

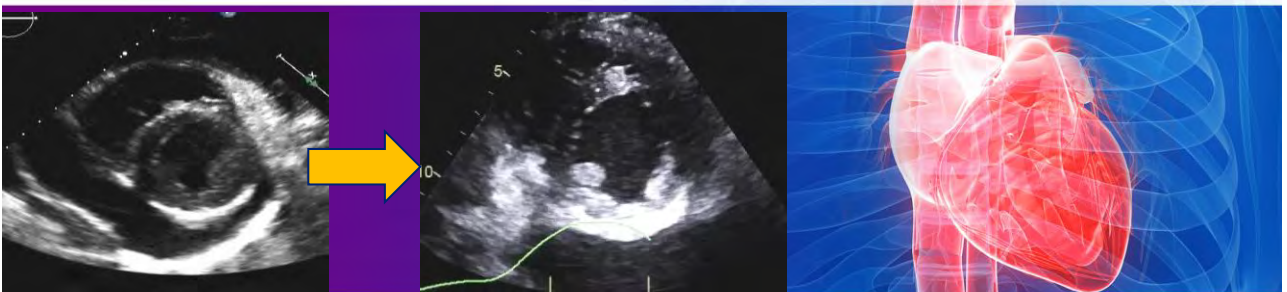
# Constrictive Pericarditis

Echo Doppler is the **GOLD** standard

Jae K. Oh, MD  
Mayo Clinic



From Tamponade to Constriction  
Non-invasive Hemodynamics



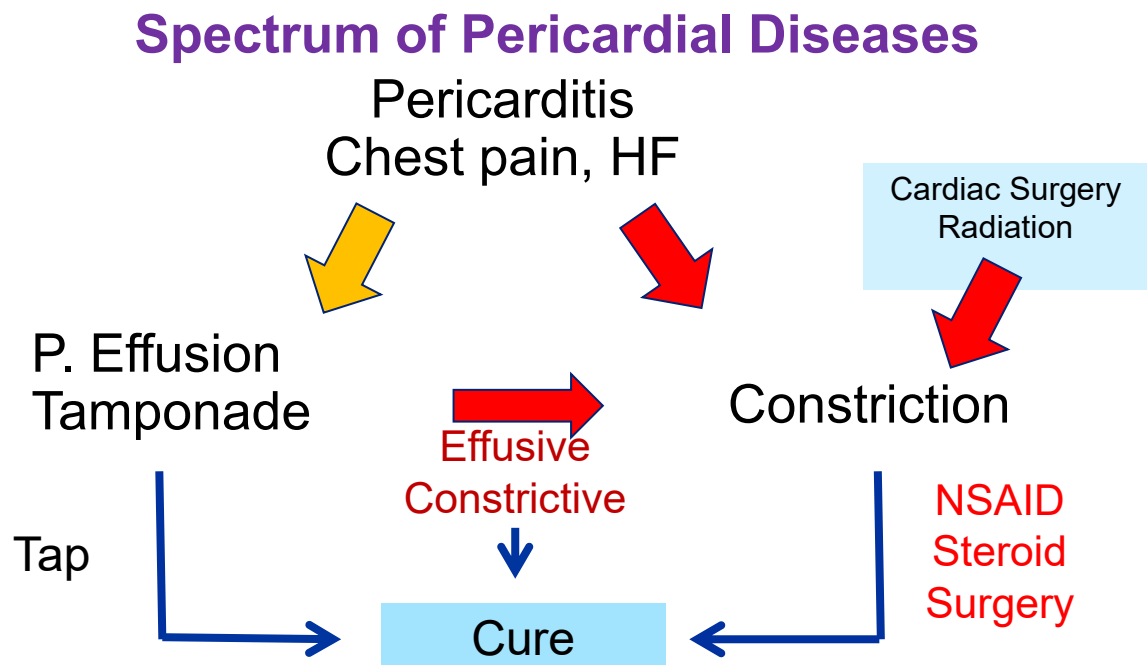
Jae K. Oh, MD

## Pericardial Diseases Contents

- Tamponade vs Effusive Constrictive Pericarditis
- Echo Diagnostic Criteria (4 parameters)
  - Respiratory variation in ventricular septal motion
  - Mitral inflow velocity
  - Mitral annulus e' velocity
  - Hepatic vein diastolic flow reversal with expiration
- Myocardial diseases vs constrictive pericarditis
- Diastolic function is the key for diagnosis and prognosis

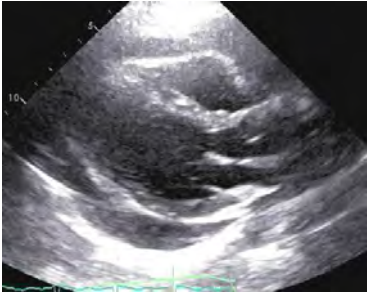


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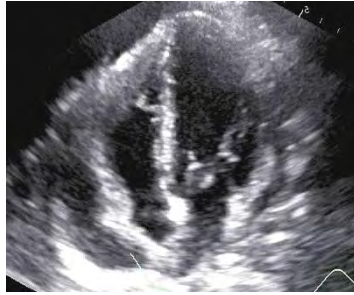


# Cardiac Tamponade

## Echocardiographic Diagnosis



RV Collapse



RA Collapse

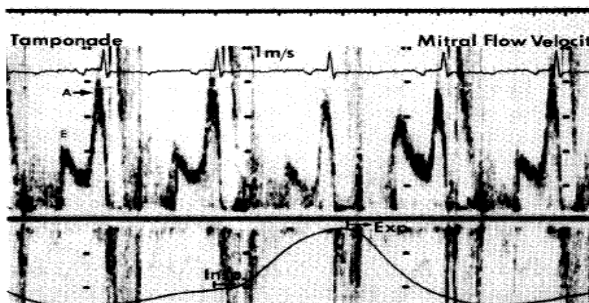


Swinging Heart

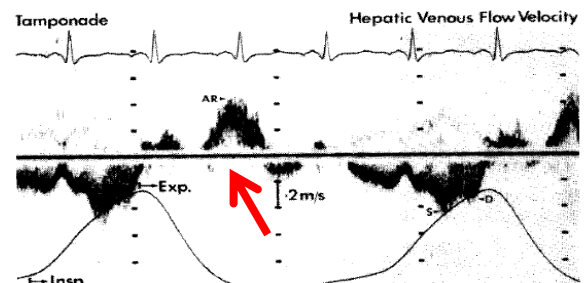
### Cardiac Tamponade: Characteristic Doppler Observations

Pure tamponade : Grade 1 pattern with minimal diastolic forward flow with expiration

DARRYL J. BURSTOW, M.B.,B.S.,\* JAE K. OH, M.D., *Division of Cardiovascular Diseases and Internal Medicine*; KENT R. BAILEY, Ph.D., *Section of Biostatistics*; JAMES B. SEWARD, M.D., A. JAMIL TAJIK, M.D., *Division of Cardiovascular Diseases and Internal Medicine*

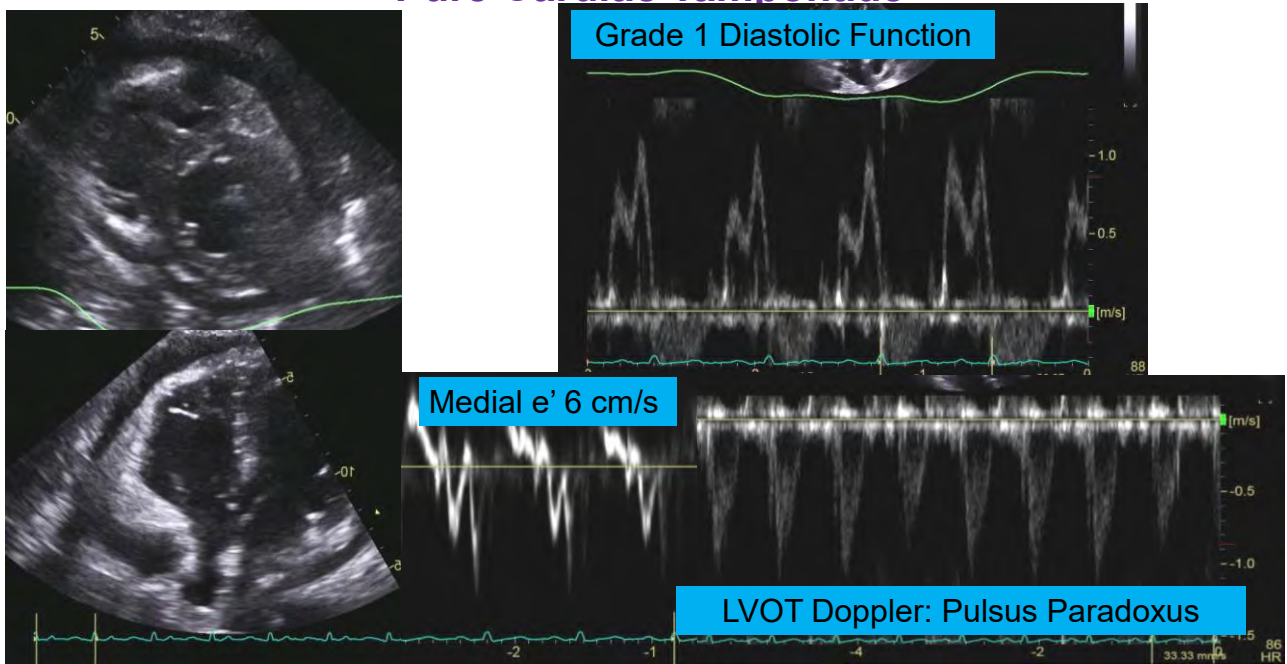


Mitral Inflow  
E < A velocity



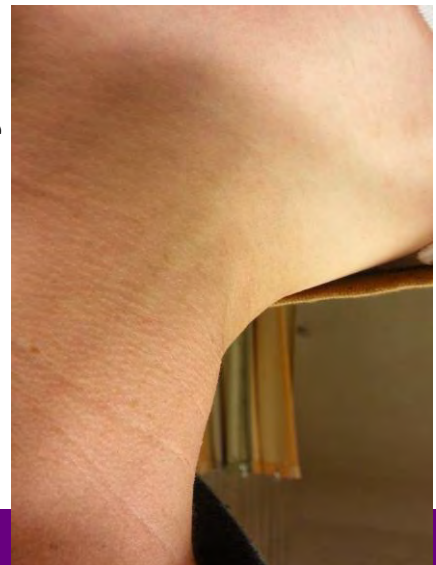
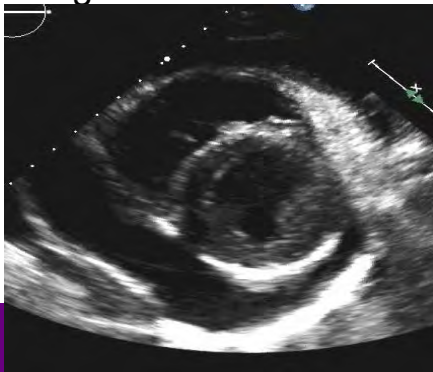
Hepatic Vein  
Diastolic reversal with expiration

