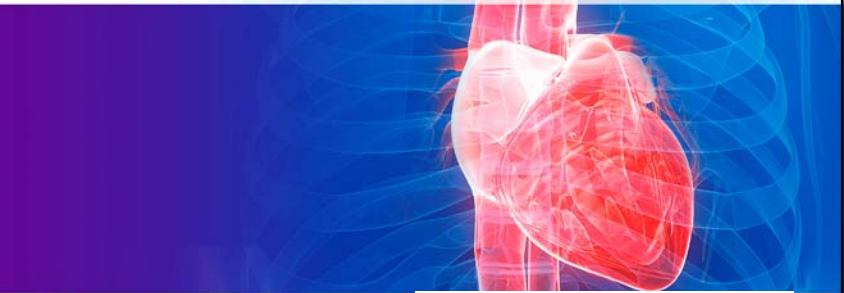




Diastolic Function Assessment

Practical Ways to Incorporate into Every Echo



Jae K. Oh, MD
Echo Hawaii 2018

©2018 MFMER | 3712003-2

Learning Objectives

My presentation will help you to

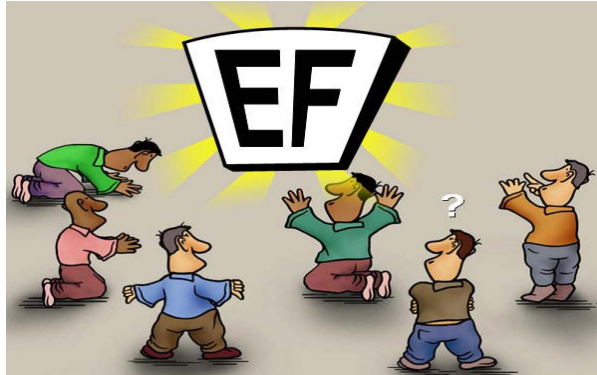
- Appreciate the importance of myocardial relaxation for satisfactory diastolic function
- Assess and Grade diastolic function
- Estimate LV filling pressure noninvasively
- Incorporate Diastolic Function assessment into every Echo
- Apply Diastolic Function Assessment in
 - *Diagnosis of HFpEF*
 - *Exercise Diastolic Test*
 - *Restrictive CM vs Constriction*



©2018 MFMER | 3712003-2

Cardiac Function

Systole and Diastole (διαστολή)



διαστολή: Greek word for dilation

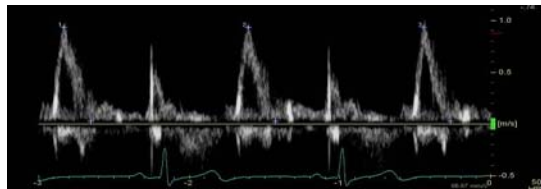
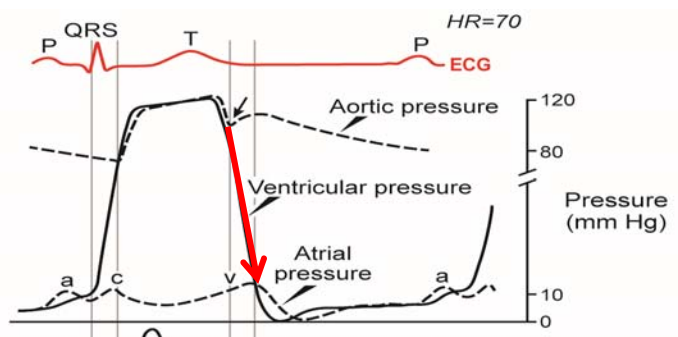
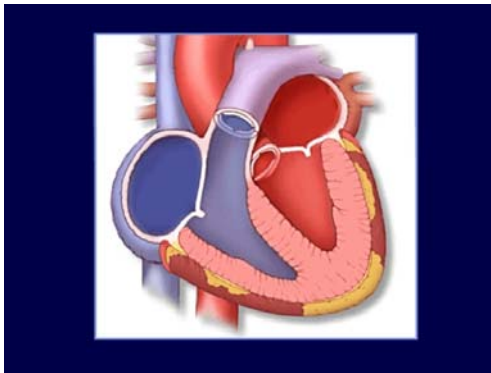


Normal diastolic function allows adequate filling of the heart without excessive increase in diastolic filling pressure at rest and with stress



