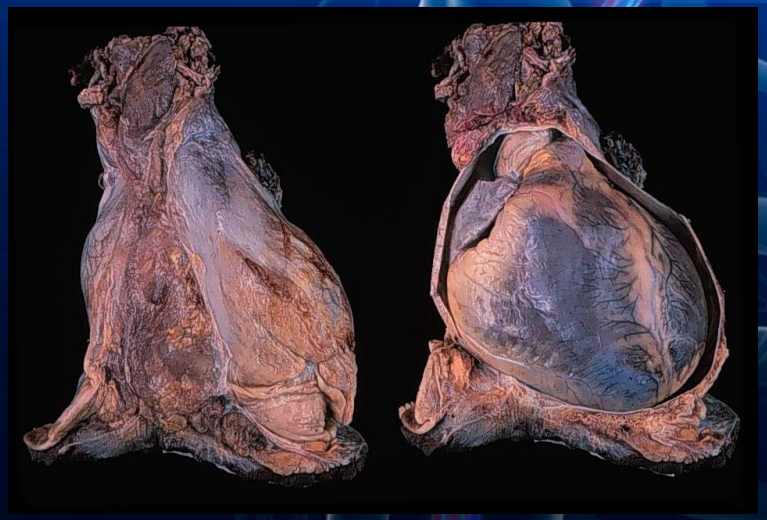
MAYO CLINIC

Pericardial Diseases
Constriction vs Restriction



Jae K. Oh, MD

ASE Board Review 2017

Echo Evaluation of Pericardial Diseases

- Constriction vs Restriction
  - Typical Constriction
  - Effusive CP
  - Transient CP
  - CP and Tricuspid Regurgitation
- Multi-modality Imaging
  - Cases
- Tamponade

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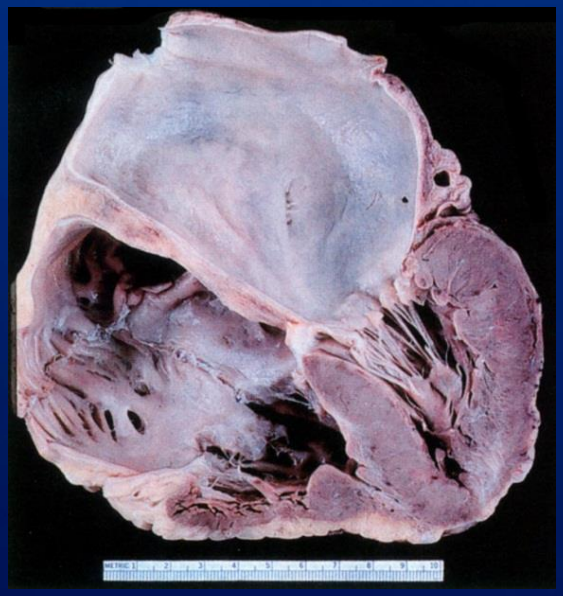
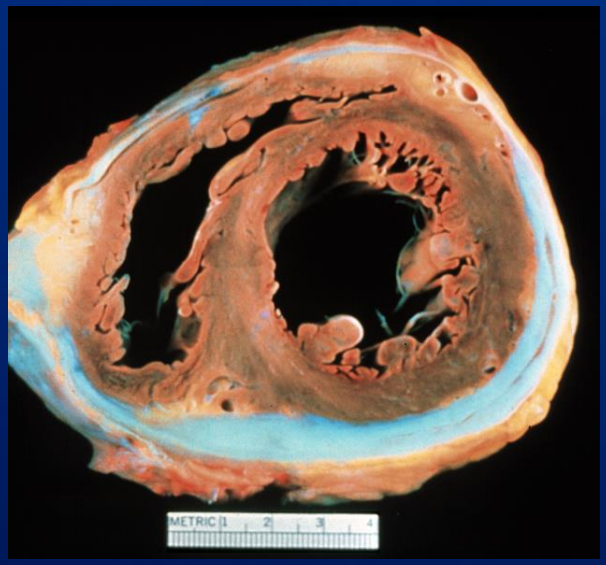
Restriction vs Constriction

Paradoxical DHF or HFpEF





No paradoxical	Pulse	Paradoxical
No variation	Diastolic Filling	Variation
Decreased ↓	Relaxation (e')	↑ Paradoxical
Inspiration	HV reversal	Expiration
Concordant	LV/RV SP	Discordant

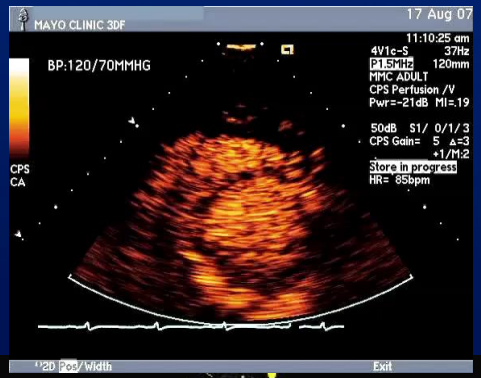
Diagnosis should be based on their characteristic HEMODYNAMICS

Echocardiographic Diagnosis of Constrictive Pericarditis: Mayo Clinic Criteria

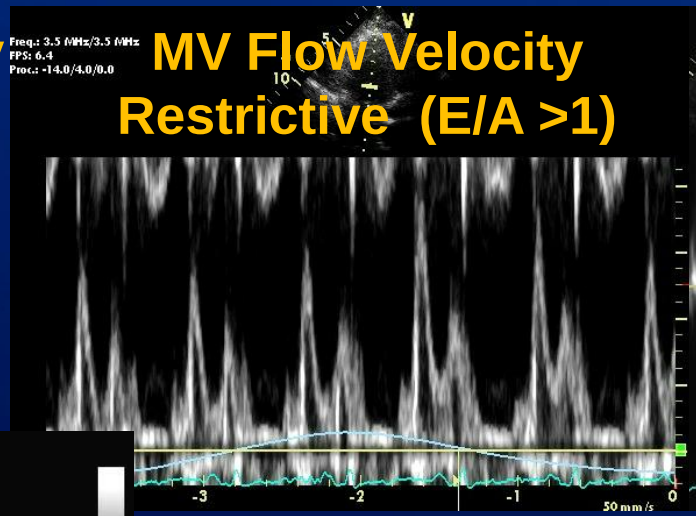
Terrence D. Welch, Lieng H. Ling, Raul E. Espinosa, Nandan S. Anavekar, Heather J. Wiste, Brian D. Lahr, Hartzell V. Schaff and Jae K. Oh

Mayo *Echo Diagnostic Criteria*

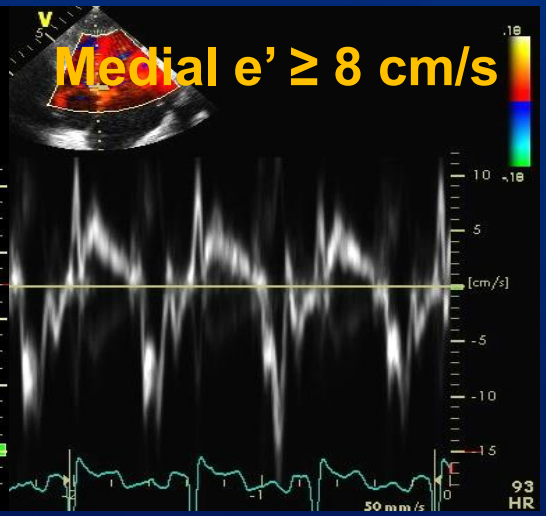
Septal *motion* abnormality



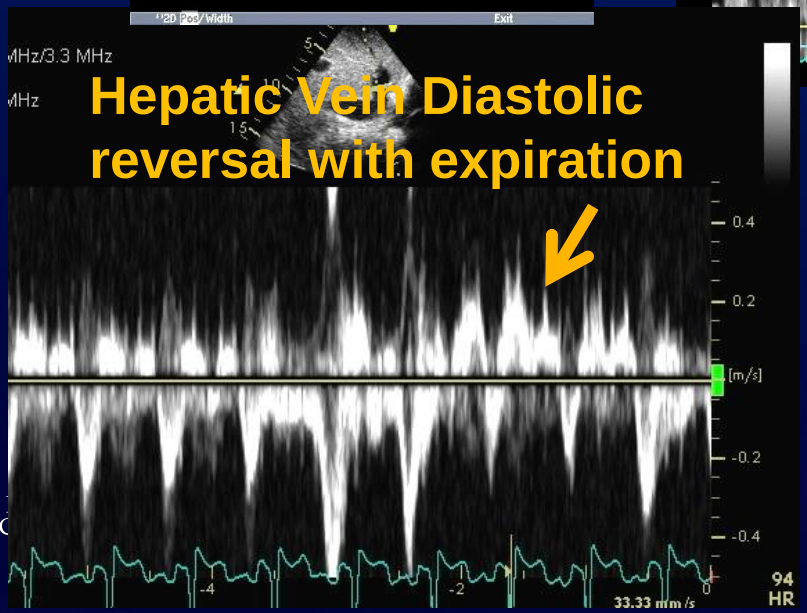
MV Flow Velocity
Restrictive (E/A >1)



Medial e' ≥ 8 cm/s



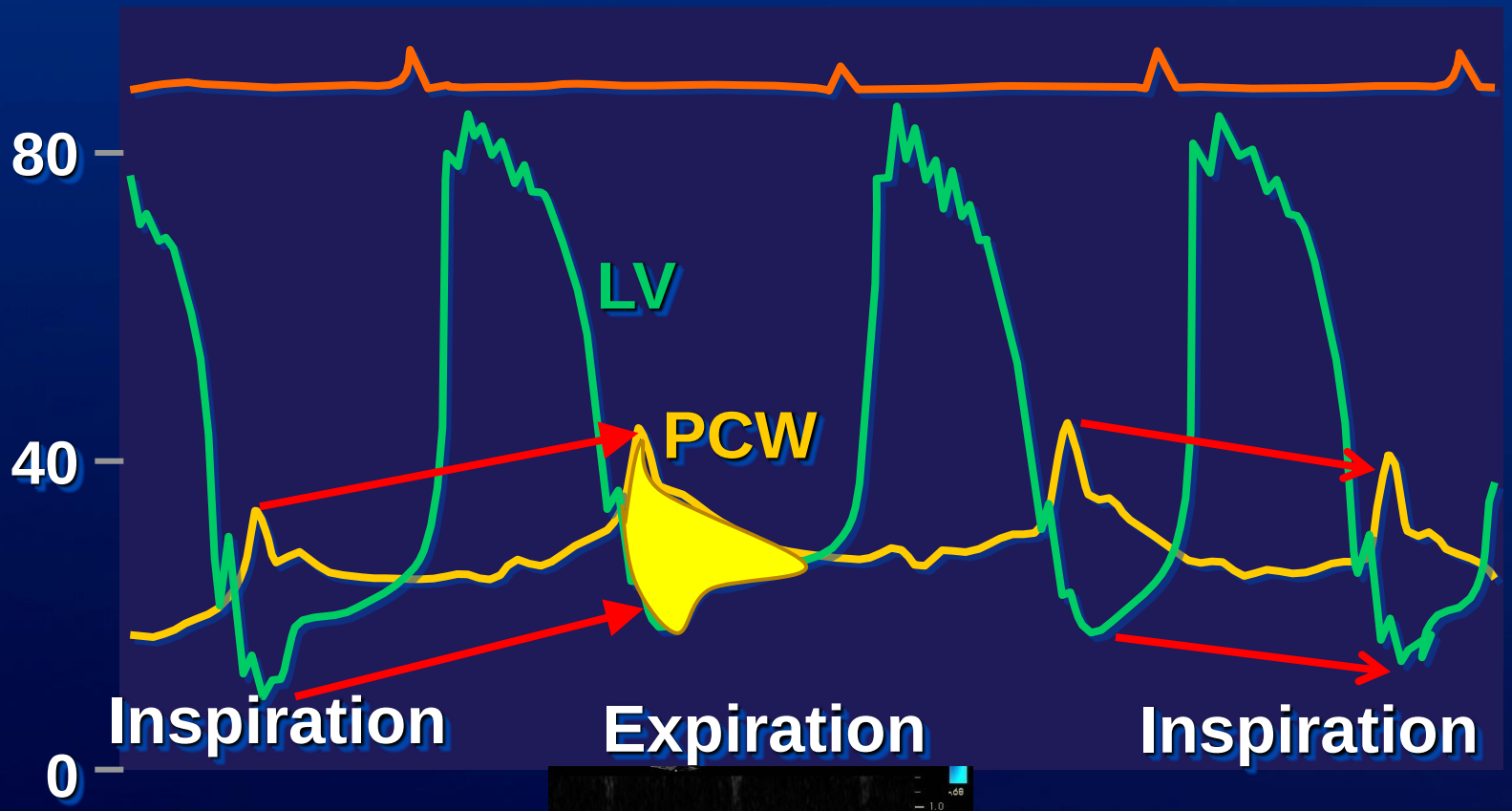
Hepatic Vein Diastolic reversal with expiration

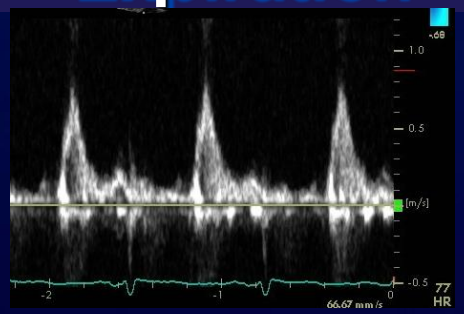


Sensitivity	87	%
Specificity	91	%

Welch et al Circ Imaging 2014

Hemodynamics of Myocardial Disease
Concordant change in PCWP and LVDP





Hatle et al. Circ 1989

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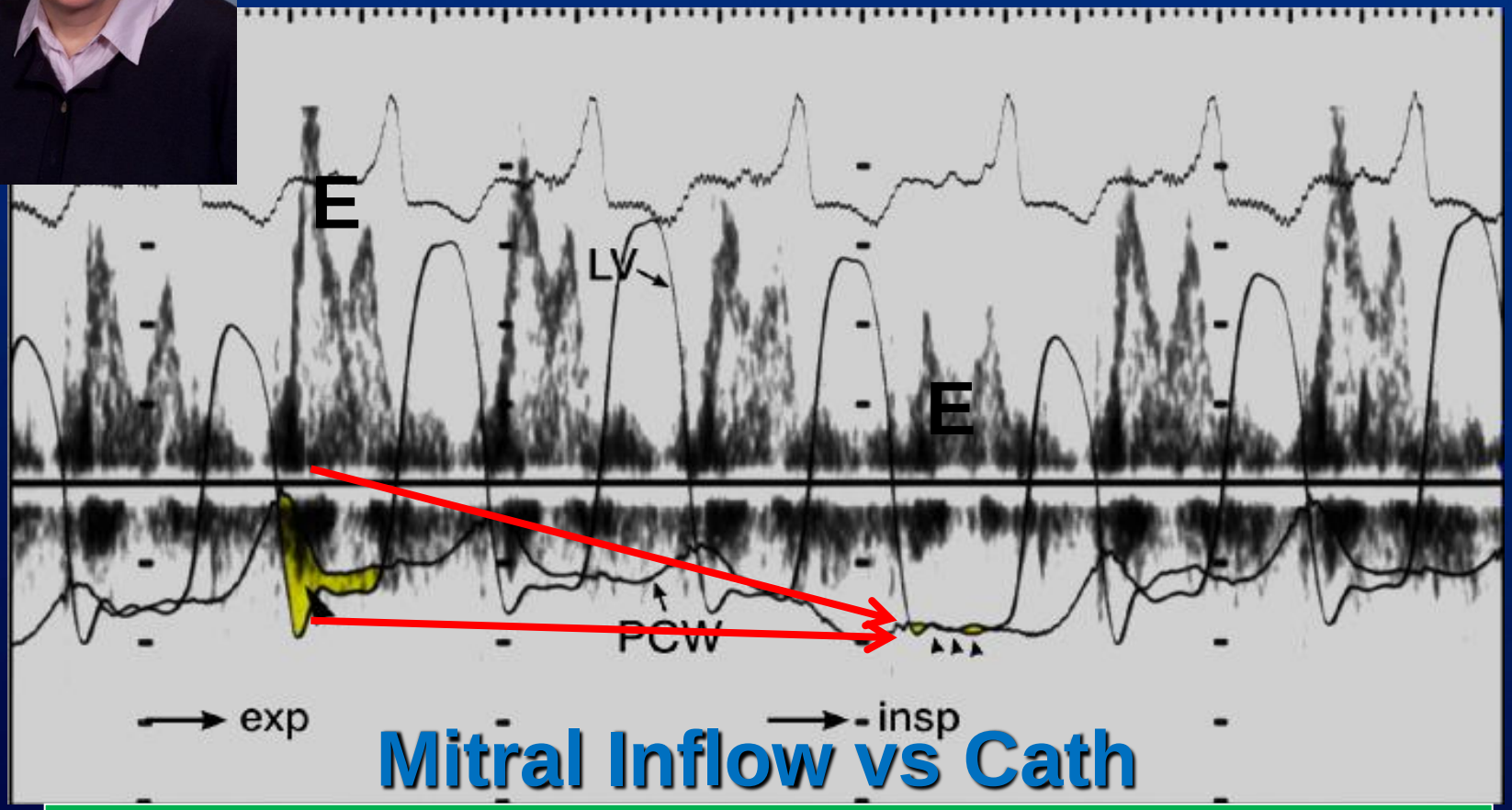
Constrictive Pericarditis



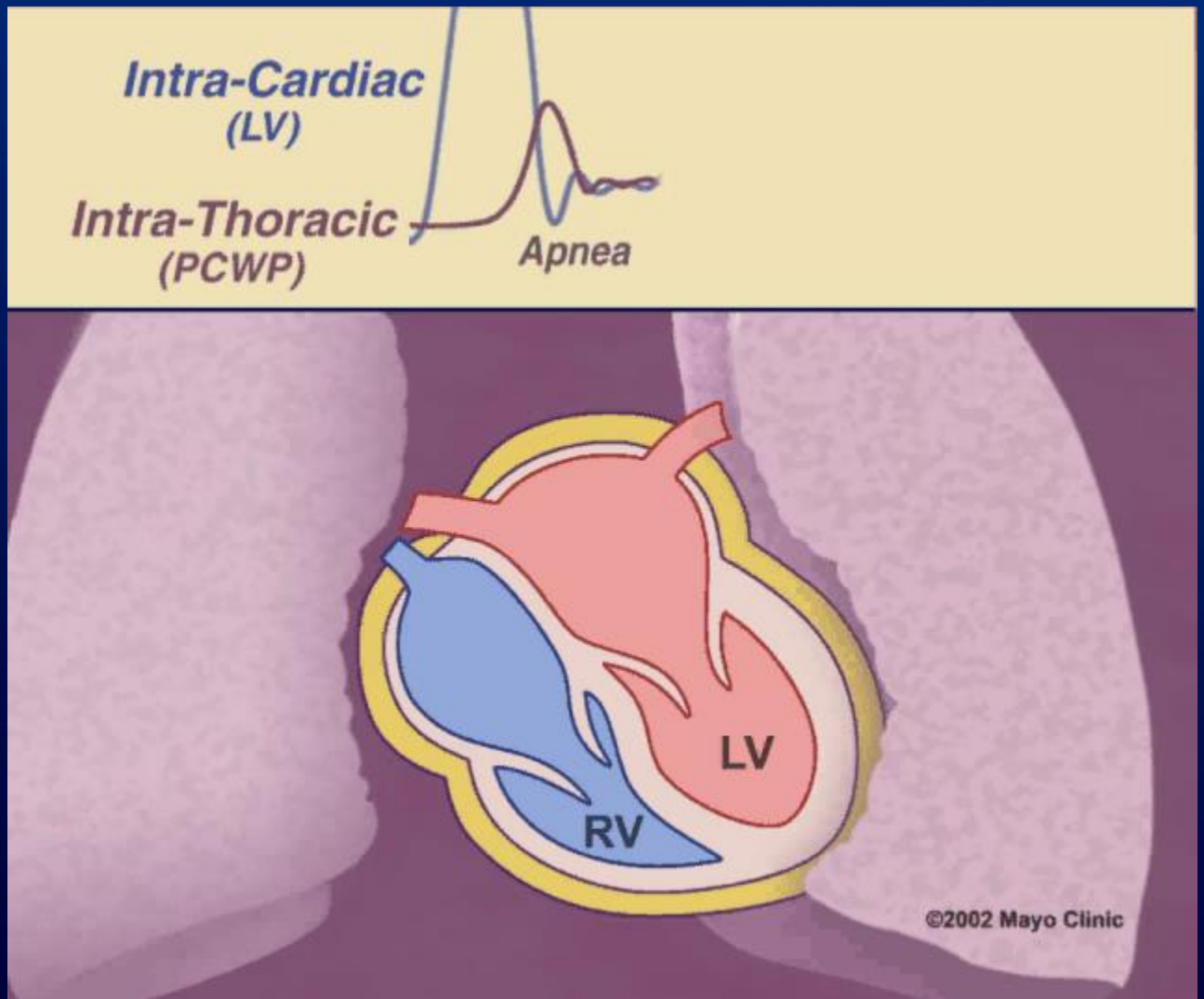
Mitral Inflow vs Cath

1. Dissociation between intrathoracic and intracardiac pressures
2. Interventricular Dependence

Hemodynamics in Constriction

Intracardiac pressure Δ < intrathoracic pressure Δ

Interventricular dependence



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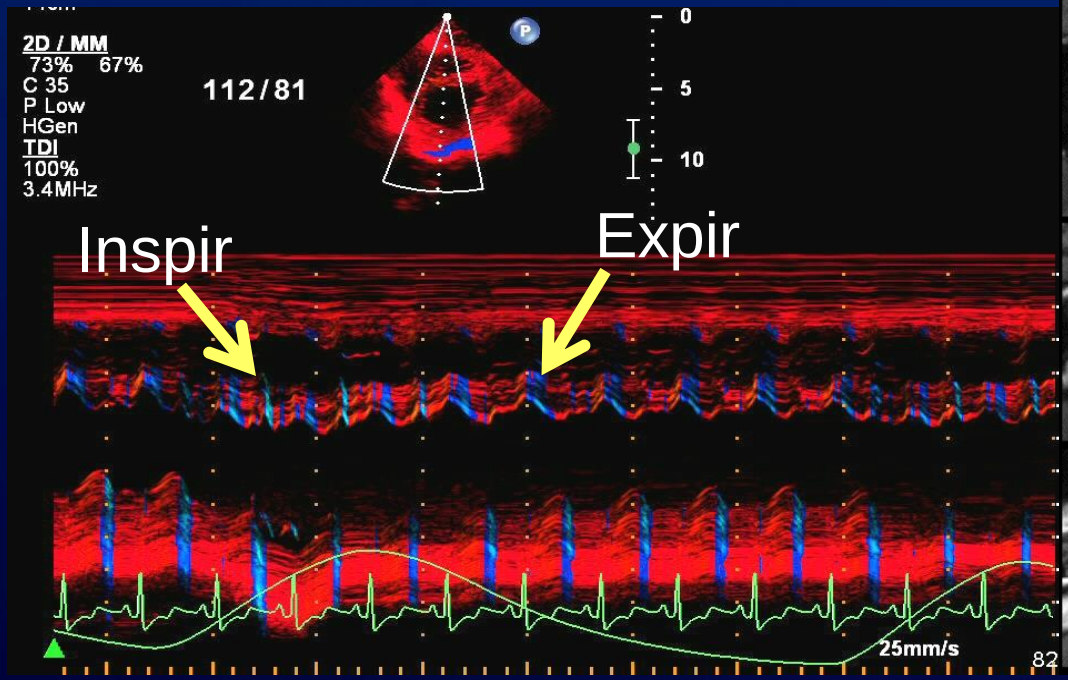
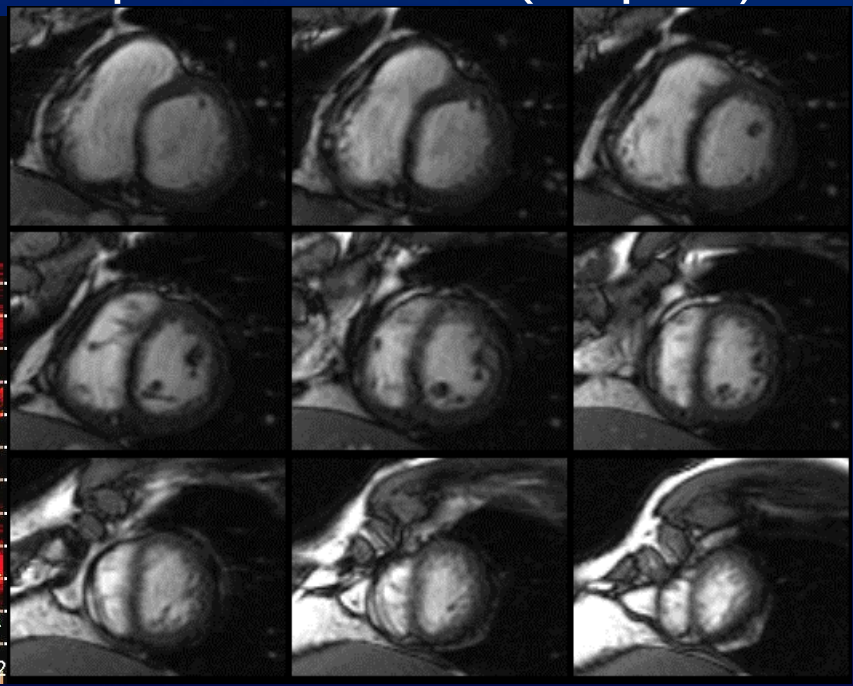
Constriction

