Infective Endocarditis
Role of Echo

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I have NO relevant financial relationships
Introduction
Infective Endocarditis

Despite advances

Antimicrobial therapy
Diagnostic imaging
Cardiac surgery

High morbidity and mortality

6 month mortality approaches 25%
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
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>
</thead>
<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, oscillating</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>Test Type</th>
<th>Sensitivity</th>
</tr>
</thead>
<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
- 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 Periaortic 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
Aneurysm (pseudoaneurysm)

Echo-free space bounded by thin tissue; often pulsatile; color Doppler flow often detected within.
Mitral and Aortic Valve Aneurysms
$E = 1.7 \text{ m/s}$
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
Examples
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>
</tr>
</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
Case 1
Case 2

Bioprosthetic Valve Vlegs
Case 3

Complex AoV endocarditis
Fistula tract toward PA
Case 4
Case 5

GB - 72 yr old F
Large MV veg and huge abscess
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

Clinical suspicion of infective endocarditis

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
The End
Backup Slides
# Infective Endocarditis
## Diagnostic Criteria

### Duke Criteria

<table>
<thead>
<tr>
<th>Major criteria</th>
<th>Typical positive blood cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Positive echocardiogram</strong></td>
</tr>
<tr>
<td></td>
<td><strong>New valvular regurgitation</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor criteria</th>
<th>Predisposing heart condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fever $\geq 38^\circ C$</td>
</tr>
<tr>
<td></td>
<td>Vascular phenomenon</td>
</tr>
<tr>
<td></td>
<td>Immunologic phenomenon</td>
</tr>
<tr>
<td></td>
<td>Suggestive blood culture</td>
</tr>
<tr>
<td></td>
<td><strong>Suggestive echocardiogram</strong></td>
</tr>
</tbody>
</table>

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**
Infective Endocarditis
Unusual Sites of Infection

- Mural endocardium
- Chordae tendinae
- Eustachian valve
- Pacemaker wire
- Calcified mitral annulus
- Mural thrombus
TTE for Infective Endocarditis

Strict Negative Criteria

- Moderate or better ultrasound quality
- Normal anatomy
- No valvular stenosis or sclerosis
- At most, trivial valve regurgitation
- At most, mild, simple pericardial effusion
- Absence of implanted hardware or central venous catheter
- No evidence of vegetation

Infective Endocarditis
Special Populations

- Right-sided endocarditis
- End-stage real disease – dialysis
- Pacemakers, ICDs, and devices
- Prosthetic valve endocarditis
Infective Endocarditis
Incidence of Embolic Events

Steckelberg (Mayo Clinic)
Initial TTE - Advantages

- Immediate availability, safe, portable
- High specificity for vegetation (up to 98%)
- Valve dysfunction assessed accurately
- Serves as baseline
- Easily repeated → occurrence of complications
- LV size and function
- Pulmonary hypertension
Initial TTE - Disadvantages

- Poor quality studies
- Limited sensitivity (≈ 65%)
- Extension of infection (sensitivity ≈ 30%)
- Prosthetic valves (sensitivity ≈ 30 – 35%)
ACC/AHA Guideline
Transesophageal Echo in Endocarditis

Class I

3. TEE is recommended to diagnose complications of infective endocarditis with potential impact on prognosis and management (eg abscesses, perforation, and shunts) (Level of evidence: C)

4. TEE is recommended as first-line diagnostic study to diagnose prosthetic valve endocarditis and assess for complications (Level of evidence: C)

Adapted from ACC/AHA 2008 Valvular Disease Guidelines
J Am Coll Cardiol 52:e1-142(2008)