Endocarditis

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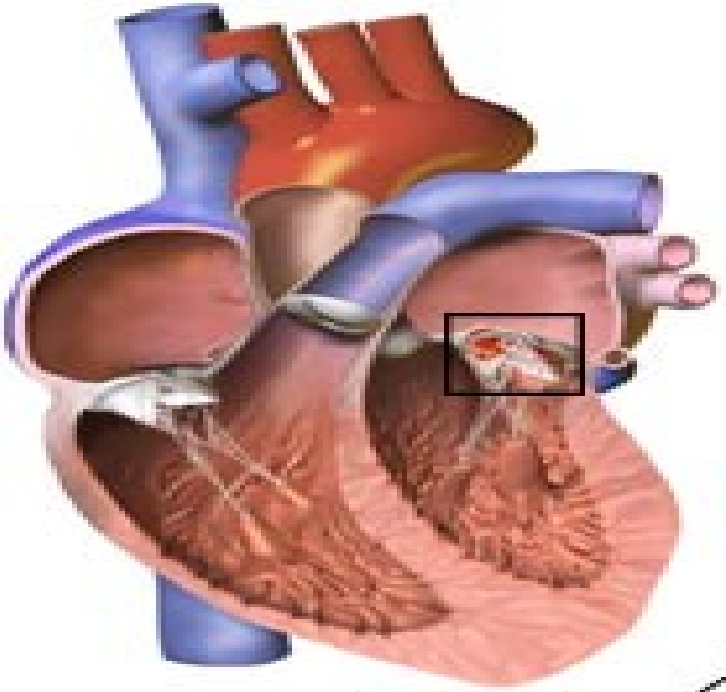
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Definition

- Infection of the endocardial surface of the heart, which may include one or more heart valves, the mural endocardium, or a septal defect.

Endocarditis

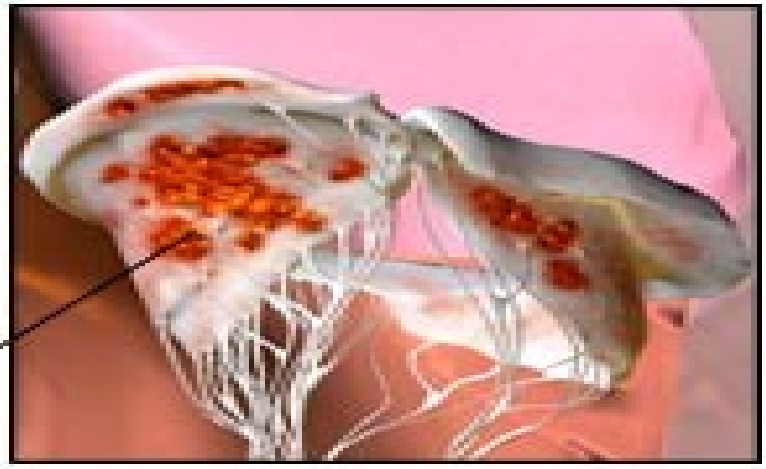
An infection of the innermost layers of the heart. It may occur in people with congenital and valvular diseases, and those who have had rheumatic fever.



