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PRINCIPLES OF ENDOCARDITIS

Definition
Endovascular microbial infection of cardiovascular structures

Location
- Valves
- Large intrathoracic vessels
- Ventricular and atrial endocardium
- Prosthetic material
- Polymere associated structures (lines)
- Eustachian valve

Pathophysiology of Endocarditis

Vegetation is an infected mass attached to endocardial structures, such as valves or implanted intracardiac material. On 2D echo they frequently appear as oscillating structures of variable size and morphology.

Principle of a “super-infected” thrombus: The endothelial lesion initiates a repair process which involves thrombus formation. In the presence of bacteremia this thrombus may be super-infected. Further consequences include repair ad integrum, tissue destruction, embolism, and defect healing.
PRINCIPLES OF ENDOCARDITIS

Microbiology

- Staph. aureus 25%
- Staph. epidermidis 13%
- Enterococcus 11%
- Strept. bovis 20%
- Culture negative 17%
- Other 14%

Epidemiologic Facts on Endocarditis

- Large geographical variations in the incidence of endocarditis (3–10 episodes/100,000 person-years)
- Increase in the elderly population
- Sclerosis and aging also predispose to endocarditis

NATIVE VALVE ENDOCARDITIS

Diagnosis, Symptoms and Findings

- Fever/night sweat
- Predisposing factors
- Conjunctival petechiae
- Janeway lesions
- Roth spots
- Splinter hemorrhages
- Vegetations
- Regurgitations
- Complications of endocarditis (abscessive destruction)
- Pericardial effusion

Endocarditis may be manifested in many ways, many of which may be atypical. In the setting of infection, heart murmur or atypical symptoms, think of endocarditis. Early diagnosis saves lives.

Blood culture and other signs of infection (CRP, leukocytes, etc.) are equally important. A negative blood culture does NOT rule out endocarditis.

NOTES

Staph. aureus infection predisposes to abscess formation and complications of endocarditis!

MITRAL VALVE ENDOCARDITIS

- PLAX zoomed/2D

A vegetation is attached to the tip of the anterior mitral valve leaflet.
### Differential Diagnosis

- Fibrosis/calcification
- Myxomatous degeneration (e.g. mitral valve prolapse)
- Lambl's excrescence/strands
- Tangential imaging of structures
- Old vegetations
- Tumors/thrombi

### Indication for Transthoracic Echo in Suspected Endocarditis

**Clinical Suspicion of Endocarditis**

- **TTE**
  - Prosthetic valve, intercardiac device
  - Poor quality TTE
  - Positive
  - Negative (Persistent clinical suspicion)
    - **High**
    - **Low**
    - **Stop**

If the initial TEE is negative but endocarditis is still suspected, repeat TEE within 7–10 days.

**ESC guidelines 2009**
NATIVE VALVE ENDOCARDITIS

What Else to Look For?

- Involvement of other valves
- Regurgitations and resulting volume overload
- Myocardial function (right + left)
- Pericardial/pleural effusion
- Valve obstruction (large vegetations, rare)
- Coronary embolization of vegetation leading to wall motion abnormalities (rare)

COMPLICATIONS OF NATIVE VALVE ENDOCARDITIS

Complications

- Embolism
- Valve destruction
- Regurgitation/heart failure
- Abscess
- Pseudoaneurysm
- Perforation
- Fistula
- Mycotic aneurysm

Types of Valve Destruction

MV perforation

Fistula

Valve perforation is a hole in the cusp or leaflet which appears as an interruption in endocardial tissue continuity, best seen with color Doppler. In contrast, a fistula is a communication with neighbouring cavities that does not directly involve the valve (for instance, between the aorta and the left atrium).

Pseudoaneurysm – intervalvular fibrosa

MV pseudoaneurysm

Pulsatile perivalvular (echo-free) cavity communicating with the cardiovascular lumen.

NOTES

“Healing” usually leads to some degree of fibrosis or calcification of the affected valve.

Embolization is the primary manifestation of endocarditis in 28–47% of all patients. The risk of embolization depends on the size (>10 mm) and mobility of the vegetation. Exclude endocarditis in the setting of stroke and fever.
COMPLICATIONS OF NATIVE VALVE ENDOCARDITIS

Types of Valve Destruction

**AV ring abscess**
- Perivalvular cavity filled with infectious material which has a non-homogeneous (echodense/echolucent) appearance

**MV annular abscess**

**AV cusp rupture**
- Tear in the aortic cusp or chordal rupture, which usually leads to eccentric regurgitation jets.

**MV flail leaflet**

_PSEUDOANEURYSM IN AV ENDOCARDITIS – TEE long-axis view/2D_

A pulsating cavity surrounds the aortic valve (pseudoaneurysm). Numerous vegetations are present at the aortic cusps.
RIGHT HEART ENDOCARDITIS

Causes of TV Endocarditis

- Intravenous drug abuse
- Immunocompromised
- Indwelling catheters
- Pacemaker
- Pulmonic abscess + drug abuse + new heart murmur.

