Complete Summary

GUIDELINE TITLE

ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging: A report of the American College of Cardiology/American Heart Association Task Force on practice guidelines (ACC/AHA/ASNC Committee to revise the 1995 guidelines for the clinical use of cardiac radionuclide imaging).

BIBLIOGRAPHIC SOURCE(S)

ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines (ACC/AHA/ASNC Committee to revise the 1995 guidelines [trunc]. Bethesda (MD): American College of Cardiology Foundation; 2003. 69 p. [519 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Ritchie JL, Bateman TM, Bonow RO, Crawford MH, Gibbons RJ, Hall RJ, O'Rourke RA, Parisi AF, Verani MS. Guidelines for clinical use of cardiac radionuclide imaging. Report of the American College of Cardiology/American Heart Association Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures (Committee on Radionuclide Imaging), J Am Coll Cardiol 1995 Feb;25(2):521-47.

These guidelines will be reviewed 1 year after publication and yearly thereafter and considered current unless the Task Force on Practice Guidelines revises or withdraws them from circulation.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

- Chest pain
- Acute myocardial infarction (AMI)
- ST-elevation acute myocardial infarction(STEMI)
- Non-ST-elevation acute myocardial infarction (NSTEMI)
- Unstable angina (UA)
- Coronary artery disease (CAD)
- Heart failure

GUIDELINE CATEGORY

Assessment of Therapeutic Effectiveness
Diagnosis
Risk Assessment

CLINICAL SPECIALTY

Cardiology
Critical Care
Internal Medicine
Nuclear Medicine

INTENDED USERS

Physicians

GUIDELINE OBJECTIVE(S)

To make recommendations regarding the appropriate use of cardiac radionuclide imaging in the diagnosis and treatment of patients with known or suspected cardiovascular disease

TARGET POPULATION

Adults with known or suspected cardiovascular disease

INTERVENTIONS AND PRACTICES CONSIDERED

1. Myocardial perfusion imaging (MPI)
    - Stress imaging through:
        - Exercise (treadmill or upright or supine bicycle)
        - Pharmacologic modalities
            - Vasodilators (dipyridamole and adenosine)
            - Dobutamine
    - Consider concomitant use of drugs (e.g., beta-adrenergic agents, calcium channel blockers, nitrates, caffeine)
    - Perfusion tracers:

        - Thallium-201
        - Tc-99m-sestamibi
        - Tc-99m-tetrofosmin
        - Tc-99m-teboroxime (approved for use but not currently marketed in the United States)
        - Note: Tc-99-m-NOET is currently undergoing multicenter trials and is not yet approved for use.
    - Dual-isotope MPI
    - Gated-planar MPI
    - Gated-single-photon emission computed tomography (SPECT) MPI

2. Analysis of ventricular function
    - Radionuclide angiography (RNA)
        - First-pass RNA (FPRNA) (Rest, stress)
        - Planar and SPECT-gated equilibrium blood pool RNA (Rest, stress)
    - Procedures for determination of ejection fraction and volumes:
        - FPRNA
        - Gated-equilibrium blood pool RNA
        - Gated-SPECT perfusion imaging
3. Myocardial infarct-avid imaging
4. Myocardial ischemia imaging
5. Positron emission tomography

MAJOR OUTCOMES CONSIDERED

- The clinical utility of nuclear cardiological techniques in the diagnosis, assessment of disease severity/risk assessment/prognosis, and assessment of therapy in patients with cardiovascular disease
- The sensitivity, specificity, accuracy, cost-effectiveness, and effect of positive or negative results from nuclear cardiological techniques on subsequent clinical decision making
- Morbidity and mortality due to cardiovascular disease

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Hand-searches of Published Literature (Secondary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline committee conducted comprehensive searching of the scientific and medical literature on radionuclide imaging in heart disease. Because the guideline represents a full revision, no time constraints were applied to the searches and all relevant references were reviewed. In addition to broad based searching on radionuclide imaging, specific targeted searches were performed on radionuclide imaging and the following subtopics: chest pain, viability, ejection fraction (EF), hypertensive heart failure, hypertrophic heart failure, electron-beam computed

tomography (EBCT), adenosine, technetium-99m (Tc-99m), antimyosin, dipyridamole, glucarate, risk stratification, prognosis, non-Q-wave infarction, gamma-camera imaging, positron emission tomography (PET), acute myocardial infarction (AMI), heart failure, ischemia, ventricular volumes, left ventricular (LV) function, and angina. The committee reviewed all compiled reports from computerized searches and conducted additional hand searching. Throughout this literature review, abstracts of unpublished data more than 2 years old were excluded.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

