As an inflammatory disease of the interior heart lining, endocarditis mostly manifests in the area of the cardiac valves. In addition to that, an inflammation in the area of the atria or the ventricles is also possible. There can be both infectious and non-infectious causes. Mixed forms are possible as well. Rarely, endocardial-myocardial fibroses or medicament-induced cardiac valve changes occur.

Definition of Endocarditis

Endocarditis describes the inflammation of the inner membrane lining of the heart.

Epidemiology of Endocarditis

Frequency of endocarditis

In Western Europe, endocarditis has an incidence of roughly three cases out of 100,000 persons per year. Men are affected twice as often as women.
### Table 1: "Diagnosis data of hospitals in Germany, ICD10: B37.6 Candida-endocarditis" of the bill of health report of the state (GBE).

<table>
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<tr>
<td>Female</td>
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<td>11</td>
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<tr>
<td>Total</td>
<td>31</td>
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### Etiology of Endocarditis

#### Causes of endocarditis

In 45 – 65 % of all cases, **streptococci** are the cause of bacterial or infectious endocarditis. The second most frequently observed pathogens are **staphylococci**, with roughly 30 % of all cases, followed by **enterococci** (10 %). Also, other pathogens, including mycoplasma, chlamydia and fungi can trigger endocarditis, though they occur rather rarely.

Non-infectious endocarditis can be explained by **antigen-antibody reactions or immune complexes**. Examples are endocarditis rheumatic, after an infection with β-hemolyzing A-streptococci, or endocarditis Libmann-Sacks at systemic lupus erythematoses.

**Parkinson medications** or **ecstasy** can be the cause for medicament-induced cardiac valve changes.

### Classification of Endocarditis

#### Infectious endocarditis

Infectious endocarditis can be divided into **bacterial, viral and mycotic endocarditis**. With bacterial endocarditis, one has to further distinguish between an **acute and a subacute form** (endocarditis lenta).

#### Non-infectious endocarditis

Non-infectious endocarditis can be divided into three branches: **antigen-antibody reactions (endocarditis rheumatic), residue of immune complexes (endocarditis Libmann-Sacks)** and **cellular immune reaction (Löfler’s syndrome or endomyocarditis eosinophilica)**.
Further classification

Another classification can be made on the basis of localization of the endocarditis. Hereby, **endocarditis valvularis** in the area of the cardiac valves has to be distinguished from **endocarditis parietalis** in the area of the walls of the atrium or the ventricles.

Pathophysiology of Endocarditis

Endocarditis at the cellular level

A **pre-existing lesion** of the heart, like a defective valvular apparatus, is always a risk factor for the **settlement of bacteria in the endocardium**. At defective locations of the endocardium, **platelet-fibrin thrombi** settle. For example, after **dental interventions or tonsillectomy**, the **blood** is circulated by bacteria which can easily settle at damaged areas like these thrombotic plaques. This is called **transitory bacteremia**.

In addition to the inflammation, destruction of the valves and the myocardium, as well as immune complex settlements and tissue destruction occur.

Symptoms and Clinic of Endocarditis

For the exam, extracardiac manifestations are especially important. Besides general symptoms like **fever** and **tachycardia**, **fatigue**, **loss of appetite** and **weight loss**, **cardiac murmur** and **signs of cardiac insufficiency** can occur on the cardiac level on auscultation. In roughly one third of the cases, **petechiae** can be found.

Also, splinter-bleedings under the nails, painful, reddish nodules on the fingers and the toes (**Osler’s nodules**, see left image) and, occasionally, clubbed fingers and hippocratic nails as well as Janeway-lesions can be symptoms. In the eyes, retinal bleedings (Roth spots) can appear.
The kidney can also be affected. Hematuria (see right image) and proteinuria can be present. Kidney infarction in the context of embolic events, diffuse glomerulonephritis, or glomerular focal nephritis can occur.

Course of Endocarditis

Different courses of endocarditis

With bacterial endocarditis, one can distinguish between an acute and a subacute (endocarditis lenta) form. Usually, the first form is due to a staphylococci infection with quickly progressive course, fever and shivers, tachycardia and clouded awareness, quick cardiac and renal insufficiency and multi-organ failure. If this form is not treated immediately, its course is usually lethal.