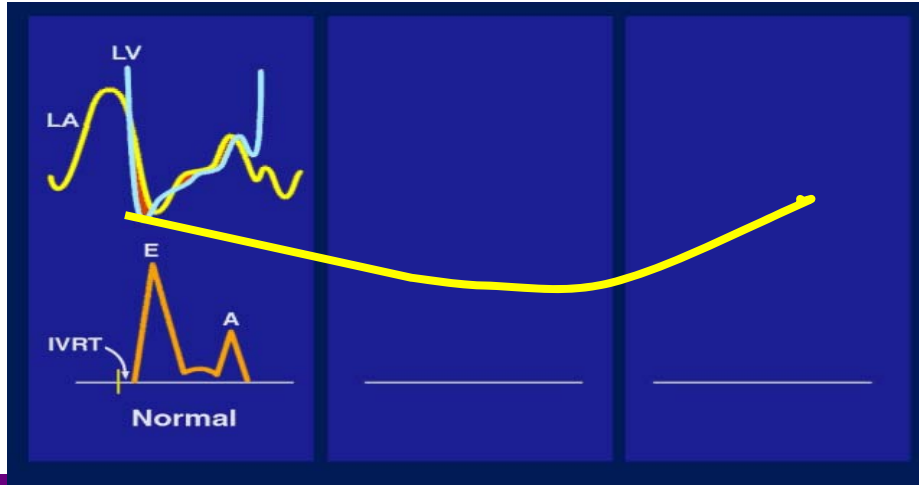
003-3

Diastolic Filling with Relaxation



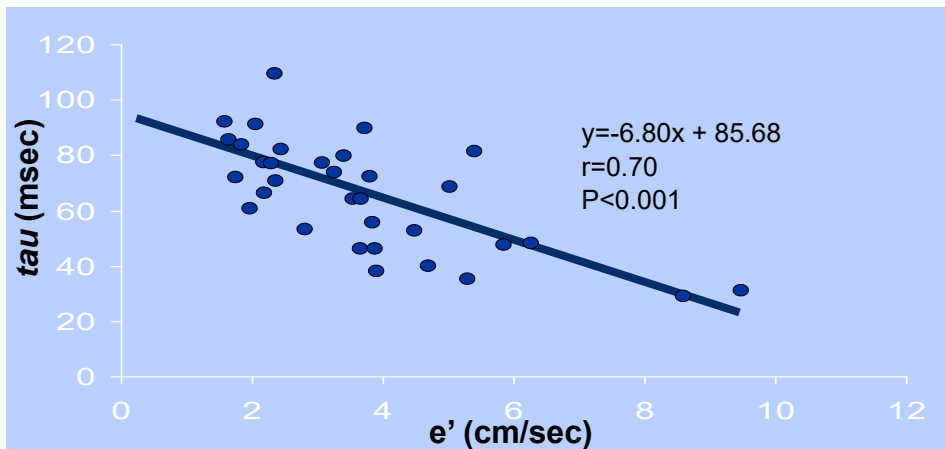
©2018 MFMER | 3712003-4

Diastolic Filling Patterns Transmitral Gradient vs Mitral Inflow



1/9/2018
©2018 MFMR | 3712003-5

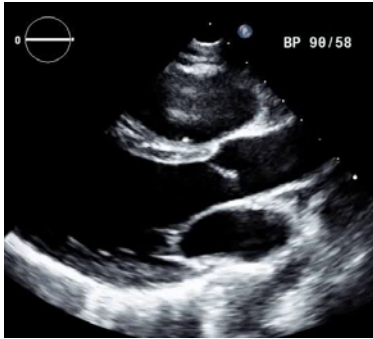
LV Relaxation by Cath and Echo τ (tau) vs e' (mitral annulus velocity)



Firstenberg et al: J Appl Physiol 90:299, 2001, Nagueh et al: JACC 1997
Oki et al: AJC 1997, Sohn et al: JACC 1997, Ommen et al: Circ 2000

©2018 MFMR | 3712003-6

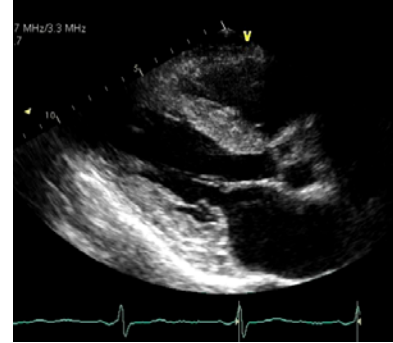
Which of following patients has the most advanced diastolic dysfunction (or impaired relaxation)?



