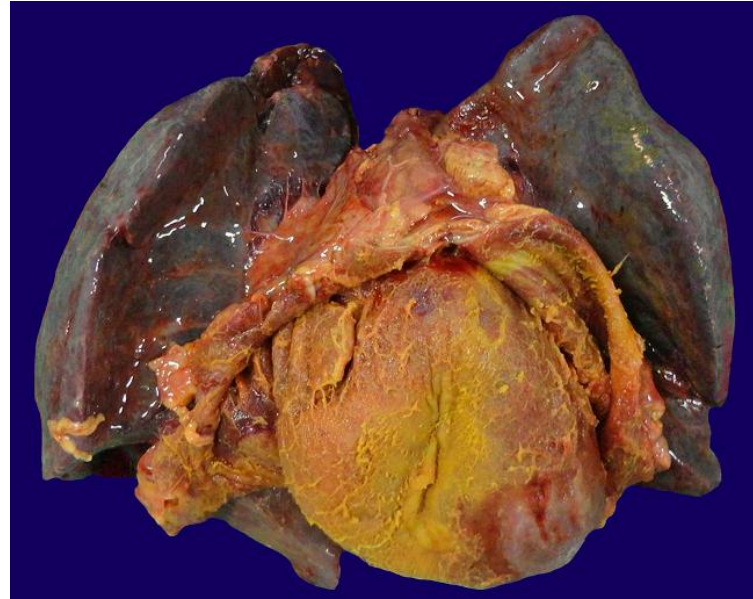


# Pericardial Disease



**Jonathan R. Lindner, MD, FASE, FACC**  
***Frances Myers Ball Professor of Medicine***  
***Vice-Chief for Research***  
**Division of Cardiovascular Medicine**  
**University of Virginia Health System**  
**Charlottesville, VA, USA**

# Research Support and Disclosures

## **Research Support/Disclosures:**

- NIH: R01-HL130036
- NIH: R01-HL165442
- NIH R01-HL1711377
- NASA: 18-18HCFBP\_1\_009
- Lantheus Medical Imaging (IIT research grant)

## **Scientific Advisory Board:**

- BioMarin Pharma Inc.
- Regeneron

# Pericardial Disease Etiologies

## Pericardial Inflammation

Infectious	<p>Viral: Coxsackieviruses A and B, echovirus, mumps, adenovirus, EBV, HIV, influenza</p> <p>Bacterial: <i>Pneumococcus</i>, <i>Streptococcus</i>, <i>Staphylococcus</i>, <i>Legionella</i></p> <p>Mycobacterial: <i>M tuberculosis</i>, <i>M avium-intracellulare</i></p> <p>Fungal: histoplasmosis, coccidioidomycosis, candidiasis, blastomycosis</p> <p>Other: syphilis, parasites, Q fever</p>
Noninfectious	<p>Idiopathic</p> <p>Neoplasm</p> <p>Metastatic disease</p> <p>Mesothelioma</p> <p>Renal failure</p> <p>Myocardial infarction</p> <p>Hypothyroidism</p> <p>Aortic dissection with hemopericardium</p> <p>Pneumonia</p>
Autoimmune-related	<p>Connective-tissue disease: SLE, RA, scleroderma, mixed</p> <p>Arteritis: polyarteritis nodosa, temporal arteritis</p> <p>Inflammatory bowel disease</p> <p>Post-MI syndrome, GVHD</p>
Drug-induced	<p>Procainamide</p> <p>Hydralazine</p> <p>Isoniazid</p> <p>Cyclosporine</p> <p>Phenytoin</p>
Trauma-related	<p>Thoracic-duct injury, Post-pericardiectomy</p> <p>Mediastinal irradiation</p>



## Tamponade Physiology

Infectious	<p>Viral: Coxsackieviruses A and B, echovirus, mumps, adenovirus, EBV, HIV, influenza</p> <p>Bacterial: <i>Pneumococcus</i>, <i>Streptococcus</i>, <i>Staphylococcus</i>, <i>Legionella</i></p> <p>Mycobacterial: <i>M tuberculosis</i>, <i>M avium-intracellulare</i></p> <p>Fungal: histoplasmosis, coccidioidomycosis, candidiasis, blastomycosis</p> <p>Other: syphilis, parasites, Q fever</p>
Noninfectious	<p>Idiopathic</p> <p>Neoplasm</p> <p>Metastatic disease</p> <p>Mesothelioma</p> <p>Renal failure</p> <p>Myocardial infarction</p> <p>Hypothyroidism</p> <p>Aortic dissection with hemopericardium</p> <p>Pneumonia</p>
Autoimmune-related	<p>Connective-tissue disease: SLE, RA, scleroderma, mixed</p> <p>Arteritis: polyarteritis nodosa, temporal arteritis</p> <p>Inflammatory bowel disease</p> <p>Post-MI syndrome, GVHD</p>
Drug-induced	<p>Procainamide</p> <p>Hydralazine</p> <p>Isoniazid</p> <p>Cyclosporine</p> <p>Phenytoin</p>
Trauma-related	<p>Thoracic-duct injury, Post-pericardiectomy</p> <p>Mediastinal irradiation</p>

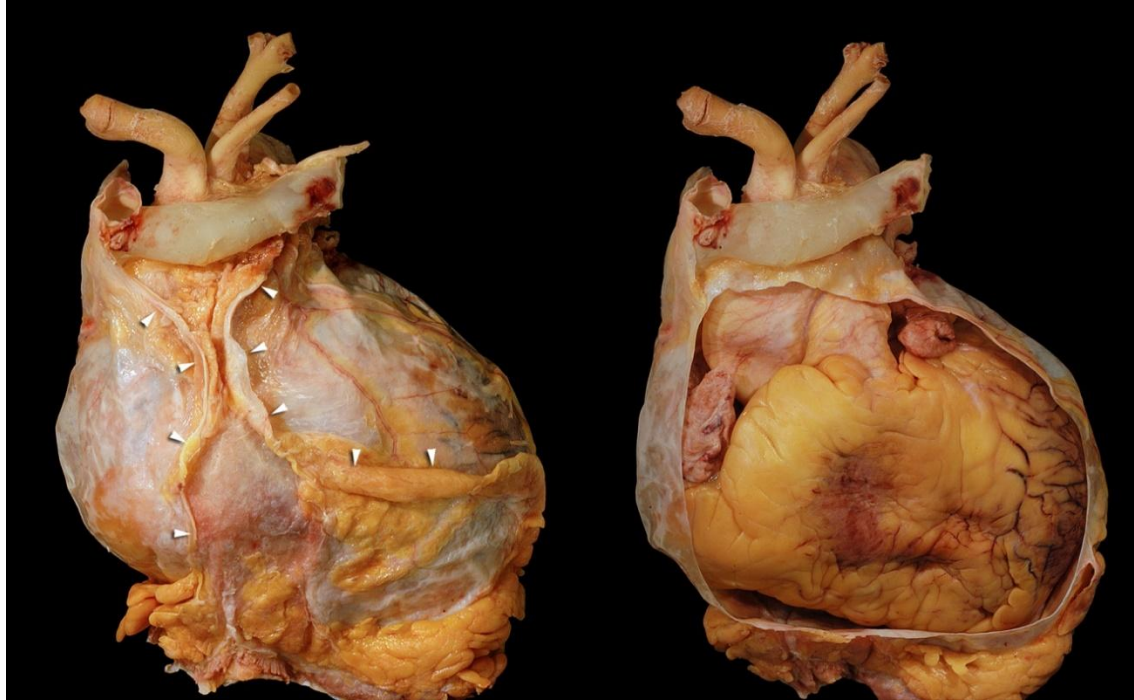


## Pericardial Constriction

Infectious	<p>Bacterial: <i>Pneumococcus</i>, <i>Streptococcus</i>, <i>Staphylococcus</i>, <i>Legionella</i></p> <p>Mycobacterial: <i>M tuberculosis</i>, <i>M avium-intracellulare</i></p> <p>Fungal: histoplasmosis, coccidioidomycosis, candidiasis, blastomycosis</p>
Noninfectious	<p>Neoplasm</p> <p>Metastatic disease</p>
Autoimmune-related	<p>GVHD</p>
Drug-induced	
Trauma-related	<p>Post-pericardiectomy</p> <p>Mediastinal irradiation</p>

# Constrictive Histology

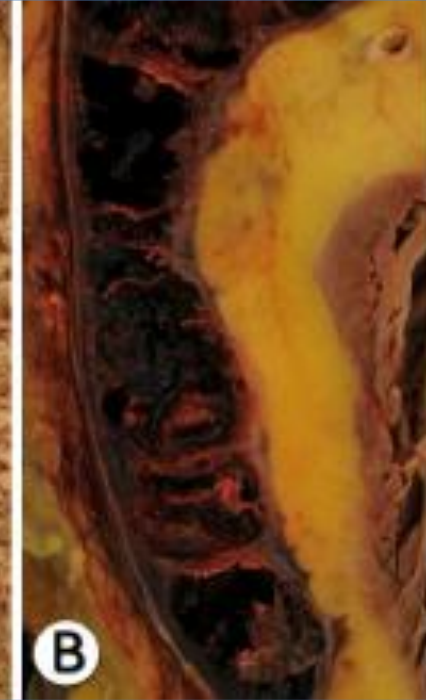
- Not all etiologies look alike histologically
- Accordingly, not all etiologies behave similarly



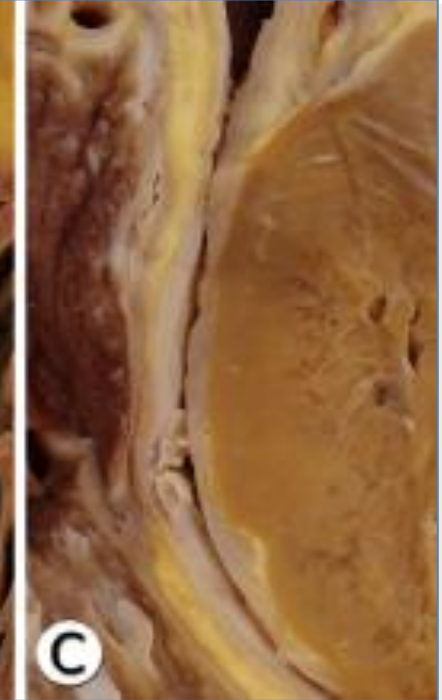
**Uremic**



**Neoplastic**



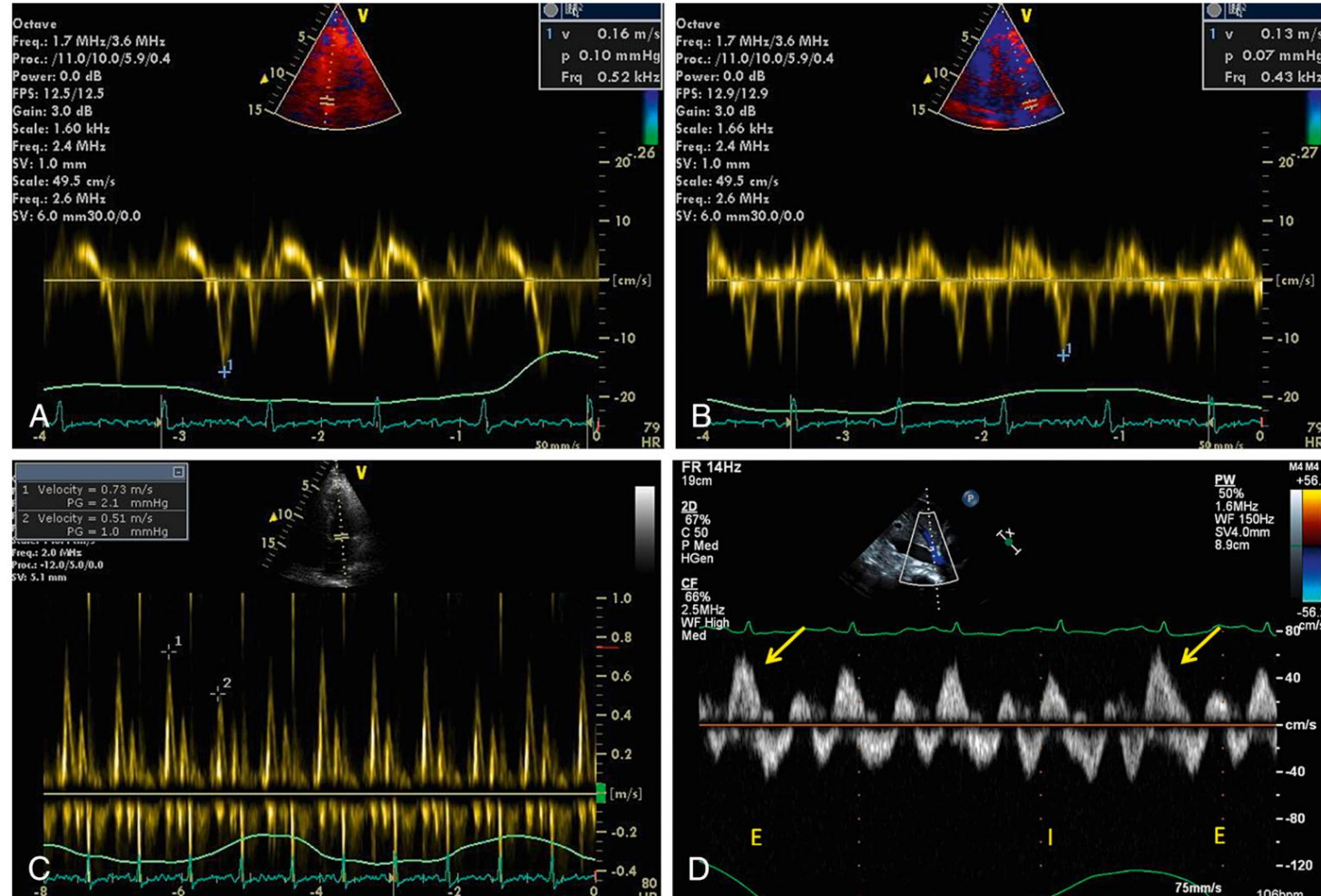
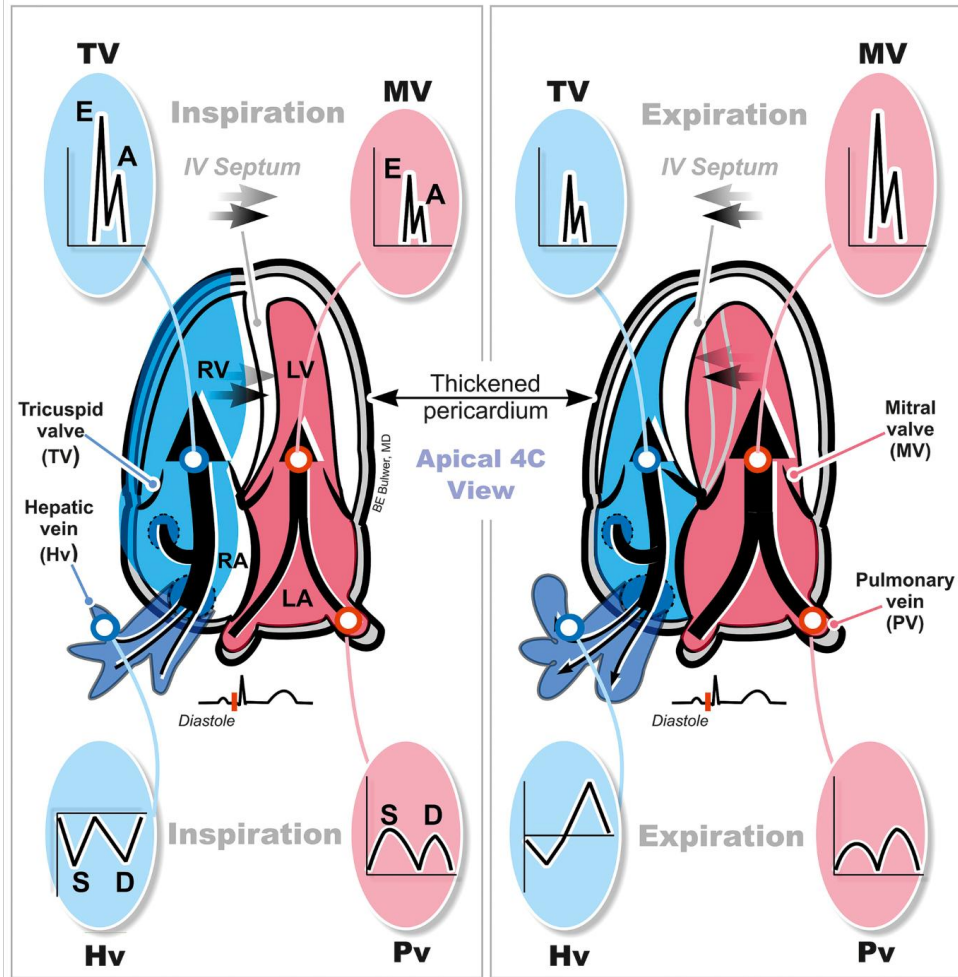
**Radiation**



