

Use of echo to manage endocarditis

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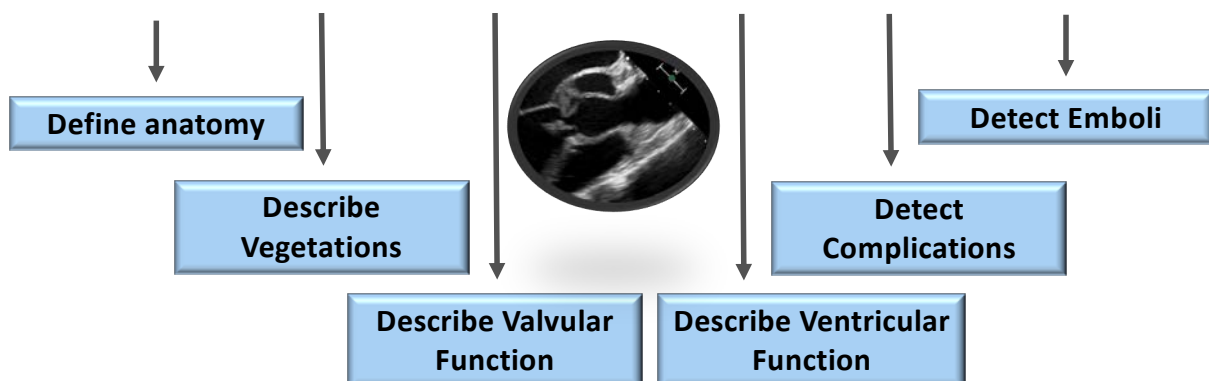
Sanger Heart and Vascular Institute

Atrium Health

No Disclosures

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Objectives in Imaging Infective Endocarditis



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Diagnosis – Modified Duke vs ESC



Major criteria

1. Blood cultures positive for IE
 - a. Typical microorganisms consistent with IE from 2 separate blood cultures:
 - *Viridans streptococci*, *Streptococcus gallolyticus* (*Streptococcus bovis*), HACEK group, *Staphylococcus aureus*; or
 - Community-acquired enterococci, in the absence of a primary focus; or
 - b. Microorganisms consistent with IE from persistently positive blood cultures:
 - ≥ 2 positive blood cultures of blood samples drawn >12 h apart; or
 - All of 3 or a majority of ≥ 4 separate cultures of blood (with first and last samples drawn ≥ 1 h apart); or
 - c. Single positive blood culture for *Coxiella burnetii* or phase I IgG antibody titre $>1:800$

2. Imaging positive for IE

- a. Echocardiogram positive for IE:
 - Vegetation;
 - Abscess, pseudoaneurysm, intracardiac fistula;
 - Valvular perforation or aneurysm;
 - New partial dehiscence of prosthetic valve.
- b. Abnormal activity around the site of prosthetic valve implantation detected by ^{18}F -FDG PET/CT (only if the prosthesis was implanted for >3 months) or radiolabelled leukocytes SPECT/CT.
- c. Definite paravalvular lesions by cardiac CT.

Minor criteria

1. Predisposition such as predisposing heart condition, or injection drug use.
2. Fever defined as temperature $>38^\circ\text{C}$.
3. Vascular phenomena (including those detected by imaging only): major arterial emboli, septic pulmonary infarcts, infectious (mycotic) aneurysm, intracranial haemorrhage, conjunctival haemorrhages, and Janeway's lesions.
4. Immunological phenomena: glomerulonephritis, Osler's nodes, Roth's spots, and rheumatoid factor.
5. Microbiological evidence: positive blood culture but does not meet a major criterion as noted above or serological evidence of active infection with organism consistent with IE.

Clinical criteria

- 2 major criteria; or
- 1 major criterion and 3 minor criteria; or
- 5 minor criteria

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Who needs TTE or TEE



Recommendation	ESC		AHA	
	Class	LOE	Class	LOE
Diagnosis				
Echocardiography is recommended as the first-line imaging test in all cases of suspected IE, and it should be performed as soon as possible (<12 hours after initial evaluation)*	I	B	I	A, B
TEE should be performed if initial TTE is negative or non-diagnostic in patients for whom there is an ongoing suspicion for IE	I	B	I	B
TEE should be considered even in patients with positive TTE, except in isolated right-sided native valve IE with good quality TTE and unequivocal echocardiographic findings	IIa	C	NSER	
TEE is recommended in patients with clinical suspicion of IE when a prosthetic heart valve or an intracardiac device is present	I	B	NSER†	
Echocardiography should be considered in <i>Staphylococcus aureus</i> bacteraemia	IIa	B	NSER	
Repeat TEE is recommended within 3-7 days,* or sooner if clinical findings change, in patients for whom there is a high suspicion of IE despite an initial negative TEE	I	C	I	B

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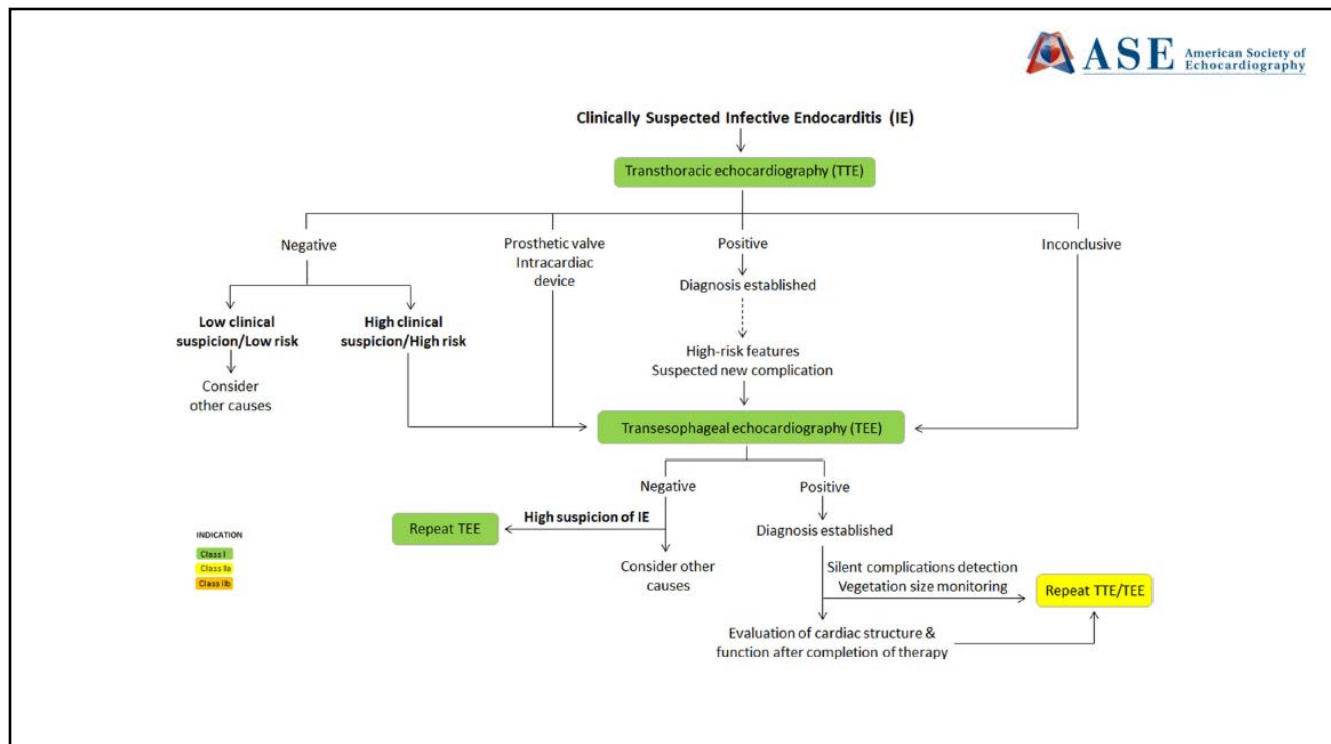
Follow up – Indications for TTE/TEE



