



Chapter 83 – Infective Endocarditis and Valvular Disease

Episode Overview:

1. List 6 risk factors for bacterial endocarditis
2. List 5 common bacteria responsible for infective endocarditis
3. Give three examples of immunologic sequelae of infective endocarditis
4. Give three examples of vascular sequelae of infective endocarditis
5. What are the diagnostic criteria for endocarditis, and how are they used?
6. List 5 lab or investigative findings in bacterial endocarditis
7. Describe the treatment of infective endocarditis
8. List four complications of IE
9. List the indications for infectious endocarditis prophylaxis. What are the empiric antibiotics used for patients with suspected infectious endocarditis?
10. Describe the Jones Criteria for Acute Rheumatic Fever
11. What is the treatment of rheumatic fever
12. Name three causes of acute mitral regurgitation
13. How is acute mitral regurgitation managed?
14. What is the pathophysiology of mitral valve prolapse? How does it present?
15. List four causes of mitral stenosis.
16. List four causes of aortic valve insufficiency.
17. List 3 physical exam findings associated with AS
18. What is critical aortic stenosis? Outline the ED management for a patient with critical aortic stenosis with CHF and hypotension.
19. List 5 complications of prosthetic valves.

WiseCracks

1. Describe
 - a. Janeway lesions
 - b. Osler nodes
 - c. Splinter hemorrhages
 - d. Roth Spots
2. What are the HACEK organisms, and what is their significance in patients with IE?
3. Brief rundown of all valvular disease - in one or two lines.

Infective Endocarditis

Principles of Disease

- increasingly becoming a disease of the aged: most cases in people > 60 yrs old
 - Other high risk groups: nosocomial infections, degenerative valve disease, prosthetic heart valves

Pathophysiology

- initiated by a sterile thrombus on the heart/valve to which microorganisms attach
- usually a cardiac valve, but can also affect:



- chordae tendinae, septal defects, endocardium, etc.
- in IVDU contaminants such as talc injure the valve leaflets - which make them more prone for bacterial seeding
- precipitants causing transient bacteremia can occur (endoscopy, dental work, colonoscopy etc.) in the susceptible host

Valvular heart disease

Anatomy:

- Three have three cusps (tricuspid, pulmonic, aortic)
- mitral - only two cusps.
- each cusp:
 - double layer of endocardium attached at its based to the fibrous skeleton of the heart.
 - margins of the cusps attached via chordae tendineae to the papillary muscles
 - ventricular contraction opens and closes the valves.

1) List 6 RFs for bacterial endocarditis

- predisposing factors for bacterial IE (Box 83-4):
 - calcific/degenerative aortic/mitral valves
 - Rheumatic heart disease
 - congenital cardiac lesions either repaired or unrepaired
 - (VSD, pulm stenosis, TEt. of fallot, palliative conduits,)
 - cardiac valve disease in a TRANSPLANTED heart
 - **mitral valve prolapse***
 - IVDU (right sided endocarditis)
 - prosthetic valve
 - history of endocarditis
- Break this list down into:
 - Cardiac
 - Non-cardiac: IVDU, indwelling IV catheters, immunosuppression, recent dental/surg. Procedure.

2) List 5 common bacteria responsible for infective endocarditis

- Most common microorganisms (Table 83-1):
 - **Staphylococcus aureus (30%)**
 - **Strep. Viridans - 18%**
 - enterococci - 10%
 - Coag-negative staph. - 10%
 - Strep. Bovis
 - Other strep.
 - non-HACEK gram negative bacteria
 - Fungi (candida, aspergillus)
 - HACEK



- *haemophilus, actinobacillus, cardiobacterium, eikenella, kingella*
- Polymicrobial
- Culture negative - 8%

3) Give three examples of immunologic sequelae of infective endocarditis

Clinical Features:

- **intermittent fever**
- **Osler nodes / roth spots / rheumatoid factor**
- **Malaise, chills, anorexia**
- non specific : weakness, myalgias, back pain, dyspnea, chest pain, cough, h/a
- murmur usually absent in EARLY disease
 - *present in < 30%*

4) Give three examples of vascular sequelae of infective endocarditis

- **Osler nodes**
- **Splinter hemorrhages**
- **Janeway lesions**
- **Roth spots**
- **Splenomegaly**

- watch for **stroke like symptoms and fever**
 - Can have emboli anywhere!
 - CRAO
 - Pneumonia
 - MI
 - Intestinal infarcts

- "classic" symptoms are rare:
 - unexplained fever,
 - osler nodes, janeway lesions, petechiae, splinter hemorrhages, glomerulonephritis, splenomegaly, retinal hemorrhages, roth spots



5) What are the diagnostic criteria for endocarditis, and how are they used?

