Guideline Summary NGC-7919

Guideline Title

ACR Appropriateness Criteria® dyspnea — suspected cardiac origin.

Bibliographic Source(s)

Abbara S, Ghoshhajra B, White RD, Woodard PK, Atalay MK, Haramati LB, Hendel RC, Khan AR, Martin ET III, Rozenshtein A, Steiner RM, Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® dyspnea -- suspected cardiac origin. [online publication]. Reston (VA): American College of Radiology (ACR); 2010. 8 p. [109 references]

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Schoepf UJ, Yucel EK, Bettmann MA, Casciani T, Gomes AS, Grollman JH, Holtzman SR, Polak JF, Sacks D, Stanford W, Jaff M, Moneta GL, Expert Panel on Cardiovascular Imaging. Shortness of breath -- suspected cardiac origin. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 5 p. [34 references]

The appropriateness criteria are reviewed biennially and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

Scope

Disease/Condition(s)

Dyspnea of suspected cardiac origin

Guideline Category

Diagnosis

Evaluation

Clinical Specialty

Cardiology

Emergency Medicine

Family Practice

Internal Medicine

Nuclear Medicine

Radiology

Intended Users

Health Plans

Hospitals

Managed Care Organizations

Physicians

Utilization Management

Guideline Objective(s)

To evaluate the appropriateness of initial radiologic examinations for patients with dyspnea of suspected cardiac origin

Target Population

Patients with dyspnea of suspected cardiac origin

Interventions and Practices Considered

1. X-ray, chest
2. Ultrasound (US)
   - Transthoracic echocardiography (TTE), resting
   - TTE, stress
   - Transesophageal echocardiography (TEE)
3. Single photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI), rest and stress
4. Positron emission tomography (PET), heart, stress
5. Technetium (Tc)-99m ventilation/perfusion (V/Q) scan, lung
6. Magnetic resonance imaging (MRI), heart function and morphology, with or without contrast
7. Computed tomography (CT)
   - Chest, with or without contrast
   - Coronary calcium
8. Computed tomography angiography (CTA)
   - Coronary arteries
   - Coronary arteries with advanced low dose techniques
   - Chest (noncoronary)
9. Cardiac catheterization with angiocardiography
10. Pulmonary arteriography
11. Radionuclide ventriculography

Major Outcomes Considered

Utility of radiologic examinations in differential diagnosis

Methodology

Methods Used to Collect/Select the Evidence

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Literature Search Procedure

The Medline literature search is based on keywords provided by the topic author. The two general classes of keywords are those related to the condition (e.g., ankle pain, fever) and those that describe the diagnostic or therapeutic intervention of interest (e.g., mammography, MRI).

The search terms and parameters are manipulated to produce the most relevant, current evidence to address the American College of Radiology Appropriateness Criteria (ACR AC) topic being reviewed or developed. Combining the clinical conditions and diagnostic modalities or therapeutic procedures narrows the search to be relevant to the topic. Exploding the term "diagnostic imaging" captures relevant results for diagnostic topics.

The following criteria/limits are used in the searches:

1. Articles that have abstracts available and are concerned with humans
2. Restrict the search to the year prior to the last topic update or in some cases the author of the topic may specify which year range to use in the search. For new topics, the year range is restricted to the last 5 years unless the topic author provides other instructions.
3. May restrict the search to Adults only or Pediatrics only.
4. Articles consisting of only summaries or case reports are often excluded from final results.

The search strategy may be revised to improve the output as needed.

Number of Source Documents

The total number of source documents identified as the result of the literature search is not known.

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

Strength of Evidence Key

Category 1 - The conclusions of the study are valid and strongly supported by study design, analysis and results.

Category 2 - The conclusions of the study are likely valid, but study design does not permit certainty.

Category 3 - The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal.

Category 4 - The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

The topic author drafts or revises the narrative text summarizing the evidence found in the literature. American College of Radiology (ACR) staff draft an evidence table based on the analysis of the selected literature. These tables rate the strength of the evidence for all articles included in the narrative text.

The expert panel reviews the narrative text, evidence table, and the supporting literature for each of the topic-variant combinations and assigns an appropriateness rating for each procedure listed in the table. Each individual panel member forms his/her own opinion based on his/her interpretation of the available evidence.

More information about the evidence table development process can be found in the American College of Radiology (ACR) Appropriateness Criteria® Evidence Table Development document (see "Availability of Companion Documents" field).