1



2

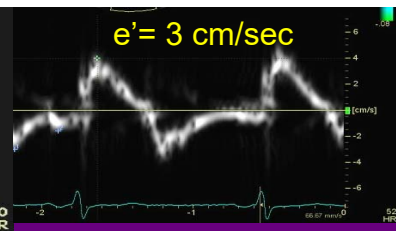
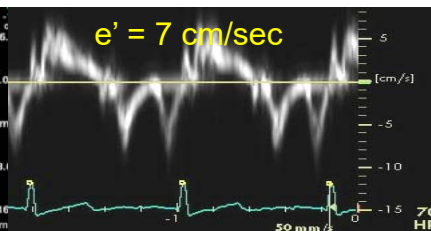
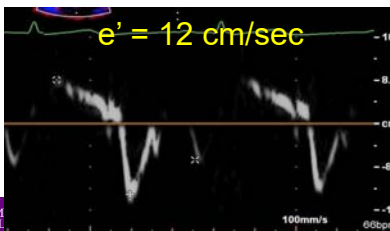
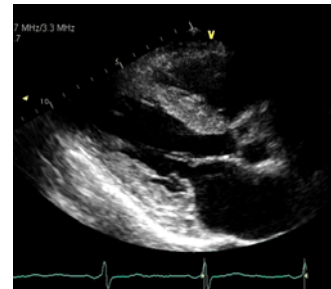


3



©2018 MFMR | 3712003-7

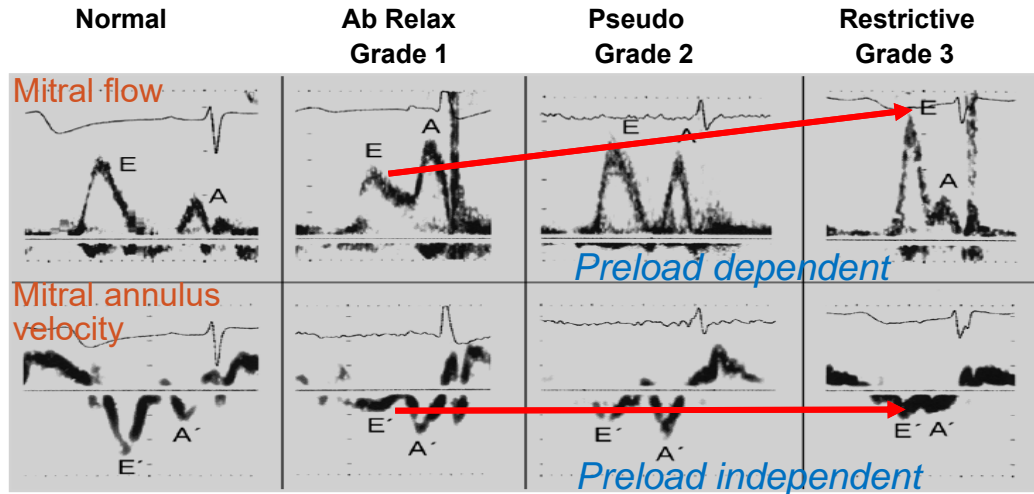
Myocardial Relaxation (e')



©2018 MFMR | 3712003-8

Evaluation of Diastolic Function

Mitral Inflow and Annulus Velocity

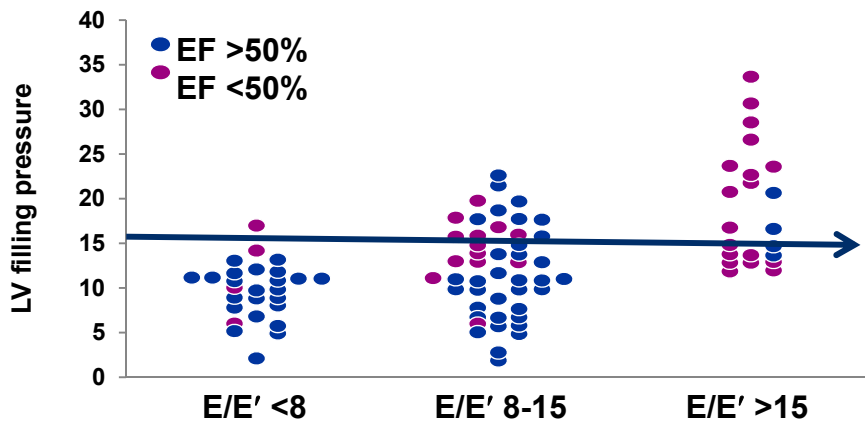


Sohn et al: JACC, 1997

©2018 MFMR | 3712003-9

Estimation of LV Filling Pressures

E/e' (Medial MV annulus)