Healthy valve



Infected valve



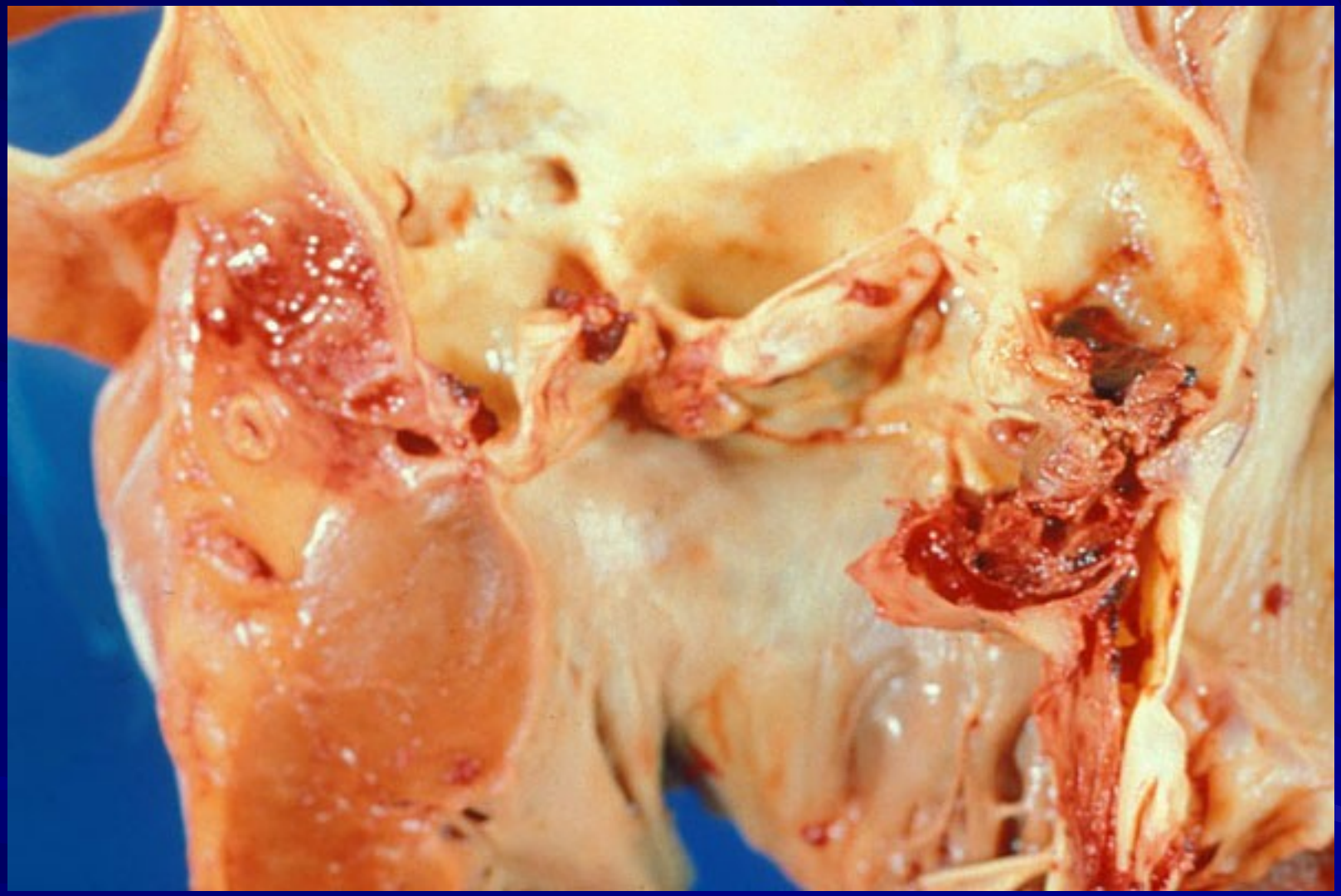
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Classification

- Native valve (acute and subacute) endocarditis
- Prosthetic valve (early and late) endocarditis
- Endocarditis related to intravenous drug use

Pathophysiology

- A high-velocity flow through a stenotic or incompetent valve or an abnormal communication between systemic and pulmonary circulations causes turbulence downstream from the opening.
- This turbulence damages or denudes the endothelium, to which platelets and fibrin adhere, and a small, sterile thrombus forms.
- In addition, indwelling intravascular catheters in the right heart may directly traumatize the endocardium or valvular endothelium.
- Circulating bacteria and inflammatory cells adhere to and grow in these thrombi, forming an infected vegetation.
- Infection may occur
  - (1) on the wall, where the turbulent jet strikes, or
  - (2) downstream, near the orifice, where the flow eddies.
- Once vegetation forms, the constant blood flow may result in embolization to virtually any organ in the body. A brisk immunologic response is produced.



Incidence

- **In the US:** Incidence is 1.4-4.2 cases per 100,000 people per year.
- **Internationally:** Incidence of disease appears to be similar throughout the developed world.

Mortality/Morbidity

- Due to secondary congestive heart failure (CHF).
- Improved general health care, improved dental care, early treatment, and antibiotic prophylaxis have decreased the mortality rate.
- High risk of complications:
  - prosthetic valve endocarditis,
  - left-sided endocarditis,
  - infection with *Staphylococcus aureus* or fungi,
  - previous endocarditis,
  - cyanotic congenital heart disease,
  - systemic-to-pulmonary shunts,
  - poor response to antibiotic therapy.

