

Infective Endocarditis

Role of Echo

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DISCLOSURE

I have **NO** relevant
financial relationships



Intro

Must Reading . . .



Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications **A Scientific Statement for Healthcare Professionals From the American Heart Association**

Endorsed by the Infectious Diseases Society of America

Larry M. Baddour, MD, FAHA, Chair; Walter R. Wilson, MD; Arnold S. Bayer, MD;
Vance G. Fowler, Jr, MD, MHS; Imad M. Tleyjeh, MD, MSc;
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Michael H. Gewitz, MD, FAHA; Matthew E. Levison, MD; Ann F. Bolger, MD, FAHA;
James M. Steckelberg, MD; Robert S. Baltimore, MD; Anne M. Fink, PhD, RN;
Patrick O’Gara, MD, FAHA; Kathryn A. Taubert, PhD, FAHA; on behalf of the American Heart Association Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease of the Council on Cardiovascular Disease in the Young, Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and Stroke Council

Background—Infective endocarditis is a potentially lethal disease that has undergone major changes in both host and pathogen. The epidemiology of infective endocarditis has become more complex with today’s myriad healthcare-associated factors that predispose to infection. Moreover, changes in pathogen prevalence, in particular a more common staphylococcal origin, have affected outcomes, which have not improved despite medical and surgical advances.

Methods and Results—This statement updates the 2005 iteration, both of which were developed by the American Heart Association under the auspices of the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease of the Young. It includes an evidence-based system for diagnostic and treatment recommendations used by the American College of Cardiology and the American Heart Association for treatment recommendations.

Conclusions—Infective endocarditis is a complex disease, and patients with this disease generally require management by a team of physicians and allied health providers with a variety of areas of expertise. The recommendations provided in this document are intended to assist in the management of this uncommon but potentially deadly infection. The clinical variability and complexity in infective endocarditis, however, dictate that these recommendations be used to support and not supplant decisions in individual patient management. (*Circulation*. 2015;132:1435-1486. DOI: 10.1161/CIR.000000000000296.)

2015 ESC Guidelines for the management of infective endocarditis

The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC)

Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM)

Authors/Task Force Members: Gilbert Habib* (Chairperson) (France), Patrizio Lancellotti* (co-Chairperson) (Belgium), Manuel J. Antunes (Portugal), Maria Grazia Bongiorno (Italy), Jean-Paul Casalta (France), Francesco Del Zotti (Italy), Raluca Dulgheru (Belgium), Gebrine El Khoury (Belgium), Paola Anna Erba^a (Italy), Bernard Jung (France), Jose M. Miro^b (Spain), Barbara J. Mulder (The Netherlands), Edyta Plonska-Gosciniak (Poland), Susanna Price (UK), Jolien Roos-Hesselink (The Netherlands), Ulrika Snygg-Martin (Sweden), Franck Thuny (France), Pilar Tornos Mas (Spain), Isidre Vilacosta (Spain), and Jose Luis Zamorano (Spain)

Habib Eur Heart J 2015;36(44):3075-3128

2016 The American Association for Thoracic Surgery (AATS) consensus guidelines: Surgical treatment of infective endocarditis: Executive summary

Gösta B. Pettersson MD, PhD, Joseph S. Coselli MD, Gösta B. Pettersson MD, PhD, Joseph S. Coselli MD, Syed T. Hussain MD, Brian Griffin MD, Eugene H. Blackstone MD, Steven M. Gordon MD, Scott A. LeMaire MD and Laila E. Woc-Colburn MD

Pettersson J Thorac Cardiovasc Surg 2017;153(6):1241-58

Proposed Modifications to the Duke Criteria for the Diagnosis of Infective Endocarditis

Jennifer S. Li,^{1,4} Daniel J. Sexton,^{2,3} Nathan Mick,³
Richard Nettles,³ Vance G. Fowler, Jr.,^{2,3}
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*From the Divisions of ¹Cardiology and ²Infectious Diseases,
and Departments of ³Medicine and ⁴Pediatrics, Duke University
School of Medicine, Durham, North Carolina*

Although the sensitivity and specificity of the Duke criteria for the diagnosis of infective endocarditis (IE) have been validated by investigators from Europe and the United States, several shortcomings of this schema remain. The Duke IE database contains records collected prospectively on >800 cases of definite and possible IE since 1984. Databases on echocardiograms and on patients with *Staphylococcus aureus* bacteremia at Duke University Medical Center are also maintained. Analyses of these databases, our experience with the Duke criteria in clinical practice, and analysis of the work of others have led us to propose the following modifications of the Duke schema. The category “possible IE” should be defined as having at least 1 major criterion and 1 minor criterion or 3 minor criteria. The minor criterion “echocardiogram consistent with IE but not meeting major criterion” should be eliminated, given the widespread use of transesophageal echocardiography (TEE). Bacteremia due to *S. aureus* should be considered a major criterion, regardless of whether the infection is nosocomially acquired or whether a removable source of infection is present. Positive Q-fever serology should be changed to a major criterion.

Li Clin Inf Dis 2000;30:633-38

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease



A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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Guidelines for the Use of Echocardiography in the Evaluation of a Cardiac Source of Embolism

Muhamed Saric, MD, PhD, FASE, Chair, Alicia C. Armour, MA, BS, RDCS, FASE, M. Samir Arnaout, MD, Farooq A. Chaudhry, MD, FASE, Richard A. Grimm, DO, FASE, Itzhak Kronzon, MD, FASE, Bruce F. Landeck, II, MD, FASE, Kameswari Maganti, MD, FASE, Hector I. Michelena, MD, FASE, and Kirsten Tolstrup, MD, FASE, *New York, New York; Durham, North Carolina; Beirut, Lebanon; Cleveland, Ohio; Aurora, Colorado; Chicago, Illinois; Rochester, Minnesota; and Albuquerque, New Mexico*

Embolism from the heart or the thoracic aorta often leads to clinically significant morbidity and mortality due to transient ischemic attack, stroke or occlusion of peripheral arteries. Transthoracic and transesophageal echocardiography are the key diagnostic modalities for evaluation, diagnosis, and management of stroke, systemic and pulmonary embolism. This document provides comprehensive American Society of Echocardiography guidelines on the use of echocardiography for evaluation of cardiac sources of embolism.

It describes general mechanisms of stroke and systemic embolism; the specific role of cardiac and aortic sources in stroke, and systemic and pulmonary embolism; the role of echocardiography in evaluation, diagnosis, and management of cardiac and aortic sources of emboli including the incremental value of contrast and 3D echocardiography; and a brief description of alternative imaging techniques and their role in the evaluation of cardiac sources of emboli.

Specific guidelines are provided for each category of embolic sources including the left atrium and left atrial appendage, left ventricle, heart valves, cardiac tumors, and thoracic aorta. In addition, there are recommendation regarding pulmonary embolism, and embolism related to cardiovascular surgery and percutaneous procedures. The guidelines also include a dedicated section on cardiac sources of embolism in pediatric populations. (J Am Soc Echocardiogr 2016;29:1-42.)

Saric *J Am Soc Echocardiogr* 2016;29:1-42

Infective Endocarditis

2015 AHA Guidelines - What's new

- Overall incidence increasing
 - Increased average age
 - IV drug use
 - Increased intracardiac devices/prosthetic valves
- Staph aureus now most common organism
- Echo/Duke criteria still primary dx tools
- New imaging techniques
 - 3D-echo
 - Head-to-toe multislice CT
 - Cardiac MRI

continued . . .

Infective Endocarditis

2015 AHA Guidelines - What's new

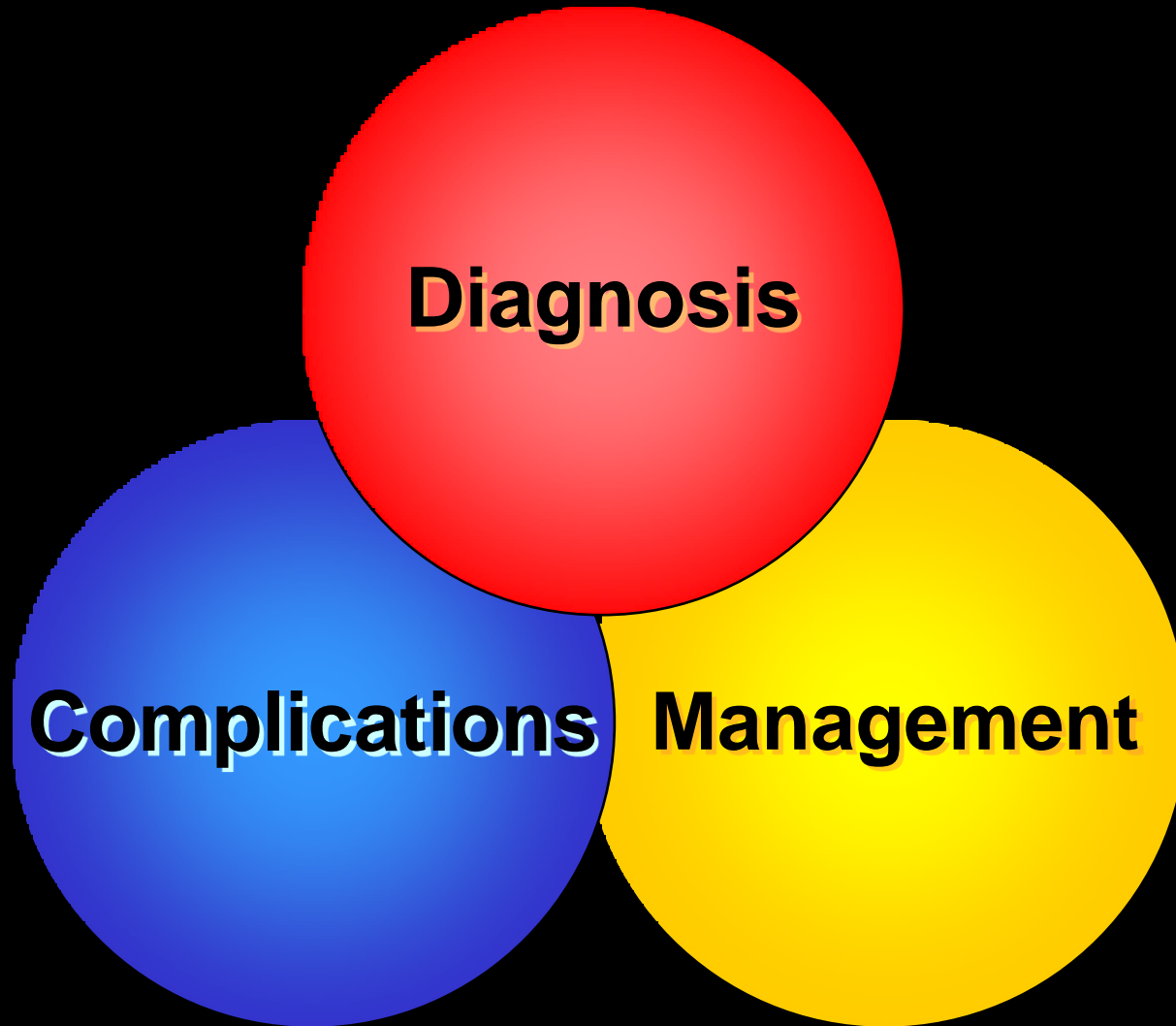
- Multidisciplinary IE Teams
- Repeat echo in 3 – 5 days if suspicion despite negative initial TEE
(compared w/2005 recommendations → 7–10 days)
- Patients undergoing surgery ≈ 50%
- Discontinuation of AC controversial

Infective Endocarditis

Role of Echocardiography

- Identify predisposing heart disease
- Establish diagnosis
- Detect complications
- Determine prognosis (risk of complications)
- Assess hemodynamic consequences
- Serial evaluation

Echo in Endocarditis





Diagnosis

March 7, 1985

THE BRITISH MEDICAL JOURNAL

THE GULSTONIAN LECTURES,
ON
MALIGNANT ENDOCARDITIS.

Delivered at the Royal College of Physicians of London, March, 1885.

