



scottedams@aol.com

www.dilbert.com



11-29-03 © 2003 United Feature Syndicate, Inc.



Infective Endocarditis

David Stultz, MD

Cardiology Fellow, PGY 6

August 31, 2005

Topics to be covered

- Epidemiology
 - Microbiology
 - Clinical presentation
 - Physical Exam Findings
 - Diagnostic Imaging
- ❖ Overview of Treatment
 - ❖ Complications
 - ❖ Indications for Surgery
 - ❖ Prognosis
 - ❖ Pearls for the Boards

Tricuspid Valve Endocarditis



© 2003-2006, David Stultz, MD

Aortic Valve Endocarditis with leaflet perforation



Crawford

Epidemiology

- Incidence of 2.4-11.6 per 100,000 patient years
- Stable or increasing in incidence
- Higher incidence in urban populations
- Elderly at 4-6x risk
- Median age 47-69
- Male:Female ratio of about 2:1
- Up to 75% of patients with native valve involvement have identifiable risk factors

Risk factors for native valve endocarditis

- Rheumatic heart disease
- Congenital heart disease
- Mitral valve prolapse
- Degenerative heart disease
- Asymmetrical septal hypertrophy
- Intravenous drug abuse

Mitral Valve Prolapse

- High prevalence
 - 2-4% of general healthy population
 - 20% of young women
- 7-30% of Native valve endocarditis without IVD
- Relative risk of 3.5-8.2 for endocarditis
- **HOWEVER** – most risk is confined to patients with prolapse **AND** a mitral regurgitation murmur

Rheumatic Heart Disease

- Declining in incidence
 - 20-25% of endocarditis cases in 1970's
 - 7-18% of endocarditis cases in 1980's
- Commonly involves
 - Mitral valve in women
 - Aortic valve in men

Congenital Heart Disease

- Accounts for
 - 10-20% of endocarditis cases in young adults
 - 8% of cases in older adults
- Common lesions
 - Patent ductus arteriosus
 - Ventricular septal defect
 - Bicuspid aortic valve

Intravenous drug use

- Risk of endocarditis 2-5 per 100 patient years
 - Higher risk than rheumatic disease or prosthetic valve
- 65-80% of IVD endocarditis population is male
- Average age 27-37
- Commonly involves tricuspid valve (46-78% of cases)

Braunwald, 1724-25

- *S. Aureus* involved in over 50% of cases

Prosthetic Valves

- Account for 10-30% of all endocarditis cases
- Risk is greatest in first 6 months after implant
 - “Early” endocarditis occurs in first 60 days
- Incidence about 5% at 5 years
- Risk declines over time
- Mechanical valve has higher risk than bioprosthesis initially
- After 1 year bioprosthesis is more risky than mechanical valve

Microbiology in a nutshell

- Any pathogen can cause endocarditis
- Common organisms
 - *Strep viridians* – 28%
 - *Staph aureus* – 28%
 - Other *Strep* species – 23%
 - Coag negative *Staph* – 7%
 - Gram-negatives – 4%
 - Other – 5%
 - No growth – 5%
- Drug resistance seen more commonly in IV drug use

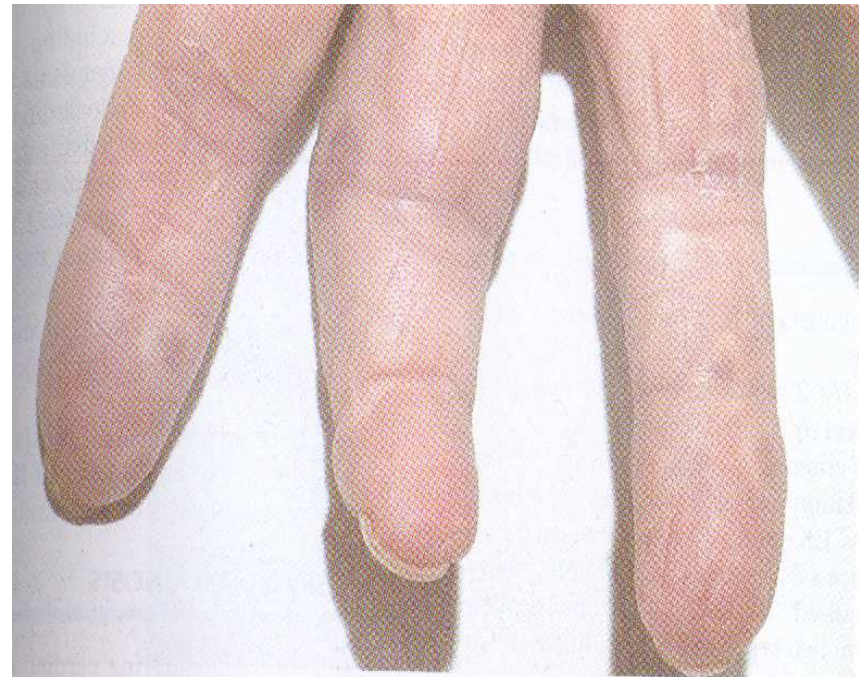
Clinical presentation

Nonspecific symptoms and signs

- Fever
- Mitral or aortic regurgitation murmurs
- Splenomegaly (50% of cases)
- Microscopic hematuria
- Sepsis – especially in acute infective endocarditis
- Joint arthritis and arthralgias
- Chronic wasting –in subacute endocarditis
- Cutaneous signs are infrequent

Osler's Nodes

- Tender violaceous nodules in pulp of fingers or toes
- Due to infective emboli or immune complex deposits



Petechial Lesions

- Petechiae may appear on extremities, chest, or mucous membranes



Splinter Hemorrhage

- Due to rupture of fine subungual capillaries
- Usually 2-3mm long in long axis of nail
- Initially blue-purple in color, change to brown or black in 1-2 days
- Move distal with nail growth
- Trauma most common cause; 20% of population have them



Splinter Hemorrhage



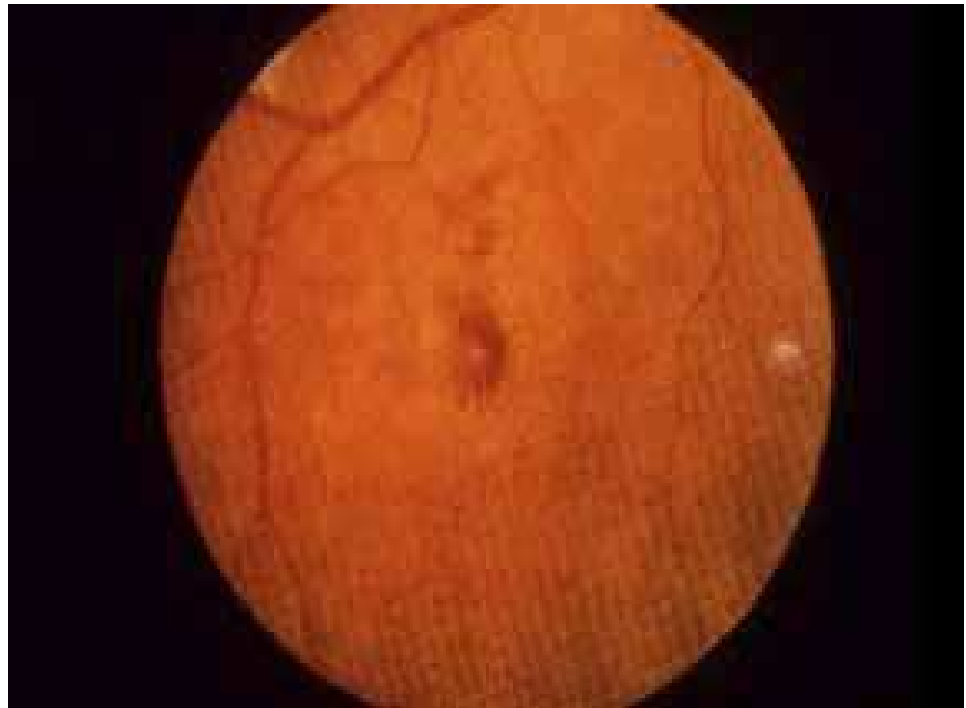
Janeway Lesions



- Nontender
- Small hemorrhagic macules or nodules
- Commonly on palms or soles

Roth Spots

- Red retinal hemorrhage
- Pale center



Clinical Presentation

Cardiac signs and symptoms

- Heart failure – especially unexplained in young pt
- Pericarditis – uncommon, often the result of abscess or fistulous tract formation
- Abnormal echocardiogram

Clinical Presentation

Complications of endocarditis

- Septic pulmonary emboli
 - Commonly in tricuspid valve endocarditis due to IV drug use
 - May cause chest pain and dyspnea
 - Pulmonary fleeting patchy infiltrates on chest xray
- Stroke – due to embolism of vegetation or thrombus
- Renal failure – rare complication due to sepsis, embolism, or immune complex reaction
- Peripheral vascular embolism

Endocarditis and Embolism

- Up to 75% of embolic events occur prior to diagnosis or treatment
- 50-65% of clinically evident emboli involve the CNS, especially in middle cerebral artery distribution
- Embolism risk decreases after 1 week of antibiotics
- Surgery indicated for 2 or more embolic events

Prosthetic Valve Endocarditis

- Early endocarditis occurs within 60 days of surgery
 - More common in patients needing reoperation or long ventilator support
 - Commonly involves *S. aureus* or fungal species
 - Acute presentation, 65% mortality
- Late endocarditis occurs more than 60 days postop
 - Subacute presentation
 - Typical subacute organisms
- Prosthetic valve endocarditis can cause mechanical failure due to abscess, valve dehiscence, paravalvular leaks

Duke criteria - Major

- 1) More than one positive blood culture typical for endocarditis
- 2) Evidence of endocardial involvement
 - New regurgitation murmur
 - Echocardiogram with oscillating mass, abscess or valve dehiscence

Duke criteria - Minor

- 1) Cardiac risk factor including IV drug use
- 2) Fever $\geq 100.4^{\circ}$ F
- 3) Vascular manifestation
- 4) Immunologic phenomena
- 5) Echocardiogram consistent with endocarditis but not meeting major criterion
- 6) Positive blood culture not meeting major criterion or serologic evidence of organism