Abnormal septal motion

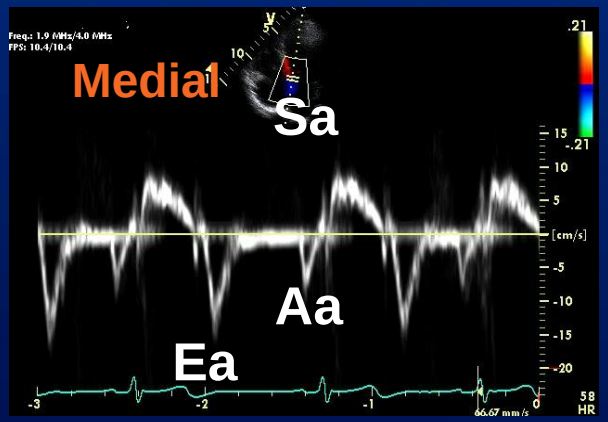
Interventricular Dependence

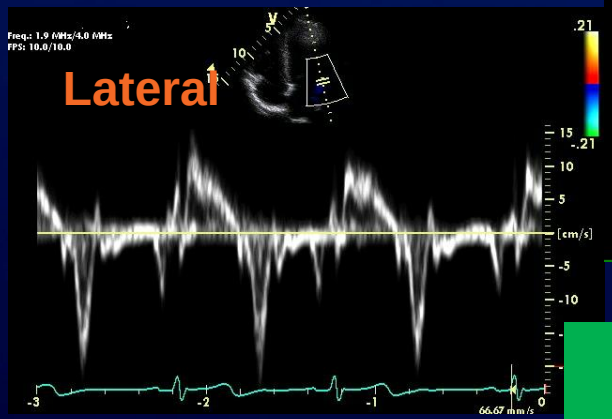
"Consider constriction if there is septal motion abnormality in patients with HF and preserved EF (HFpEF)"



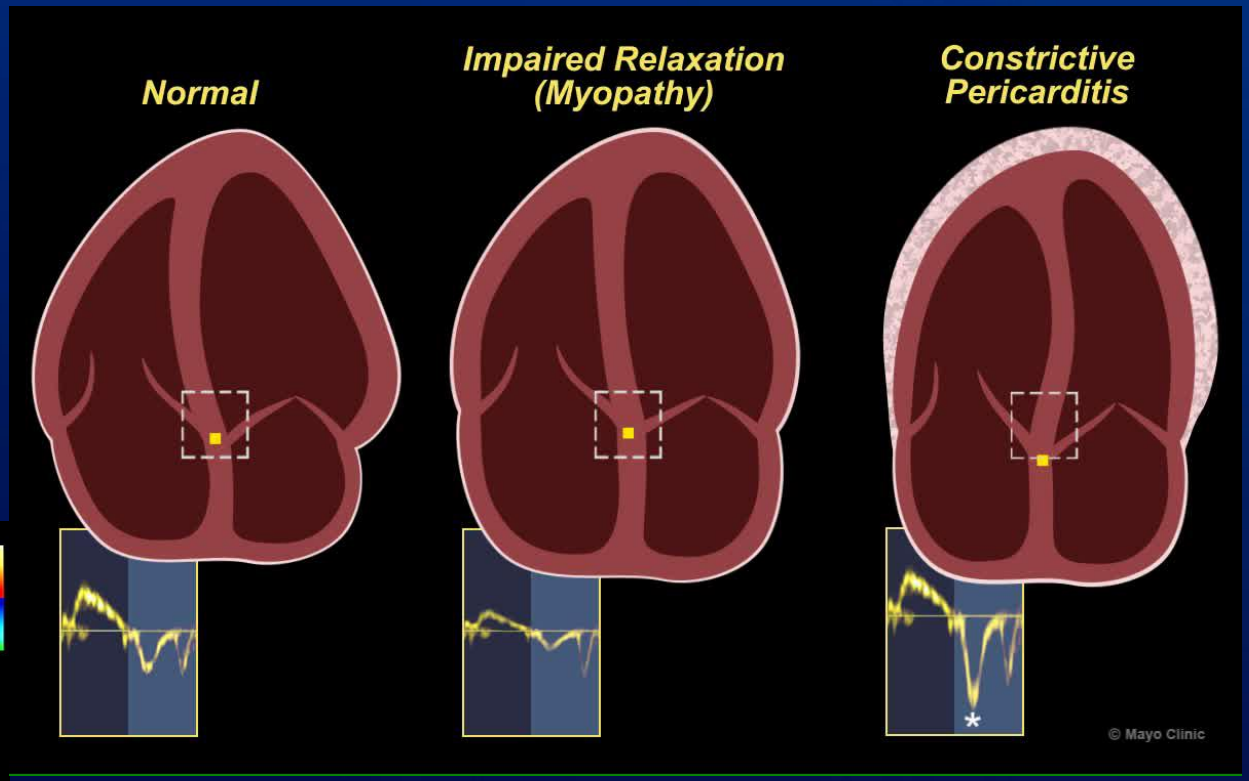


Mitral Annulus Tissue Velocity
Constriction vs Myocardial Disease





Normal

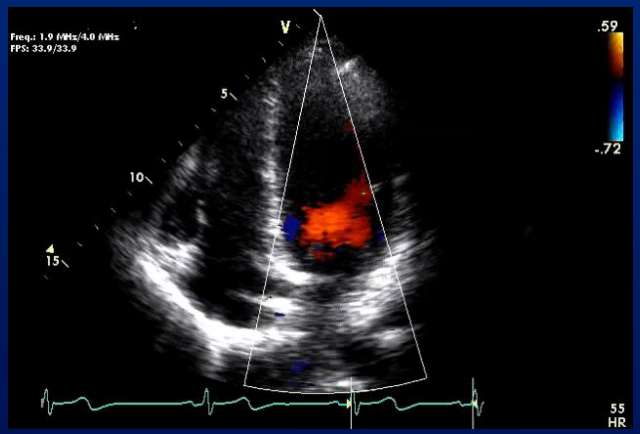


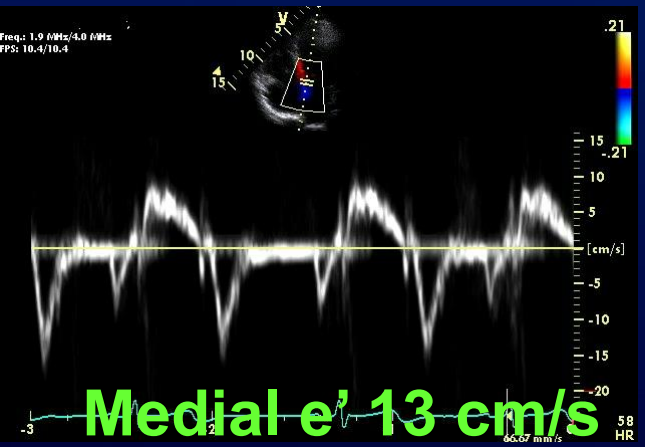
“ Mitral medial annulus velocity ≥ 8 cm/s suggests CP in pts with HF and normal EF”

Normal vs RCM vs CP

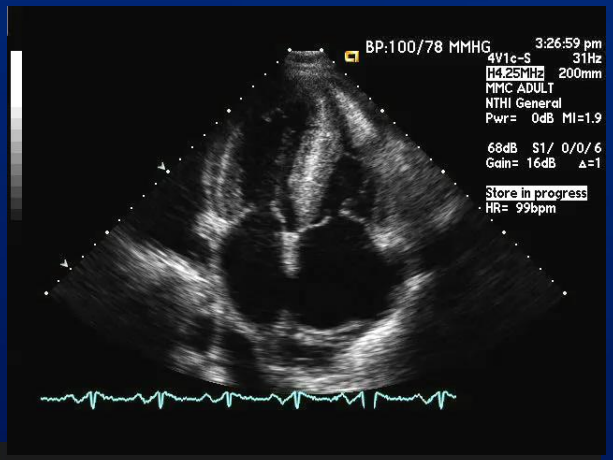
Medial Mitral e' velocity

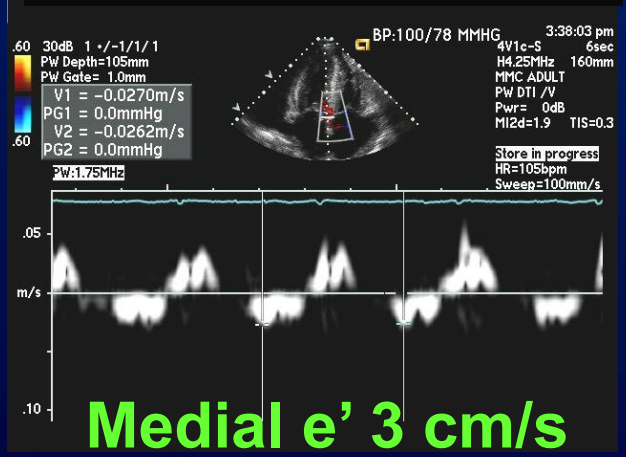
Normal



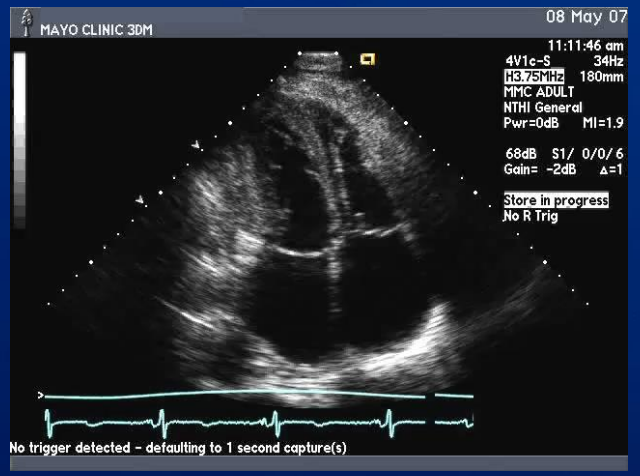


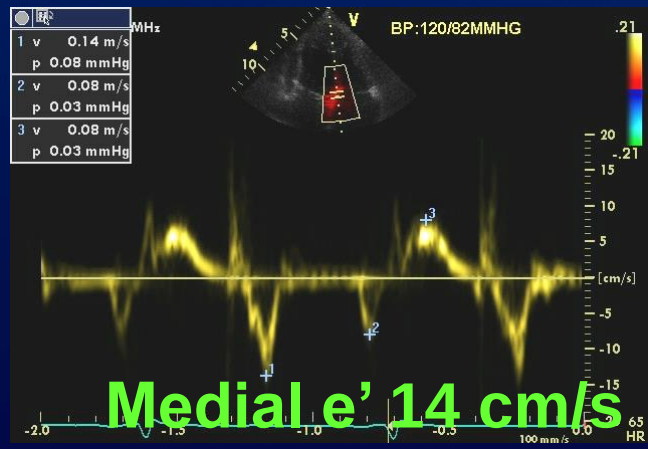
RCM





CP





Illustrative Cases

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27 yo man with fatigue and dyspnea

- Sep. 2015…Flu-like symptoms, treated with inhaler
- Oct. 2015…Pre-syncopy and palpitation
  - Pericardial rub
  - Pericardial effusion on Echo
  - Treated with Ibuprofen 2400 mg/d, Colchicine 0.6 mg BID
- Not feeling better and CRP 60
- Underwent pericardial window

27 year old man underwent a window
Referred to Mayo

- Pericardial fluid …studies were *negative*
- Not feeling better
- RUQ abdominal pain and fatigue
- U/S…Enlarged gallbladder and liver

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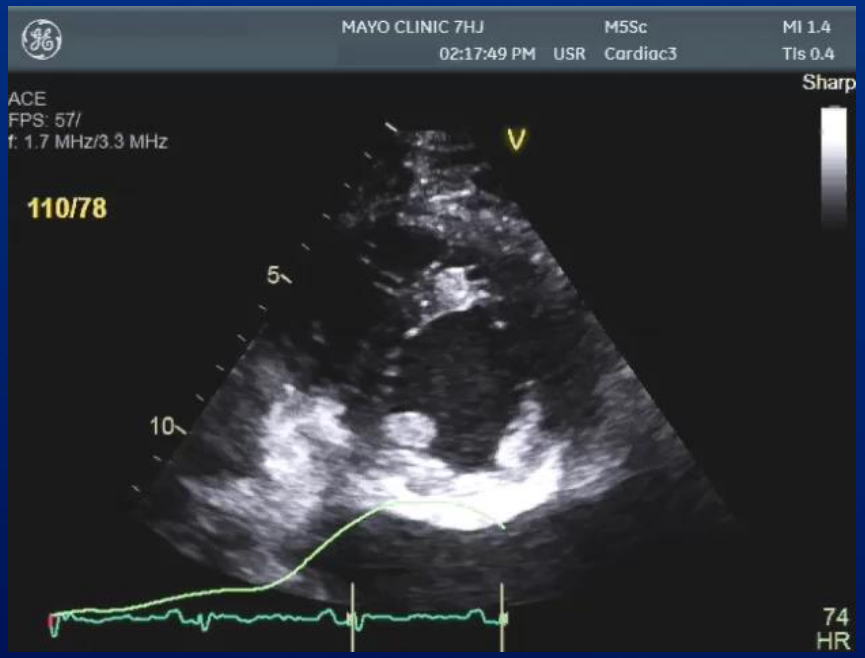
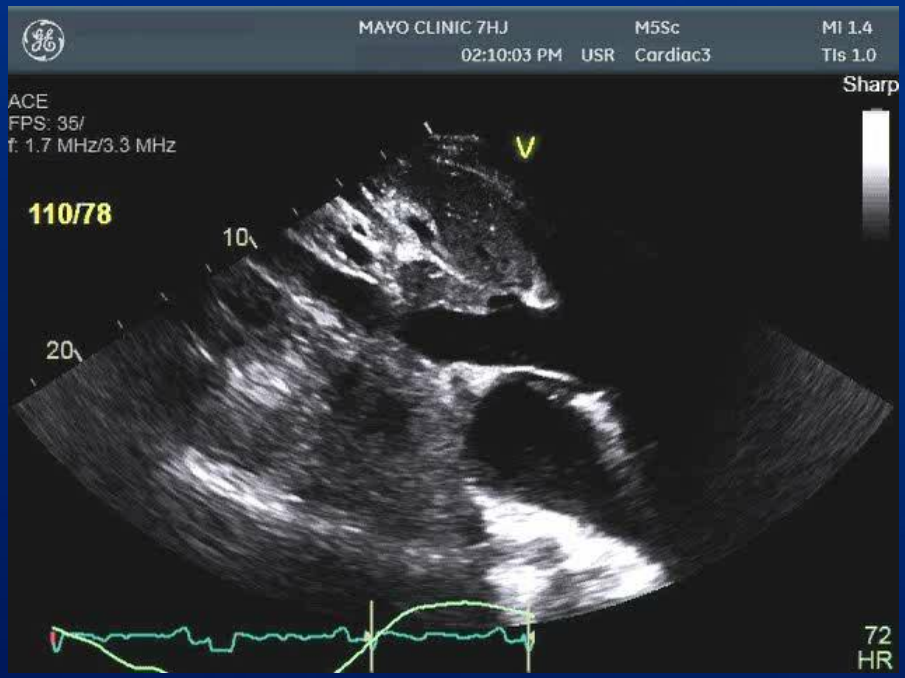
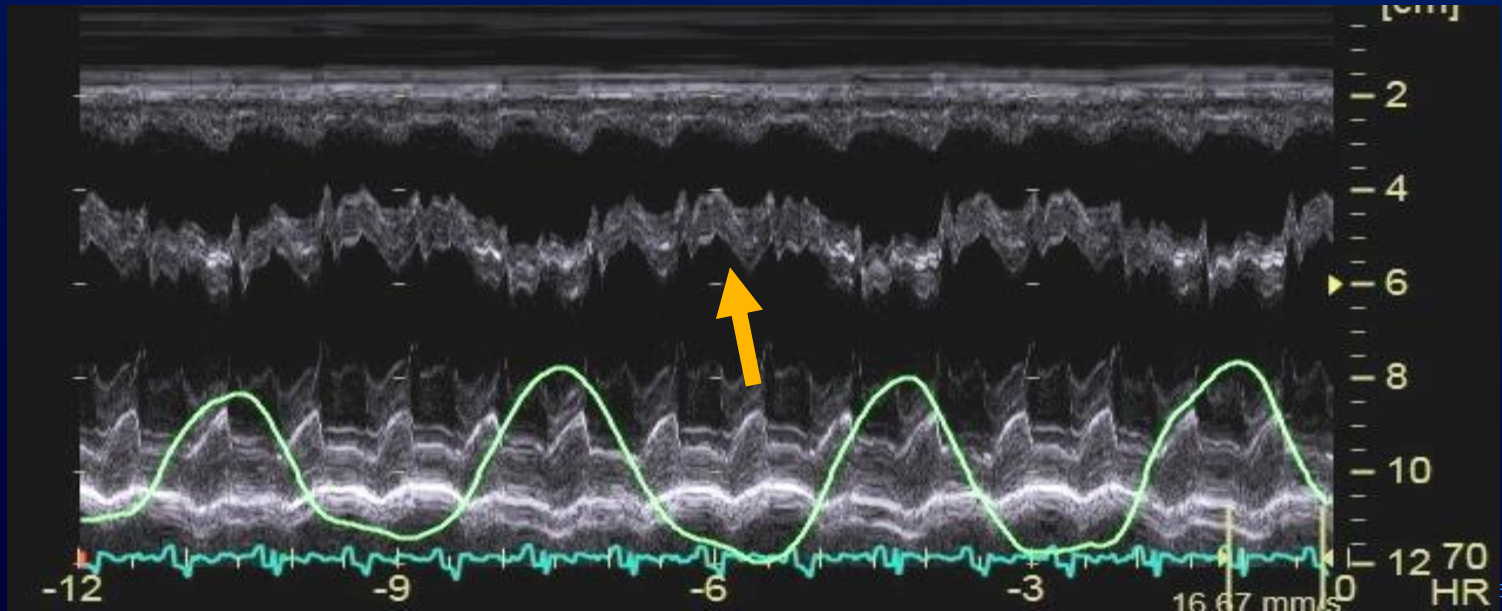
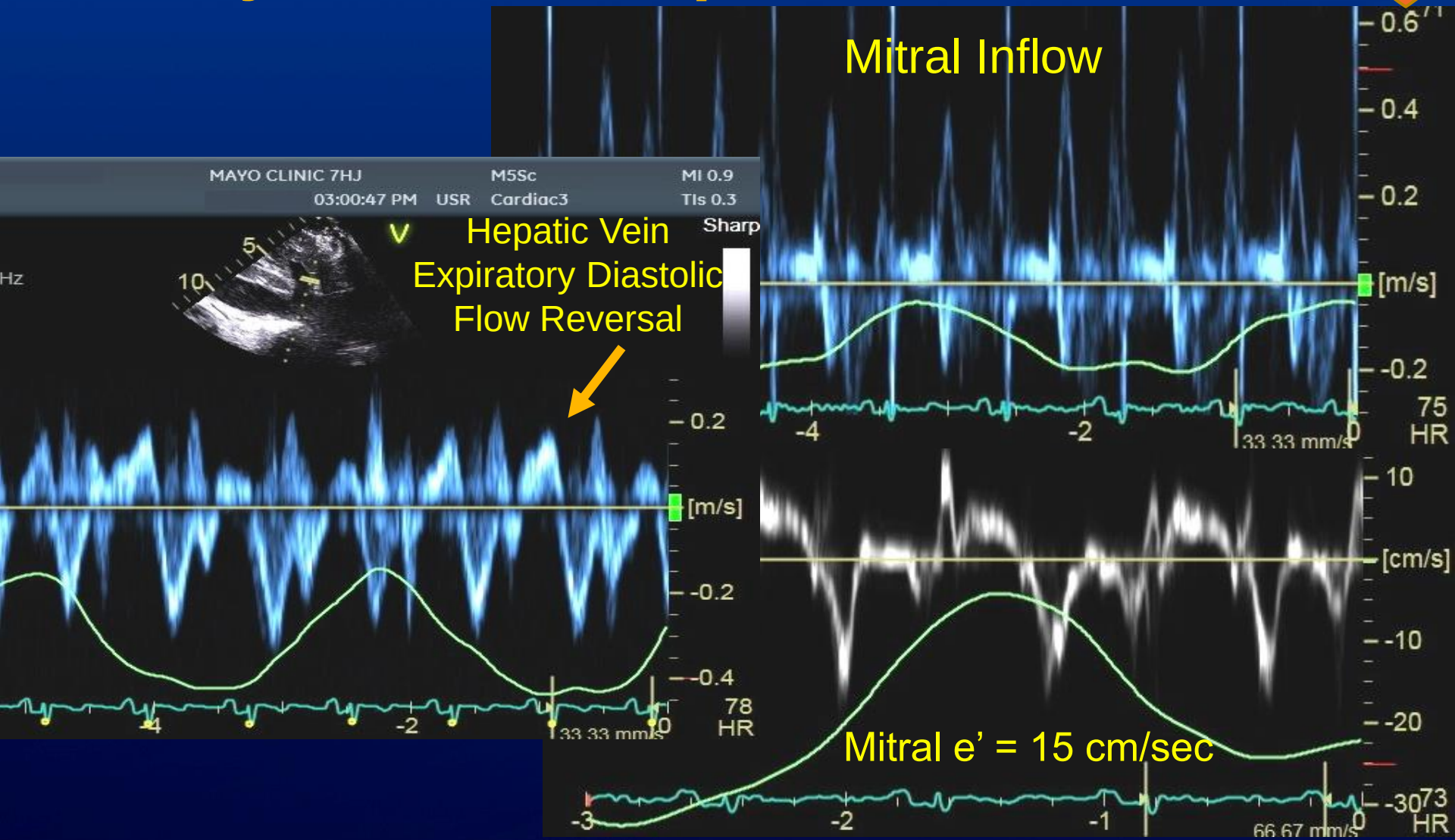

MAYO CLINIC 7HJ
M5Sc
MI 1.4
02:17:49 PM
USR
Cardiac3
TIs 0.4
Sharp
ACE
FPS: 57/
f: 1.7 MHz/3.3 MHz
110/78
5
10
74
HR


MAYO CLINIC 7HJ
M5Sc
MI 1.4
02:10:03 PM
USR
Cardiac3
TIs 1.0
Sharp
ACE
FPS: 35/
f: 1.7 MHz/3.3 MHz
110/78
10
20
72
HR


2
4
6
8
10
12
-12
-9
-6
-3
0
70
HR

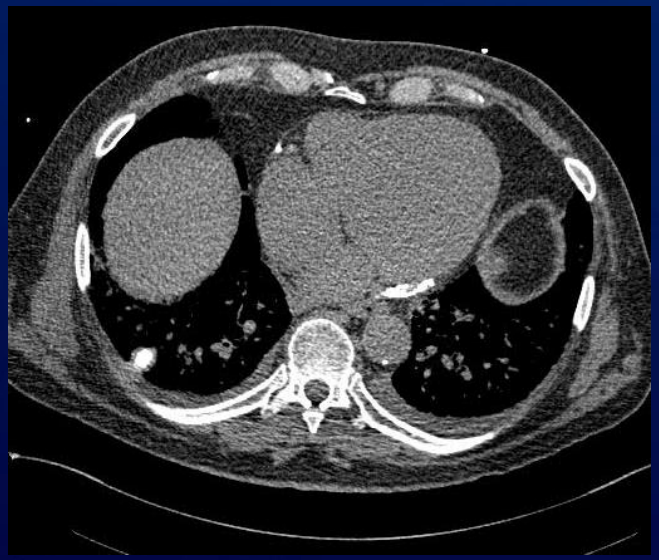
27 yo man after pericardial window



1= CT 2= MRI 3= Cath 4= Pericardiectomy

71 yo man with RUQ discomfort and dyspnea 2 years after CABG

- Physical Examination
  - JVP elevation
  - Prominent S3
  - Peripheral edema
- CT was obtained: Calcified Pericardium