A. Data derived from multiple randomized clinical trials
B. Data derived from a single randomized trial, or from nonrandomized studies
C. Consensus opinion of experts

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Guidelines for the Clinical Use of Cardiac Radionuclide Imaging were originally published in 1986 and updated in 1995. Important new developments have continued to occur since 1995, particularly in the areas of acute and chronic ischemic syndromes and heart failure. The Task Force therefore believed the topic should be revisited de novo and invited the American Society for Nuclear Cardiology (ASNC) to cosponsor this undertaking. This report represents a joint effort of the three organizations. The committee that prepared it included acknowledged experts in radionuclide testing, as well as general cardiologists and cardiologists with expertise in other imaging modalities. Committee members were drawn from both the academic and private practice sectors, with the three sponsoring organizations equally represented.

Writing groups were 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 when data exist. Patient specific modifiers, comorbidities, and issues of patient preference that might influence the choice of particular tests or therapies were considered, as well as frequency of follow-up and cost effectiveness.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

The American College of Cardiology/American Heart Association classifications I, II, and III are used to summarize indications as follows:

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

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/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 the procedure/treatment is not useful/effective and in some cases may be harmful

COST ANALYSIS

The American College of Cardiology/American Heart Association (ACC/AHA) 2002 Guideline Update for the Management of Patients With Chronic Stable Angina encourages the use of cardiac imaging as a gatekeeper to cardiac catheterization in order to minimize the rate of normal catheterizations and to enrich the angiographic population with a greater proportion of patients with significant, yet treatable disease. To test the principle of selective resource use, a team of researchers reported that when catheterization was limited to patients with moderate-severe perfusion abnormalities (i.e., summed stress score [SSS] greater than 8), significant cost savings were achieved for 5,183 patients undergoing dual isotope stress single-photon emission computed tomography (SPECT) imaging. The results revealed a 17% reduction in the rate of cardiac catheterization and cost savings ranging from 22 to 55% for high- to low-risk pretest patients. The SSS appeared to identify patients who benefited from revascularization; in comparing the patients undergoing early revascularization to those undergoing medical therapy, a reduction in mortality with revascularization was observed only in those with very abnormal SSS. Another team of researchers have reported similar excellent outcomes with medical versus invasive strategies in patients without high-risk stress nuclear findings.

A third group evaluated a population of 11,249 consecutive stable angina (SA) patients, gathered in a large multicenter trial comprising many U.S. laboratories. In a matched cohort study comparing direct catheterization to myocardial perfusion SPECT with selective catheterization in patients with chronic stable angina, for all levels of pretest clinical risk, there was a substantial reduction (31

to 50%) in costs when using the SPECT plus selective catheterization approach. This reduction was seen in both the diagnostic (early) and follow-up (late) costs, and included costs of revascularization. Rates of subsequent nonfatal MI and cardiac death were virtually identical in all patient risk subsets. The rate of revascularization, however, was reduced by nearly 50% in the myocardial perfusion imaging (MPI) with selective catheterization cohort.

METHOD OF GUIDELINE VALIDATION

External Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

This document was reviewed by three official reviewers nominated by the American College of Cardiology Foundation (ACCF), three official reviewers nominated by the American Heart Association (AHA), three official reviewers nominated by the American Society of Nuclear Cardiology (ASNC), the ACC/AHA Task Force on Practice Guidelines, and four additional content reviewers.

The document was approved by the American College of Cardiology Foundation Board of Trustees in July 2003, the American Heart Association Science Advisory and Coordinating Committee in July 2003, and the American Society of Nuclear Cardiology Board of Directors in July 2003.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Definitions for the weight of the evidence (A-C) and classes of recommendations (I-III) can be found at the end of the "Major Recommendations" field.