Methods Used to Formulate the Recommendations

Expert Consensus (Delphi)

Description of Methods Used to Formulate the Recommendations

Modified Delphi Technique

When the data available from existing scientific studies are insufficient, the American College of Radiology Appropriateness Criteria (ACR AC) employs systematic consensus techniques to determine appropriateness. The ACR AC panels use a modified Delphi technique to determine the rating for a specific procedure. A series of surveys are conducted to elicit each individual panelist's expert opinion of the appropriateness of an imaging or therapeutic procedure for a specific clinical scenario based on the available data. ACR staff distributes surveys to the panelists along with the evidence table and narrative. Each panelist interprets the available evidence and rates each procedure. Voting surveys are completed by panelists without consulting other panelists. The ratings are integers on a scale between 1 and 9, where 1 means the panel member feels the procedure is "least appropriate" and 9 means the panel member feels the procedure is "most appropriate." Each panel member has one vote per round to assign a rating. The surveys are collected and de-identified and the results are tabulated and redistributed after each round. A maximum of three rounds are conducted. The modified Delphi technique enables each panelist to express individual interpretations of the evidence and his or her expert opinion without excessive bias from fellow panelists in a simple, standardized and economical process.

Consensus among the panel members must be achieved to determine the final rating for each procedure. If eighty percent (80%) of the panel members agree on a single rating or one of two consecutive ratings, the final rating is determined by the rating that is closest to the median of all the ratings. Up to three voting rounds are conducted to achieve consensus.

If consensus is not reached through the modified Delphi technique, the panel is convened by conference call. The strengths and weaknesses of each imaging examination or procedure are discussed and a final rating is proposed. If the panelists on the call agree, the rating is accepted as the panel's consensus. The document is circulated to all the panelists to make the final determination. If consensus cannot be reached, "No consensus" appears in the rating column and the reasons for this decision are added to the comment sections.

Rating Scheme for the Strength of the Recommendations

Not applicable

Cost Analysis

Guideline developers reviewed published cost analyses.

Method of Guideline Validation

Internal Peer Review

Description of Method of Guideline Validation

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

Recommendations

Major Recommendations

ACR Appropriateness Criteria®

Clinical Condition: Dyspnea--Suspected Cardiac Origin

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	8		☢
US echocardiography transthoracic resting	8		O

US echocardiography transthoracic stress	7		O
SPECT MPI rest and stress	7		☢☢☢☢
PET heart stress	7		☢☢☢
MRI heart function and morphology with or without contrast	7	See statement regarding contrast in text under "Anticipated Exceptions."	O
CTA coronary arteries	6		☢☢☢☢
CTA coronary arteries with advanced low dose techniques	6		☢☢☢
CTA chest (noncoronary)	6		☢☢☢
Cardiac catheterization with angiocardiography	6		☢☢☢
US echocardiography transesophageal	5		O
CT chest with or without contrast	5		☢☢☢
Radionuclide ventriculography	4		☢☢☢
Tc-99m V/Q scan lung	3		☢☢☢
CT coronary calcium	3		☢☢☢
Arteriography pulmonary	3		☢☢☢☢
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Shortness of breath, also known as dyspnea, has no precise definition, and patients vary in their attempts to describe the sensation, as it is diffuse in etiology. Dyspnea may be of neurogenic, respiratory, or cardiac origin and may be associated with disease states, as well as deconditioning, anemia, or anxiety. Some patients have a combination of these factors that produce dyspnea at rest, after exercise, or in certain positions (orthopnea, trepopnea, or platypnea, i.e., recumbent, on one side, or in the upright position). Dyspnea may have an acute onset or may be chronic. It is more common in the elderly.

It is not always easy to distinguish between the various causes of dyspnea, although history, physical examination, and simple laboratory tests usually provide insights. The electrocardiogram, plain chest radiograph, and complete blood count have traditionally been part of the initial diagnostic workup. Pulmonary function testing and oximetry are important tests when chronic obstructive pulmonary disease (COPD) or asthma is suspected. Cardiopulmonary exercise testing, with measurement of peak oxygen uptake, is useful in this assessment when combinations of cardiac and respiratory causes are being considered.

Imaging can play a central role in the differentiation of the underlying cause of dyspnea (see the National Guideline Clearinghouse [NGC] summary ACR Appropriateness Criteria® chronic dyspnea — suspected pulmonary origin).