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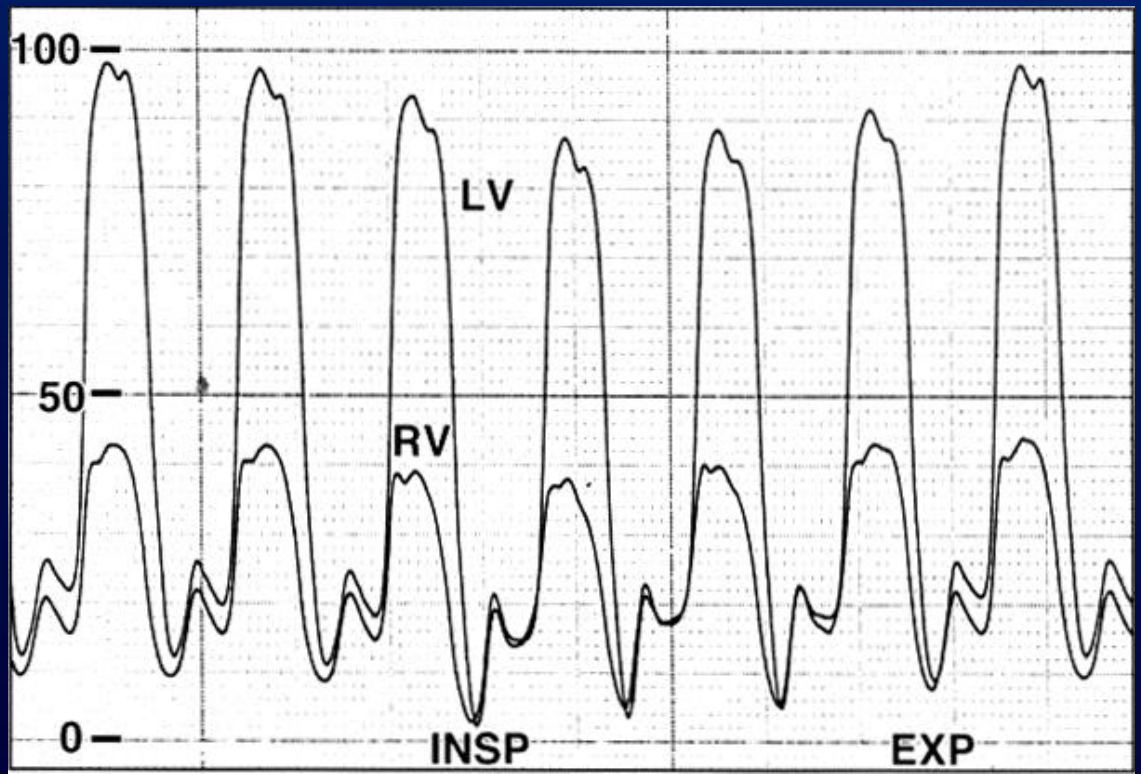
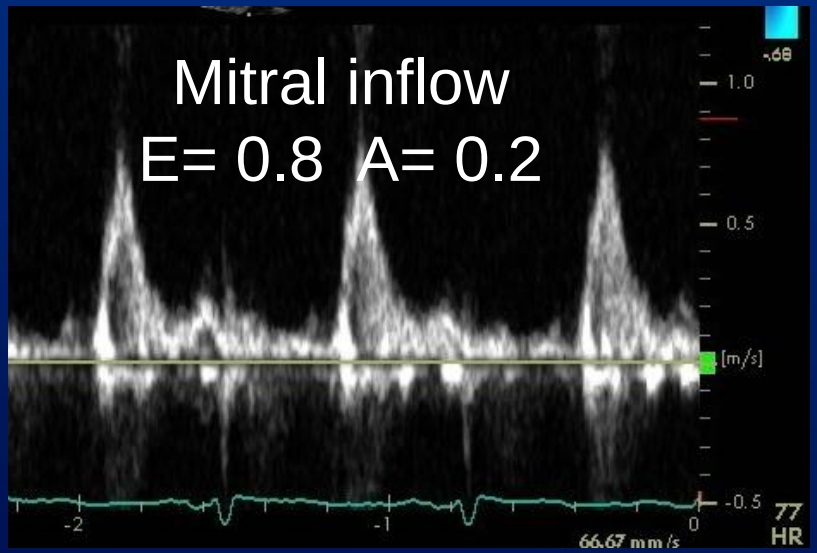
71 yo man with calcified pericardium
Referred for Pericardiectomy

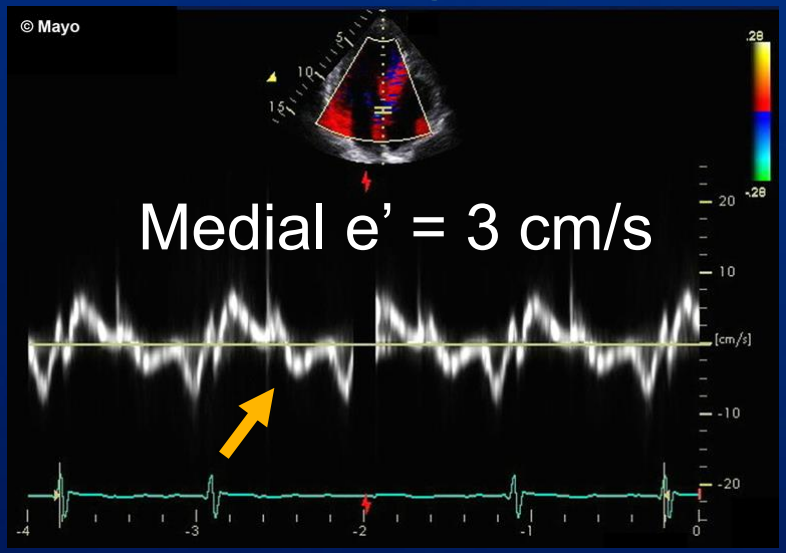
- Cardiac Cath
  - Normal Coronaries
  - Elevated RAP, RVEDP, LVEDP
    Equalized LV/RV EDP



MAYO CLINIC

71 year old man with calcified pericardium
Referred for Pericardiectomy





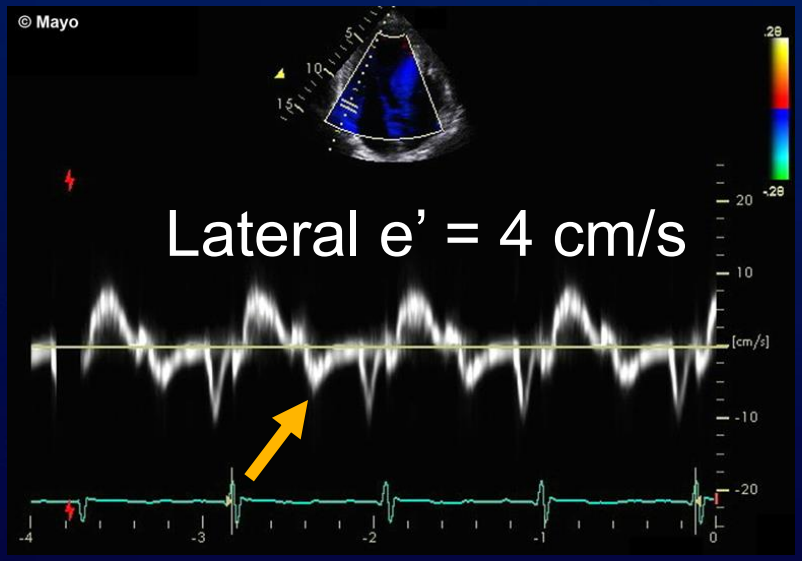
What would you do next?

1= Pericardiectomy

2= HF Medical Rx

3= Myocardial Biopsy

4= MRI



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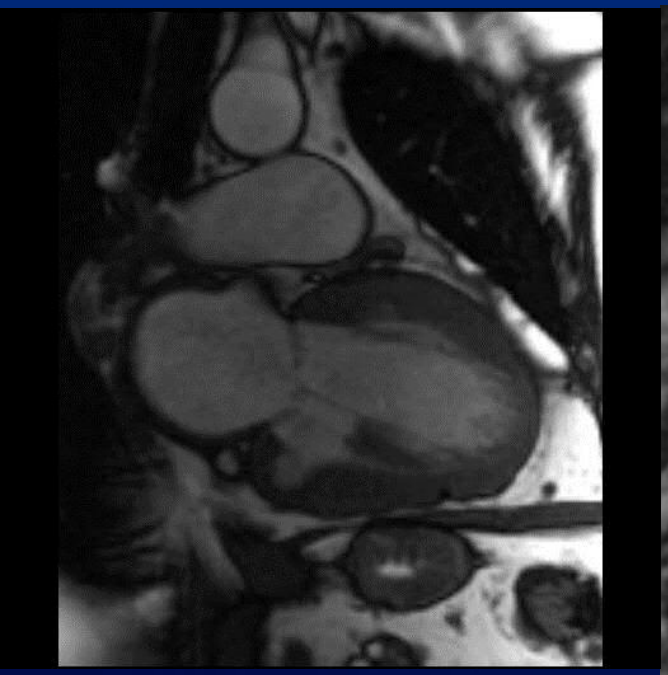
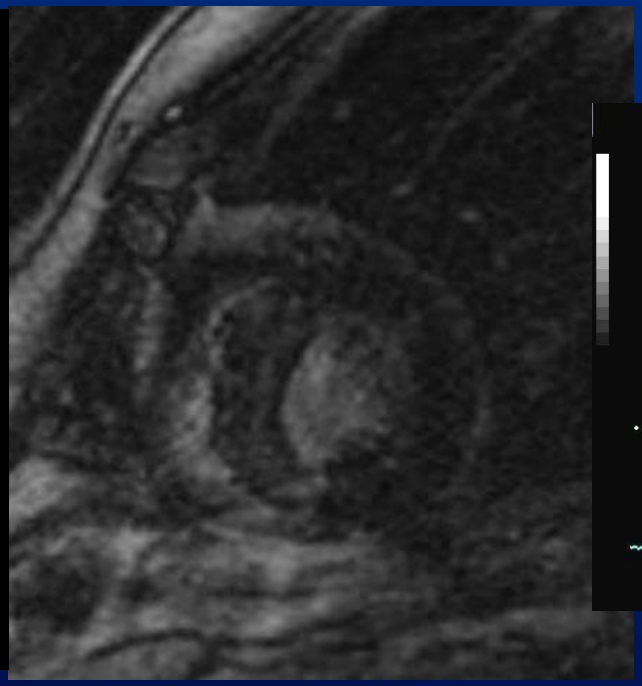
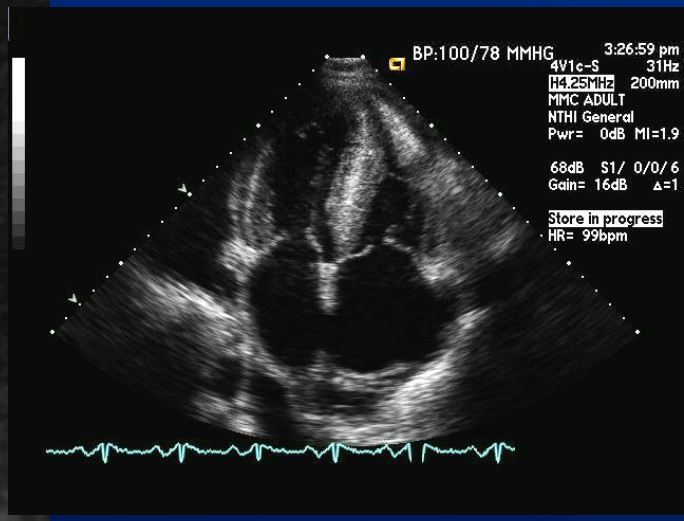
71 year old man with calcified pericardium







MRI : Patchy myocardial delayed enhancement and increased wall thickness

Cardiac Amyloidosis

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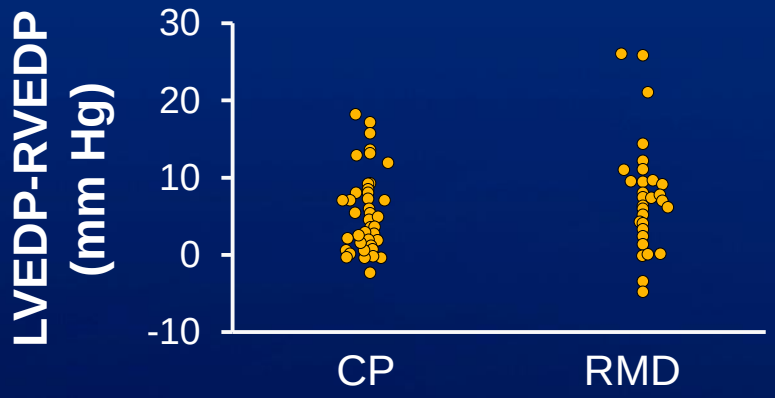
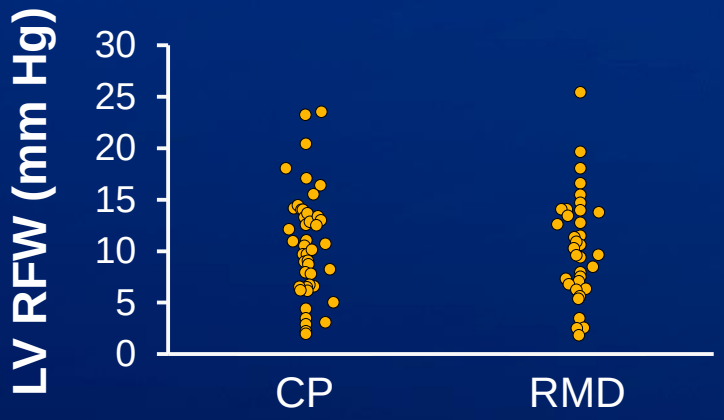
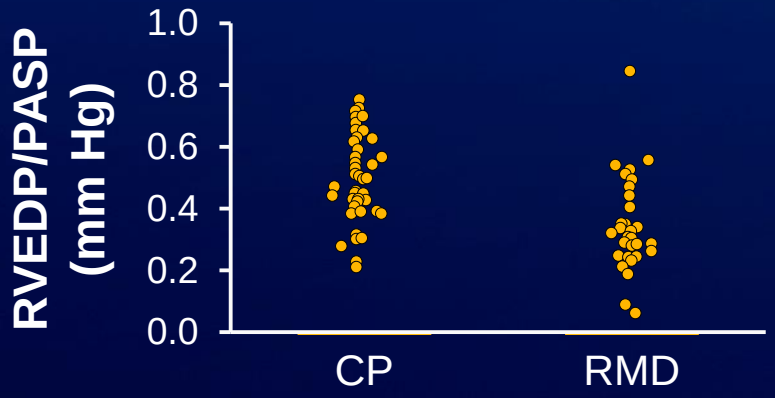
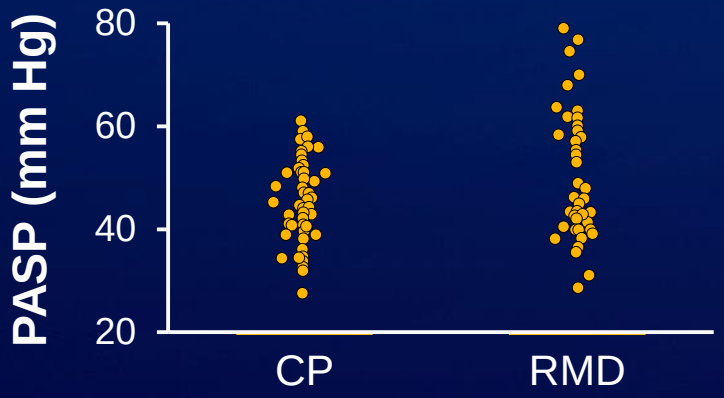
Constriction vs Restriction

Traditional Hemodynamic Diagnostic parameters









Talreja et al: J Am Coll Cardiol 51:315, 2008

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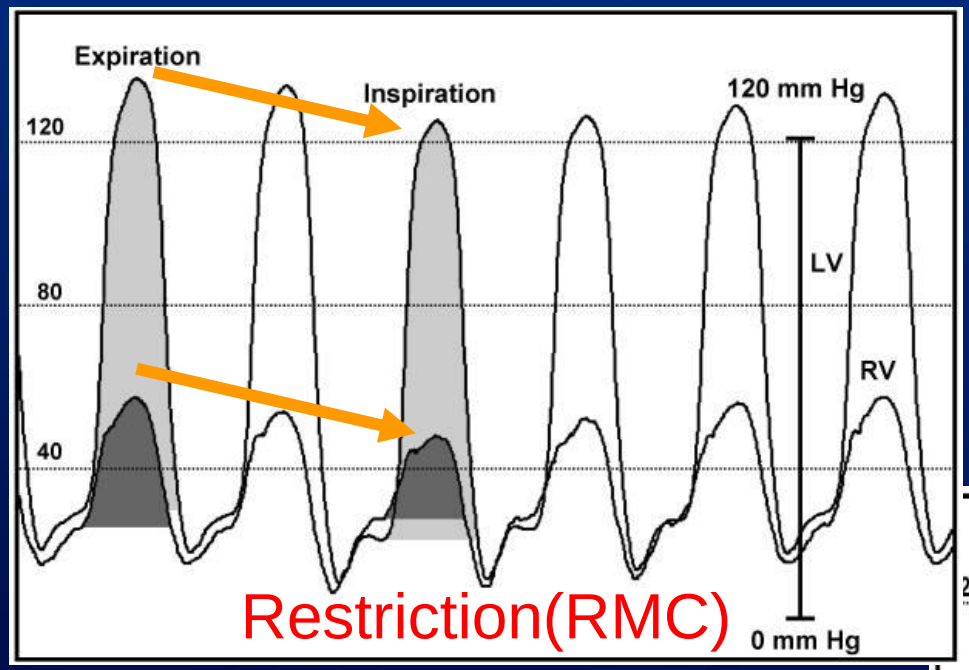
Constrictive Pericarditis in the Modern Era

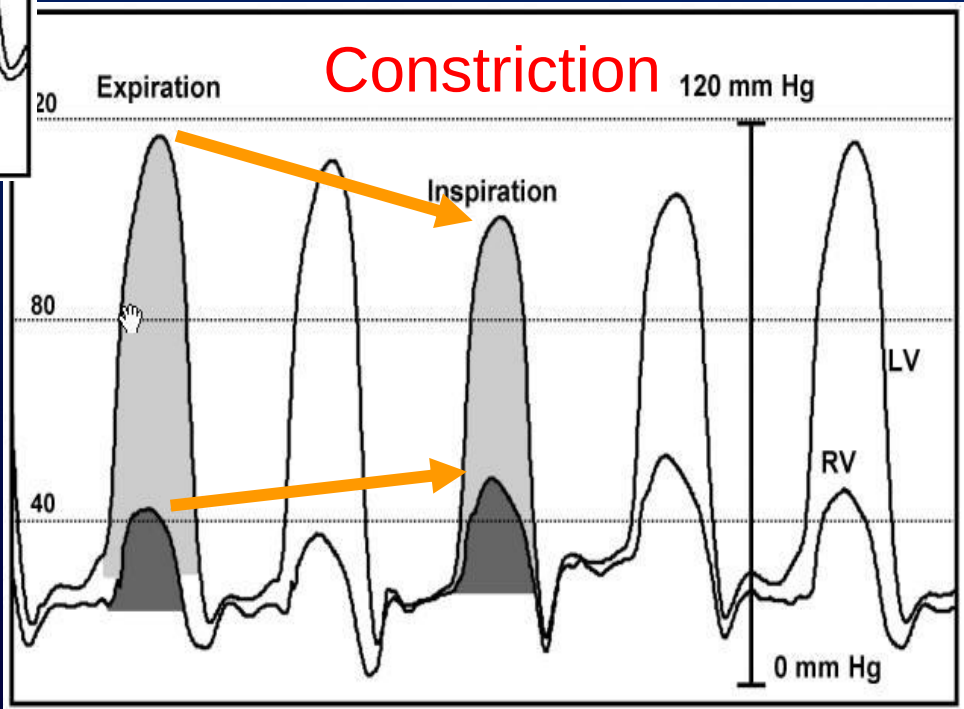
Novel Criteria for Diagnosis in the Cardiac Cath Laboratory (Talreja, Nishimura, Oh, Holmes. Jan. 2008 JACC)



Restriction(RMC)

Concordant change

Discordant change



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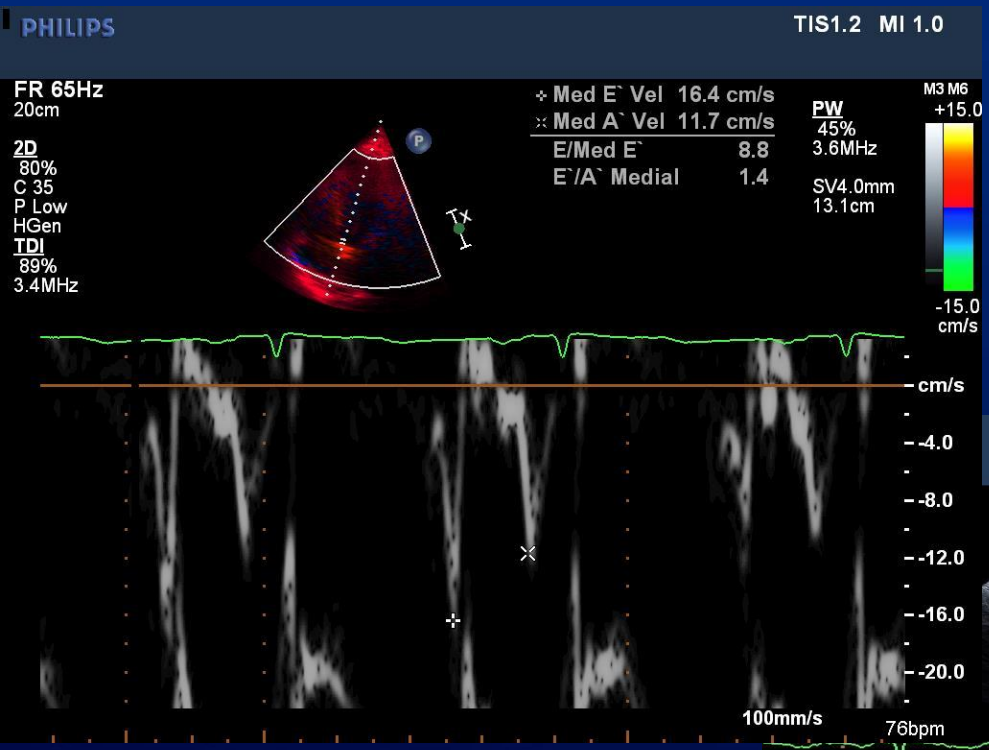
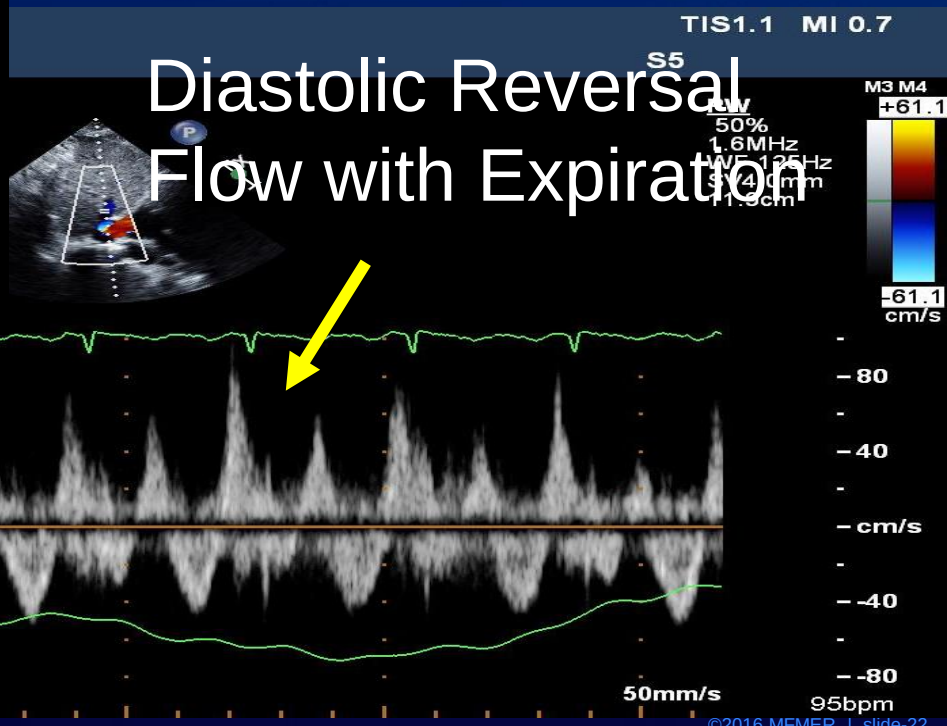
An e-mail from a junior staff at a major MC
52 year old man waiting for heart transplantation
(Had Echo, MRI, and cardiac cath performed)



Dx= RCM



Diastolic Reversal Flow with Expiration

Medial e' = 20 cm/sec

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What would you recommend?