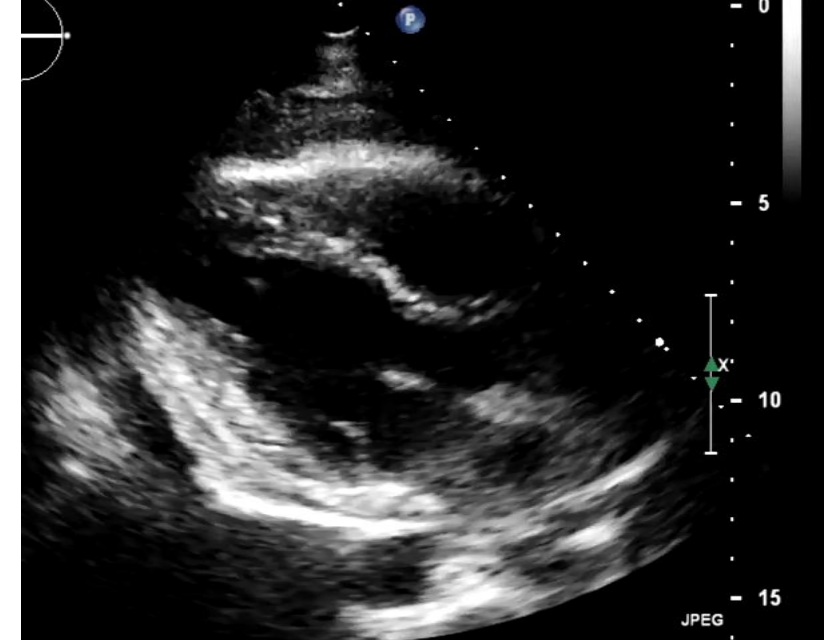
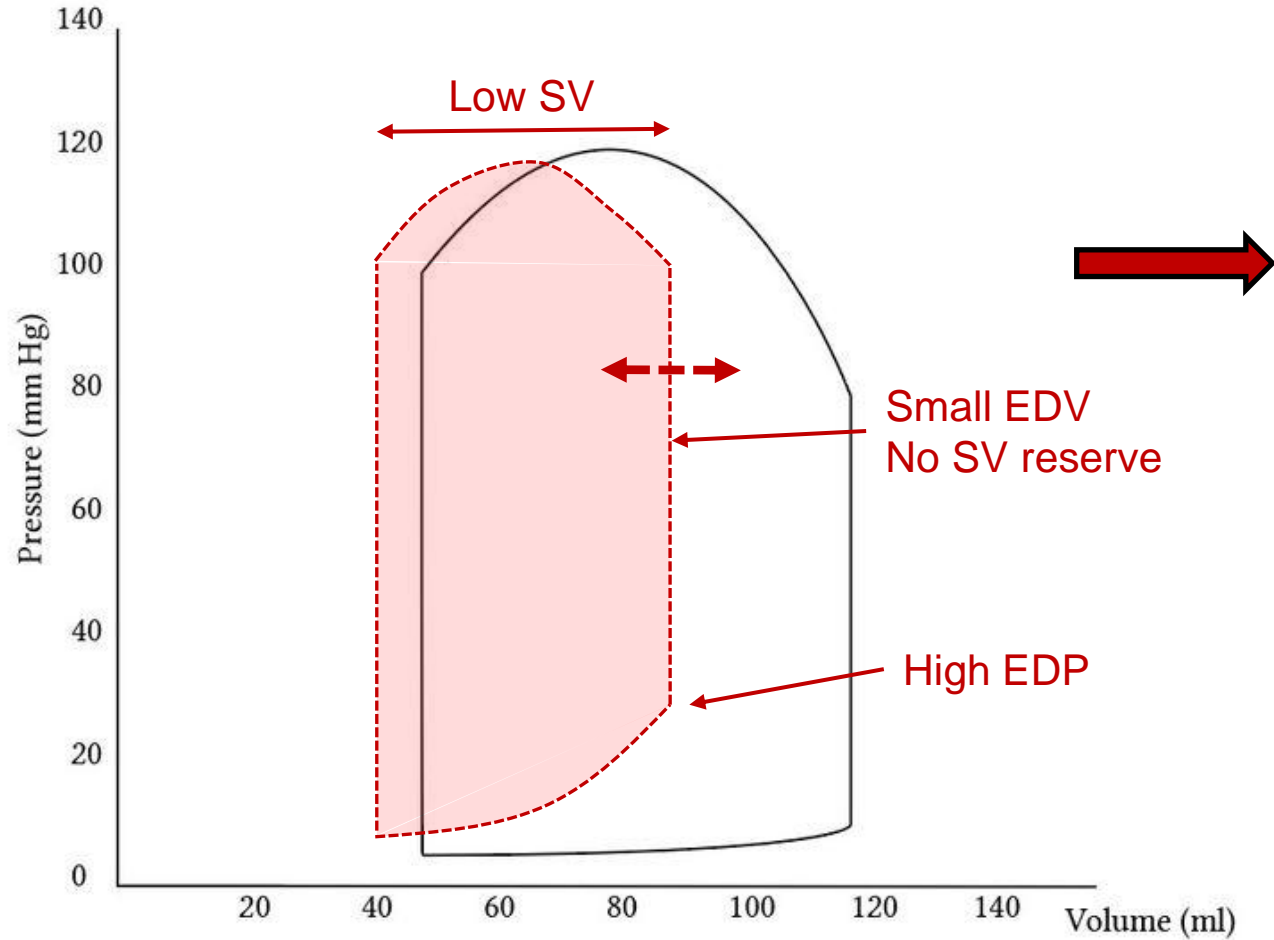


# Constrictive Physiology - Doppler

## Echo Doppler Findings: Constrictive Pericarditis



# Constrictive Physiology – Low output, High diastolic pressure



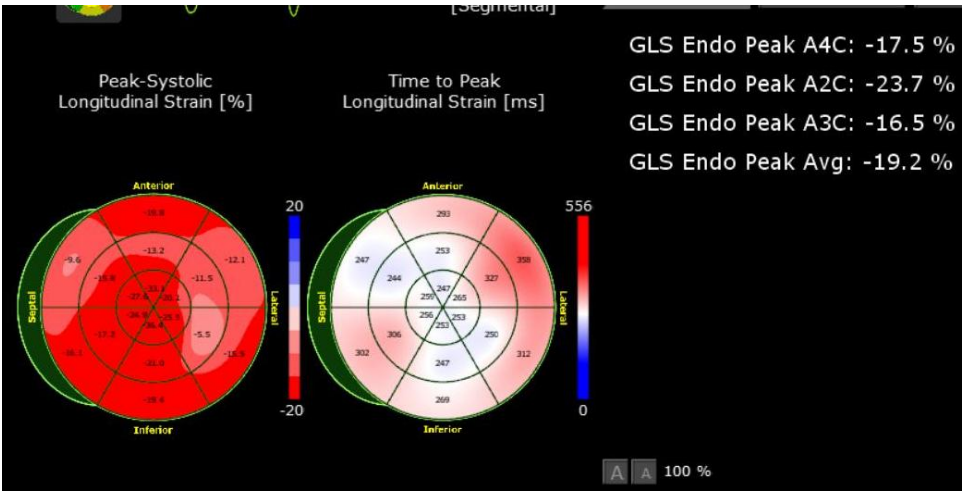
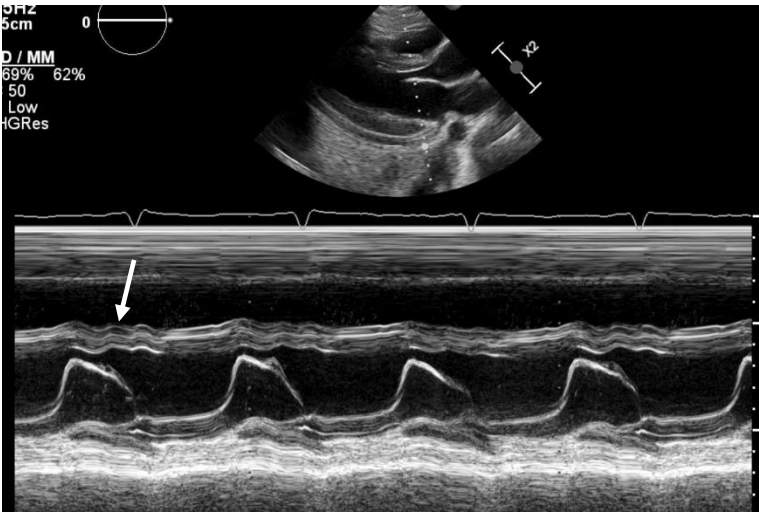
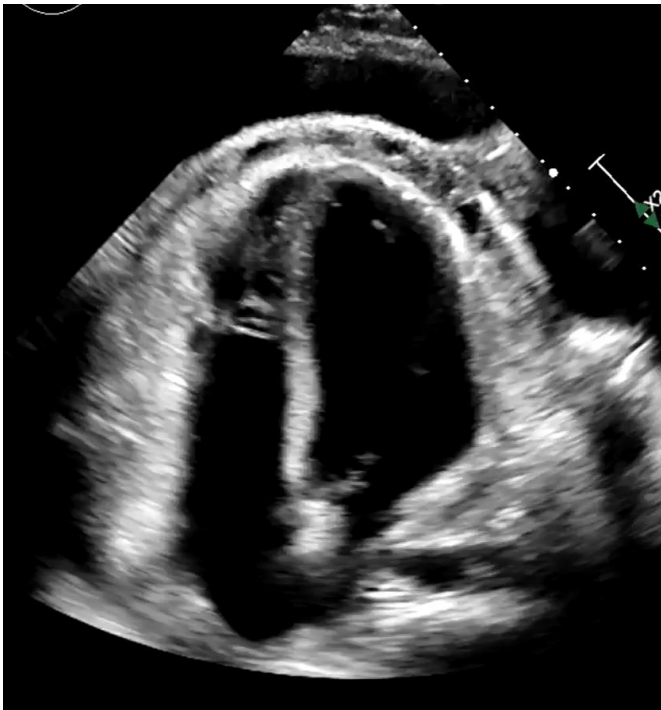
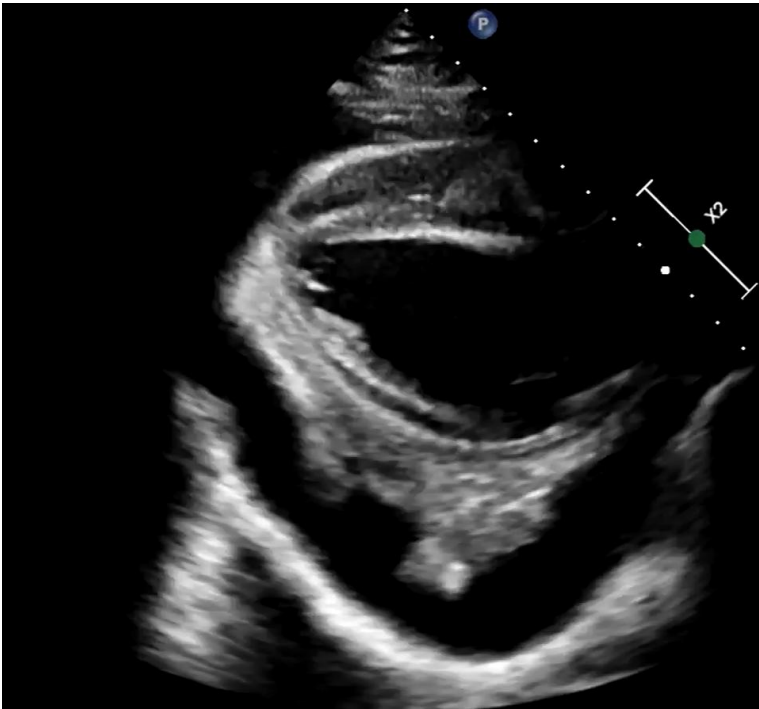
- Exercise intolerance
- Renal dysfunction
- Fatigue
- Edema
- Hepatomegaly
- Chest pain

## Case Presentation of Constriction

Use all of the information provided to you on:

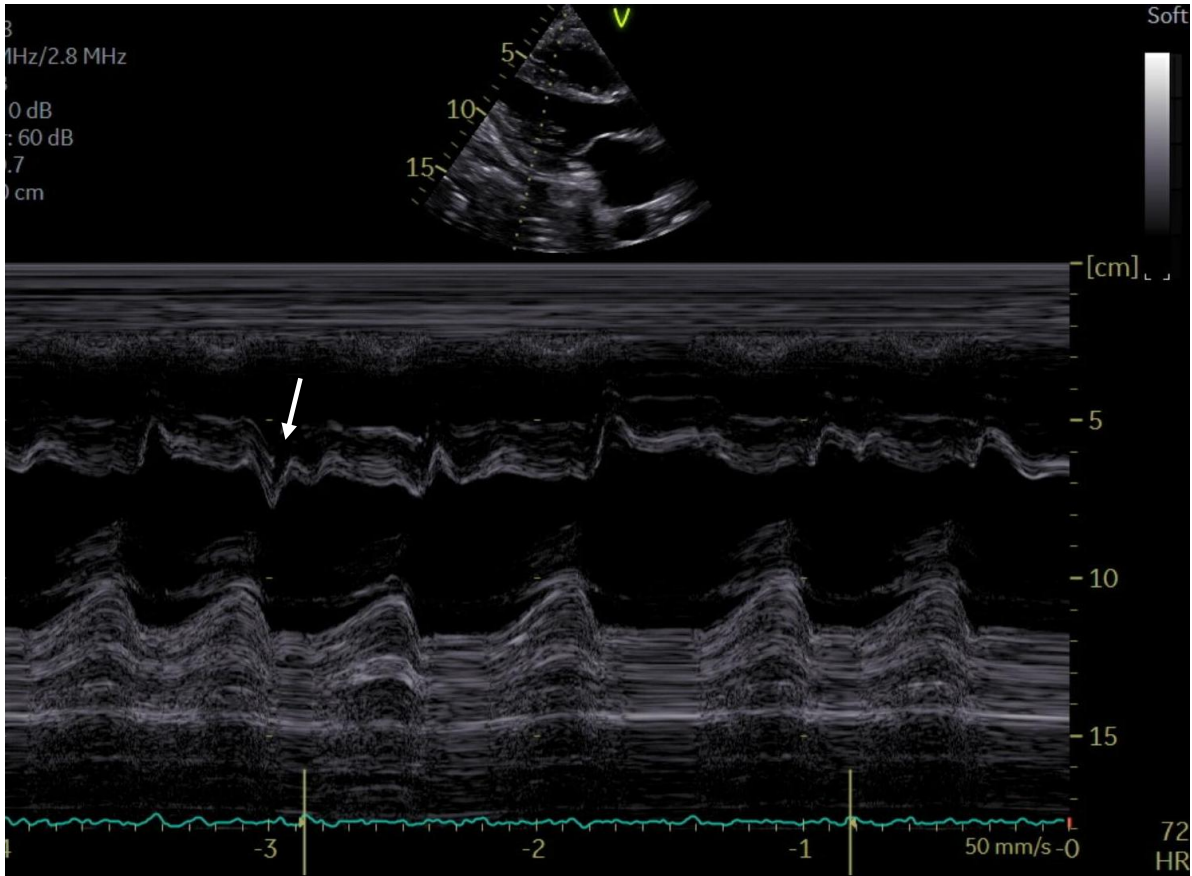
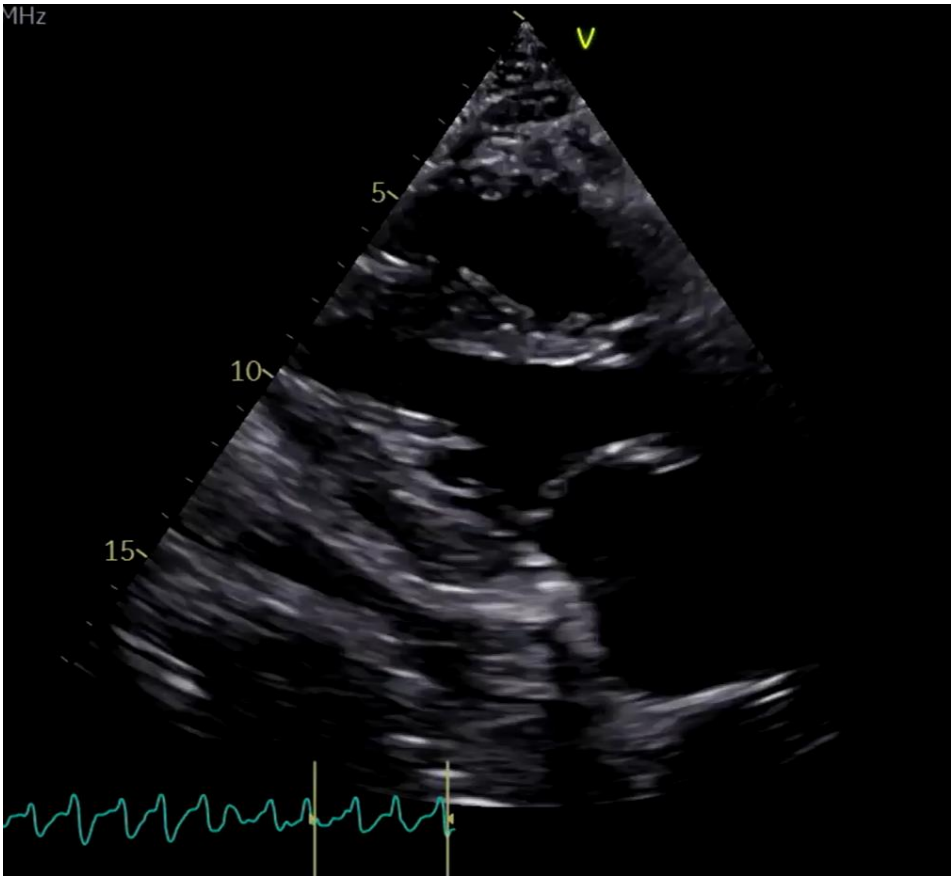
- Ventricular interdependence and respirophasic changes in Frank-Starling mechanism
- Severely impaired late diastolic compliance
- Elevated EDPs
- Tethering of walls to the mediastinum