Follow-up				
Repeat TEE should be performed after an initially positive TEE if clinical suspicion of a new complication of IE arises (e.g. persistent fever, changes in cardiac murmurs, heart failure, embolism, new atrioventricular block, or arrhythmia)	I	B	I	B
	I	C	Ila	C
TTE is recommended at the time of antimicrobial therapy completion to evaluate cardiac and valve morphology and function				

J Nucl Cardiol. 2019 Feb;26(1):303-308

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TTE vs TEE



TTE: Sensitivity: 70% for native valves
50% for prosthetic valves

Specificity: 90%

TEE: Sensitivity: 96% for native valves
92% for prosthetic valves

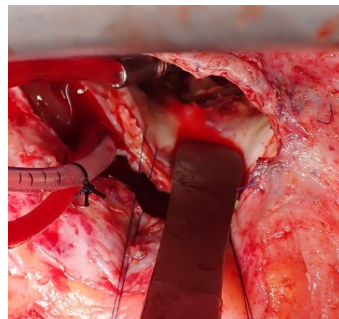
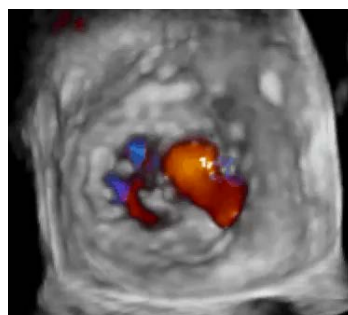
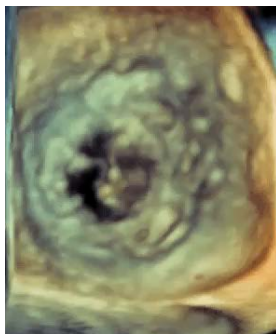
Specificity: 90%

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Role of 3D Echo



- Improved spatial information regarding size and attachments.
- Increased sensitivity for detecting and sizing abscess cavities
- Facilitate the diagnosis of prosthetic valve dehiscence



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Differential Diagnosis



- Lambls/strands
- Suture/prosthetic material
- Redundant chords
- Eustachian/Chiari
- MVP/MAC
- Off-axis imaging of normal valve leaflets
- Tumors: papillary fibroelastoma

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Characteristics of a vegetation



- **Texture:** Like myocardium
- **Location:** Upstream side of the valve in the path of the jet or on prosthetic material
- **Motion:** Chaotic/orbiting; independent of valve motion
- **Shape:** Lobulated and amorphous
- **Company:** Abscess and pseudoaneurysm, fistulae, prosthetic dehiscence, paravalvular leak, significant regurgitation



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Characteristics suggestive of something other than vegetation

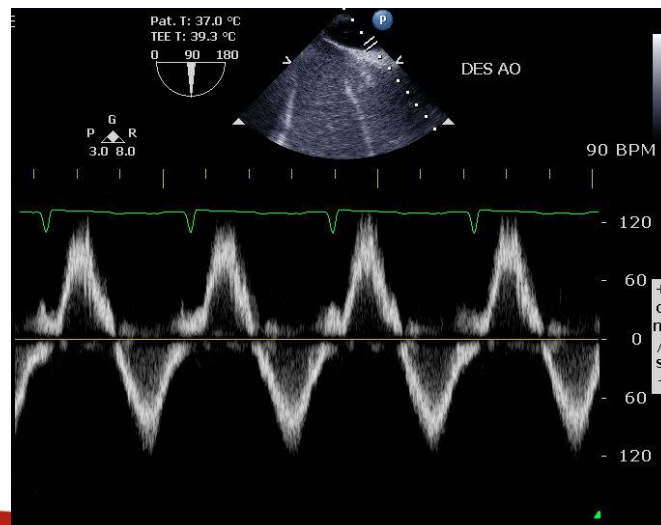
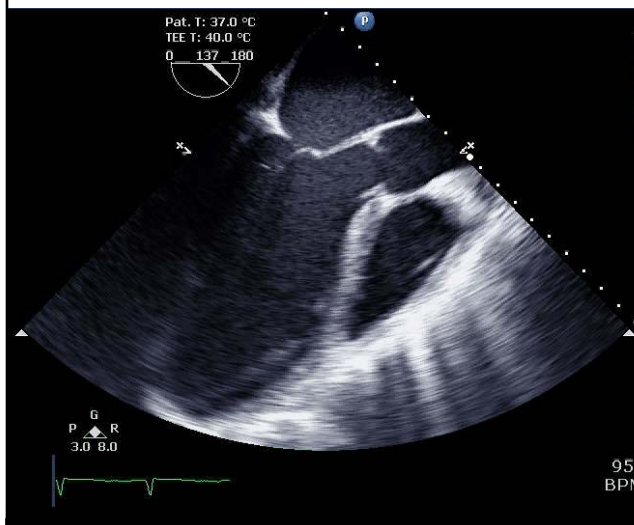
- **Texture:** High reflectors: calcium or pericardium
- **Location:** Downstream surface of valve
- **Shape:** Stringy or hair-like strands with narrow attachment
- **Company:** No turbulent flow or regurgitation

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When should I call my friendly surgeon?