1. Being a junior staff, keep quiet
2. Believing in Echo-Doppler, un-list him and further evaluation
3. Proceed with transplantation

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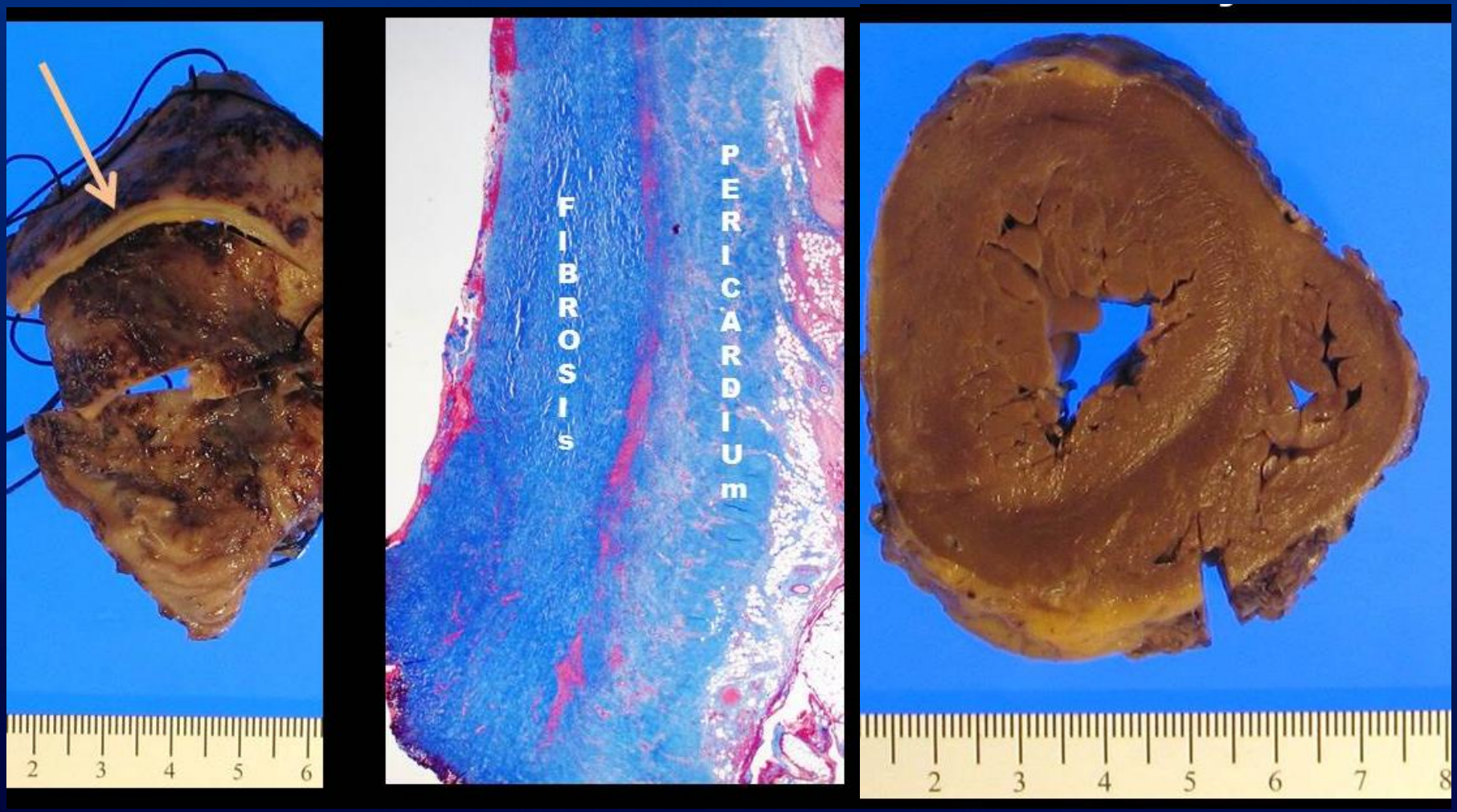
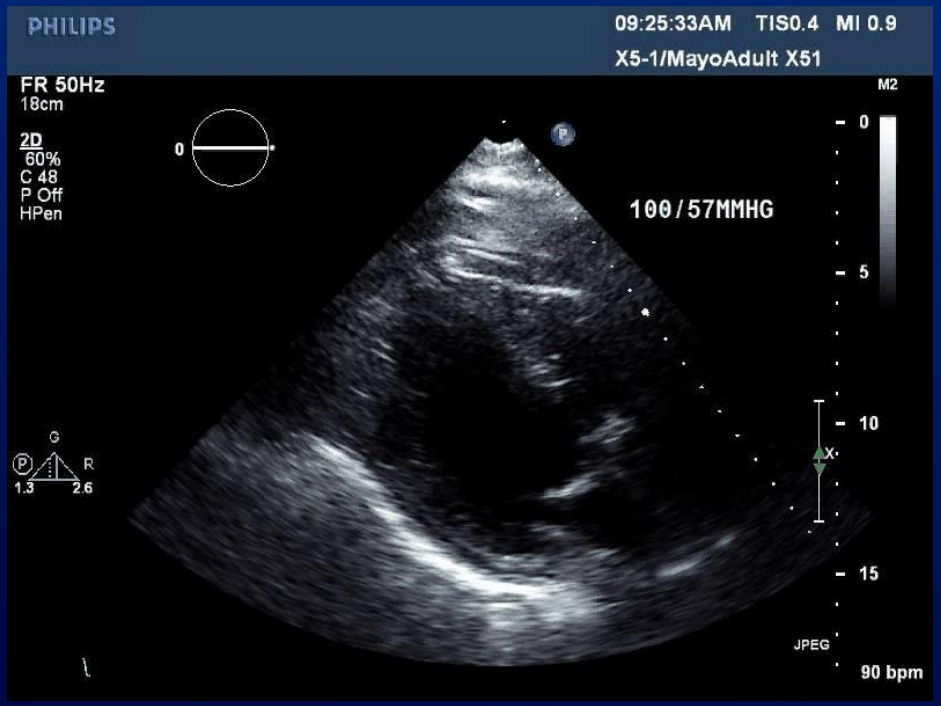
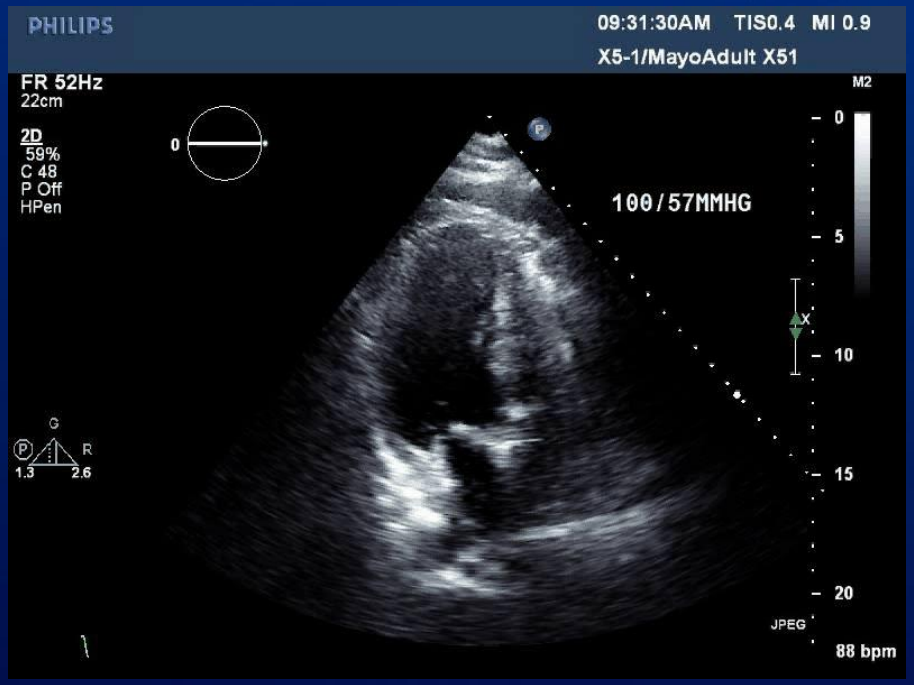
Explanted Heart



77 yo man with severe aortic stenosis

TAVR and PM implantation





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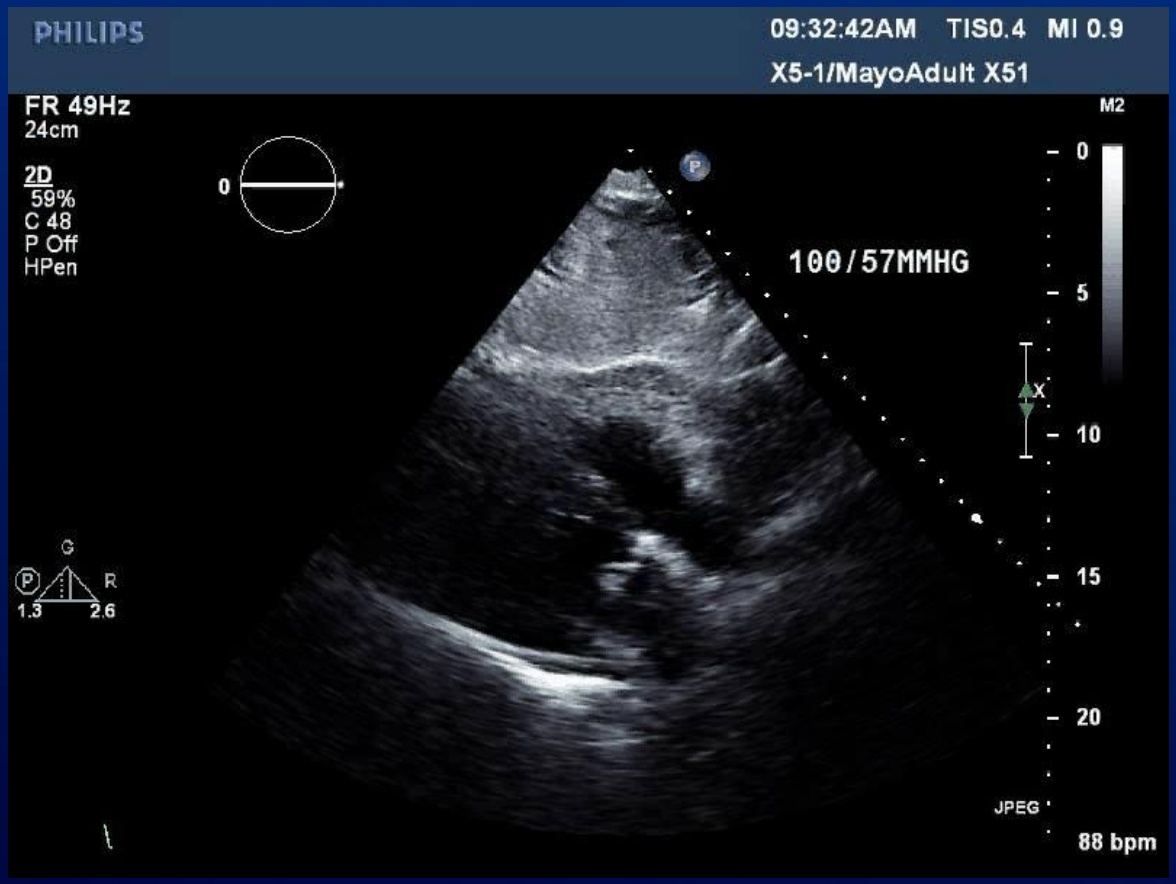
77 yo man with severe aortic stenosis
TAVR and PM implantation & RV Perforation

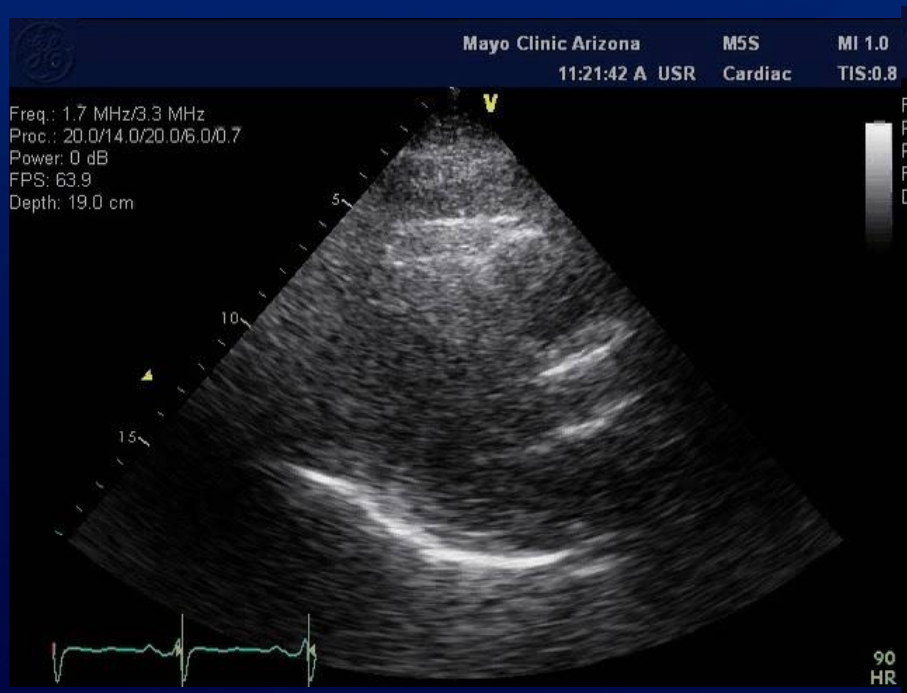


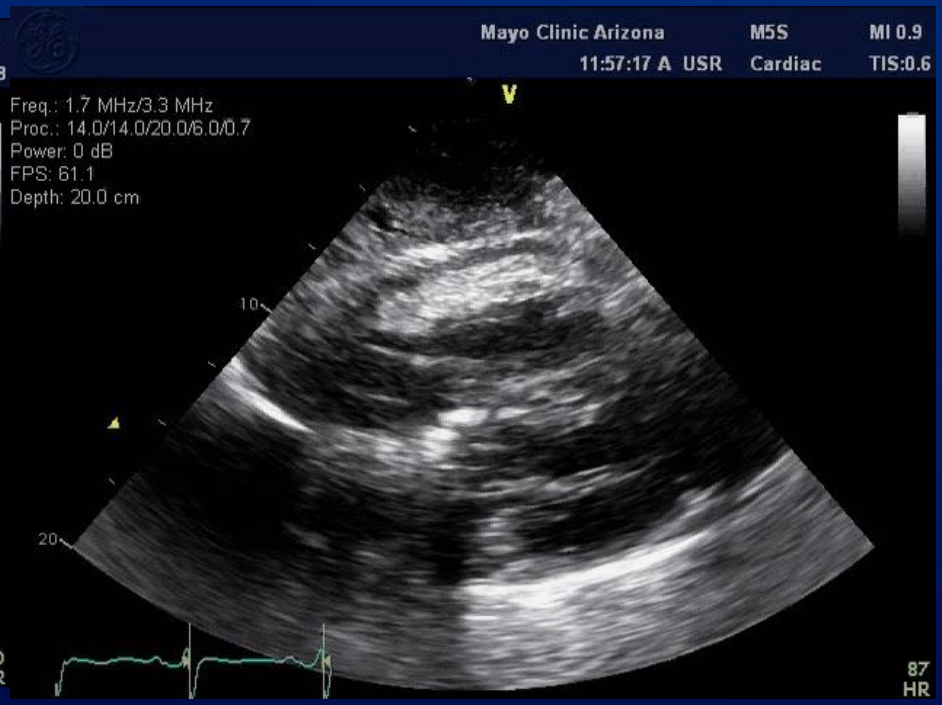
Pericardiocentesis yielded 125 cc of bloody fluid

MAYO CLINIC

77 yo man with severe aortic stenosis

Increasing dyspnea 2 months after pericardiocentesis





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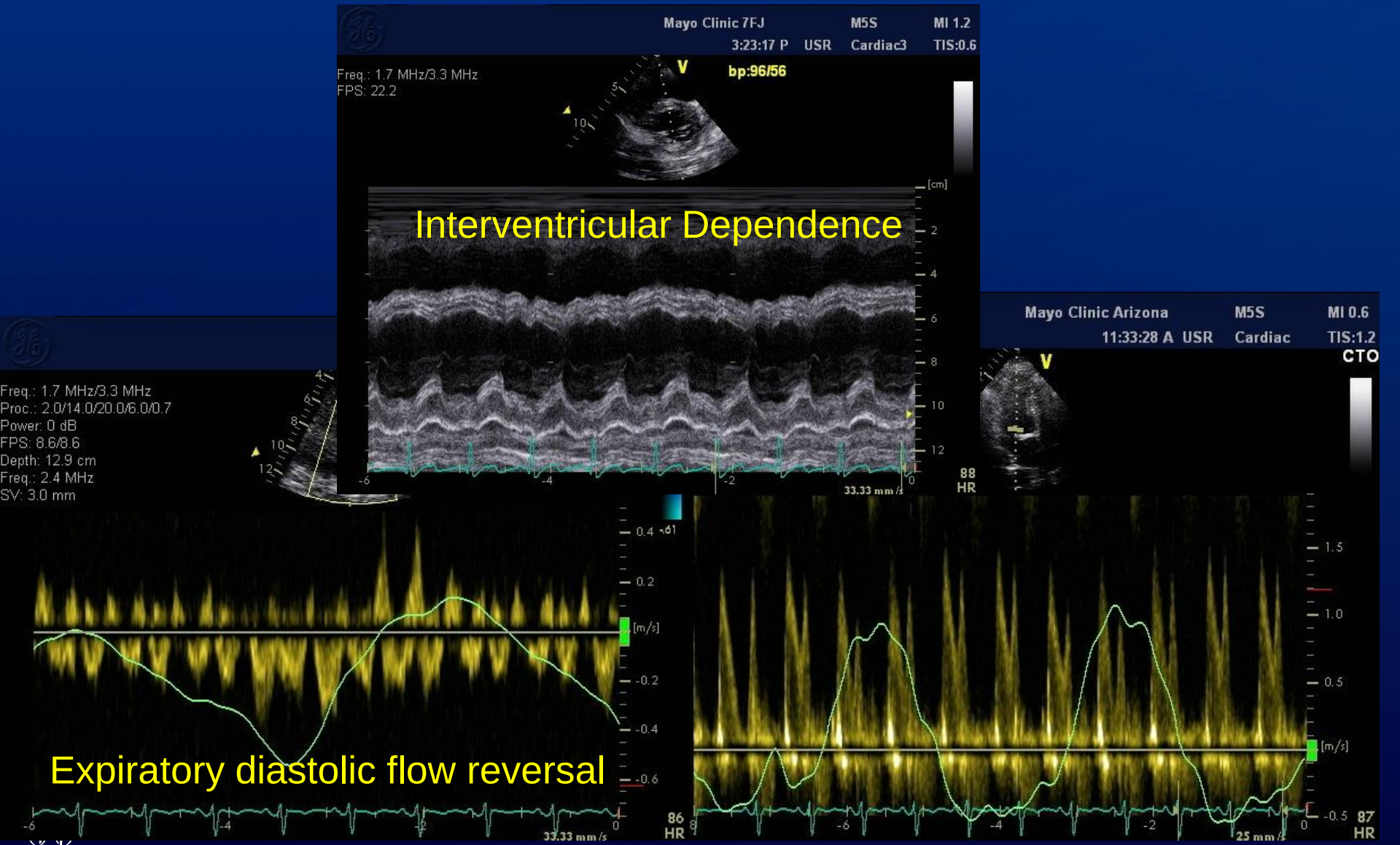
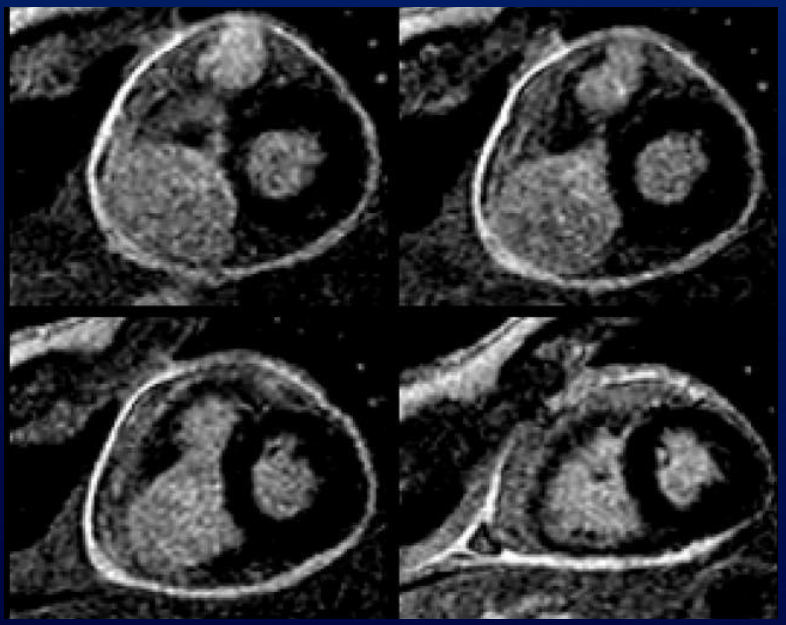
Effusive-Constrictive Pericarditis



Cardiac Magnetic Resonance Imaging Pericardial Late Gadolinium Enhancement and Elevated Inflammatory Markers Can Predict the Reversibility of Constrictive Pericarditis After Antiinflammatory Medical Therapy

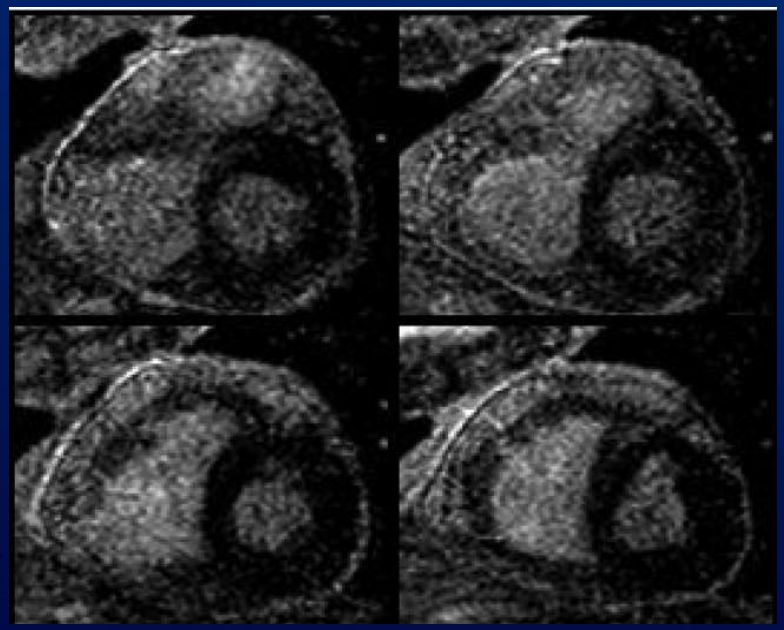
A Pilot Study

DaLi Feng, MD; James Glockner, MD, PhD; Kyehun Kim, MD; Matthew Martinez, MD; Imran S. Syed, MD; Philip Araoz, MD; Jerome Breen, MD; Raul E. Espinosa, MD; Thoralf Sundt, MD; Hartzell V. Schaff, MD; Jae K. Oh, MD



Baseline

Medical RX



3 Months

Circulation Oct 3rd 2011

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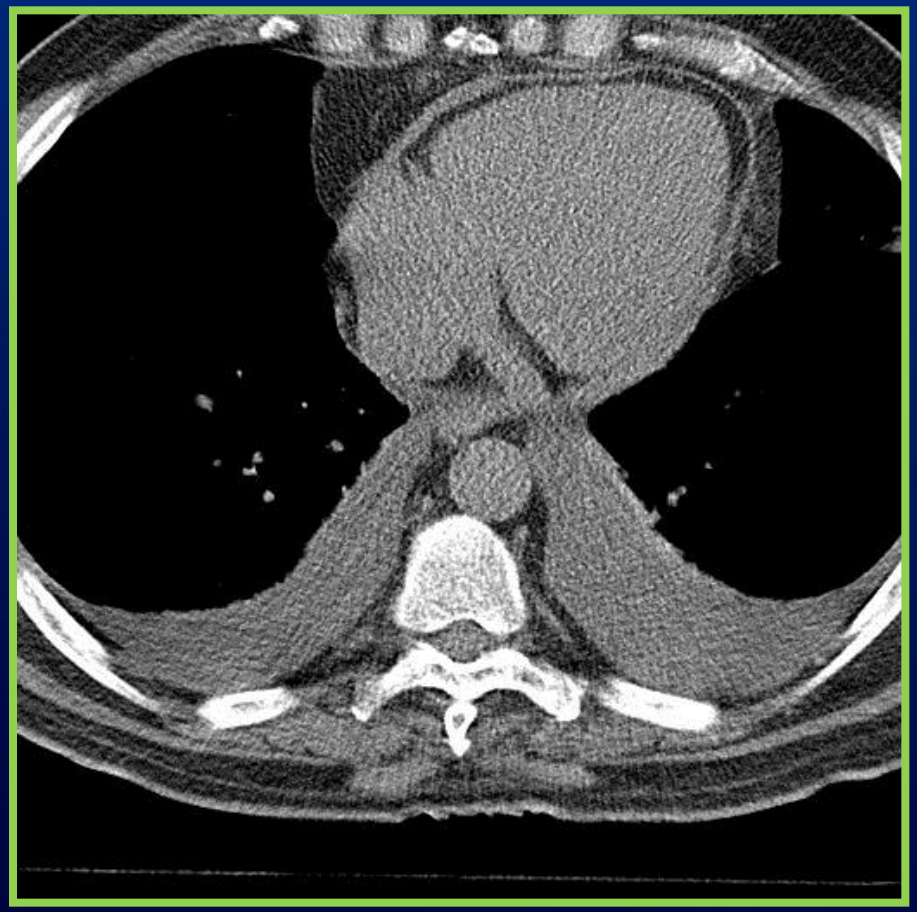
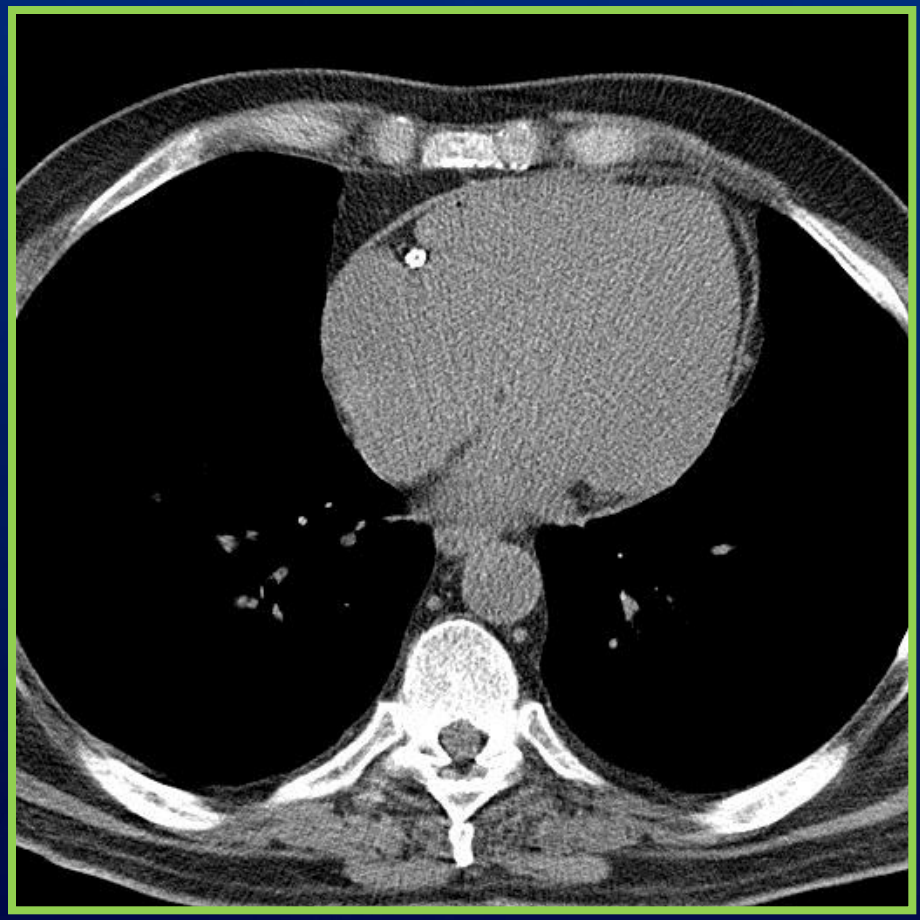
Transient Constrictive Pericarditis
One week of Steroid Rx