## Pure Cardiac Tamponade



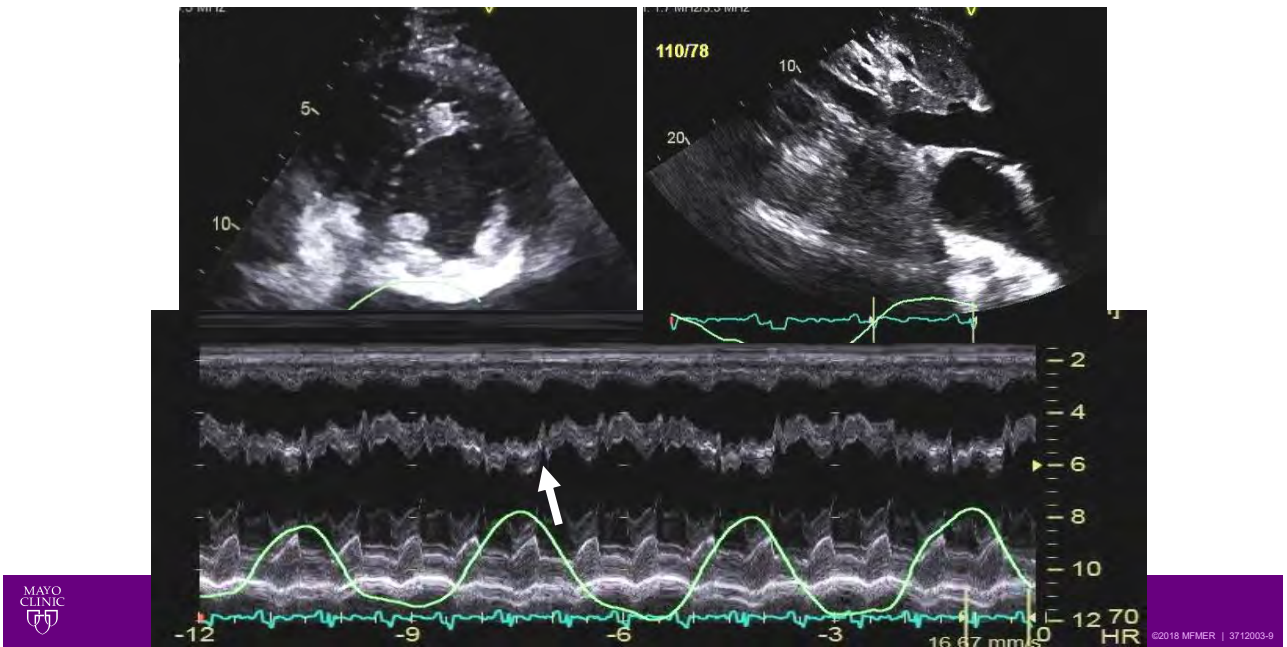
## 27 year old man underwent a window Referred to Mayo

- Acute Pericarditis with effusion
- Pericardial Window
- Pericardial fluid ...studies were *negative*
- Not feeling better

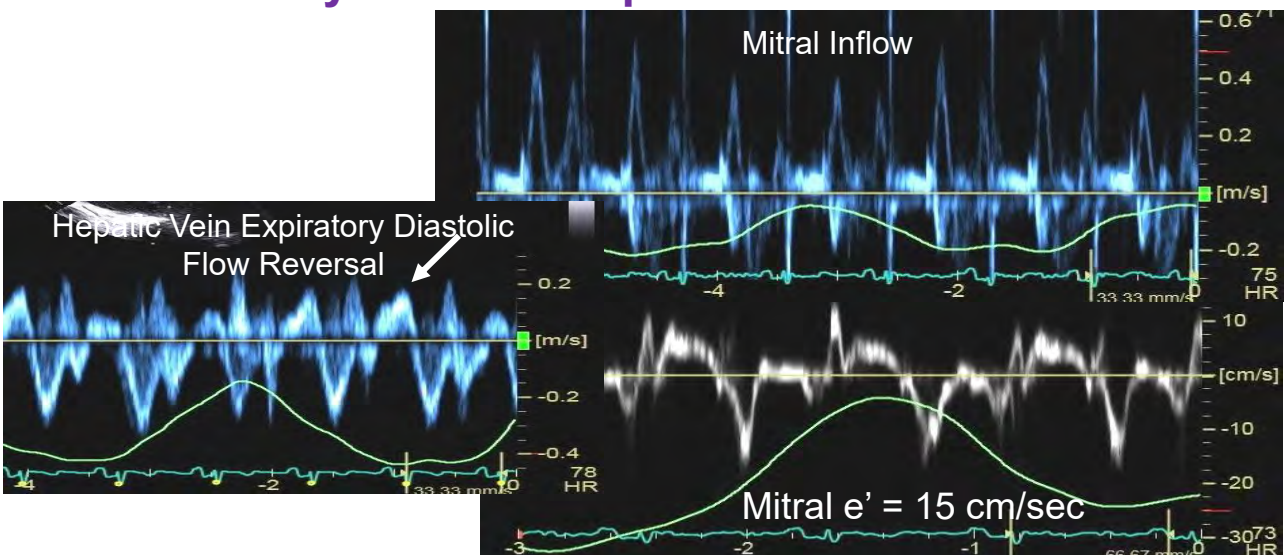


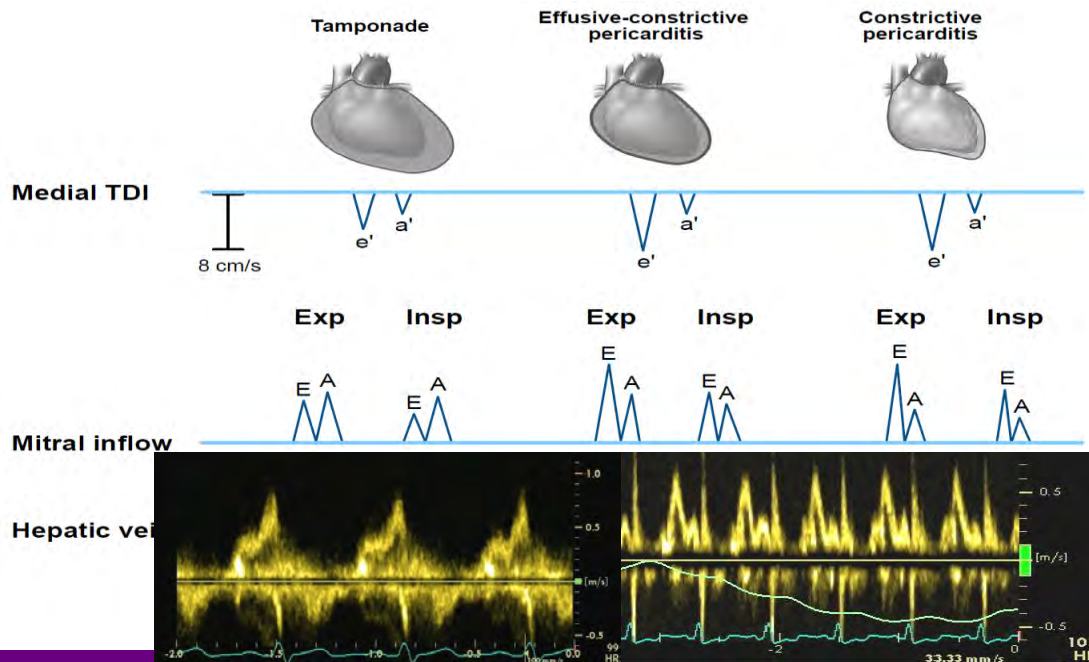


## Effusive-Constrictive Pericarditis



## 27 yo man after pericardial window

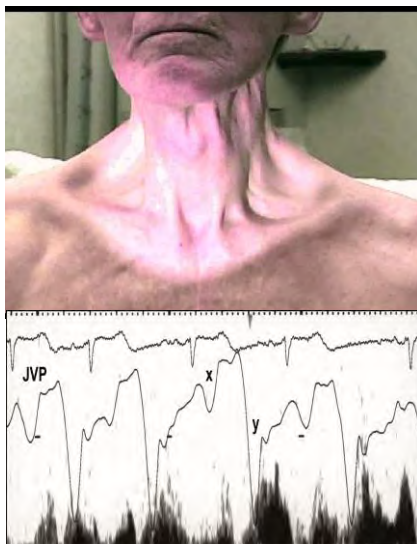




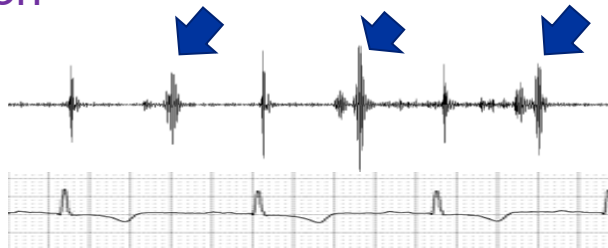
Miranda, Oh et al EJCVC Imaging 2018

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## Diagnosis of Constriction



- JVP elevation with rapid "y" descent
- Pericardial Knock
- Hepatomegaly
- Pitting edema
- Calcified pericardium



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## Constrictive Pericarditis Traditional Diagnostic Criteria

- JVP Elevation: Kussmaul : **Can be seen in RCM**
- Pulsus Paradoxus: **Can be seen in COPD, Obesity**
- Thick Pericardium: **Normal in 20% of CP**
- Calcified Pericardium: **In 20 % of CP**
- Equalization of End-diastolic Pressures: **Also in RCM**
- Pulmonary Artery Systolic Pressure < 50 mmHg: **1/3 have PASP higher than 50 mmHg**

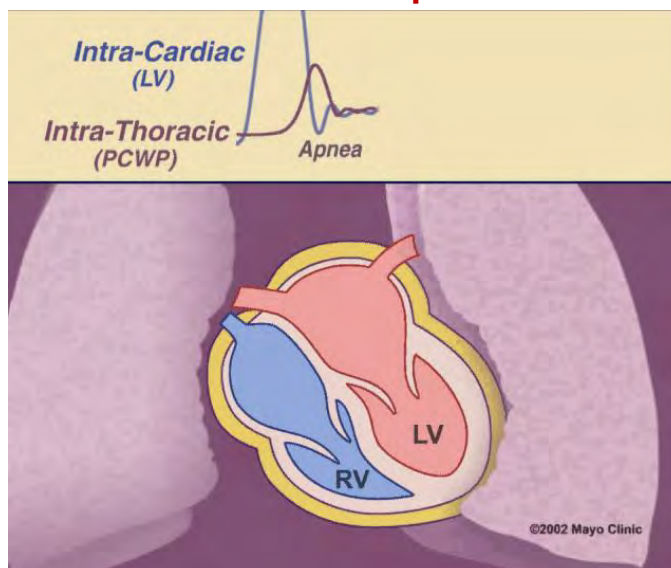
Diagnosis of constriction should be based on Characteristic HEMODYNAMICS