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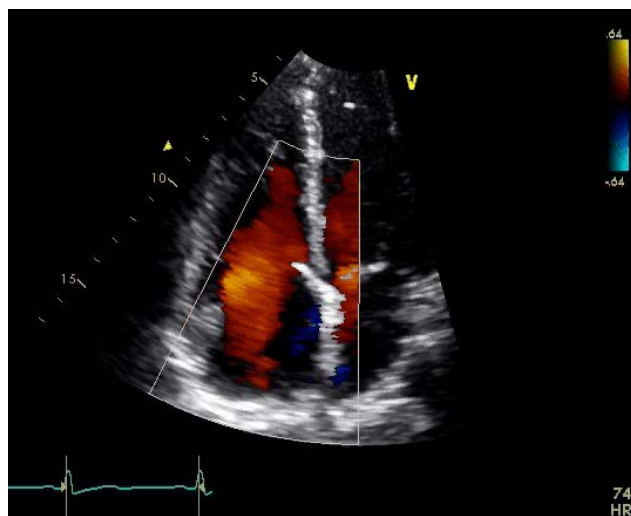
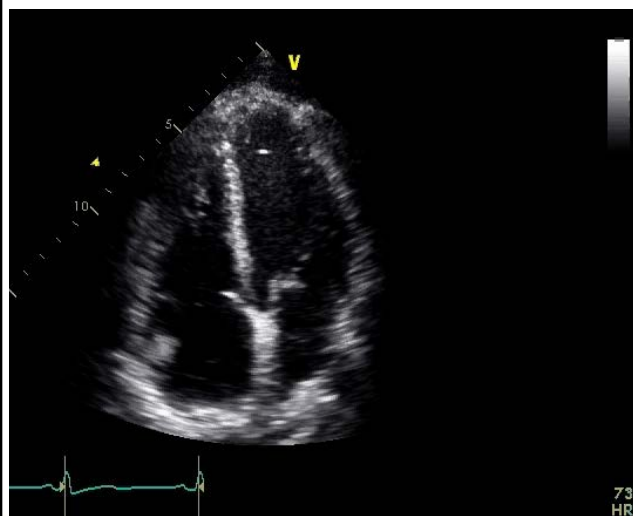
How much valve destruction, and what is the hemodynamic consequence?



43 year-old Diabetic with Group G strep

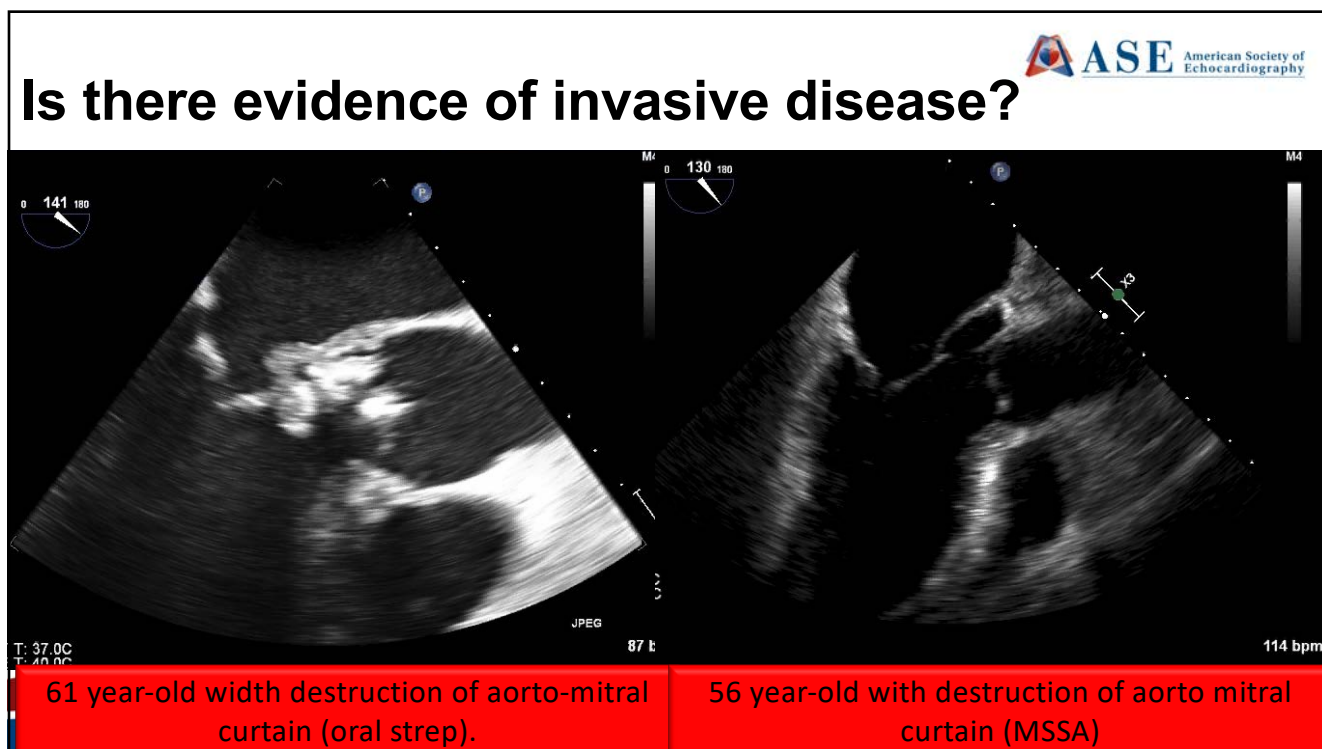
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How much valve destruction, and what is the hemodynamic consequence?