Duke Criteria - Diagnosis

- Definite Endocarditis
 - Positive histology or culture from vegetation
 - Two major criteria
 - One major and three minor criteria
 - Five minor criteria
- Rejected
 - Firm alternative diagnosis
 - Resolution after ≤ 4 days of antibiotics
- Possible Endocarditis

Diagnostic Imaging

- Echocardiography
- Chest Xray
- CT
- MRI
- Nuclear

Chest Xray

- Nonspecific findings
- Cardiomegaly
- Nodular infiltrates
 - Tricuspid valve endocarditis causing septic emboli



CT and MRI

Still Mostly Experimental

- Primarily evaluate brain for complications
- Isolated CT case reports
 - Large aortic root abscess and AV fistula
- MRI can potentially diagnose complications of aortic root aneurysms or abscesses

Nuclear Imaging

- Tagged WBC scans have been used
 - Can identify vegetations
 - Nonspecific
 - High false negative
- Case reports suggest that positive scan can be used to detect local complications of endocarditis
- Useful to detect metastatic septic embolism

Echocardiography

- Major Duke criteria
- Diagnose and management of infective endocarditis
- Vegetations – detected in 67% of “definite” cases by Duke criteria
 - Irregular shape
 - Occur on low-pressure side of turbulent jet
 - Atrial side in mitral and tricuspid regurgitation
 - Ventricular side in aortic and pulmonic regurgitation
 - May occur on other nonvalvular locations

Vegetation characteristics

- Large vegetation (>10mm) has 3 times risk of embolization compared to small ones¹
- Prolapsing vegetations or extravalvular involvement carries higher risk of heart failure, brain embolization, need for valve replacement²
- However, poor interobserver reproducibility of these characteristics

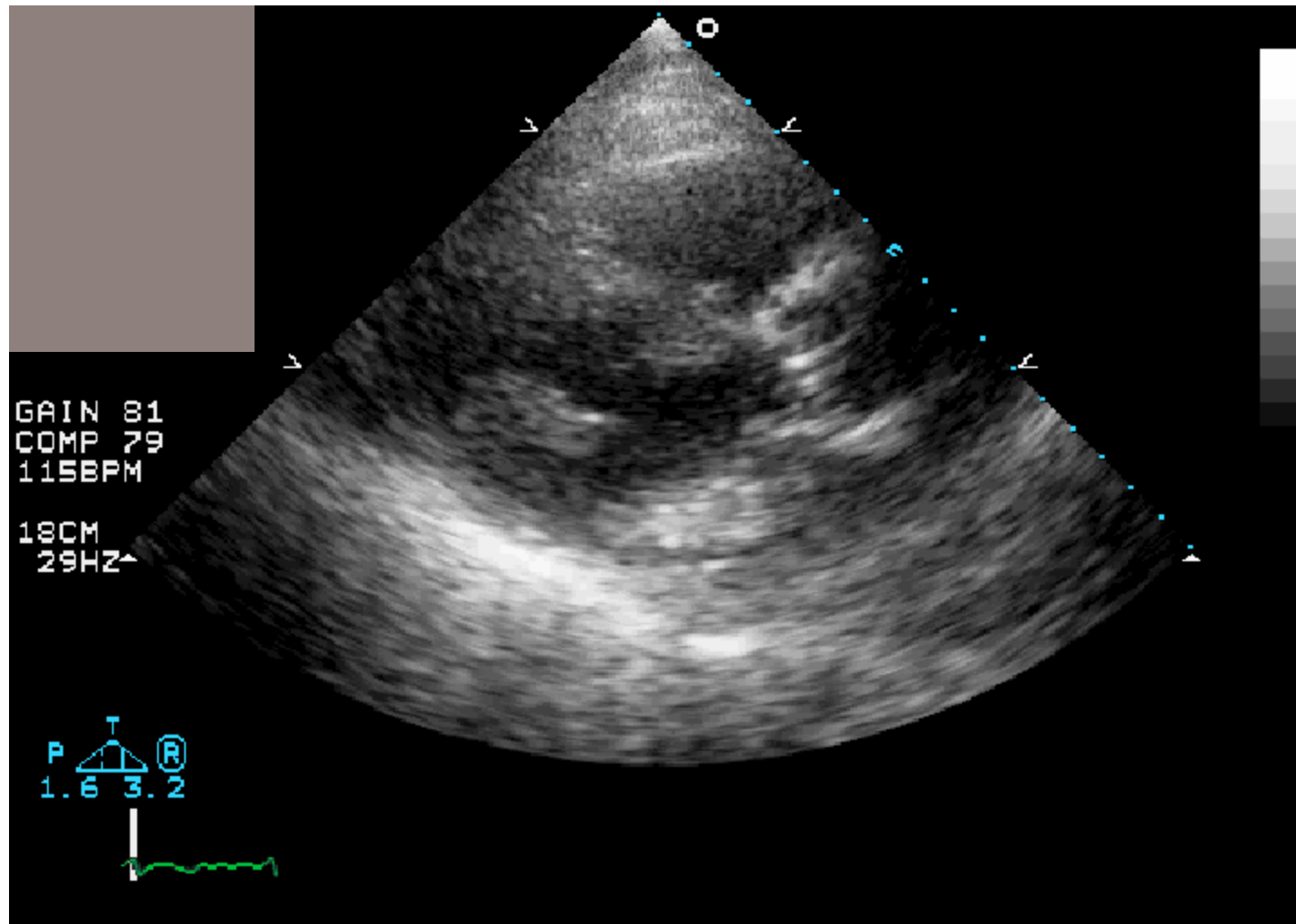
¹Tischler M, Vaitkus P. The ability of vegetation size on echocardiography to predict complications: a meta-analysis. J Amer Soc Echo 1997; 10:562-8.

²Sanfillipo A, Picard M, Newell J, et al. Echocardiographic assessment of patients with infectious endocarditis: prediction of risk for complication. J Am Coll Cardiol 1991; 18:1191-9.

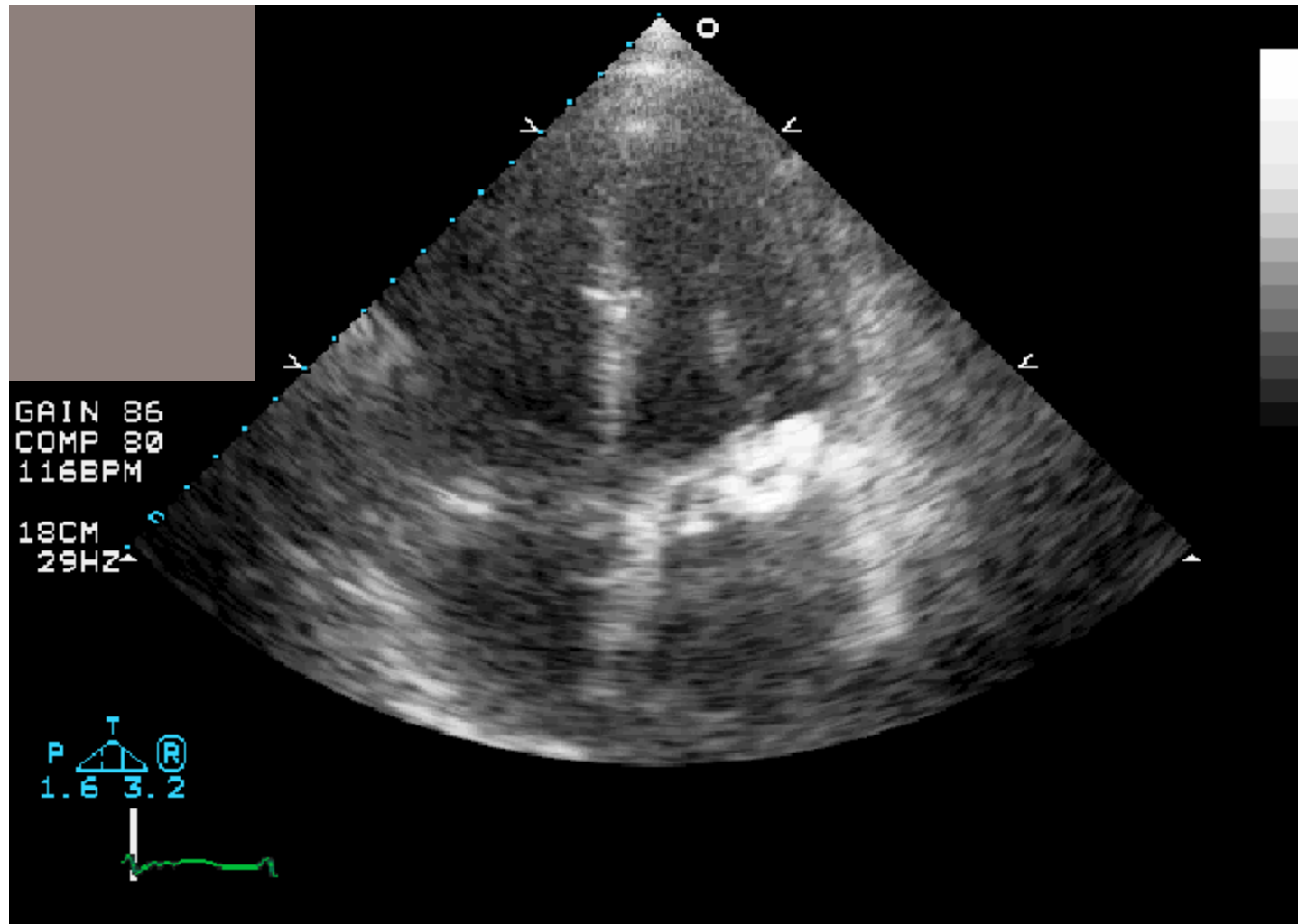
Valvular location

- Small series show 26% mortality of aortic location vs. 16% with mitral location
- Aortic valve endocarditis more resistant to antibiotic therapy, more likely to need surgery
- Mitral valve endocarditis, especially anterior leaflet, has highest incidence of embolization