Age

- Bacterial endocarditis is most frequently observed in adults, but the incidence in children with congenital heart disease or central indwelling venous catheters continues to rise.

History

- Symtoms due to bacteremia, local cardiac invasion by organisms, peripheral embolization, and the formation of immune complexes.
- nonspecific symptoms; however, 85-99% of patients are febrile.
- fatigue, chills, sweats, anorexia, malaise, a cough, a headache, myalgia and/or arthralgia, and confusion.
- Patients with acute bacterial endocarditis present with an acute, toxic, febrile illness and symptoms that have lasted less than 2 weeks. A history of intravenous (IV) drug use may be elicited. *S aureus* is the most common cause of acute bacterial endocarditis.
- Patients with subacute bacterial endocarditis present with a more nonspecific flulike illness and symptoms that have lasted more than 2 weeks.

Physical

- nonspecific and varied. Fever is present in 85-99% of patients with endocarditis. Fever is usually low grade with a temperature rarely exceeding 39°C, remittent, and typically not associated with rigors.
- A new or changing heart murmur is noted in 20-80% of patients.
- Neurologic abnormalities occur in approximately 30-40% of patients and are most frequent in endocarditis caused by *S aureus.*
- Peripheral symptoms may be observed.
  - Petechiae are the most common of these symptoms (20-40%).
  - Splinter and subungual hemorrhages
  - Osler nodes are small, tender, subcutaneous nodules
- Acute heart failure may be due to valve destruction or distortion and/or rupture of the chordae tendineae.
- Hepatosplenomegaly is noted in approximately 15-20% of patients.
- Renal insufficiency, as a result of immune complex–mediated glomerulonephritis, occurs in less than 15% of patients with endocarditis and may cause hematuria but rarely azotemia.
- In neonates, endocarditis commonly produces septic embolic phenomena, such as osteomyelitis, meninigitis, and pneumonia.



Diagnosis/Duke criteria

- Major criteria
  - Positive blood cultures (2 separate cultures for a typical endocarditis microorganism, such as *Streptococcus viridans* or HACEK organism [*Haemophilus parainfluenzae, Haemophilus aphrophilus, Haemophilus paraphrophilus, Actinobacillus actinomycetemcomitans, Cardiobacterium hominis, Eikenella corrodens,* or *Kingella* species], persistently positive blood cultures, or evidence of infection with a *Coxiella* organism and/or Q fever)
  - Positive echocardiographic findings (eg, oscillating mass and/or vegetation, paravalvular abscess, or dehiscence of a prosthetic valve)
  - New valvular regurgitation
- Minor criteria
  - Predisposition (history of IV drug use or congenital heart disease)
  - Fever with a temperature >38°C
  - Vascular phenomena (arterial emboli, septic pulmonary infarcts, intracranial hemorrhage, conjunctival hemorrhage, Janeway lesions [painless, hemorrhagic lesions on palms and soles])
  - Immunologic phenomena (glomerulonephritis, Osler nodes, Roth spots, positive result for rheumatoid factor)
  - Positive blood cultures without meeting the criteria above or serologic evidence of active infection consistent with endocarditis

Causes

- High-risk conditions
  - Congenital heart disease (septal defects, valve disease, cyanotic heart disease)
  - Acquired valve disease
  - Prosthetic valve
  - IV drug use
  - Previous episode of bacterial endocarditis
  - Surgical systemic to pulmonary shunts and conduits
  - Central venous catheters
- High-risk procedures Dental procedures (extractions, implants, root canals)
  - Respiratory procedures (tonsillectomy and adenoidectomy, surgical operations, bronchoscopy)
  - GI procedures (sclerotherapy, biliary tract surgery, endoscopic retrograde cholangiopancreatography [ERCP])
  - Genitourinary tract (prostatic surgery, cystoscopy, urethral dilation)

Microbiology

- Gram-positive organisms, particularly alpha-hemolytic streptococci (*S vifidans*), *S aureus,* and coagulase-negative staphylococci, are the most common offenders.
- Enterococci are rare but dangerous causative organisms because they often are highly resistant to antibiotic treatment.
- *Haemophilus, Actinobacillus, Cardiobacterium, Eikenella,* and *Kingella* species (HACEK organisms) are particularly common in neonates and immunocompromised children.
- Fungal endocarditis is a severe disease with poor prognosis. Complications are common.