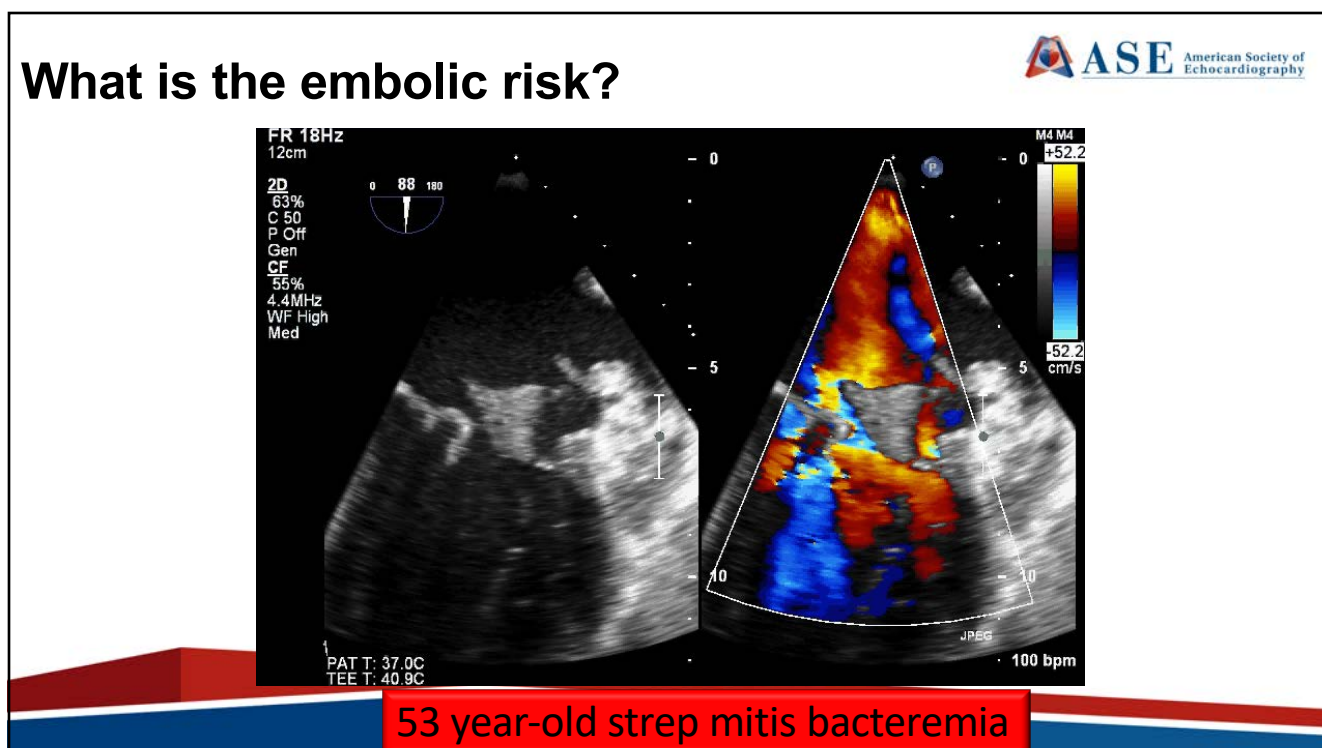


24 year-old nursing student c IVU with MRSE

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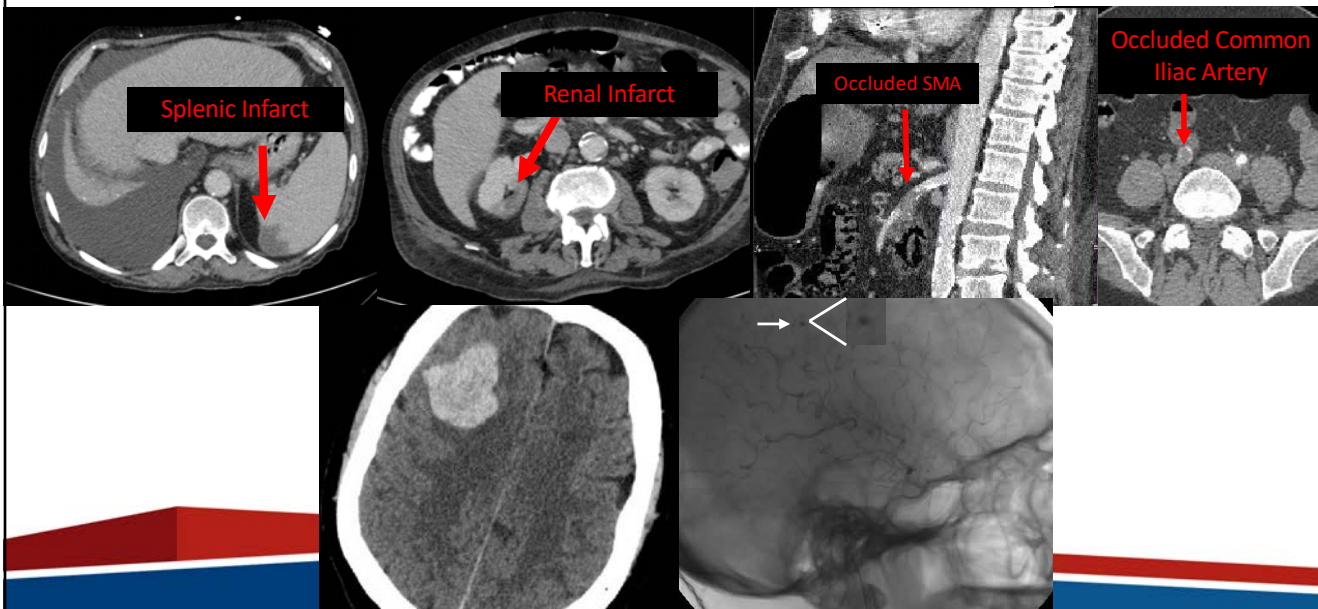
What is the embolic risk?



57 year-old with ESRD, Proteus, ventricular tachycardia

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Is there extra-cardiac metastatic disease?



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Indications for surgery

Left-sided Endocarditis

- Valve regurgitation with heart failure
- Paravalvular extension
- >10mm if low risk for surgery or >30mm
- Persistent bacteremia
- Recurrent emboli
- Difficult to treat pathogens

Right-sided Endocarditis

- >20mm
- Recurrent PE
- Persistent bacteremia
- Devices
- Rarely: heart failure or invasive disease
- Difficult to treat pathogens

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Classifications in Endocarditis

Clinical

Sub-acute vs Acute

Community-acquired, health care-associated (nosocomial or non-nosocomial), or IVDU