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## Hemodynamics in Constriction

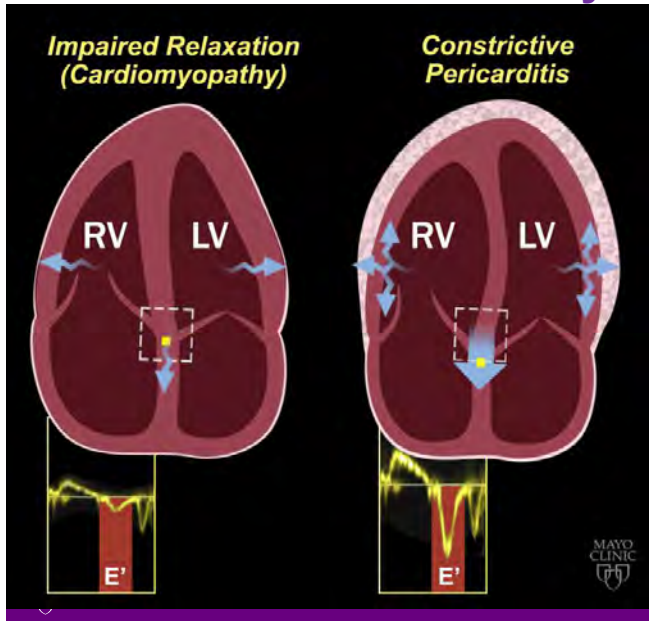
**Intracardiac pressure  $\Delta$  < intrathoracic pressure  $\Delta$**   
**Interventricular dependence**



CP1051850-19

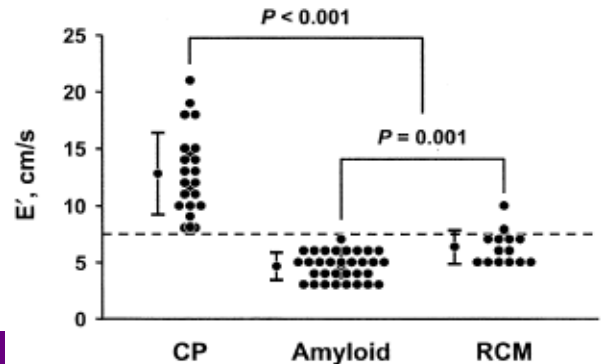


## Medial e' velocity a key in CP vs RCM



### Differentiation of Constrictive Pericarditis from Restrictive Cardiomyopathy Using Mitral Annular Velocity by Tissue Doppler Echocardiography

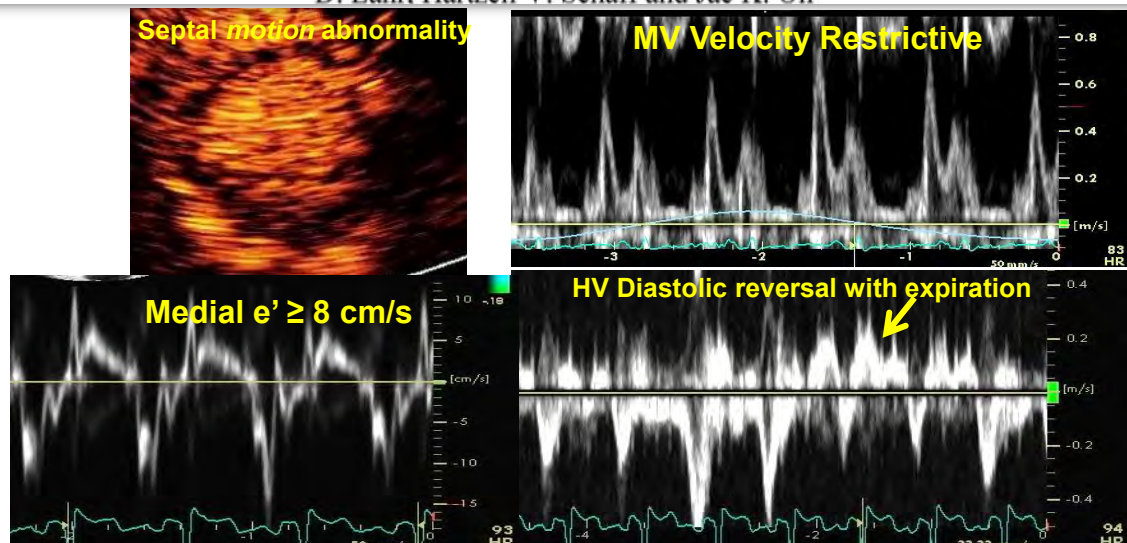
Jong-Won Ha, MD, PhD, Steve R. Ommen, MD, A. Jamil Tajik, MD, Marion E. Barnes, MSc, Naser M. Ammash, MD, Morie A. Gertz, MD, James B. Seward, MD, and Jae K. Oh, MD



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### 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



Welch et al Circ Imaging 2014



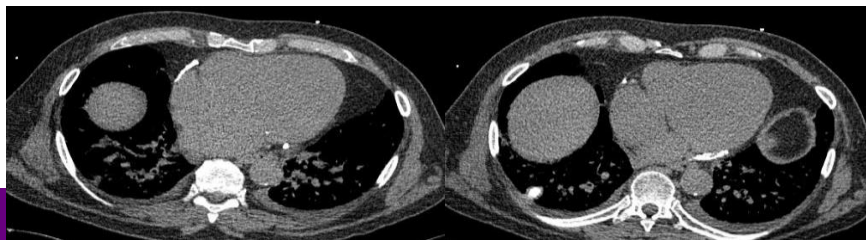
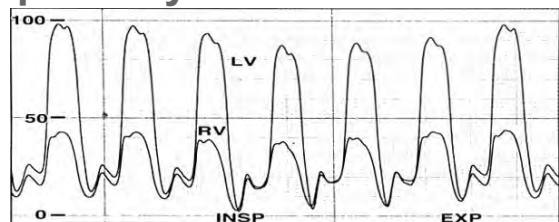
# Myocardial or Pericardial ?



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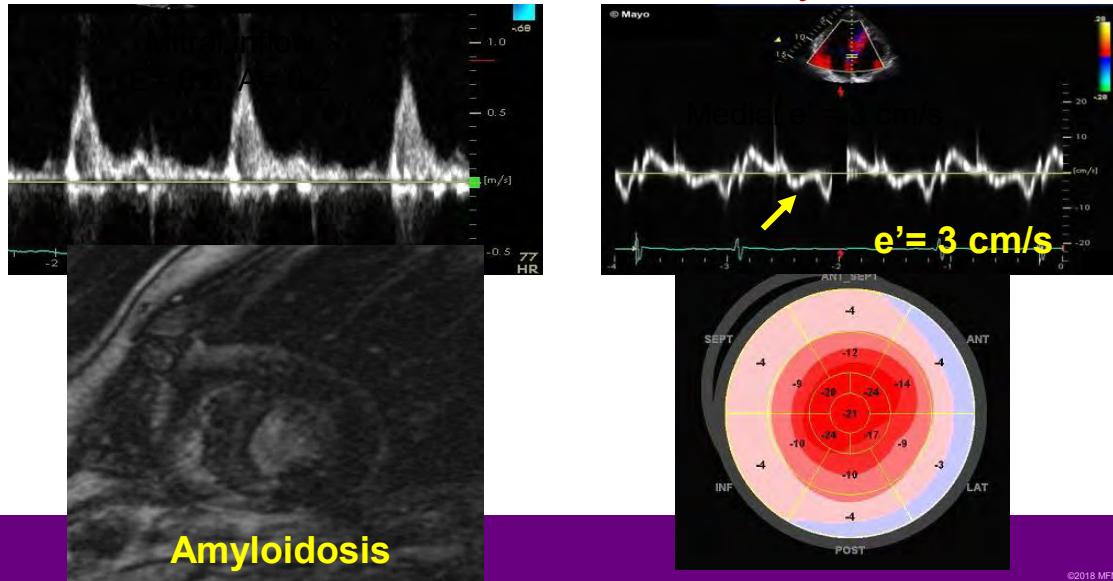
## 71 yo man with worsening dyspnea 2 years after CABG

- Physical Examination
  - JVP elevation
  - Prominent S3
  - Peripheral edema
- Cardiac Cath...Equalized end-diastolic pressures
- CT was obtained: Calcified Pericardium



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## 71 year old man with calcified pericardium Referred for Pericardiectomy



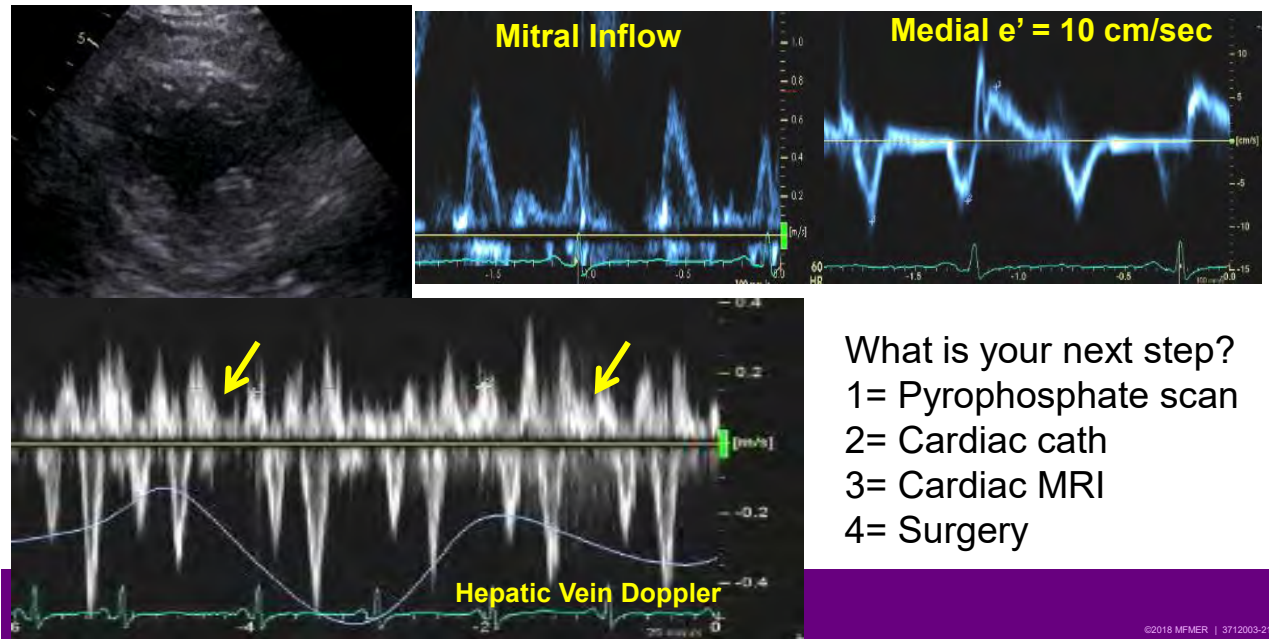
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## 70 year old man with HF referred to Cardiomyopathy Clinic