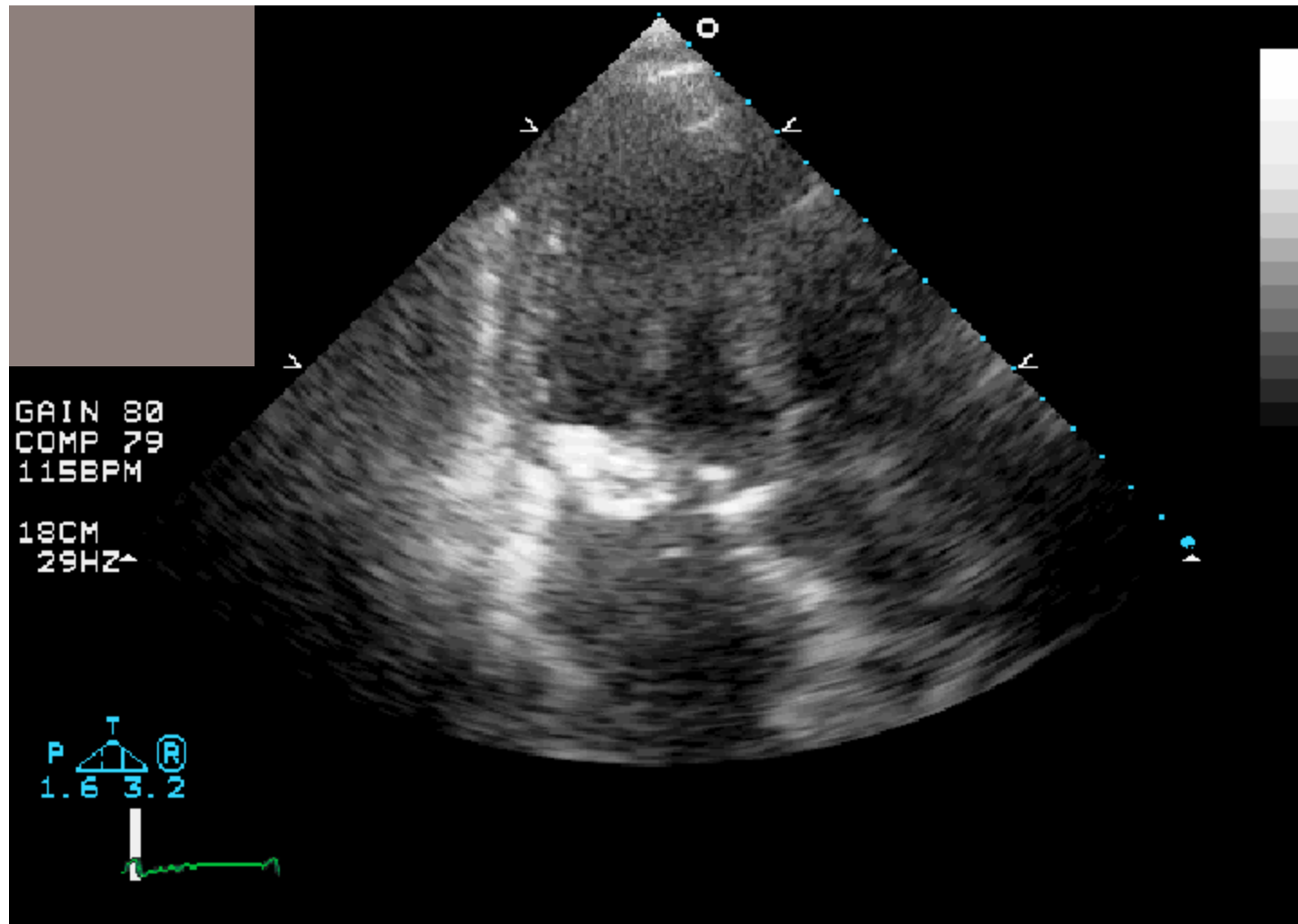
Mitral valve vegetation posterior leaflet



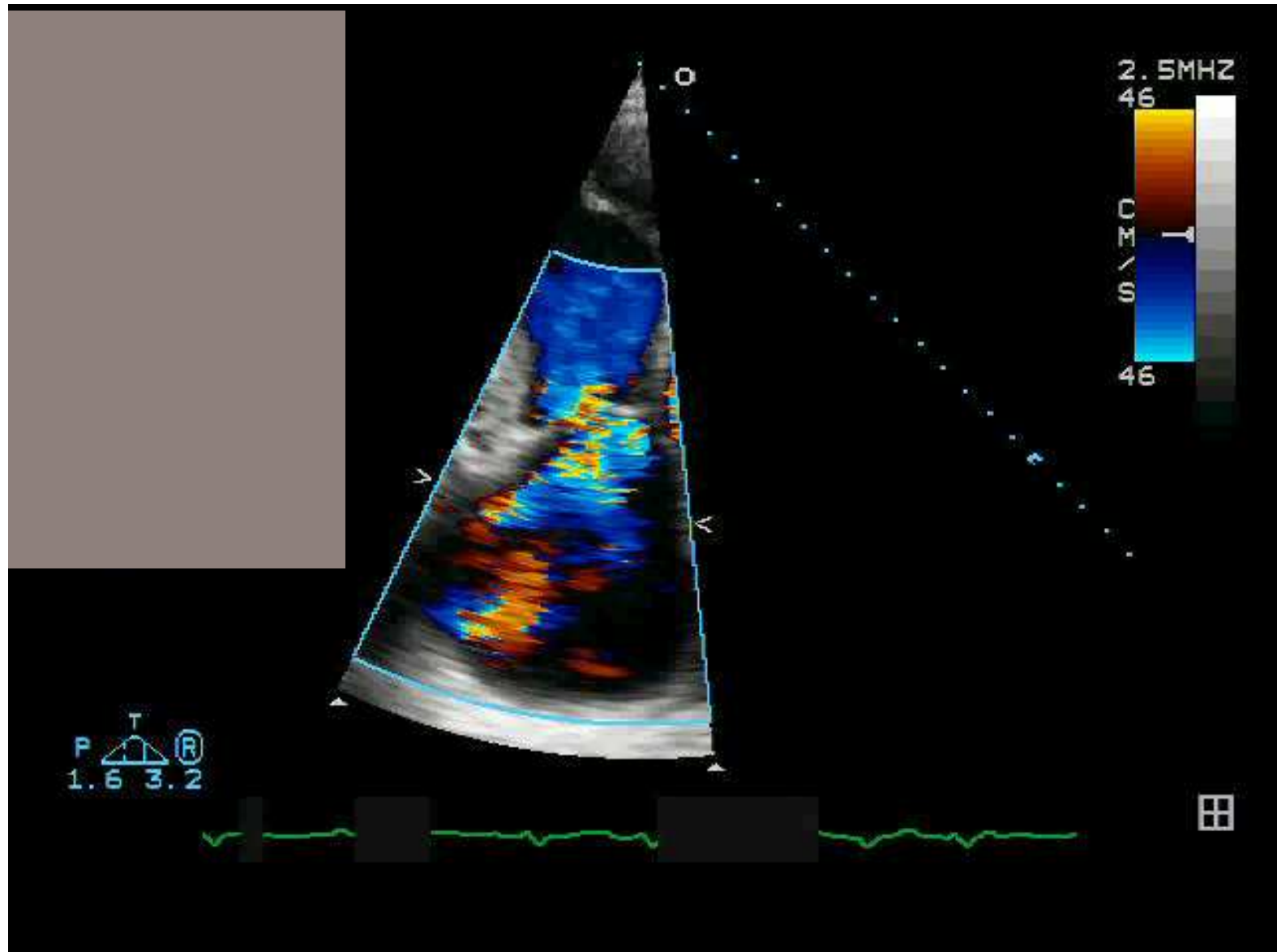
Mitral valve vegetation posterior leaflet