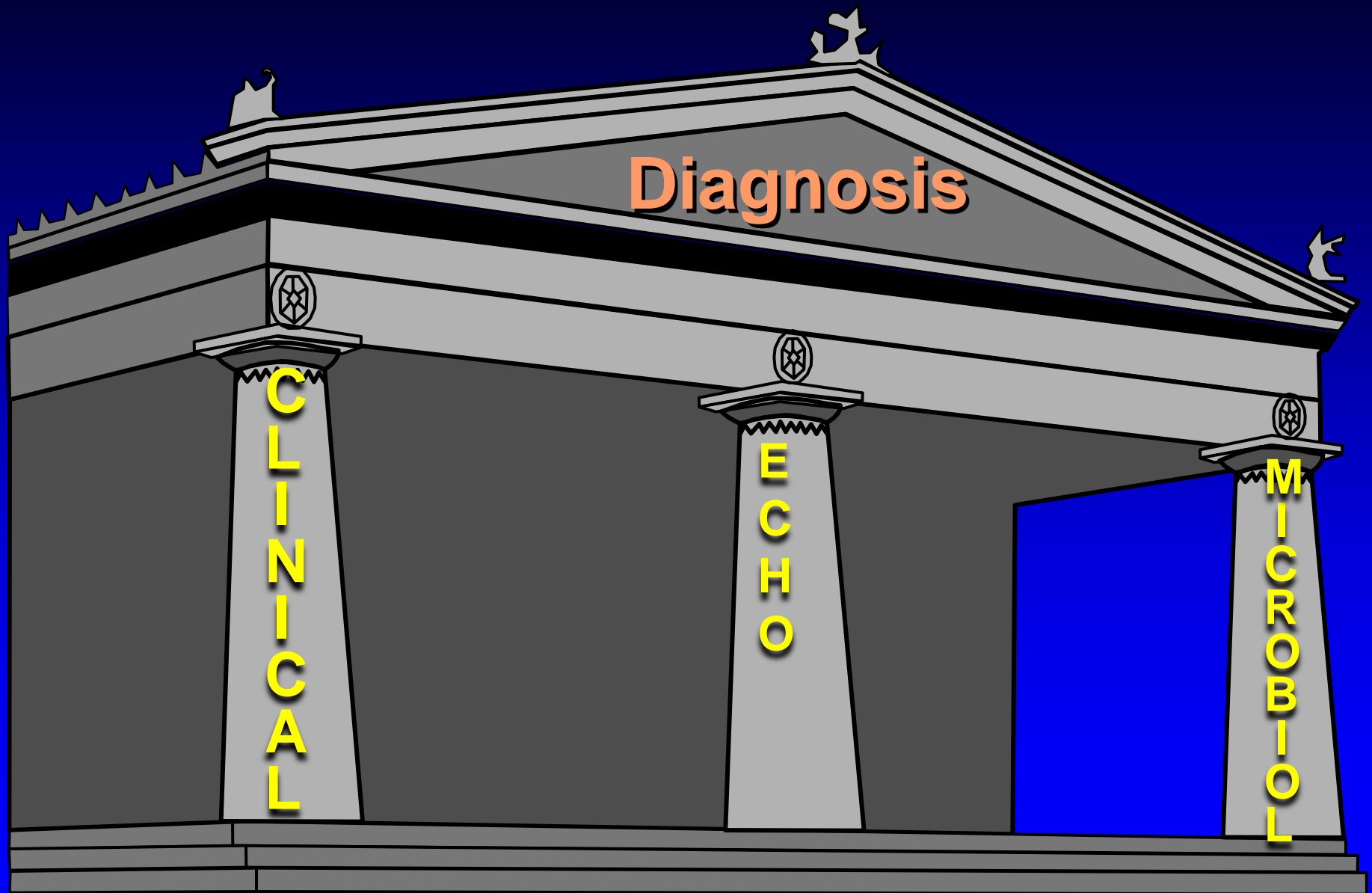
BY WILLIAM OSLER, M.D.,

Professor of Clinical Medicine at the University of Pennsylvania, Philadelphia.

The protean character of the malady, the latency of the cardiac symptoms, and the close simulation of other disorders, combine to render the detection peculiarly difficult.

it is only in recent years that the text-books have contained chapters upon it. The protean character of the malady, the latency of the cardiac symptoms, and the close simulation of other disorders, combine to render the detection peculiarly difficult.

Infective Endocarditis



Diagnosis of Infective Endocarditis

Duke Criteria

- Empirically derived, retrospectively tested, prospectively validated
- Has become standard for all current studies on infective endocarditis
- Original data based solely on TTE
- Shortcomings of original criteria have led to recent proposed modifications

Diagnosis of Infective Endocarditis

Shortcomings of Duke Criteria

- “Possible IE” group too broad
- Relative risk of IE in *Staph Aureus* bacteremia under-recognized
- Poor diagnostic sensitivity in suspected Q-fever IE
- Role of TEE not included

Diagnosis of Infective Endocarditis

Proposed Modifications of Duke Criteria

- Redefinition of “Possible IE”
 - Old: 1 minor criteria *and* did not meet criteria for “rejected IE”
 - New: 1 major and 1 minor criteria *or* 3 minor criteria
- **Echocardiographic minor criteria eliminated**
- Presence of *S. aureus* bacteremia should be considered a major criteria
(regardless of whether infection is nosocomially acquired or whether a removable source of infection is present)
- Single blood culture positive for *C. burnetii* or antiphase I IgG antibody titer $\geq 1:800$ should be major criteria

- **TEE recommended in select patients**

Li et al
Clin Inf Dis 30:633(2000)

**The Duke criteria and echocardiography
are still the primary tools for diagnosing
endocarditis**



Smart Tools

Diagnostic Criteria for Endocarditis

- 1994 → Duke criteria¹: Major and minor criteria
 - Echo, microbiology, clinical
 - 3 categories: definite, possible, rejected
- 1990s (mid-late) → 12 major studies
 - Nearly 1700 patients
 - Confirmed high sens/spec Duke
- 2000 – Li² → modification of Duke criteria
 - Universally accepted
 - In current use

¹Durack Am J Med 96:200(1994) ²Li Clin Infect Dis 200;30:633-638

Developments in Endocarditis that Improved Diagnosis and Prognosis

- Antibacterial therapy
- Clinical microbiology
- Cardiac imaging (echocardiography)
- Cardiac surgery

Infective Endocarditis

Reasons for False Negative Echos

- Poor acoustic window(s)
- Small vegetations (< 3 mm)
- Recent embolization
- Nonoscillating vegetations
- Atypically located vegetations
- Pre-existing cardiac lesions
 - Degenerative or sclerotic valves
 - Prosthetic valves
 - Intracardiac devices

Infective Endocarditis

Causes of False Negative TTE Studies

- Prosthetic valve
- Small vegetation <5 mm
- Poor acoustic window for any reason
- Incomplete visualization of all portions of a valve

Infective Endocarditis

Unusual Sites of Infection

- Mural endocardium
- Chordae tendinae
- Eustachian valve
- Pacemaker wire
- Calcified mitral annulus
- Mural thrombus

What is Vegetation ?

Clump of infected material consisting of fibrin, platelets, red and white blood cells, and microorganisms



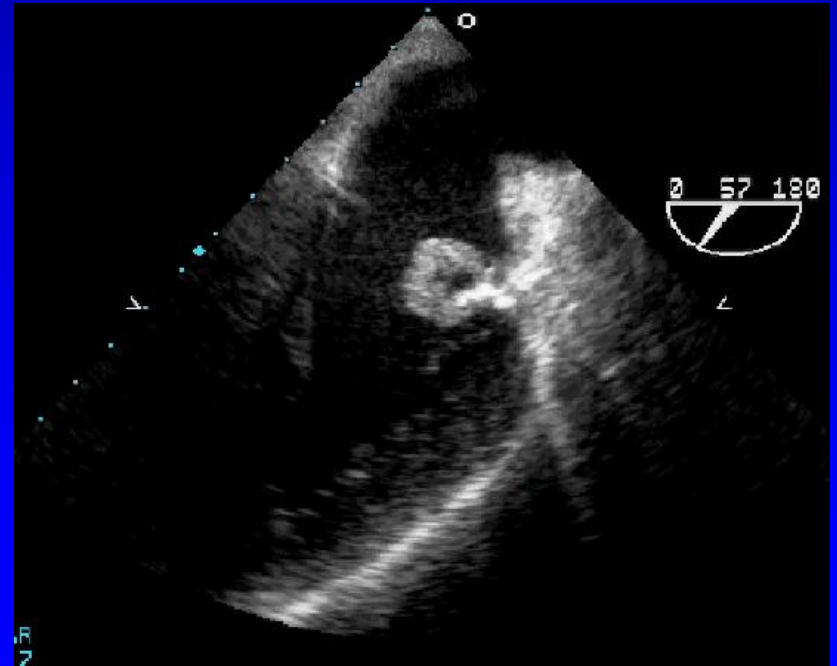




Echo Characteristics of Infective Endocarditis

Vegetation Irregularly shaped, discrete echogenic mass adherent to, yet distinct from cardiac surface.

Oscillation of mass supportive, not mandatory



Vegetations → (Echo hallmark)

Echo Characteristics

- Localized echo-density
- Irregular shape (“shaggy”)
- Pedunculated or sessile
- Rarely impair valve motion
- Often flutter or vibrate

Echo Criteria for Defining a Vegetation

Positive Features	Negative Features
Low reflectance	High echogenicity
Attached to valve	Nonvalvular location
Irregular shape	Smooth surface
Pedunculated or sessile	-----
Mobile, oscillating	Nonmobile
Valve regurgitation	Absence of regurgitation

Where to Look for Vegetations

- LV side of aortic valve
- LA side of mitral valve
- RA side of tricuspid valve

Infective Endocarditis

Technical Tips

- Assess all valves in zoom mode
- Use highest possible tsdr frequency
- Place focal zone at level of valves
- Slow angulation and tilting through the valves from all possible views to image all aspects of the these 3D structures



87

27

87.28

0 95 180



27

87

27

Detection of Vegetations

	Sensitivity
TTE	40 – 80%
TEE	>95%

Sens/Spec depend on pre-test probability

Infective Endocarditis

Mimics of Vegetations

- Myxomatous degeneration
- Ruptured or redundant chordae
- Focal thickening or calcium deposits (e.g., MAC)
- Nodules of Arantius
- Retained mitral leaflets post MVR
- Lambl's excrescences
- Sutures, strands on prosthetic valves
- Thrombus, tumor (esp papillary fibroelastoma)



Complications

Infective Endocarditis

Structural Complications

- Leaflet rupture, flail
- Leaflet perforation
- Abscess
- Aneurysm
- Fistula
- Prosthetic valve dehiscence
- Embolization
- Pericardial effusion

Infective Endocarditis

Hemodynamic Complications

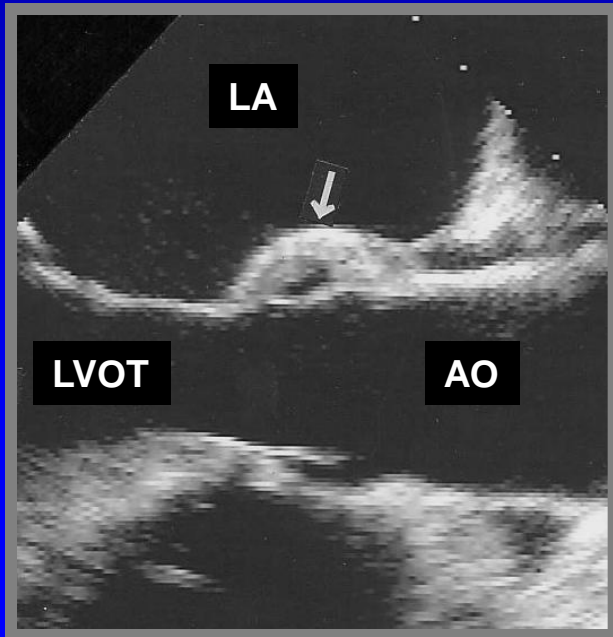
- Acute valvular regurgitation
- Heart failure
- Intracardiac shunt
- Cardiac tamponade
- Valve obstruction
- Hemolysis