Abbreviations: ACS, acute coronary syndrome; CABG, coronary artery bypass graft surgery; CAD, coronary artery disease; CCS, coronary calcium score; CT, computed tomography; ECG, electrocardiogram; FDG, flurodeoxyglucose; FPRNA, first pass radionuclide angiography; LBBB, left bundle-branch block; LV, left ventricular or left ventricle; LVH, left ventricular hypertrophy; MPHR, maximal-predicted heart rate; MPI, myocardial perfusion imaging; PCI, percutaneous coronary intervention; PET, positron emission tomography; RNA, radionuclide angiogram; RV, right ventricular or right ventricle; SPECT, single-photon emission computed tomography; STEMI, ST-segment elevation myocardial infarction; Tc-99m, technetium-99m; Tl-201, thallium-201

Recommendations for Emergency Department Imaging for Suspected Acute Coronary Syndromes (ACS)

Indication	Test	Class	Level of Evidence
1. Assessment of myocardial risk in possible ACS patients with nondiagnostic ECG and initial serum markers and enzymes, if available.	Rest MPI	I	A

Indication	Test	Class	Level of Evidence
2. Diagnosis of CAD in possible ACS patients with chest pain with nondiagnostic ECG and negative serum markers and enzymes or normal resting scan.	Same day rest/stress perfusion imaging	I	B
3. Routine imaging of patients with myocardial ischemia/necrosis already documented clinically, by ECG and/or serum markers or enzymes	Rest MPI	III	C

Abbreviations: ACS, acute coronary syndromes; CAD, coronary artery disease; ECG, electrocardiogram; MPI, myocardial perfusion imaging

Recommendations for Use of Radionuclide Testing in Diagnosis, Risk Assessment, Prognosis, and Assessment of Therapy After Acute ST-Segment Elevation Myocardial Infarction (STEMI)

Patient Subgroup(s)	Indication	Test	Class	Level of Evidence
All	1. Rest LV function	Rest RNA or EGC-gated SPECT	I	B
Thrombolytic therapy without catheterization	2. Detection of inducible ischemia and myocardium at risk	Stress MPI with ECG-gated SPECT whenever possible	I	B
Acute STEMI	3. Assessment of infarct size and residual viable myocardium	MPI at rest or with stress using gated SPECT	I	B
	4. Assessment of RV function with suspected RV infarction	Equilibrium or FPRNA	IIa	B

Abbreviations: ECG, electrocardiography; FPRNA, first-pass radionuclide angiography; LV, left ventricular; MPI, myocardial perfusion imaging; RNA, radionuclide angiography; RV, right ventricular; SPECT, single-photon emission computed tomography; STEMI, ST-segment elevation myocardial infarction

Recommendations for Use of Radionuclide Testing for Risk Assessment/Prognosis in Patients With Non-ST-Segment Elevation Myocardial Infarction (NSTEMI) and Unstable Angina (UA)

Indication	Test	Class	Level of Evidence
1. Identification of inducible ischemia in	Stress MPI with ECG	I	B

Indication	Test	Class	Level of Evidence
the distribution of the "culprit lesion" or in remote areas in patients at intermediate or low risk for major adverse cardiac events.	gating whenever possible		
2. Identification of the severity/extent of inducible ischemia in patients whose angina is satisfactorily stabilized with medical therapy or in whom diagnosis is uncertain.	Stress MPI with ECG gating whenever possible	I	A
3. Identification of hemodynamic significance of coronary stenosis after coronary arteriography.	Stress MPI	I	B
4. Measurement of baseline LV function.	RNA or gated SPECT	I	B
5. Identification of the severity/extent of disease in patients with ongoing suspected ischemia symptoms when ECG changes are nondiagnostic.	Rest MPI	IIa	B

Abbreviations: ECG, electrocardiography; LV, left ventricular; MPI, myocardial perfusion imaging; RNA, radionuclide angiography; SPECT, single-photon emission computed tomography

Cardiac Stress Myocardial Perfusion Single-Photon Emission Computed Tomography (SPECT) in Patients Able to Exercise

Recommendations for Diagnosis of Patients With an Intermediate Likelihood of Coronary Artery Disease (CAD) and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Able to Exercise (to at least 85% of Maximal Predicted Heart Rate)

