohler III	Content Reviewer–Individual Review	None	None	None	None
Roberta Oka, RN	Content Reviewer–AHA Atherosclerosis PVD Steering Committee	None	None	None	None
Dr Joseph P. Ornato	Official Reviewer–ACC/AHA TF on PGL, Lead Reviewer	None	None	None	Genentech Meridian Revivant Wyeth
Dr Kenneth Ouriel	Content Reviewer–ACC PVD Committee	TBD	TBD	TBD	TBD
Dr William Pearce	Official Reviewer–AHA	None	None	None	None
Carolyn A. Robinson	Organizational Reviewer–SVN	None	None	None	None
Dr Robert D. Safian	Organizational Reviewer–SCAI	None	None	None	Boston Scientific Cordis/Johnson & Johnson eV3 Medtronic
Dr Sonia I. Skarlatos	Organizational Reviewer–NHLBI	None	None	None	None
Dr Kimberly A. Skelding	Content Reviewer–AHA Diag and Interv Cardiac Cath Cmte	None	None	None	None
Dr Vincenza Snow	Organizational Reviewer–ACP/ASIM	None	None	None	None
Dr Thomas L. Whitsett	Organizational Reviewer–SVMB	None	None	None	None

This table represents the relationships of peer reviewers with industry that were disclosed at the time of peer review of this guideline. It does not necessarily reflect relationships with industry at the time of publication. Participation in the peer review process does not imply endorsement of the document.

* Names are listed in alphabetical order.

ACCF = American College of Cardiology Foundation; ACP = American College of Physicians; AHA Diag and Interv Cardiac Cath Cmte = AHA Diagnostic and Interventional Cardiac Catheterization Committee; ASIM = American Society of Internal Medicine; BOG = Board of Governors; BOT = Board of Trustees; NHLBI = National Heart, Lung, and Blood Institute; PV = peripheral vein; PVD = peripheral vascular disease; SCAI = Society for Cardiovascular Angiography and Interventions; SVMB = Society of Vascular Medicine and Biology; SVN = Society for Vascular Nursing; TBD = to be determined; TF on CECD = Task Force on Clinical Expert Consensus Documents; TF on PGL = Task Force on Practice Guidelines.

CME TEST QUESTIONS

Examination available at http://directory.sirweb.org/jvircme

1. Which of the following would *not* be recommended therapy for abdominal aortic aneurysm?
   a. Intervention for an asymptomatic 4.0-cm infrarenal abdominal aortic aneurysm in a 55-year-old man
   b. Intervention for a 4.8-cm infrarenal abdominal aortic aneurysm in a 55-year-old woman
   c. Perioperative administration of beta-adrenergic blocking agents (in the absence of contraindications) in a 55-year-old man undergoing surgical repair of abdominal aortic aneurysm
   d. Endovascular repair of infrarenal aortic aneurysm in a 55-year-old man with severe coronary artery disease

2. Which of the following is recommended with regard to pharmacologic therapy in patients with known lower extremity peripheral arterial disease?
   a. Beta-adrenergic blocking drugs are contraindicated for treatment of hypertension.
   b. Treatment with a hydroxymethyl glutaryl (HMG) coenzyme-A-reductase inhibitor (statin) medication is indicated to achieve a target LDL-cholesterol level of less than 100 mg/dL.
   c. Folic acid and B_{12} vitamin supplements in patients with homocysteine levels greater than 14 μmol/L are highly recommended.
   d. Aspirin, in daily doses of 75–325 mg, has not proven to be effective in reducing the risk of myocardial infarction, stroke, or vascular death.

3. In which of the following scenarios is diagnostic testing to identify clinically significant renal artery stenosis *not* recommended?
   a. Patients with the onset of hypertension before the age of 30 years
   b. Patients with the onset of hypertension after the age of 55 years
   c. Patients with malignant hypertension (hypertension with coexistent evidence of acute end-organ damage)
   d. Patients who require three antihypertensive medications, including a diuretic, to achieve blood pressure control

4. In which of the following clinical scenarios should the diagnosis of acute nonocclusive intestinal ischemia be suspected?
   a. 50-year-old man who develops acute abdominal pain following a carotid angiogram performed via a right femoral artery puncture
   b. 62-year-old woman who has lost 30 lb over the last six months, who describes being afraid of eating large meals because she invariably develops abdominal pain shortly after eating
   c. 34-year-old woman taking birth control pills, with recent onset of abdominal ascites, who develops severe acute abdominal pain
   d. 35-year-old man with a history of cocaine abuse, who develops the abrupt onset of severe abdominal pain