Microbiology

Anatomic

Left vs. Right-sided

Invasive vs. Non-invasive

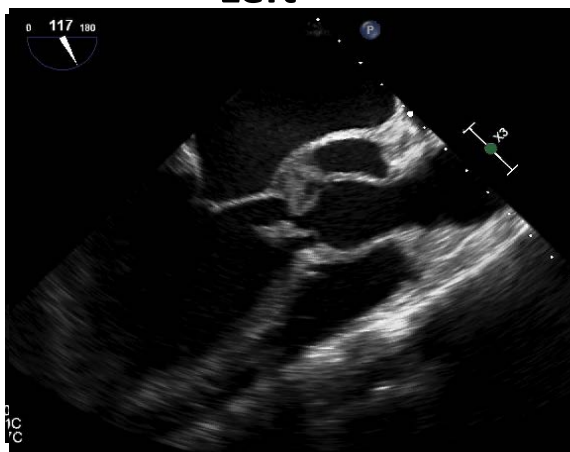
Native, prosthetic, or cardiac-device

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A Tale of Two Sides



Left



**IVDU
MSSA**

Right



**IVDU
MSSA**

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A Tale of Two Sides



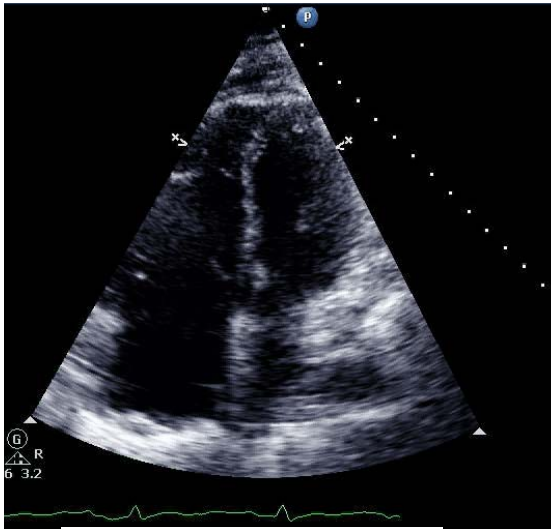
**Emergent
Surgery**



**25 days in
CICU**

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Eventual Surgery



Right Ventricle at One Month



Right Ventricle at Six Months

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Definitions

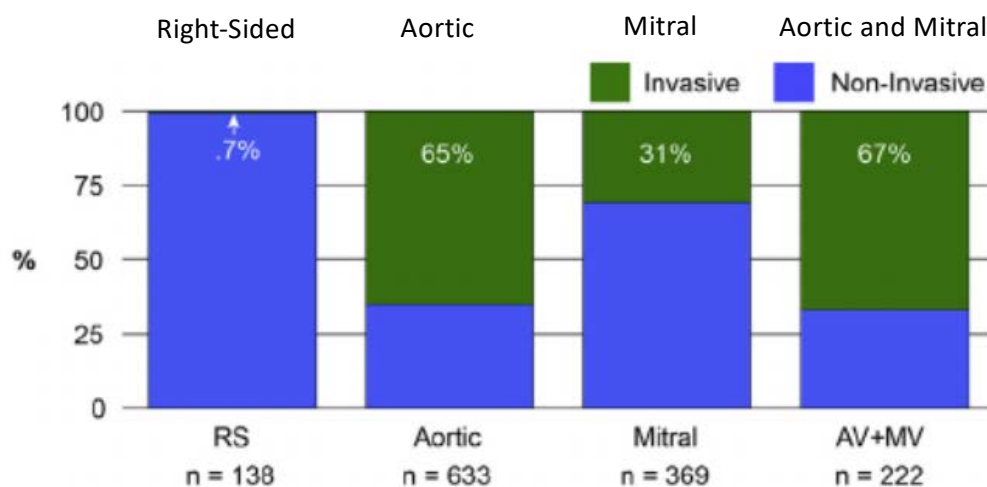


	Surgery/necropsy	Echocardiography
Vegetation	Infected mass attached to an endocardial structure or on implanted intracardiac material.	Oscillating or non-oscillating intracardiac mass on valve or other endocardial structures, or on implanted intracardiac material.
Abscess	Perivalvular cavity with necrosis and purulent material not communicating with the cardiovascular lumen.	Thickened, non-homogeneous perivalvular area with echodense or echolucent appearance.
Pseudoaneurysm	Perivalvular cavity communicating with the cardiovascular lumen.	Pulsatile perivalvular echo-free space, with colour-Doppler flow detected.

	Surgery/necropsy	Echocardiography
Perforation	Interruption of endocardial tissue continuity.	Interruption of endocardial tissue continuity traversed by colour-Doppler flow.
Fistula	Communication between two neighbouring cavities through a perforation.	Colour-Doppler communication between two neighbouring cavities through a perforation.
Valve aneurysm	Saccular outpouching of valvular tissue.	Saccular bulging of valvular tissue.
Dehiscence of a prosthetic valve	Dehiscence of the prosthesis.	Paravalvular regurgitation identified by TTE/TOE, with or without rocking motion of the prosthesis.

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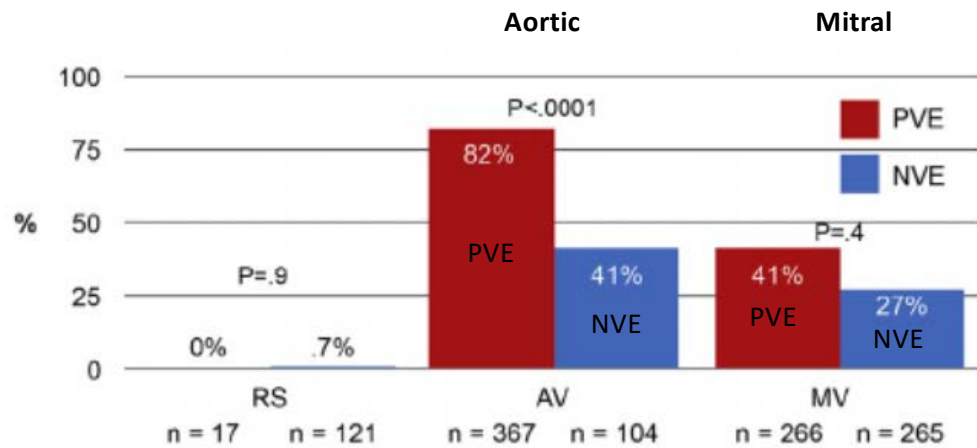
How common is invasive disease?



J Thorac Cardiovasc Surg 2018;155:54-61.

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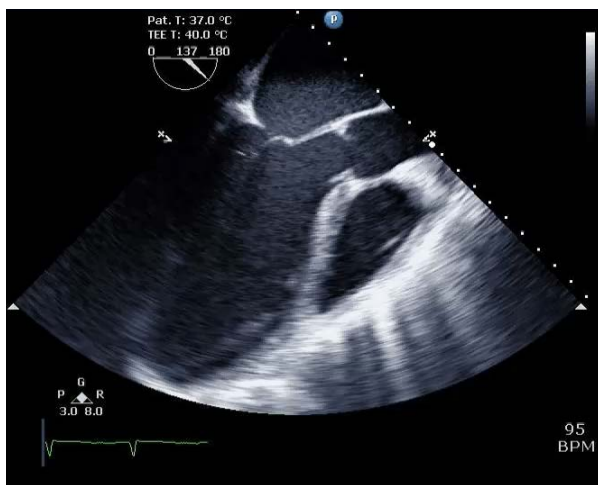
How common is invasive disease?



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Both Patients Need Emergent Surgery



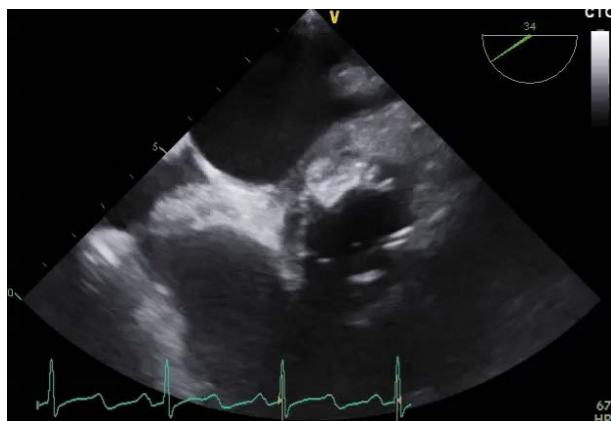
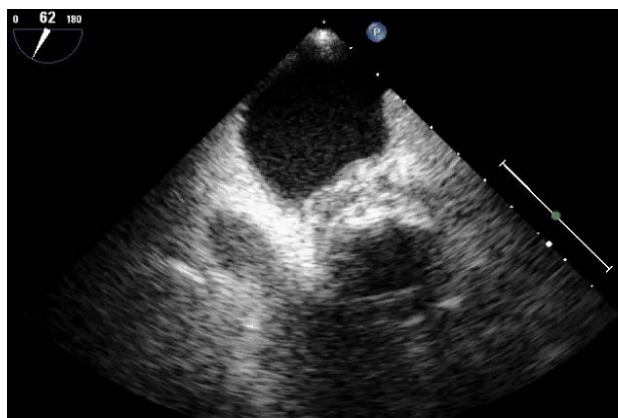
Non-Invasive