Congestive heart failure (CHF) is the most common cardiac cause of dyspnea. CHF may involve both systolic and diastolic left ventricular dysfunction. Although we commonly think of systolic dysfunction as most important because it produces decreased cardiac output, it is the diastolic dysfunction that appears to be associated with the symptom of dyspnea and with reduced functional capacity under the New York Heart Association (NYHA) grading system in some cases. Some patients may have CHF and dyspnea with normal ejection fractions and can be classified as having diastolic heart failure. Ischemic heart disease is the most common cause of CHF, but other etiologies include valvular heart disease, intracardiac shunts, various cardiomyopathies (including hypertensive, hypertrophic, restrictive, or dilated), right ventricular failure or overload with abnormal septal intrusion on the left ventricle (LV), and pericardial disease with limited diastolic filling due to constriction.

Imaging studies are invaluable for establishing the diagnosis and, in many instances, determining the appropriate management strategy in the setting of dyspnea. Chest radiography and echocardiography have remained the major imaging tools employed for directly assessing patients with dyspnea, with peripheral ultrasound allowing further evaluation of potential venous thromboembolic disease (see the NGC summary ACR Appropriateness Criteria® suspected lower-extremity deep vein thrombosis). In addition, radionuclide imaging has traditionally played an important role in evaluating myocardial perfusion and systolic function when ischemic heart disease is suspected and for inclusion or exclusion of pulmonary embolus. Cardiac magnetic resonance imaging (MRI) is gaining acceptance for noninvasive evaluation of the myocardium, cardiac chambers, valves, and pericardium when cardiac causes of dyspnea are suspected. Computed tomography angiography (CTA) of the heart, pulmonary arteries, or thoracic aorta now play significant roles in the noninvasive workup of suspected low to intermediate-risk test of coronary artery disease (CAD), pulmonary embolism, or thoracic aortic disease associated with aortic valve dysfunction, respectively. Cardiac angiography and coronary arteriography are invasive imaging techniques that are used extensively for diagnosing or excluding ischemic disease and, together with cardiac hemodynamics and endomyocardial biopsy, are important for precise evaluation of cardiac function and etiology of cardiomyopathies.

Radiograph

The radiograph remains readily available and may provide important information about the underlying etiology of dyspnea. Most noncardiac causes related to primary respiratory conditions can be identified using radiography. In the acute setting, CHF is fairly reliably manifested by pulmonary vascular redistribution with alveolar pulmonary edema, while in the chronic situation, cardiomegaly combined with vascular prominence and interstitial edema is more typical. In about half of patients with chronic CHF, cardiomegaly is seen on a radiograph, and evidence of specific chamber enlargement is helpful in detecting valvular heart disease. Elevation of left ventricle end-diastolic pressure (LVEDP), however, is not always accompanied by signs of interstitial edema, particularly in patients who have undergone treatment, whereas clinical symptoms and NYHA grade tend to parallel the radiographic findings of elevated pulmonary capillary wedge pressure (PCWP). Absence of the radiographic signs of congestion does not ensure a normal LVEDP or PCWP in patients with chronic CHF.

Echocardiography

Transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) are widely available techniques that play an extremely important role in evaluating patients with dyspnea of suspected cardiac origin. LV size, global and regional systolic contraction, diastolic function (relaxation and filling), myocardial wall thickness and texture, and valve

dysfunction are accurately evaluated with a combination of two-dimensional and color Doppler techniques. Abnormalities of diastolic function can be detected in patients with normal heart size. Pericardial restraint during filling can often be inferred. Pericardial effusion is easily detected, but pericardial thickening and calcification are not readily seen. Patterns of central venous flow during phases of respiration aid in the differentiation of constrictive and restrictive pathophysiology by echocardiography when Doppler imaging is applied. Consequently, such TTE evaluations are invaluable to the evaluation of the dyspneic patient with suspected cardiac disease. Stress echocardiography is useful to detect regional wall motion abnormalities in ischemic situations. Stress TTE is highly accurate for the detection of CAD and can be performed in combination with either exercise or pharmacologically induced stress.

Serial echocardiography studies are easily performed without cumulative risks from repetitive radiation exposure. TTE has limitations related to acoustic window restrictions and certain body types, as well as operator experience. TEE is somewhat invasive and should be reserved for cases that require better definition of the mitral valve or when TTE is unsatisfactory.