Class I

1. Exercise myocardial perfusion SPECT to identify the extent, severity, and location of ischemia in patients who do not have left bundle-branch block (LBBB) or an electronically-paced ventricular rhythm but do have a baseline electrocardiogram (ECG) abnormality that interferes with the interpretation of exercise-induced ST-segment changes (ventricular pre-excitation, left ventricular hypertrophy [LVH], digoxin therapy, or more than 1-mm ST depression) (Level of Evidence: B)
2. Adenosine or dipyridamole myocardial perfusion SPECT in patients with LBBB or electronically-paced ventricular rhythm (Level of Evidence: B)
3. Exercise myocardial perfusion SPECT to assess the functional significance of intermediate (25 to 75%) coronary lesions (Level of Evidence: B)
4. Exercise myocardial perfusion SPECT in patients with intermediate Duke treadmill score (Level of Evidence: B)
5. Repeat exercise myocardial perfusion imaging after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event (Level of Evidence: C)

Class IIa

1. Exercise myocardial perfusion SPECT at 3 to 5 years after revascularization (either percutaneous coronary intervention [PCI] or coronary artery bypass graft surgery [CABG]) in selected high-risk asymptomatic patients (Level of Evidence: B)
2. Exercise myocardial perfusion SPECT as the initial test in patients who are considered to be at high risk (patients with diabetes or patients otherwise defined as having a more than 20% 10-year risk of a coronary heart disease event) (Level of Evidence: B)

Class IIb

1. Repeat exercise myocardial perfusion SPECT 1 to 3 years after initial perfusion imaging in patients with known or a high likelihood of CAD and stable symptoms and a predicted annual mortality of more than 1% to redefine the risk of a cardiac event (Level of Evidence: C)
2. Repeat exercise myocardial perfusion SPECT on cardiac active medications after initial abnormal perfusion imaging to assess the efficacy of medical therapy (Level of Evidence: C)
3. Exercise myocardial perfusion SPECT in symptomatic or asymptomatic patients who have severe coronary calcification (computed tomography [CT] coronary calcium score more than the 75th percentile for age and sex) in the presence on the resting ECG of pre-excitation [Wolff-Parkinson-White syndrome] or more than 1 mm ST-segment depression (Level of Evidence: B)
4. Exercise myocardial perfusion SPECT in asymptomatic patients who have a high-risk occupation. (Level of Evidence: B)

Cardiac Stress Myocardial Perfusion SPECT in Patients Unable to Exercise

Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD Who Are Unable to Exercise.

Class I

1. Adenosine or dipyridamole myocardial perfusion SPECT to identify the extent, severity, and location of ischemia. (Level of Evidence: B)
2. Adenosine or dipyridamole myocardial perfusion SPECT to assess the functional significance of intermediate (25 to 75%) coronary lesions (Level of Evidence: B)
3. Adenosine or dipyridamole myocardial perfusion SPECT after initial perfusion imaging in patients whose symptoms have changed to redefine the risk for cardiac event (Level of Evidence: C)

Class IIa

1. Adenosine or dipyridamole myocardial perfusion SPECT at 3 to 5 years after revascularization (either PCI or CABG) in selected high-risk asymptomatic patients (Level of Evidence: B)

2. Adenosine or dipyridamole myocardial perfusion SPECT as the initial test in patients who are considered to be at high risk (patients with diabetes or patients otherwise defined as having a more than 20% 10-year risk of a coronary heart disease event). (Level of Evidence: B)
3. Dobutamine myocardial perfusion SPECT in patients who have a contraindication to adenosine or dipyridamole (Level of Evidence: C)

Class IIb

1. Repeat adenosine or dipyridamole myocardial perfusion imaging 1 to 3 years after initial perfusion imaging in patients with known or a high likelihood of CAD and stable symptoms, and a predicted annual mortality of more than 1%, to redefine the risk of a cardiac event (Level of Evidence: C)
2. Repeat adenosine or dipyridamole myocardial perfusion SPECT on cardiac active medications after initial abnormal perfusion imaging to assess the efficacy of medical therapy (Level of Evidence: C)
3. Adenosine or dipyridamole myocardial perfusion SPECT in symptomatic or asymptomatic patients who have severe coronary calcification (CT Coronary Calcium Score more than the 75th percentile for age and sex) in the presence on the resting ECG of LBBB or an electronically-paced ventricular rhythm (Level of Evidence: B)
4. Adenosine or dipyridamole myocardial perfusion SPECT in asymptomatic patients who have a high-risk occupation (Level of Evidence: C)