- 2 months history of increasing dyspnea and fluid retention
- Pleural effusion : Treated with thoracentesis
- Abnormal light chain with increased kappa
- Family history of Myeloma and Amyloidosis
- Cardiac catheterization : Normal coronaries
  - LVEDP = 28, PA = 41/21, PAWP = 23, RV = 38/13 , CI = 1.9



## 70 year old man with heart failure with preserved LVEF

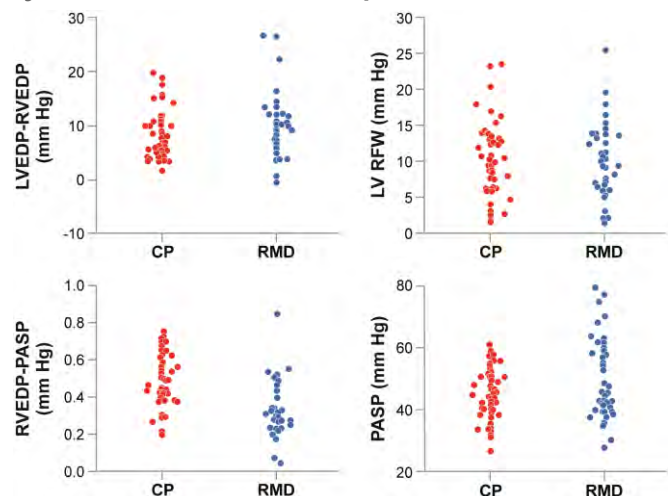


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## Constriction vs Restrictive Myocardial Disease

### Traditional Hemodynamic Data Comparison

- Equalization LV/RV End-diastolic pressure
- Pulmonary artery systolic pressure (PASP)  $\leq 50$  mmHg
- RVEDP / PASP  $\geq 1/3$

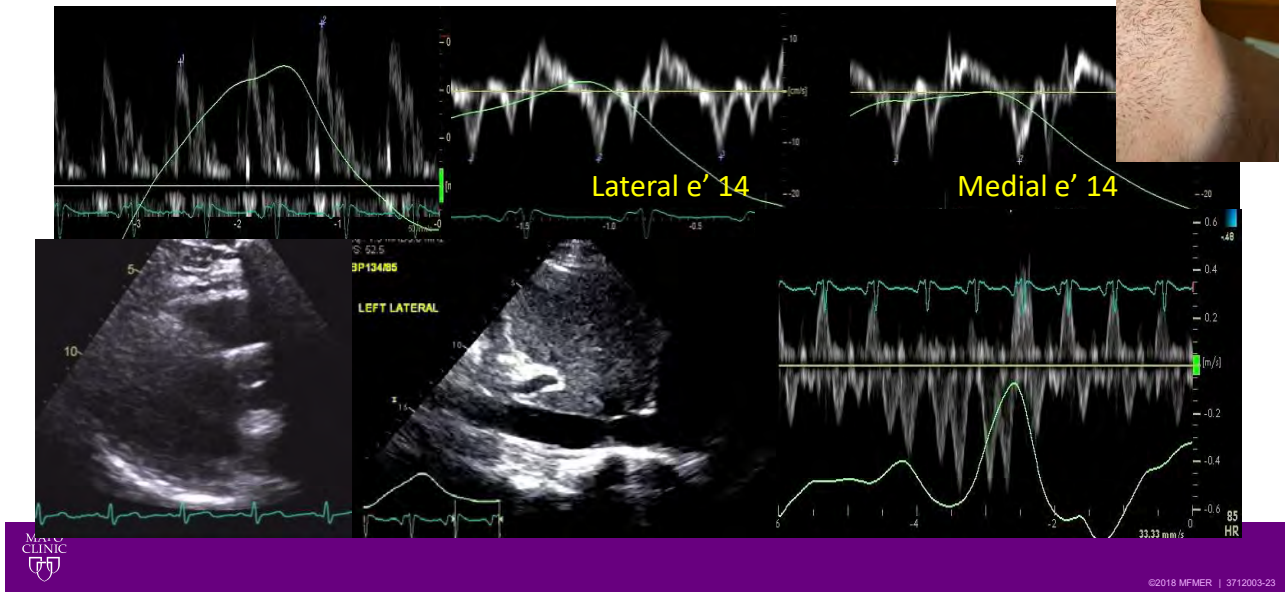


Vaitkus and Kussmaul AHJ 1991

Talreja , Nishimura et al. JACC 2008

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## 26 yo male with HF after viral illness



## Right and left heart catheterization No Constriction !

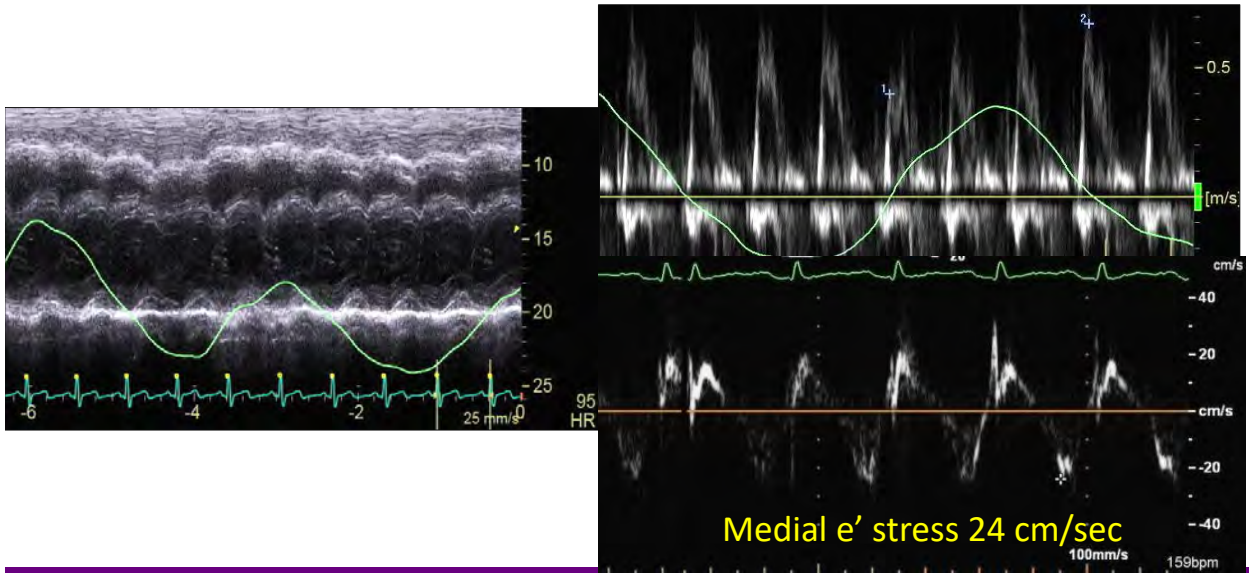
### FINAL DIAGNOSIS

1. Mildly elevated multichamber diastolic pressures
2. Normal dominant left coronary artery
3. 2500cc saline bolus administered

	RA	RV	PA	LV	PCWP
Rest	11	30/7, 16	25/14/19		12
After 2.5 L saline		29/10, 16		124/8, 18	13

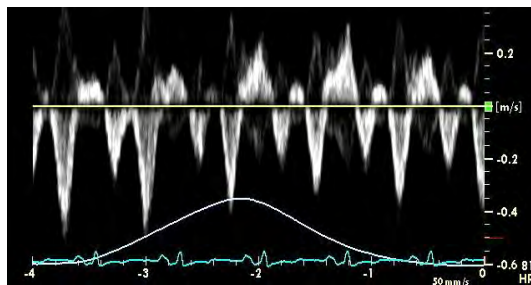


## Exercise Echocardiography in Constriction

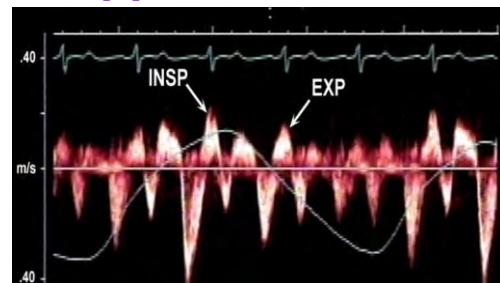


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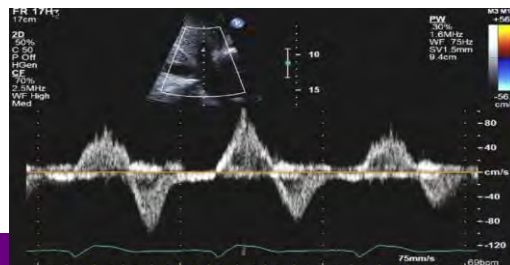
## Hepatic Vein Doppler