Echo Characteristics of Infective Endocarditis

Abscess

Thickened area or mass within the myocardium or annular region

Appearance is nonhomogeneous and may be echogenic, echolucent or both

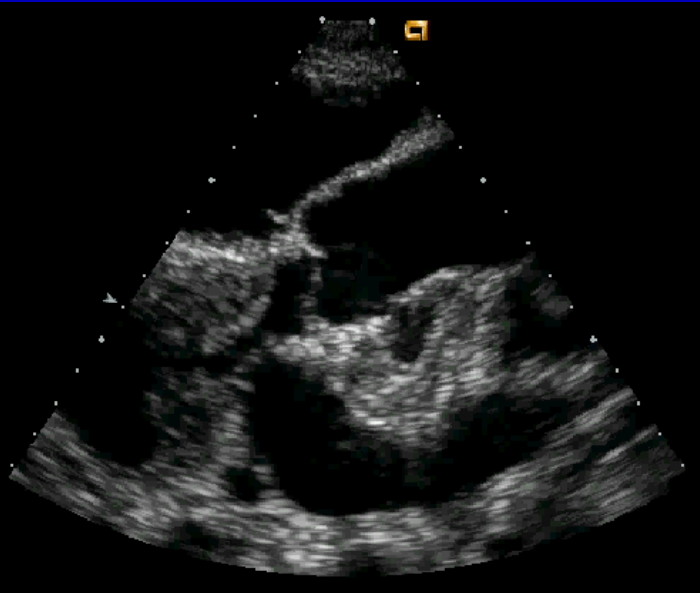


Echo Characteristics of Infective Endocarditis

Abscess

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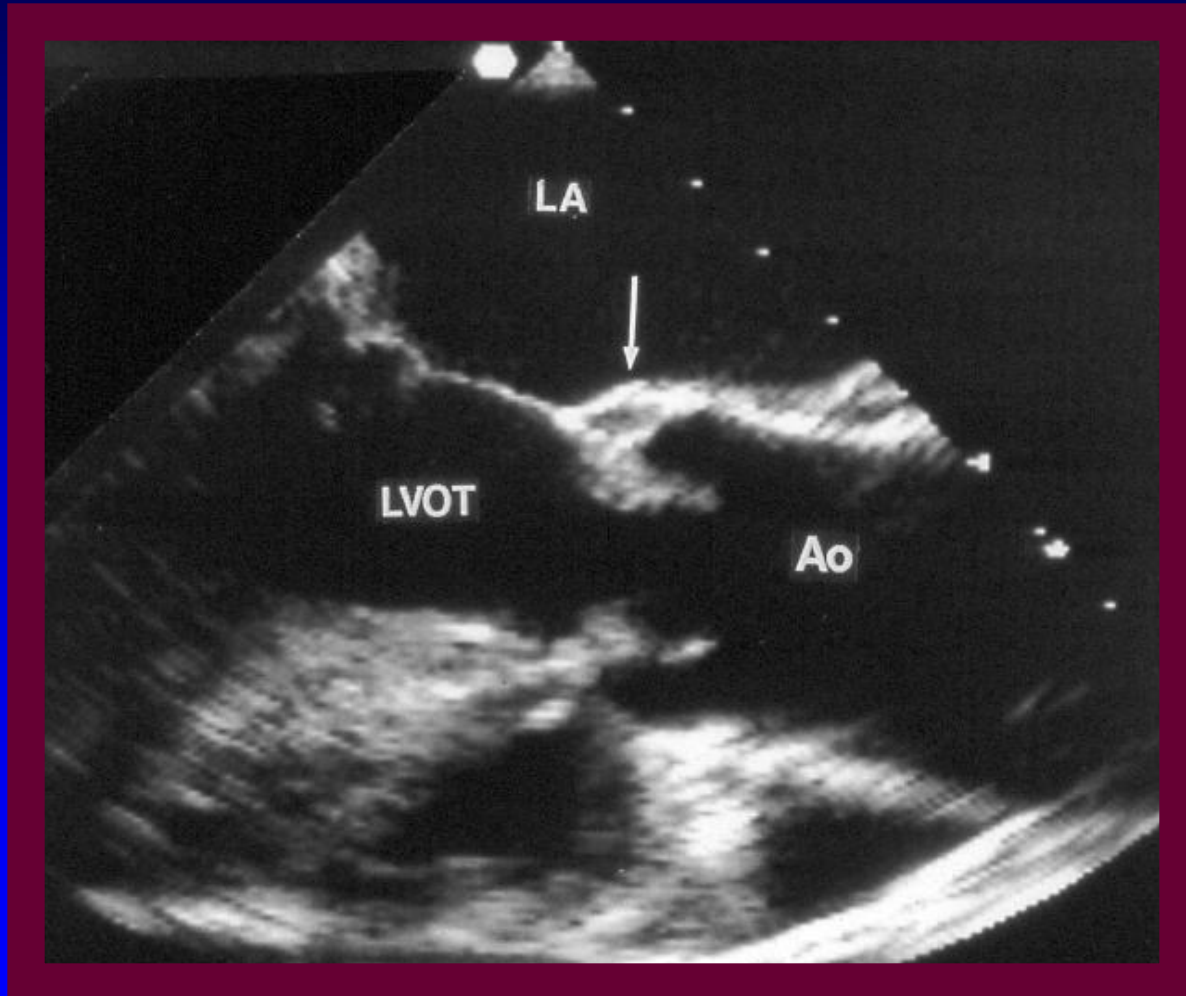


Perivalvular Abscess

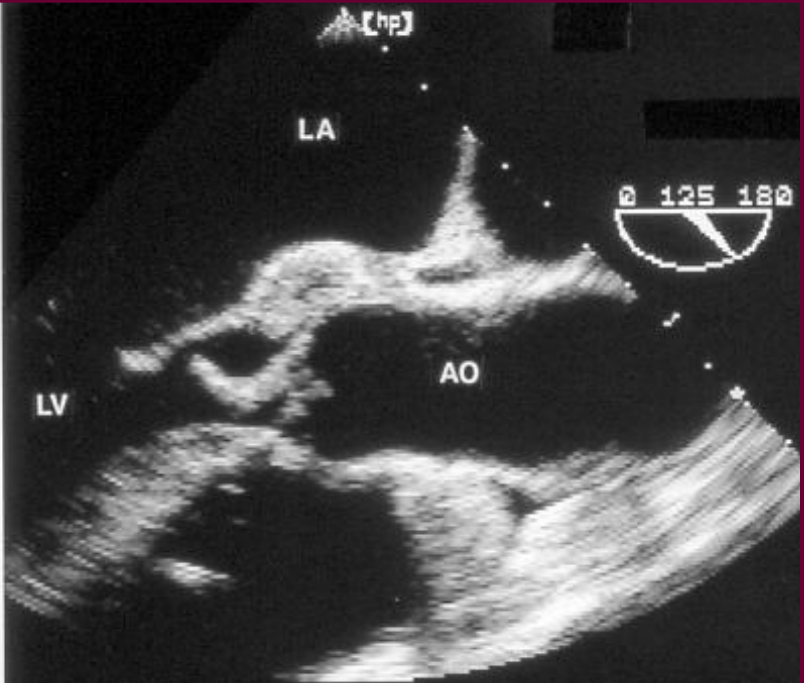
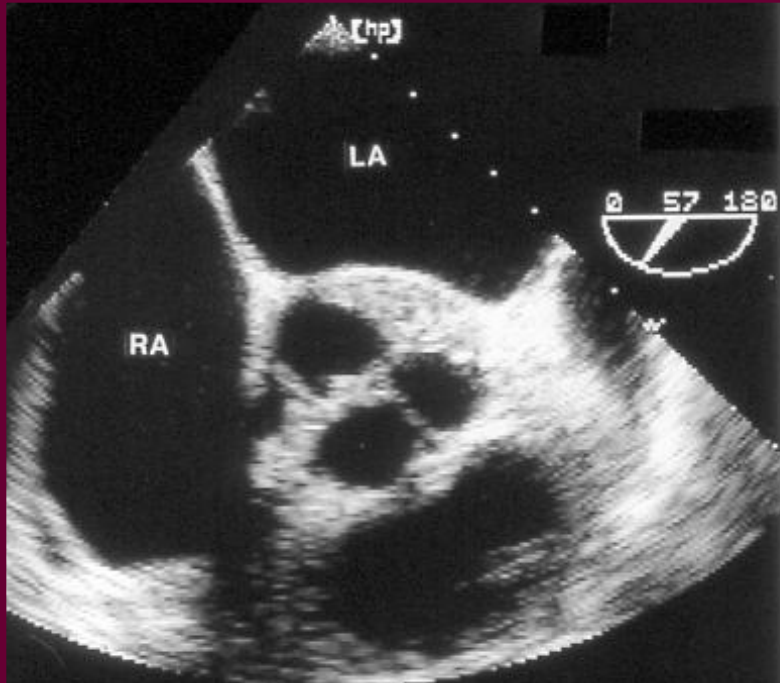
Echo Features

- Walled-off echo-free space
- Focal thickening of aortic wall
- Echo-density in ventricular septum
- Rocking of prosthetic valve
- Sinus of Valsalva aneurysm