Cardiac Stress Myocardial Perfusion Positron Emission Tomography (PET)

Recommendations for Diagnosis of Patients With an Intermediate Likelihood of CAD and/or Risk Stratification of Patients With an Intermediate or High Likelihood of CAD

Class I

1. Adenosine or dipyridamole myocardial perfusion PET in patients in whom an appropriately indicated myocardial perfusion SPECT study has been found to be equivocal for diagnostic or risk stratification purposes (Level of Evidence: B)

Class IIa

1. Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are unable to exercise (Level of Evidence: B)
2. Adenosine or dipyridamole myocardial perfusion PET to identify the extent, severity, and location of ischemia as the initial diagnostic test in patients who are able to exercise but have LBBB or an electronically-paced rhythm (Level of Evidence: B)

Cardiac Stress Perfusion Imaging Before Noncardiac Surgery

Recommendations

Class I

1. Initial diagnosis of CAD in patients with intermediate pretest probability of disease and abnormal baseline ECG* or inability to exercise (Level of Evidence: B)
2. Prognostic assessment of patients undergoing initial evaluation for suspected or proven CAD with abnormal baseline ECG* or inability to exercise (Level of Evidence: B)
3. Evaluation of patients following a change in clinical status (e.g., acute coronary syndrome [ACS]) with abnormal baseline ECG* or inability to exercise (Level of Evidence: B)
4. Initial diagnosis of CAD in patients with LBBB and intermediate pretest probability of disease, when used in conjunction with vasodilator stress (Level of Evidence: B)
5. Prognostic assessment of patients with LBBB undergoing initial evaluation for suspected or proven CAD, when used in conjunction with vasodilator stress (Level of Evidence: B)
6. Assessment of patients with intermediate or minor clinical risk predictors** and poor functional capacity (less than 4 metabolic equivalent [METS]) who require high-risk noncardiac surgery***, when used in conjunction with pharmacologic stress (Level of Evidence: C)
7. Assessment of patients with intermediate clinical risk predictors**, abnormal baseline ECGs*, and moderate or excellent functional capacity (more than 4 METS) who require high-risk noncardiac surgery (Level of Evidence: C)

*Baseline ECG abnormalities that interfere with interpretation of exercise-induced ST-segment changes include LBBB, ventricular pre-excitation, ventricular pacing, LVH with repolarization changes, more than 1-mm ST depression, and digoxin therapy.

**As defined in the ACC/AHA Guideline Update for Perioperatiave Cardiovascular Evaluation for Noncardiac Surgery, intermediate clinical risk predictors include mild angina, prior myocardial infarction (MI), compensated or prior heart failure, diabetes, and renal insufficiency. Minor clinical risk predictors include advanced age, abnormal ECG, rhythm other than sinus, low functional capacity, history of cerebrovascular accident, and uncontrolled hypertension.

***High-risk surgery is defined by emergent operations (particularly in the elderly), aortic and other major vascular surgery, peripheral vascular surgery, and other prolonged operations in which major fluid shifts are anticipated (i.e., reported cardiac risk often more than 5%).

Class IIb

1. Routine assessment of active, asymptomatic patients who have remained stable for up to 5 years after CABG surgery (Level of Evidence: C)
2. Routine evaluation of active asymptomatic patients who have remained stable for up to 2 years after previous abnormal coronary angiography or noninvasive assessment of myocardial perfusion (Level of Evidence: C)
3. Diagnosis of restenosis and regional ischemia in active asymptomatic patients within weeks to months after PCI (Level of Evidence: C)

4. Initial diagnosis or prognostic assessment of CAD in patients with right bundle-branch block or less than 1-mm ST depression on resting ECG (Level of Evidence: C)

Class III

1. Routine screening of asymptomatic men or women with low pretest likelihood of CAD (Level of Evidence: C)
2. Evaluation of patients with severe comorbidities that limit life expectancy or candidacy for myocardial revascularization (Level of Evidence: C)
3. Initial diagnosis or prognostic assessment of CAD in patients who require emergency noncardiac surgery (Level of Evidence: C)