- Culture-negative endocarditis occurs when a patient has typical clinical or echocardiographic findings of endocarditis, with persistently negative blood cultures. Common causes include recent antibiotic therapy or infection caused by a fastidious organism that grows poorly in vitro.

Differentials

- Acute Lymphoblastic Leukemia
  Acute Myelocytic Leukemia
  Arthritis, Septic
  Endocarditis, Fungal
  Fever in the Toddler
  Fever in the Young Infant
  Heart Failure, Congestive
  Kawasaki Disease
  Meningitis, Bacterial
  Myocarditis, Nonviral
  Pneumonia
  Rheumatic Fever
  Vasculitis and Thrombophlebitis

Lab Studies

- The most definitive laboratory tests are multiple blood cultures that grow an organism known to cause endocarditis.
  - Blood cultures should be obtained from all high risk patients.
  - 3 separate samplings within 1-24 hours is recommended, according to the clinical presentation.
  - Venous blood samples should be obtained from different peripheral sites.
  - The microbiology laboratory should be notified of the clinical suspicion for endocarditis.
  - If no growth is observed by the second day of incubation, 2 more blood cultures should be obtained.
  - Blood cultures should be repeated during therapy to demonstrate clearance of bacteremia.
- Other laboratory studies include a FBC, measurement of the (ESR) and C-reactive protein level, test for rheumatoid factor, and urinalysis.
  - Anemia is present in 70-90% of patients and is usually normocytic and normochromic. Leukocytosis is noted in 20-30% of patients.
  - ESR is elevated in almost all patients except for those with CHF, renal failure, and disseminated intravascular coagulation (DIC).
  - A positive rheumatoid factor is observed in 40-50% of patients with endocarditis of more than 6 weeks' duration. Immune complexes are also observed in patients with prolonged disease.
  - Urinalysis may show proteinuria (50-60%) and/or microscopic hematuria (30-50%).

Imaging

- Echocardiography is the primary modality for detecting endocarditis in patients in whom the diagnosis is suspected. In fact, echocardiographic features suggestive of infectious endocarditis are considered major criteria for confirming the diagnosis (see the modified Duke criteria above). Typical findings include vegetations, abscesses, and new valvular insufficiency.
  - Transthoracic echocardiography (TTE) has a greater sensitivity in infants and children than in adults. Reported sensitivity is as high as 81%.
  - Transesophageal echocardiography (TEE) is occasionally required when transthoracic acoustic windows are inadequate.
- MRI has identified paravalvular extension of infection, aortic root aneurysms, and fistulas. Its utility relative to echocardiography has not been widely established.

Medical Care

- complete eradication of the organism is required. Treatment ranges from 4-8 weeks.
- Therapy is tailored according to the etiologic agent.

