Complete Summary

GUIDELINE TITLE

Suspected bacterial endocarditis.

BIBLIOGRAPHIC SOURCE(S)

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. Suspected bacterial endocarditis. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 5 p. [27 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Higgins CB, Levin DC, Bettmann MA, Gomes AS, Grollman J, Henkin RE, Hessel SJ, Kelley MJ, Needleman L, Polak JF, Stanford W, Wexler L, Abbott W, Port S. Suspected bacterial endocarditis. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):73-7.

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

COMPLETE SUMMARY CONTENT

SCOPE
METHODOLOGY - including Rating Scheme and Cost Analysis
RECOMMENDATIONS
EVIDENCE SUPPORTING THE RECOMMENDATIONS
BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS
QUALIFYING STATEMENTS
IMPLEMENTATION OF THE GUIDELINE
INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES
IDENTIFYING INFORMATION AND AVAILABILITY
DISCLAIMER

SCOPE

DISEASE/CONDITION(S)

Bacterial endocarditis

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Cardiology
Family Practice
Internal 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 suspected bacterial endocarditis

TARGET POPULATION

Patients with suspected bacterial endocarditis

INTERVENTIONS AND PRACTICES CONSIDERED

1. Chest x-ray
2. Ultrasound (US), heart
    - Transesophageal echocardiography (TEE)
    - Transthoracic echocardiography (TTE) with Doppler
    - TTE without Doppler
3. Magnetic resonance imaging (MRI), heart
4. Invasive (INV), heart, cardiac catheterization and angiography
5. Computed tomography (CT)
    - Heart, electrocardiogram (ECG)-gated
    - Chest
6. Nuclear medicine (NUC), heart, indium-label white blood cell (WBC) study

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, and the major applicable articles were identified and collected.

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 Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The

survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

In two studies, transthoracic echocardiography (TTE) was found to be the more cost effective test in patients with intermediate or high pretest probability of infective endocarditis.

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: Suspected Bacterial Endocarditis

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, chest	9	
US, heart, transesophageal (TEE)	8	Clinical reference standard. Invasive test. Most useful in patients with moderate to high clinical likelihood.
US, heart, transthoracic with	7	

Radiologic Exam Procedure	Appropriateness Rating	Comments
Doppler (TTE)		
US, heart, transthoracic without Doppler (TTE)	6	
MRI, heart	6	Probably indicated to rule out paravalvular abscess
INV, heart, cardiac catheterization and angiography	6	Indicated preoperatively
CT, heart, ECG-gated	6	Multidetector with maximal temporal and spatial resolution. Probably indicated to rule out paravalvular abscess and/or pseudoaneurysm. Emerging technology.
CT, chest	4	
NUC, heart, indium-labeled WBC Study	4	
Appropriateness Criteria Scale **1 2 3 4 5 6 7 8 9** **1 = Least appropriate 9 = Most appropriate**		

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

Infective endocarditis has been classified as acute endocarditis and subacute endocarditis. Typically, acute endocarditis is produced by a virulent organism (such as Staphylococcus aureus) on a normal valve, while subacute endocarditis is produced by less virulent organisms (Streptococcus viridans or Staphylococcus epidermis) on an abnormal valve. Infective endocarditis can also be classified as infection of prosthetic valves. In recent years, infective endocarditis of normal right-sided valves has become frequent as a consequence of intravenous injection of illicit drugs. While acute endocarditis of left-sided cardiac valves nearly invariably causes congestive heart failure, heart failure may also occur with subacute infective endocarditis. The diagnostic work-up of patients with suspected infective endocarditis varies somewhat, depending upon the presence of congestive heart failure.

Infective endocarditis is fundamentally a clinical diagnosis based on the presence of positive blood cultures in association with characteristic symptoms and physical findings. Imaging is used to support the diagnosis by demonstration of vegetations of cardiac valves and, in complicated cases, perivalvular abscesses. Imaging is also used to assess the severity of valvular damage, identify complications, and recognize the presence and severity of heart failure.

Chest X-ray

The chest x-ray is used to determine cardiac chamber size and the presence and severity of pulmonary venous hypertension and edema; it is necessary for the evaluation of infective endocarditis. It is used to monitor the severity of the hemodynamic consequences of valvular regurgitation caused by infectious endocarditis and to assess response to treatment. Chest x-ray is also used to identify abnormal contour of the great arteries or cardiac chambers which might be indicative of perivalvular abscess. In right-sided endocarditis the chest x-ray is effective for demonstration of pulmonary infarcts and abscesses.

Cardiac Fluoroscopy

In rare occasions, cardiac fluoroscopy may be indicated for the evaluating prosthetic cardiac valves afflicted with endocarditis. It is used to determine excess mobility of the valve during the cardiac cycle; this finding may be highly suggestive of valve dehiscence caused by infective endocarditis.

Transthoracic Echocardiography

Transthoracic echocardiography (TTE) plays an important role in the evaluation of infective endocarditis. It can demonstrate vegetations on cardiac valves, valvular regurgitation, and perivalvular abscess. It is the most frequently used imaging study for confirming the diagnosis of infective endocarditis. The demonstration of vegetations by echocardiography establishes the diagnosis. Studies show that criteria for the diagnosis, which includes the findings on TTE and particularly transesophageal echocardiography (TEE), were significantly better than traditional criteria based upon clinical and bacteriologic criteria. While TEE has been shown to have significantly higher sensitivity than TTE for identifying vegetations, specificities were similar. The positive predictive value of echocardiography for the diagnosis has been shown to be 97% while the negative predictive value was 94%.

