I have **NO** relevant financial relationships
Intro
Must Reading . . .
AHA Scientific Statement

Infected Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications

A Scientific Statement for Healthcare Professionals From the American Heart Association

_Endorsed by the Infectious Diseases Society of America

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Background—Infected endocarditis is a potentially lethal disease that has undergone major changes in both host and pathogen. The epidemiology of infected endocarditis has become more complex with today’s myriad healthcare-associated factors that predispose to infection. Moreover, changes in pathogen prevalence, in particular a more common staphylococcal origin, have affected outcomes, which have not improved despite medical and surgical advances.

Methods and Results—This statement updates the 2005 iteration, both of which were developed by the American Heart Association under the auspices of the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease of the Young. It includes an evidence-based system for diagnostic and treatment recommendations used by the American College of Cardiology and the American Heart Association for treatment recommendations.

Conclusions—Infected endocarditis is a complex disease, and patients with this disease generally require management by a team of physicians and allied health providers with a variety of areas of expertise. The recommendations provided in this document are intended to assist in the management of this uncommon but potentially deadly infection. The clinical variability and complexity in infected endocarditis, however, dictate that these recommendations be used to support and not supplant decisions in individual patient management. (Circulation. 2015;132:1435-1486. DOI: 10.1161/CIR.0000000000000296.)
2015 ESC Guidelines for the management of infective endocarditis

The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC)

Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM)

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Proposed Modifications to the Duke Criteria for the Diagnosis of Infective Endocarditis

Jennifer S. Li,1,4 Daniel J. Sexton,2,3 Nathan Mick,3 Richard Nettles,3 Vance G. Fowler, Jr.,2,3 Thomas Ryan,1,3 Thomas Bashore,1,3 and G. Ralph Corey2,3

Although the sensitivity and specificity of the Duke criteria for the diagnosis of infective endocarditis (IE) have been validated by investigators from Europe and the United States, several shortcomings of this schema remain. The Duke IE database contains records collected prospectively on >800 cases of definite and possible IE since 1984. Databases on echocardiograms and on patients with Staphylococcus aureus bacteremia at Duke University Medical Center are also maintained. Analyses of these databases, our experience with the Duke criteria in clinical practice, and analysis of the work of others have led us to propose the following modifications of the Duke schema. The category “possible IE” should be defined as having at least 1 major criterion and 1 minor criterion or 3 minor criteria. The minor criterion “echocardiogram consistent with IE but not meeting major criterion” should be eliminated, given the widespread use of transesophageal echocardiography (TEE). Bacteremia due to S. aureus should be considered a major criterion, regardless of whether the infection is nosocomially acquired or whether a removable source of infection is present. Positive Q-fever serology should be changed to a major criterion.
CLINICAL PRACTICE GUIDELINE: FOCUSED UPDATE

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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Guidelines for the Use of Echocardiography in the Evaluation of a Cardiac Source of Embolism

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Embolism from the heart or the thoracic aorta often leads to clinically significant morbidity and mortality due to transient ischemic attack, stroke or occlusion of peripheral arteries. Transthoracic and transesophageal echocardiography are the key diagnostic modalities for evaluation, diagnosis, and management of stroke, systemic and pulmonary embolism. This document provides comprehensive American Society of Echocardiography guidelines on the use of echocardiography for evaluation of cardiac sources of embolism.

It describes general mechanisms of stroke and systemic embolism; the specific role of cardiac and aortic sources in stroke, and systemic and pulmonary embolism; the role of echocardiography in evaluation, diagnosis, and management of cardiac and aortic sources of emboli including the incremental value of contrast and 3D echocardiography; and a brief description of alternative imaging techniques and their role in the evaluation of cardiac sources of emboli.

Specific guidelines are provided for each category of embolic sources including the left atrium and left atrial appendage, left ventricle, heart valves, cardiac tumors, and thoracic aorta. In addition, there are recommendations regarding pulmonary embolism, and embolism related to cardiovascular surgery and percutaneous procedures. The guidelines also include a dedicated section on cardiac sources of embolism in pediatric populations. (J Am Soc Echocardiogr 2016;29:1-42.)
Infective Endocarditis
2015 AHA Guidelines - What’s new

• Overall incidence increasing
  - Increased average age
  - IV drug use
  - Increased intracardiac devices/prosthetic valves

• Staph aureus now most common organism

• Echo/Duke criteria still primary dx tools

• New imaging techniques
  - 3D-echo
  - Head-to-toe multislice CT
  - Cardiac MRI

continued . . .
Infective Endocarditis
2015 AHA Guidelines - What’s new

• Multidisciplinary IE Teams

• Repeat echo in 3 – 5 days if suspicion despite negative initial TEE
  (compared w/2005 recommendations → 7–10 days)

• Patients undergoing surgery ≈ 50%

• Discontinuation of AC controversial

Baddour  Circulation 2015;132:1435-1486
Infective Endocarditis
Role of Echocardiography