Radionuclide Imaging

Equilibrium-gated blood-pool imaging of the LV (radionuclide ventriculography) provides reliable and reproducible measurements of ejection fraction, regional wall motion abnormalities, and diastolic dysfunction. In patients undergoing radionuclide imaging for dyspnea of suspected cardiac origin, dyspnea appears to be an independent predictor of an increased risk for death from cardiac causes and from any cause. More recently, combined assessments of LV function and myocardial perfusion based on SPECT with a variety of agents can be performed at rest and after stress with exercise, dobutamine, dipyridamole, adenosine, or regadenoson. These studies give reliable results that detect areas of ischemia, infarction, and hibernating myocardium. Recently, new software algorithms such as iterative reconstruction, maximum a posteriori noise regularization and resolution recovery, and new hardware and detector materials have become available, allowing for image acquisitions at significantly shorter acquisition times (one fifth to one half), or alternatively at lower doses compared with conventional algorithms.

PET has many of the same attributes but with generally higher image quality. PET may be useful in patients with dyspnea and suspected myocardial ischemia for demonstrating abnormalities in regional perfusion and/or metabolic behavior of the myocardium (see the NGC summary ACR Appropriateness Criteria® chronic chest pain — high probability of coronary artery disease).

Limitations of SPECT and PET include decreased detection of ischemia in the presence of balanced disease and decreased sensitivity of chemical stress examinations when compared with exercise stress examinations. Artifacts from diaphragmatic and breast attenuation may complicate the interpretation of these examinations, although new CT attenuation correction algorithms address these difficulties.

Ventilation/perfusion (V/Q) scanning is a useful means of evaluation for suspected pulmonary embolism if contrast-enhanced CT is contraindicated. Disadvantages include lack of sensitivity and specificity in the presence of underlying cardiopulmonary disease (especially in the setting of an abnormal chest x-ray), increased fetal radiation dose in pregnant women, and the inability to diagnose alternative causes of chest pain (see the NGC summary ACR Appropriateness Criteria® acute chest pain — suspected pulmonary embolism).

Computed Tomography

Conventional CT with contrast infusion gives limited information about cardiac chambers. It can detect pericardial disease and is quite useful for detecting pulmonary causes of dyspnea. Compared to conventional radiography, CT enables superior assessment of pulmonary vascularity in the context of CHF. CTA of the chest with contrast timed to specifically enhance the pulmonary arteries has emerged as a first-line test to evaluate for pulmonary embolism and can differentiate causes of pulmonary hypertension such as chronic thromboembolic disease, underlying lung pathology, and their sequelae. (See the NGC summary ACR Appropriateness Criteria® acute chest pain — suspected pulmonary embolism). When the contrast is timed to enhance the thoracic aorta, CTA can effectively detect aortic conditions predisposing to dyspnea (e.g., Stanford Type A dissection), often due to aortic valve involvement (see the NGC summary ACR Appropriateness Criteria® acute chest pain — suspected aortic dissection).

Electrocardiogram (ECG)-synchronized CT is also emerging as an important tool for the non-invasive detection of CAD, particularly in patients at low to intermediate risk. There is a growing body of evidence that suggests that noninvasive coronary CTA (CCTA) is a test of high accuracy when differentiating ischemic from nonischemic etiologies of dilated cardiomyopathy based on assessment for CAD, although the severity (number of stenotic lesions and degree of stenosis) of heavily calcified lesions may still be overestimated (see the NGC summaries ACR Appropriateness Criteria® chronic chest pain — high probability of coronary artery disease and ACR Appropriateness Criteria® chest pain, suggestive of acute coronary syndrome).

ECG-gated studies can be performed with multidetector row CT, which provides detailed information on general cardiovascular and thoracic pathology. Effusions and pericardial calcification are easily detected. Precise and reproducible measurements of ventricular volumes, wall thickness, and regional contraction abnormalities can be made using multi-phasic reconstructions, although multidetector row CT should not be used primarily for evaluating cardiac function due to the radiation dose associated with retrospectively gated studies.

As with all imaging tests involving use of iodinated contrast material, the diagnostic benefit needs to be weighed against the risk of inducing or worsening CHF due to contrast-related volume overload. Recent advances in cardiac CT imaging technology allow for further reduction of the radiation dose from CCTA; available new dose-reducing techniques include prospective triggering, adaptive statistical iterative reconstruction, and high-pitch spiral acquisition.

However, these newer low-dose techniques may not be the appropriate choice in all patients due to their dependency on a combination of factors, including heart rate, rhythm, and clinical indication. Thus, while these techniques are promising in terms of reducing patient radiation dose, their overall accuracy and utility as compared to standard CCTA techniques are not yet completely defined.