Several studies evaluated the diagnostic value of TTE and TEE in relation to the pretest probability of infective endocarditis based upon clinical assessment in pediatric and adult patients. These studies concluded that echocardiography is less indicated in patients with low probability of endocarditis. TTE is the procedure of choice for patients with intermediate or high probability of endocarditis. In right-sided endocarditis, TTE and TEE demonstrated a similar number of vegetations and frequency of tricuspid regurgitation.

The size and other characteristics of vegetations on echocardiography have been shown to be useful in predicting complications such as peripheral embolization. Increase or failure to decrease in size of vegetation on serial echocardiograms during antibiotic therapy has been shown to be predictive of a prolonged and/or complicated course of infective endocarditis.

Transesophageal Echocardiography

TEE is indicated and increasingly used in suspected infective endocarditis for demonstrating vegetations, perivalvular abscess, valvular regurgitation and

ventricular function. It is the most sensitive imaging technique for identifying vegetations, which are the hallmark for the definitive diagnosis of infective endocarditis. Criteria for diagnosing infective endocarditis using echocardiographic features improve upon the diagnostic accuracy of using clinical criteria alone. TEE has better sensitivity than TTE for detecting vegetations. A review has claimed that in experienced hands, TEE has a greater than 90% sensitivity and specificity for detecting intracardiac lesions associated with infective endocarditis. This and another review also concluded that a negative TEE almost always means a very low probability of infective endocarditis.

TEE has been shown to be very effective for monitoring the size and other characteristics of vegetation and for detecting complications such as perivalvular abscesses. TEE has improved sensitivity and accuracy compared to TTE for identifying perivalvular abscesses. TEE is indicated for suspected infective endocarditis of prosthetic valves; it is significantly more accurate than TTE. Furthermore, monitoring the size of vegetations during treatment contributes information concerning prognosis and risk of complications, although the usefulness of repeated TTE for altering patient management decreases with the number of repetitions.

In two studies, TTE was found to be the more cost effective test in patients with intermediate or high pretest probability of infective endocarditis.

TEE is indicated in many patients with suspected infective endocarditis, especially those in whom TTE is inconclusive or in patients with suspected perivalvular abscess.

Radioisotope Scanning

Radioisotope scanning is probably indicated in the evaluation of suspected infective endocarditis. Several types of radioisotope scans may be used for identifying and localizing infected vegetations and perivalvular abscesses. Gallium 67 and indium111- labeled white cells are routinely used. Although these techniques are useful in isolated patients, they have a low sensitivity and add little to the usual diagnosis of infective endocarditis.

More recently, immunoscintigraphy using technetium99m-labeled anti-NCA-95 antigranulocyte antibodies has been proposed as a method of localization. In one study, this scan had a sensitivity of 79% and specificity of 82% compared to echocardiography, which had a sensitivity of 88% and specificity of 97%. However, the combination of echocardiography and immunoscintigraphy has a sensitivity of 100% and specificity of 82%.

Magnetic Resonance Imaging

MRI is probably indicated for the evaluation of infective endocarditis. However, its use should be limited to the evaluation of complications such as perivalvular and myocardial abscesses and infectious pseudoaneurysms. It is less accurate than TTE and TEE for identifying valvular vegetations. Cine MRI and velocity encoded cine MRI can be used for the semiquantification and quantification of the volume of valvular regurgitation, respectively.

Computed Tomography

There is limited evidence in the literature to support the use of CT for the assessment of patients with suspected endocarditis. However, particularly ECG-gated multidetector-row CT is emerging as an important tool for non-invasive cardiac assessment and is probably indicated in the evaluation of complications of infective endocarditis, such as the identification of perivalvular and myocardial abscesses and infective pseudoaneurysms. CT may be indicated in right-sided endocarditis for demonstrated septic pulmonary infarcts and abscesses.

CT is less accurate than TTE and TEE for identifying valvular vegetation. Consequently, the role of CT, like MRI, is for the evaluation of complicated cases of infective endocarditis.

Catheterization and Ventricular Angiography

Catheterization and ventriculography are indicated in infective endocarditis with congestive heart failure. They may be used to assess the severity of valvular dysfunction and ventricular function prior to surgery. These tests are not indicated for patients with uncomplicated endocarditis on native valves in whom surgical intervention is not contemplated. Catheterization and ventriculography may be indicated for endocarditis of prosthetic valves when echocardiographic results are equivocal.

Abbreviations

- CT, computed tomography
- ECG, electrocardiogram
- INV, invasive
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- US, ultrasound
- WBC, white blood cell

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 for evaluation of patients with suspected bacterial endocarditis

POTENTIAL HARMS

Not stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An 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.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

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. Suspected bacterial endocarditis. [online publication]. Reston (VA): American College of Radiology (ACR); 2006. 5 p. [27 references]

ADAPTATION

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

DATE RELEASED

1998 (revised 2006)

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 Cardiovascular Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: U. Joseph Schoepf, MD; E. Kent Yucel, MD; Michael A. Bettmann, MD; Thomas Casciani, MD; Antoinette S. Gomes, MD; Julius H. Grollman, MD; Stephen R. Holtzman, MD; Joseph F. Polak, MD, MPH; David Sacks, MD; William Stanford, MD; Michael Jaff, MD; Gregory L. Moneta, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

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The appropriateness criteria are reviewed annually 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.

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the 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 is available:

- ACR Appropriateness Criteria®. Background and development. 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.

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.

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