Small Posterior Periaortic Abscess



Periaortic Abscess



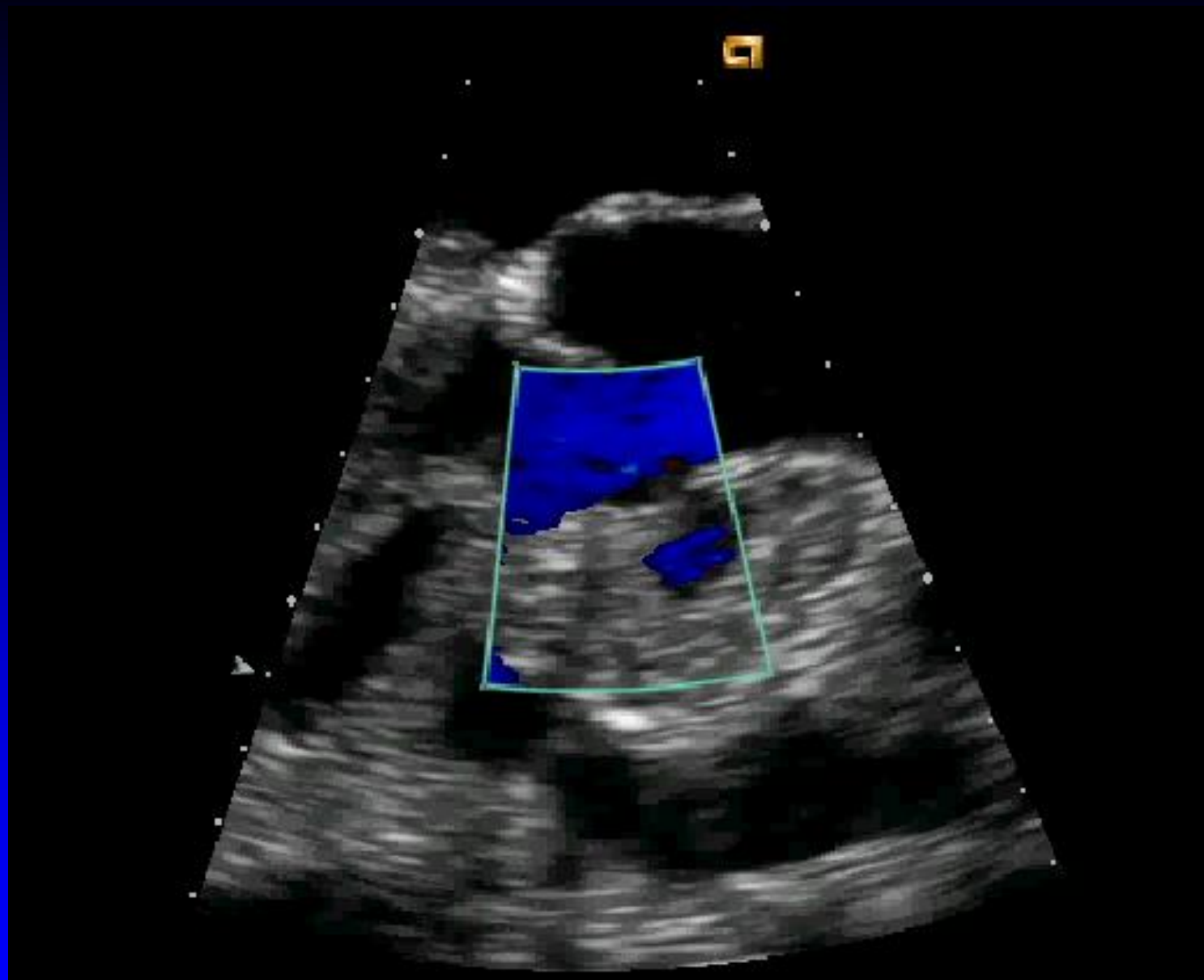
Periaortic Abscess



Perivalvular Abscess

When Diagnosis May Be Difficult

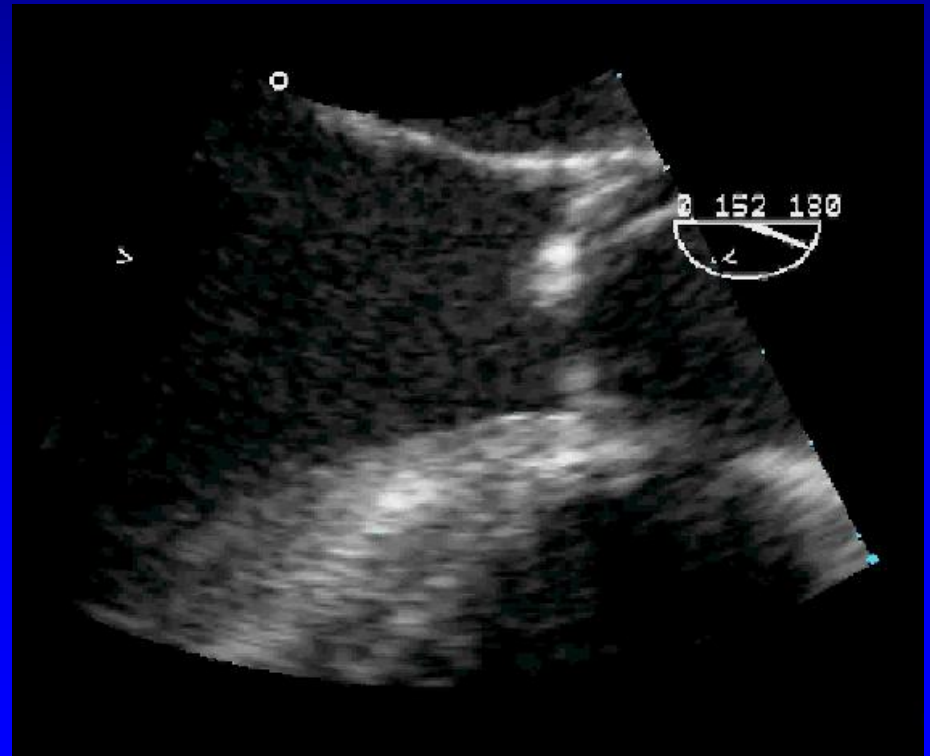
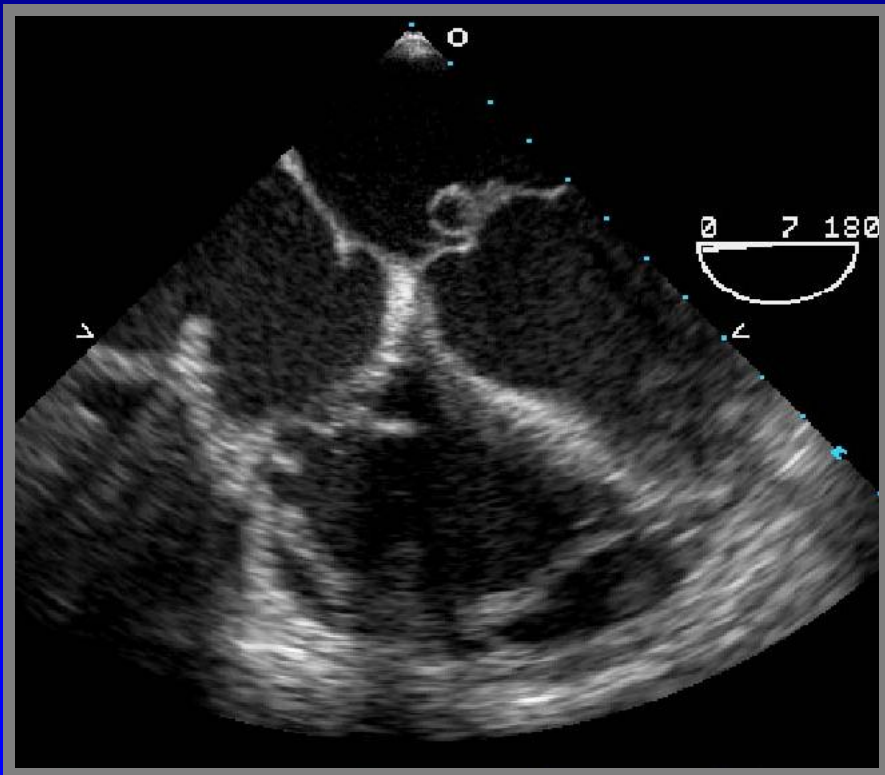
- Small abscess
- Echo performed very early in course
- Abscess localized around calcification in posterior mitral annulus
- Prosthetic valves

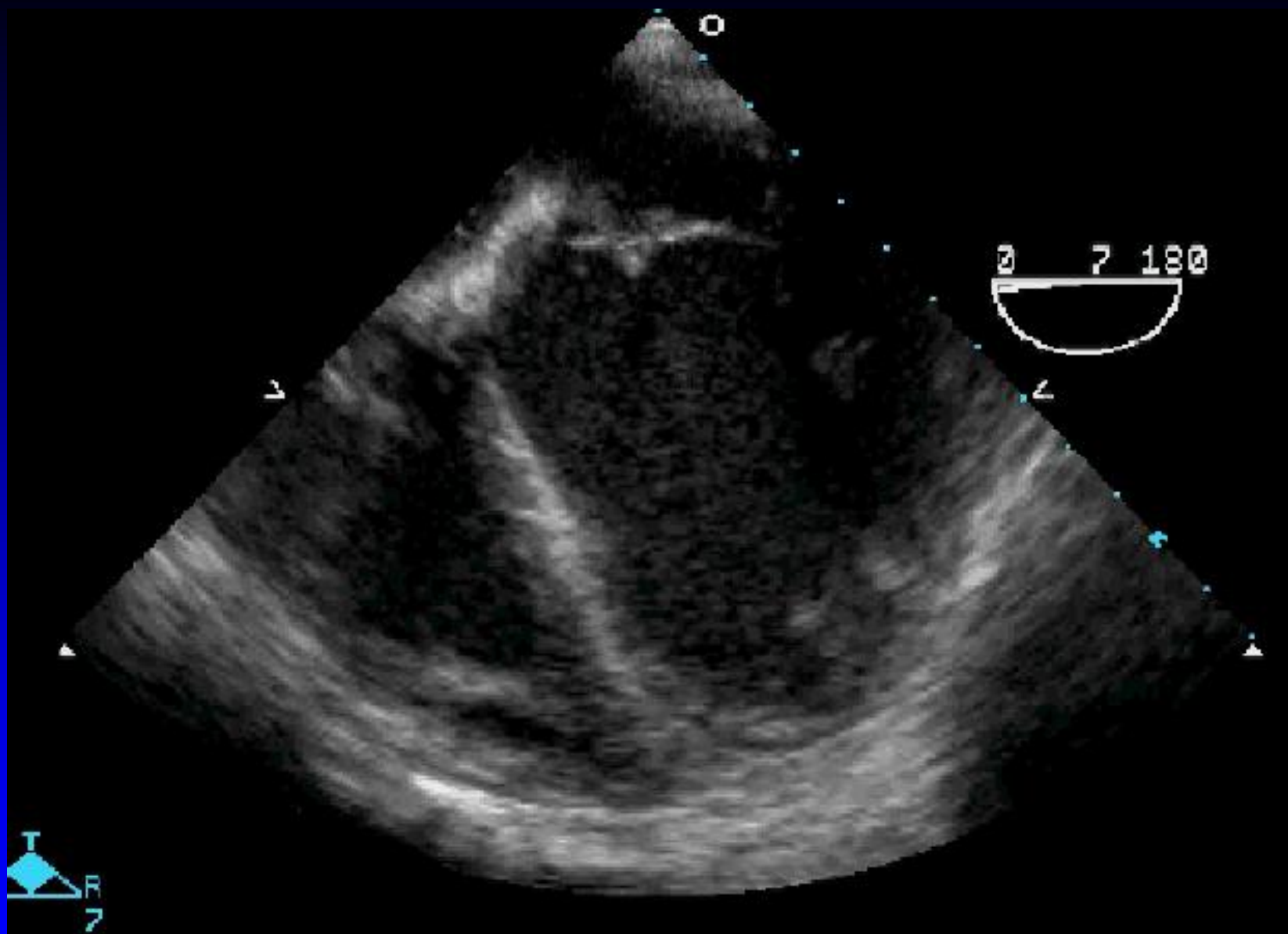


Echo Characteristics of Infective Endocarditis

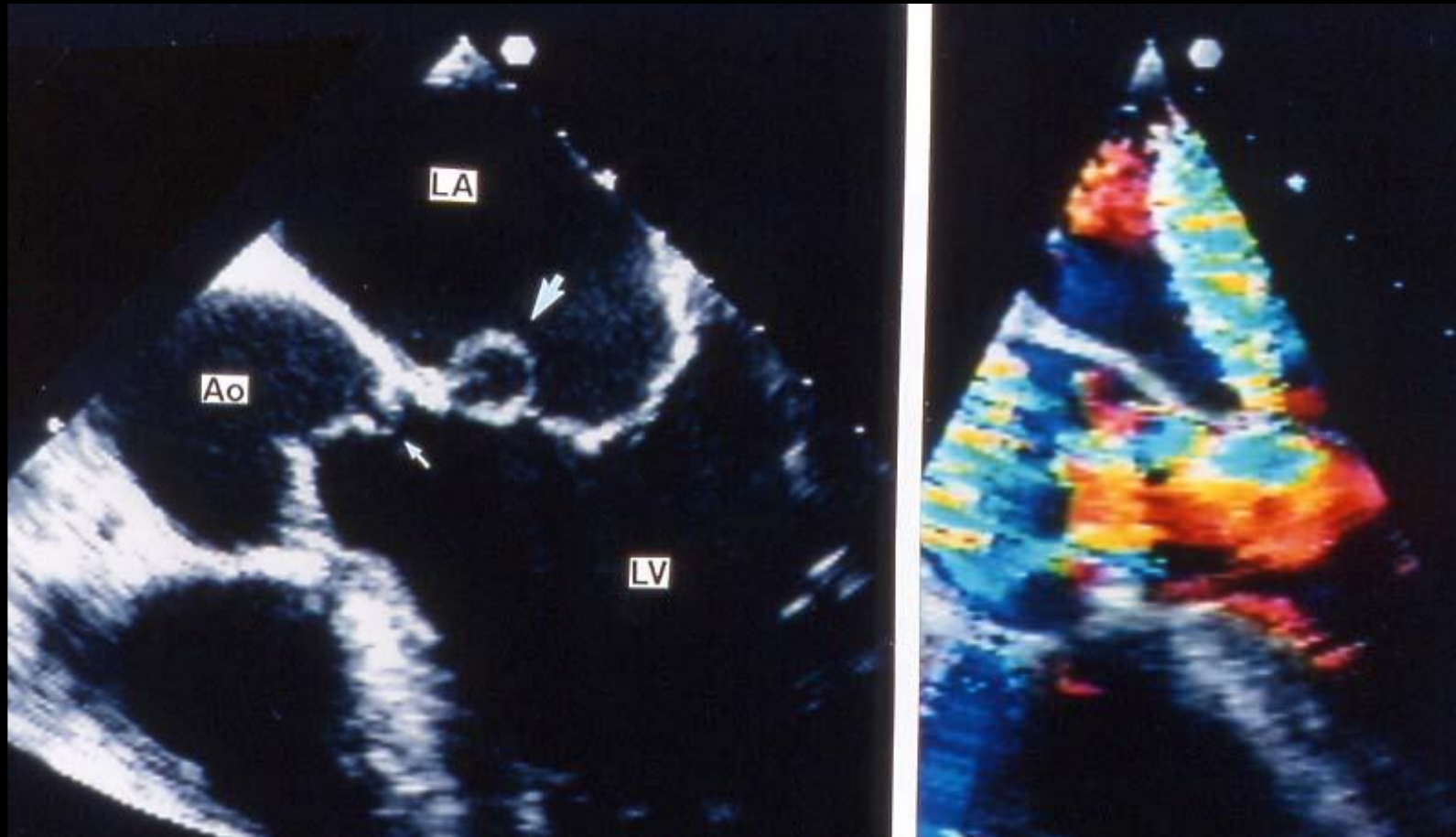
Aneurysm
(pseudoaneurysm)