Magnetic Resonance Imaging

Current ECG-gated MRI techniques routinely yield high-quality images that are acquired over a single breath-hold or even during a single heartbeat. Currently there are few established indications for MRI in the setting of acute dyspnea. However, dynamic MRI techniques (e.g., cine, tagging, flow mapping) reveal anatomic and functional abnormalities of the myocardium, cardiac chambers, valves, and pericardium without the need for radiation or contrast administration. Valve lesions that may be responsible for dyspnea can be accurately characterized and quantified.

Applications of MRI to functional studies of myocardial contraction and diastolic relaxation have shown accurate characterization of functional abnormality. Thus, although MRI may not be the first-line imaging test in the workup of

dyspnea, it is a valuable test for diagnosing several cardiac entities that may present with chronic dyspnea. Growing evidence exists that demonstrates the utility of MRI to differentiate ischemic from nonischemic cardiomyopathies, to detect nontransmural infarcts and missed infarcts, to characterize various nonischemic cardiomyopathies, to diagnose myocarditis or endomyocardial fibrosis, to characterize congenital heart lesions (such as shunts), and to offer prognostic value in several situations.

Invasive Techniques

Physiological studies with hemodynamic monitoring of right heart and pulmonary wedge pressures are often useful in detecting a cardiac cause of dyspnea when the etiology is obscure. Coronary angiography is the reference imaging modality in patients with heart failure and anginal chest pain and continues to play a significant role in confirming absence of obstructive coronary disease in patients with heart failure due to nonischemic cardiomyopathy. LV function is more easily determined noninvasively. Pulmonary arteriography is an invasive test that allows a sensitive evaluation of the pulmonary vasculature as well as functional information such as pulmonary-artery and right-heart pressure measurements, although the test is limited by interobserver variability. For the evaluation of pulmonary embolism as a cause of dyspnea, invasive pulmonary arteriography is usually reserved as a second-line test in rare cases (see the NGC summary of the ACR Appropriateness Criteria® acute chest pain — suspected pulmonary embolism).

Summary

- Dyspnea is a poorly understood symptom that may have pulmonary, cardiac, or psychological causes.
- The chest radiograph is often useful in initially differentiating between cardiac and pulmonary causes.
- The echocardiogram is the noninvasive modality of choice for assessing ventricular systolic and diastolic function and valve function.
- Radiographs and echocardiographs are widely available, have virtually no risk, and are suitable for serial studies.
- Radionuclide imaging (primarily SPECT, but with growing contribution by PET) is widely used as a method for study of myocardial perfusion at rest and under stress. Stress TTE can be employed to detect myocardial ischemia based on assessment of physiological changes in regional contraction.
- ECG-gated multidetector row CT has value in CAD detection in symptomatic patients with either low-to-intermediate CAD risk or equivocal echocardiographic or SPECT results for ischemia evaluation. Its diagnostic accuracy to noninvasively differentiate between ischemic and nonischemic causes of cardiomyopathies and its ability to determine ventricular volumes and function are supportive.
- CTA of the chest is now a first-line approach to the assessment of suspected pulmonary embolism or proximal thoracic aortic disease.
- Cardiac MRI has the ability to differentiate myocardial fibrosis from ischemic infarcts and nonischemic cardiomyopathies, as well as to accurately evaluate global and regional function, and can characterize and quantify valvular dysfunction.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. There is growing literature regarding NSF. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the ACR Manual on Contrast Media (see the "Availability of Companion Documents" field).

Abbreviations

- CT, computed tomography
- CTA, computed tomography angiography
- MPI, myocardial perfusion imaging
- MRI, magnetic resonance imaging
- PET, positron emission tomography
- SPECT, single photon emission computed tomography
- Tc, technetium
- US, ultrasound
- V/Q, ventilation/perfusion

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☢	<0.1 mSv	<0.03 mSv
☢☢	0.1-1 mSv	0.03-0.3 mSv
☢☢☢	1-10 mSv	0.3-3 mSv
☢☢☢☢	10-30 mSv	3-10 mSv
☢☢☢☢☢	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are

designated as NS (not specified).

Clinical Algorithm(s)

Algorithms were not developed from criteria guidelines.