Box 83-1

Duke Criteria (Clinical) for Diagnosis of Infective Endocarditis

Definite Endocarditis

Endocarditis is considered definitely present if any one of the following combinations of clinical findings is present:

- Two major clinical criteria
- One major and any three minor clinical criteria
- Five minor clinical criteria

Possible Endocarditis

Possible endocarditis is defined as the presence of any one of the following combinations of clinical findings:

- One major and one or two minor clinical criteria
- Three minor clinical criteria

Rejected Endocarditis

The diagnosis of endocarditis is considered rejected if any of the following occurs:

- A firm alternate diagnosis is made.
- Resolution of clinical manifestations occurs after 4 days of antibiotic therapy or less.
- Clinical criteria for possible or definite infective endocarditis not met.

Major Criteria

Positive blood cultures (of typical pathogens) from at least two separate cultures

Evidence of endocardial involvement by echocardiography, such as the following:

- Endocardial vegetation
- Paravalvular abscess
- New partial dehiscence of prosthetic valve
- New valvular regurgitation

Minor Criteria

Predisposition: Predisposing heart condition or intravenous drug use

Fever: Temperature $>38^{\circ}\text{C}$

Vascular phenomena: Arterial emboli, septic pulmonary infarcts, mycotic aneurysm, conjunctival hemorrhages, or Janeway lesions

Immunologic phenomena: Osler's nodes, Roth's spots, and rheumatoid factor

Microbiologic evidence: Single positive blood culture (except for coagulase-negative *Staphylococcus* or an organism that does not cause endocarditis)

Echocardiogram findings: Consistent with endocarditis but do not meet major criteria



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Modified Duke criteria for diagnosis of infective endocarditis - Table A

Definite IE is established in the presence of any of the following:
Pathologic criteria
Pathologic lesions: vegetation or intracardiac abscess demonstrating active endocarditis on histology OR
Microorganism: demonstrated by culture or histology of a vegetation or intracardiac abscess
Clinical criteria
Using specific definitions listed in Table B:
2 major clinical criteria OR
1 major and 3 minor clinical criteria OR
5 minor clinical criteria
Possible IE*
Presence of 1 major and 1 minor clinical criteria OR presence of 3 minor clinical criteria
Rejected IE
A firm alternate diagnosis is made OR
Resolution of clinical manifestations occurs after ≤ 4 days of antibiotic therapy OR
No pathologic evidence of infective endocarditis is found at surgery or autopsy after antibiotic therapy for four days or less
Clinical criteria for possible or definite IE not met

IE: infective endocarditis.

* The category of possible IE represents a modification from the previous published Duke criteria.

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- The DUKE Criteria!
 - Definite
 - Unlikely ...but it's still possible
 - KNOT endocarditisrejected!! = DUKE
- Three categories:
- And Major and minor criteria

	Definite	Possible	Rejected
Major Criteria: 1. >2 cultures positive for typical pathogens 2. ECHO findings a. endocardial Vegetation b. paravalv. abscess c. new dehiscence of a prosthetic valve d. new valve. regurg	<ul style="list-style-type: none"> ● 2 major ● 1 mj + 3 min ● 5 minor 	<ul style="list-style-type: none"> ● 1 mj + 1-2 min ● 3 minor 	<ul style="list-style-type: none"> ● resolution of clinical manifestations after 4 days of ABX ● criteria aren't met
Minor Criteria: 1. predisposition 2. Fever 3. VAscular phenomena 4. Immunologic			



phenomena 5. Micro. evidence 6. Echo. findings other than above			
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Caveats: they were designed for people with native heart valves; thus they are less sensitive in prosthetic valve IE, right sided IE, or cardiac devices.