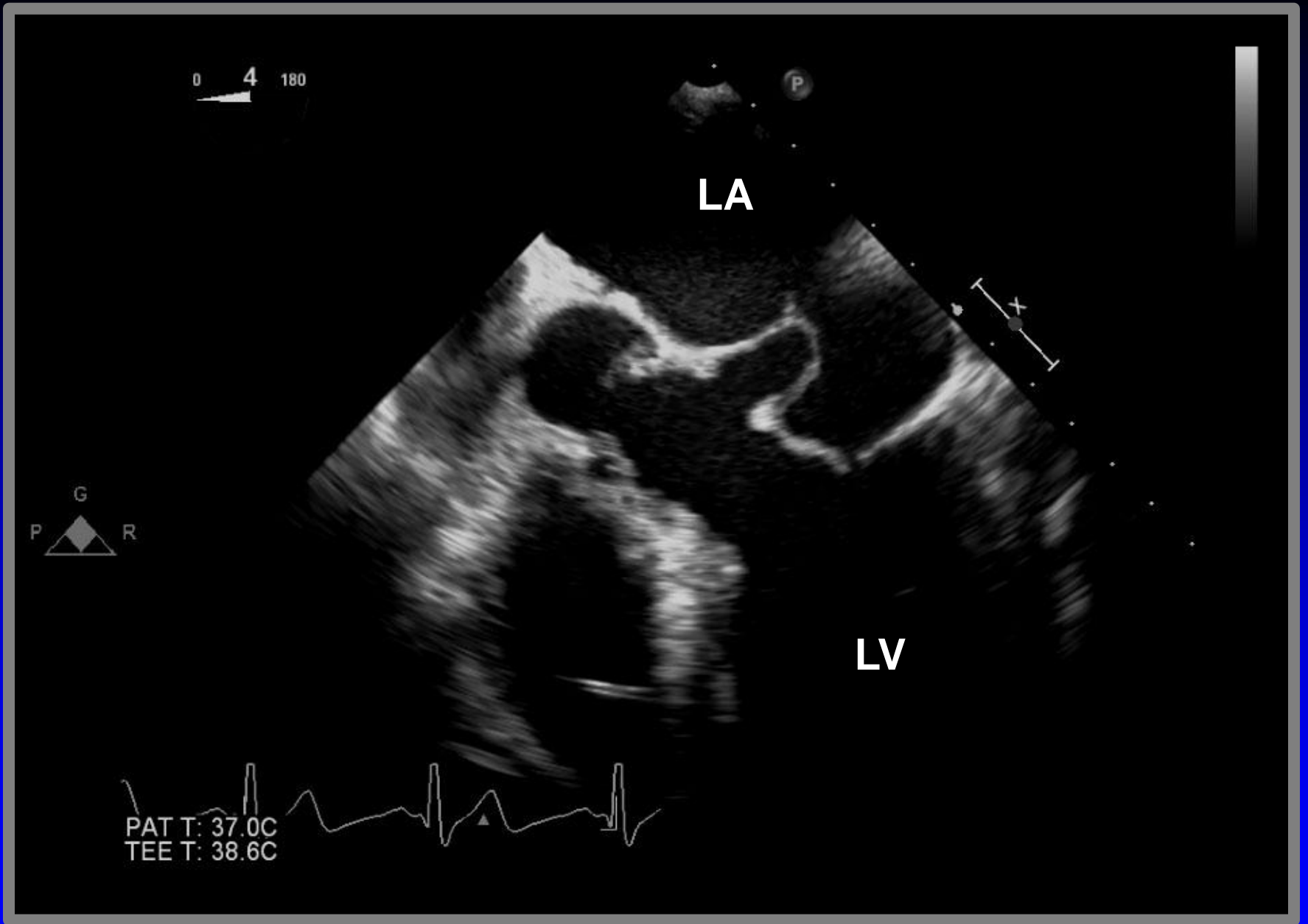
Echo-free space bounded by thin tissue; often pulsatile; color Doppler flow often detected within