Ommen SR et al: Circulation 102:1788, 2000

©2018 MFMR | 3712003-10

ASE/EACVI GUIDELINES AND STANDARDS

Recommendations for the Evaluation of Left Ventricular Diastolic Function by Echocardiography: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

Four Major Diagnostic Parameters Normal Values

1. E' velocity ≥ 7 (med), 10 (lat) cm/s
2. E/e' ≤ 14 (Ave), 15(Med)
3. TR velocity ≤ 2.8 m/sec
4. LAVI ≤ 34 mL/m²



JASE and EJ CV Imaging April 2016

©2018 MFMER | 3712003-11

New Criteria for Diastolic Function Assessment

In pts with normal LVEF $\geq 50\%$

- 1 – Septal e' velocity ≥ 7 cm/s or lateral e' velocity ≥ 10 cm/s
- 2 – Average E/e' ≤ 14 , 15 (Med)
- 3 – TR velocity ≤ 2.8 m/s
- 4 – LA volume index ≤ 34 mL/m²

≥ 3 Normal

2 and 2

≥ 3 Abnormal

Normal diastolic function

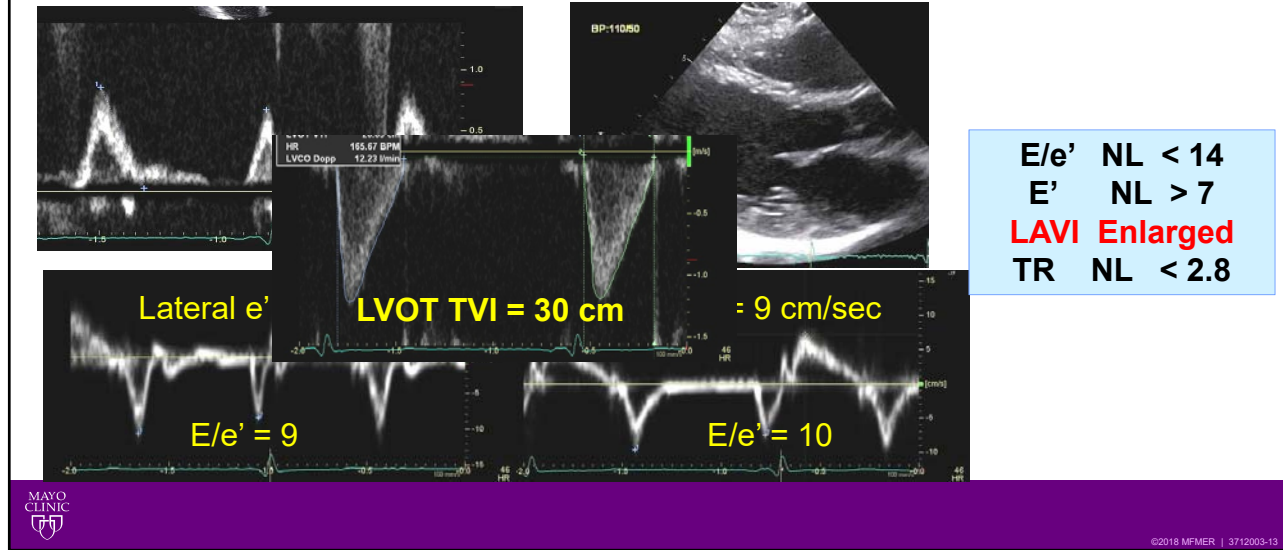
Indeterminate

Diastolic dysfunction



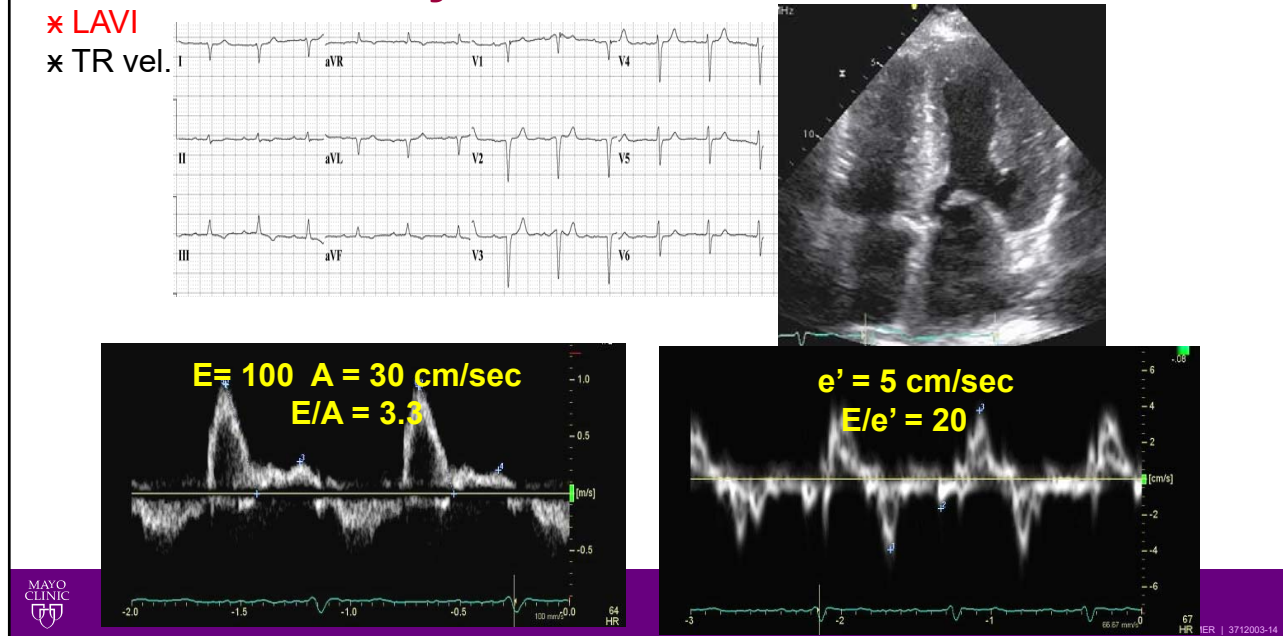
©2018 MFMER | 3712003-12

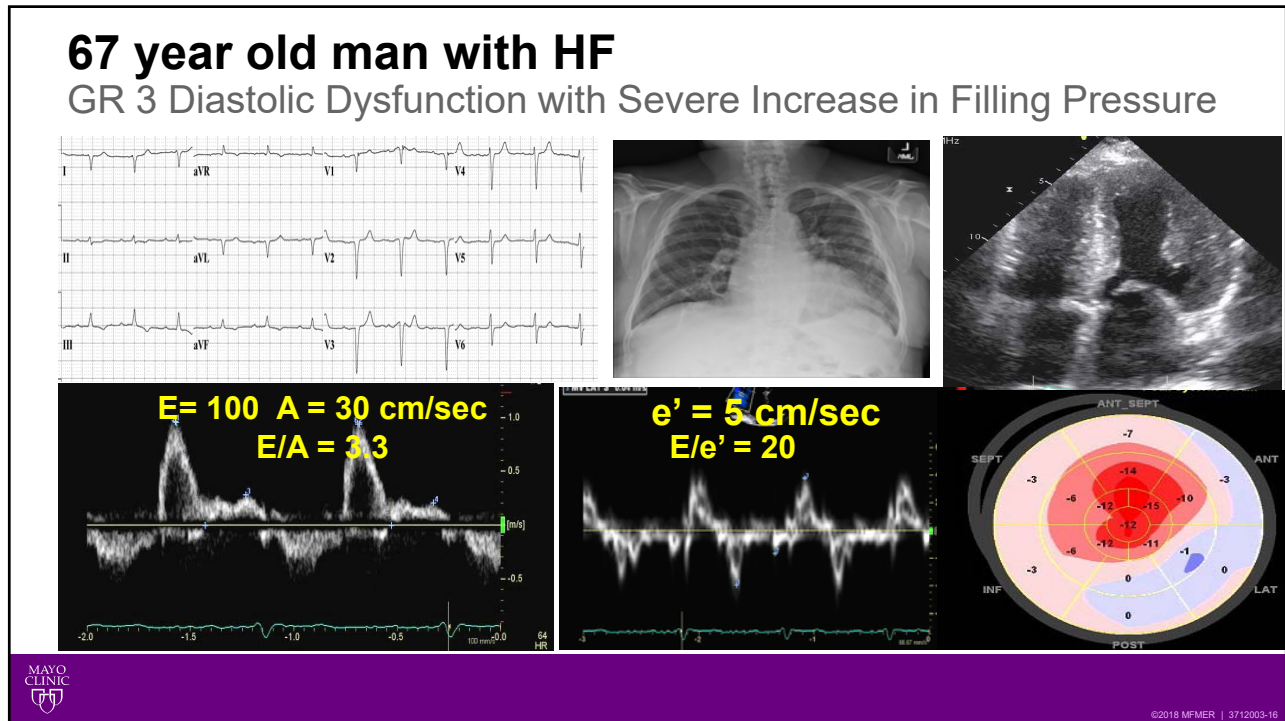
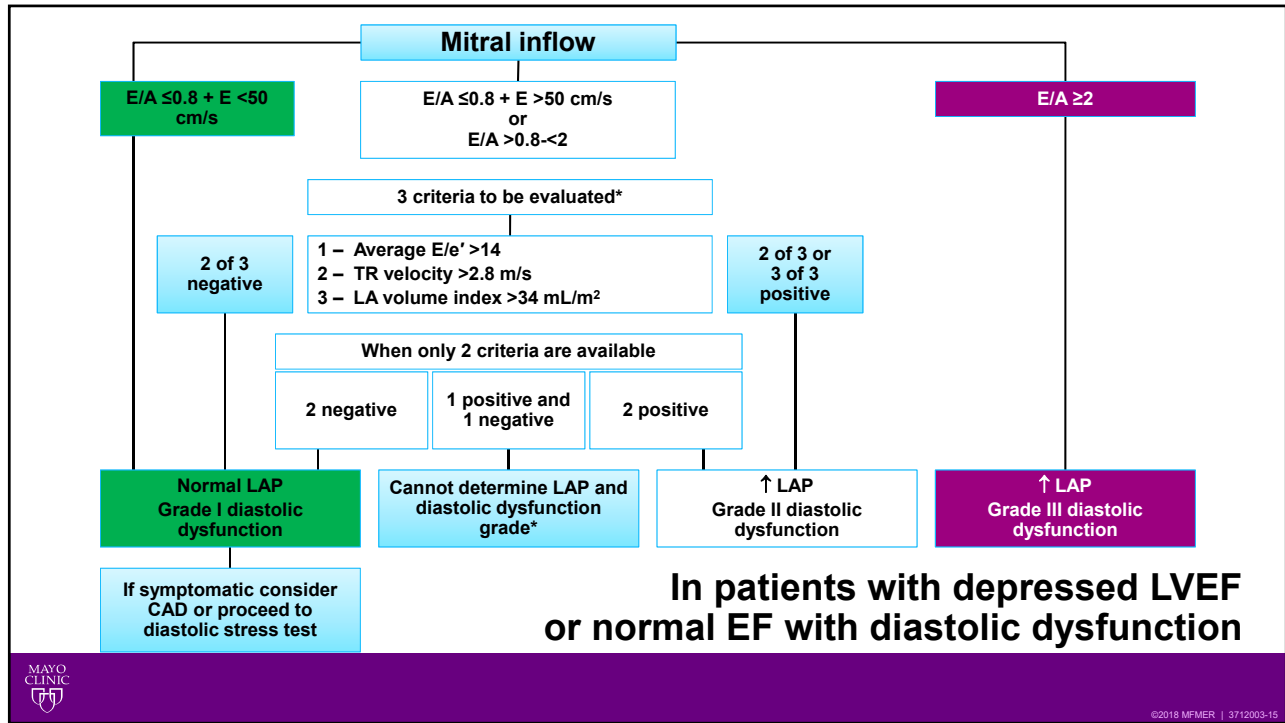
71 year old woman with HR 45 BPM & LAVI = 39 mL/m²