6) List 5 lab or investigative findings in bacterial endocarditis

Diagnostic Strategies:

- usually nonspecific
 - leukocytosis, CRP elevated, anemia, microscopic hematuria,
 - abnormal CXR or ECG
- ****need three (3) blood cultures from separate sites****
- TTE non-diagnostic in 20% of people (60% sens)
- TEE much better
- Duke Criteria are the best:
 - 95% sens, 99% spec.

Don't forget about the culture negative IE patient - the patient with negative blood cultures and persistent fevers AND at least one or more clinical findings of IE. This category also includes people with ECHO findings of vegetations on echo.

7) Describe the treatment of infective endocarditis

Box 83-2 Initial Empirical Therapy for Bacterial Endocarditis³⁸

Native Valve
 Penicillin G 4 million units IV q4h + nafcillin 2 g IV q4h
Or
 Vancomycin 15 mg/kg IV q12h
Plus
 Gentamicin 1 mg/kg IV q8h

Native Valve (+ Injection Drug Use)
 Vancomycin 15 mg/kg IV q12h

Prosthetic Valve
 Vancomycin 15 mg/kg IV q12h
Plus
 Gentamicin 1 mg/kg IV q8h

IV, intravenously.

Ideally we treat based on culture results...



Native valve endocarditis is usually caused by a gram +ve organism; people with prosthetic valves require more elaborate antimicrobial regimens (i.e. involve ID and the cardiac surgeon!)

- empirical ED therapy:
 - Vancomycin 15 mg/kg IV q12hrs
 - esp. with history of IVDU!
 - Ceftriaxone 2 g IV
 - can also be exchanged with ampicillin and Gentamicin 1mg/kg IV q 8hrs
- Surgical therapy for IE - Box 83-3
 - IE + Acute heart failure
 - Fungal endocarditis
 - Periannular extension of infection
 - Recurrent emboli
 - Large. mobile vegetations
 - Persistent bacteremia

8) List four complications of IE.

1. Cardiac
 - a. Heart failure
 - b. Perivalvular abscess
2. Embolic
 - a. CVA
 - b. Blindness - due to CRAO
 - c. Pain syndromes from intestinal / cardiac infarctions
 - d. Metastatic infections (showered lung)
3. Neuro:
 - a. Stroke
 - b. Acute encephalopathy
 - c. Meningo-ecphalitis
 - d. Seizures
4. Renal
 - a. Infarction
 - b. Glomerular nephritis
5. MSK:
 - a. Vertebral osteomyelitis

9) List the indications for infectious endocarditis prophylaxis. What are the empiric antibiotics used for pts with suspected infectious endocarditis?

- Because the evidence for antibiotic prophylaxis is weak, the UK no longer recommends it. See: <http://heart.bmj.com/content/103/12/937>
- However, Rosen's doesn't cover it in much detail. They state that:



- all procedures routinely performed in the ED unless obviously stimulating an abscess or infection do NOT require prophylactic ABX in patients with prosthetic heart valves.

According to uptodate:

- High risk patients (anyone with foreign material in their heart or congenital heart disease or history of IE) should receive amoxicillin for most resp/GI/GU biopsy-like procedures, dental work, or SSTI's undergoing manipulation....

10) Describe the Jones Criteria for Acute Rheumatic Fever

So, we're shifting pace to talk about Rheumatic fever....let's take a quick dive into this rare disease before discussing the Jones criteria.

Rheumatic Fever

- dramatic decline since the 1920s
 - improved living conditions, use of abx,
- 2-4 cases per 100,000
- peds peak in 4-9 yr olds, 25-35 yr olds in impoverished areas