Constriction



Myocardial Disease



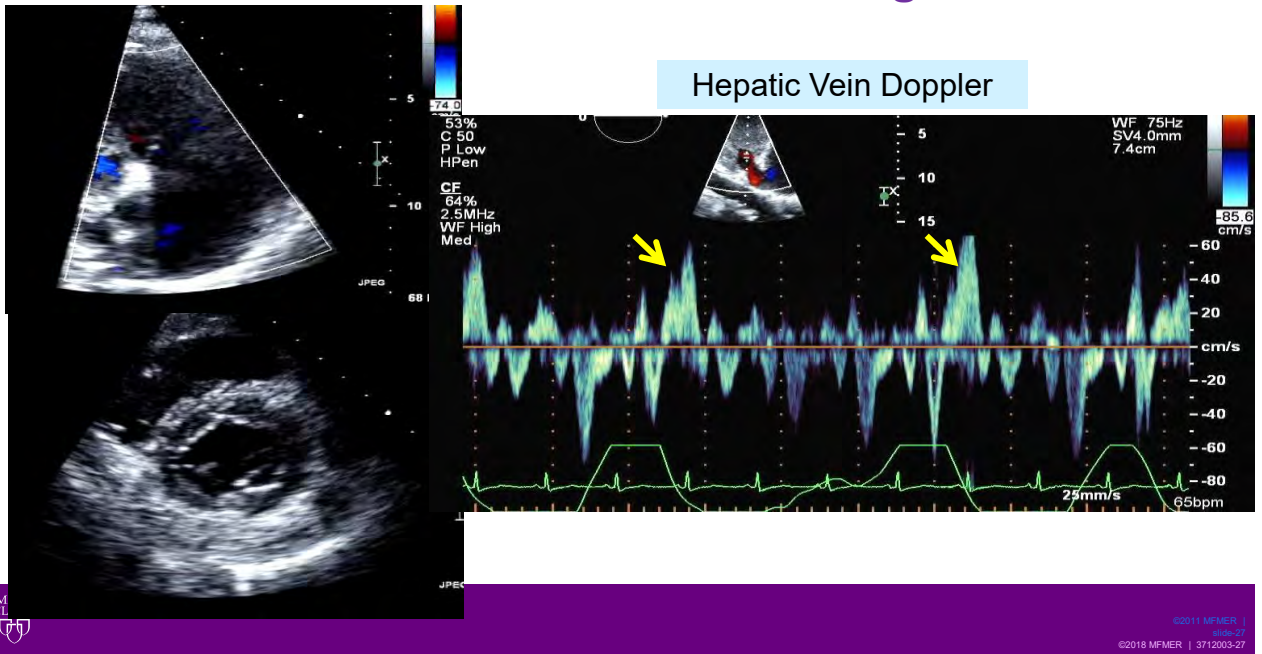
Severe TR



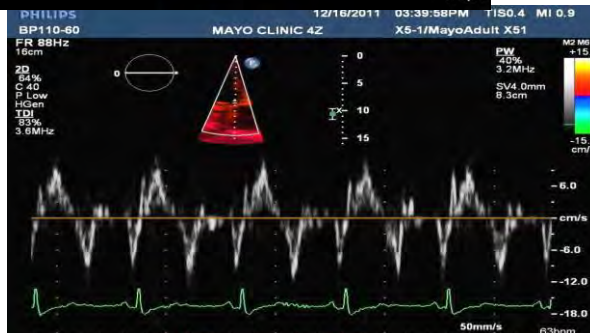
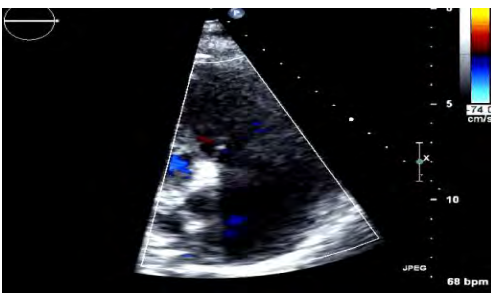
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## Heart failure with ascites and leg edema

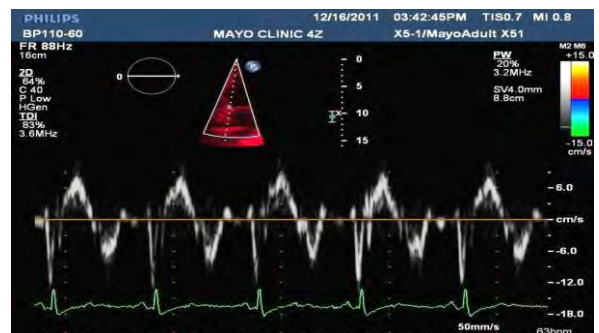
### Hepatic Vein Doppler



### Annulus Reversus Severe TR and CP

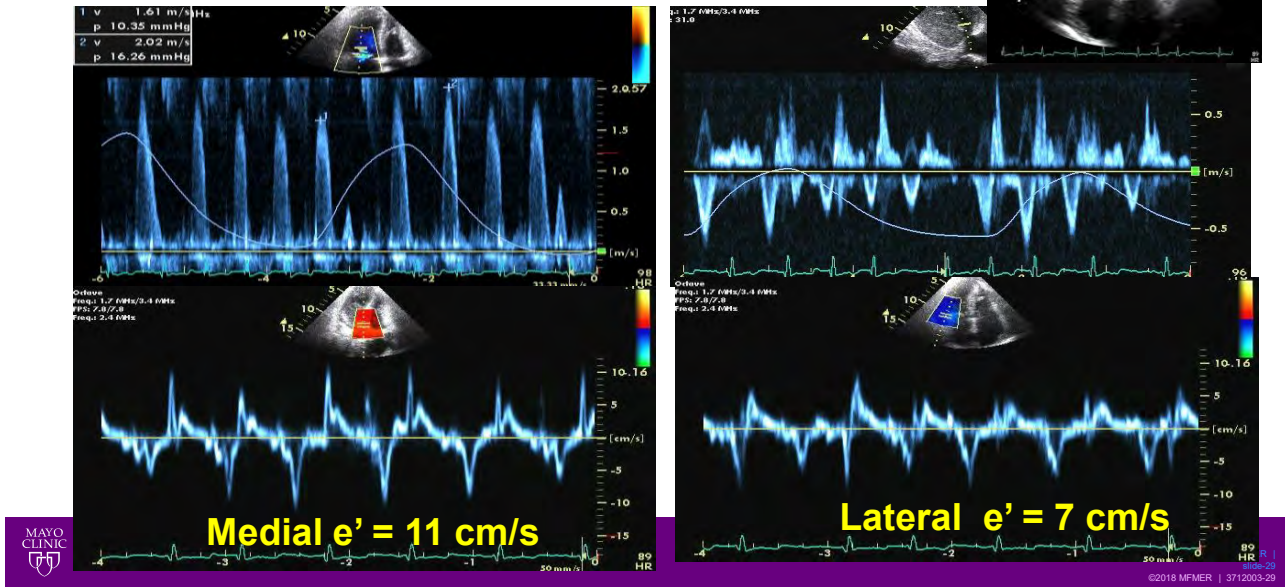


Medial  $e' = 12$  cm/sec

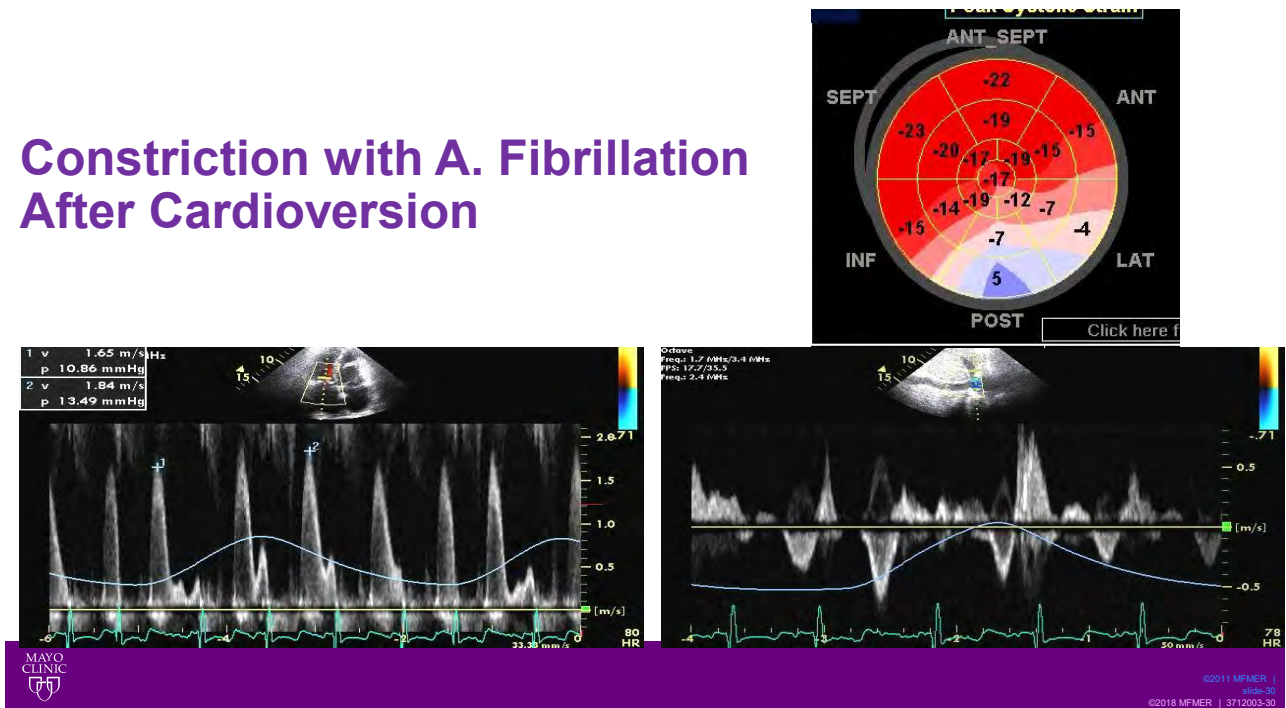


Lateral  $e' = 9$  c/sec

## Constriction with Atrial Fibrillation



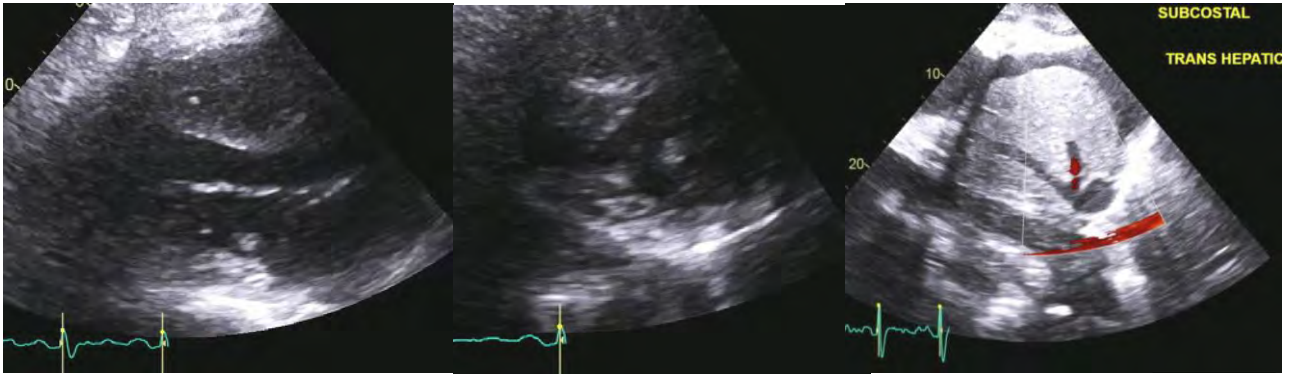
## Constriction with A. Fibrillation After Cardioversion