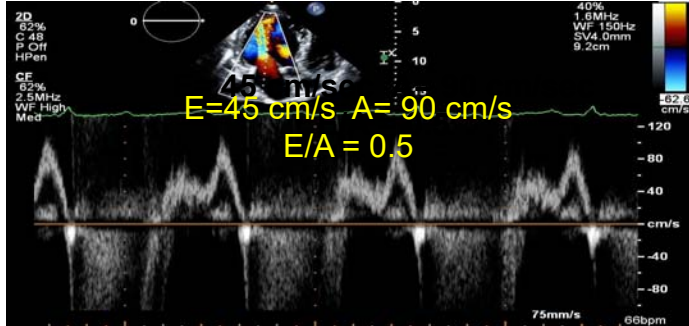
- ✗ E'
- ✗ E/e'
- ✗ LAVI
- ✗ TR vel.

67 year old man with HF





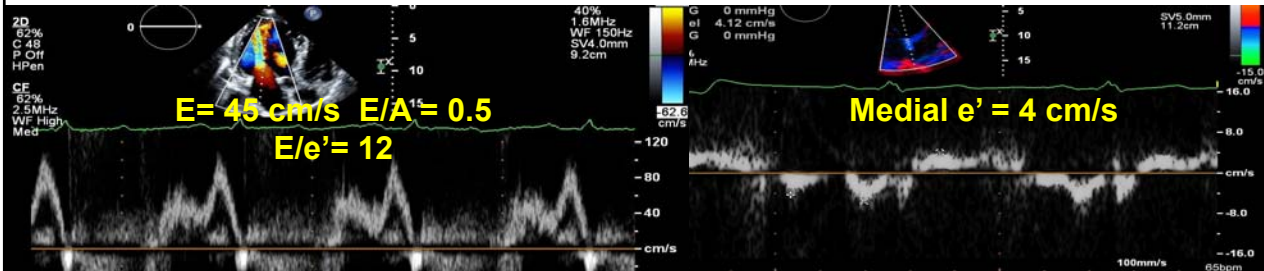
67 yo man with ischemic CM and HF
 Gr. 1 dysfunction = normal filling pressure



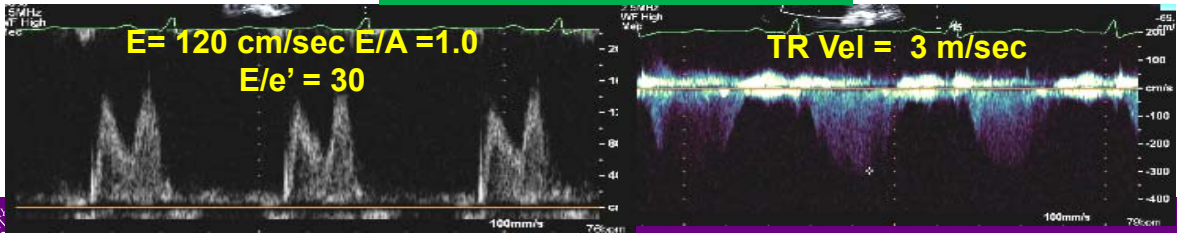
Grade 1 Dysfunction
 $E/A \leq 0.8$
 $E < 50 \text{ cm/sec}$