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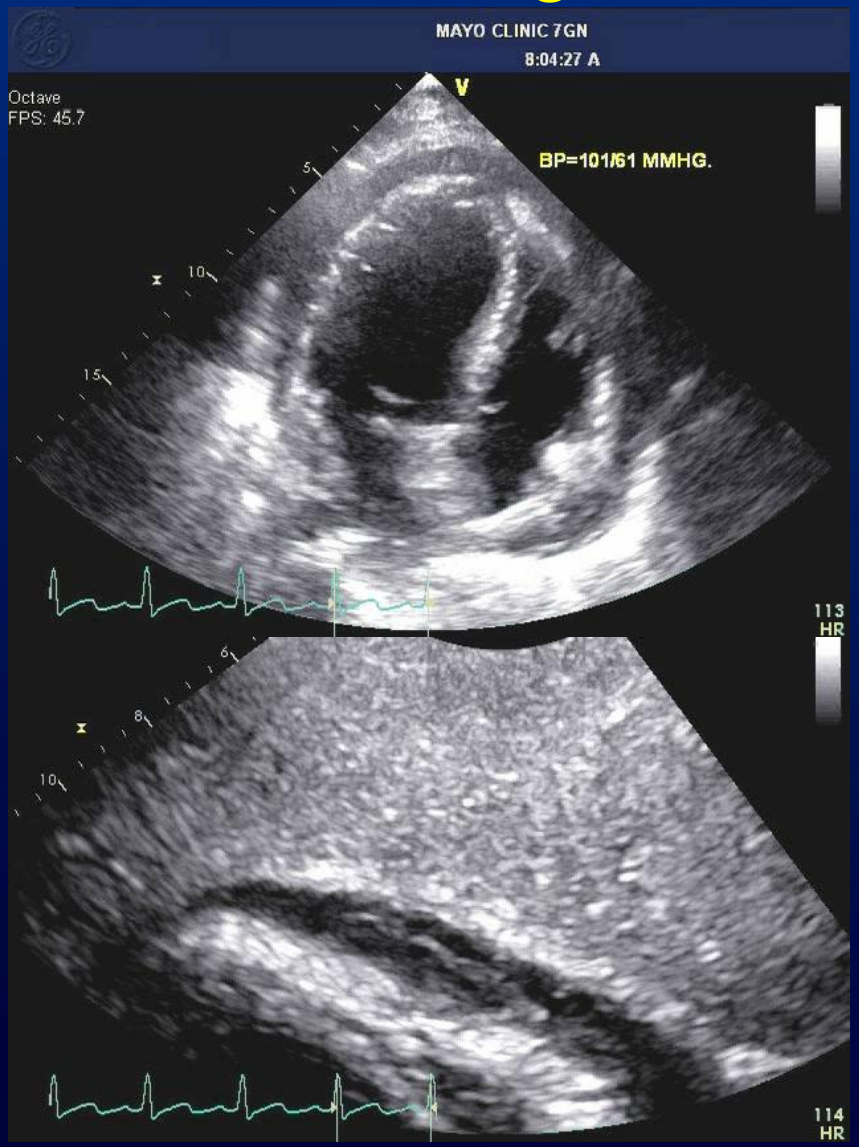
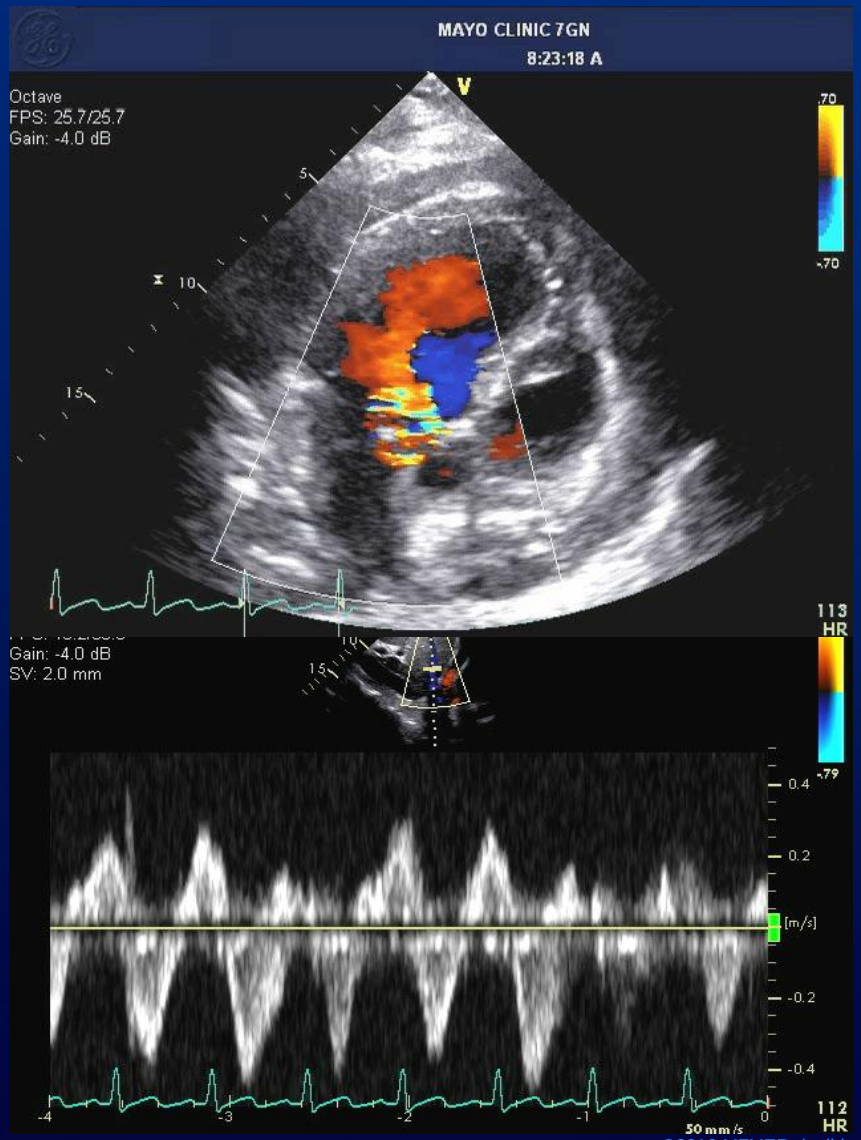
Transient Constriction

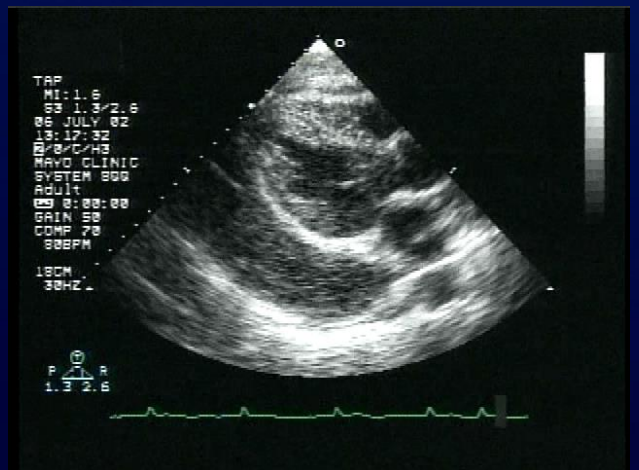
	Reversible (N=14)	Persistent (N=15)
Age	54 ± 17	59 ± 16
LVEF	57 ± 3	60 ± 3
E' (cm/sec)	12 ± 1	11 ± 1
Steroid Rx	71 %	53 %
Pericardium	3.8 ± 0.6 mm	4.0 ± 0.6 mm
DE Pericardium	4.4 ± 0.4 mm	2.1 ± 0.4mm
Grade 3-4/4 DE	93 %	33 %
Sed rate	45 to 4	25 to 20
CRP	75 to 2	14 to 15

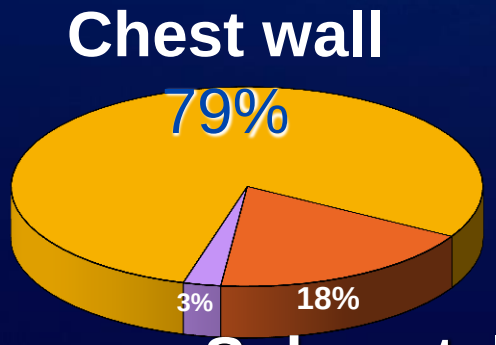
35 yo man presents with dyspnea and fever
BP 80/40 mmHg





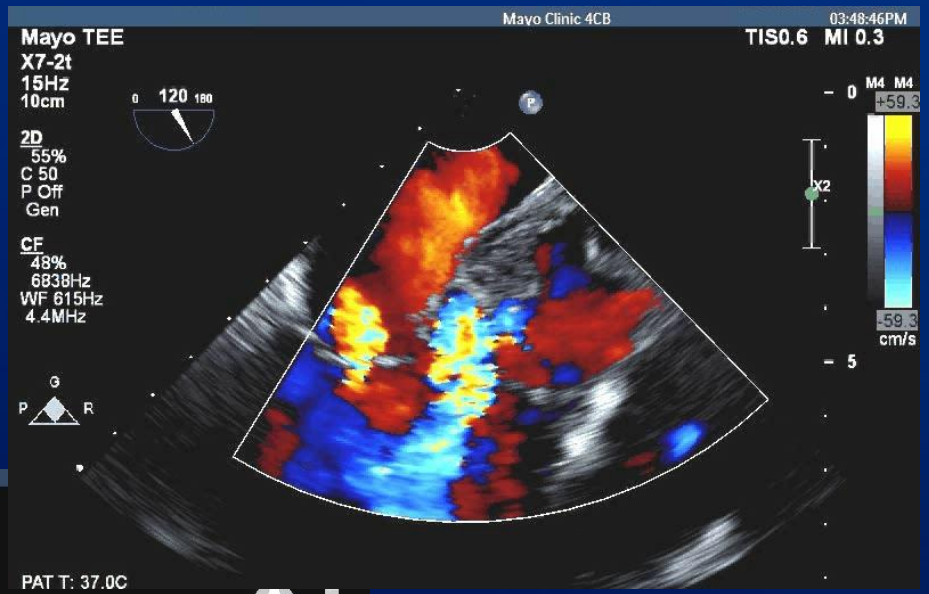
Echo guided Pericardiocentesis

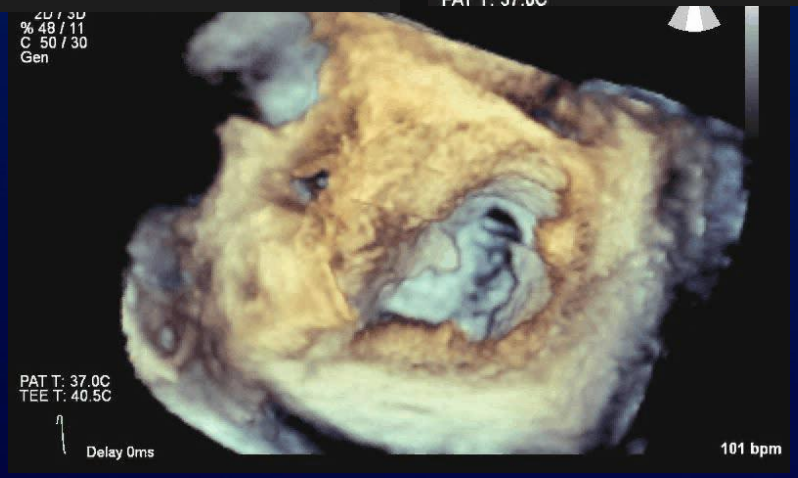




Location

35 yo man with tamponade and fever
TEE after pericardiocentesis





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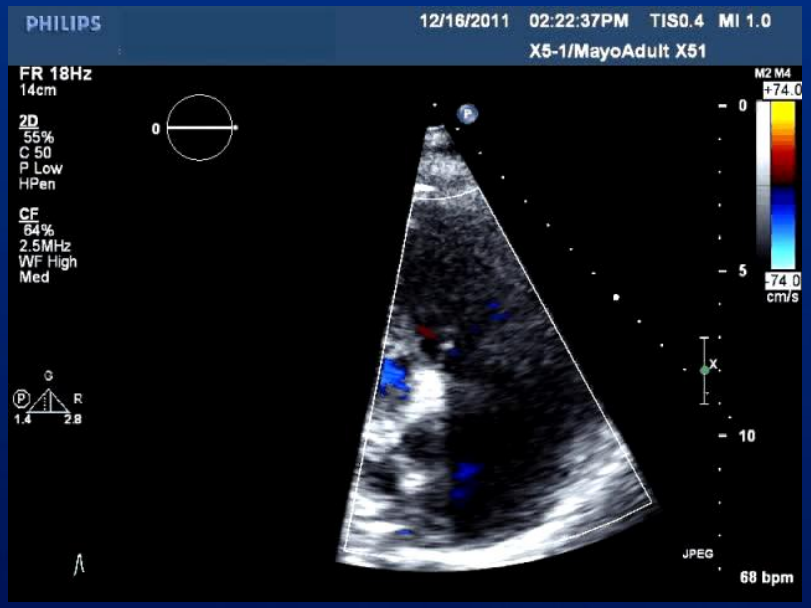
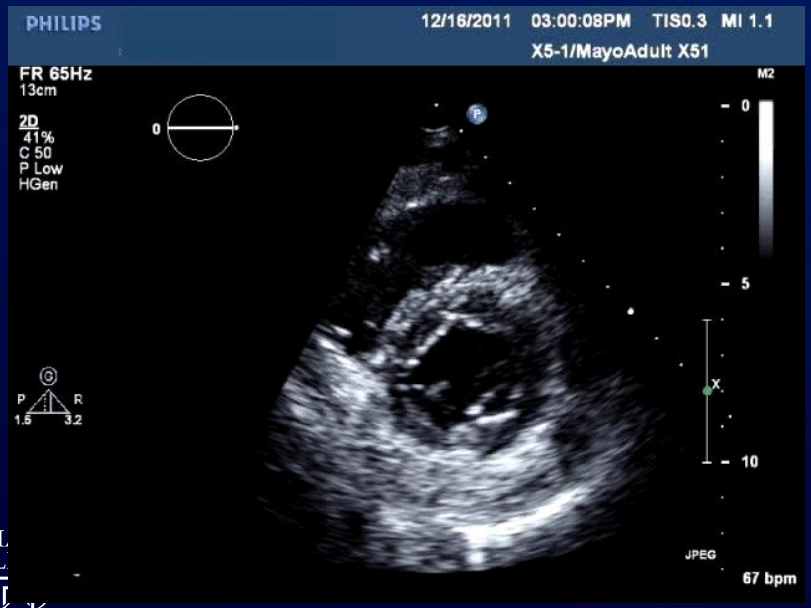
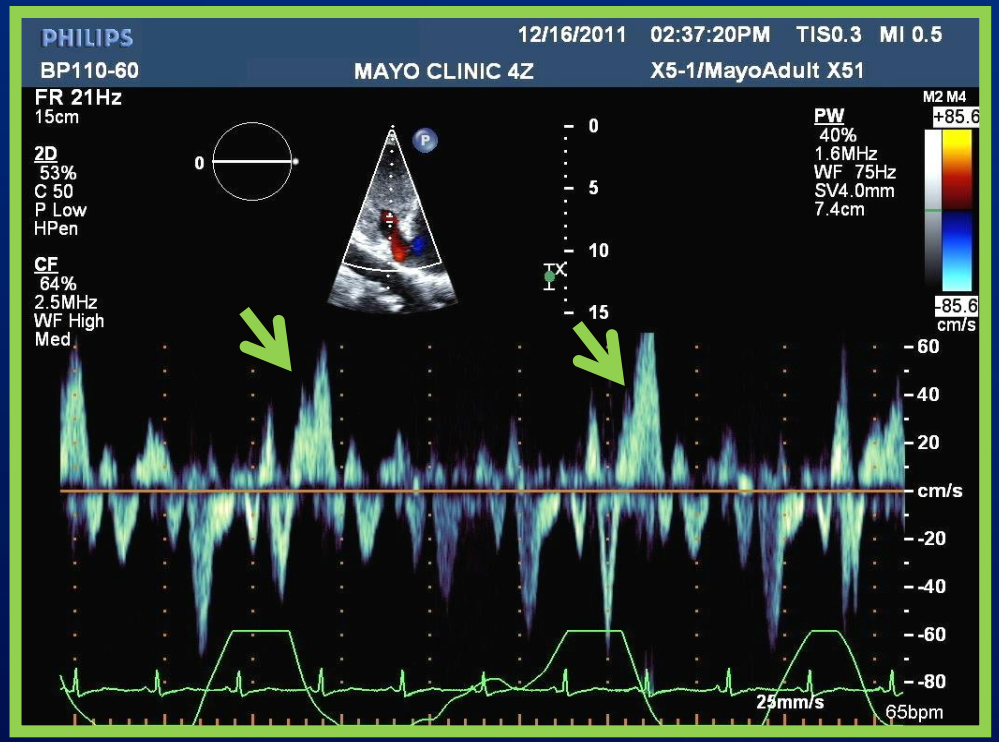
Heart failure with ascites and leg edema







1= Severe TR

2=Constriction

3= TR + CP

4= TR and RV dysfunction

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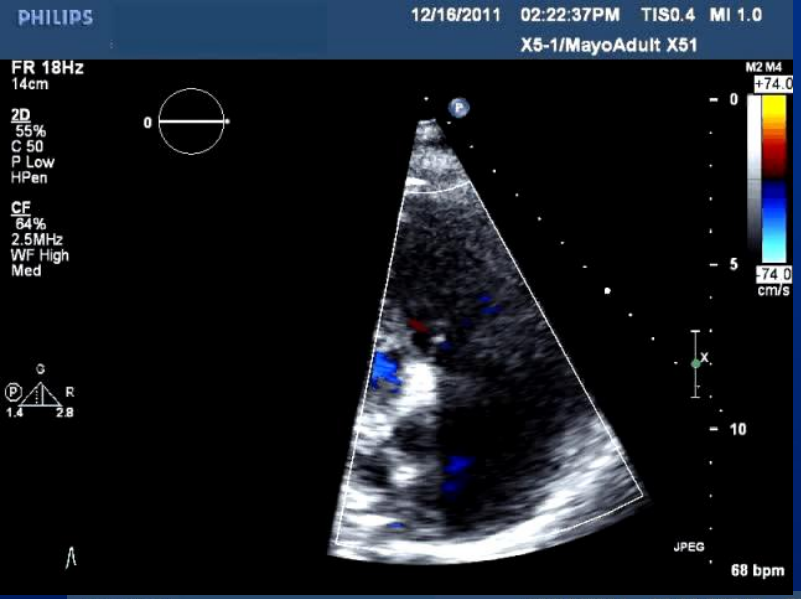
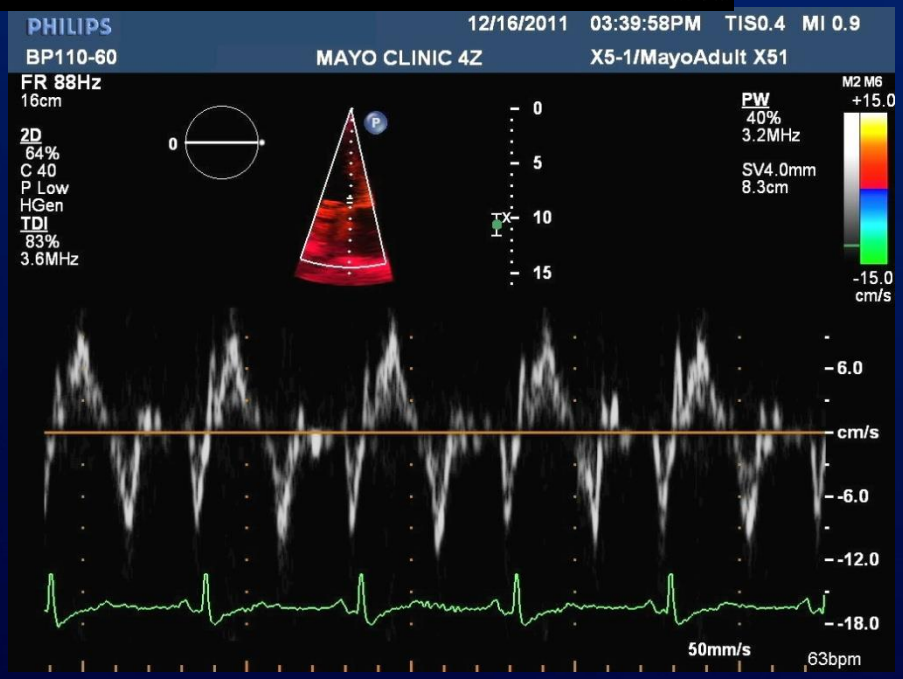
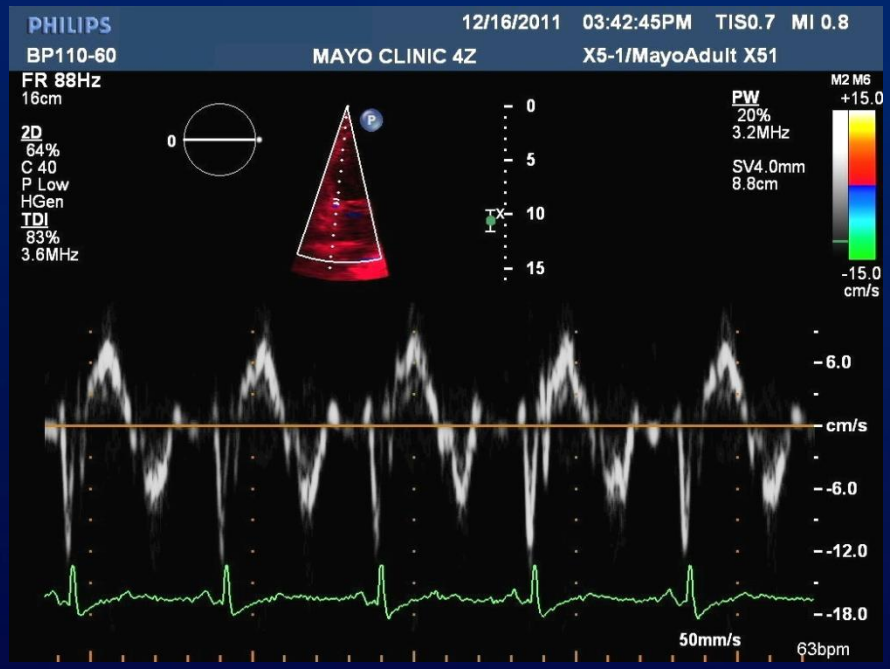
Annulus Reversus
Severe TR and CP







Medial e' = 12 cm/sec

Lateral e'= 9 c/sec

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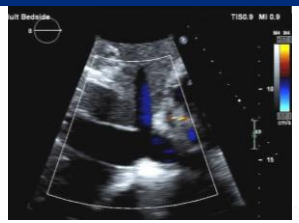
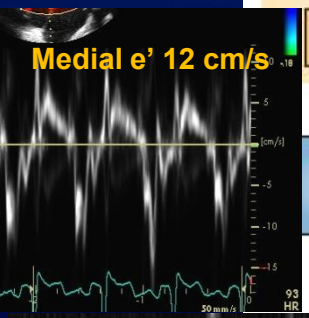
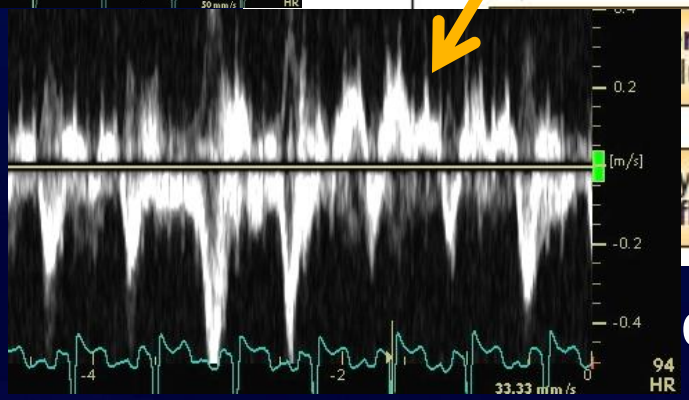
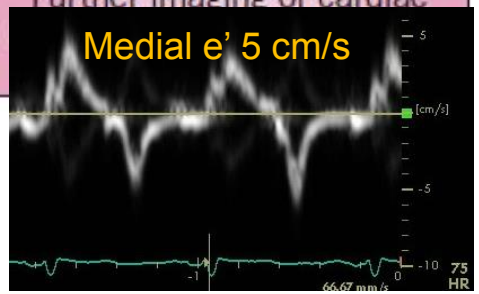
Constriction or Myocardial Disease ?
Diagnostic Algorithm









Mitral inflow E/A >0.8
+
Dilated inferior vena cava

Yes

No

Ventricular septal motion abnormality with respiration

Constriction/restriction unlikely

Yes

No

Mitral medial e'

>8 cm/s

6–8 cm/s

<6 cm/s

Further imaging or cardiac

Constrictive pericarditis*

Mixed constriction/ restriction

Restrictive cardiomyopathy

ral e' < medial e'
lus reversus

Most likely constriction

y end-diastolic
flow velocity ≥0.8

Definite constriction

ed, Schaff, Oh Nature Review Sep 2014

47 pages

ASE EXPERT CONSENSUS STATEMENT

JASE 2013

American Society of Echocardiography Clinical Recommendations for Multimodality Cardiovascular Imaging of Patients with Pericardial Disease

Endorsed by the Society for Cardiovascular Magnetic Resonance and Society of Cardiovascular Computed Tomography

Allan L. Klein, MD, FASE, Chair, Suhny Abbara, MD, Deborah A. Agler, RCT, RDCS, FASE, Christopher P. Appleton, MD, FASE, Craig R. Asher, MD, Brian Hoit, MD, FASE, Judy Hung, MD, FASE, Mario J. Garcia, MD, Itzhak Kronzon, MD, FASE, Jae K. Oh, MD, FASE, E. Rene Rodriguez, MD, Hartzell V. Schaff, MD, Paul Schoenhagen, MD, Carmela D. Tan, MD, and Richard D. White, MD, *Cleveland and*

In the modern era, multimodality imaging is essential in the diagnosis and management of pericardial syndromes. Echocardiography is the initial test for most pericardial syndromes, including acute pericarditis,recurrent pericarditis, and CP. CMR and CT can usually be added when there is complexity not handled by echocardiography or technically limited windows or when tissue characterization is needed, such as with edema and inflammation.