Surgical Care

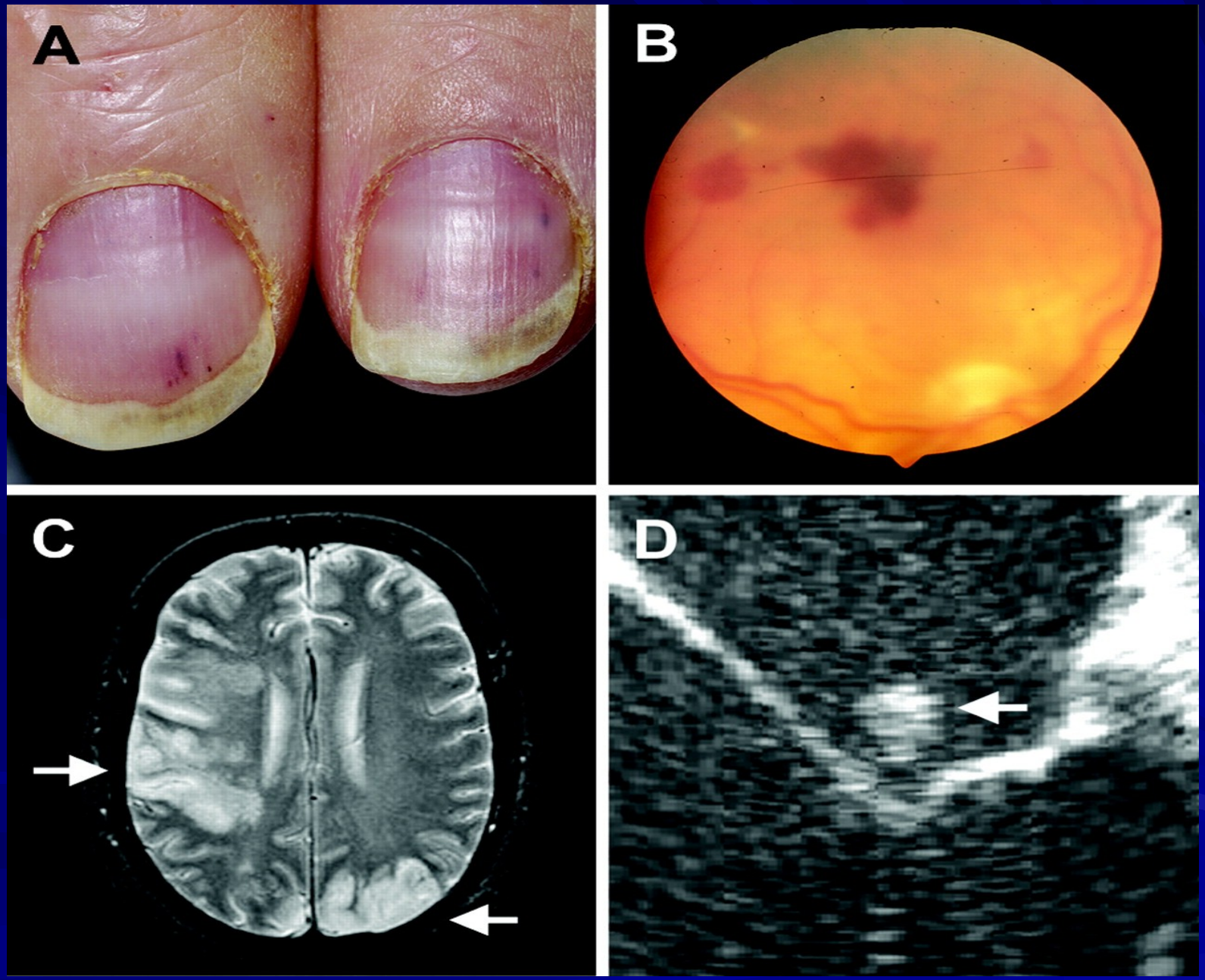
- Absolute indications for surgery include
  - progressive cardiac failure,
  - valve obstruction,
  - definitive perivalvular abscess,
  - noncandidal fungal infection,
  - pseudomonal infection.
  - Relative indications include persistent bacteremia despite appropriate antibiotic therapy, candidal endocarditis, and very large vegetations >10 mm.
- Surgery should be performed without delay in patients with severe CHF secondary to valvular regurgitation. Surgery for patients who have had a recent neurologic injury should be evaluated and possibly delayed to make modifications to avoid intracranial hemorrhage.

Complications/Cardiac

- Cardiac complications include
- heart failure,
- valvular disease,
- valve ring abscess,
- myocardial disease or abscess,
- conduction abnormalities (including arrhythmia or heart block), and
- pericardial disease.
- In rare cases, coronary artery embolic events can occur.

Extracardiac complications

- Embolic complications:
  - splenic emboli with infarction or abscess,
  - embolization to the pulmonary artery, and
  - emboli to the femoral artery, resulting in extremity pain and decreased pulses.
- Mycotic aneurysms occur in 10-20% of patients with endocarditis. They are often multiple and may involve any vessel.
- Vasculitis may result from circulating immune complexes that may deposit in various endothelial surfaces. Local complement activation appears to generate an immune response that causes vascular injury.
- Cutaneous manifestations include petechiae, Osler nodes, Janeway lesions, and splinter hemorrhages.
- Neurologic syndromes include cerebral embolism, infarction, and intracerebral hemorrhage and stroke. Seizures, meningitis, and mental status changes have also been reported.
- Renal embolism and infarction is the most common renal lesion in patients with bacterial endocarditis. This complication may result in pain in the flank or abdomen but may be asymptomatic in as many as 50% of cases.