- Identify predisposing heart disease
- Establish diagnosis
- Detect complications
- Determine prognosis (risk of complications)
- Assess hemodynamic consequences
- Serial evaluation
Echo in Endocarditis

Diagnosis

Complications

Management
Diagnosis
The protean character of the malady, the latency of the cardiac symptoms, and the close simulation of other disorders, combine to render the detection peculiarly difficult.
Infective Endocarditis

Diagnosis

CLINICAL

ECHO

MICROBIOL
Diagnosis of Infective Endocarditis

Duke Criteria

• Empirically derived, retrospectively tested, prospectively validated

• Has become standard for all current studies on infective endocarditis

• Original data based solely on TTE

• Shortcomings of original criteria have led to recent proposed modifications
Diagnosis of Infective Endocarditis

Shortcomings of Duke Criteria

- “Possible IE” group too broad
- Relative risk of IE in *Staph Aureus* bacteremia under-recognized
- Poor diagnostic sensitivity in suspected Q-fever IE
- Role of TEE not included
Diagnosis of Infective Endocarditis
Proposed Modifications of Duke Criteria

• **Redefinition of “Possible IE”**
  - Old: 1 minor criteria *and*
    did not meet criteria for “rejected IE”
  - New: 1 major and 1 minor criteria *or*
    3 minor criteria

• **Echocardiographic minor criteria eliminated**

• Presence of *S. aureus* bacteremia should be considered a major criteria
  (regardless of whether infection is nosocomially acquired or whether a removable source of infection is present)

• Single blood culture positive for *C. burnetii* or antiphase I IgG antibody titer ≥ 1:800 should be major criteria

• **TEE recommended in select patients**

Li et al
The Duke criteria and echocardiography are still the primary tools for diagnosing endocarditis
Diagnostic Criteria for Endocarditis

• 1994 → Duke criteria\(^1\): Major and minor criteria
  → Echo, microbiology, clinical
  → 3 categories: definite, possible, rejected

• 1990s (mid-late) → 12 major studies
  → Nearly 1700 patients
  → Confirmed high sens/spec Duke

• 2000 – Li\(^2\) → modification of Duke criteria
  → Universally accepted
  → In current use

Developments in Endocarditis that Improved Diagnosis and Prognosis

- Antibacterial therapy
- Clinical microbiology
- Cardiac imaging (echocardiography)
- Cardiac surgery
Infective Endocarditis

Reasons for False Negative Echos

- Poor acoustic window(s)
- Small vegetations (< 3 mm)
- Recent embolization
- Nonoscillating vegetations
- Atypically located vegetations
- Pre-existing cardiac lesions
  - Degenerative or sclerotic valves
  - Prosthetic valves
  - Intracardiac devices
Infective Endocarditis

Causes of False Negative TTE Studies

- Prosthetic valve
- Small vegetation <5 mm
- Poor acoustic window for any reason
- Incomplete visualization of all portions of a valve
Infective Endocarditis
Unusual Sites of Infection

- Mural endocardium
- Chordae tendinae
- Eustachian valve
- Pacemaker wire
- Calcified mitral annulus
- Mural thrombus
What is Vegetation?

Clump of infected material consisting of fibrin, platelets, red and white blood cells, and microorganisms.
Echo Characteristics of Infective Endocarditis

Vegetation

Irregularly shaped, discrete echogenic mass adherent to, yet distinct from cardiac surface.

Oscillation of mass supportive, not mandatory
Vegetations ➔ (Echo hallmark) Echo Characteristics

- Localized echo-density
- Irregular shape ("shaggy")
- Pedunculated or sessile
- Rarely impair valve motion
- Often flutter or vibrate
## Echo Criteria for Defining a Vegetation

<table>
<thead>
<tr>
<th>Positive Features</th>
<th>Negative Features</th>
</tr>
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<tbody>
<tr>
<td>Low reflectance</td>
<td>High echogenicicity</td>
</tr>
<tr>
<td>Attached to valve</td>
<td>Nonvalvular location</td>
</tr>
<tr>
<td>Irregular shape</td>
<td>Smooth surface</td>
</tr>
<tr>
<td>Pedunculated or sessile</td>
<td>------</td>
</tr>
<tr>
<td>Mobile, oscilliating</td>
<td>Nonmobile</td>
</tr>
<tr>
<td>Valve regurgitation</td>
<td>Absence of regurgitation</td>
</tr>
</tbody>
</table>
Where to Look for Vegetations

- LV side of aortic valve
- LA side of mitral valve
- RA side of tricuspid valve
Infective Endocarditis

Technical Tips

• Assess all valves in zoom mode

• Use highest possible tsdr frequency

• Place focal zone at level of valves

• Slow angulation and tilting through the valves from all possible views to image all aspects of the these 3D structures
Detection of Vegetations