# Constriction: Bounce, Reduced Regional Strain, Lateral Tethering



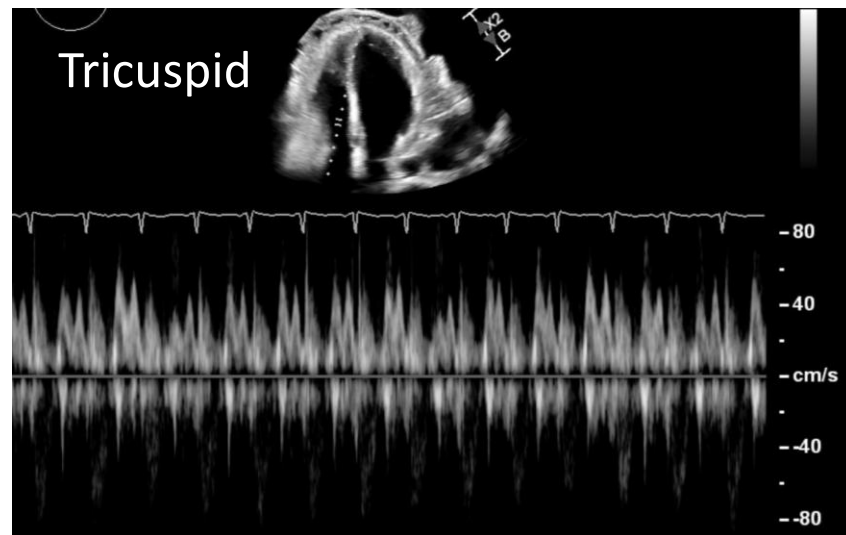
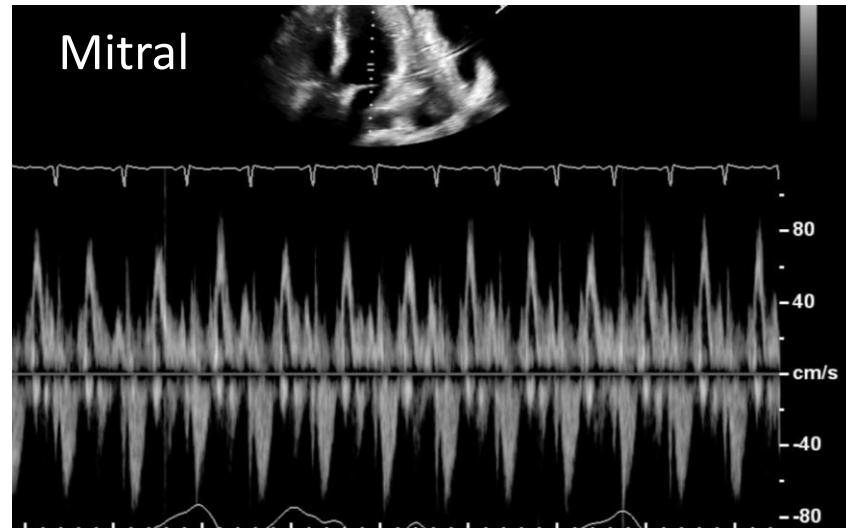


# Respirophasic Bounce and Early Closure of MV

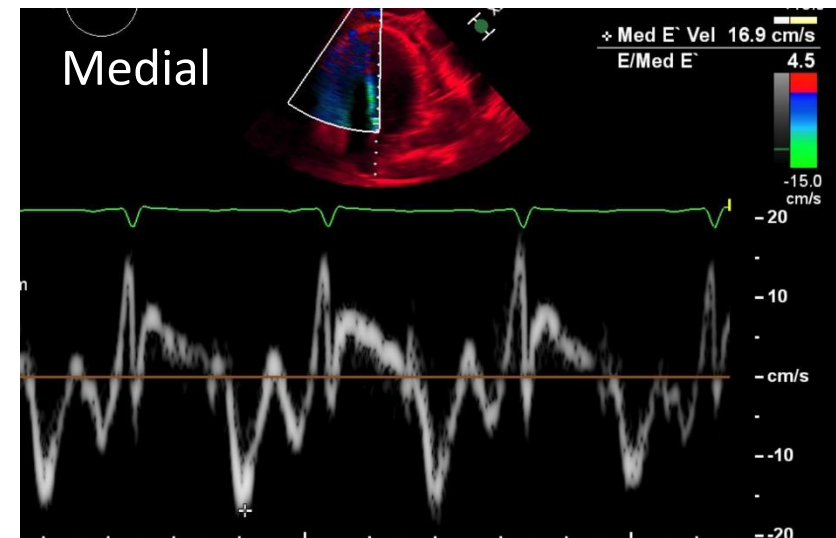
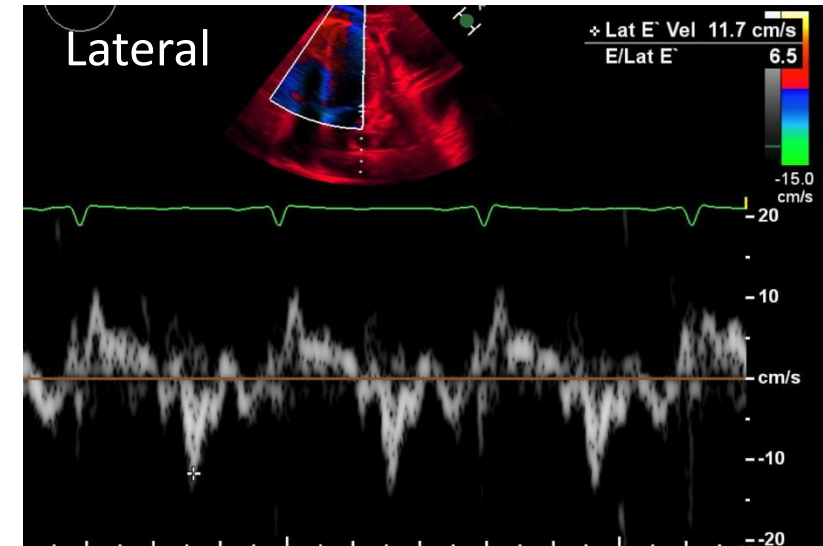


# Ventricular Interdependence and Lateral Wall Tethering

## Ventricular Inflow

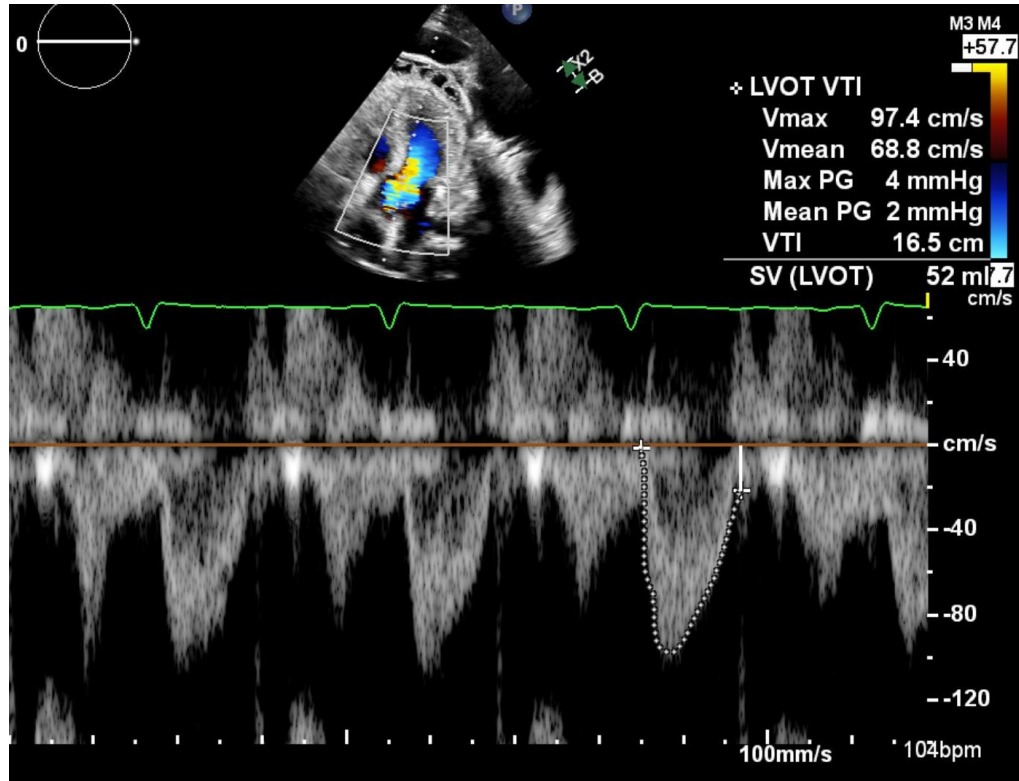


## Lateral Wall Tethering

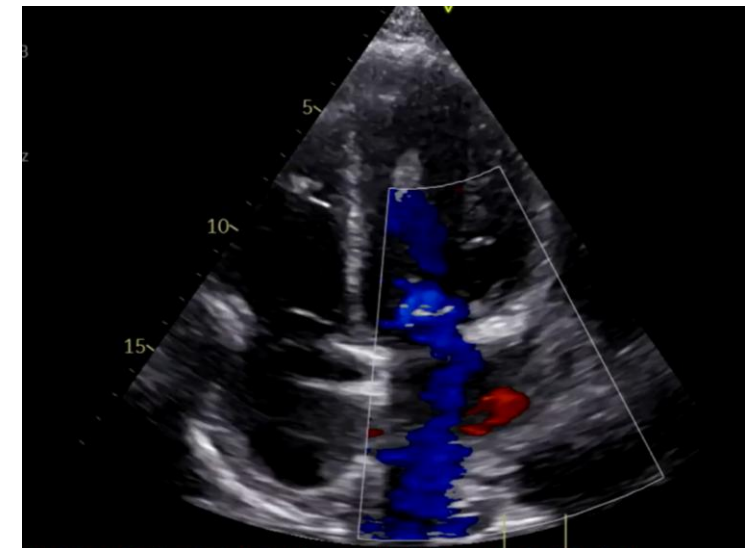
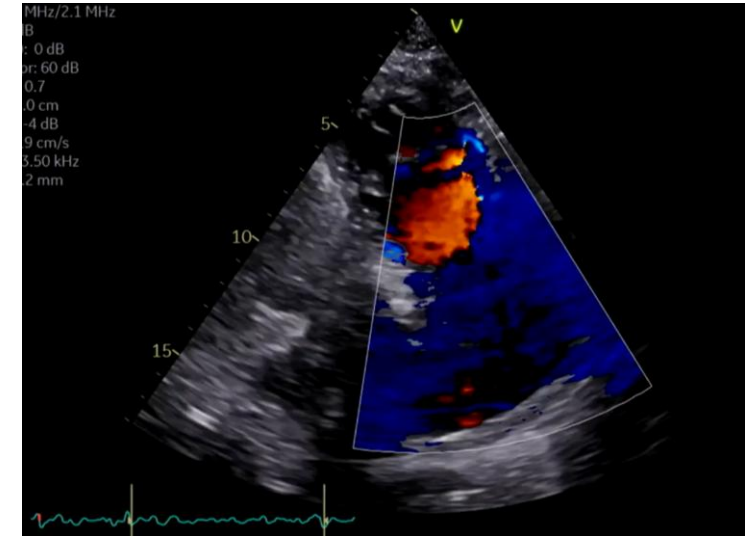


# High End Diastolic Pressure from Late Diastolic Non-compliance

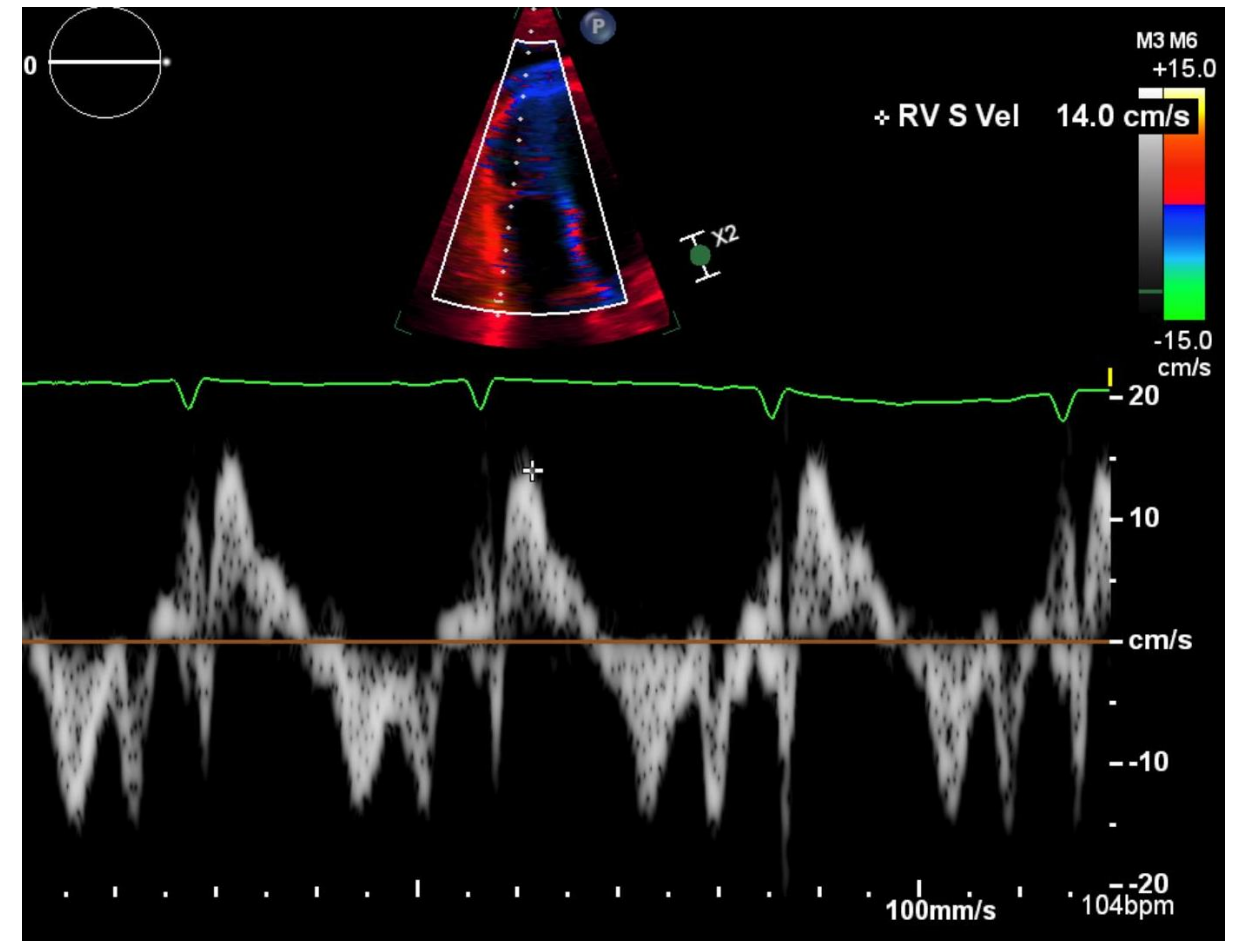
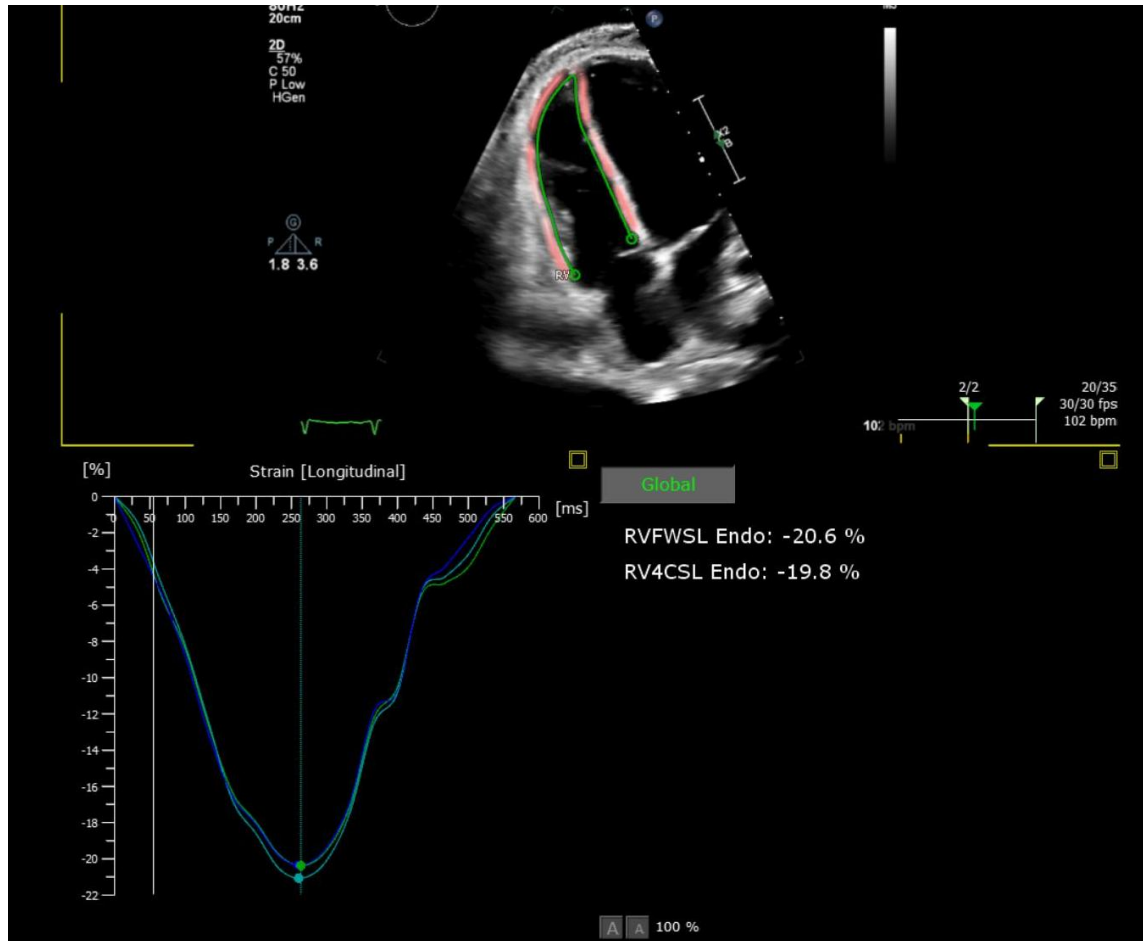
Normal LVEF but low Svi  
Mid-diastolic J-wave