Mitral valve vegetation posterior leaflet

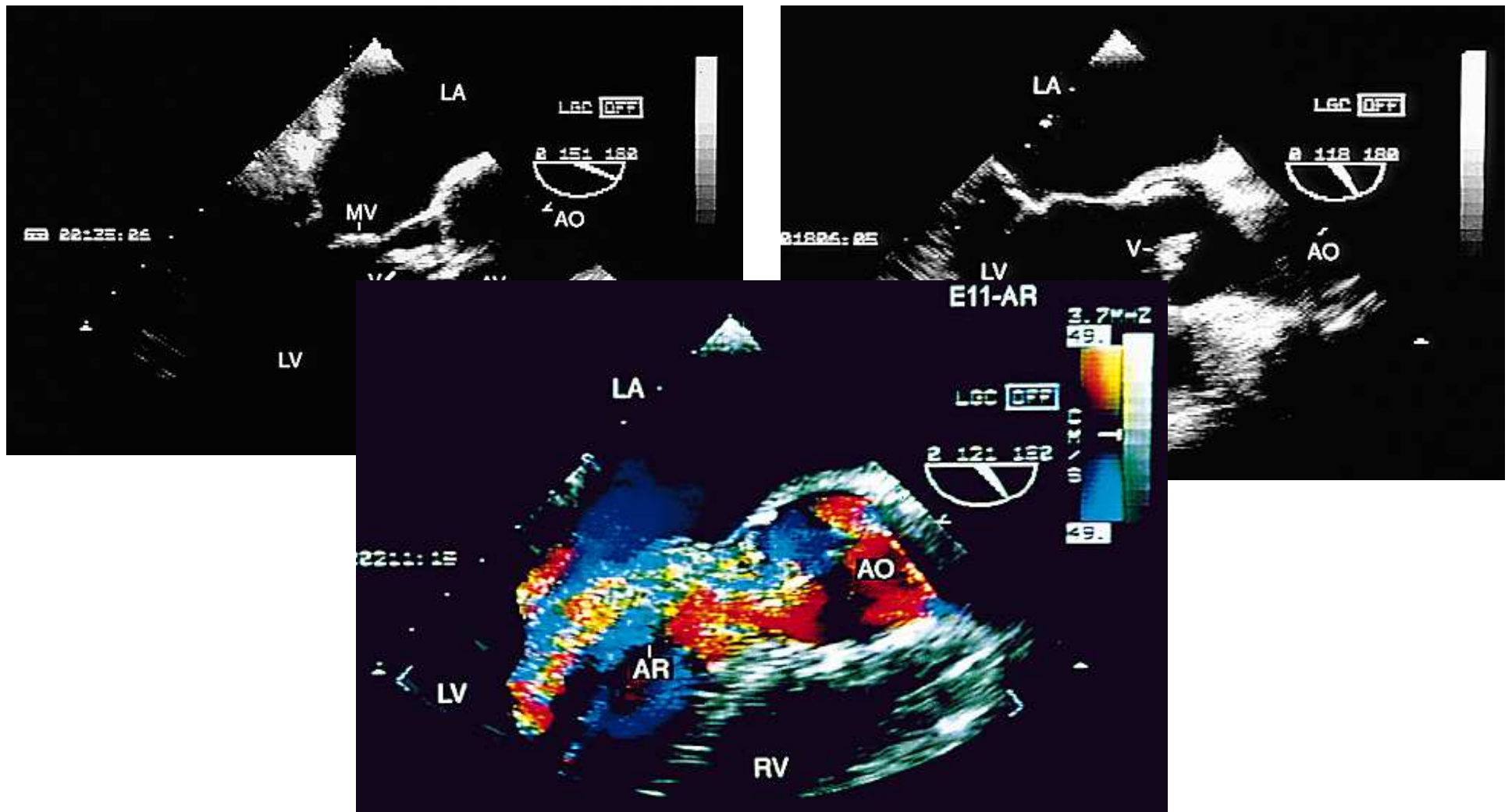


Tricuspid regurgitation

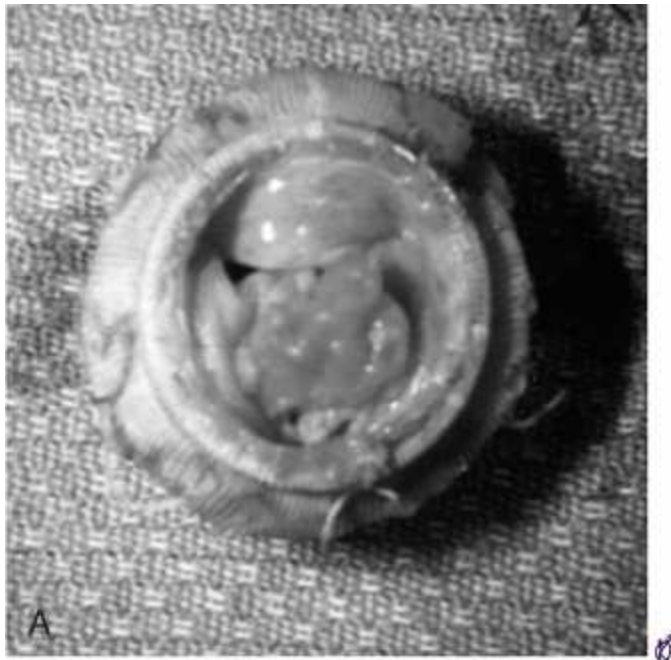




Aortic valve vegetation



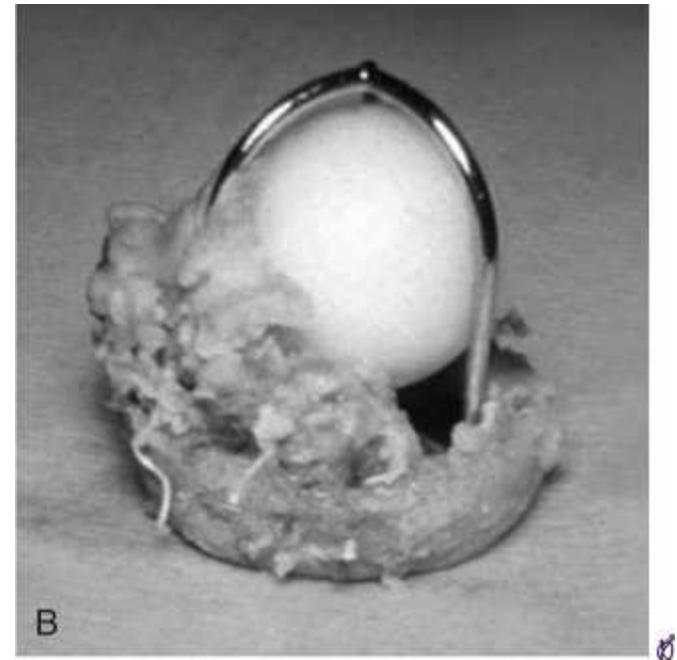
Prosthetic endocarditis



Copyright © 2005 by Elsevier Inc.

A large vegetation caused by *Candida albicans* partially occludes the orifice of a bioprosthetic valve removed from the mitral position

Braunwald

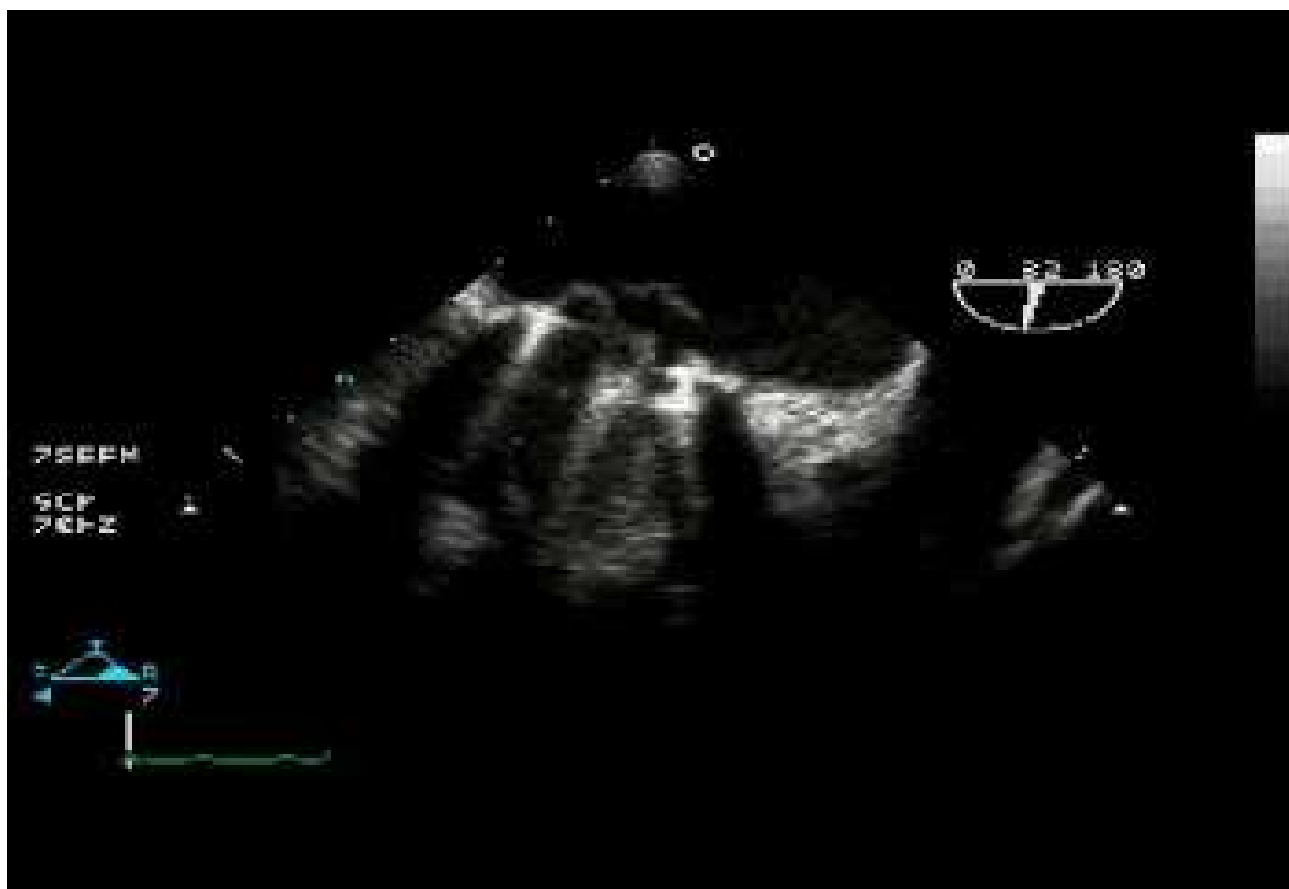


Copyright © 2005 by Elsevier Inc.

A Starr-Edwards prosthesis removed from the aortic position, where this large vegetation related to *Aspergillus* infection partially obstructed the outflow tract but also allowed regurgitation by preventing valve closure.