Principles of Disease

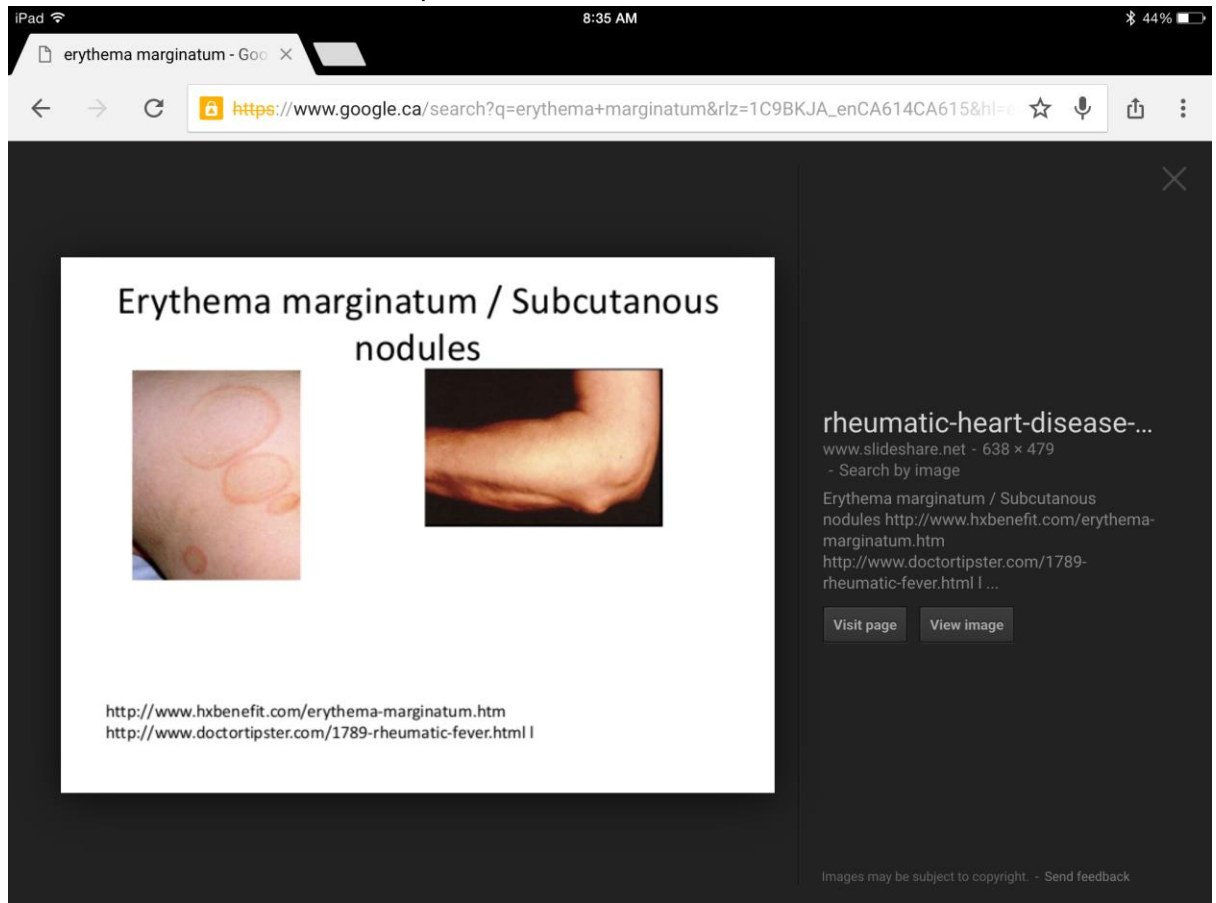
- delayed, NON-suppurative complication of Strep. pharyngitis
 - unknown pathogenesis
- Exaggerated immuno. response to Group A beta-hemolytic strep. --> antibodies cross reacting with tissues in the heart/joints/skin/CNS
- ***anyone with a hx of ARF are predisposed to recurrent infections and heart damage
- ARF does not equal RHD!
 - Rheumatic heart disease occurs 15-20 yrs post ARF as a type of acquired valvular disease

Clinical Features

- post initial pharyngitis:
 - latency period 1-5 weeks
 - then signs of ARF appear
 - >30% of people DON'T remember having pharyngitis
 - Fever,
 - Arthritis, carditis, chorea, SubCut nodules, erythema marginatum (<10% of cases)
 - **migratory polyarthritis**
 - affecting large joints (knees, ankles, elbows, wrists)
 - pain out of proportion
 - sterile inflammatory fluid
 - Cardiac manifestations
 - peri/myo/endo-carditis
 - Mitral valve regurg.
 - new high pitched systolic murmur
 - Sydenham Chorea (St Vitus' dance)



- random rapid purposeless movements of the upper extremities and face
- erythema marginatum: non pruritic, painless, smoke ring of erythema on trunk/extremities
- Nodules: painless