## 33 yo male with morbid obesity BMI 76

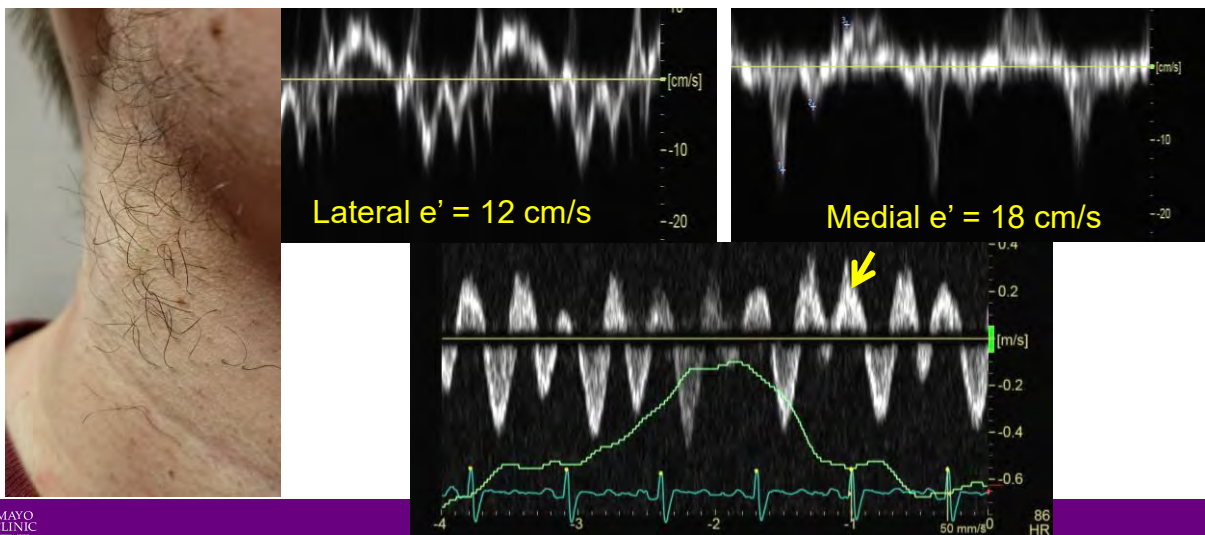
Referred from Lymphedema Clinic



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## 33 yo male with morbid obesity BMI 76 (550 lbs)

Referred from Lymphedema Clinic



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## Pure vs Mixed Constriction

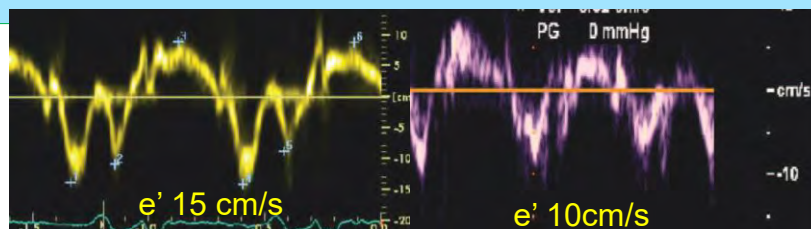


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### Mitral and Tricuspid Annular Velocities Before and After Pericardiectomy in Patients With Constrictive Pericarditis

Gabriella Veress, MD; Lieng H. Ling, MD; Kye-Hun Kim, MD, PhD; Jacob P. Dal-Bianco, MD; Hartzell V. Schaff, MD; Raul E. Espinosa, MD; Rowlens M. Melduni, MD; Jamil A. Tajik, MD; Thoralf M. Sundt, III, MD; Jae K. Oh, MD

	Primary CP	Secondary CP	Primary CP	Secondary CP
	Baseline		Post Pericardiectomy	
Medial e'	14.6 ± 3.4	10.3 ± 3.5	9.0 ± 2.9	7.0 ± 2.0
Lateral e'	12.8 ± 3.8	10.3 ± 2.8	10.0 ± 3.0	7.6 ± 2.0



Veress et al. Circulation CV Imaging July 2011

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## Constrictive Pericarditis in 26 Patients With Histologically Normal Pericardial Thickness

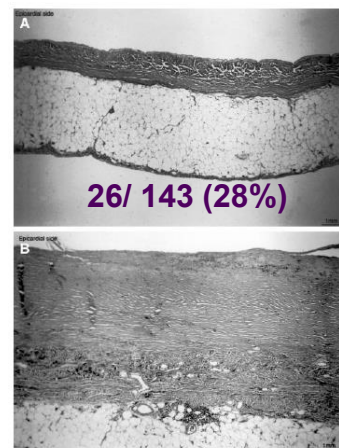
Deepak R. Talreja, MD; William D. Edwards, MD; Gordon K. Danielson, MD;  
Hartzell V. Schaff, MD; A. Jamil Tajik, MD; Henry D. Tazelaar, MD;  
Jerome F. Breen, MD; Jae K. Oh, MD

**Background**—Traditionally, increased pericardial thickness has been considered an essential diagnostic feature of constrictive pericarditis. Although constriction with a normal-thickness pericardium has been demonstrated clinically by noninvasive imaging, the details of cliniconathological correlates have not been described.

**Pericardium was of normal thickness ( $\leq 2$  mm) in 18% and this group was mostly from cardiac surgery, radiation and previous MI with same hemodynamics.**

absence of increased thickness.

**Conclusions**—Pericardial thickness was not increased in 18% of patients with surgically proven constrictive pericarditis, although the histopathological appearance was focally abnormal in all cases. When clinical, echocardiographic, or invasive hemodynamic features indicate constriction in patients with heart failure, pericardiectomy should not be denied on the basis of normal thickness as demonstrated by noninvasive imaging. (*Circulation*. 2003;108:1852-1857.)



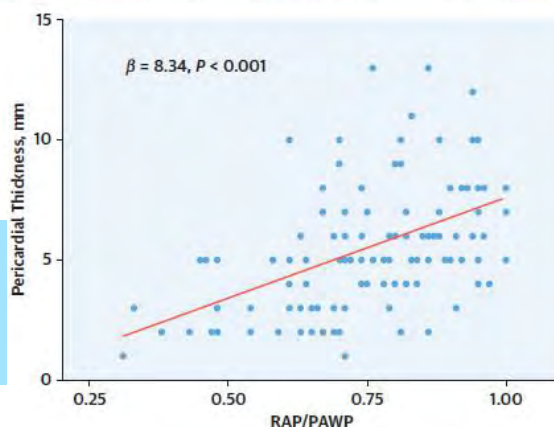
Talreja , Oh et al. *Circulation* 2003

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## Right Atrial/Pulmonary Arterial Wedge Pressure Ratio in Primary and Mixed Constrictive Pericarditis

Jeong Hoon Yang, MD,<sup>a,b</sup> William R. Miranda, MD,<sup>a</sup> Barry A. Borlaug, MD,<sup>a</sup> Rick A. Nishimura, MD,<sup>a</sup>  
Hartzell V. Schaff, MD,<sup>c</sup> Kevin L. Greason, MD,<sup>c</sup> Joseph J. Maleszewski, MD,<sup>d</sup> Jae K. Oh, MD<sup>a,b</sup>

**RAP/PAWP is lower in patients with relatively normal pericardial thickness**

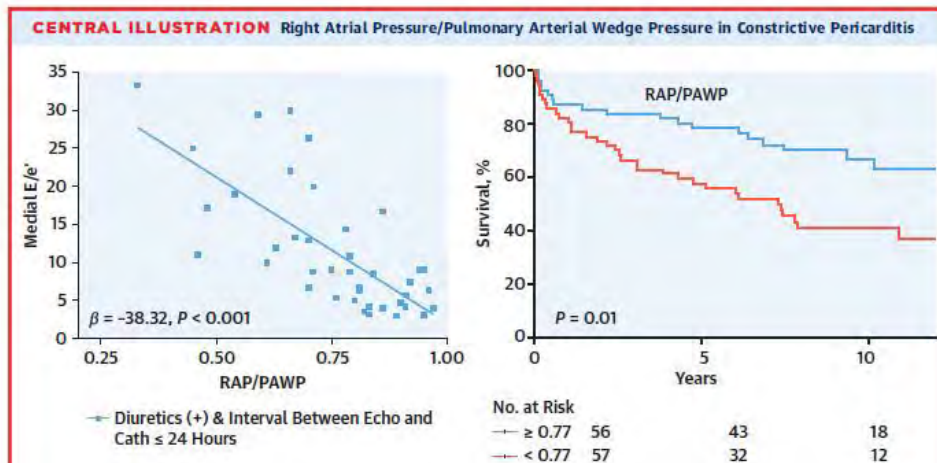


Yang JH et al. *JACC* 2019

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## Right Atrial/Pulmonary Arterial Wedge Pressure Ratio in Primary and Mixed Constrictive Pericarditis

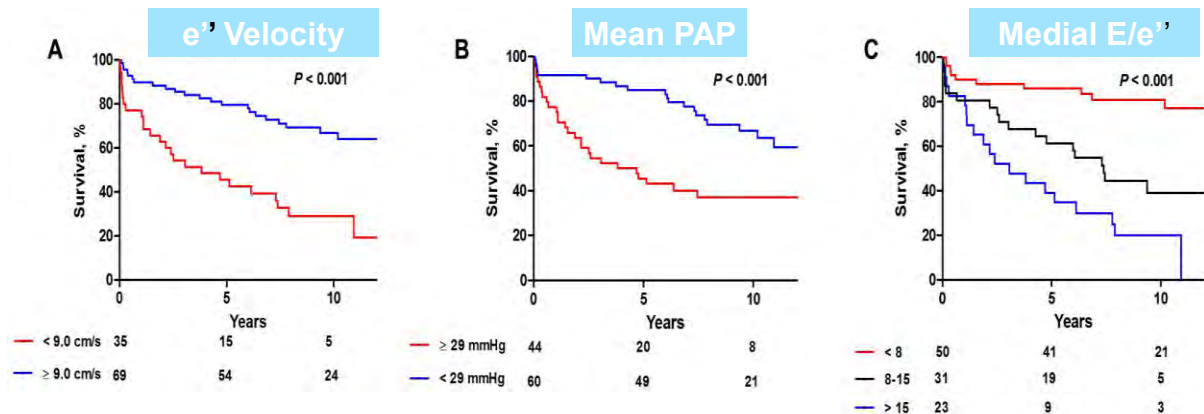
Jeong Hoon Yang, MD,<sup>a,b</sup> William R. Miranda, MD,<sup>a</sup> Barry A. Borlaug, MD,<sup>a</sup> Rick A. Nishimura, MD,<sup>a</sup> Hartzell V. Schaff, MD,<sup>c</sup> Kevin L. Greason, MD,<sup>c</sup> Joseph J. Maleszewski, MD,<sup>d</sup> Jae K. Oh, MD<sup>a,b</sup>



Yang JH et al. JACC 2019

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## Survival after Pericardiectomy Predictors : Medial e' , PAP, and E/e'



Yang, Miranda, Oh et al. Submitted

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THE LANCET

[SEPT. 7, 1935]

## ADDRESSES AND ORIGINAL ARTICLES

CHRONIC CONSTRICTIVE PERICARDITIS  
(PICK'S DISEASE)

TREATED BY PERICARDIAL RESECTION\*

BY PAUL D. WHITE, M.D. Harvard  
FROM THE MASSACHUSETTS GENERAL HOSPITAL, BOSTON, MASS.