Prosthetic Valve Endocarditis

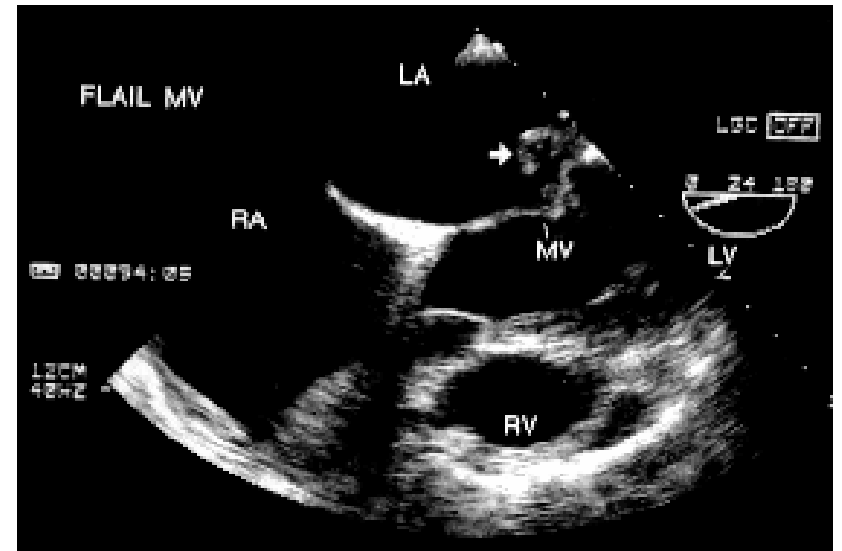
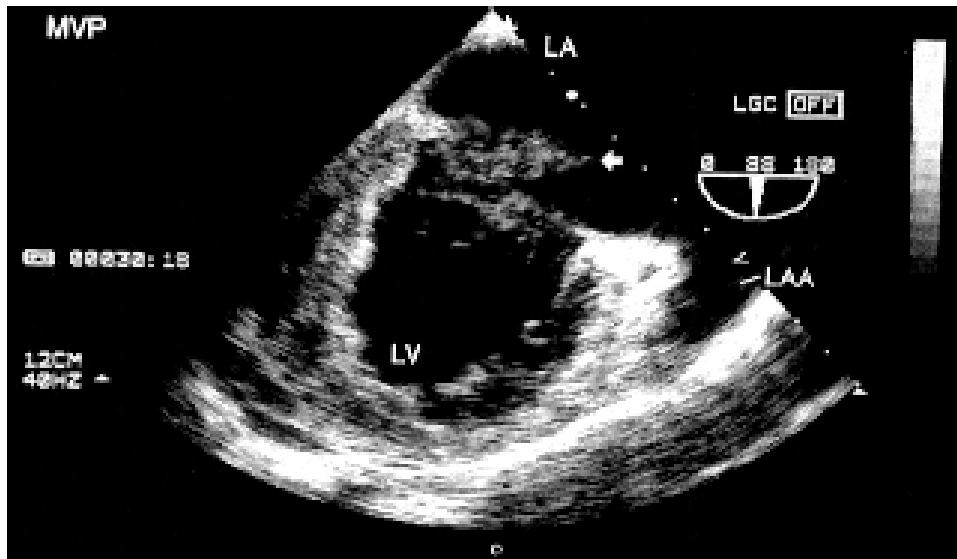
Vegetation on sewing ring of St Jude MV



Echocardiographic mimics

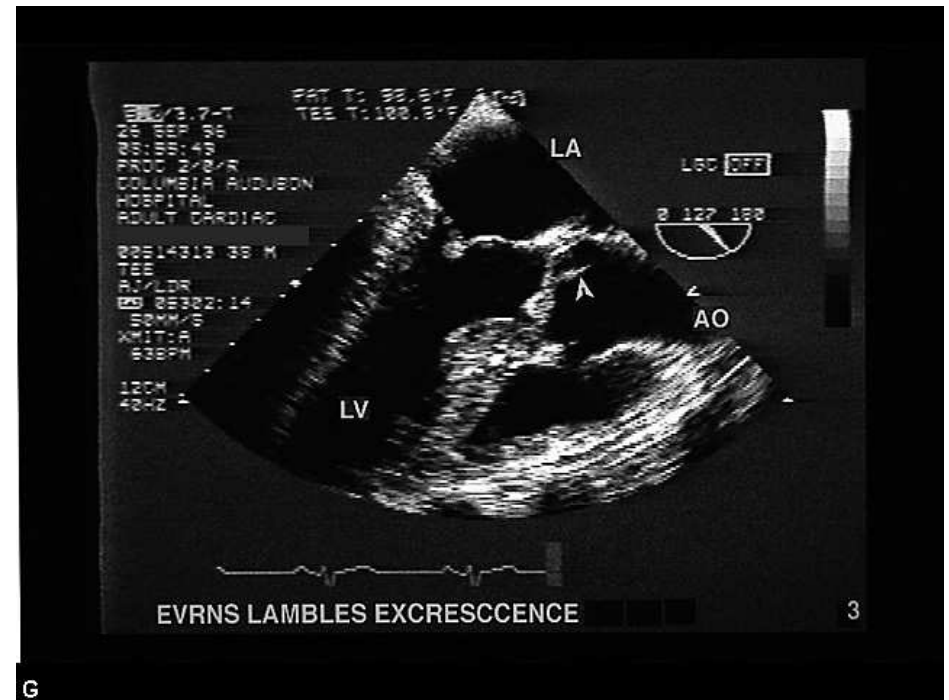
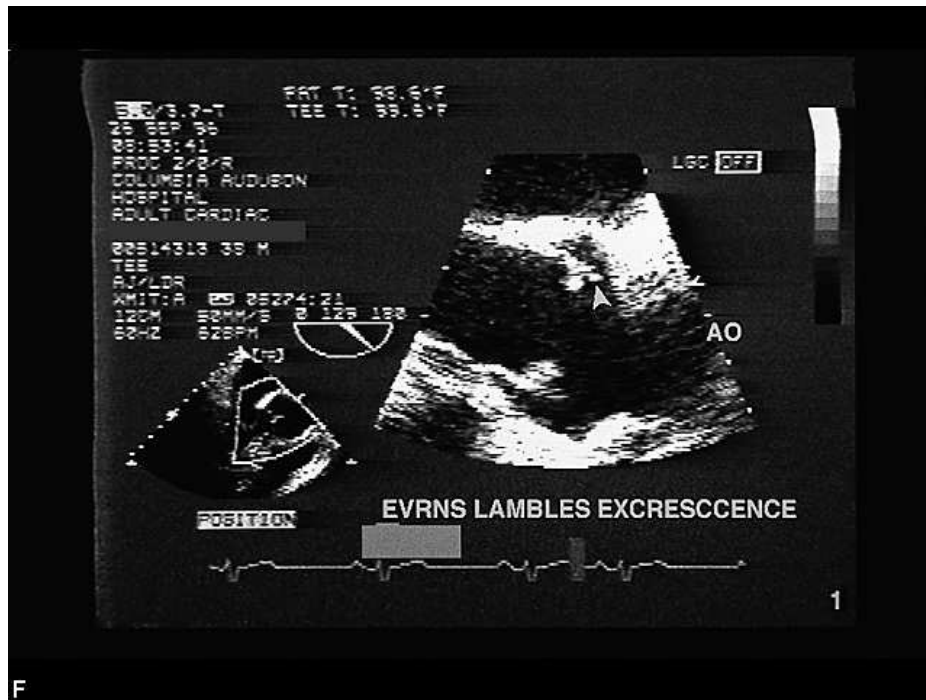
- Sterile vegetations (marantic endocarditis)
 - Libman-Sacks endocarditis
 - Systemic malignancy
- Myxomatous valves
- Cardiac tumors
- Degenerative thickening
- Lambl's excrescence – small, multiple filamentous tags on heart valves found in 70-90% of adults at autopsy