Tricuspid Valve Endocarditis – Facts

- The most common organisms are Staphylococcus aureus (60–80%) and Pseudomonas.
- Pulmonary hypertension, pulmonary embolism or tricuspid regurgitation may result in right heart failure.
- The prognosis is relatively good (10% inhospital mortality), but is poor in fungal infection.
- High recurrence rates.
- Endocarditis frequently causes a flail tricuspid valve leaflet.
- Tricuspid valve endocarditis may also occur in patients without predisposing factors.
- Valvar destruction
- Septic pulmonary embolism
- Lung abscess

Complications

- Valve destruction
- Involvement of neighbouring cardiac structures
- Septic pulmonary embolism
- Lung abscess

PROSTHETIC VALVE ENDOCARDITIS

Risk Factors

- Heart failure
- Wound complications
- Direct contamination during cardiac surgery
- Valve degeneration
- Prior history of endocarditis
- Prosthesis thrombi (super-infection)

Differential Diagnosis

- Artefacts
- Subvalvular residuals
- Surgical materials
- Strands
- Thrombus
- Hematoma

compare your findings with previous studies.

NOTES

Tricuspid valve endocarditis is very likely in patients with pulmonic abscess + drug abuse + new heart murmur.

Use atypical views to image tricuspid valve endocarditis and also look for pleural effusion (secondary to pulmonary infection).

Tricuspid valve vegetations may become very large.

Prosthetic valve endocarditis is difficult to detect. Transesophageal echo is recommended in case of suspicion. Find out which operation was performed, talk to the surgeon. Surgical material such as suture material or patches may mimic endocarditis.
NOTES

Prosthetic valve endocarditis is a life-threatening condition and is associated with a poor prognosis.

PERIANNUlar PROStHETIC VALVE ABSCESS – TEE short-axis/2D
The echodense area surrounding the prosthesis corresponds to a periannular abscess. Additionally, a large vegetation is seen on the rim of the cusps.

PACemaker/polvemer-ASSOCIATED ENDOCARDITIS

Pacemaker lead infection is difficult to diagnose. A negative study does not rule out endocarditis. Combine transthoracic and transesophageal echo to visualize as many portions of the leads as possible.

Clinical Presentation

• Fever, subfebrile (recurrent)
• Pulmonary embolism
• Local complications

• Septic shock (acute)
• Poor general condition

Typical Sites of Infection

• Vena cava superior
• Right atrium
• Tricuspid valve

• Tricuspid annulus

PROSTHETIC VALVE ENDOCARDITIS

Complications

• Periannular abscess
• Pseudoaneurysms
• Paravalvular leaks

• Valve dehiscence
• Valve obstruction
• Fistula

Predisposing Factors

• Pouch/Pocket infection
• Impaired immunity
• Systemic infection
• Temporary pacing before implantation

• Diabetes
• The surgeon’s experience
• Advanced age

Typical Sites of Infection

• Vena cava superior
• Right atrium
• Tricuspid valve

• Tricuspid annulus
PACEMAKER/POLYMER-ASSOCIATED ENDOCARDITIS

NOTES

CENTRAL LINE ENDOCARDITIS
– apical four-chamber view/2D & TEE bicaval view/2D

Central line with its tip in the right atrium. Mobile vegetation attached to the catheter (thickened tip) on transthoracic echo (left) and the adjacent wall (right) seen in TEE.

NON-INFECTIVE/ABACTERIAL ENDOCARDITIS

Types

• Marantic endocarditis
• Hypercoagulable state

• Libman-Sacks endocarditis
• Antiphospholipid syndrome

Echo Characteristics

• Valve thickening
• Mild or moderate regurgitation

• Small vegetations
• Pericardial effusion

Cardiac Manifestations of Libman-Sacks Endocarditis

• Valve thickening and vegetations
• Mural thrombus
• Spontaneous contrast

• Left + right ventricular dysfunction
• Pericardial effusion

LIBMAN-SACKS ENDOCARDITIS – apical three-chamber view/2D

Patient with lupus and antiphospholipid syndrome. Several small vegetations are seen on the mitral valve.
## INDICATIONS FOR SURGERY

### ESC Guidelines 2009

**Recommendations for Surgery in Infective Endocarditis (IE)**

<table>
<thead>
<tr>
<th>Heart Failure</th>
<th>Timing</th>
<th>Class</th>
<th>Level</th>
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<td>Aortic or mitral IE with severe acute regurgitation or valve obstruction, causing refractory pulmonary edema or cardiogenic shock</td>
<td>Emergency</td>
<td>I</td>
<td>B</td>
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<tr>
<td>Aortic or mitral IE with fistula into a cardiac chamber or pericardium causing refractory pulmonary edema or shock</td>
<td>Emergency</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Aortic or mitral IE with severe acute regurgitation or valve obstruction and persistent heart failure or echocardiographic signs of poor hemodynamic tolerance (early mitral closure or pulmonary hypertension)</td>
<td>Urgent</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Aortic or mitral IE with severe regurgitation and no HF</td>
<td>Elective</td>
<td>Ila</td>
<td>B</td>
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### Uncontrolled Infection

- Locally uncontrolled infection (abscess, false aneurysm, fistula, enlarging vegetation)
  - Urgent
  - I
  - B

- Persistent fever and positive blood cultures > 7 – 10 days
  - Urgent
  - I
  - B

- Infection caused by fungi or multiresistant organisms
  - Urgent elective
  - I
  - B

### Prevention of Embolism

- Aortic or mitral IE with large vegetations and one or more embolic episodes despite appropriate antibiotic therapy
  - Urgent
  - I
  - B

- Aortic or mitral IE with large vegetations (>10 mm) and other predictors of complicated course of disease (heart failure, persistent infection, abscess)
  - Urgent
  - I
  - B

- Isolated very large vegetations (>15 mm)
  - Urgent
  - IIb
  - B