Diastolic MR/TR

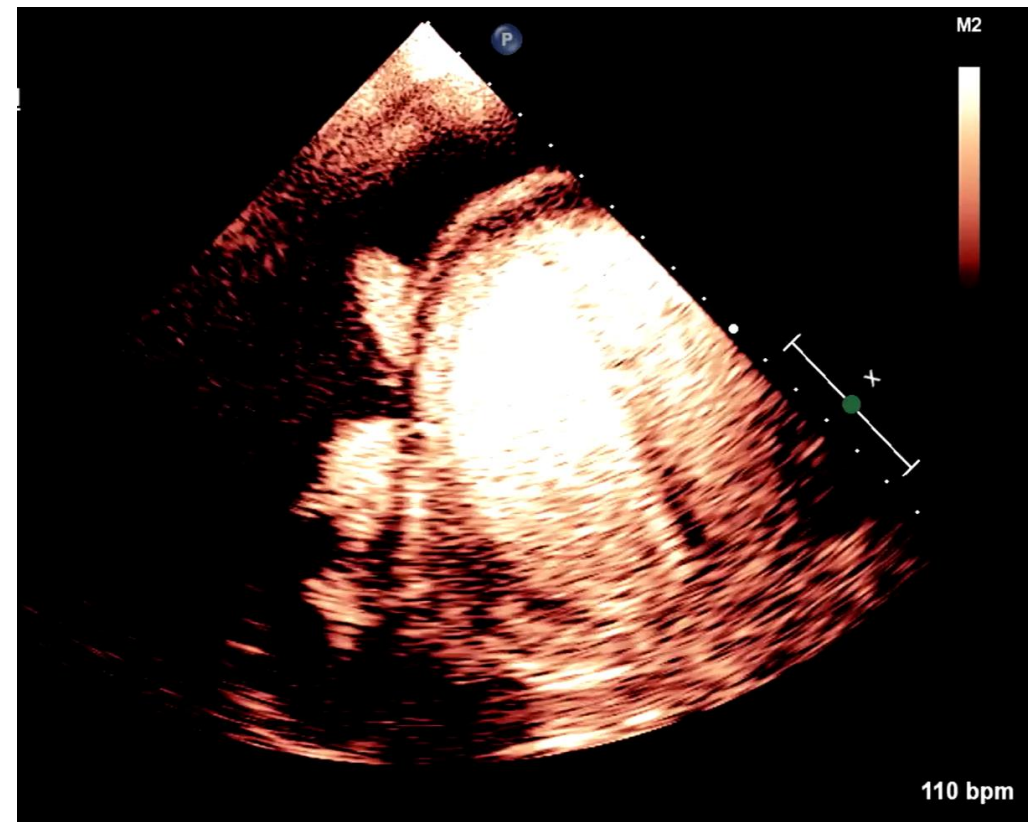
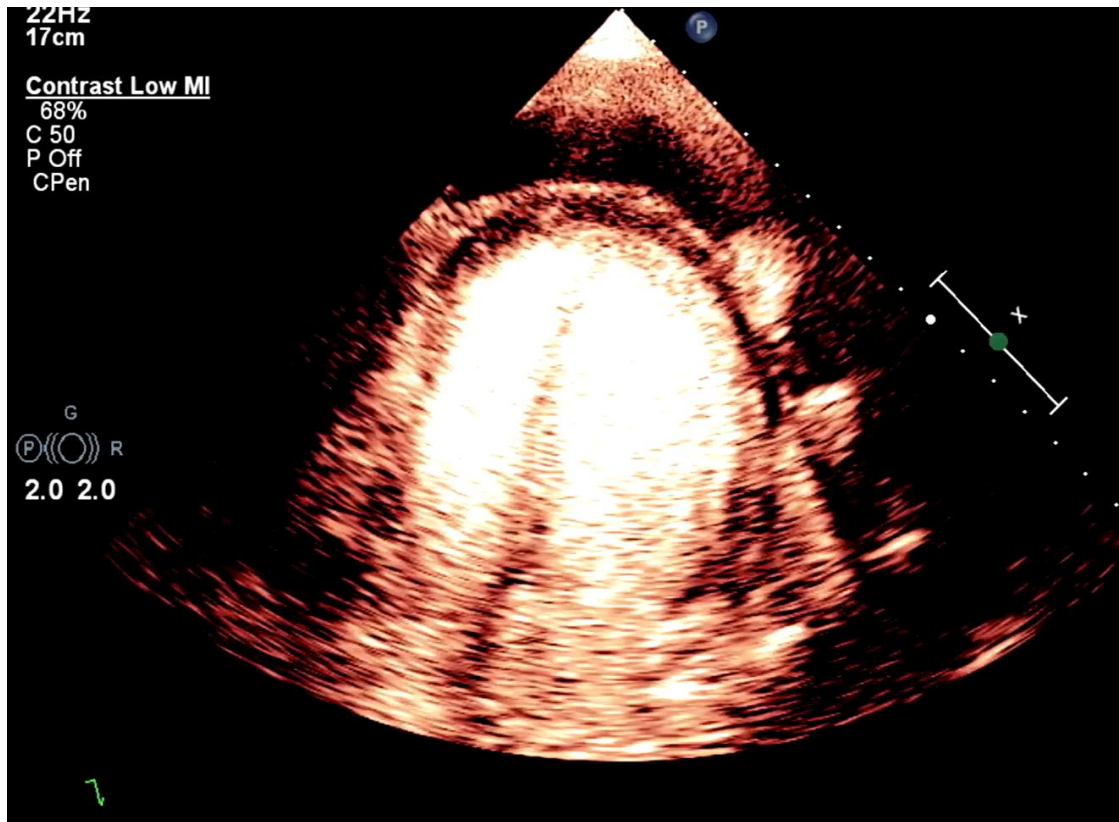


# Tethered RV: Reduced Total RVFWS but Normal Early Systolic TDI Velocity





# Even Contrast Helps



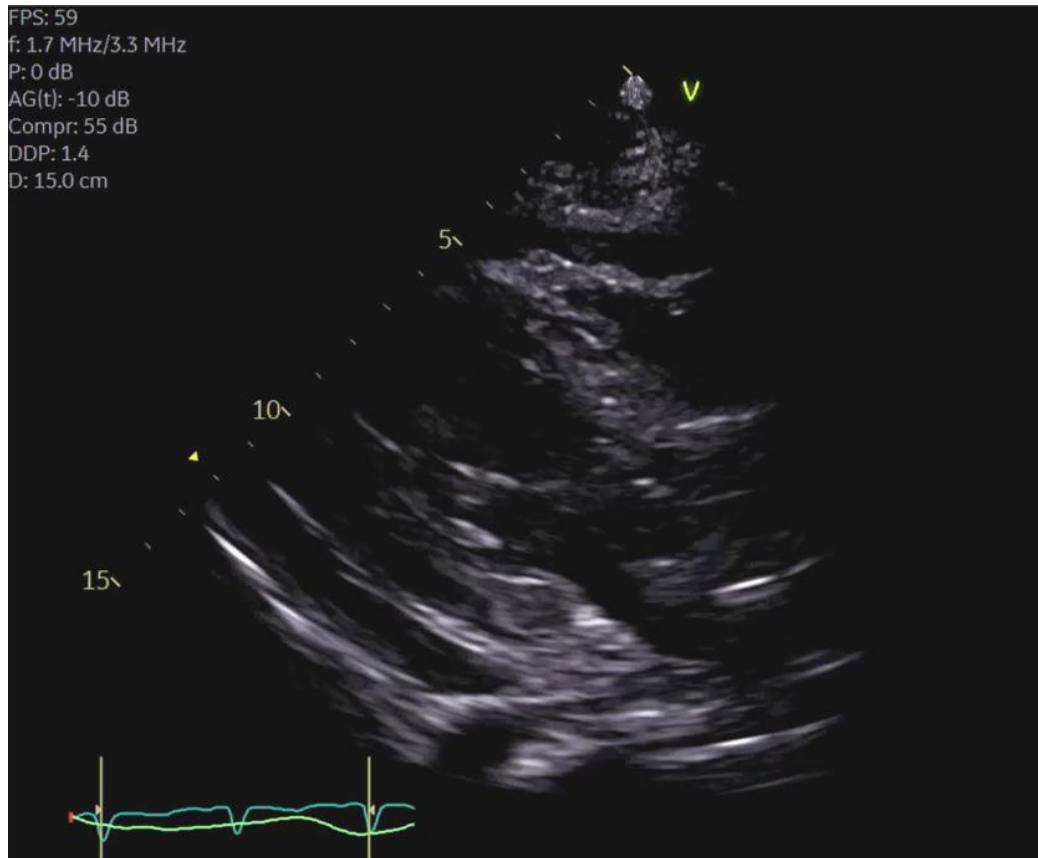
## Case Presentation: A Classic Example of Effusive Constrictive

- 27 y.o. male with metastatic epithelioid fibrosarcoma
- Admitted with pericardial effusion and tamponade; underwent successful pericardiocentesis and drain for 3 days
- Echo repeated 6 days after removal of drain

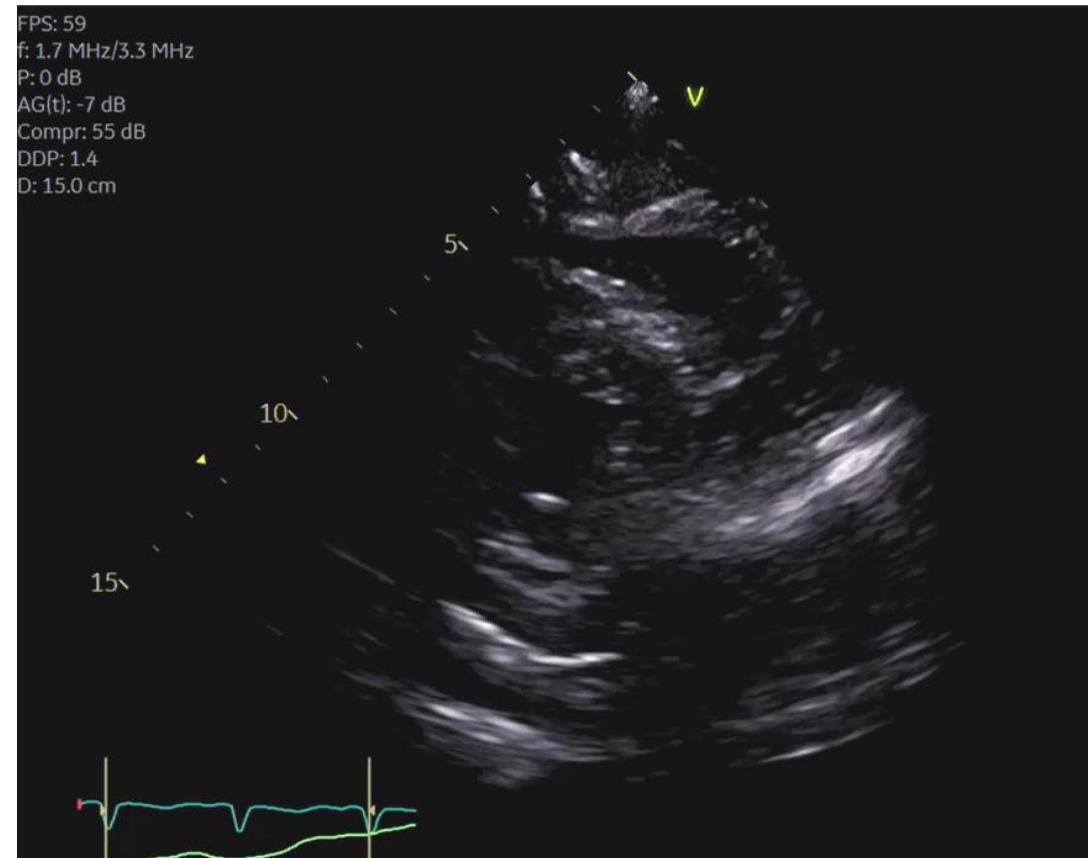
# Case Presentation: A Classic Example of Effusive Constrictive