Invasive

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Invasive Disease: Abscess



- Abnormal thickening with heterogeneous echodensity
 - Anterior extent often difficult on TEE, especially with prosthetic valves

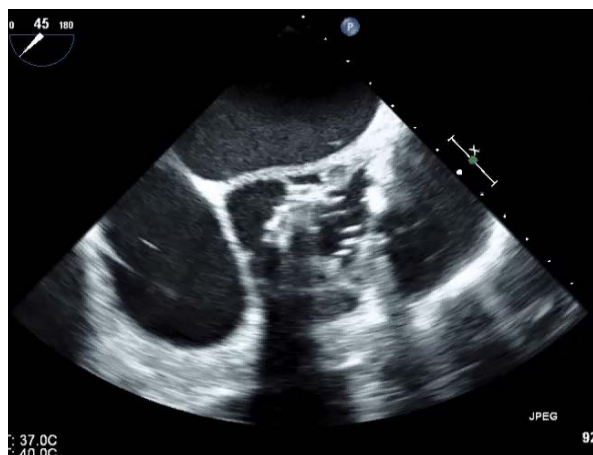
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Invasive Disease: Abscess Cavity



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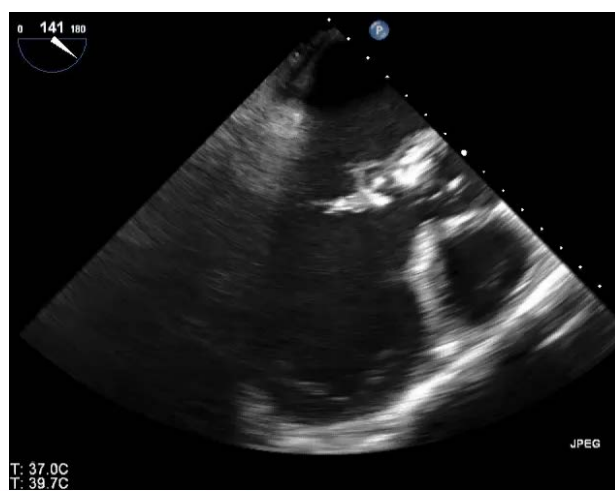
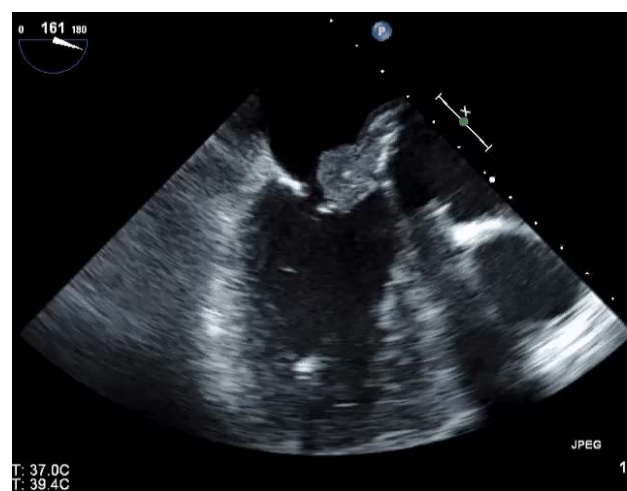
Invasive Disease: Pseudoaneurysm



Development of anechoic space and pulsatile

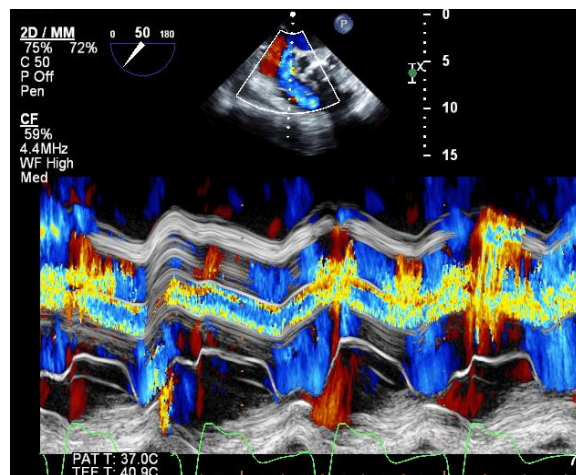
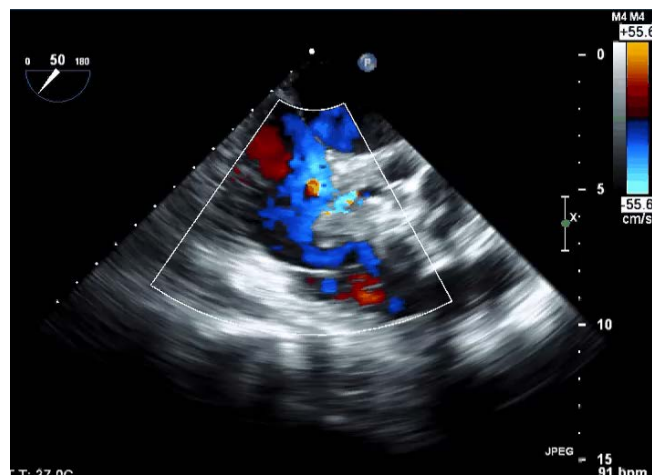
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Invasive Disease: Destruction of Intervallvular Fibrosa