The establishment of the diagnosis of chronic constrictive pericarditis has a three-fold importance: (1) it affords the explanation of a group of symptoms and signs in an obscure case; (2) it obviates confusion

The establishment of the diagnosis of CP has a three-fold importance



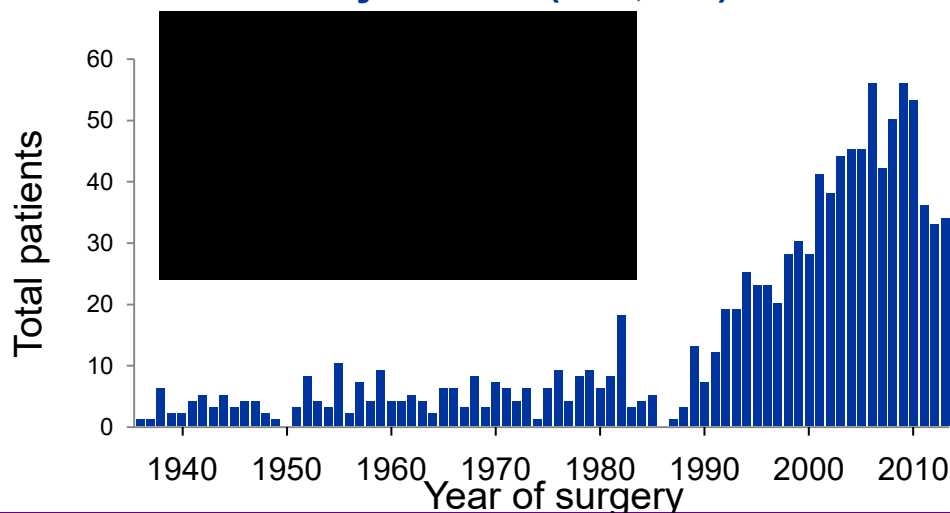
1. It affords the explanation of a group of symptoms and signs
2. It obviates confusion with other conditions
3. Expert thoracic surgery may now lead to cure what was once a hopeless disease



P.D. White The Lancet 1935

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## Pericardiectomy for Constrictive Pericarditis Mayo Clinic (n=1,066)



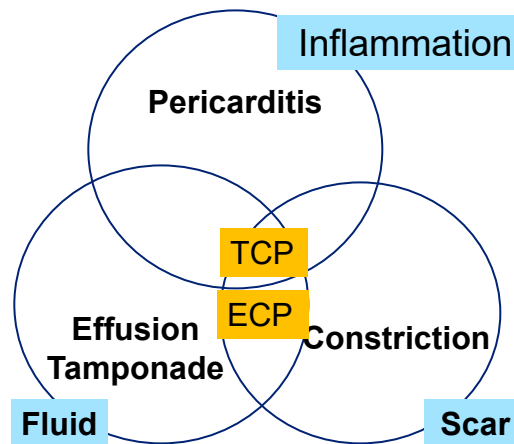
Murashita, Schaff, Greason et al Ann Thorac Surg 2017

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## Tamponade to Constriction: Summary

### Non-invasive Hemodynamics



- A spectrum of disease
- Tamponade and Constriction diagnosed by Echo hemodynamics
- Mitral inflow pattern can predict effusive constrictive pericarditis
- Effusive CP
  - 10-20% after Tap
  - Medical Rx possible
- Non-invasive hemodynamic assessment can be more reliable than invasive hemodynamics



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## Pericardial Diseases Team

### Department of CV Diseases

#### Cardiology

- Nandan Anavekar, MD
- Raul Espinosa, MD
- Sharonne Hayes, MD
- Garvan Kane, MD
- Allen Luis, MD
- Rowlen Melduni, MD
- William Miranda, MD
- Jae Oh, MD

#### Cardiac Surgery

- Kevin Greason, MD
- Hartzell Schaff, MD
- Joseph Dearani, MD
- John Stulak, MD
- Rocky Daily, MD

#### Cardiac Pathology

- Joseph Maleszewski, MD

#### Rheumatology

- Eric Matteson, MD
- Kevin Moder, MD

#### Imaging

- Eric Williamson, MD
- Phillip Young, MD
- James Glockner, MD
- CV Echo Lab

#### Fellows (Old and Current)

- JW Ha, MD
- Michel Senni, MD
- Gabriella Veress, MD
- Lieng Ling, MD
- Smonporn Boonyaratavej, MD
- Terrence Welch, MD
- F. Syed, MD, KH Kim, MD
- Dali Feng, MD J. Haley, MD
- D. Talreja, MD C. Tei, MD
- WM Soo, MD JH Yang, MD
- J. Dal-Bianco, MD G. Achyraya, MD

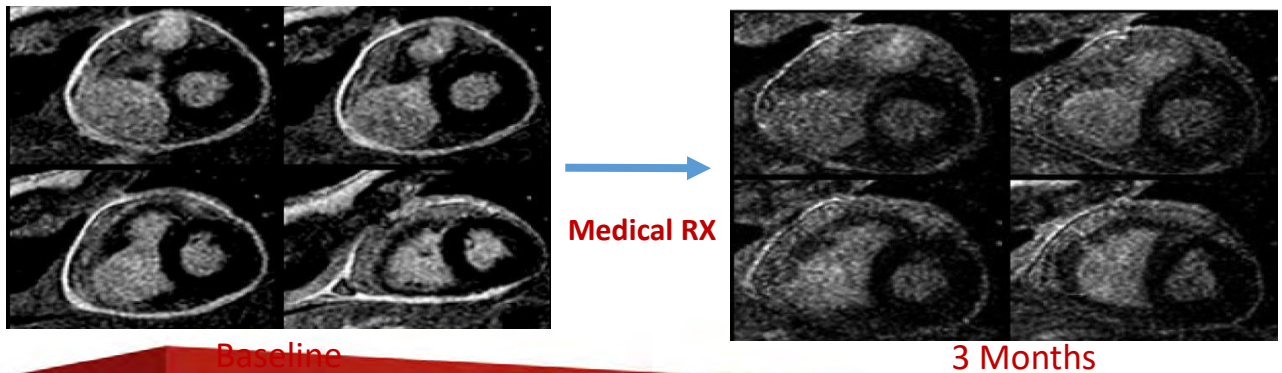


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# Cardiac Magnetic Resonance Imaging Pericardial Late Gadolinium Enhancement and Elevated Inflammatory Markers Can Predict the Reversibility of Constrictive Pericarditis After Antiinflammatory Medical Therapy

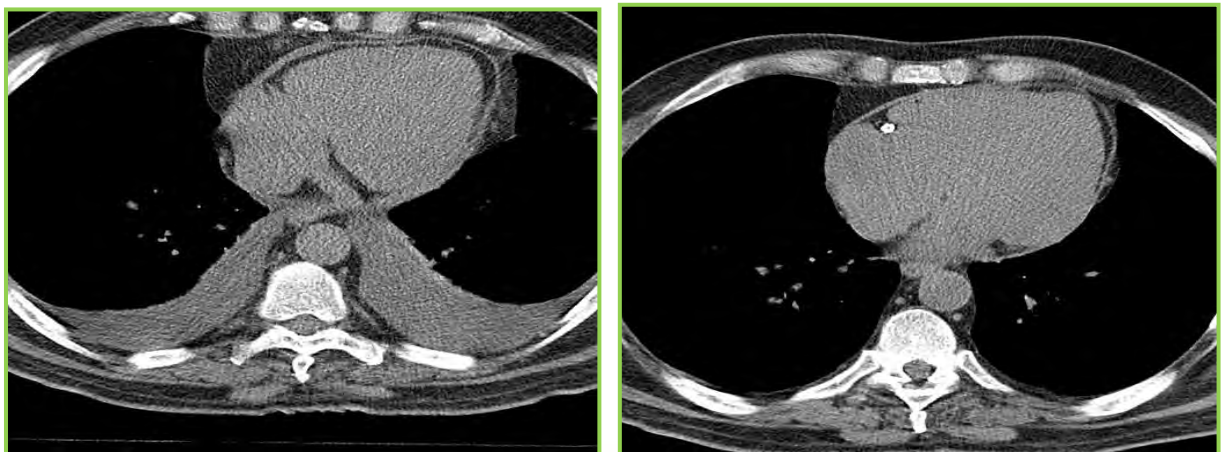
## A Pilot Study

DaLi Feng, MD; James Glockner, MD, PhD; Kye-hun 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