- Vitals: HR 120-124 bpm, BP 116/82 mm Hg

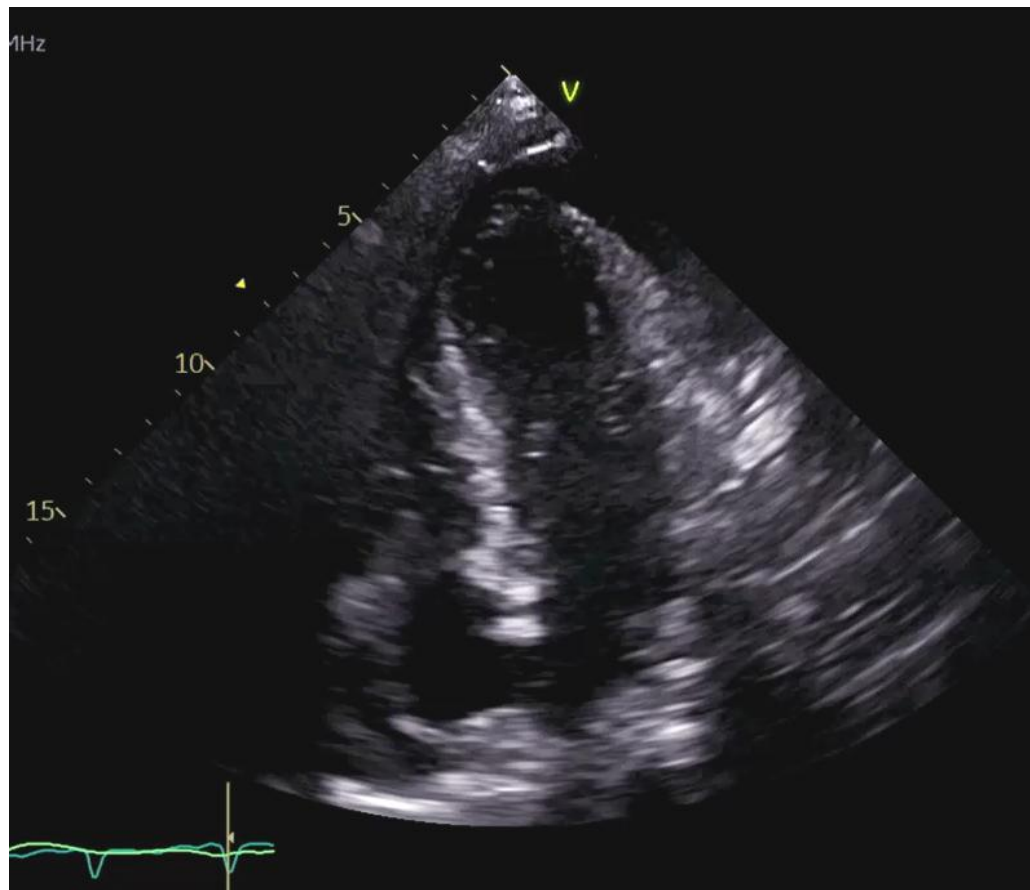
PLAX



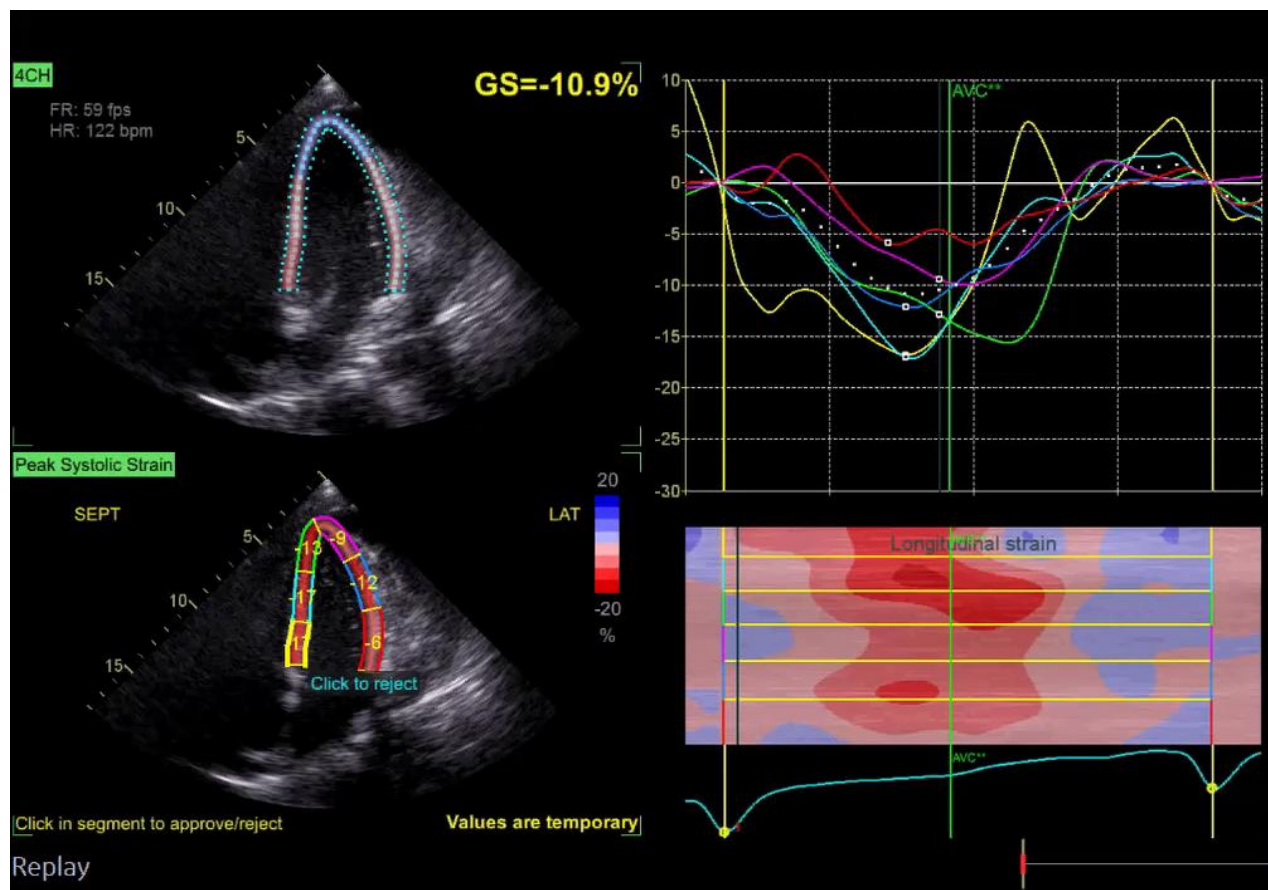
PSAX



Ap 4ch



Ap 4 ch Long. Strain



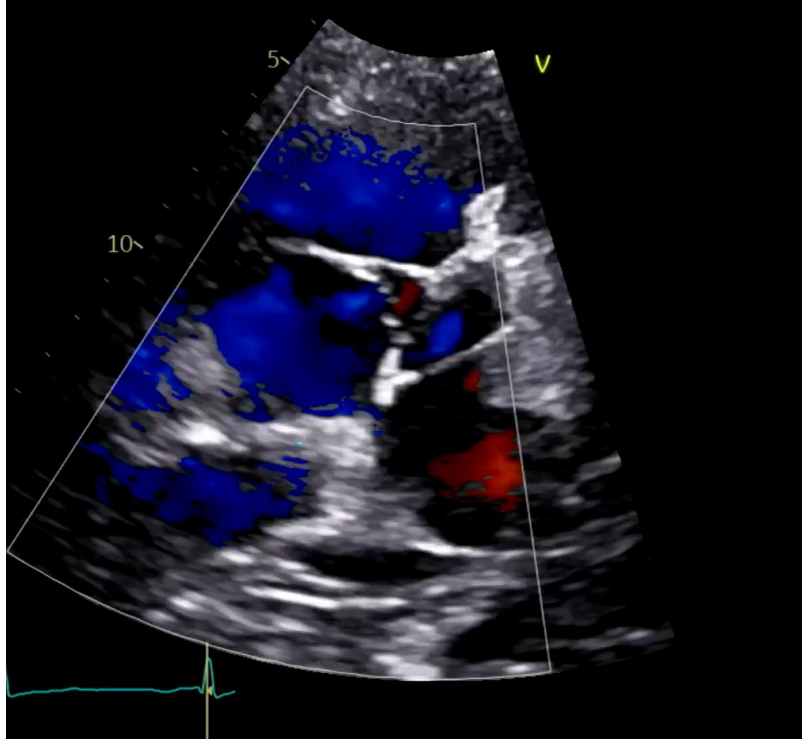
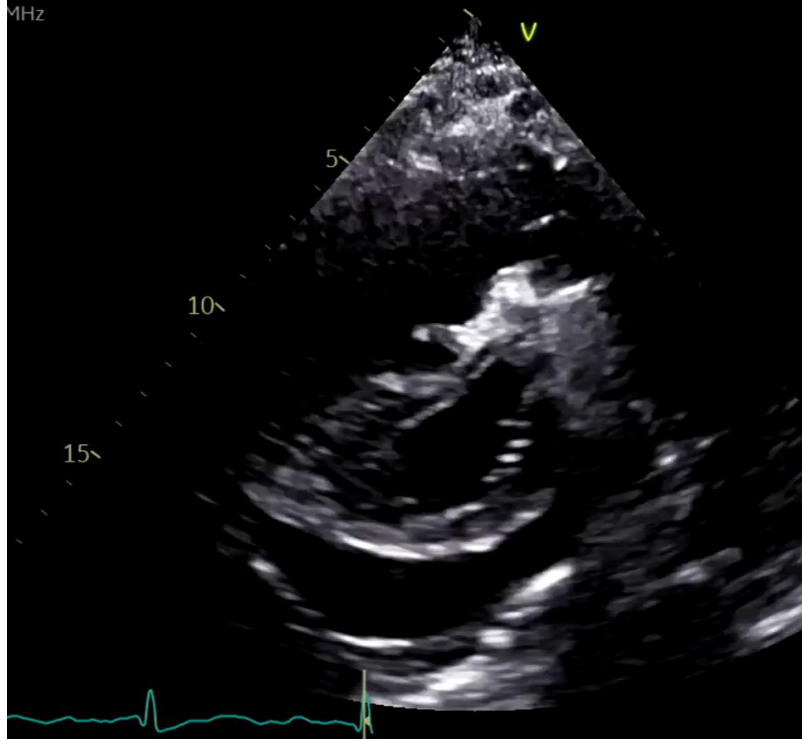
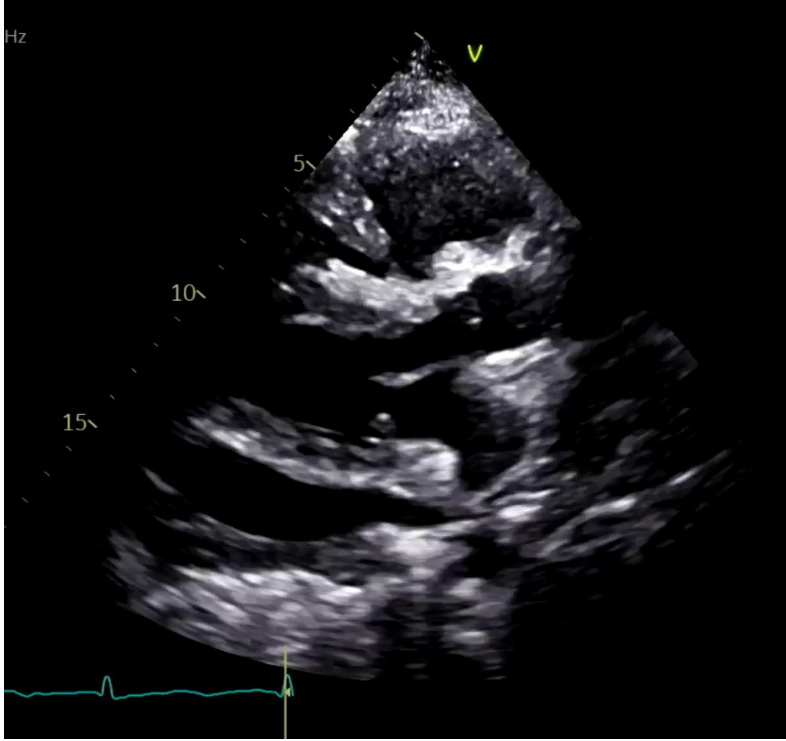


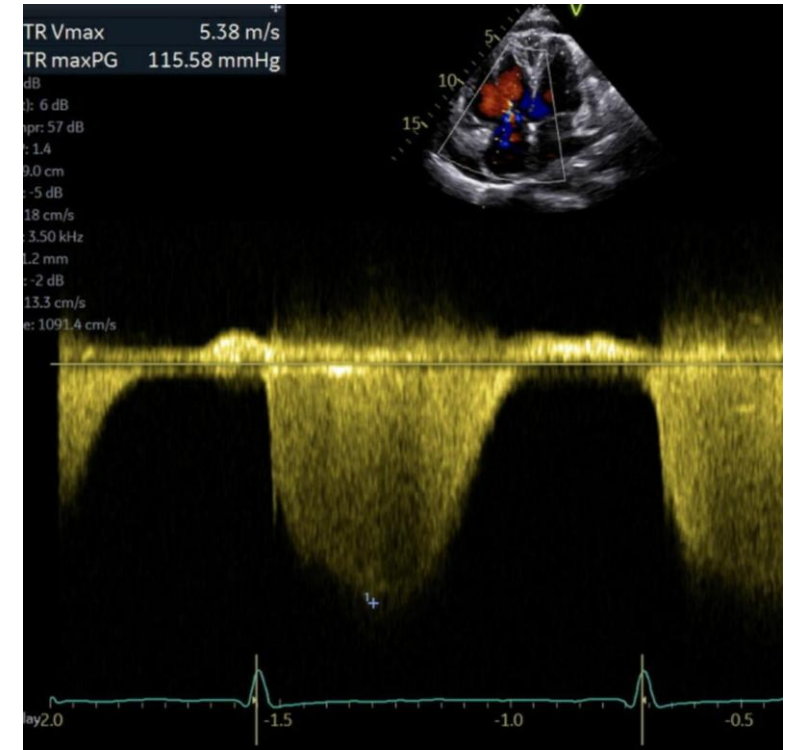
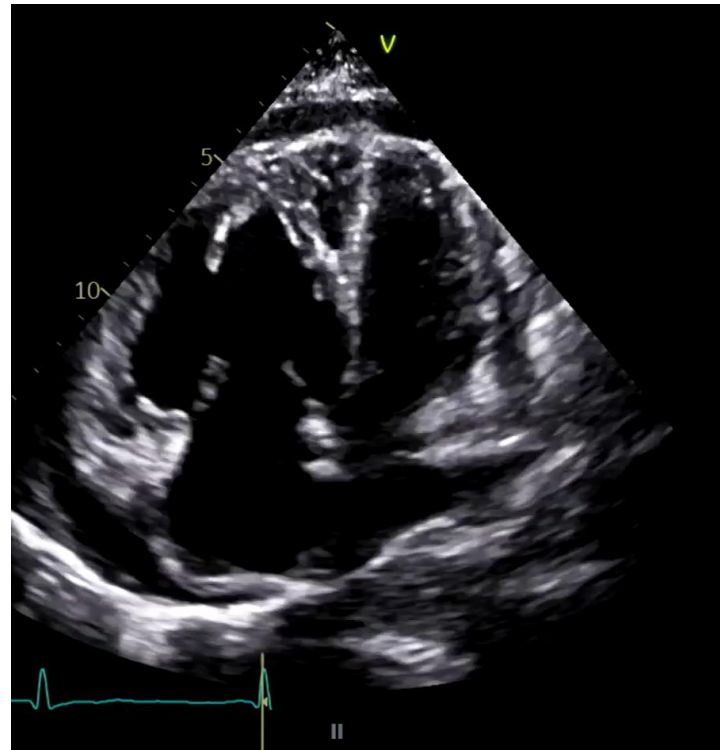
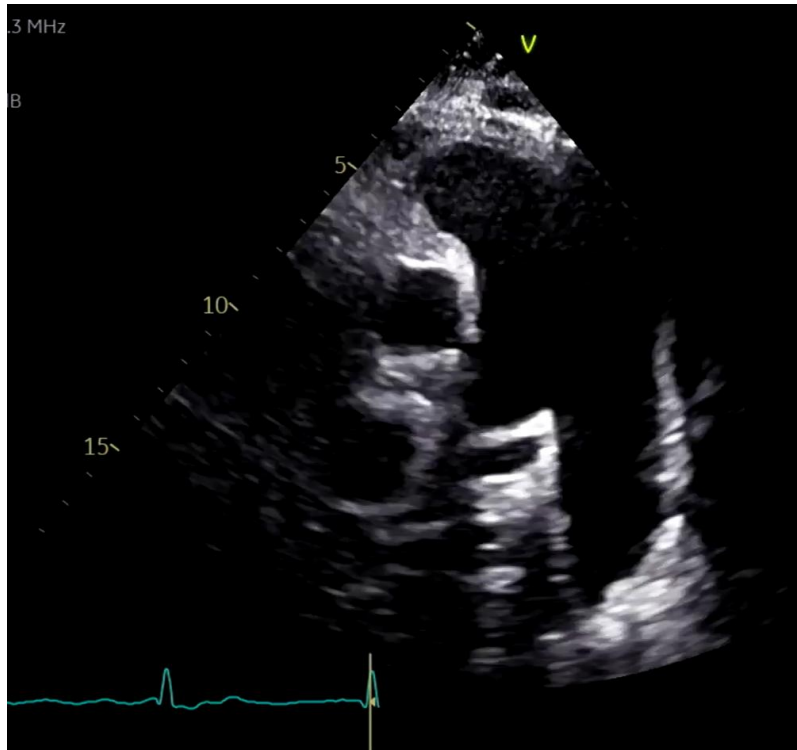
## Summary of Key Data

- Simpson's LVEF = 78%
- GLS = 11.2%
- Stroke volume = 35 mL; Svi = 18 mL/m<sup>2</sup>
- Twist: 2°, Torsion 0.3°/cm

## Mimics: Case Presentation of RV Restriction

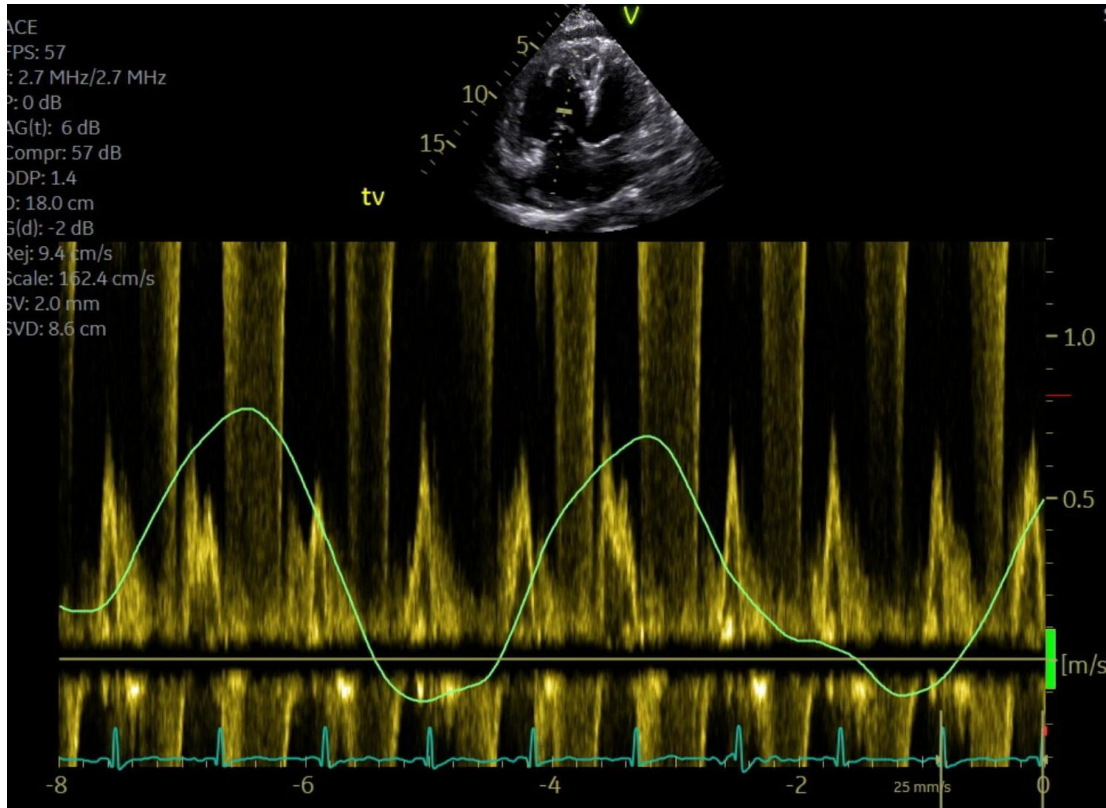
- 62 y.o. female with history of pulmonary hypertension
- Presents to ED with DOE and found to have borderline hypotension (BP: 90/68) and hypoxemia (O<sub>2</sub> sat 88%)
- Echo ordered and performed prior to any documented ED evaluation of JVP or pulsus paradox.