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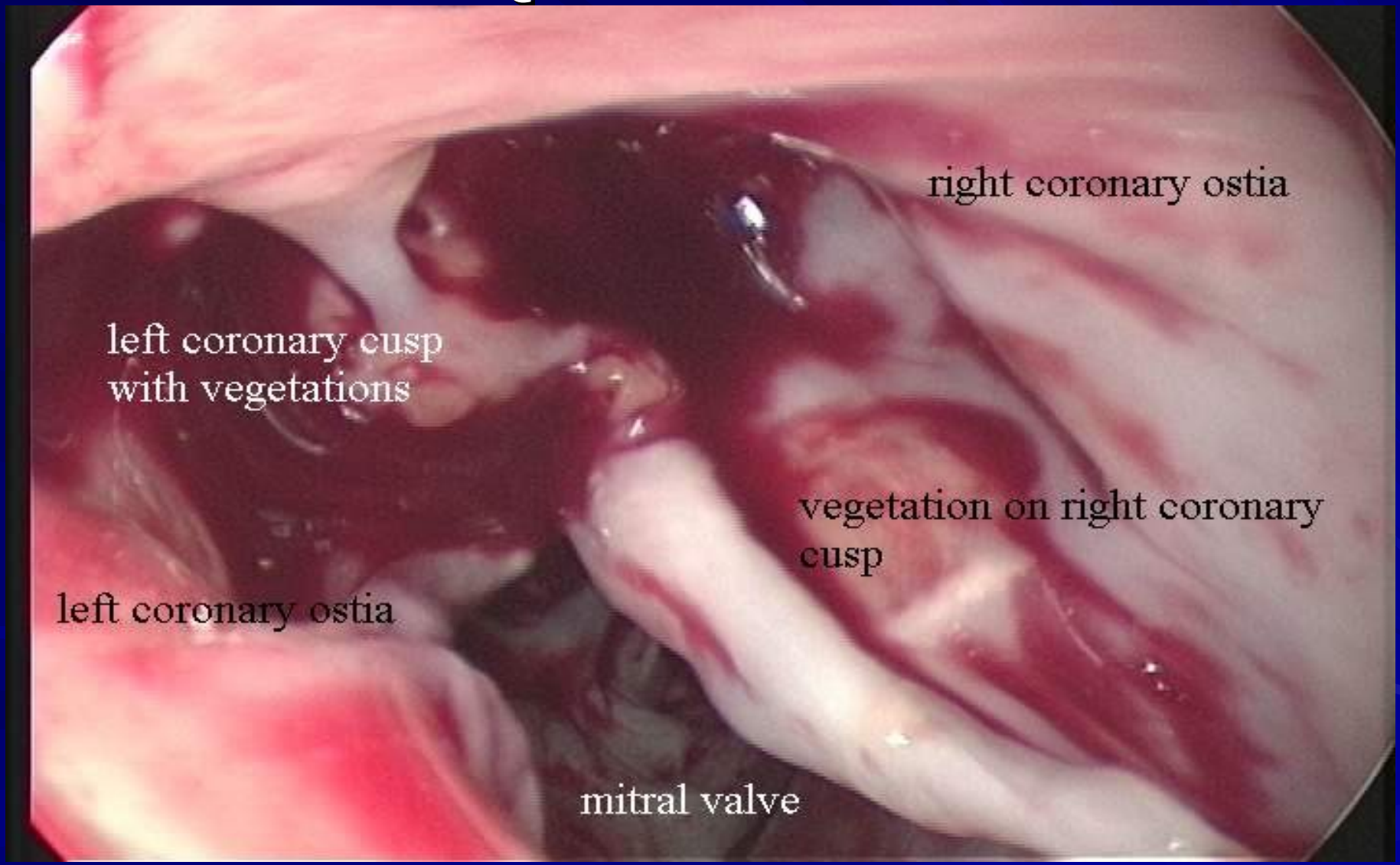
Prognosis

- The prognosis of bacterial endocarditis varies with the etiologic agent. Infection by a penicillin-sensitive *Streptococcus,* diagnosed early, has a cure rate of almost 100%.
- Because many infections are diagnosed late or due to resistant organisms, the average mortality rate is approximately 20-25%

Patient Education

- Patient and parent education is critical to ensure appropriate antimicrobial prophylaxis before high-risk procedures are performed in children with congenital heart disease.

Questions?


right coronary ostia
left coronary cusp
with vegetations
vegetation on right coronary
cusp
left coronary ostia
mitral valve