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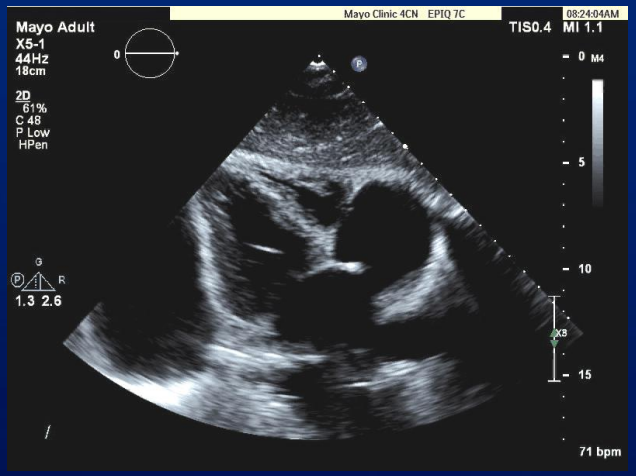
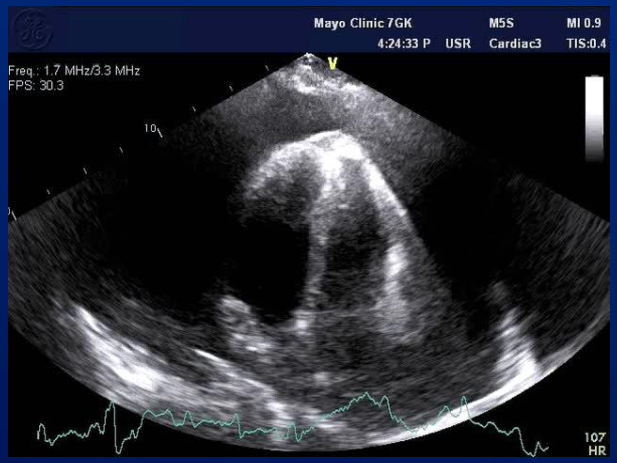
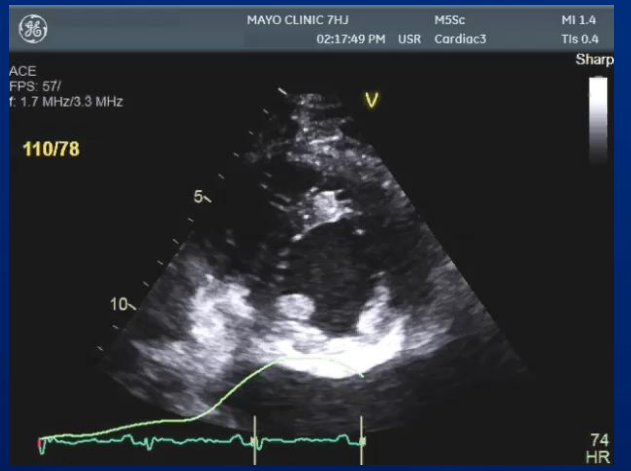
Echocardiography for Pericardial Diseases



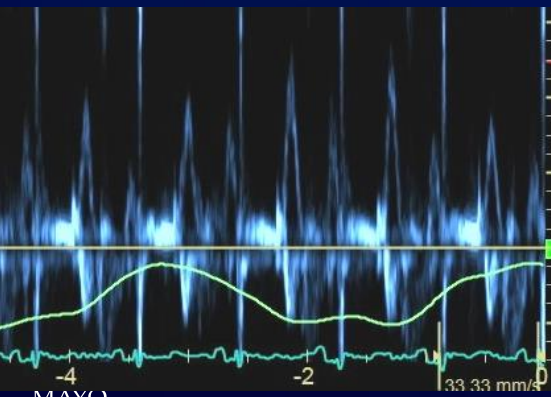
Cyst

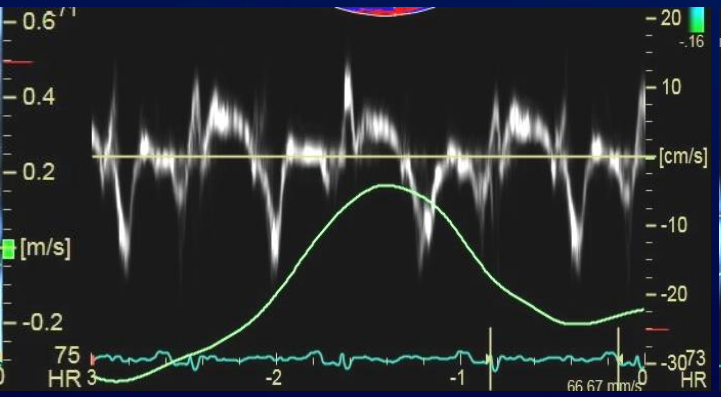


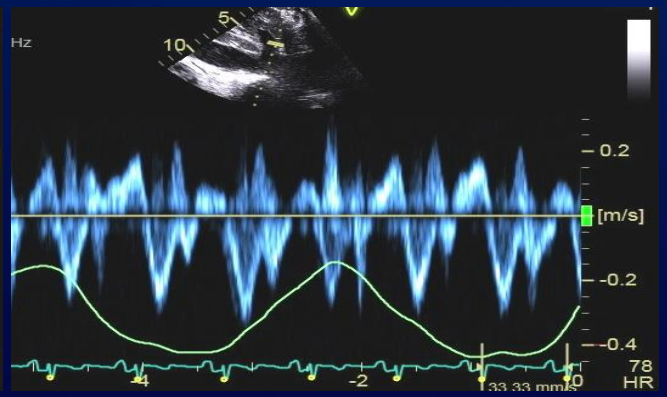
Tamponade



Constriction







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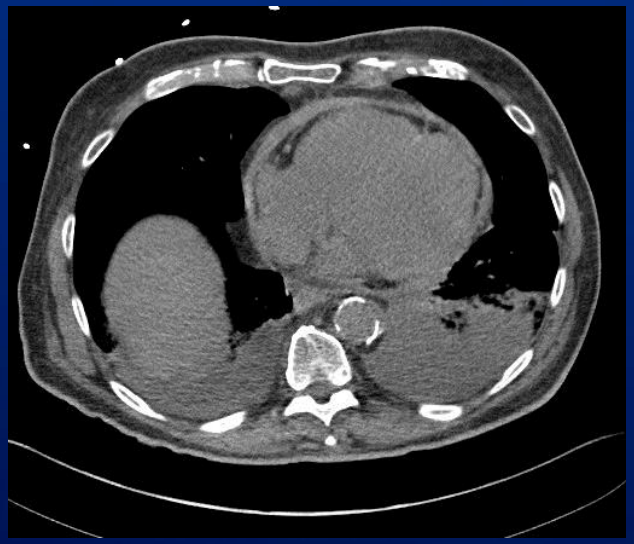
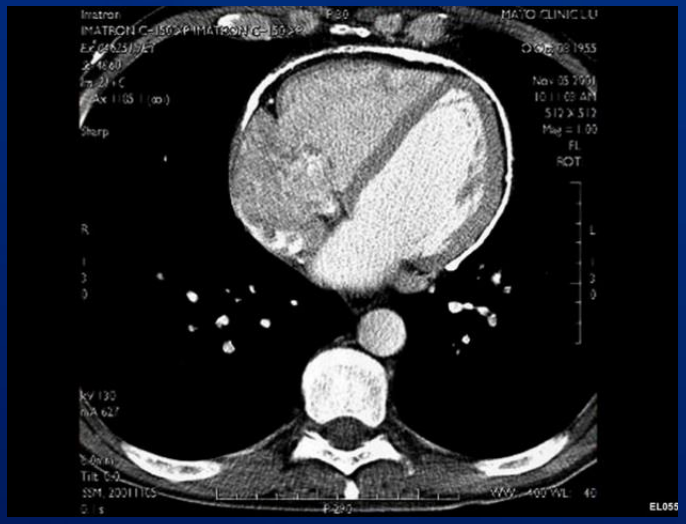
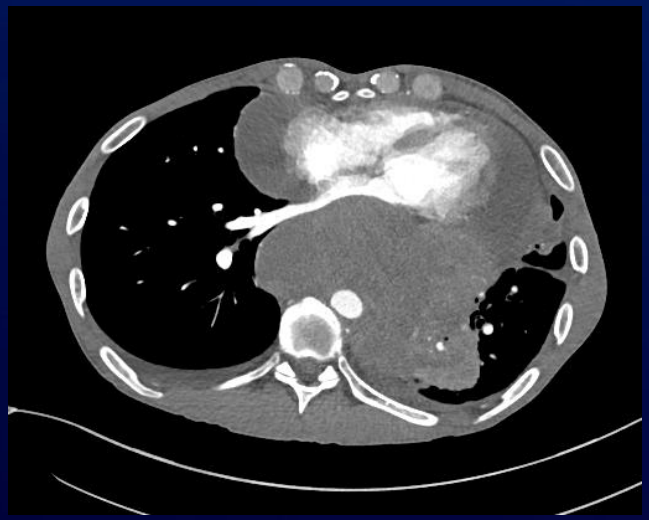
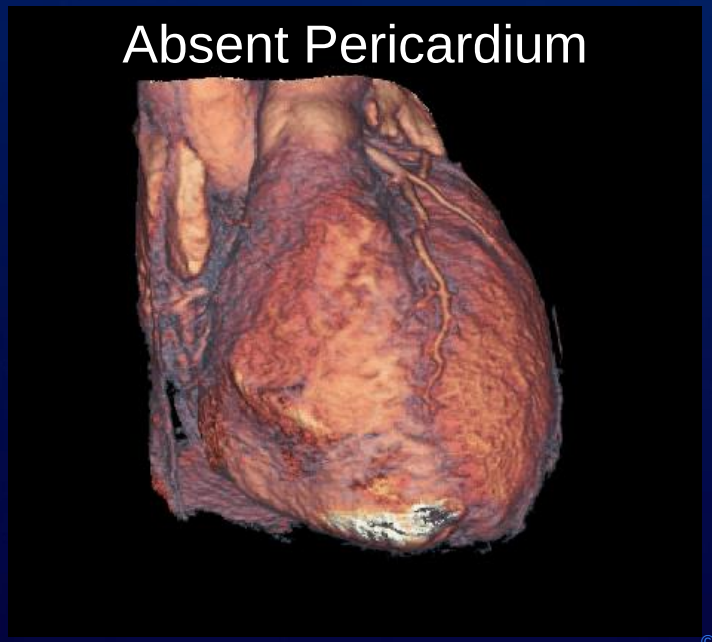
Cardiac CT for Pericardial Diseases









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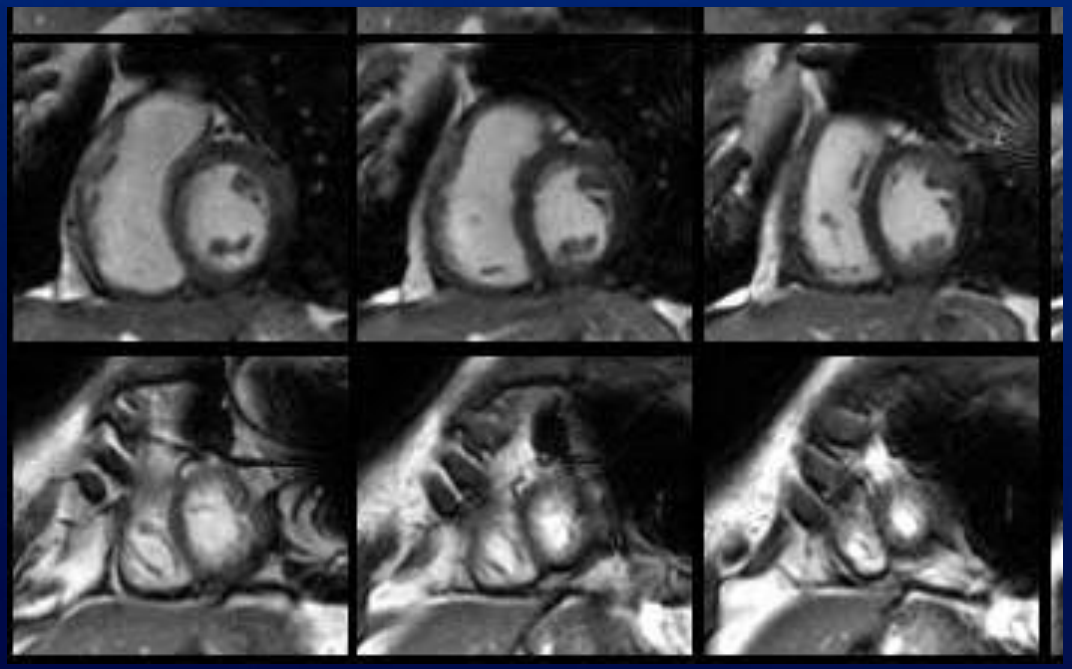
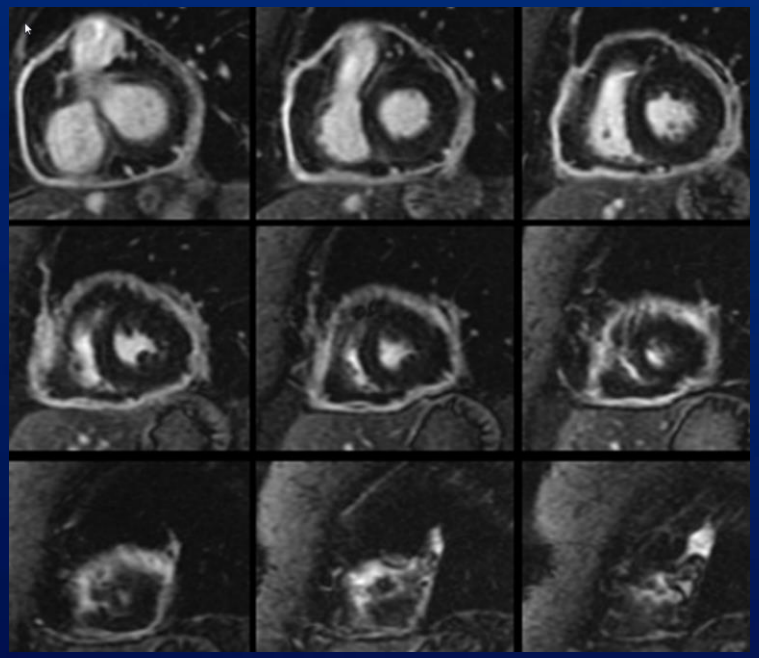
Cardiac MRI for Pericardial Diseases



Interventricular Dependence with typical septal motion



Extensive pericardial enhancement & adjacent left pleural

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Illustrative Cases

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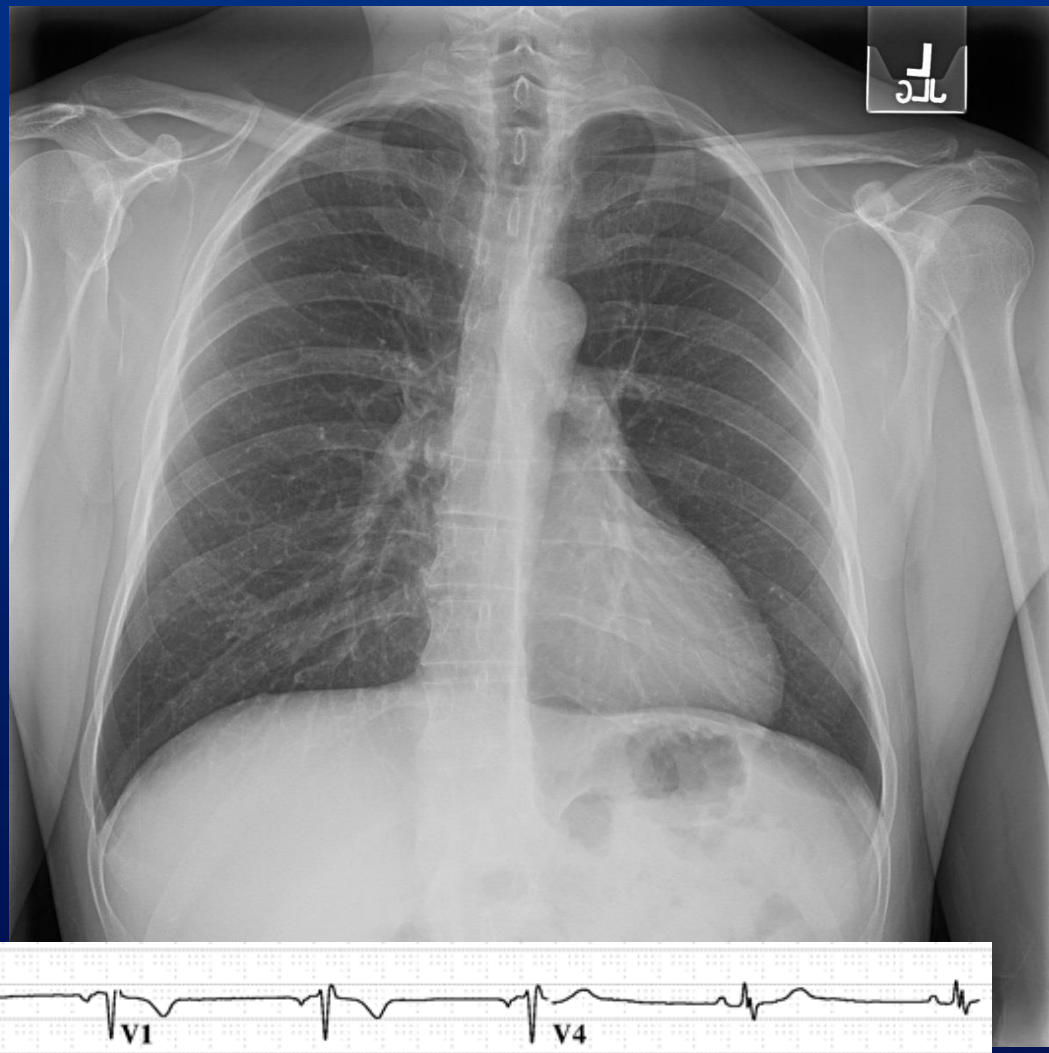
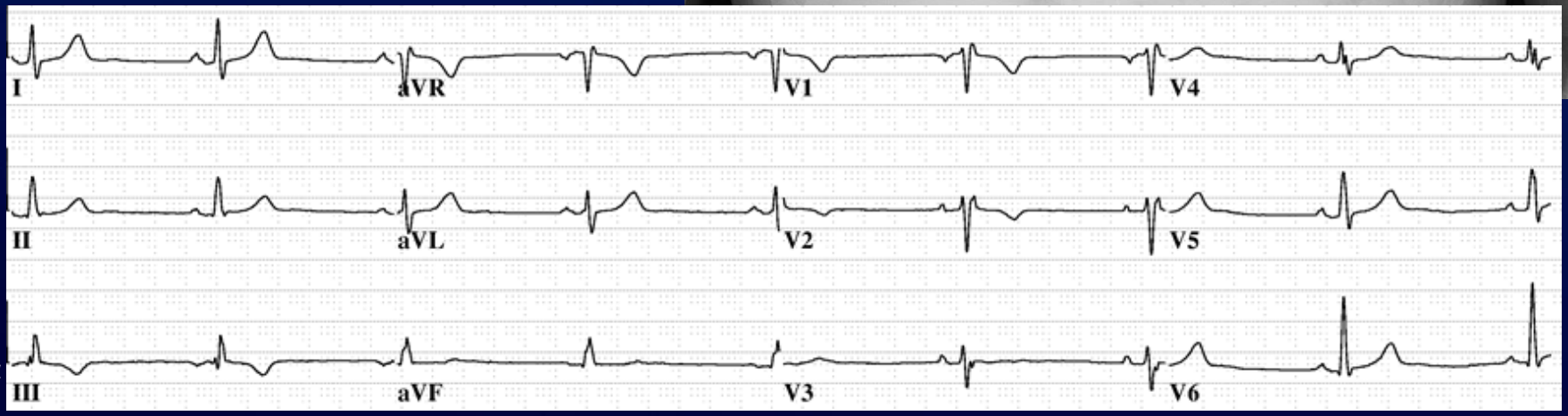
47 year old man

- Chest pain
- Not exertional
- Normal Examination





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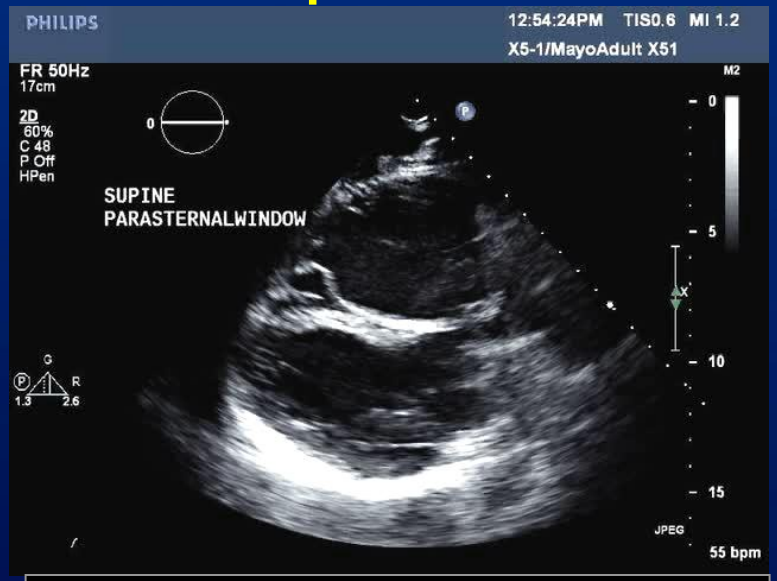
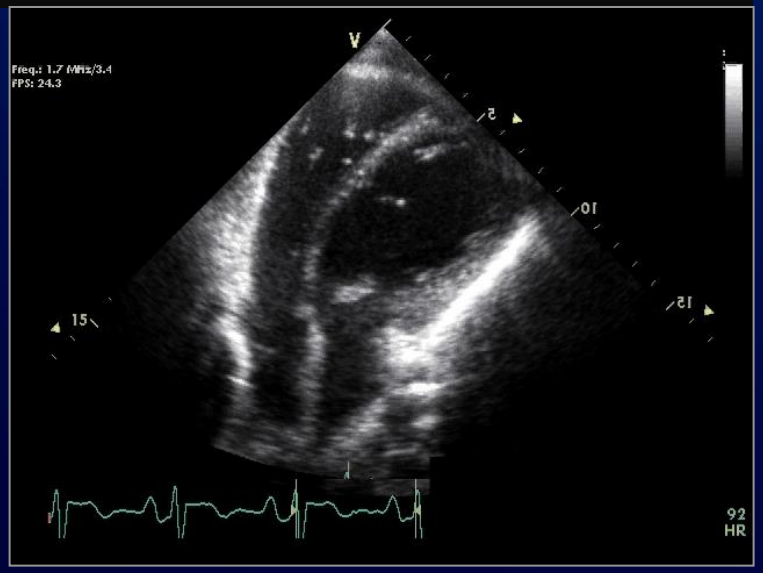
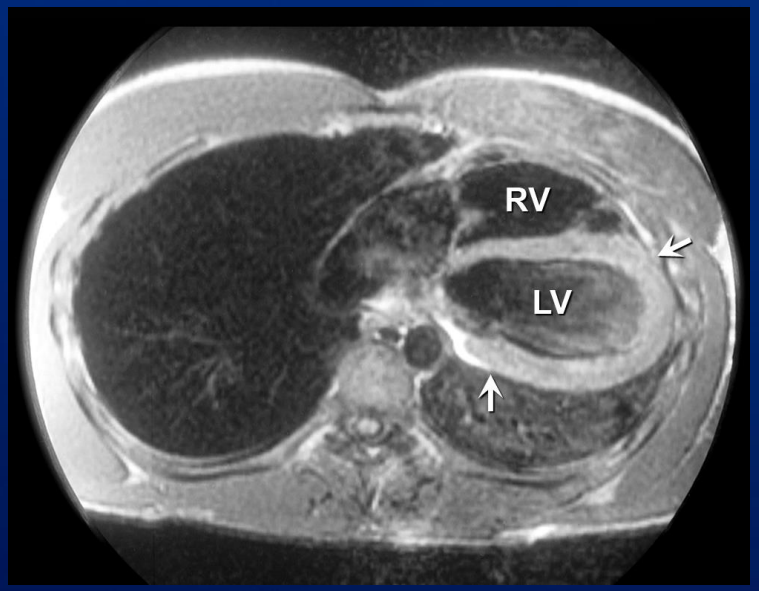
47 year old man with chest pain
Absent pericardium







- Usually left side
- Heart shifted to left
- Mostly asymptomatic
- Strangulation can happen