Typical pathogen of endocarditis lenta is Streptococcus viridans. The beginning of this form is insidious with unspecific fever. The course is slow and is accompanied with increasing cardiac insufficiency.

Diagnostic of Endocarditis

Options for diagnosing endocarditis

Besides anamnesis, where the physician has to inquire for previous interventions on the
patients with cardiac defects as well as for intravenous drug abuse and the overall clinical picture, transesophageal echocardiography (TEE) is also a part of the diagnostic procedure. With this method, valvular vegetations from 2 – 3 mm, and eventually present valvular defects, can be detected.

Note: Gold standard is the preparation of at least three pairs of aerobic and anaerobic blood cultures before start of therapy!

Diagnosis of bacterial endocarditis

For diagnostic of bacterial endocarditis, the Duke criteria are suitable. If two primary criteria, or one primary criterion and three secondary criteria, or five secondary criteria, are present, infectious endocarditis is probable.

The primary criteria include:

- At least two positive blood cultures with typical pathogens before start of antibiotic therapy.
- Positive echocardiography finding.

The secondary criteria include:

- Fever over 38 °C.
- Predisposing factors.
- Immunological phenomenons like Osler's nodules or glomerulonephritis.
- Serological detection of a germ, which does not meet the requirements for a primary criterion.
- Echocardiography finding, which suggests endocarditis, but does not meet the requirements for a primary criterion.

Therapy of Endocarditis

Treatment of endocarditis

Mainly, therapy depends on the pathogen. If it is unknown, one should follow the calculated initial therapy and adjust it if an antibiogram is available.

For treatment of native-valve endocarditis or a valve prosthesis surgery, which has been performed more than 12 months in the past, the application of ampicillin with sulbactam and gentamicin or amoxicillin with clavulanic acid and gentamicin and ciprofloxacin is recommended.

If the valve prosthesis surgery has been performed less than 12 months ago, the combination of vancomycin, gentamicin and rifampicin is obligatory. For patients that are allergic to β-lactam-antibiotics, the combination of vancomycin, gentamicin and ciprofloxacin is recommended.

Prophylaxis of Endocarditis

For prophylaxis of endocarditis there are several indications. Those include patients with valve replacement or reconstructed valves, patients who have already overcome endocarditis and patients with inherent cardiac defects.
Indications for endocarditis

Situations in which endocarditis is indicated are **dental interventions** like tooth extractions, periodontal interventions and **interventions in the respiratory tract** like adenotomies and tonsillectomies, even if the patients do not exhibit a manifested infection.

If the patients already have manifested infections, **interventions in the gastrointestinal and urogenital tract or on the skin and dermal appendage tissues** represent indications for **endocarditis prophylaxis**, which should correspond to the pathogen if possible. Also, prophylaxis is always indicated just before surgery in the context of **cardiac surgical interventions**.

Review Questions

The answers can be found below the references.

1. **Which pathogens most frequently cause bacterial endocarditis?**
   - A. Streptococci
   - B. Staphylococci
   - C. Enterococci
   - D. Chlamydia
   - E. Clostridia

2. **Which of the following symptoms is least typical for endocarditis?**
   - A. Fever
   - B. Tachycardia
   - C. Petechiae
   - D. Osler’s nodules
   - E. Pulsus paradoxus

3. **Which of the following antibiotic combinations is most suitable for treating artificial valve endocarditis?**
   - A. Vancomycin, Gentamicin, Rifampicin
   - B. Ampicillin, Sulbactam, Gentamicin
   - C. Amoxicillin, clavulanic acid, Gentamicin
   - D. Ampicillin, Sulbactam, Rifampicin
   - E. Amoxicillin, clavulanic acid, Rifampicin

References

ALLEX Alles fürs Examen Band A – Thieme 2012
Duale Reihe: Innere Medizin, 3. Auflage – Thieme 2013
Endokarditis via DocCheck Flexikon
Herold, Gerd u.a.: Innere Medizin 2014

**Correct answers:** 1B, 2E, 3A