Recommendations for Use of Radionuclide Imaging in Patients With Heart Failure: Fundamental Assessment

Indication	Test	Class	Level of Evidence
1. Initial assessment of LV and RV function at rest*	Rest RNA	I	A
2. Assessment of myocardial viability for consideration of revascularization in patients with CAD and LV systolic dysfunction who do not have angina	MPI (see Table 5), PET	I	B
3. Assessment of the copresence of CAD in patients without angina	MPI	IIa	B
4. Routine serial assessment of LV and RV function at rest	Rest RNA	IIb	B
5. Initial or serial assessment of ventricular function with exercise	Exercise RNA	IIb	B

*National consensus treatment guidelines are directed by quantitative assessment of LVEF and identification of LVEF less than or equal to 40%.

Abbreviations: CAD, coronary artery disease; LV, left ventricular; MPI, myocardial perfusion imaging; PET, positron emission tomography; RNA, radionuclide angiography

Recommendations for the Use of Radionuclide Techniques to Assess Myocardial Viability

Indication	Test	Class	Level of Evidence
1. Predicting improvement in regional and global LV function after revascularization	Stress/redistribution/reinjection ^{201}TI	I	B
	Rest-redistribution imaging	I	B
	Perfusion plus PET FDG imaging	I	B

Indication	Test	Class	Level of Evidence
	Resting sestamibi imaging	I	B
	Gated SPECT sestamibi imaging	IIa	B
	Late ^{201}Tl redistribution imaging (after stress)	IIb	B
	Dobutamine RNA	IIb	C
	Postexercise RNA	IIb	C
	Postnitroglycerin RNA	IIb	C
2. Predicting improvement in heart failure symptoms after revascularization.	Perfusion plus PET FDG imaging	IIa	B
3. Predicting improvement in natural history after revascularization	^{201}TI imaging (rest-redistribution and stress/redistribution/reinjection)	I	B
	Perfusion plus PET FDG imaging	Ia	B

Abbreviations: FDG, flurodeoxyglucose; PET, positron emission tomography; RNA, radionuclide angiography; SPECT, single-photon emission computed tomography; ^{201}Tl, thallium-201

Recommendations for the Use of Radionuclide Imaging to Diagnose Specific Causes of Dilated Cardiomyopathy

Indication	Test	Class	Level of Evidence
1. Baseline and serial monitoring of LV function during therapy with cardiotoxic drugs (e.g., doxorubicin)	Rest RNA	I	A
2. RV dysplasia	Rest RNA	IIa	B
3. Assessment of posttransplant obstructive CAD	Exercise perfusion imaging	IIb	B
4. Diagnosis and serial monitoring of Chagas disease	Exercise perfusion imaging	IIb	B
5. Diagnosis of amyloid heart disease	^{99m}Tc-pyrophosphate imaging	IIb	B
6. Diagnosis and serial monitoring of sarcoid heart disease	Rest perfusion imaging	IIb	B
	Rest ^{67}Ga imaging	IIb	B
7. Detection of myocarditis	Rest ^{67}Ga imaging	IIb	B
	^{111}In antimyosin antibody imaging	IIb	C

Abbreviations: ^{67}Ga, gallium-67; ^{99m}Tc-pyrophosphate, Tc-99m-pyrophosphate; ^{111}In, indium-111; CAD, coronary artery disease; LV, left ventricular; RNA, radionuclide angiography; RV, right ventricular

Recommendations for the Use of Radionuclide Imaging to Evaluate Hypertrophic Heart Disease

Indication	Test	Class	Level of Evidence
1. Diagnosis of CAD in hypertrophic cardiomyopathy	Rest and exercise perfusion imaging	IIb	B
2. Diagnosis and serial monitoring of hypertensive hypertrophic heart disease	Rest RNA	IIb	B
3. Diagnosis and serial monitoring of hypertrophic cardiomyopathy, with and without outflow obstruction	Rest RNA	III	B

Abbreviations: CAD, coronary artery disease; RNA, radionuclide angiography

Recommendations for the Use of Radionuclide Imaging in Valvular Heart Disease

Indication	Test	Class	Level of Evidence
1. Initial and serial assessment of LV and RV function	Rest RNA	I	B
2. Initial and serial assessment of LV function	Exercise RNA	IIb	B
3. Assessment of the copresence of coronary disease	MPI	IIb	B