Myxomatous mitral valve

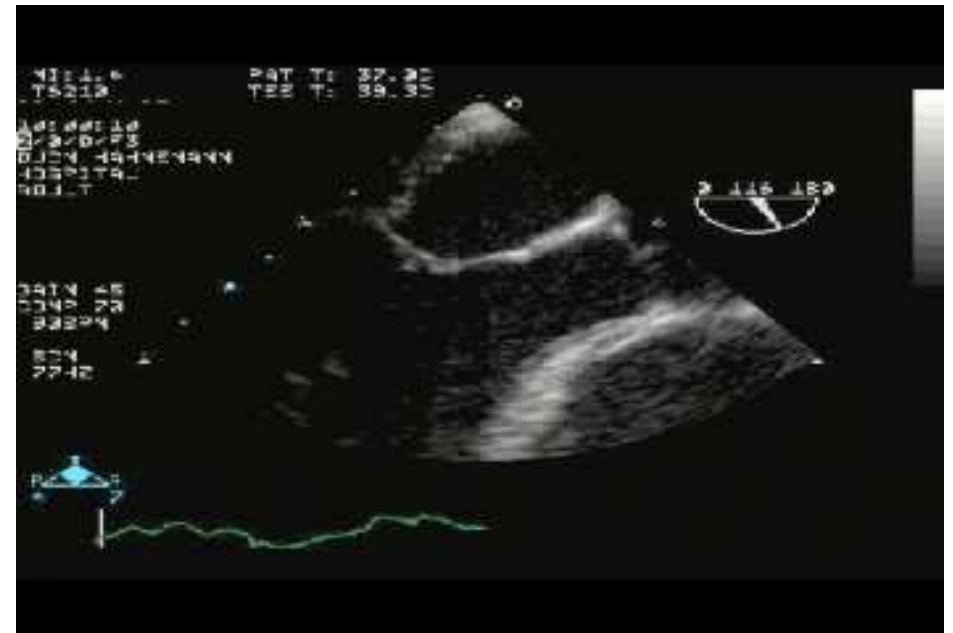


Flail myxomatous mitral valve prolapsing into left atrium

Lambert's Excrescence



Fibroelastoma



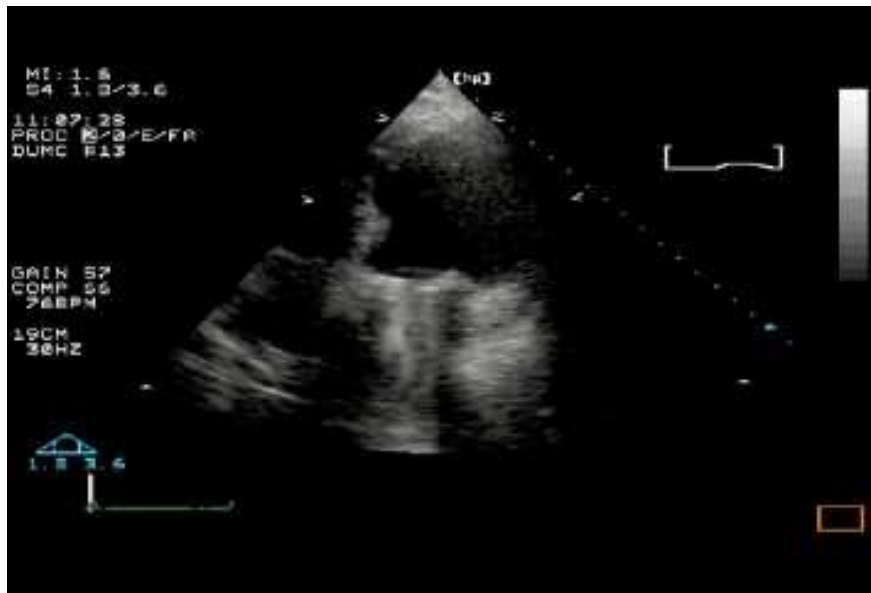
Echocardiography

TTE vs. TEE

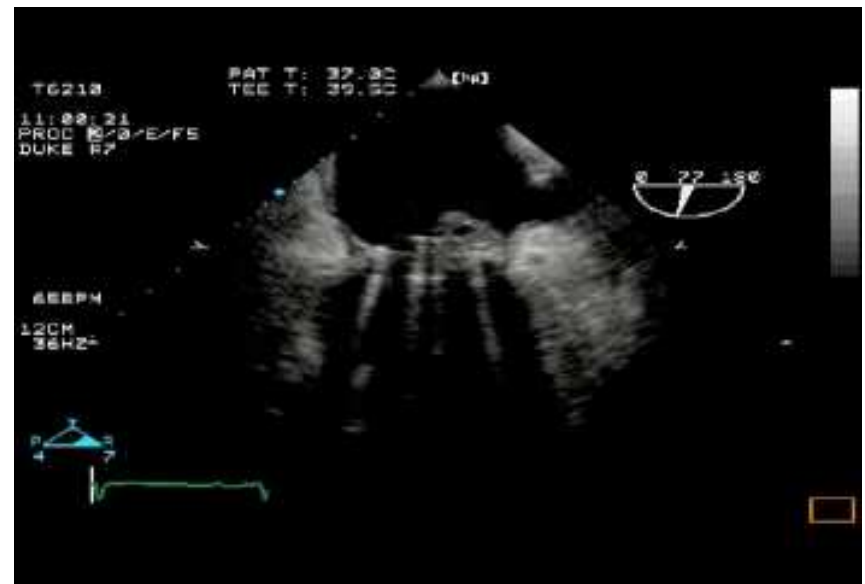
- Transthoracic
 - 18-63% sensitivity
 - Can rule out endocarditis only with good quality images and a low pre-test probability
 - Low sensitivity for detecting complications of endocarditis
- Transesophageal
 - 48-100% sensitive
 - Indicated in all cases of suspected prosthetic valve endocarditis

Prosthetic Valve Endocarditis

Vegetation of St Jude MV



Transthoracic



Transesophageal

Overview of Medical Treatment

- Target therapy to blood culture
- Bactericidal antibiotics
 - β -lactam preferred
 - Monotherapy for MRSA with 1st generation cephalosporin is feasible
 - Vancomycin less bactericidal than penicillins
- Therapy for >4 weeks
 - Studies involving 2 week courses generally not as efficacious

Anticoagulation and Endocarditis

somewhat controversial

- Anticoagulation not indicated in native valve endocarditis
- In prosthetic valve endocarditis due to *Staph Aureus*, it may be beneficial to stop anticoagulation during the acute phase
- Aspirin therapy does not reduce embolic complications, and may increase bleeding

Chan KL, Dumesnil JG, Cujec B et al. A randomized trial of aspirin on the risk of embolic events in patients with infective endocarditis. *J Am Coll Cardiol.* 2003 Sep 3;42(5):775-80

Sexton, 280

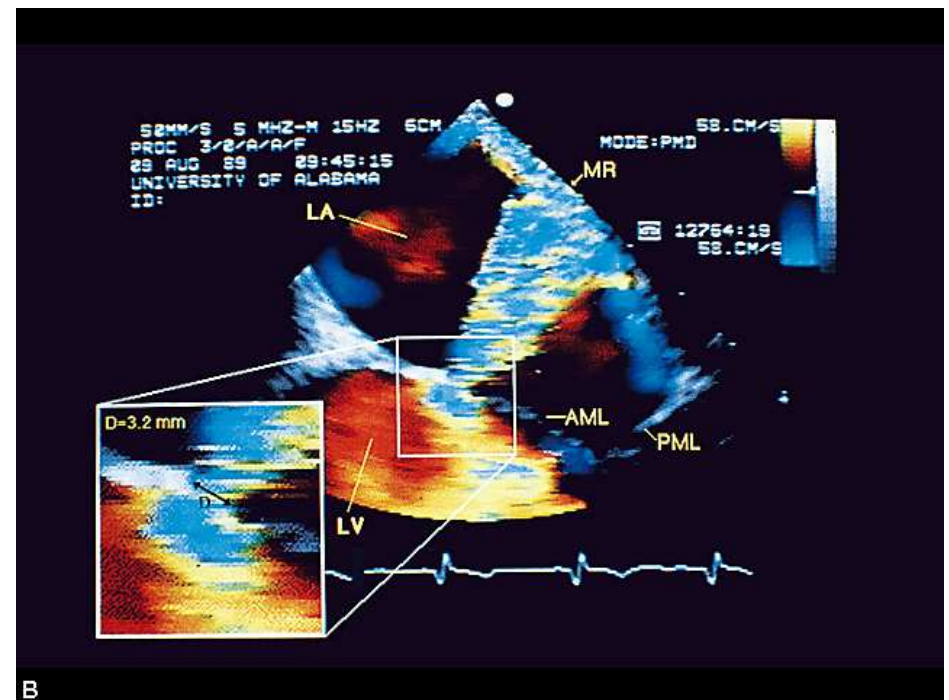
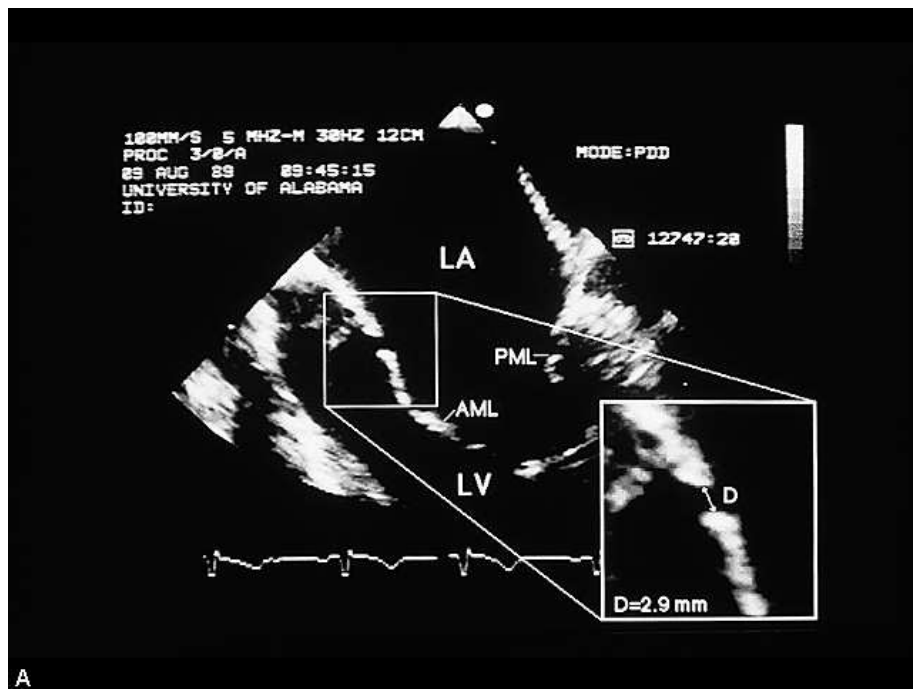
Indications for Surgery

- Heart failure refractory to medical treatment
 - NYHA class 3-4 due to endocarditis
 - Caused by aortic or mitral regurgitation (acute or subacute)
- Prosthetic valve endocarditis (most cases)
 - Medical management may suffice if
 - Late onset infection (>12 months after prosthesis)
 - Low virulence organism (viridians step, HACEK, enterococci)
 - No evidence of invasive infection
- Local invasive complications
 - Periannular extension, abscess, mycotic aneurysm, pseudoaneurysm, fistula
 - Heart block may herald local extension

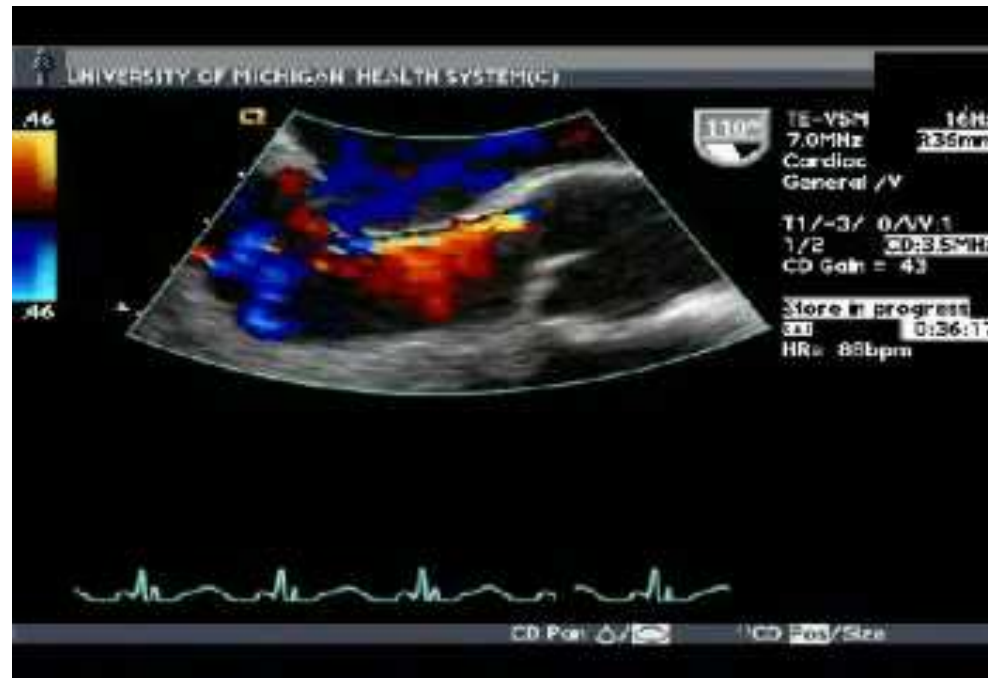
Indications for Surgery

- 2 or more Major embolic events
 - A recent stroke presents higher operative risk (CVA extension)
 - Prefer to perform surgery at least 10-14 days after CVA
- Major valve dysfunction
 - Valve obstruction
 - Regurgitation
 - Leaflet perforation
- Resistance to antibiotic therapy
 - Persistent bacteremia after 7 days of antibiotics
 - Exclude extracardiac foci of infection
 - Recurrent fever is common, not necessarily an indication of antibiotic failure