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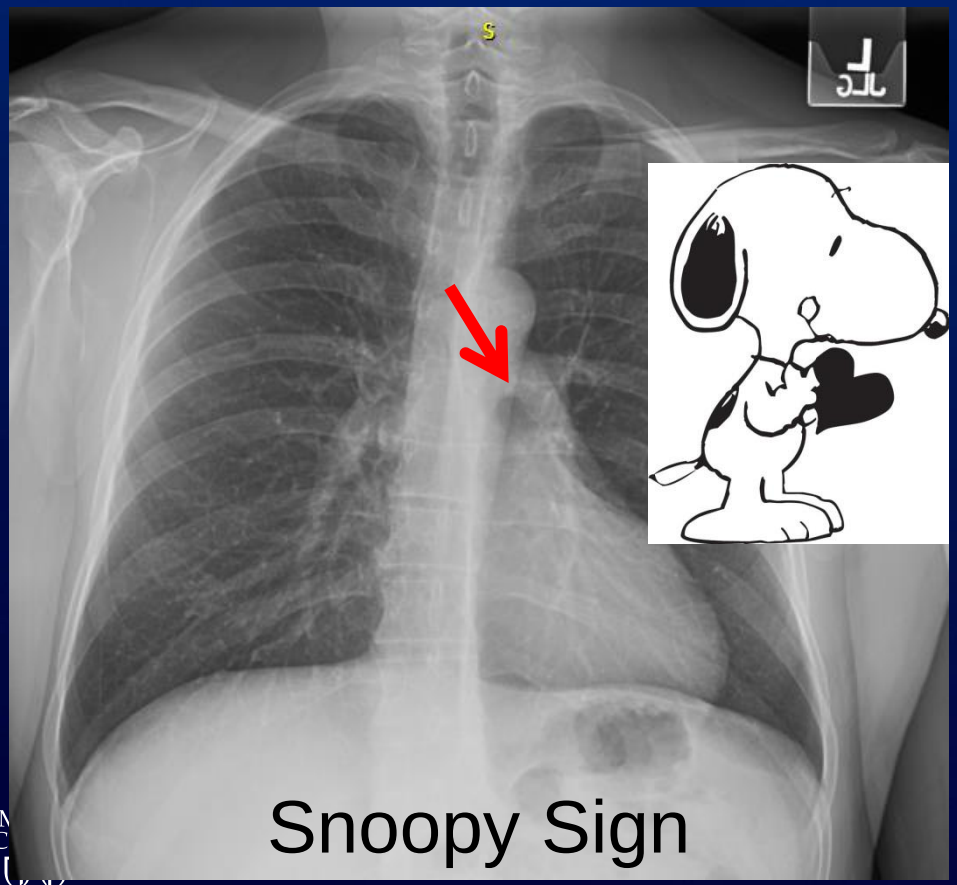
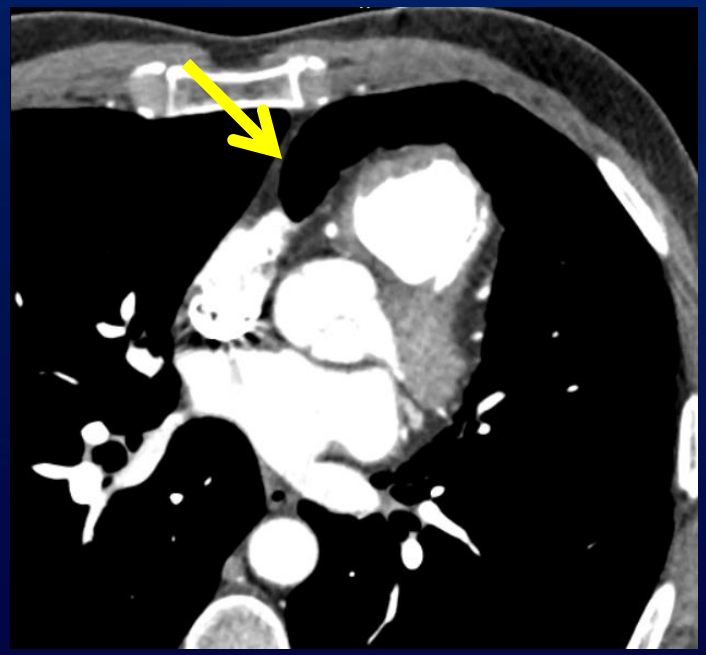
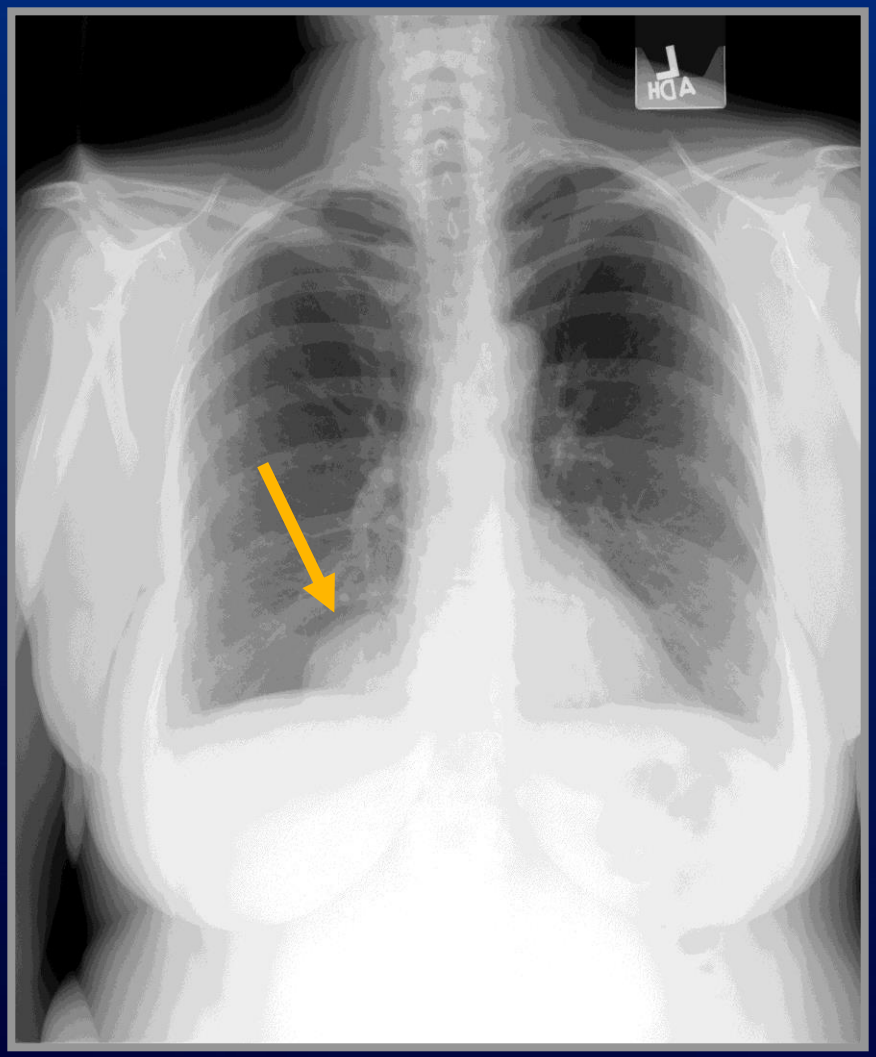
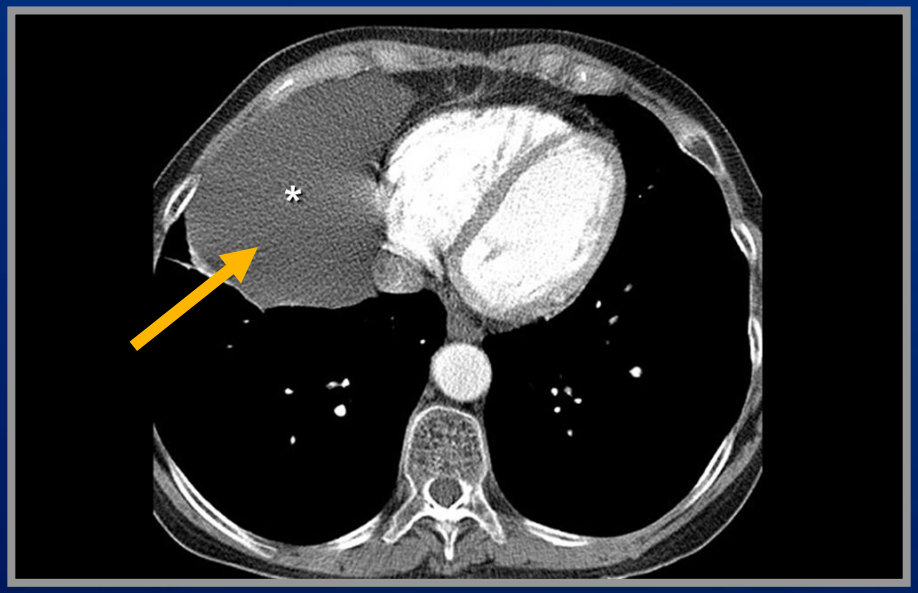
Congenital Absence of the Pericardium

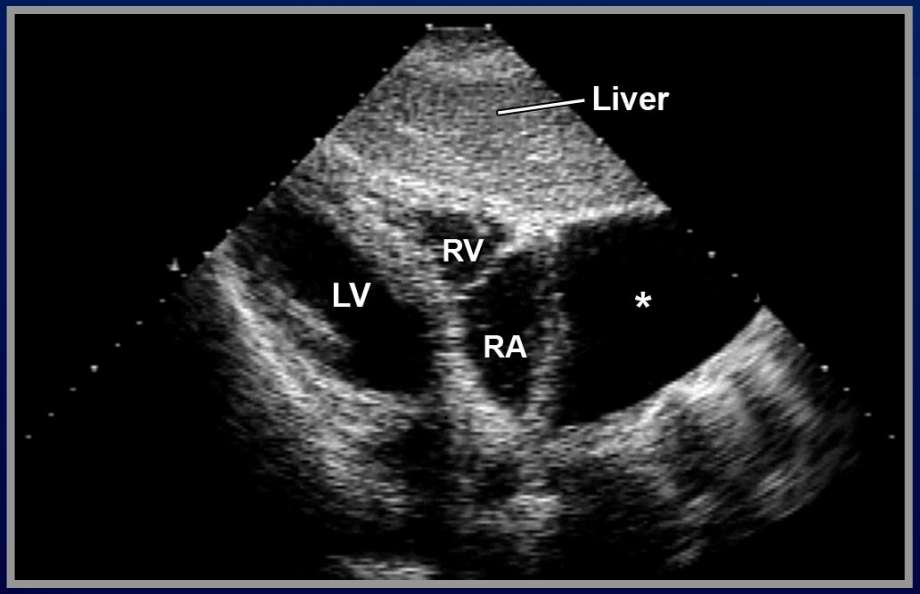




Pericardial Cyst







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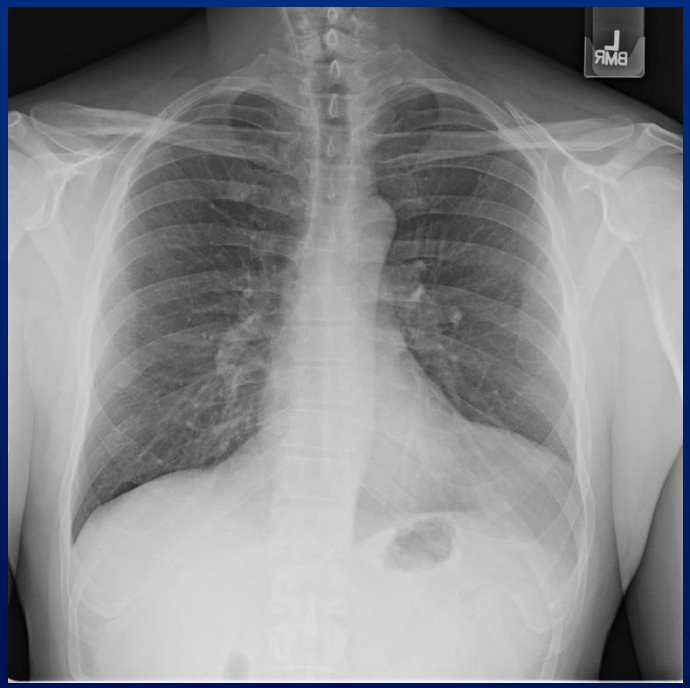
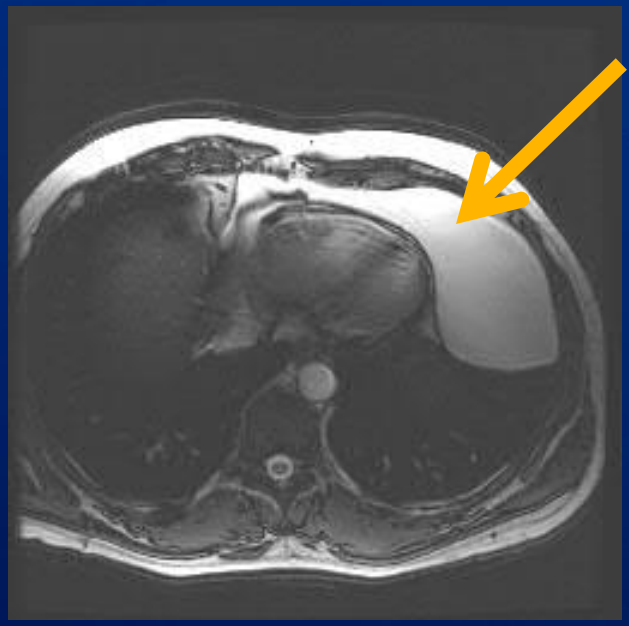
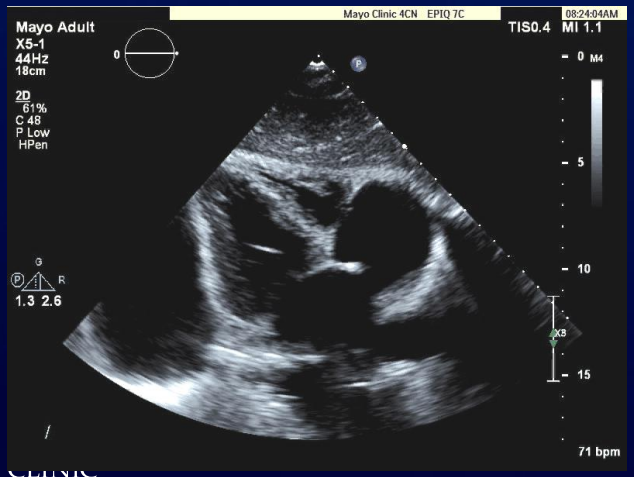
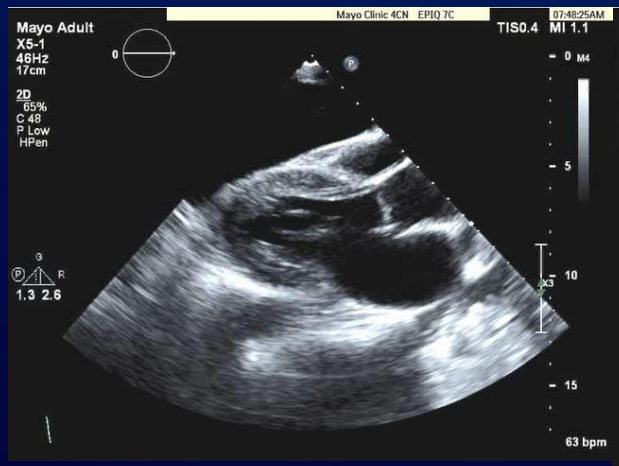
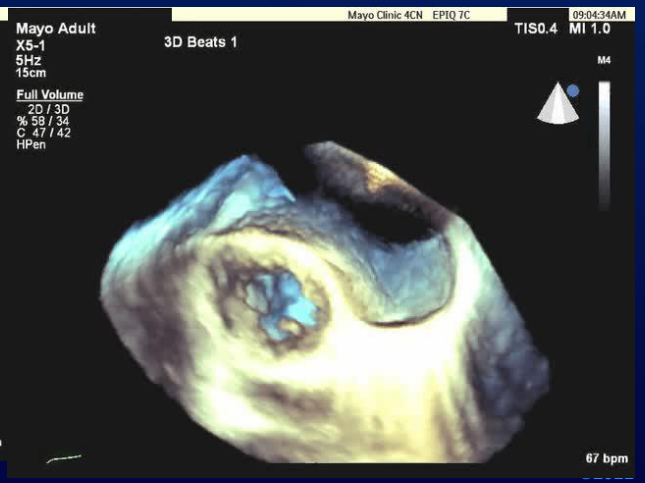
A large pericardial cyst





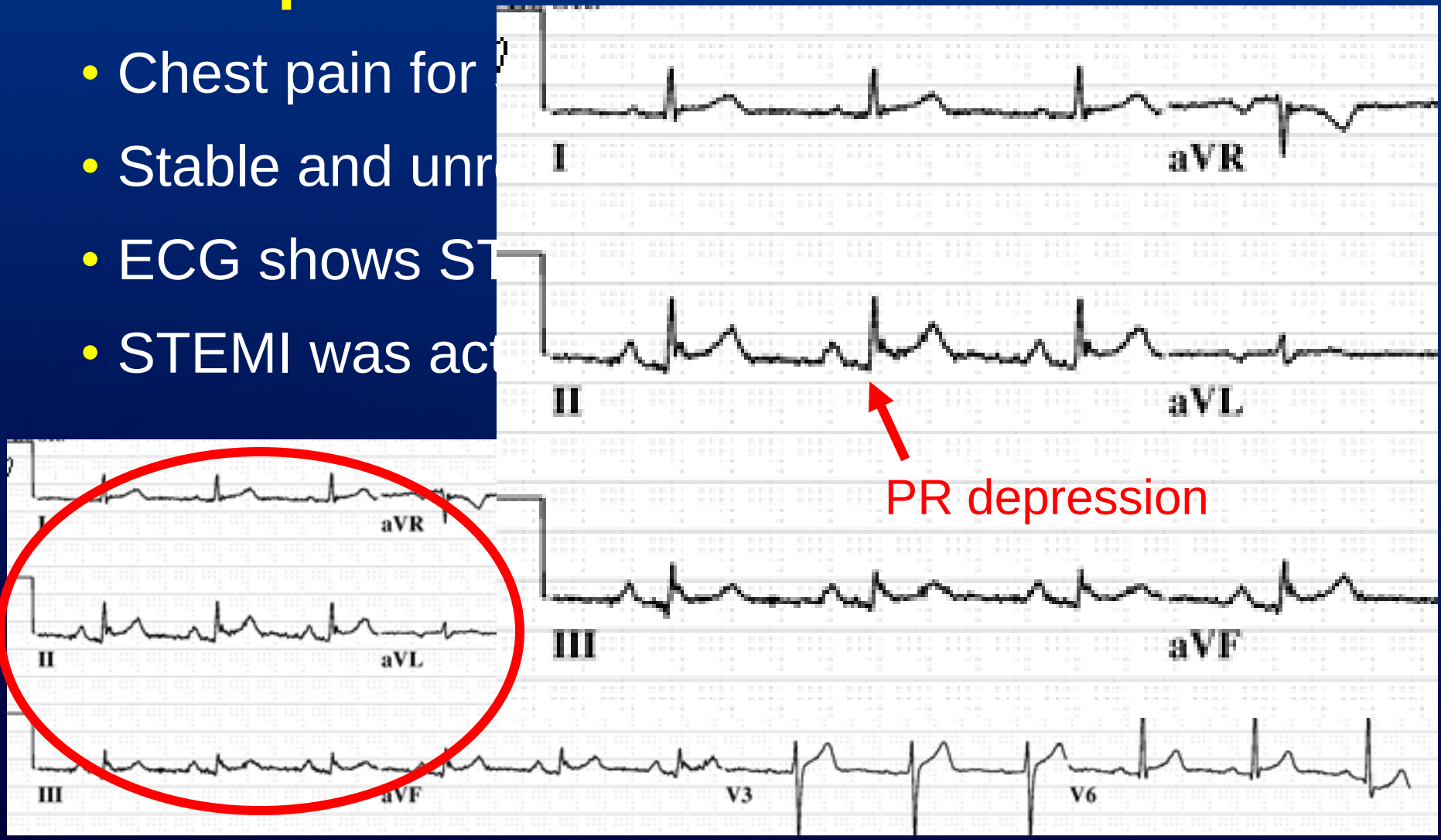






46 year old male smoker presents with chest pain to a local ED

- Chest pain for
- Stable and unr
- ECG shows ST
- STEMI was ac



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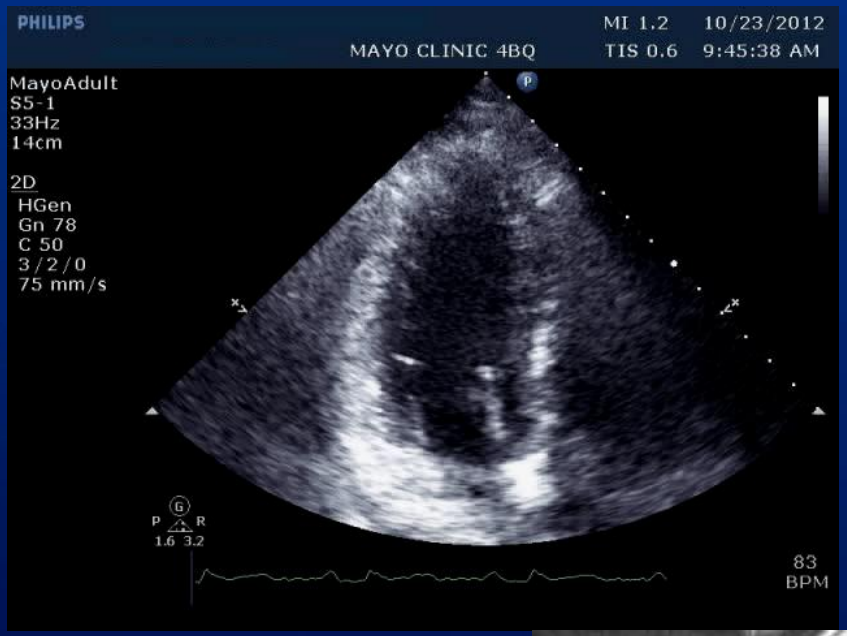
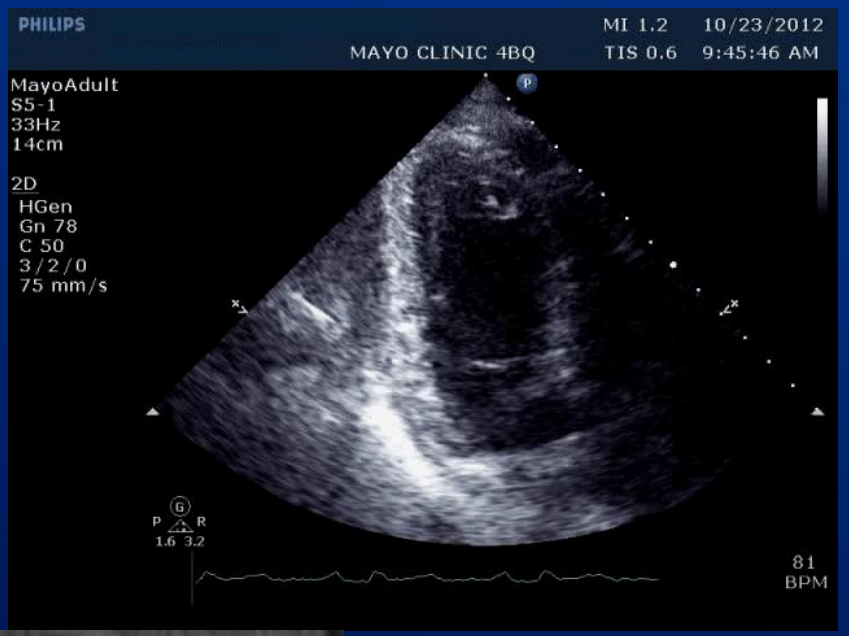
46 year old man with ? STEMI





MRI with Delayed Enhancement

Pericardial Inflammation

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Acute Pericarditis

Management Recommendation

- Nonsteroidal anti-inflammatory (NSAID) agent for 1 month : *ASA (1.5-2 Gr/d), Ibuprofen (2.5-3 Gr/d), Indocin (25-50 mg tid or qid)*
- *Colchicine* for 3 months
  0.6 mg twice a day
  17 % vs 38 % Recurrence rate
- Avoid steroid if possible
- Avoid vigorous exercise for 1-2 months