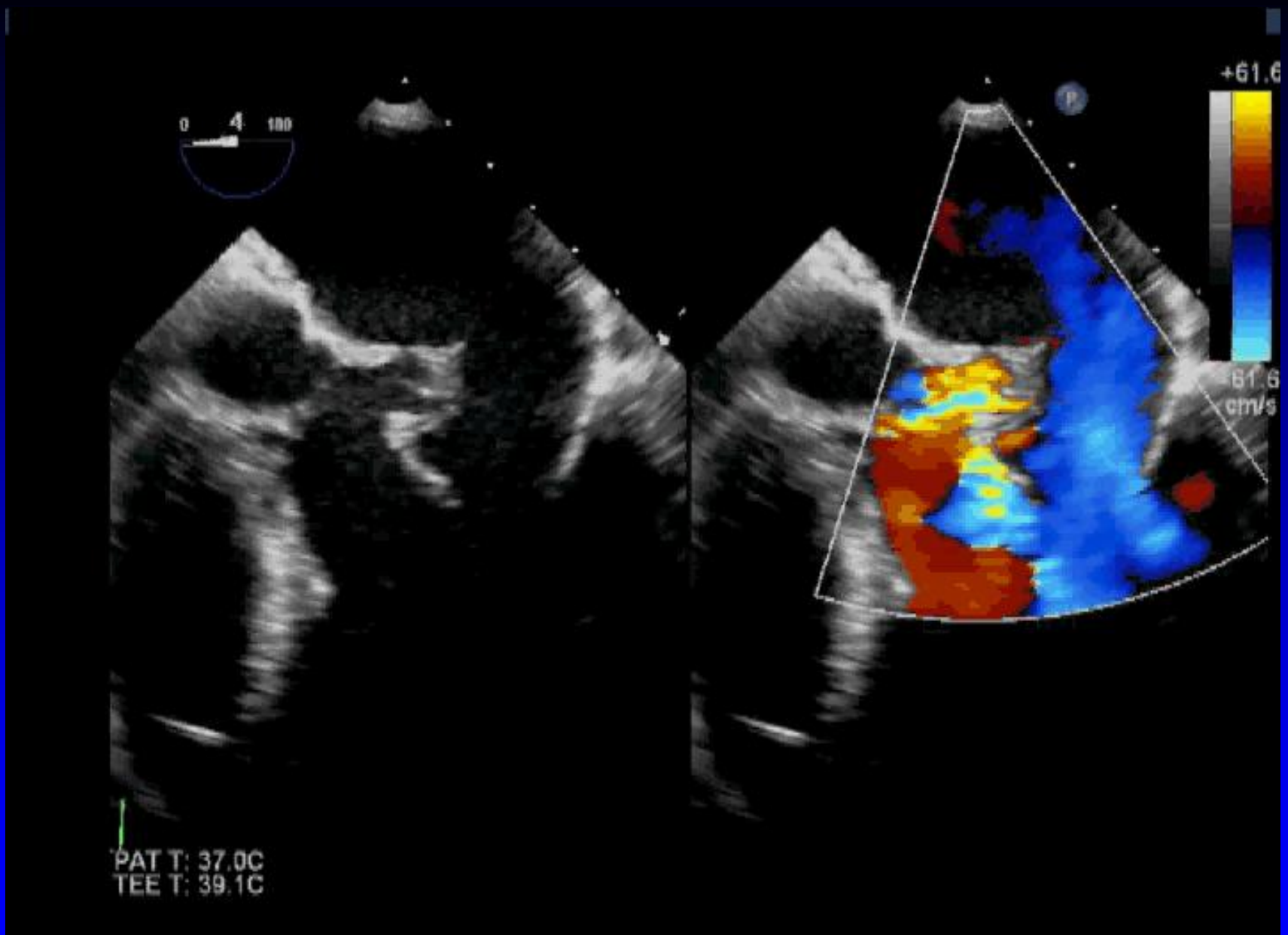
Mitral and Aortic Valve Aneurysms



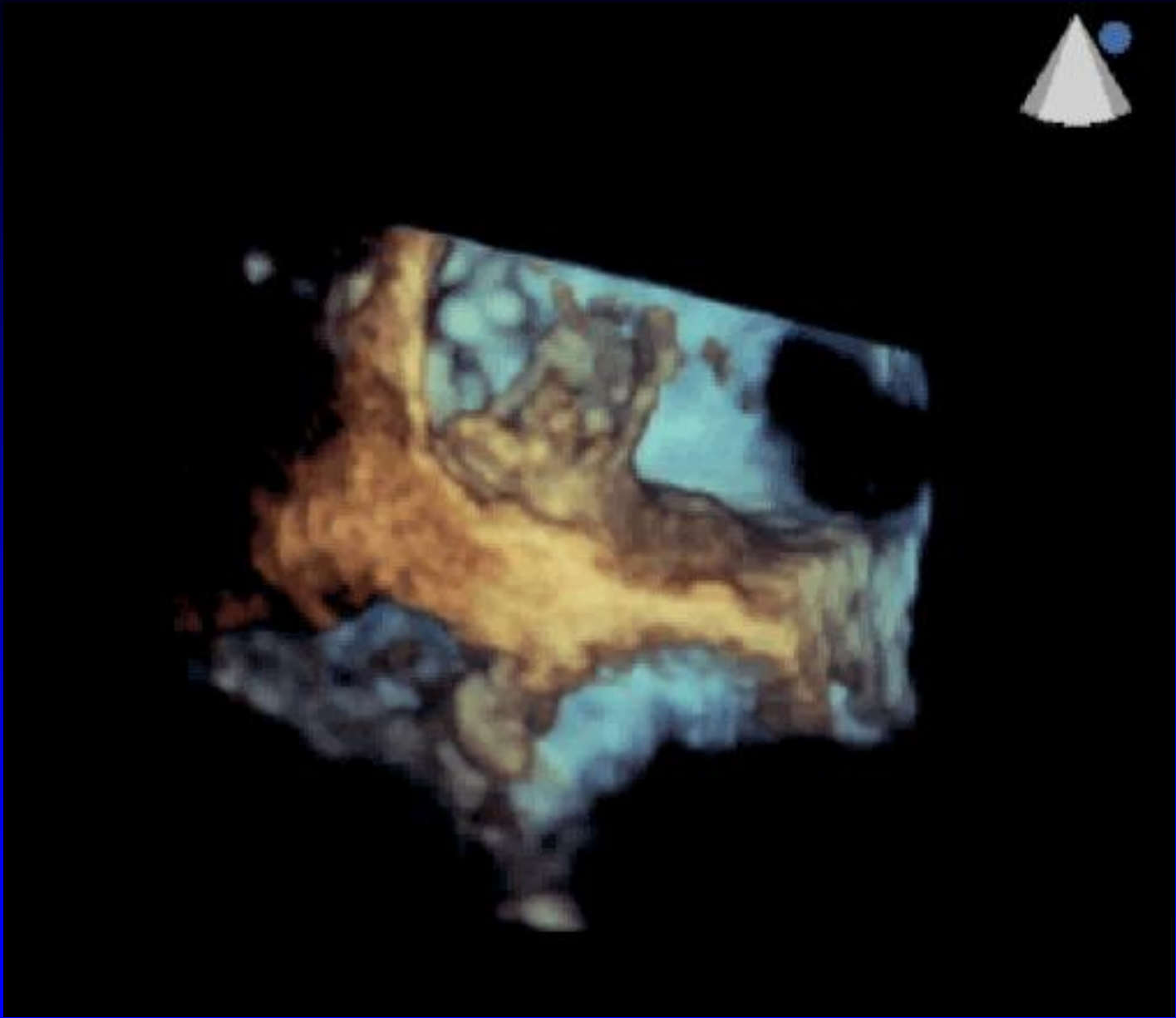


Another Case

a



b



C

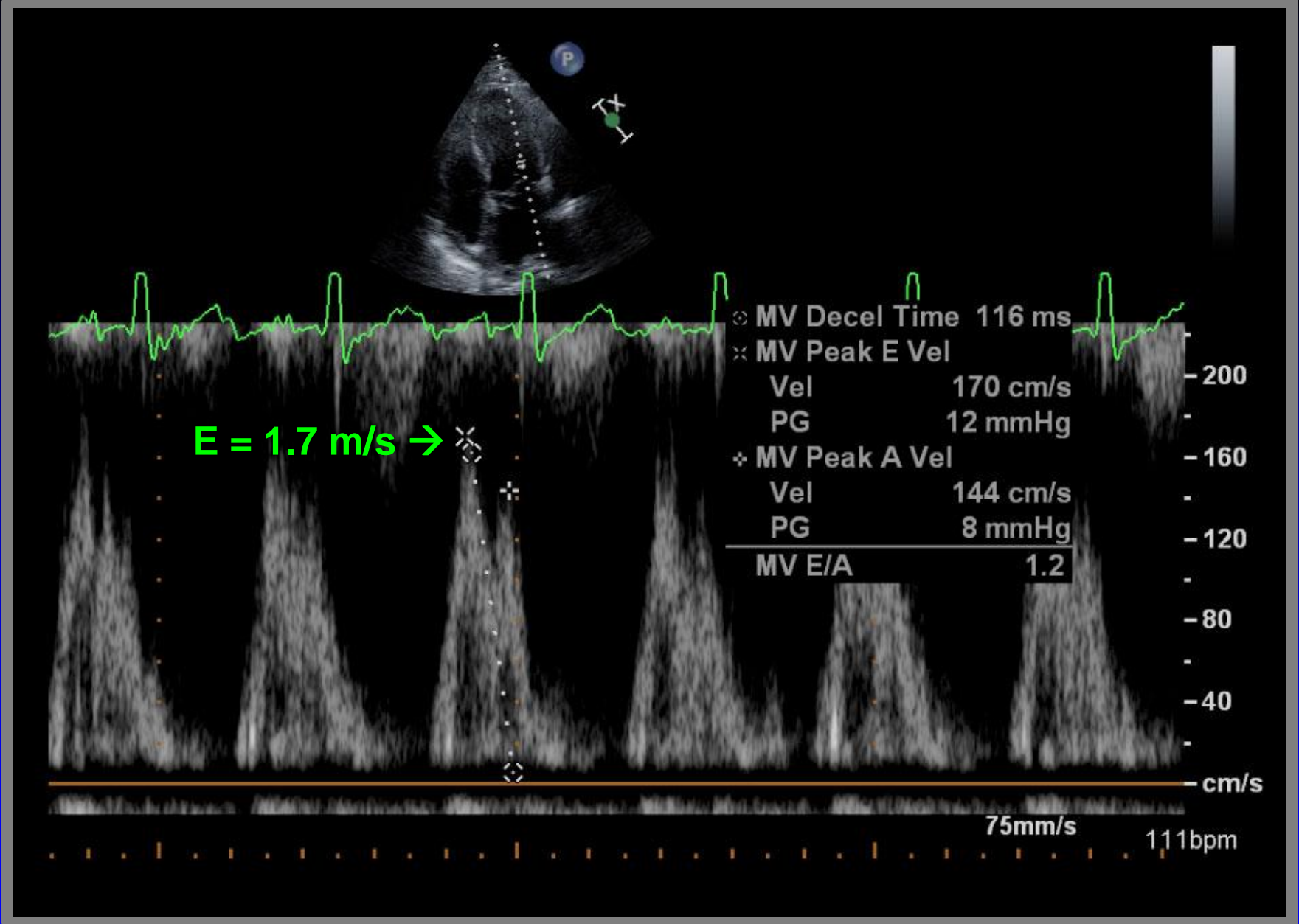
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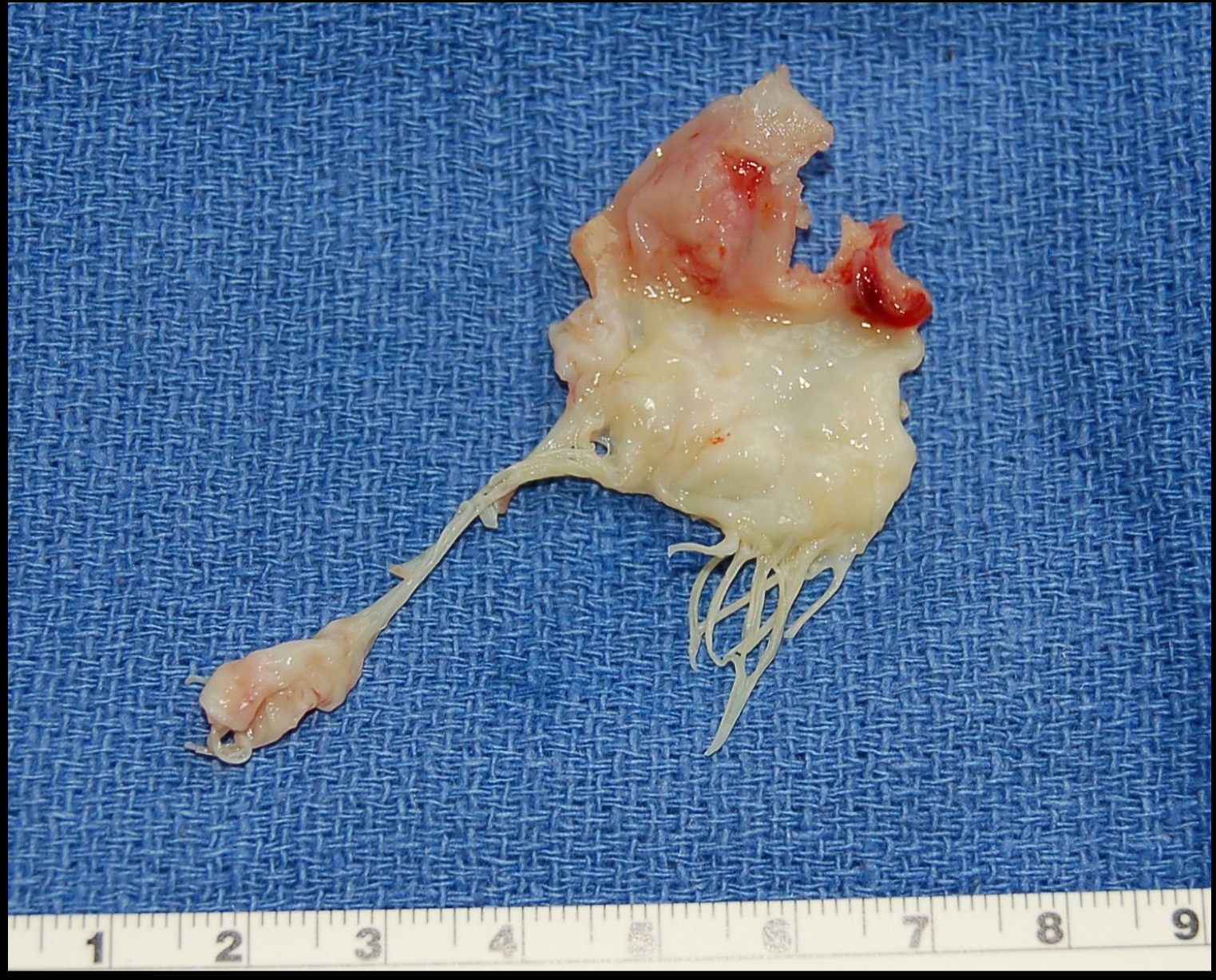