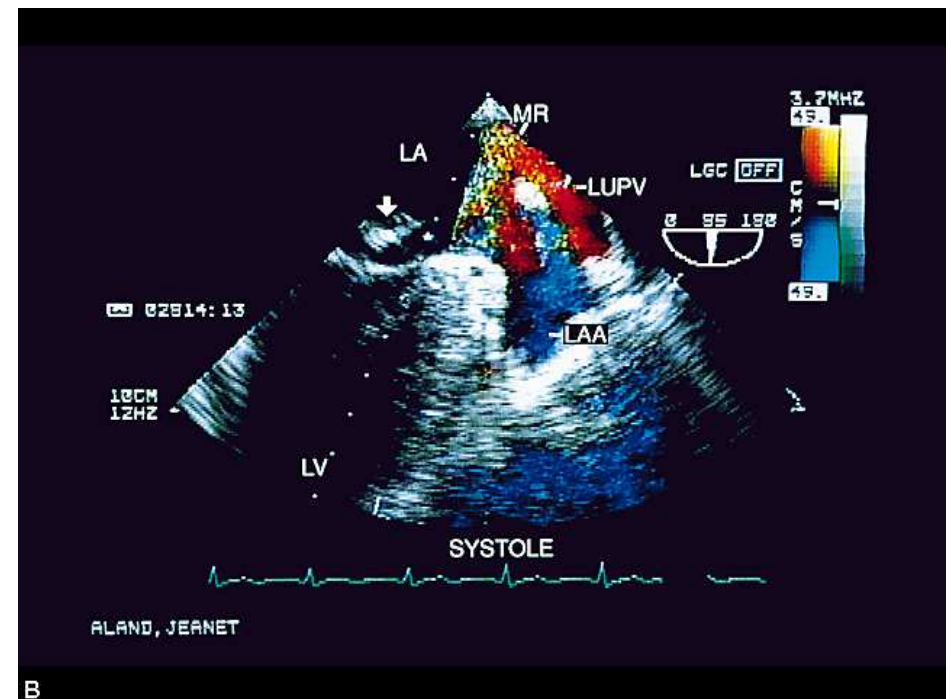
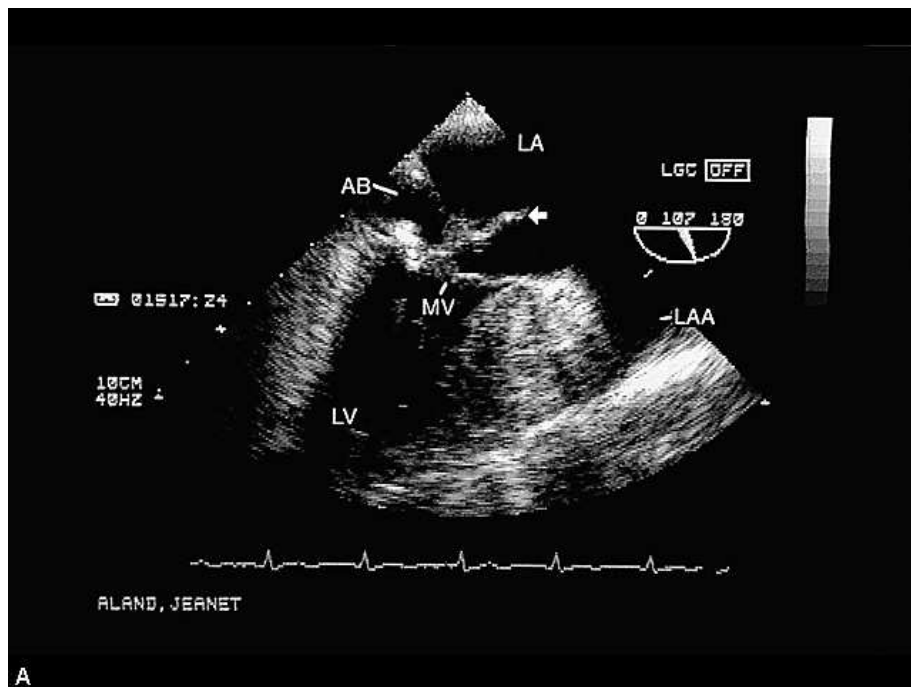
Anterior Mitral Leaflet Perforation



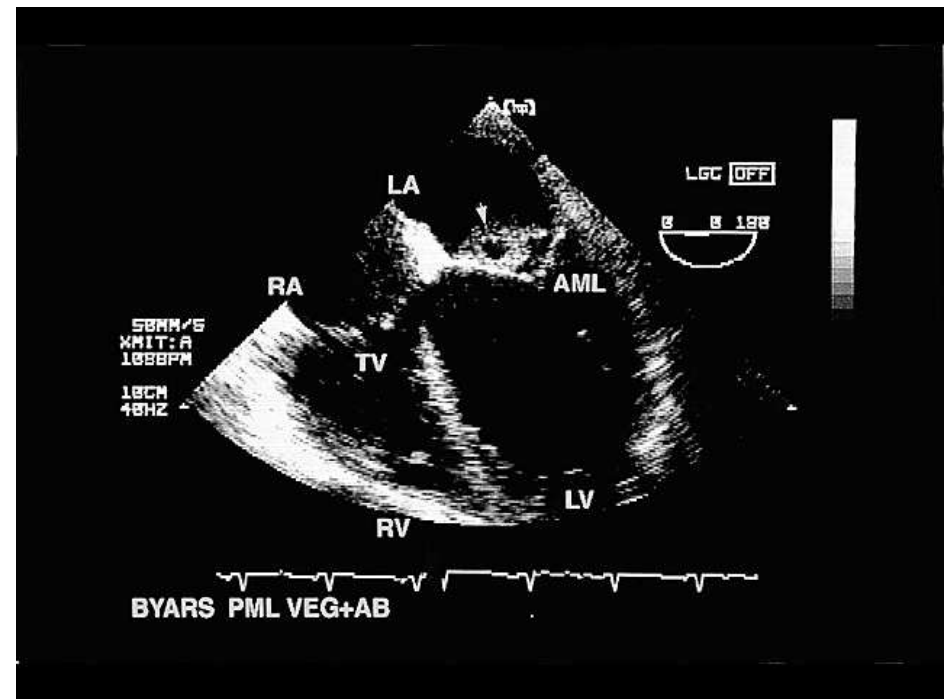
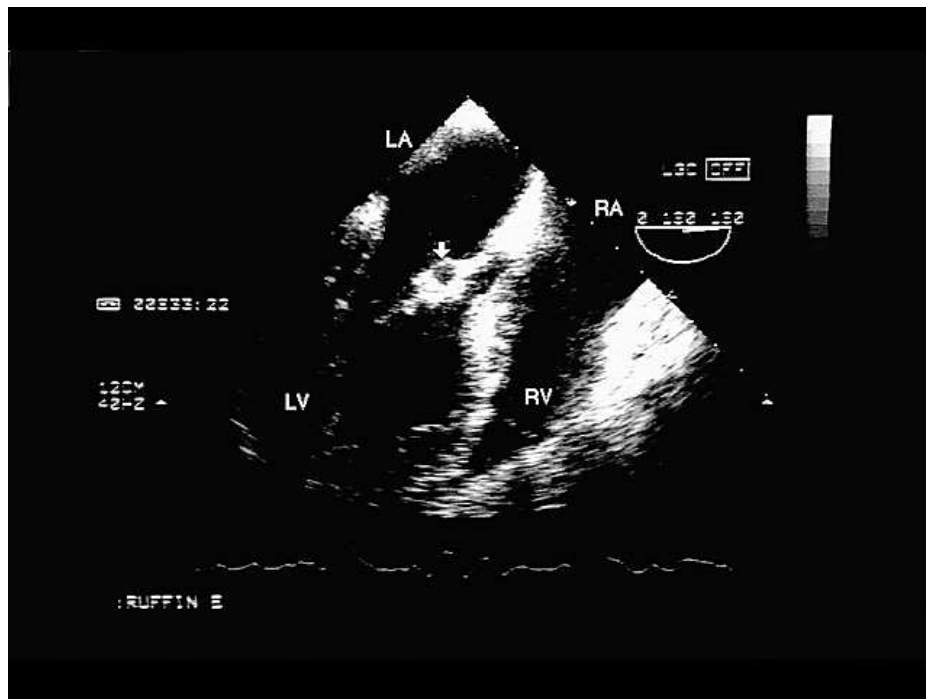
Aortic leaflet perforation with AR