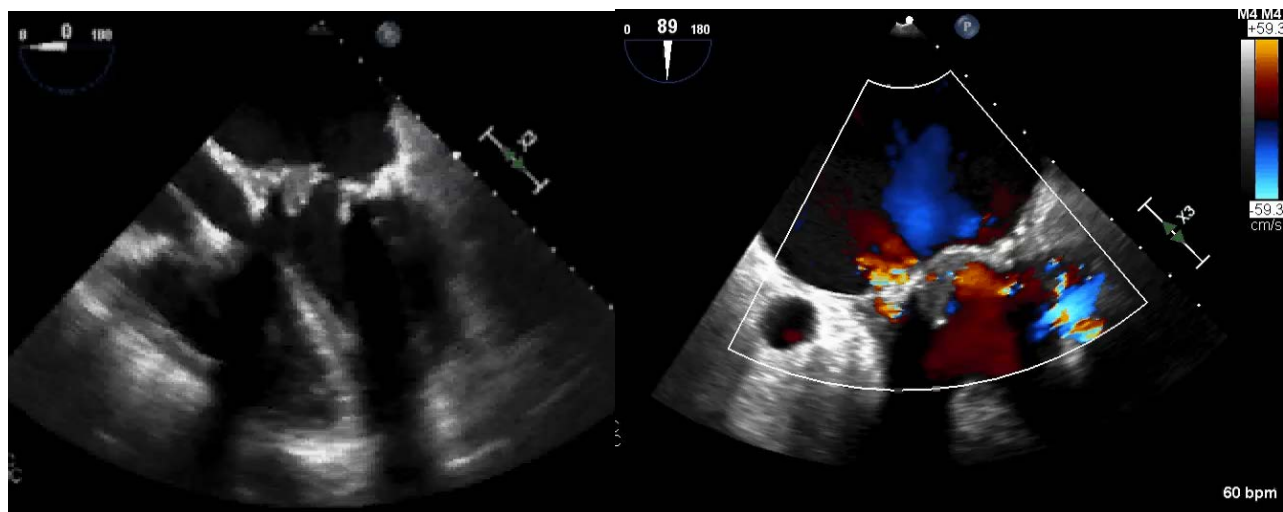
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Invasive Disease: Fistulas



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Invasive Prosthetic Mitral Valve Disease



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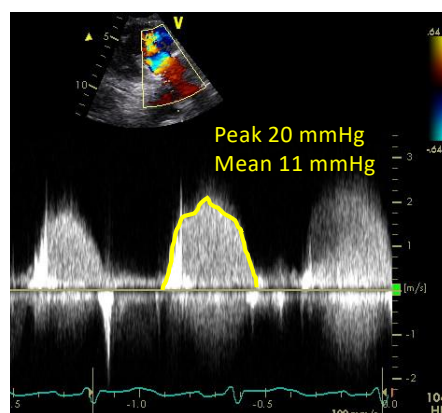
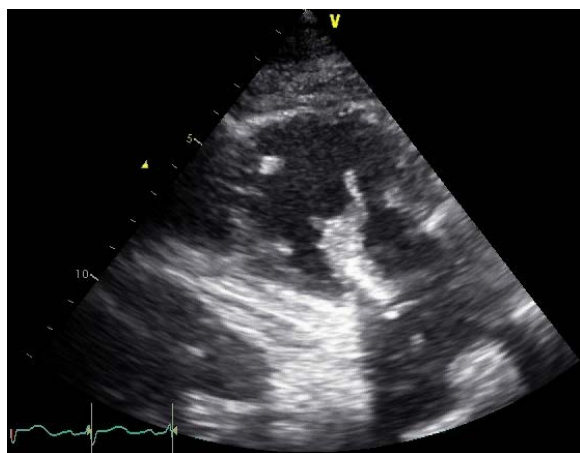
Left vs. Right-sided

Invasive vs. Non-invasive

Native vs prosthetic, or cardiac-device

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Foreign Material: TVR in IVDU



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Foreign Material: Bentall procedure



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Foreign Material: PPM leads



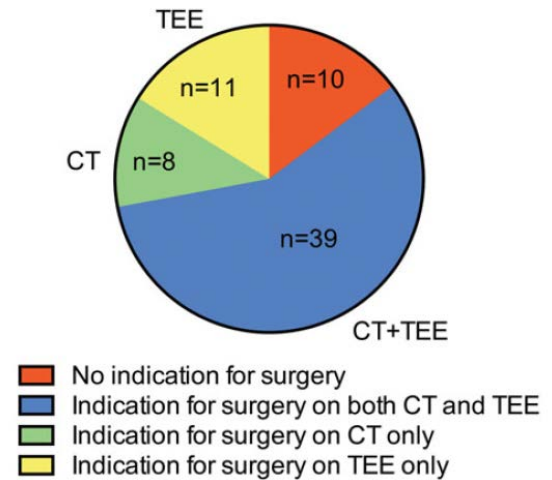
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CTA and TEE may be complementary



Generalizations:

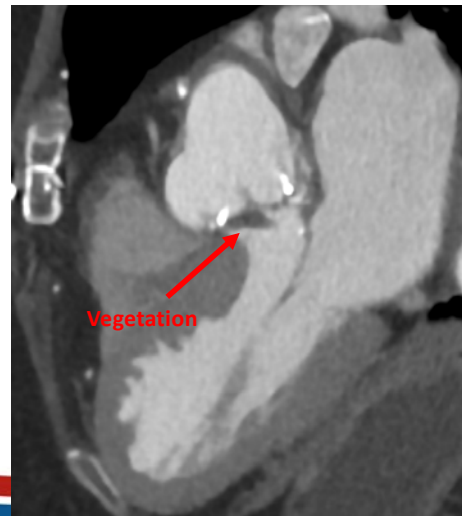
- Given temporal resolution, TEE better at identifying vegetations
- Given field-of-view, CTA better at identifying extent of invasive complications



Eur J Card Thor Surg 2016;1165-1171.

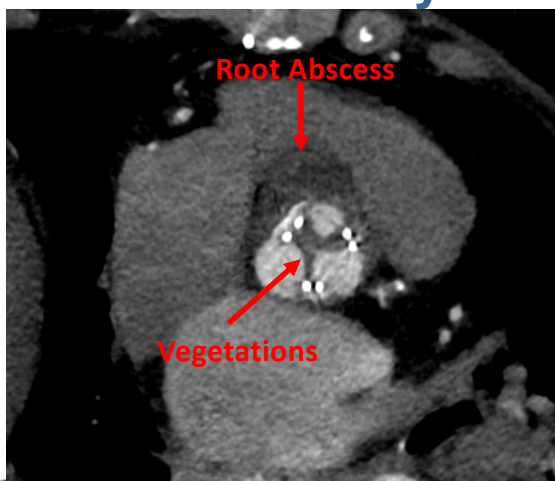
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Case Examples: Endocarditis Protocol (4D CTA of the heart followed by delayed FLASH of the chest)



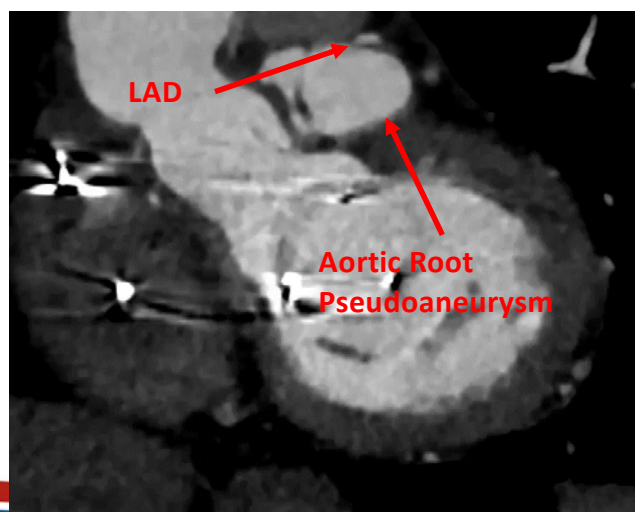
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Case Examples: Endocarditis Protocol (4D CTA of the heart followed by delayed FLASH of the chest)