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
</tr>
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<tbody>
<tr>
<td>TTE</td>
<td>40 – 80%</td>
</tr>
<tr>
<td>TEE</td>
<td>&gt;95%</td>
</tr>
</tbody>
</table>

Sens/Spec depend on pre-test probability
Infective Endocarditis
Mimics of Vegetations

- Myxomatous degeneration
- Ruptured or redundant chordae
- Focal thickening or calcium deposits (e.g., MAC)
- Nodules of Arantius
- Retained mitral leaflets post MVR
- Lambl's excrescences
- Sutures, strands on prosthetic valves
- Thrombus, tumor (esp papillary fibroelastoma)
Complications
Infective Endocarditis

Structural Complications

- Leaflet rupture, flail
- Leaflet perforation
- Abscess
- Aneurysm
- Fistula
- Prosthetic valve dehiscence
- Embolization
- Pericardial effusion
Infective Endocarditis
Hemodynamic Complications

- Acute valvular regurgitation
- Heart failure
- Intracardiac shunt
- Cardiac tamponade
- Valve obstruction
- Hemolysis
Echo Characteristics of Infective Endocarditis

Abscess

Thickened area or mass within the myocardium or annular region

Appearance is nonhomogeneous and may be echogenic, echolucent or both
Echo Characteristics of Infective Endocarditis

**Abscess**

Thickened area or mass within the myocardium or annular region

Appearance is nonhomogeneous and may be echogenic, echolucent or both
Perivalvular Abscess

Echo Features

- Walled-off echo-free space
- Focal thickening of aortic wall
- Echo-density in ventricular septum
- Rocking of prosthetic valve
- Sinus of Valsalva aneurysm
Small Posterior Periaortie Abscess
Periaortic Abscess
Periaortic Abscess
Perivalvular Abscess

When Diagnosis May Be Difficult

- Small abscess
- Echo performed very early in course
- Abscess localized around calcification in posterior mitral annulus
- Prosthetic valves
Echo Characteristics of Infective Endocarditis

**Aneurysm** (pseudoaneurysm)

- Echo-free space bounded by thin tissue; often pulsatile; color Doppler flow often detected within
Mitral and Aortic Valve Aneurysms
Another Case
E = 1.7 m/s
Left upper pulmonary vein
Aortic Valve
Mitral valve from LA side
Mitral valve from LV side
Echo Characteristics of Infective Endocarditis

**Perforation**
Defect in body of valve leaflet with evidence of flow through defect
Perforation
Perforation
Perforation
Echo Characteristics of Infective Endocarditis

**Dehiscence**
Rocking motion of prosthetic valve with excursion $>15^\circ$ in at least one direction
Periannular Abscess

- Aortic annulus
- Mitral-aortic intervalvular fibrosa
- Aorto-septal junction
Aortic Valve Endocarditis

TEE Recognition of Subaortic Complications

Karalis et al  (Hahneman & Loma Linda)
Circulation  86:353(1992)
Detection of Subaortic Complications
Comparison of TEE vs TTE

<table>
<thead>
<tr>
<th>Methods</th>
<th>n</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>TEE</td>
<td>22/24</td>
<td>92</td>
</tr>
<tr>
<td>TTE</td>
<td>5/24</td>
<td>21</td>
</tr>
</tbody>
</table>

Karalis et al  (Hahnemann and Loma Linda)
Circulation  86:353(1992)
Cases
Infective Endocarditis

Summary

1. Accurate diagnosis requires integration of clinical suspicion, microbiological information, and echo data

2. Diagnosis can be facilitated by integrated schema such as the Duke criteria

3. All patients with suspected endocarditis should undergo echo, with the choice of modality tailored to the clinical situation
Infective Endocarditis

Summary

4. Low threshold for TEE imaging

5. Early surgical consultation

6. For the remainder of their lives, survivors of acute IE should receive secondary prevention with prophylactic antibiotics for procedures typically associated with high risk of transient bacteremia with organisms known to cause IE
Use of Echo in Suspected Infective Endocarditis

Clinical suspicion of infective endocarditis

- Transthoracic echocardiography
  - Prosthetic valve or intracardiac device
  - Positive for infective endocarditis
  - Non-diagnostic images
  - Negative for infective endocarditis

Transesophageal echocardiography

High

Low

Stop

Adapted from Habib Eur Heart J 2015;36:3075-3128
ESC Guidelines for management of infective endocarditis
The ESC strongly supports the management of patients with IE in reference centres by a specialized team.

2015 ESC Guidelines for the management of IE
Infective Endocarditis
Multidisciplinary Team

- Cardiologists (special competency in valve disease)
- Echocardiographers
- Cardiothoracic surgeons (expertise in complex valve surgery)
- Infectious disease specialists
- Neurologists
Topics Not Covered

- Staph aureus bacteremia
- TTE vs TEE
- Embolic potential/embolic complications
- SBE prophylaxis – the controversy
- When to operate on acute IE
- Fungal endocarditis
- Nonbacterial thrombotoc endocarditis
The End