Left upper pulmonary vein



Aortic Valve



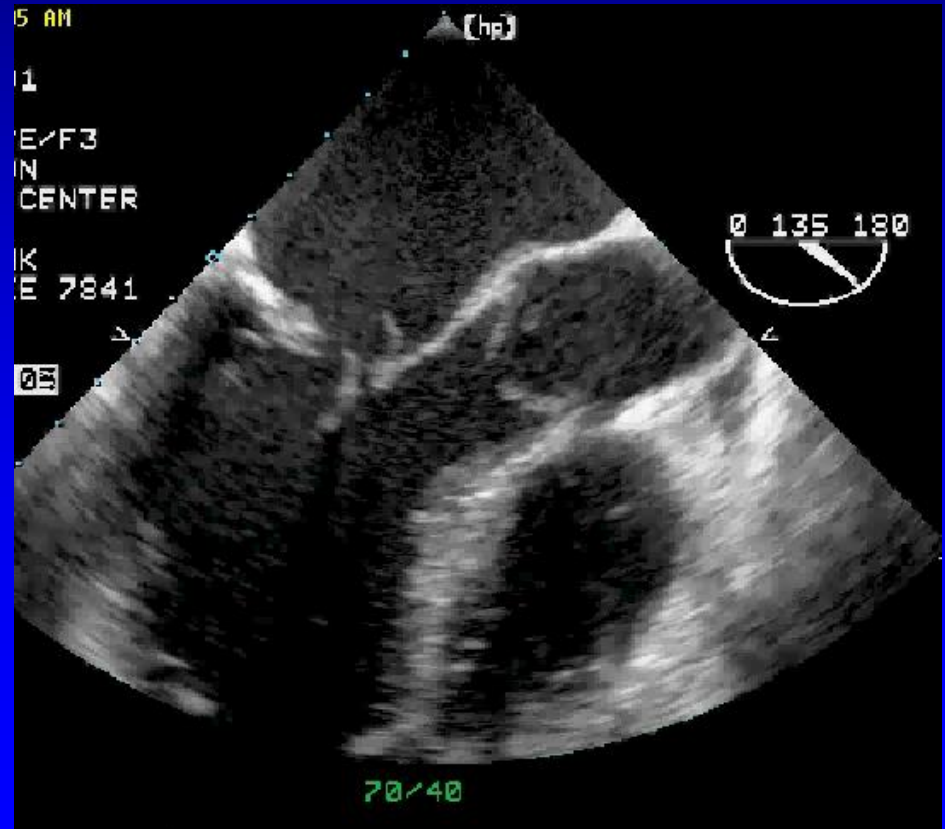
Mitral valve from LA side



Mitral valve from LV side

Echo Characteristics of Infective Endocarditis

Perforation Defect in body of valve leaflet with evidence of flow through defect



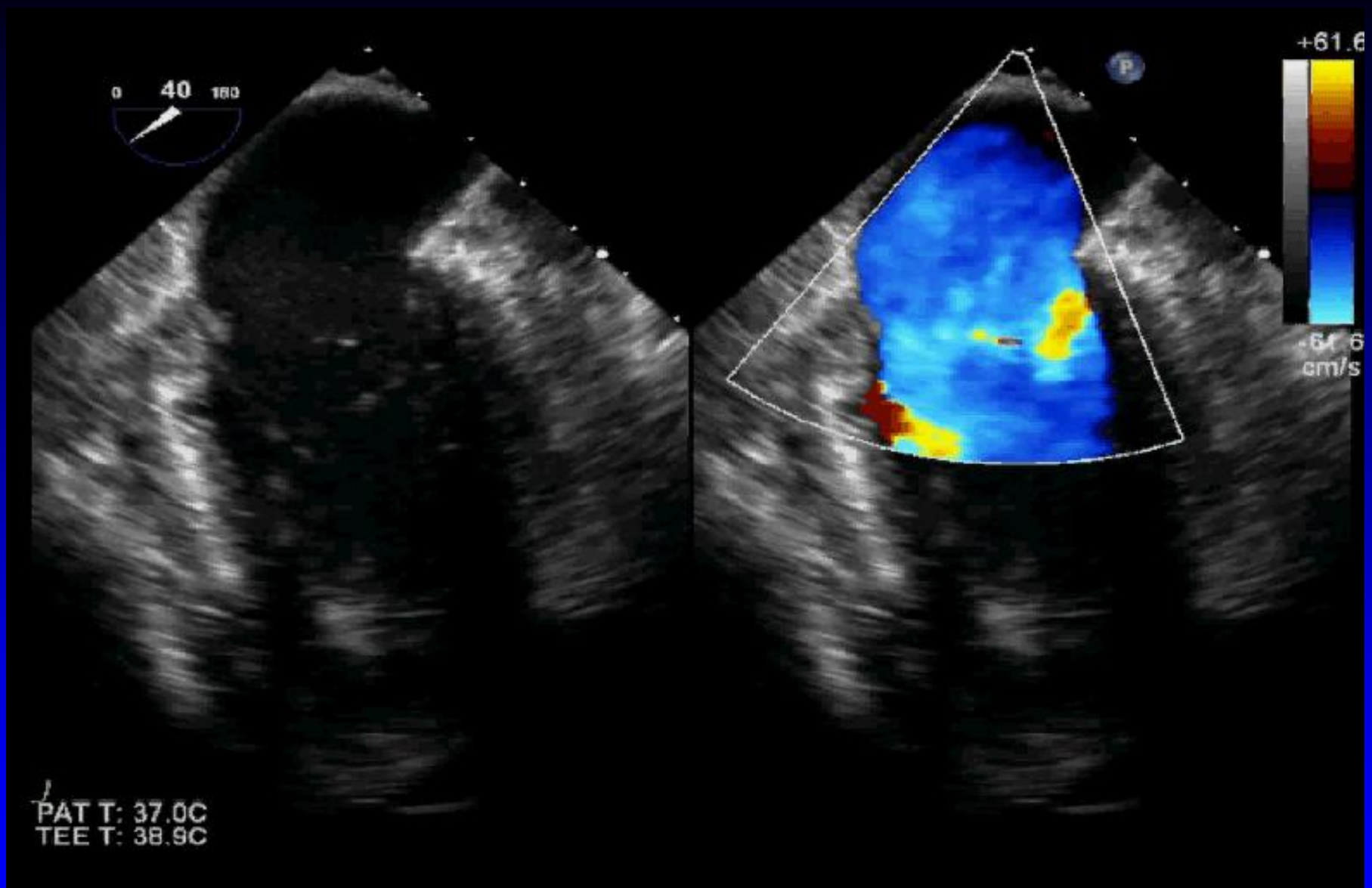
Perforation



P



T: 37.0C
T: 39.1C



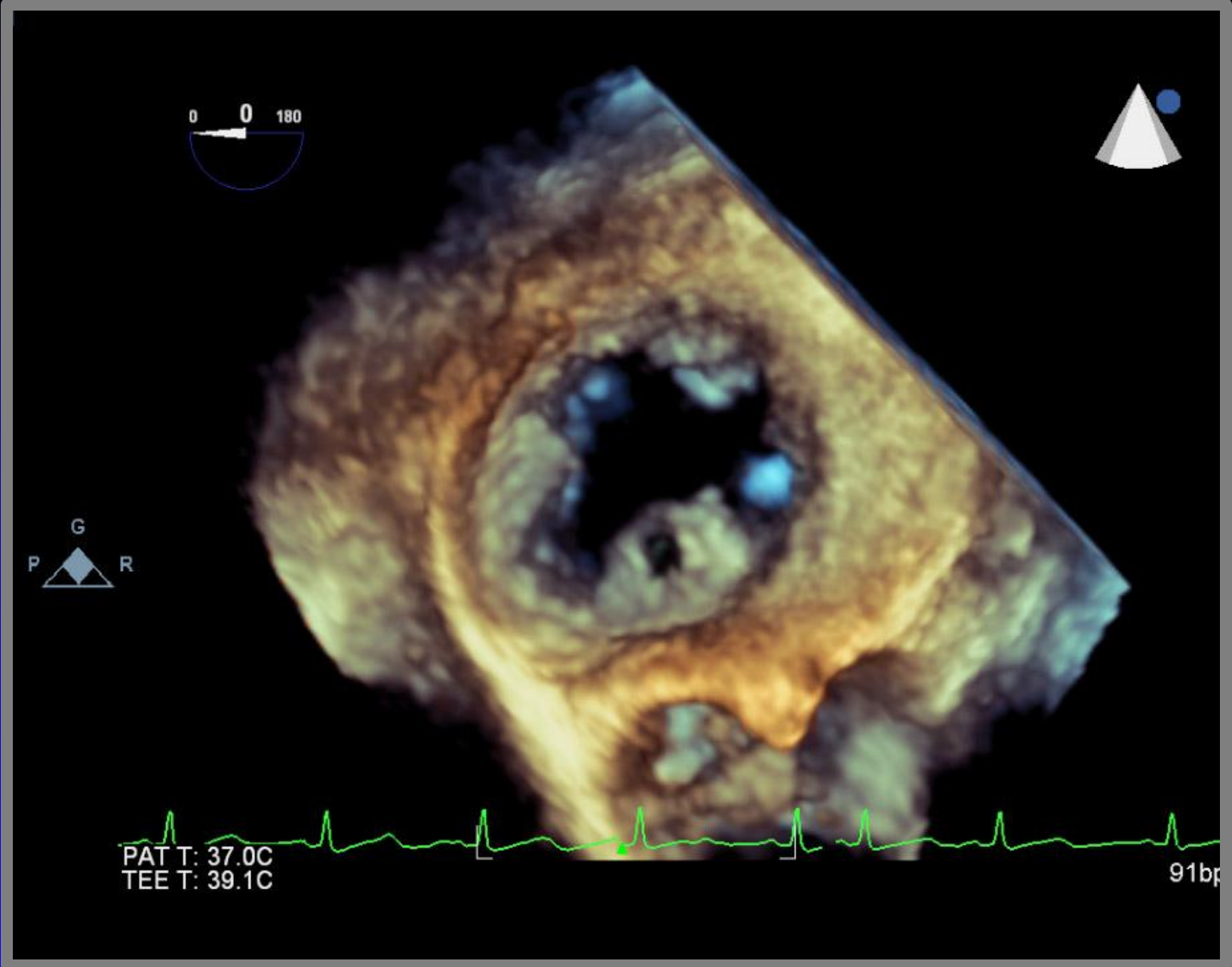
Perforation

82 180

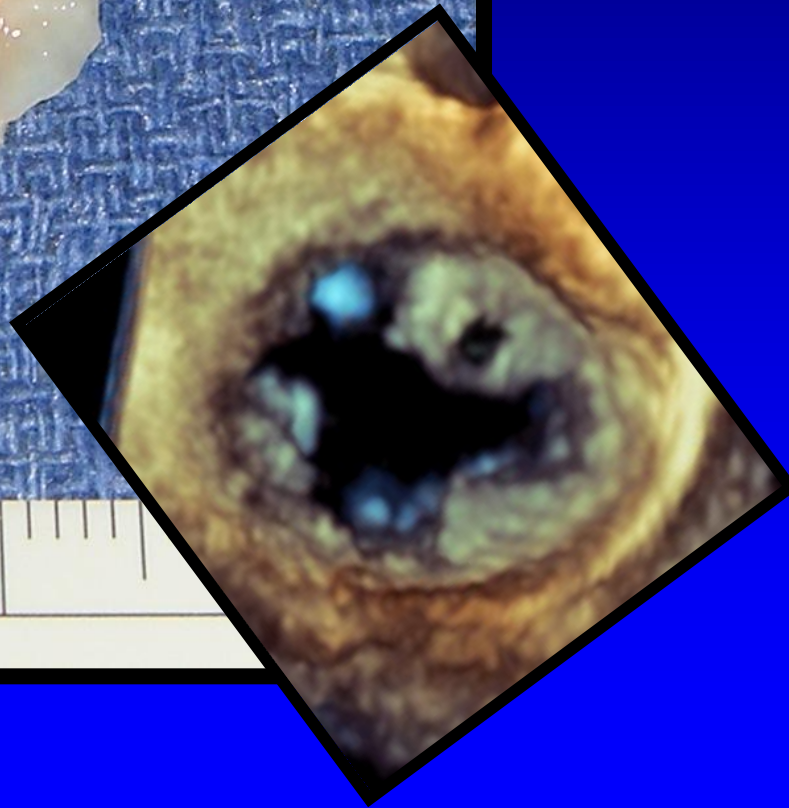


37.0C
39.0C

Perforation

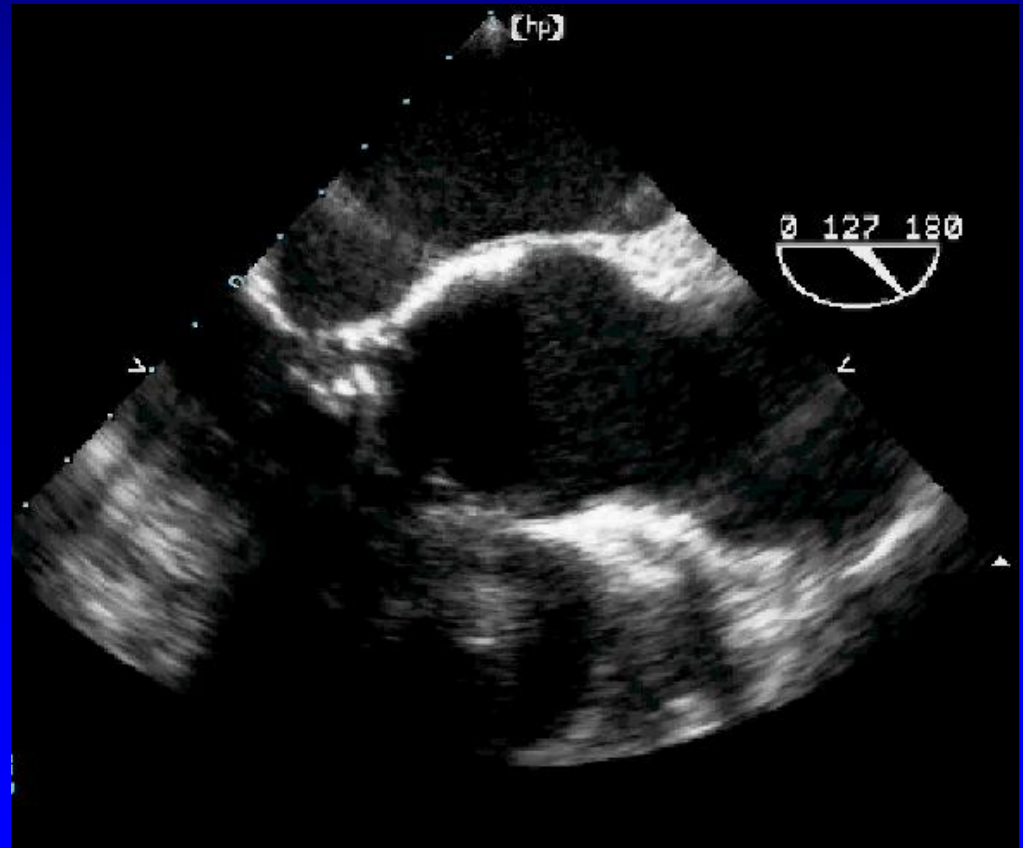
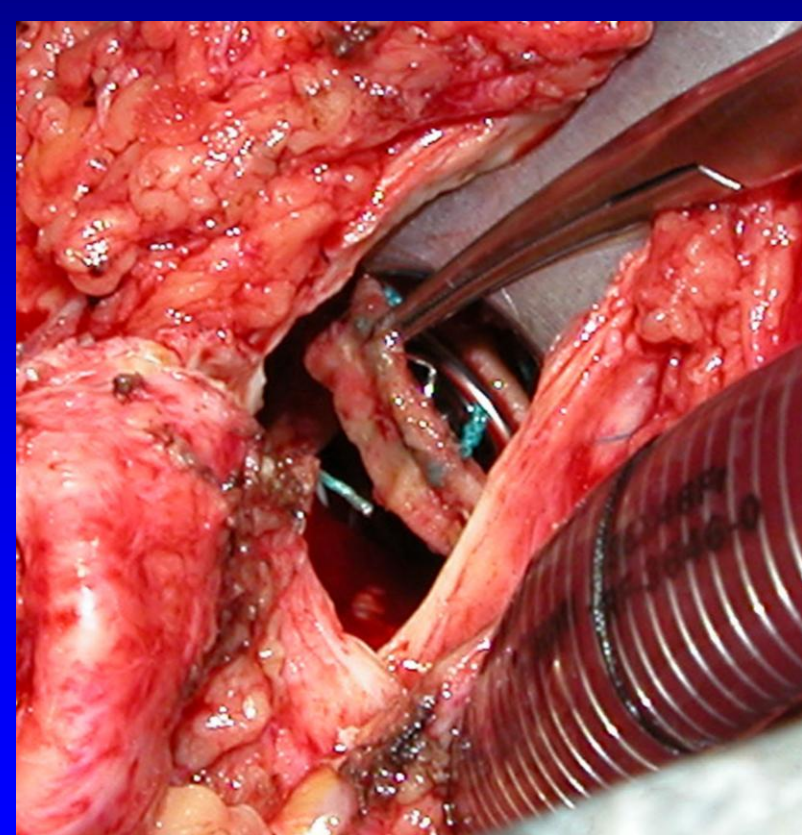