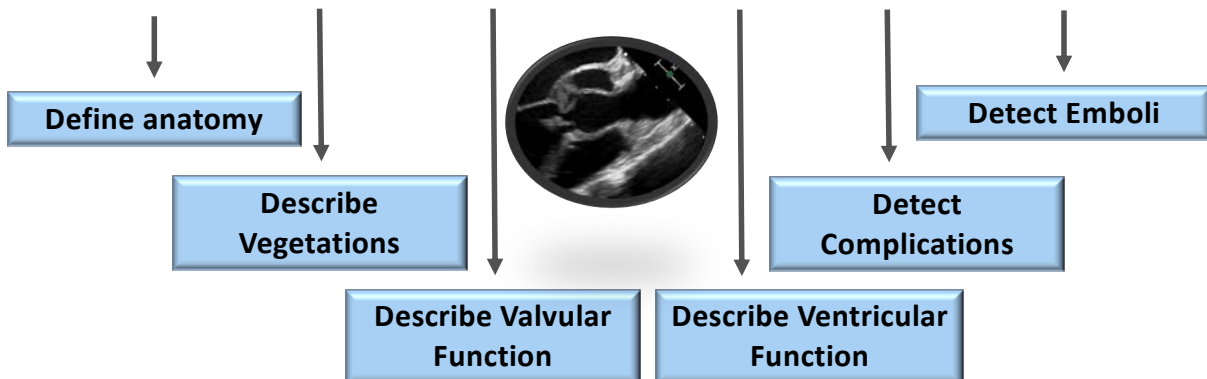
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Mitral Valve
Pseudoaneurysm



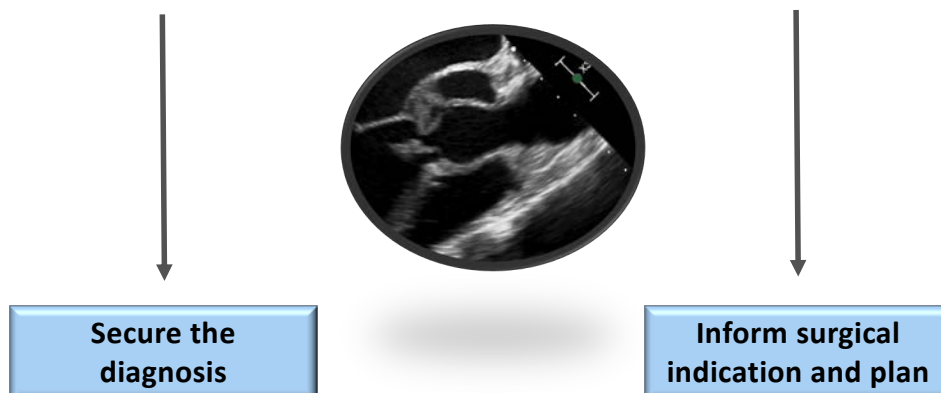
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Objectives in Imaging Infective Endocarditis

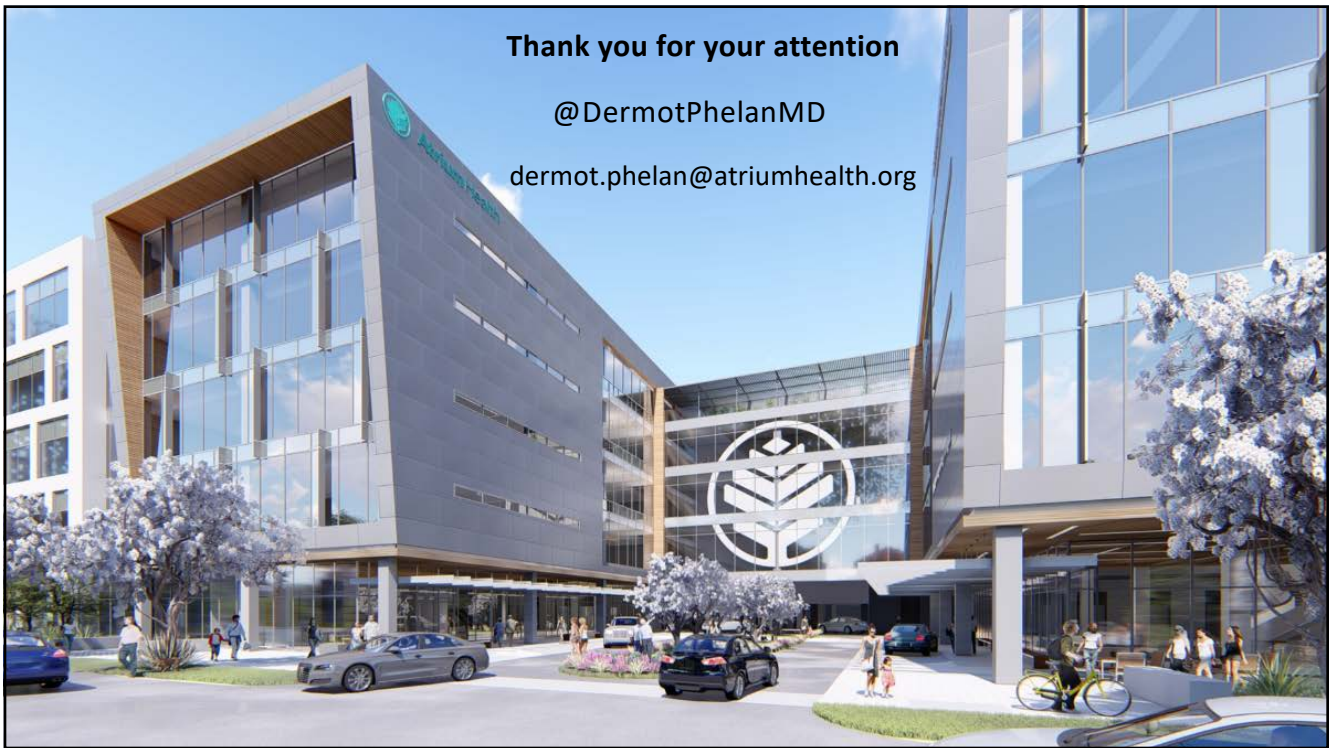


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What the ordering physician wants



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Thank you for your attention

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