Abbreviations: LV, left ventricular; RNA, radionuclide imaging angiography; RV, right ventricular; MPI, myocardial perfusion imaging

Recommendations for the Use of Radionuclide Imaging in Adults with Congenital Heart Disease

Indication	Test	Class	Level of Evidence
1. Initial and serial assessment of LV and RV function	Rest RNA	I	B
2. Shunt detection and quantification	FPRNA	IIa	B

Abbreviations: FPRNA, first-pass radionuclide angiography; LV, left ventricular; RV, right ventricular; RNA, radionuclide angiography

Definitions:

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

Class II: Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/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 the procedure/treatment is not useful/effective and in some cases may be harmful

Strength of Evidence

A. Data derived from multiple randomized clinical trials
B. Data derived from a single randomized trial, or from nonrandomized trials
C. Consensus opinion of experts

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

Recommendations in this guideline are derived from the literature search results. The type of supporting evidence is identified with each recommendation (see "Major Recommendations" field).

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Appropriate use of testing and technology in the diagnosis and treatment of patients with known or suspected cardiovascular disease
- Decreased morbidity and mortality associated with cardiovascular disease due to contribution of radionuclide imaging studies in the diagnosis, assessment of severity of disease/risk assessment/prognosis, and assessment of therapy

POTENTIAL HARMS

Dipyridamole and Adenosine

Both dipyridamole and adenosine are safe and well tolerated despite frequent mild side effects, which occur in 50% and 80% of patients, respectively. With

dipyridamole infusion, the most common side effect is chest pain (18 to 42%), with arrhythmia occurring in less than 2%. Noncardiac side effects have included headache (5 to 23%), dizziness (5 to 21%), nausea (8 to 12%), and flushing (3%). With adenosine infusion, chest pain has been reported in 57%, headache in 35%, flushing in 25%, shortness of breath in 15%, and first-degree atrioventricular block in 18%. The side effects of adenosine or dipyridamole are less frequent when vasodilator stress is combined with low-level exercise. Dipyridamole and adenosine side effects are antagonized by theophylline; however, this drug is ordinarily not needed after adenosine because of the latter's ultrashort half-life (less than 10 seconds). The ability of these drugs to cause coronary vasodilation can be blocked by caffeine and other methylxanthines. Thus, patients are instructed to avoid these agents for 24 hours before testing.

Dobutamine

Although side effects are frequent during dobutamine infusion, the test appears to be relatively safe, even in the elderly. The most frequently reported noncardiac side effects (total 26%) in a study of 1,118 patients included nausea (8%), anxiety (6%), headache (4%), and tremor (4%) (497). Common arrhythmias included premature ventricular beats (15%), premature atrial beats (8%), supraventricular tachycardia, and nonsustained ventricular tachycardia (3 to 4%). Atypical chest pain was reported in 8%, and angina pectoris in approximately 20%.

CONTRAINDICATIONS

CONTRAINDICATIONS

Severe side effects are rare, but both dipyridamole and adenosine may cause severe bronchospasm in patients with asthma or reactive airway disease; therefore, they are contraindicated in these patients.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- These practice guidelines are intended to assist physicians and other qualified healthcare professionals in clinical decision making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions. These guidelines attempt to define practices that meet the needs of most patients in most circumstances. The ultimate judgment regarding care of a particular patient must be made by the physician and patient in light of all of the circumstances presented by that patient.
- This report overlaps with several previously published American College of Cardiology/American Heart Association (ACC/AHA) guidelines for patient treatment that potentially involve cardiac radionuclide imaging. These include published guidelines for chronic stable angina (SA; 2002), unstable angina and non-ST-elevation myocardial infarction (UA/NSTEMI; 2002), heart failure (2001), perioperative cardiovascular evaluation for noncardiac surgery (2002), exercise testing (2002), valvular heart disease (1998), and acute

myocardial infarction (AMI; 1999). The present report is not intended to include information previously covered in these guidelines, or to provide a comprehensive treatment of the topics addressed in these guidelines.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines (ACC/AHA/ASNC Committee to revise the 1995 guidelines [trunc]. Bethesda (MD): American College of Cardiology Foundation; 2003. 69 p. [519 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1995 Feb (revised 2003 Aug)

GUIDELINE DEVELOPER(S)

American College of Cardiology Foundation - Medical Specialty Society
American Heart Association - Professional Association
American Society of Nuclear Cardiology - Professional Association

SOURCE(S) OF FUNDING

The American College of Cardiology and the American Heart Association. No outside funding accepted.