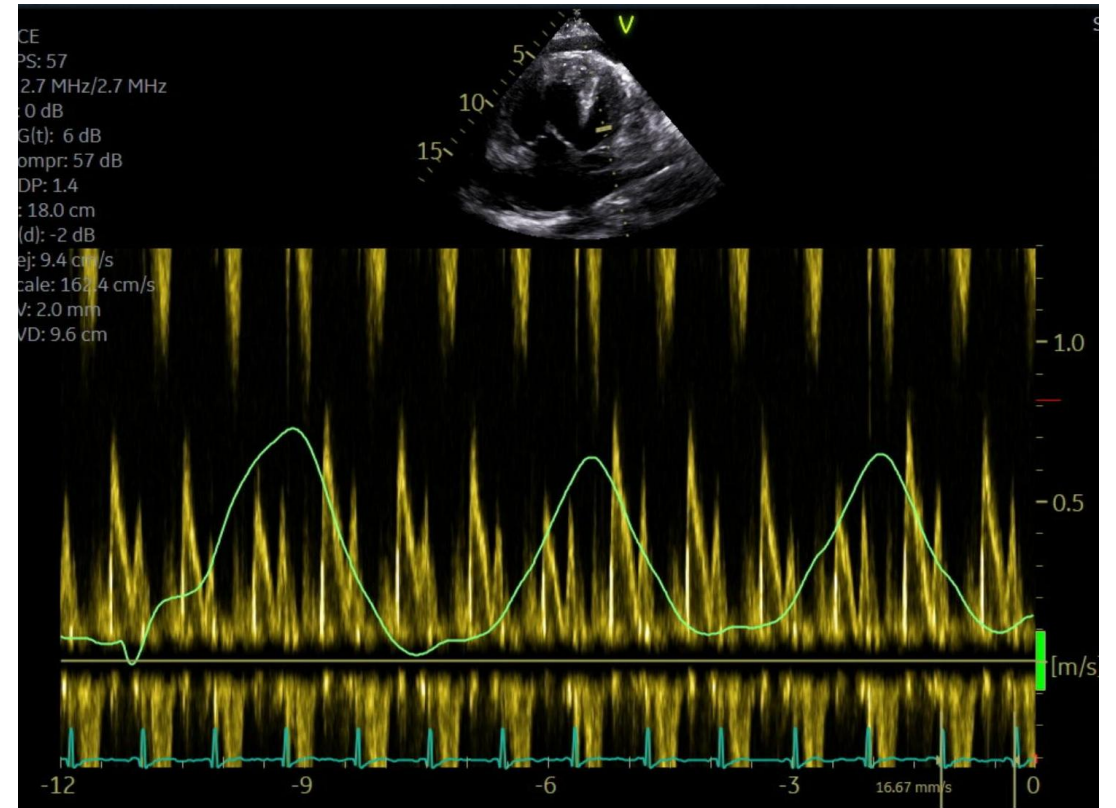




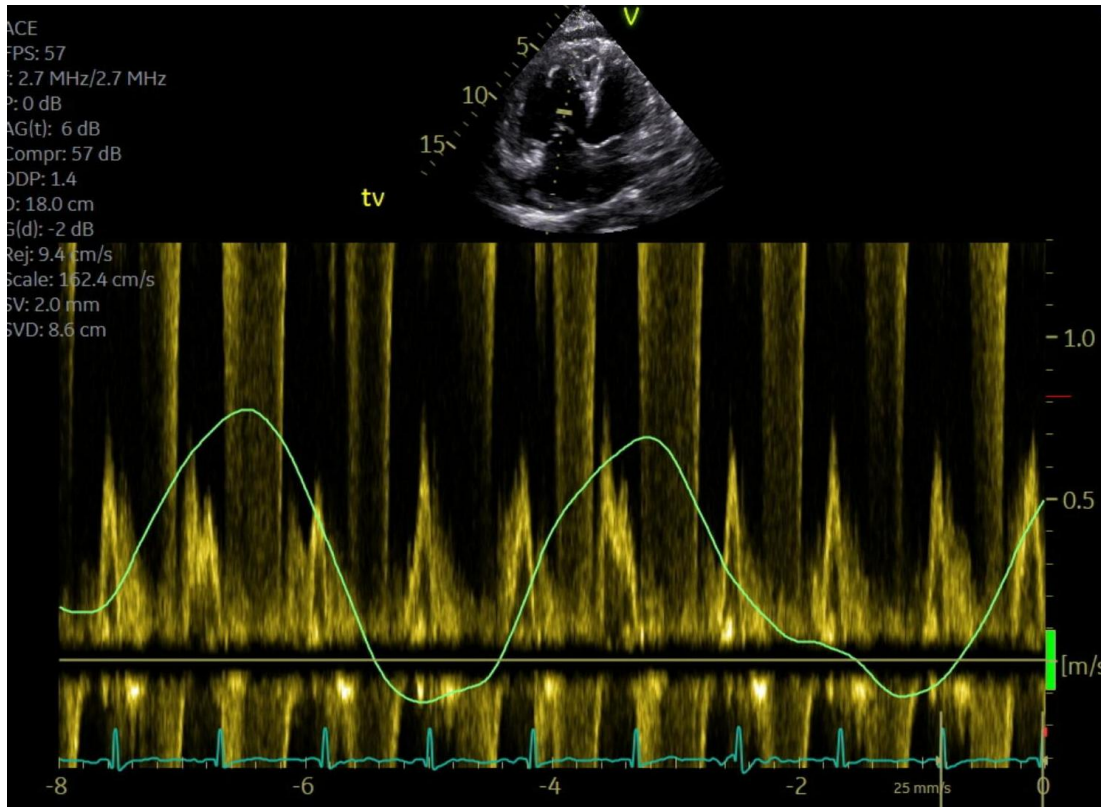
## Tricuspid Inflow



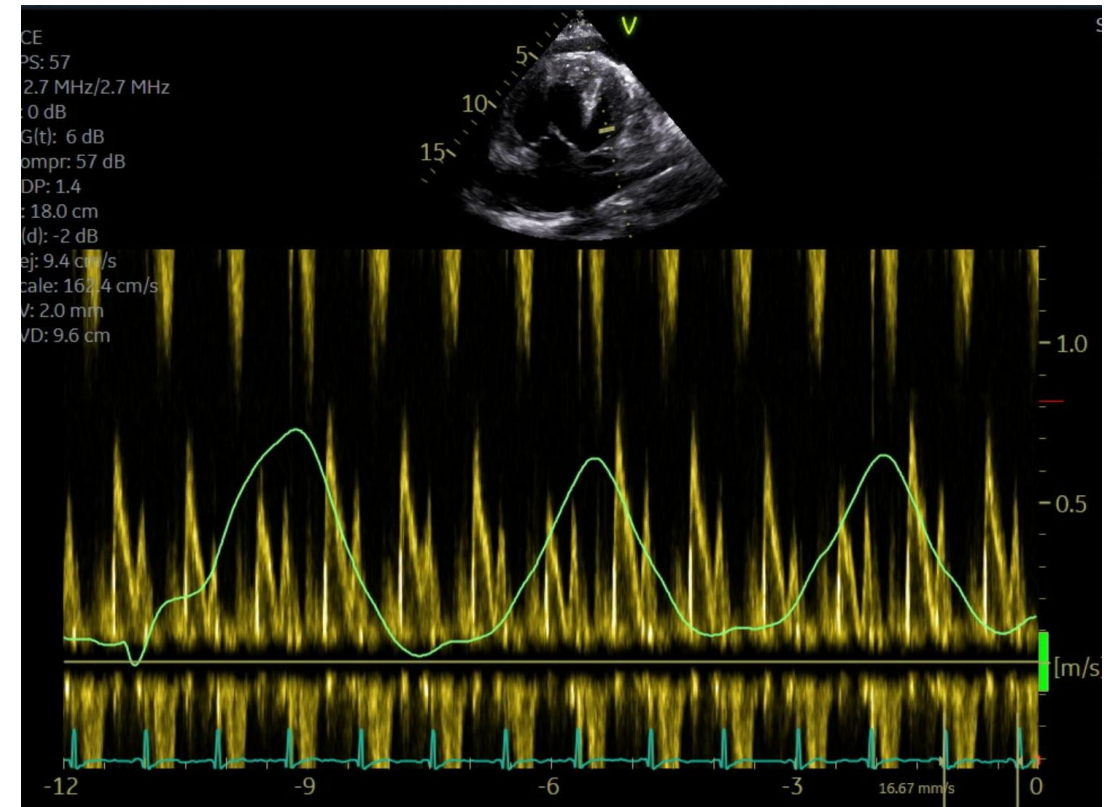
## Mitral Inflow



## Tricuspid Inflow

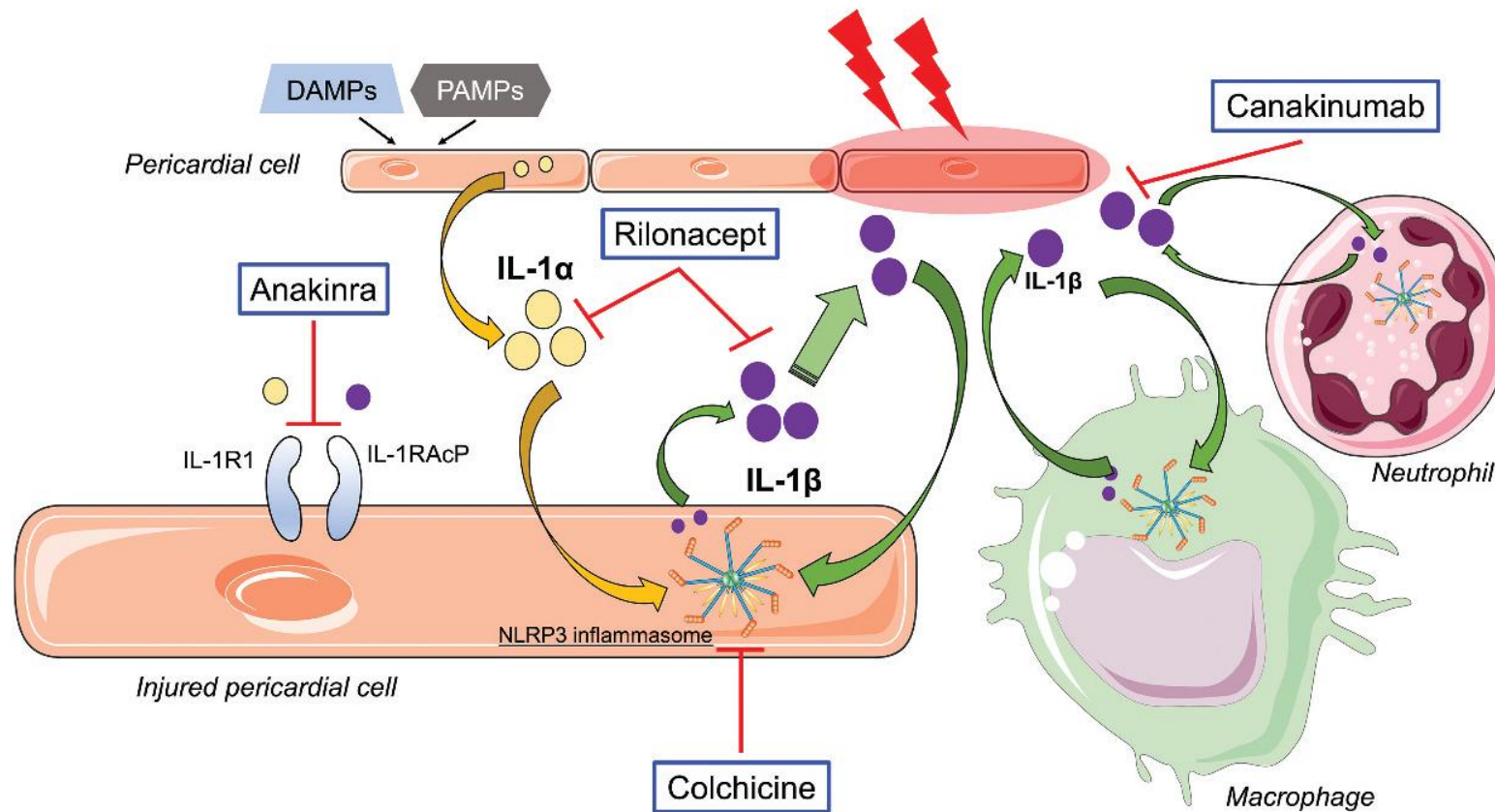


## Mitral Inflow



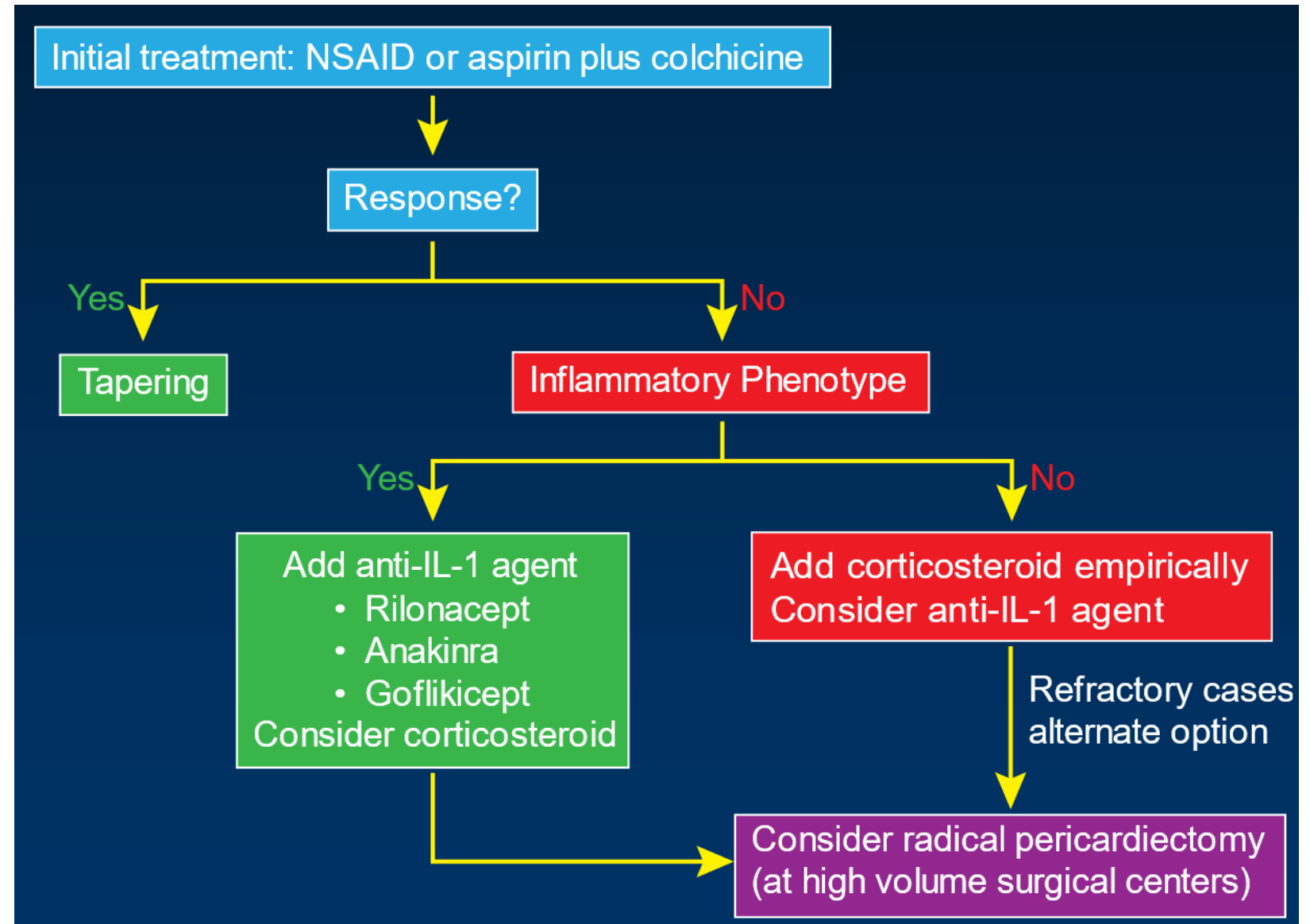
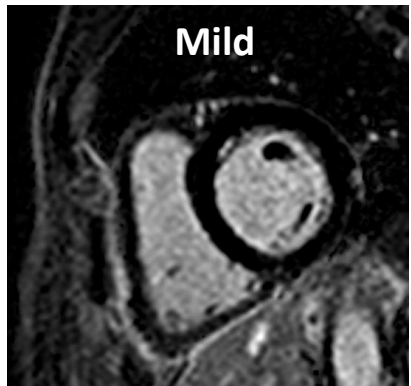
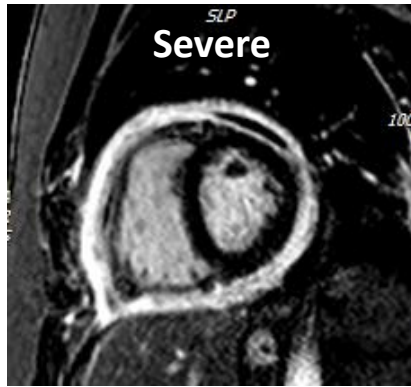
- Restrictive RV physiology
- Isolated LV tamponade physiology from effusion and restrictive RV