Diagnosis

- Jones Criteria:
 - Antecedent Strep infection PLUS:
 - >2 Mj criteria
 - 1 mj + 2 minor
 - Antistreptolysin antibody titres (ASO) (positive for 4-6 weeks)
 - Increased CRP
 - Prolonged PR interval



Box 83-5

Jones Criteria (Revised) for the Diagnosis of Acute Rheumatic Fever

Major Manifestations

Carditis
Polyarthrititis
Chorea
Erythema marginatum
Subcutaneous nodules

Minor Manifestations

Arthralgias
Fever
Increased erythrocyte sedimentation rate or C-reactive protein
Prolonged PR interval

Evidence of Preceding Streptococcal Infection

Positive throat culture for group A beta-hemolytic streptococci or positive rapid streptococcal antigen test
Elevated or rising streptococcal antibody titer, most often antistreptolysin O

11) What is the treatment of rheumatic fever

Management

- All people should receive ABX regardless of clinical history of pharyngitis
- Treatment:
 - Penicillin to eradicate group A beta-hemolytic streptococcus
 - IM one time dose or PO x 10 days
 - same treatment plan for adults and kids
 - Need to get source control
 - Arthritis
 - anti-inflammatory agents to treat the bad arthritis
 - ASA or naproxen for joint symptom relief
 - Steroids for severe carditis
 - Treatment of CHF using the standard treatment
- *****Treatment of ARF does NOT prevent progression to RHD!*****
- Prevention
 - treat those with Group A strep. Pharyngitis (and a previous history of ARF) **within 9 days** of the onset of symptoms
 - Or give Penicillin G every 28 days - for 5-40 years!

12) Name three causes of acute and three causes of chronic mitral regurgitation.



Acute

Idiopathic rupture
Ischemia induced papillary muscle dysfunction
Post-MI papillary muscle rupture
Infective endocarditis

Chronic

Dilated cardiomyopathy
RHD
MVP
Connective tissue disorder

13) How is acute and chronic MR managed?

Mitral Regurgitation

- Acute
 - emergency cardiac TEE and Cath.
 - Nitrates and diuretics
 - intra-aortic balloon pump

- Chronic
 - Management:
 - diuretics and afterload reducers
 - surgery

14) What is the pathophysiology of mitral valve prolapse? How does it present?

Mitral valve Prolapse:

- usually benign billowing of a leaflet during systole
- can be associated with
 - mitral regurg, endocarditis, arrhythmias
 - connective tissue dz.
- Symptoms
 - Chest pain, palpitations, dyspnea, lightheadedness, fatigue
- "auscultated click in midsystole"
- Management:
 - Beta-blockers
 - exercise,
 - relaxation techniques
 - usually a benign disease

15) List four causes of mitral stenosis



Mitral Stenosis

- #1 cause is Rheum. Heart disease (>85%)
 - symptoms develop after the latency period of 10-30 yrs post Group A strep. infection
- Another cause:
 - congenital mitral stenosis / annular calcification - aging, post-infection, degeneration
- Pathophys:
 - impeded LA --> LV flow leads to left atrial hypertension -- > decreased CO --> pulmonary congestion --> pulm. hypertension --> RV failure
 - #1 complication = A. Fib.
 - need to rate control
- Clinical features
 - dyspnea on exertion, dec. exercise tolerance
 - orthopnea
 - Classic (RARE) presentations: "hemoptysis, hoarseness"
 - Loud S1 with opening SNAP, low pitched rumbling diastolic apical murmur
 - CXR:
 - LAE
 - EKG: a fib, LAE, RVH
- Management:
 - "**SLOW AND FULL**"
 - diuresis for vasc. congestion
 - Anti-coag. for A fib,
 - Surgery
 - Treat Anemia, hypothyroidism, etc.