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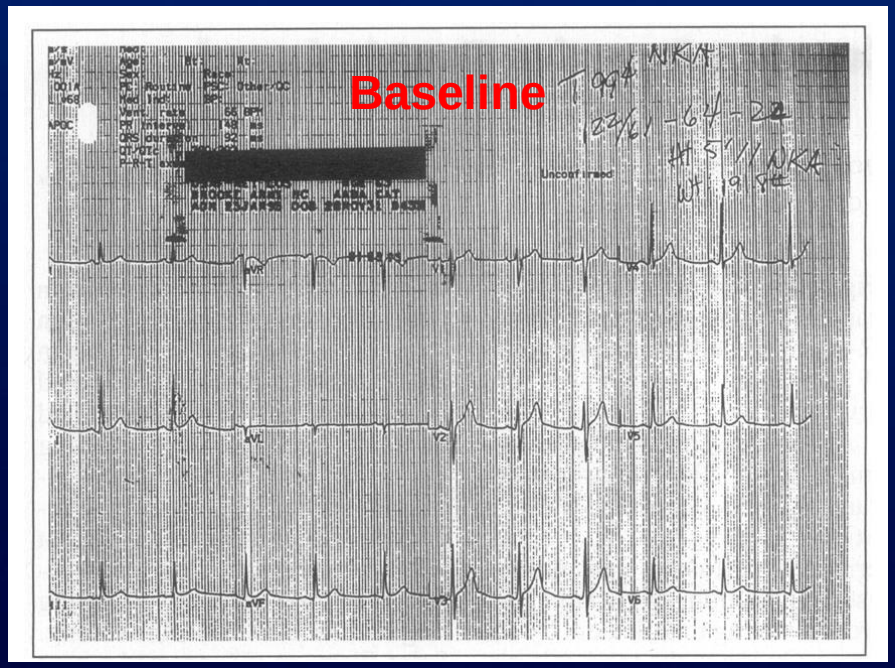
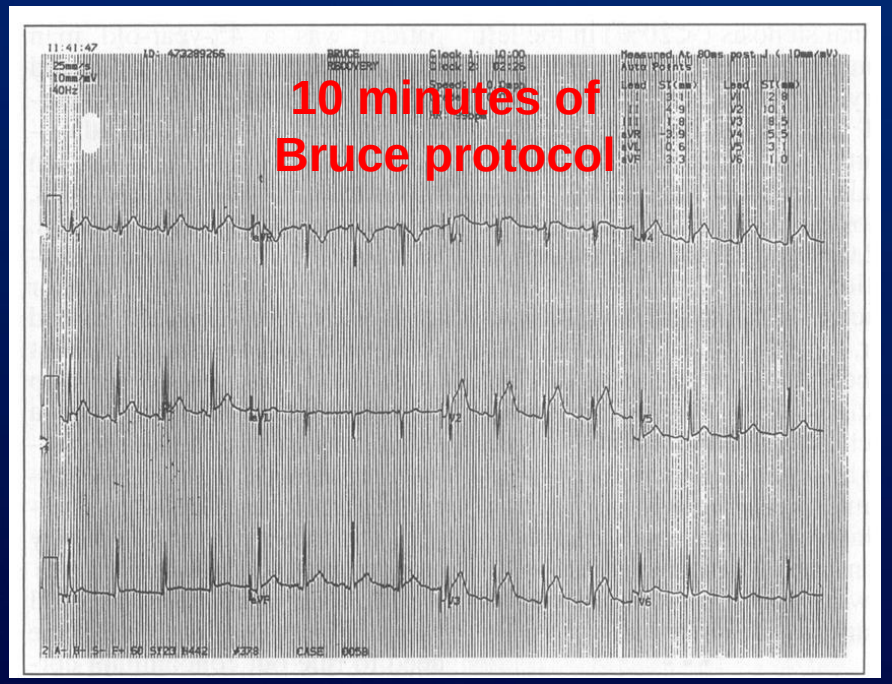
Pericarditis Causing Exercise Test Induced ST-Elevations

Thien M. Do, MD, Miguel A. Campos-Esteve, MD, Michael A. Berry, MD, Robert S. Rudolphi, MD, and James K. Gilman, MD

A 63-year-old man with several cardiac risk factors but without a history of coronary artery disease presented to the emer- (Figure 2). The ST elevation then gradually subsided, and diffuse PR-segment depression with mild ST elevation (1 mm) was ob- tinguish early repolarization from pericarditis since the ST elevation returned to the isoelectric line in the former but remained elevated

American J. Cardiology 1996;78: 251





63 yo man with chest pain, normal coronary angiogram, no cardiac enzyme elevation, elevated ESR, and small pericardial effusion

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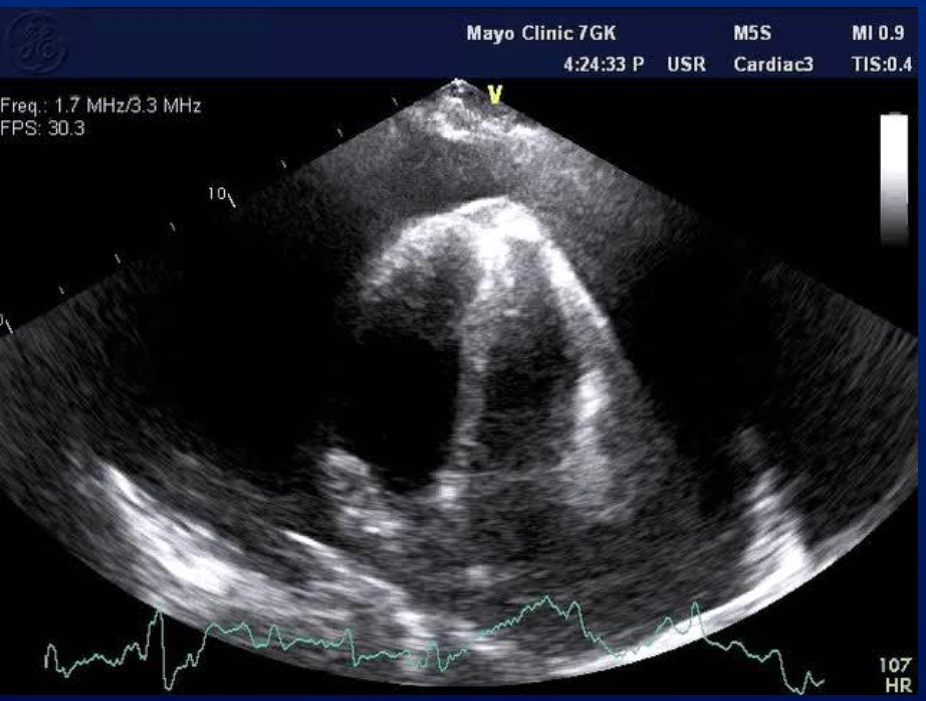
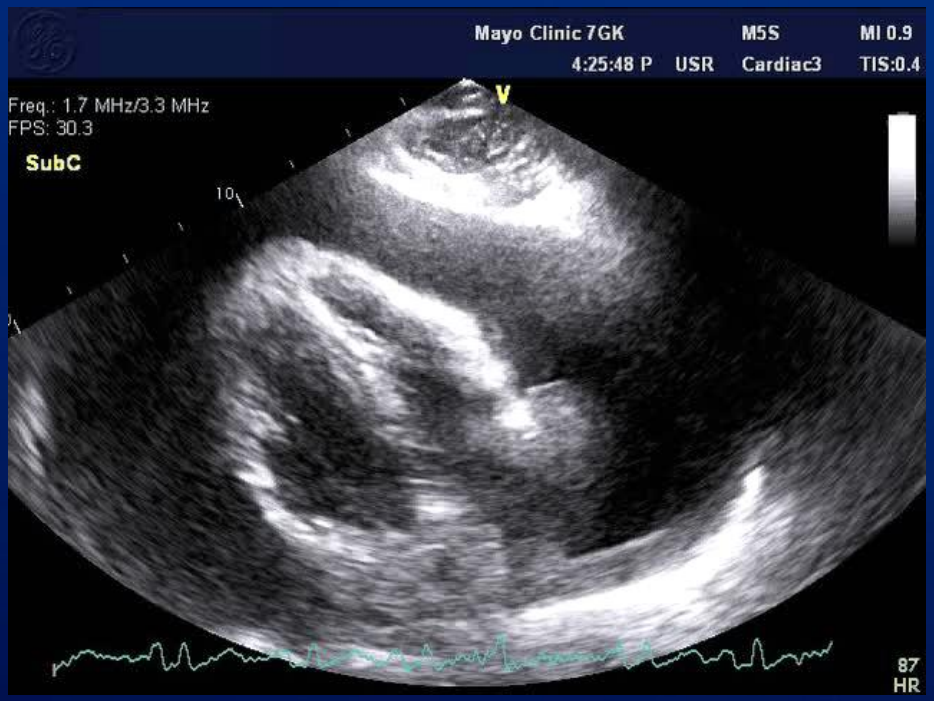
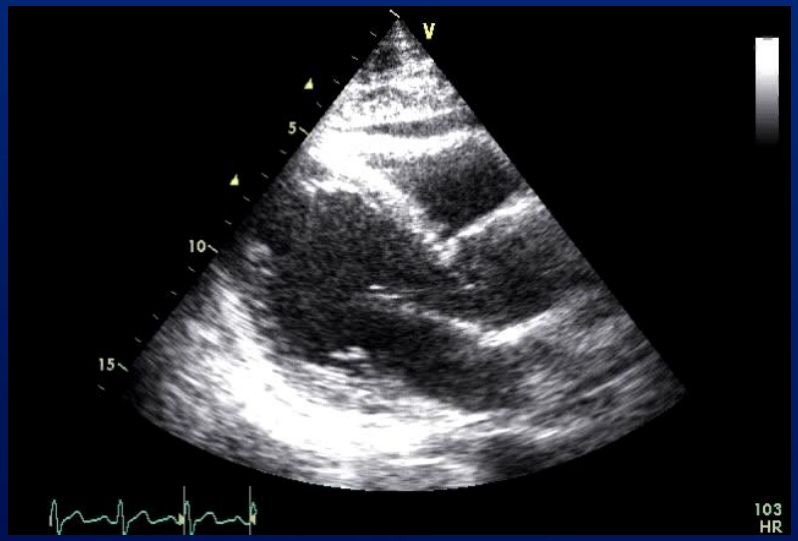
51 year old with SLE and BP 150/115

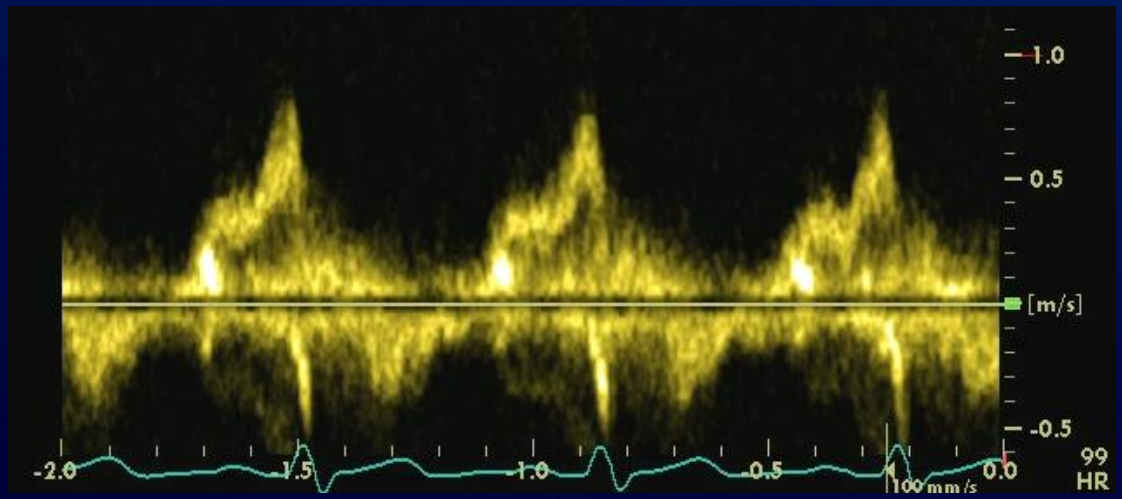




57 year old male with STEMI

Thrombolysis and Stent
Hypotensive and tachycardic





1. Dopamine
2. IABP
3. Fluid
4. Surgery

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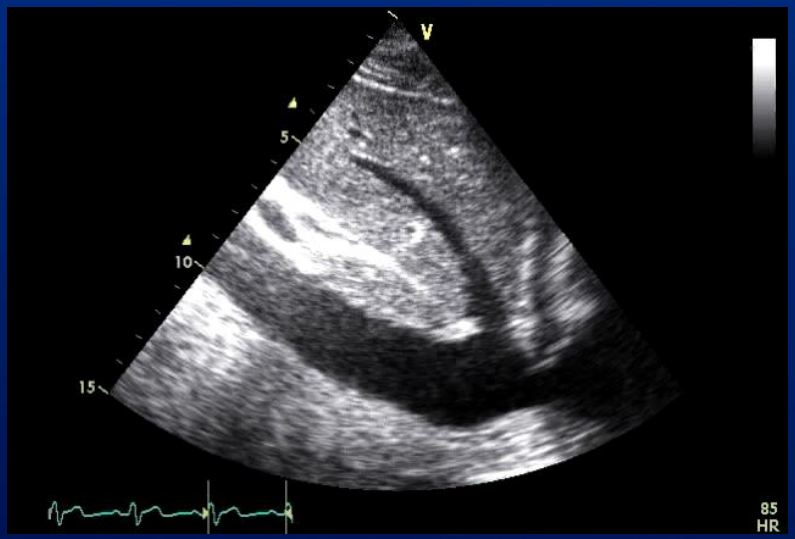
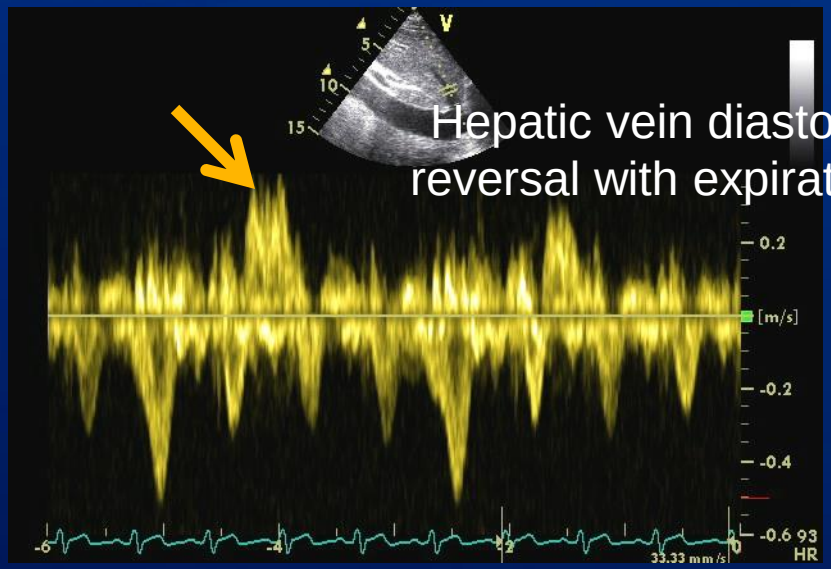
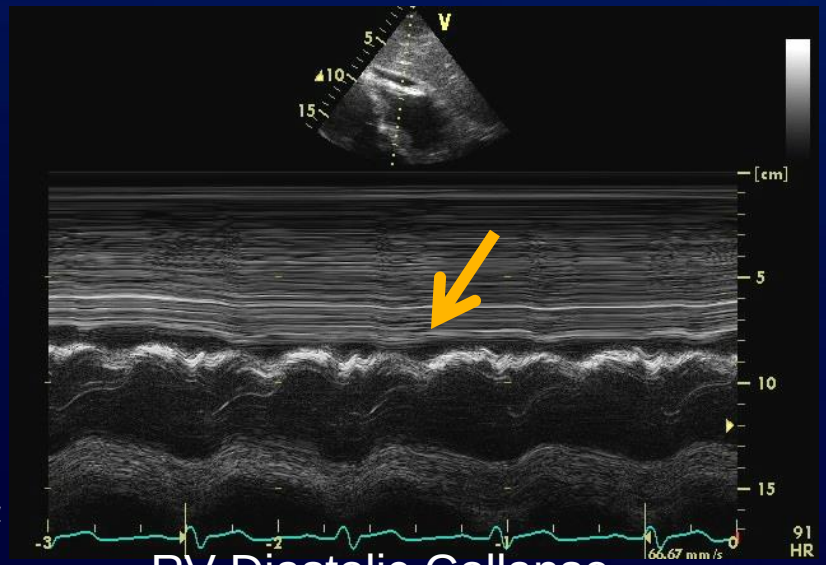
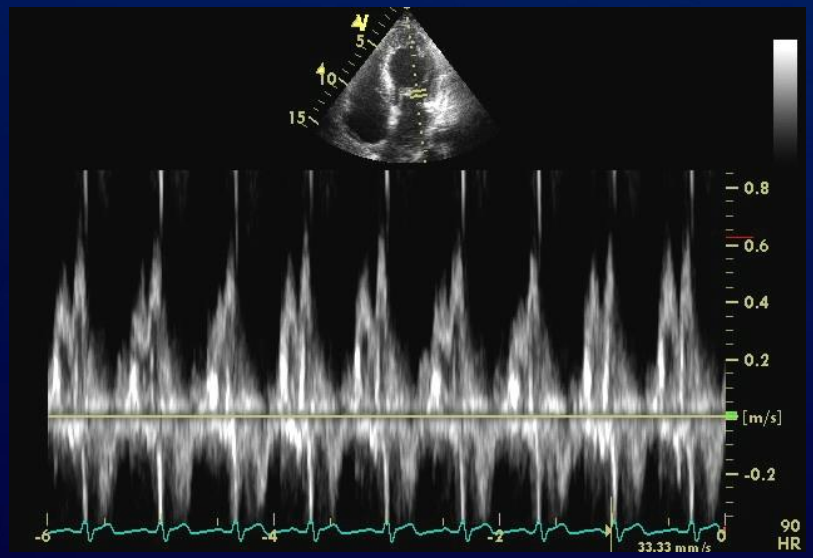
57 year old man with STEMI

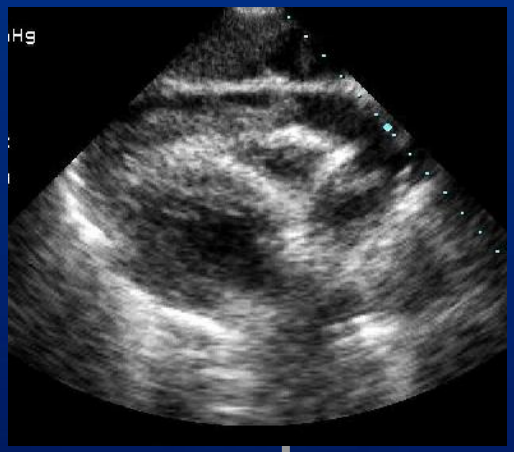


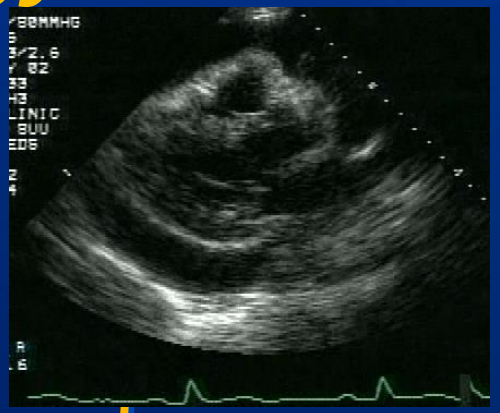


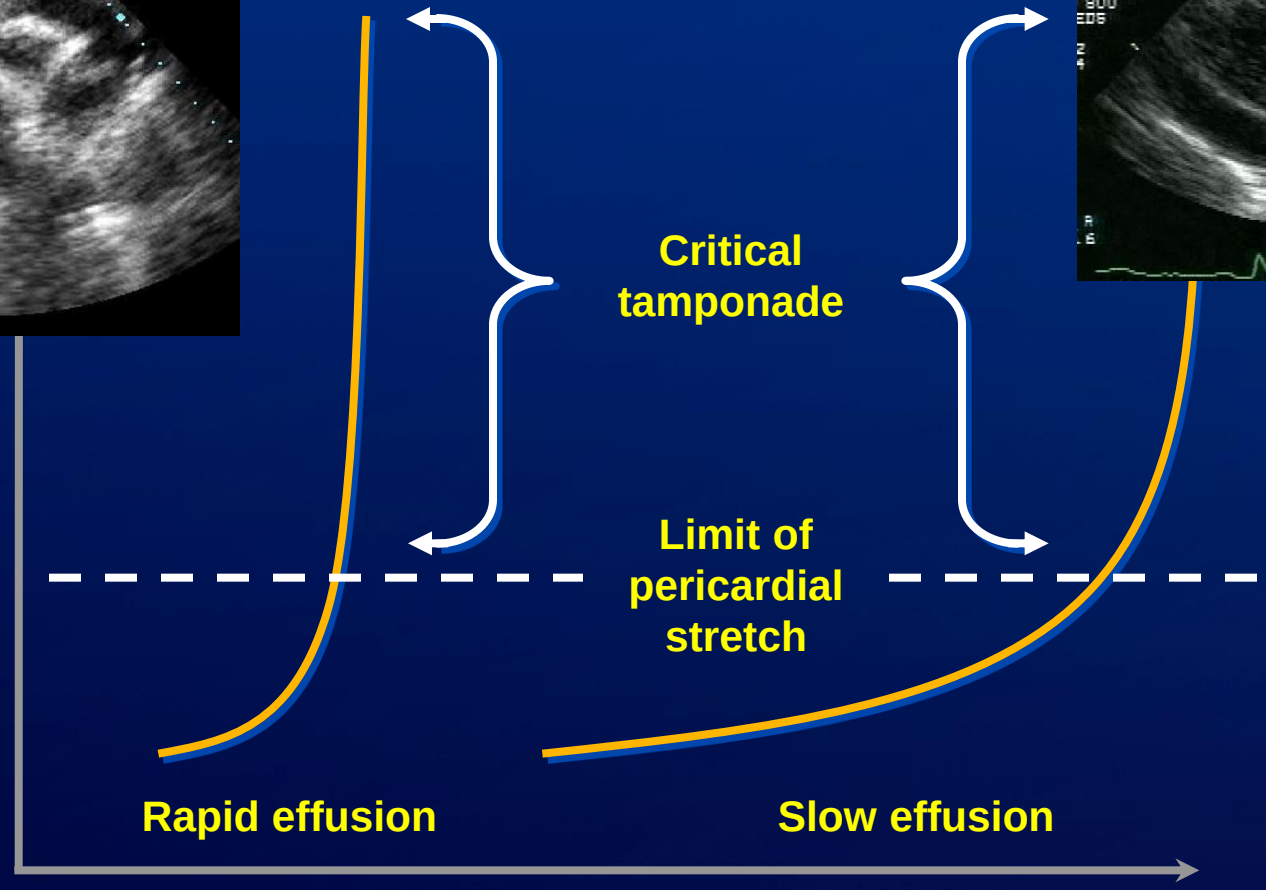




Tamponade Physiology







NEJM 349: 684, 2003

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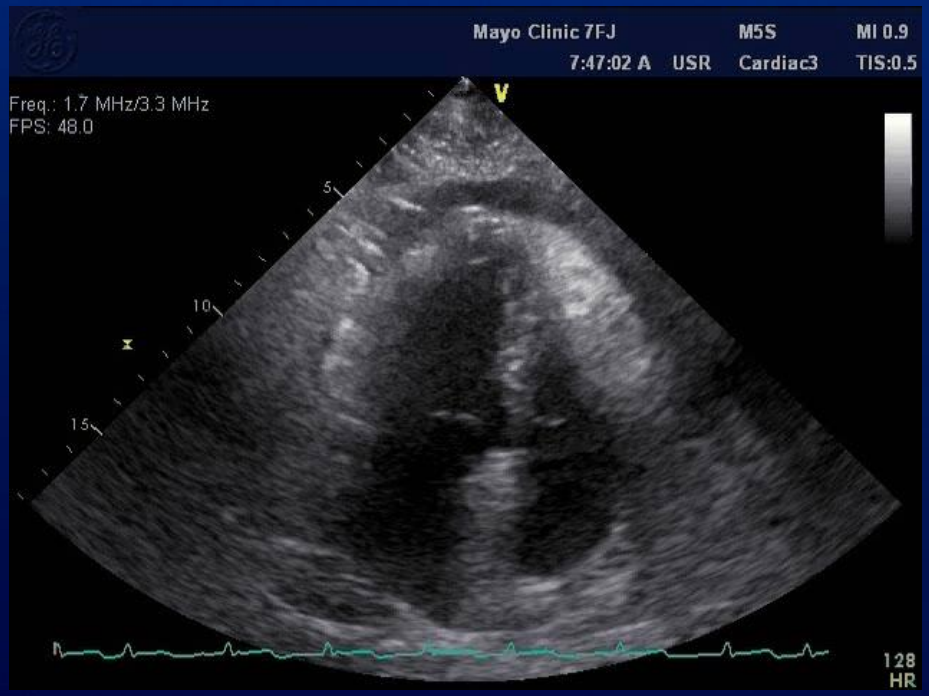
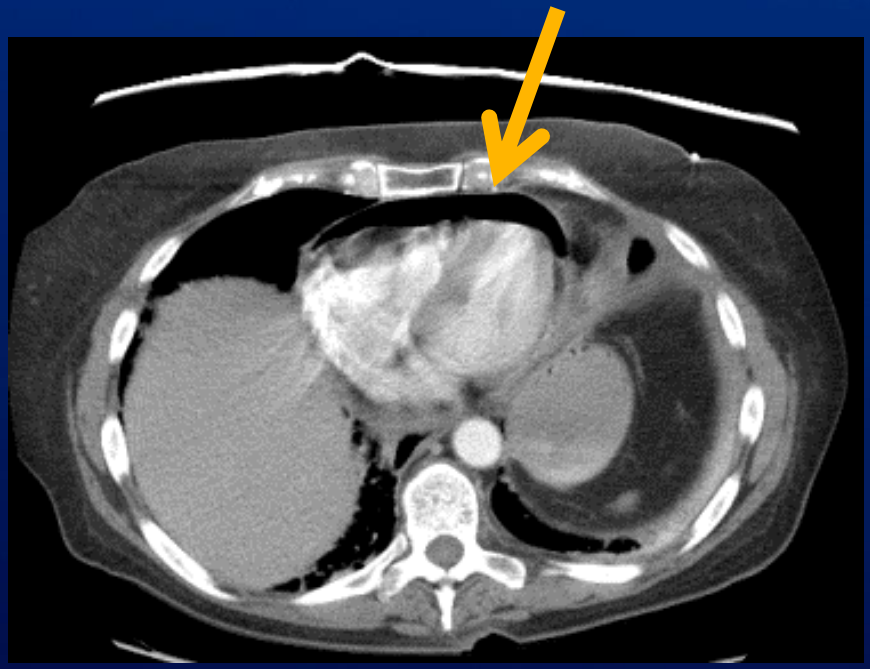
CP1299236-6

66 year old woman with dyspnea
Gastro-pericardial fistula





Pneumo-pericardium

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Thank you for listening!

Oh.jae@mayo.edu