Perforation



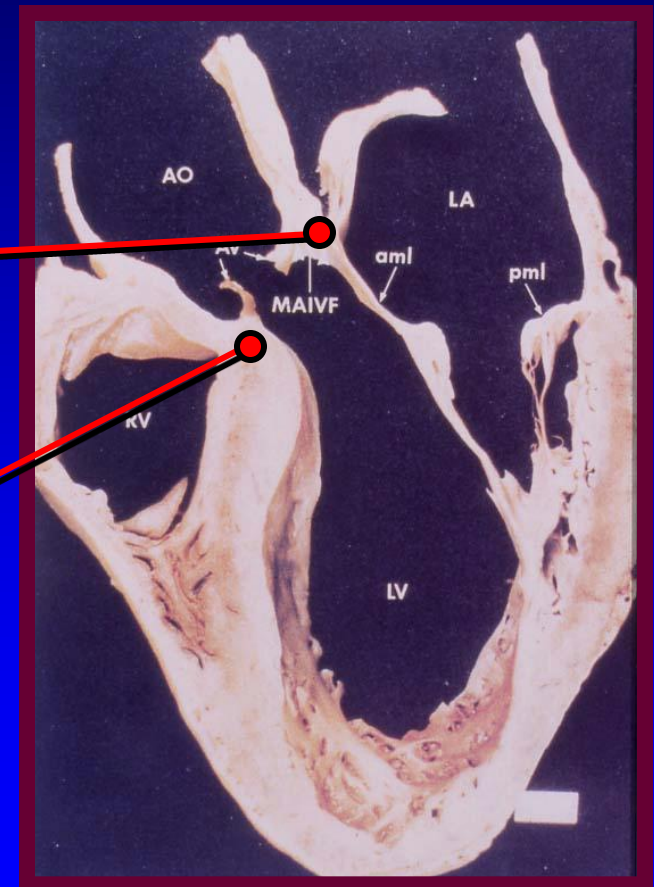
Echo Characteristics of Infective Endocarditis

Dehiscence Rocking motion of prosthetic valve with excursion $>15^\circ$ in at least one direction



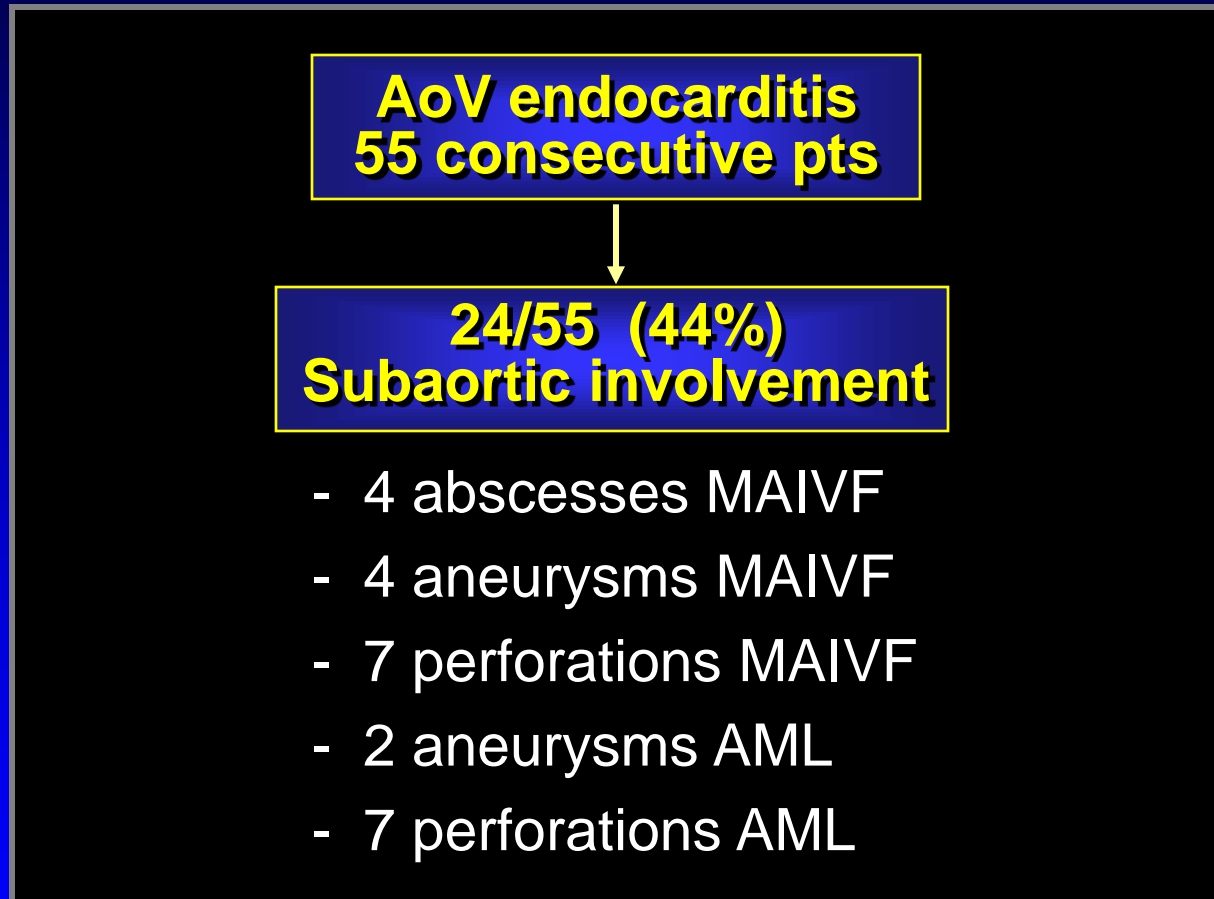
Periannular Abscess

- Aortic annulus
- Mitral-aortic intervalvular fibrosa
- Aorto-septal junction



Aortic Valve Endocarditis

TEE Recognition of Subaortic Complications



Karalis et al (Hahneman & Loma Linda)

Circulation 86:353(1992)

Detection of Subaortic Complications

Comparison of TEE vs TTE

Methods	n	%
TEE	22/24	92
TTE	5/24	21

Karalis et al (Hahnemann and Loma Linda)
Circulation 86:353(1992)

Cases

Infective Endocarditis

Summary

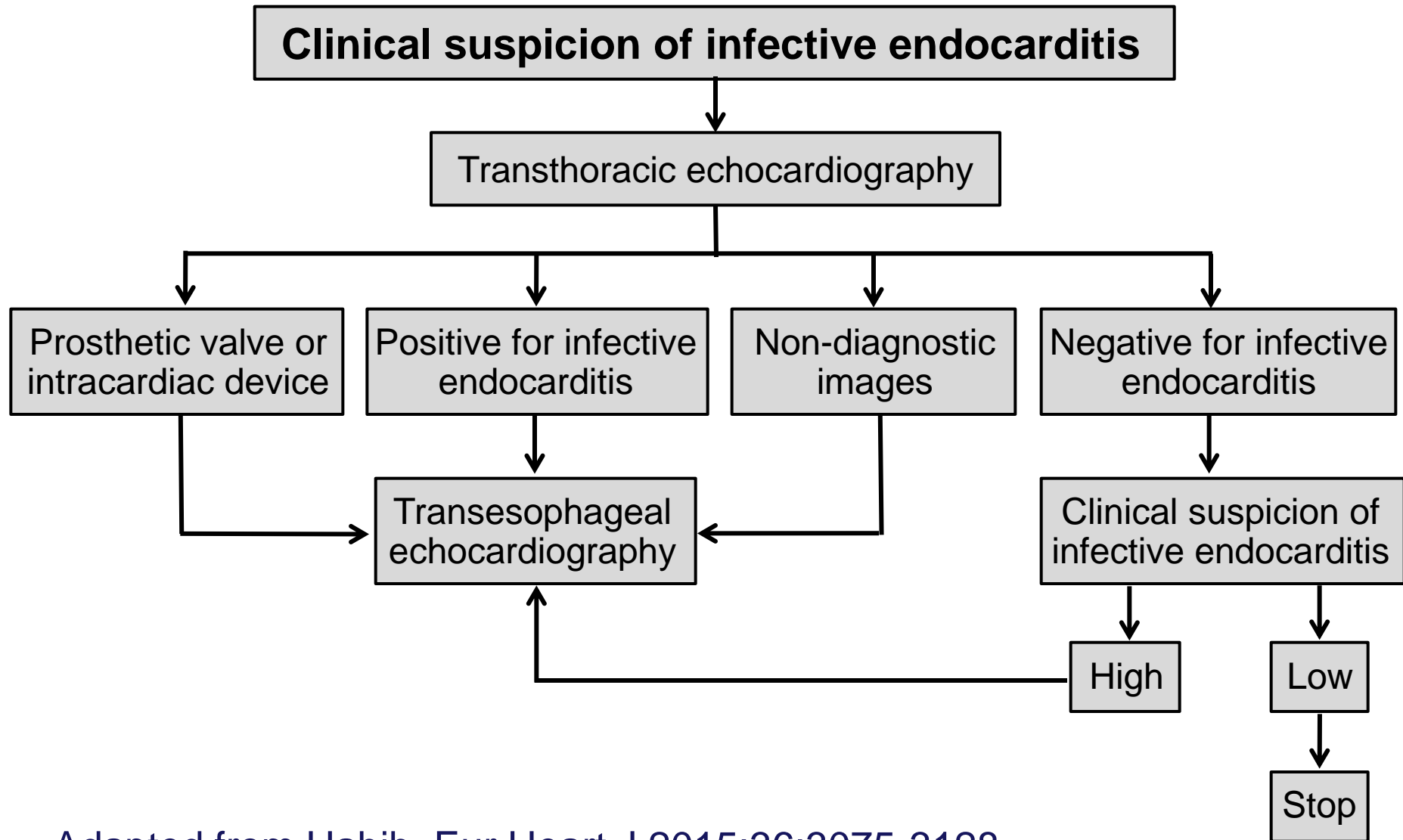
1. Accurate diagnosis requires integration of clinical suspicion, microbiological information, and echo data
2. Diagnosis can be facilitated by integrated schema such as the Duke criteria
3. All patients with suspected endocarditis should undergo echo, with the choice of modality tailored to the clinical situation

Infective Endocarditis

Summary

4. Low threshold for TEE imaging
5. Early surgical consultation
6. For the remainder of their lives, survivors of acute IE should receive secondary prevention with prophylactic antibiotics for procedures typically associated with high risk of transient bacteremia with organisms known to cause IE

Use of Echo in Suspected Infective Endocarditis



Adapted from Habib Eur Heart J 2015;36:3075-3128
ESC Guidelines for management of infective endocarditis

The Endocarditis Team

“The ESC strongly supports the management of patients with IE in reference centres by a specialized team.”

2015 ESC Guidelines for the management of IE
Habib et al Eur Heart J 2015;36:3075-3128.

Infective Endocarditis

Multidisciplinary Team

- Cardiologists (special competency in valve disease)
- Echocardiographers
- Cardiothoracic surgeons (expertise in complex valve surgery)
- Infectious disease specialists
- Neurologists

Topics Not Covered

- Staph aureus bacteremia
- TTE vs TEE
- Embolic potential/embolic complications
- SBE prophylaxis – the controversy
- When to operate on acute IE
- Fungal endocarditis
- Nonbacterial thrombotoc endocarditis

The End