Circulation Oct 3<sup>rd</sup> 2011

## Transient Constrictive Pericarditis One week of Steroid Rx

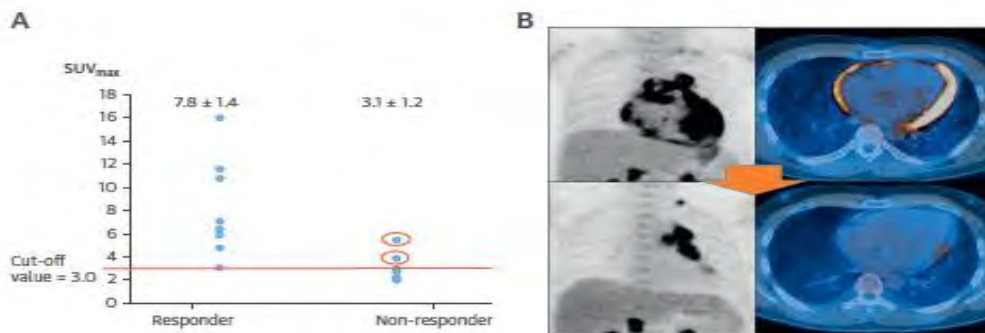


©20

# [<sup>18</sup>F]Fluorodeoxyglucose PET/CT Predicts Response to Steroid Therapy in Constrictive Pericarditis



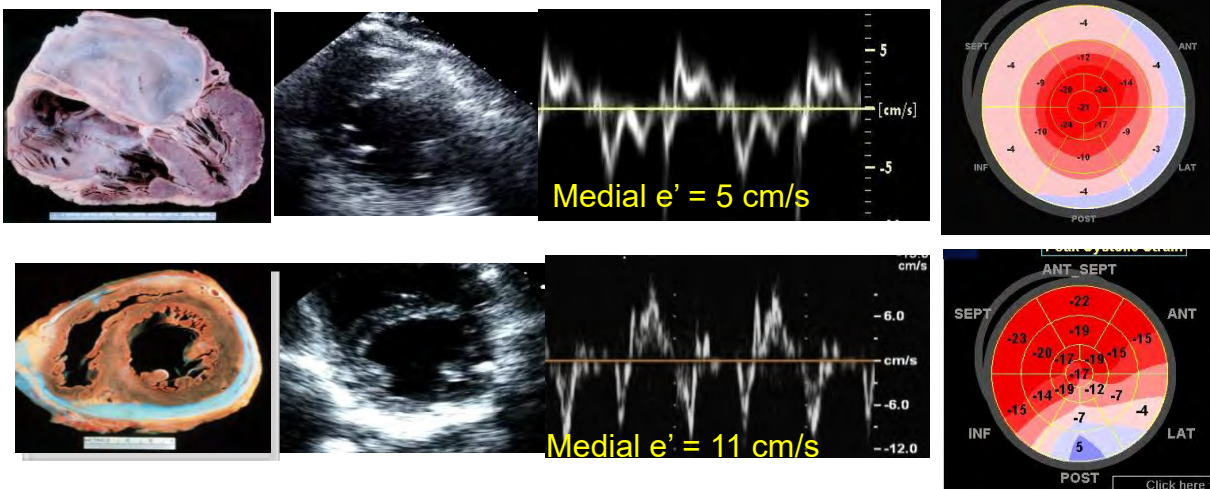
American Society of  
Echocardiography



SA Cheng, JK Oh et al JACC Feb 2017

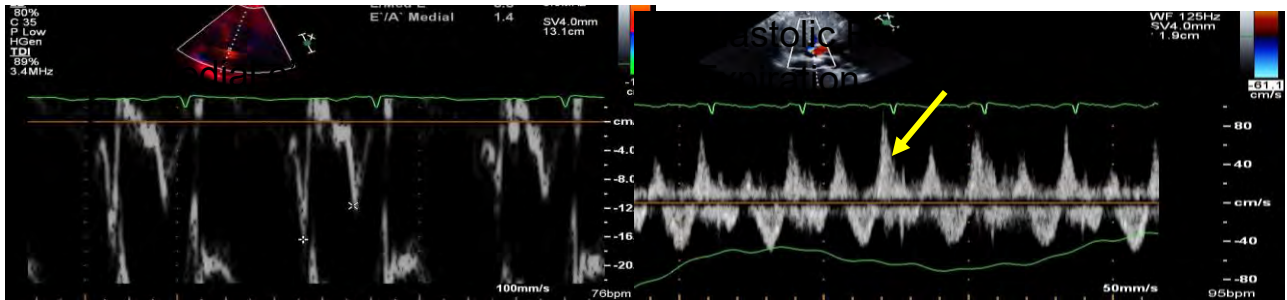
## Restriction or Constriction?

Diagnosis based on 2-D , e' and strain imaging



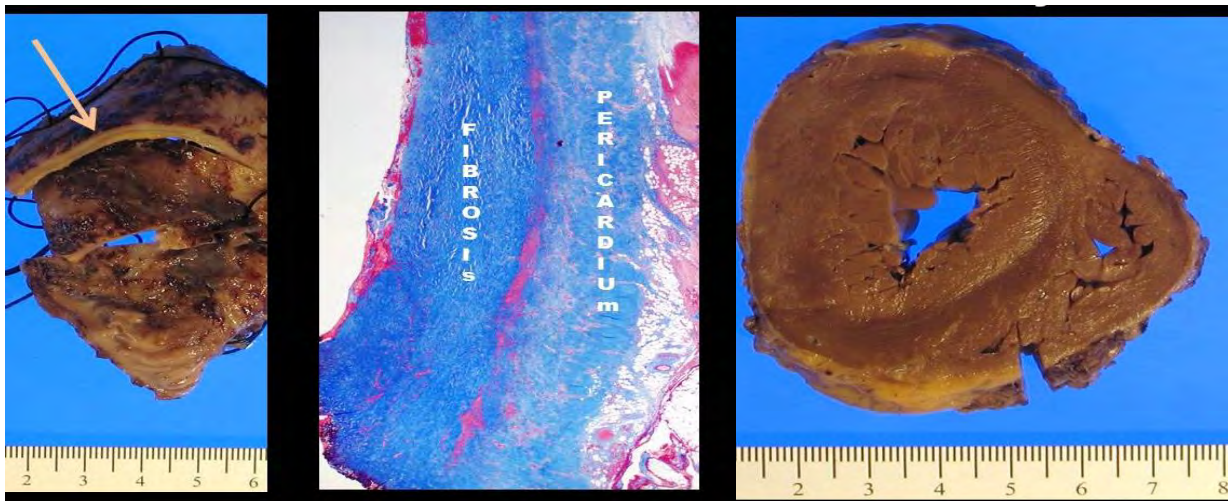


An e-mail from a junior staff at a major MC  
 52 year old man with RCM waiting for heart  
 transplantation  
 (Had Echo, MRI, and cardiac cath performed)



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## Explanted Heart

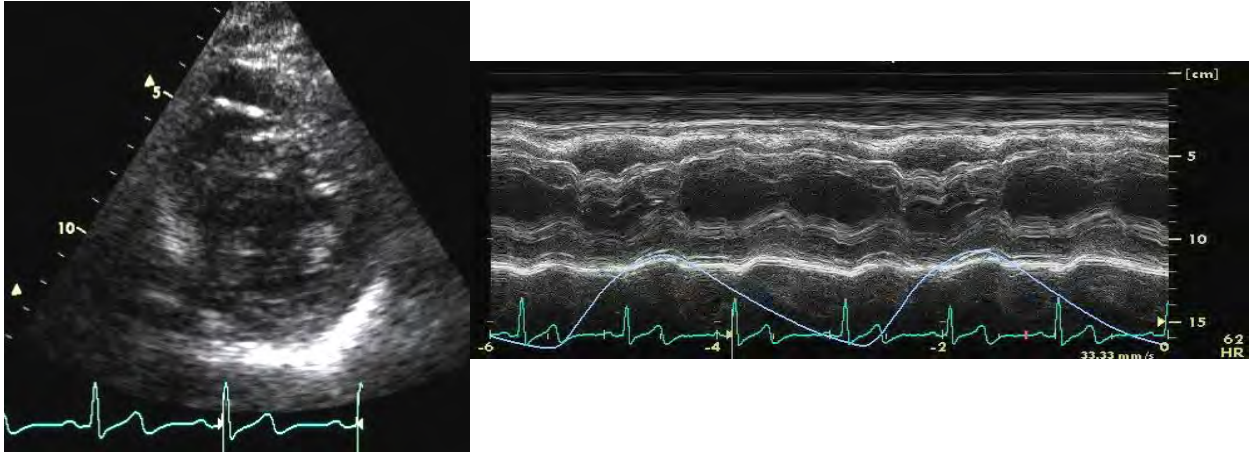


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# A 27 yo woman with Asthma

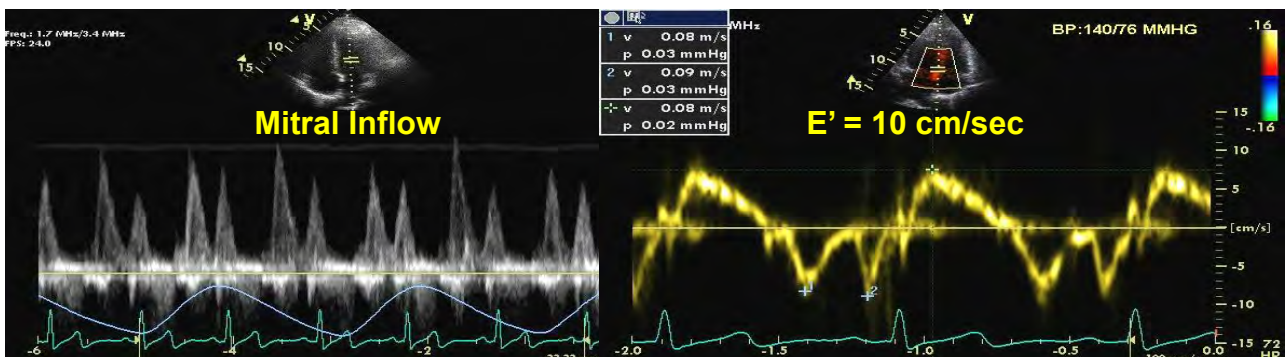
## Marked Septal Motion Abnormality



©2018 MFMR | 3712003-49

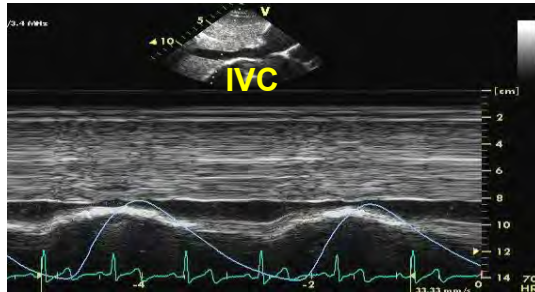
# A 27 yo woman with dyspnea

## Constrictive Pericarditis?



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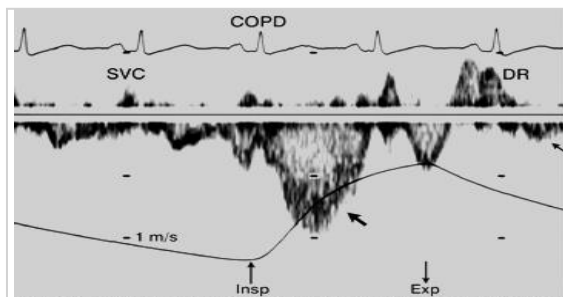
# A 27 yo woman with dyspnea Pulsus Paradoxus with Asthma



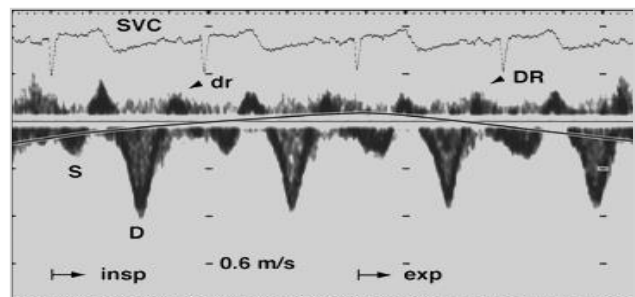
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## Constrictive vs COPD/Asthma *SVC Flow Velocities*

### COPD



### Constriction



Boonyaratavej S, et al. J Am Coll Cardiol 1998 Dec; 32 : 2043-8

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## Echo Asia 2020 in HongKong (May 22-24)

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**Contact Us**

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