# Pharmacotargeting of Recurrent Pericarditis





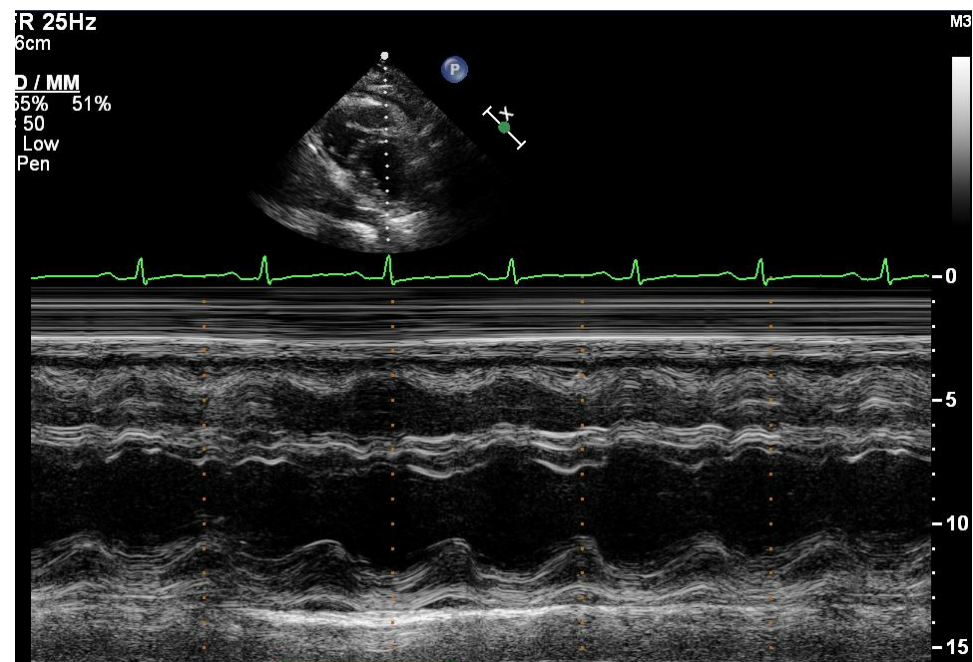
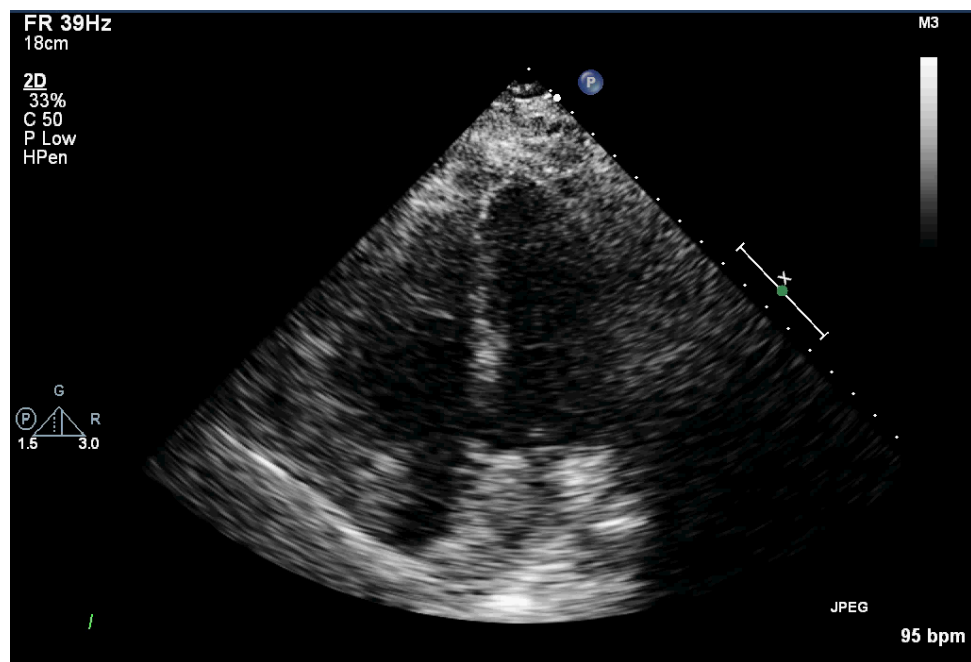
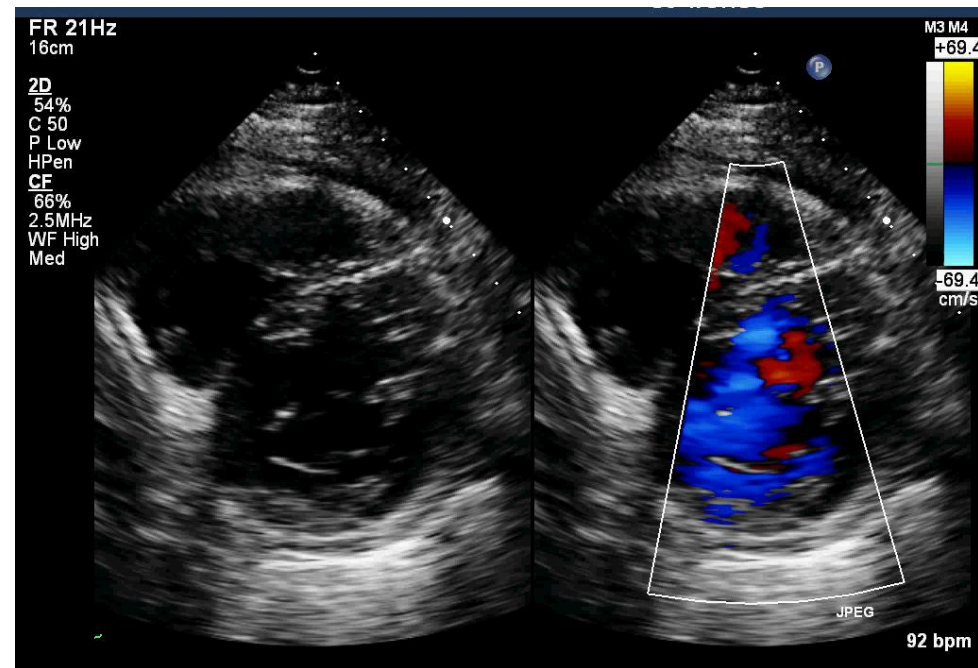
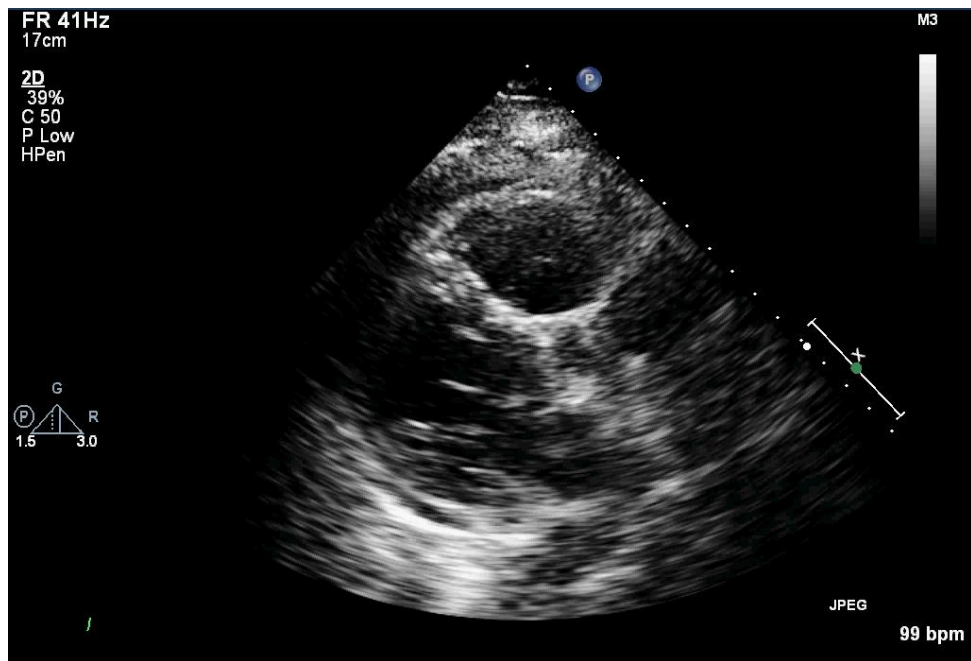
# The New Paradigm for RSx



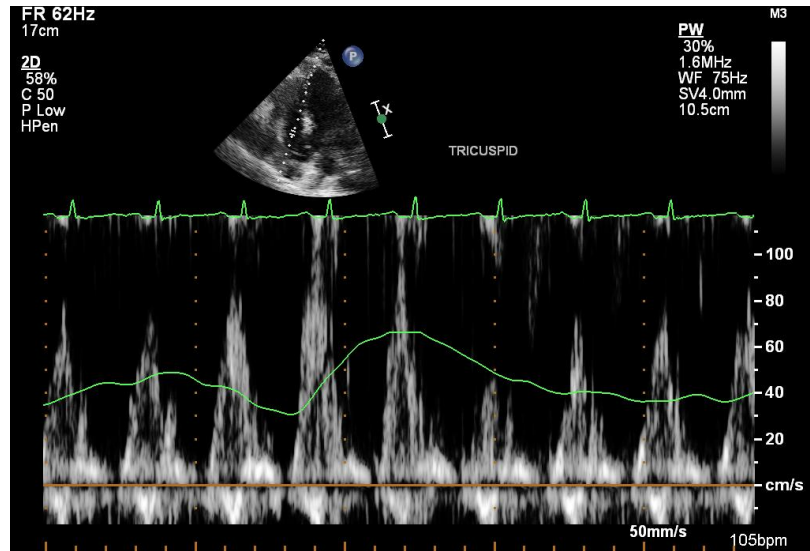


## Case Presentation – Precision Rx for Constriction

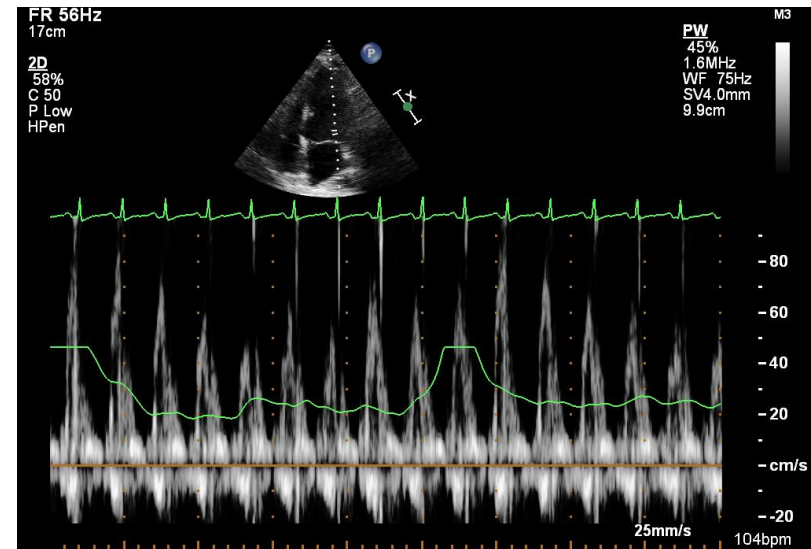
- 37 yo female with CML refractory to multiple TKIs
- Underwent sibling allogeneic BMT 3 yrs prior to presentation
- Presents with sharp, pleuritic CP similar to sx with PE last yr but with nausea, diarrhea and abdominal pain
- Exam unremarkable except for tachycardia, possible S3; and sclerodermatous skin