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The recommendations are based on analysis of the current literature and expert panel consensus.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Selection of appropriate initial radiologic imaging procedures to aid in differential diagnosis of patients with dyspnea of suspected cardiac origin

Potential Harms

- Disadvantages of ventilation/perfusion (V/Q) scanning include lack of sensitivity and specificity in the presence of underlying cardiopulmonary disease (especially in the setting of an abnormal chest x-ray), increased fetal radiation dose in pregnant women, and the inability to diagnose alternative causes of chest pain.
- As with all imaging tests involving use of iodinated contrast material, the diagnostic benefit of *conventional computed tomography (CT)* with contrast infusion needs to be weighed against the risk of inducing or worsening congestive heart failure due to contrast related volume overload.

Gadolinium-based Contrast Agents

Nephrogenic systemic fibrosis (NSF) is a disorder with a scleroderma-like presentation and a spectrum of manifestations that can range from limited clinical sequelae to fatality. It appears to be related to both underlying severe renal dysfunction and the administration of gadolinium-based contrast agents. It has occurred primarily in patients on dialysis, rarely in patients with very limited glomerular filtration rate (GFR) (i.e., <30 mL/min/1.73 m^2), and almost never in other patients. Although some controversy and lack of clarity remain, there is a consensus that it is advisable to avoid all gadolinium-based contrast agents in dialysis-dependent patients unless the possible benefits clearly outweigh the risk, and to limit the type and amount in patients with estimated GFR rates <30 mL/min/1.73 m^2. For more information, please see the American College of Radiology (ACR) Manual on Contrast Media (see the "Availability of Companion Documents" field).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults. Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® Radiation Dose Assessment Introduction document (see "Availability of Companion Documents" field).

Qualifying Statements

Qualifying Statements

The American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

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)

Abbara S, Ghoshhajra B, White RD, Woodard PK, Atalay MK, Haramati LB, Hendel RC, Khan AR, Martin ET III, Rozenshtein A, Steiner RM, Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® dyspnea -- suspected cardiac origin. [online publication]. Reston (VA): American College of Radiology (ACR); 2010. 8 p. [109 references]

Adaptation

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

Date Released

1995 (revised 2010)

Guideline Developer(s)

American College of Radiology - Medical Specialty Society

Source(s) of Funding

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

Guideline Committee

Committee on Appropriateness Criteria, Expert Panel on Cardiac Imaging

Composition of Group That Authored the Guideline

Panel Members: Suhny Abbara, MD (*Principal Author*); Brian Ghoshhajra, MD, MBA (*Research Author*); Richard D. White, MD (*Panel Chair*); Pamela K. Woodard, MD (*Panel Vice-Chair*); Michael K. Atalay, MD, PhD; Linda B. Haramati, MD, MS; Robert C. Hendel, MD; Arfa R. Khan, MD; Edward T. Martin, III, MD; Anna Rozenshtein, MD; Robert M. Steiner, MD

Financial Disclosures/Conflicts of Interest

Not stated

Guideline Status

This is the current release of the guideline.

This guideline updates a previous version: Schoepf UJ, Yucel EK, Bettmann MA, Casciani T, Gomes AS, Grollman JH, Holtzman SR, Polak JF, Sacks D, Stanford W, Jaff M, Moneta GL, Expert Panel on Cardiovascular Imaging. Shortness of breath -- suspected cardiac origin. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 5 p. [34 references]

The appropriateness criteria are reviewed biennially and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

Guideline Availability

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

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

Availability of Companion Documents

The following are available:

- ACR Appropriateness Criteria®. Overview. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria®. Literature search process. Reston (VA): American College of Radiology; 1 p. Electronic copies: Available in Portable Document Format (PDF) from the ACR Web site.
- ACR Appropriateness Criteria®. Evidence table development – diagnostic studies. Reston (VA): American College of Radiology; 2013 Nov. 3 p. Electronic copies: Available in PDF from the ACR Web site.

Radiology; 2013 Nov. 5 p. Electronic copies: Available in PDF from the ACR Web site.

- ACR Appropriateness Criteria®. Radiation dose assessment introduction. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the ACR Web site.
- ACR Appropriateness Criteria® Manual on contrast media. Reston (VA): American College of Radiology; 90 p. Electronic copies: Available in PDF from the ACR Web site.

Patient Resources

None available

NGC Status

This summary was completed by ECRI on February 20, 2001. The information was verified by the guideline developer on March 14, 2001. This summary was updated by ECRI on August 11, 2006. This summary was updated by ECRI Institute on November 9, 2010. This summary was updated by ECRI Institute on January 13, 2011 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents.

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