16) List four causes of aortic valve insufficiency

Aortic insufficiency

- **aka: aortic regurg.**
 - aortic valve doesn't close tightly so flow moves from aorta to LV
- caused by:
 - bicuspid valve, RHD, IE
 - ectasia, aneurysm, dissection
 - Elderly patient with hypertension causing scleroSis and dilation of the ascending aorTa.
- pathophysiology
 - LV compliance decreases, and LV pressure increases --> pulm congestion
 - mild pressure gradient between aorta and ventricle
- clinical features:
 - sx:
 - sound like aortic dissection/resp. distress/cardiogenic shock
 - need echo to diagnose
- management:
 - needs urgent valve replacement



- vasodilators
- diuretics

17) List 3 physical exam findings associated with aortic stenosis

Aortic stenosis

- #1 cause: calcific degeneration
 - in the elderly and CAD
 - other preconditions:
 - Bicuspid aortic valve
 - RHD
- significant reduction: valve area <50%,
- Clinical features:
 - Progression of symptoms: angina --> syncope --> CHF -->
 - Parvus et tardis - slow, rate of palpable rise in carotid pulse
 - Crescendo - decrescendo murmur, mid to late peaking
 - S4 gallop
 - Causing a reduced second heart sound.

18) What is critical aortic stenosis? Outline the ED management for a pt with critical aortic stenosis with CHF and hypotension.

- Critical stenosis valve area <0.8cm squared.
 - or ****Pressure gradient >50 mmHg*****
- compensated LVH can maintain CO until the stenosis becomes too severe!
 - then patients become
 - ****preload dependent with LITTLE reserve*****
 - need to delicately balance myocardial O₂ supply and demand
- Management:
 - judicious fluid resuscitation
 - blood transfusion
 - return to Sinus rhythm
 - **AVOID**
 - **nitrates**
 - **diuretics**
 - **inotropic agents**
 - Although dobutamine may be considered in a closely monitored setting.
 - need surgery
 - Slowly use diuretics and an ACE inhibitor if needed.

19) List 5 complications of prosthetic valves

- structural failure
 - rare
 - present in shock
- thrombosis of the valve



- CHF
- systemic embolization (thromboembolic)
 - avoided by higher INR goal of 2.5-3.5
 - usually CNS strokes
 - at high risk for hemorrhagic conversion
- hemolysis
 - hemolytic anemia due to sheer forces
 - fatigue, jaundice, dark urine, dyspnea,
- endocarditis
 - highest during the initial months post-op
 - early <60 days
- Vary based on valve type:
 - mechanical
 - bioprosthetic

WiseCracks:

1) Describe the following lesions

a. Janeway lesions

Non-tender erythematous macules on the palms and soles. They are micro-abscesses. Much more common than Osler's and Roth's spots (these were described in the pre-antibiotic era).

b. Osler nodes

Tender subcutaneous violaceous nodules usually on the pads of fingers and toes. (papulopustules)

c. Splinter hemorrhages

Non-blanching, linear, reddish brown lesions under the nail beds

d. Roth Spots

Exudative, edematous hemorrhagic lesions of the retina with pale centres.

2) What are the HACEK organisms, and what is their significance in patients with IE?

- HACEK
 - haemophilus, actinobacillus, cardiobacterium, eikenella, kingella
- These are rare <5-10%. They are fastidious gram -ve bacilli
- They occur in people with native valves, who DO NOT use IV drugs
- Historically hard to culture (>6 days needed, and thought to be the etiology in culture-negative IE), but now with automated blood culturing machines they can be cultured in 5 days or so.
- Susceptible to ceftriaxone

3) What are buzz-bizz features of all four valve diseases?

- Mitral stenosis
 - Rheumatic heart disease - keep them SLOW and FULL
- Mitral regurg:



- Sudden fulminant pulmonary edema (find out why!!)- reduce the afterload!
- Mitral valve prolapse:
 - Usually a benign disease - chill the heart out (beta blockers)
- Aortic regurg/insufficiency
 - Can acutely present in cardiovascular collapse and CHF - think about florid infective endocarditis or aortic dissection. These people need surgery! (Diuretics, and vasodilators in the mean time, maybe dobutamine!)
- Aortic stenosis:
 - Very common disease. Be very careful in suddenly dropping afterload or increasing it....all our go to agents are risky (diuretics, nitroglycerin, vasopressors)
 - Carefully sustain preload. Start low go slow - consider an ACE inhibitor and diuretic to slowly manage hypertension and. Symptoms.
- Right sided valve disease:
 - Tricuspid heart disease - usually age related degeneration, managed with diuretics
 - Pulmonic valve disease - rare!