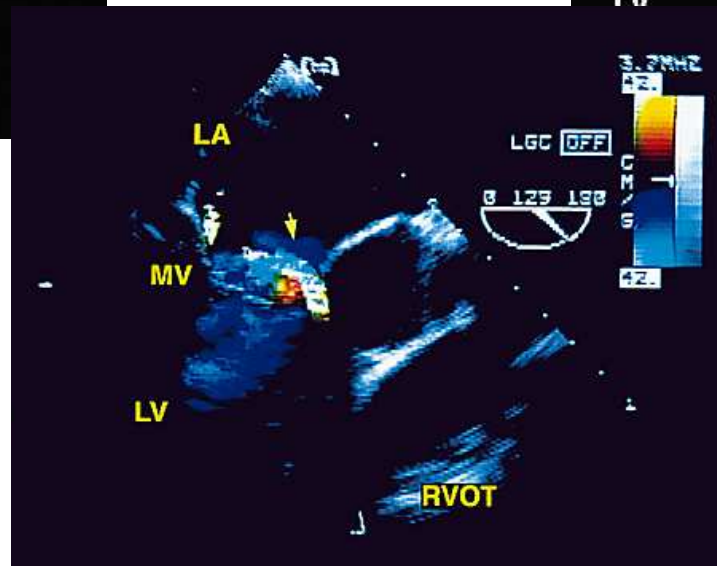
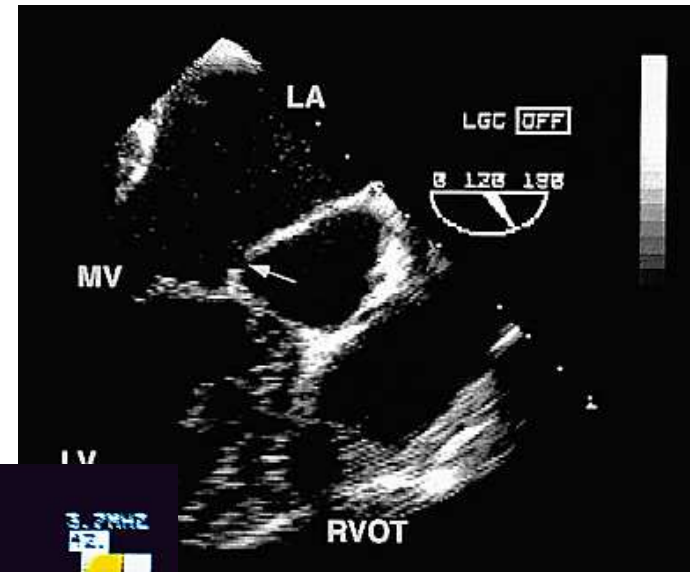
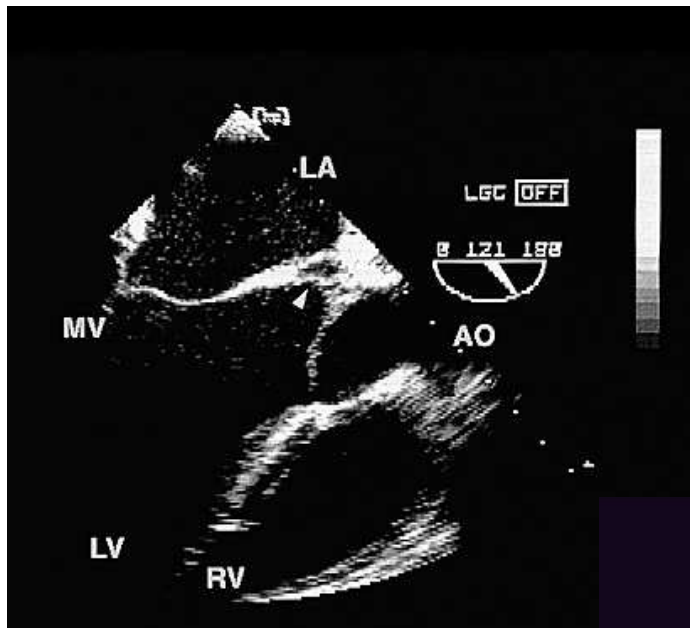
Ruptured Chordae with Severe MR



Mitral Valve Abscess



Fistula of Aorta-LA (Annulus fibrosa Aneurysm)



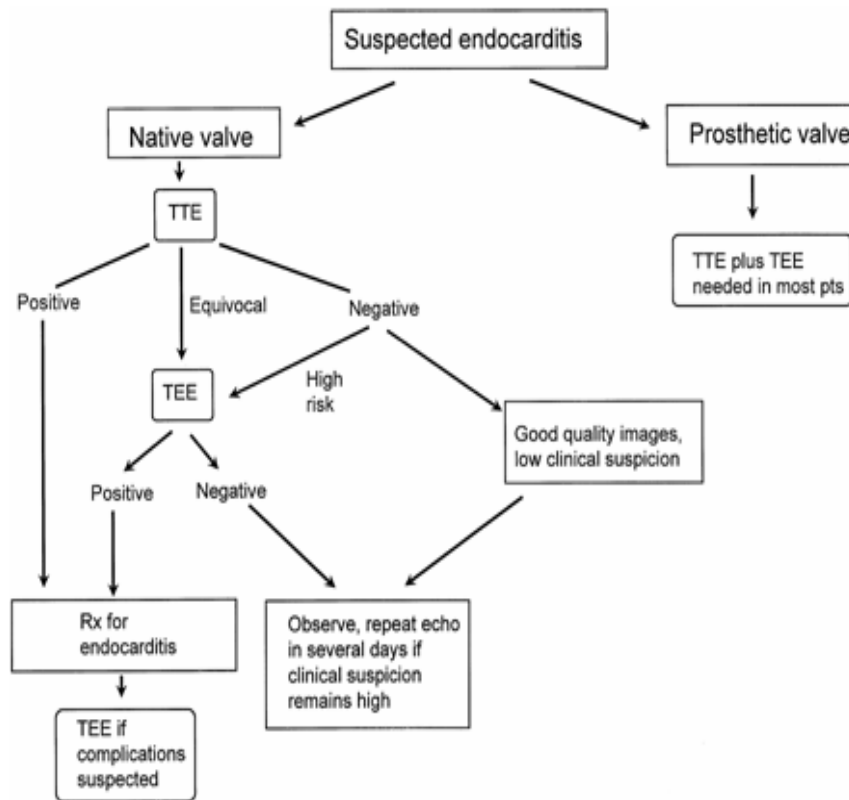
Surgical Considerations

- Surgery needed in 25-30% in acute phase, 20-40% in subacute phase
- No prerequisite for antibiotics before surgery
 - Equivalent mortality (8.5%) for patients having surgery before 10 days and after 10 days of antibiotics
- Consider early surgical intervention with aggressive pathogen (*Staph Aureus*, fungal sp.)

Prognosis

- Overall mortality of 20-25%
- Patients with surgical intervention have 61% survival at 10 years
- Risks of high mortality
 - Elderly
 - Aggressive pathogen (*S. Aureus*)
 - Presence of embolism
 - More extensive valve damage
 - Renal involvement
 - Longer duration of endocarditis

Diagnostic Algorithm



- TEE indicated for suspected prosthetic valve endocarditis
- TTE can rule in endocarditis
- TTE can only rule out endocarditis with good quality images and a low pre-test probability

Endocarditis prophylaxis

A brief summary

- Procedures needing prophylaxis
 - Dental procedures which cause bleeding
 - Surgery involving GI or upper respiratory mucosa
 - Esophageal dilatation
 - Sclerotherapy for varices
 - ERCP with biliary obstruction
 - Urologic procedures
 - Cystoscopy
 - Urethral dilatation
 - Catheterization in presence of UTI
 - Prostate surgery

Endocarditis prophylaxis

- Procedures that do not need prophylaxis
 - Dental procedures which do not cause bleeding
 - Intubation
 - Flexible bronchoscopy (with or without biopsy)
 - TEE
 - Cardiac catheterization, PCI
 - GI endoscopy (with or without biopsy)
 - Most gynecologic procedures performed in the absence of infection

Endocarditis prophylaxis

- High risk –
 - GI/GU always use ampicillin/vancomycin + gentamicin
 - Oral procedures use Amoxicillin/Ampicillin/Clindamycin
- Prosthetic valves
- Prior endocarditis
- Cyanotic congenital heart disease
- Surgical systemic-pulmonary shunts
- Ventricular septal defect
- Coarctation of aorta
- Patent ductus arteriosus

Endocarditis prophylaxis

- Medium risk – use amoxicillin, ampicillin or vancomycin
 - Acquired Valvular dysfunction (Mitral or aortic regurgitation or stenosis)
 - MVP with regurgitation or leaflet thickening
 - Tricuspid or pulmonary disease
 - Bicuspid aortic valve
 - Aortic valve sclerosis with hemodynamic abnormality
 - Surgically repaired intracardiac lesions without hemodynamic abnormality (for 6 months post-op)
 - HOCM

Endocarditis prophylaxis

- Low risk – no prophylaxis
 - MVP without regurgitation
 - Isolated atrial septal defect (secundum)
 - Trivial regurgitation lesions
 - CAD
 - Pacemaker
 - CABG
 - Prior rheumatic fever without valve disease

Pearls for the Boards

- Association of *Strep. Bovis* with GI malignancy, especially colon cancer
- *Candida* bacteremia should have ophthalmologic evaluation (endophthalmitis)
- Identify patients who should and should not receive endocarditis prophylaxis
 - MVP without regurgitation does not need prophylaxis
 - ASD (secundum) does not need prophylaxis
- Recognize that a prosthetic valve will most likely need surgical treatment

References

- Baddour LM, Wilson WR, Bayer AS, Fowler VG Jr, Bolger AF, Levison ME, Ferrieri P, Gerber MA, Tani LY, Gewitz MH, Tong DC, Steckelberg JM, Baltimore RS, Shulman ST, Burns JC, Falace DA, Newburger JW, Pallasch TJ, Takahashi M, Taubert KA. Infective endocarditis: diagnosis, antimicrobial therapy, and management of complications: a statement for healthcare professionals from the committee on rheumatic Fever, endocarditis, and kawasaki disease, council on cardiovascular disease in the young, and the councils on clinical cardiology, stroke, and cardiovascular surgery and anesthesia, american heart association--executive summary: endorsed by the infectious diseases society of america. *Circulation*. 2005 Jun 14;111(23):3167-84.
- Braunwald E, Zipes DP, Libby P: *Heart Disease* 7th ed. Philadelphia, WB Saunders, 2004.
- Cabell CH, Abrutyn E. Progress toward a global understanding of infective endocarditis; Lessons from the International Collaboration on Endocarditis. *Cardiol Clin* 21 (2003) 147-158.
- Crawford MH, Durack DT. Clinical presentation of infective endocarditis. *Cardiol Clin* 21 (2003) 159-166.
- Fitzpatrick TB et. Al: *Color Atlas & Synopsis of Clinical Dermatology*, 4th ed. New York, McGraw-Hill, 2001.
- Nanda, NC, Domanski MJ. *Atlas of Transesophageal Echocardiography*. Philadelphia: Lippincott Williams & Wilkins, 1998.
- Olaison L, Pettersson G. Current best practices and guidelines; Indications for surgical intervention in infective endocarditis. *Cardiol Clin* 21 (2003) 235-251.
- Sachdev M, Peterson GE, Jollis JG. Imaging techniques for diagnosis of infective endocarditis. *Cardiol Clin* 21 (2003) 185-195.
- Sexton DJ, Spelman D. Current best practices and guidelines; Assessment and management of complications in infective endocarditis. *Cardiol Clin* 21 (2003) 273-282.