GUIDELINE COMMITTEE

American College of Cardiology (ACA)/American Heart Association)AHA)/American Society of Nuclear Cardiology (ASNC) Committee to Revise the 1995 Guidelines for the Clinical Use of Cardiac Radionuclide Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

The committee membership consisted of acknowledged experts in radionuclide testing, as well as general cardiologists and cardiologists with expertise in other imaging modalities: both the academic and private practice sectors were represented.

Committee Members: Francis J. Klocke, MD, MACC, FAHA (Chair); Michael G. Baird, MD, FACC, FAHA; Timothy M. Bateman, MD, FACC, FAHA; Daniel S. Berman, MD, FACC, FAHA; Blase A. Carabello, MD, FACC, FAHA; Manuel D. Cerqueira, MD, FACC, FAHA; Anthony N. DeMaria, MD, MACC, FAHA; J. Ward Kennedy, MD, MACC, FAHA; Beverly H. Lorell, MD, FACC, FAHA; Joseph V. Messer, MD, MACC, FAHA; Patrick T. O'Gara, MD, MACC, FAHA; Richard O. Russell, Jr., MD, FACC; Martin G. St. John Sutton, MBBS, FACC; James E. Udelson, MD, FACC; Mario S. Verani, MD, FACC*; Kim Allan Williams, MD, FACC, FAHA

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*Deceased
**Former Task Force Member
#Former Task Force Chair

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

The American College of Cardiology/American Heart Association Task Force on Practice Guidelines makes every effort to avoid any actual or potential conflicts of interest that might arise as a result of an outside relationship or personal interest of a member of the writing panel. Specifically, all members of the writing panel are asked to provide disclosure statements of all such relationships that might be perceived as real or potential conflicts of interest. These statements are reviewed by the parent task force, reported orally to all members of the writing panel at the first meeting, and updated as changes occur.

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Ritchie JL, Bateman TM, Bonow RO, Crawford MH, Gibbons RJ, Hall RJ, O'Rourke RA, Parisi AF, Verani MS. Guidelines for clinical use of cardiac radionuclide imaging. Report of the American College of Cardiology/American Heart Association Task Force on Assessment of Diagnostic and Therapeutic Cardiovascular Procedures (Committee on Radionuclide Imaging), J Am Coll Cardiol 1995 Feb;25(2):521-47.

These guidelines will be reviewed 1 year after publication and yearly thereafter and considered current unless the Task Force on Practice Guidelines revises or withdraws them from circulation.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Cardiology (ACC) Web site.

Copies are also available from the American Heart Association (AHA) Web site.

Print copies: Available from ACC, Educational Services, 9111 Old Georgetown Road, Bethesda, MD 20814-1699. Also available from AHA, Public Information 7272 Greenville Avenue, Dallas, TX 75231-4596 (Reprint No. 71-0112).

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACC/AHA/ASNC guidelines for the clinical use of cardiac radionuclide imaging--executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASNC Committee to Revise the 1995 Guidelines for the Clinical Use of Cardiac Radionuclide Imaging). J Am Coll Cardiol. 2003 Oct 1;42(7):1318-33; Circulation. 2003 Sep 16;108(11):1404-18.

Electronic copies: Available from the American College of Cardiology (ACC) Web site in Portable Document Format (PDF).

Print copies: Available from ACC, Educational Services, 9111 Old Georgetown Road, Bethesda, MD 20814-1699. Also available from AHA, Public Information 7272 Greenville Avenue, Dallas, TX 75231-4596 (Reprint No. 71-0112).

PATIENT RESOURCES

None provided

NGC STATUS

This summary was completed by ECRI on June 30, 1998. The information was verified by the guideline developer on December 1, 1998. This summary was

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