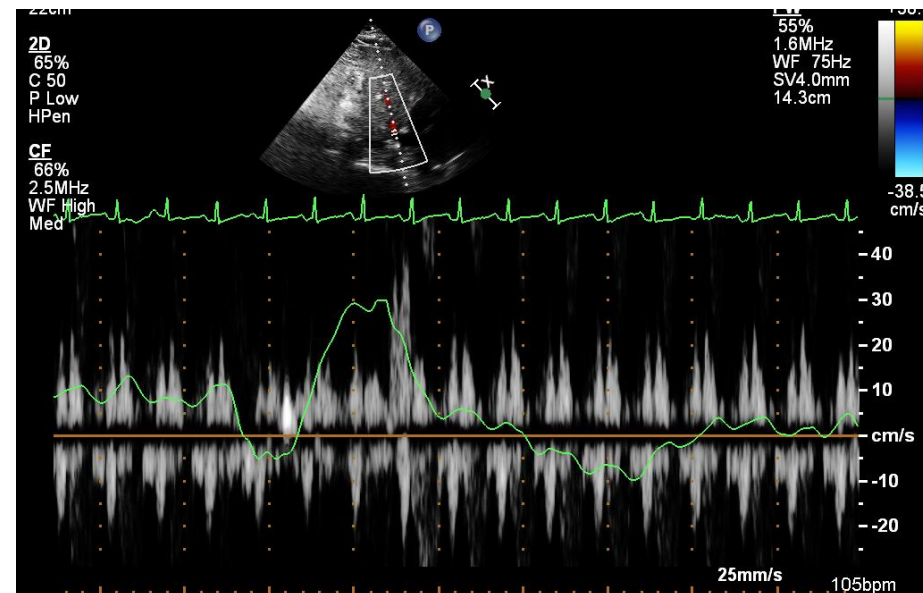
## Tricuspid Inflow



## Mitral Inflow

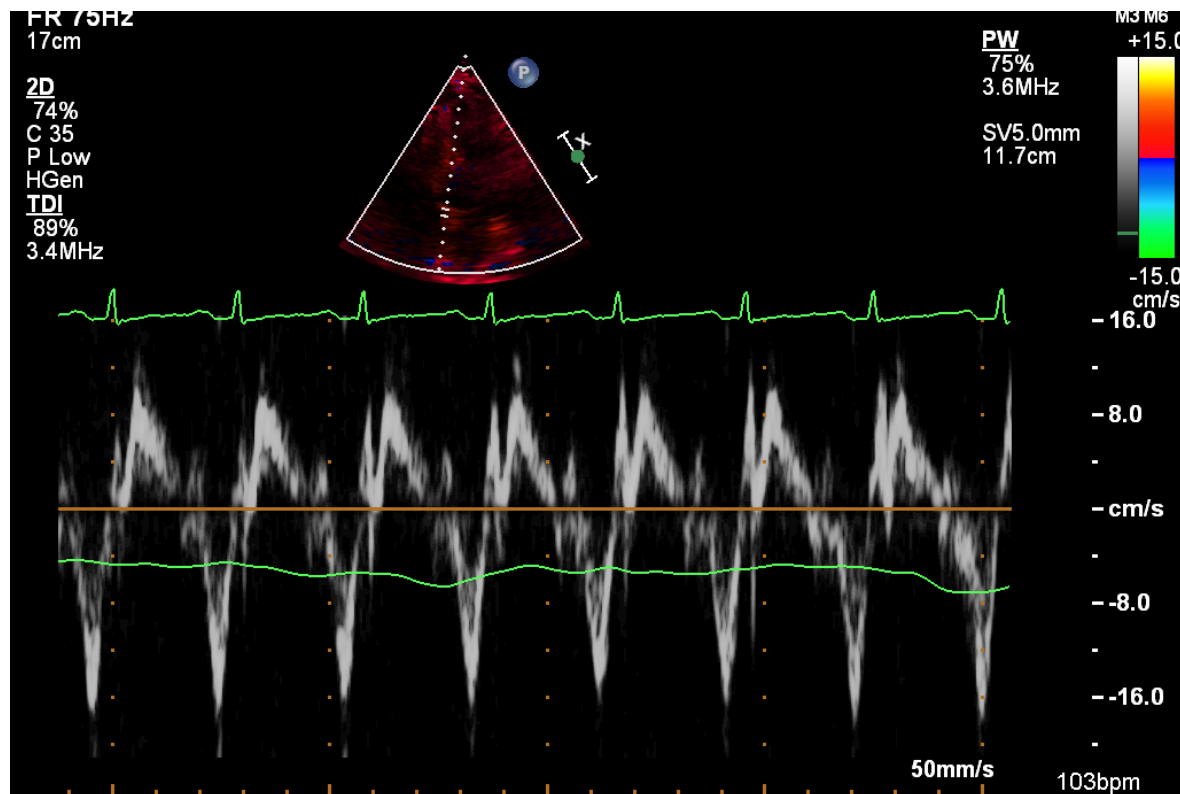


## Hepatic Vein

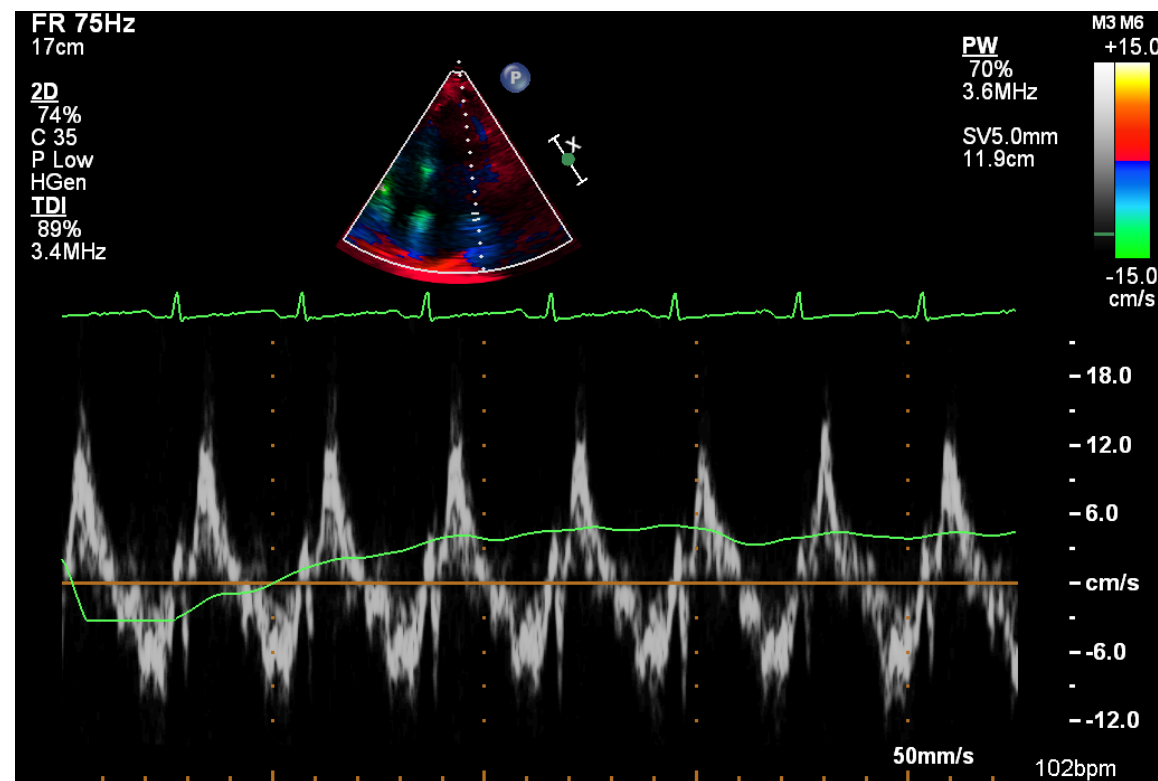


# Tissue Doppler

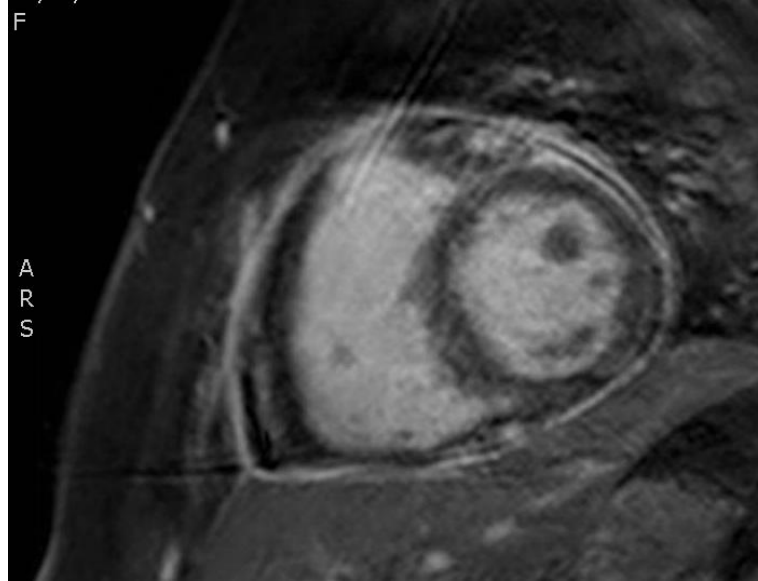
## Medial Mitral Annulus



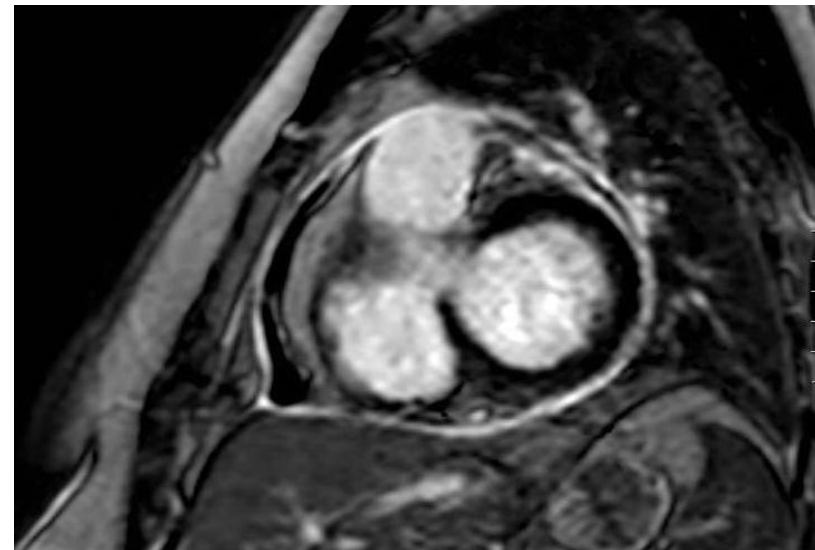
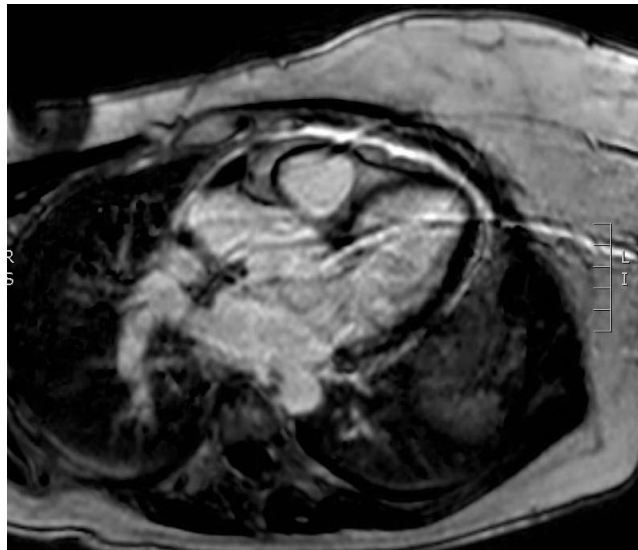
## Lateral Mitral Annulus



*Early Gd-DTPA Enhancement*

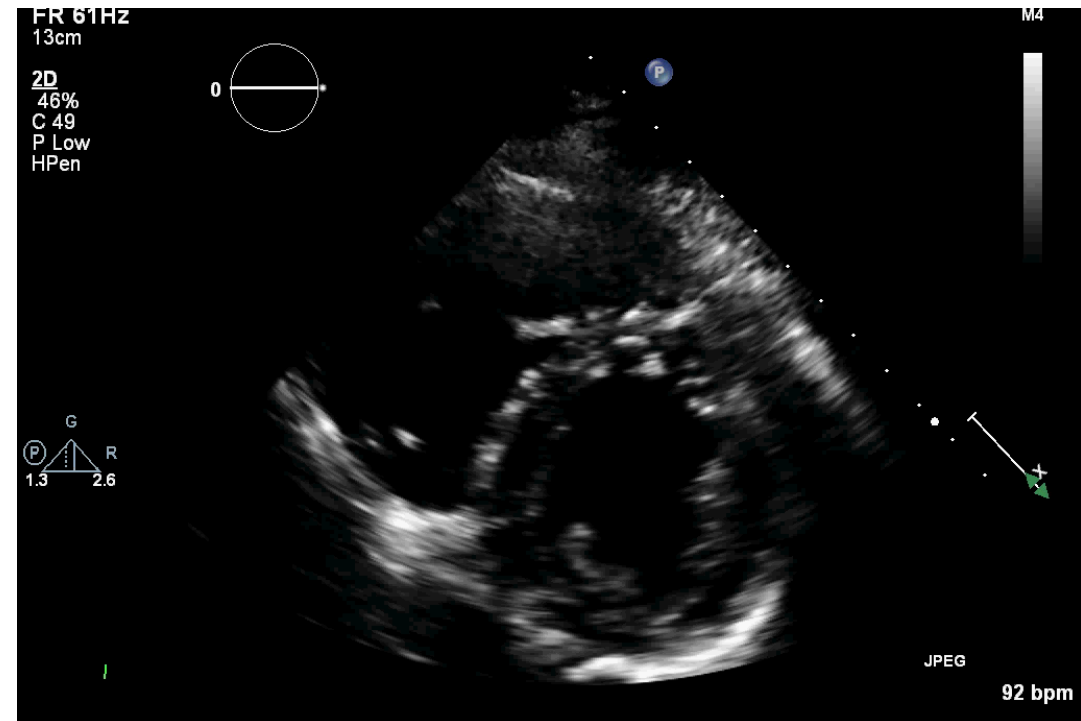
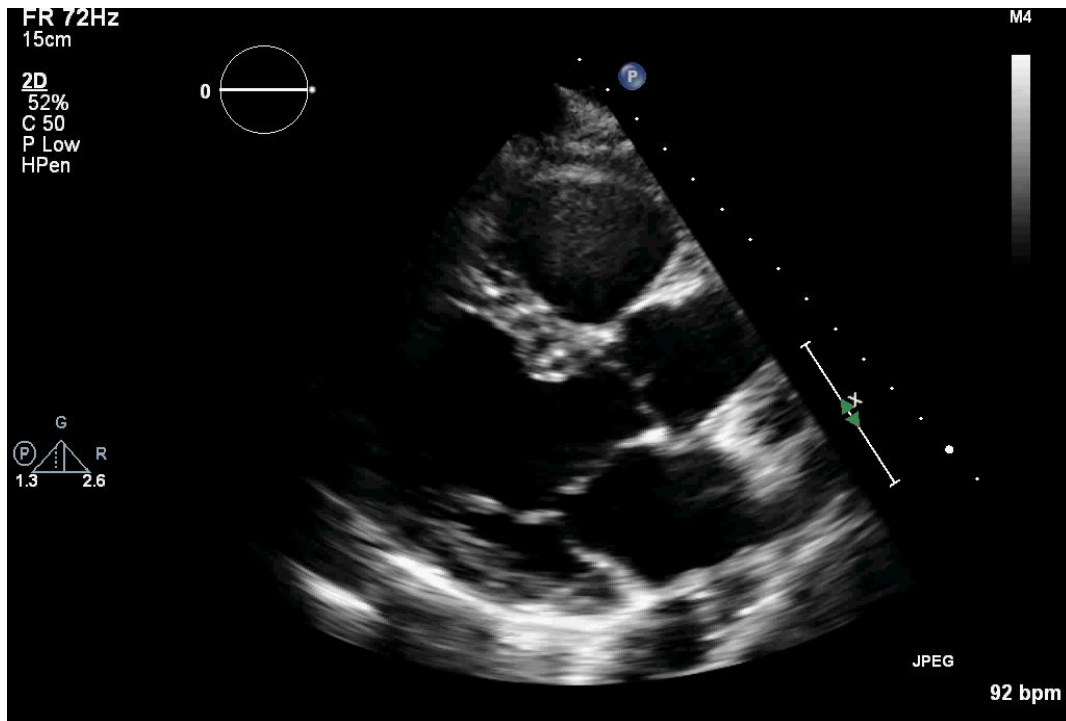


*Delayed Gd-DTPA Enhancement*

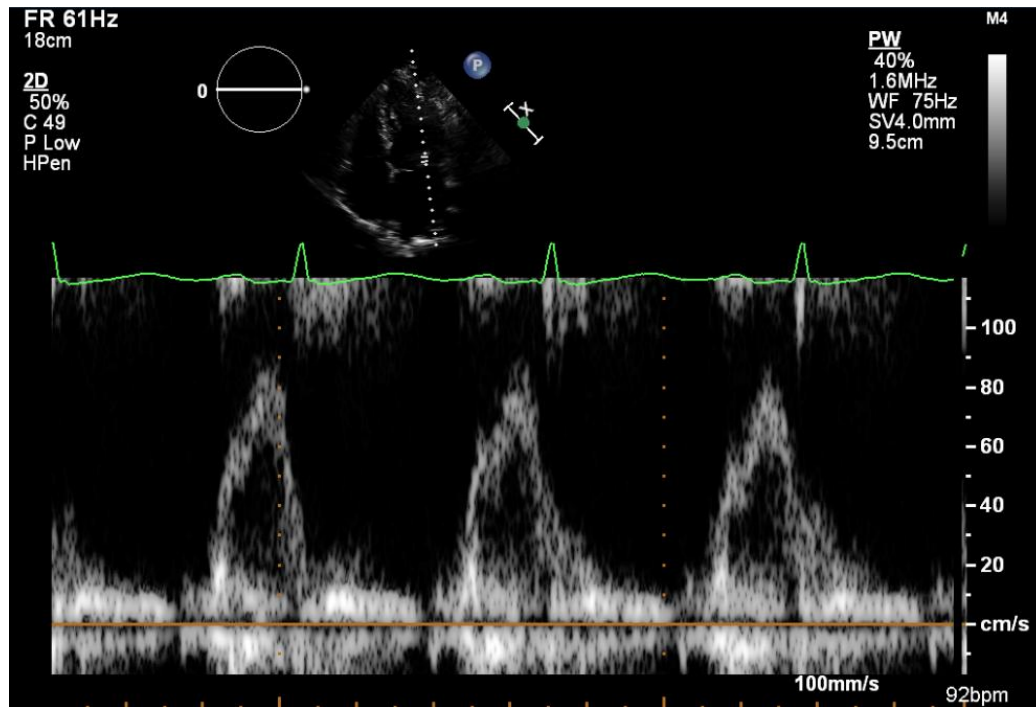




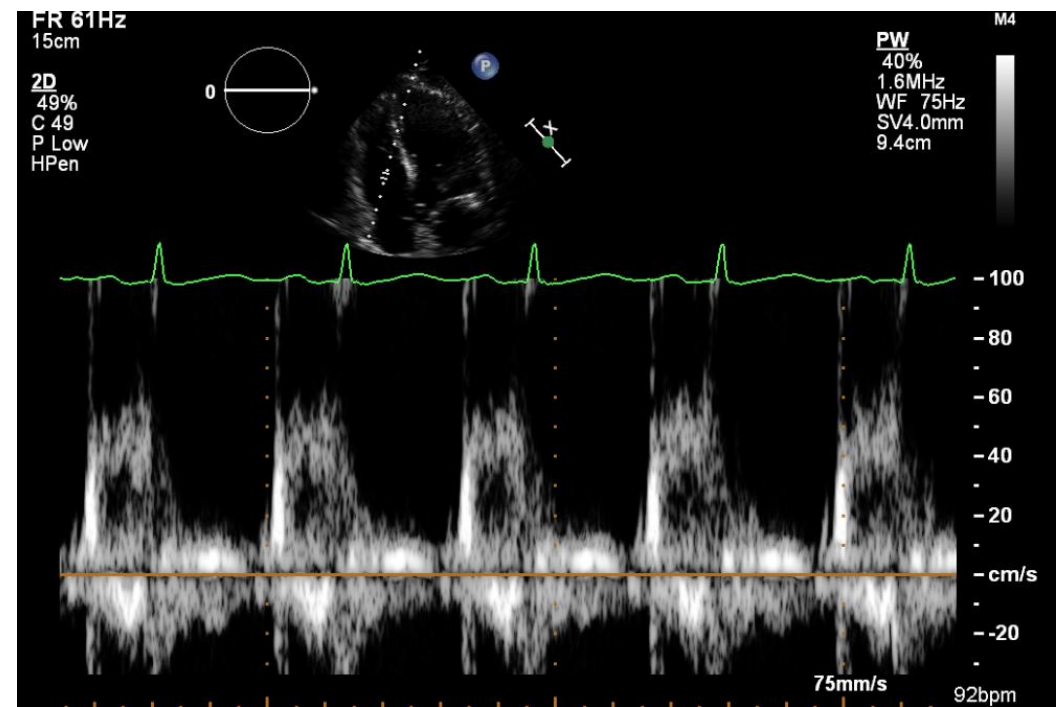
## 3 weeks after steroids



## *Transmitral Doppler*



## *Trans-tricuspid Doppler*



# Summary

Pericardial constriction is:

- A great lesson in CV physiology
- A reason to use multimodality imaging
- Potentially treatable with non-surgical medical therapy
- A good test of anyone's echo skills