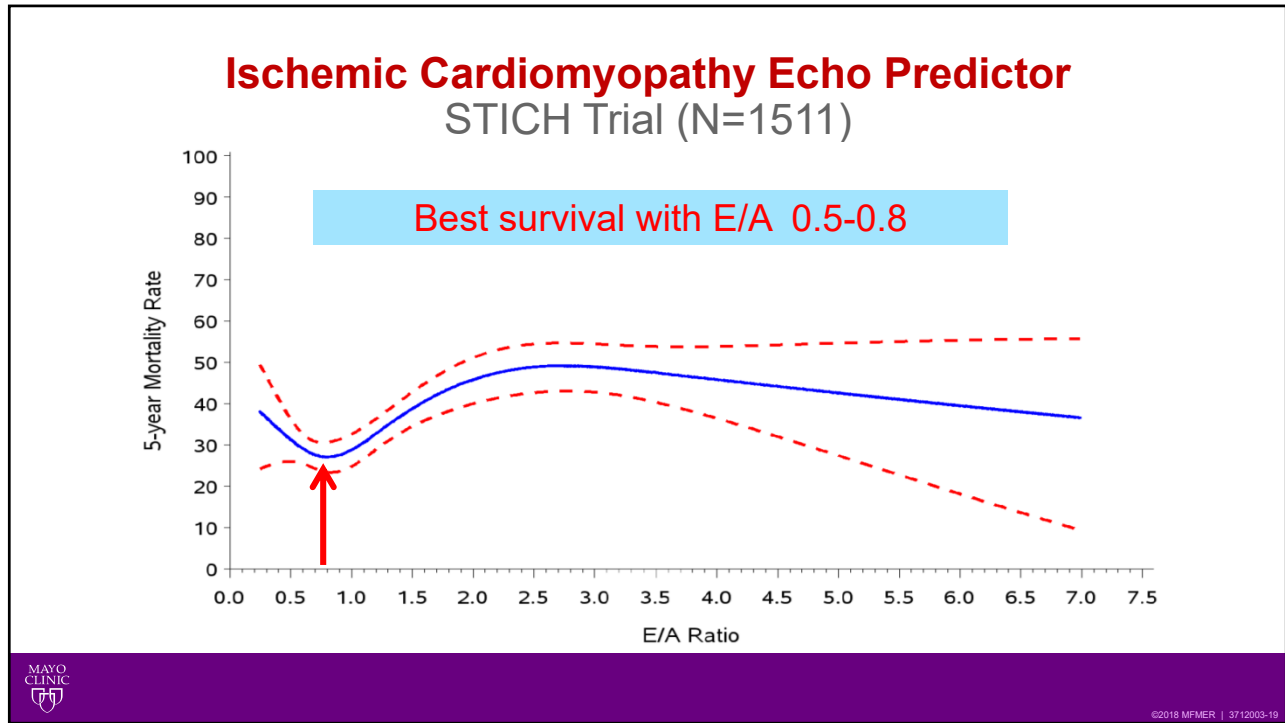


67 year old man with ischemic CM and HF



2 months before

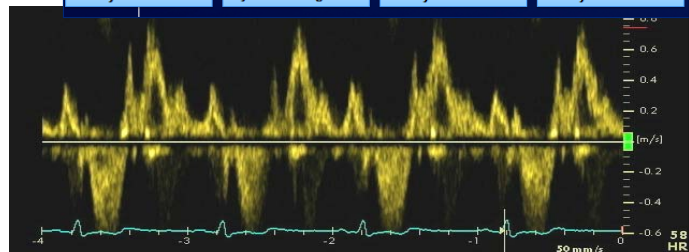
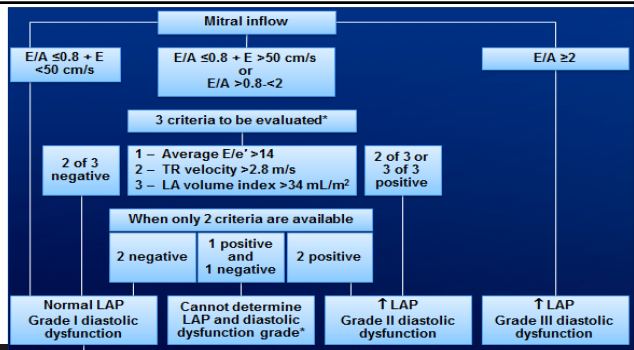




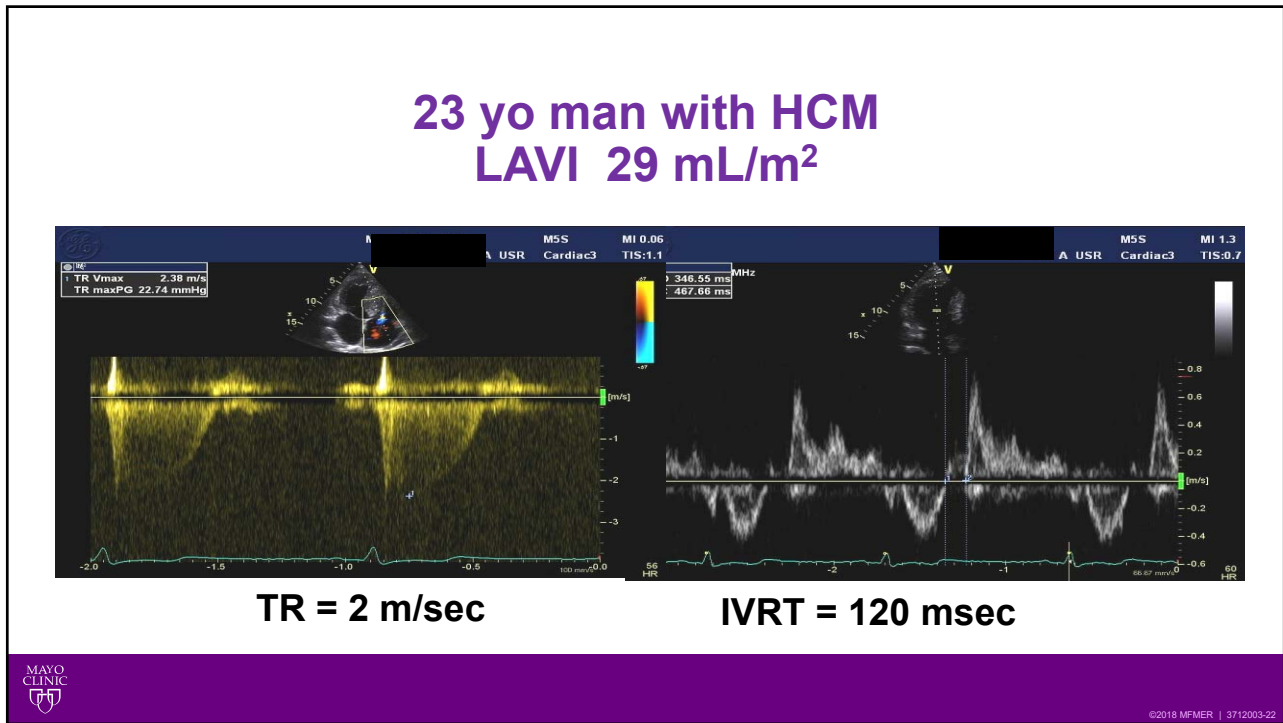
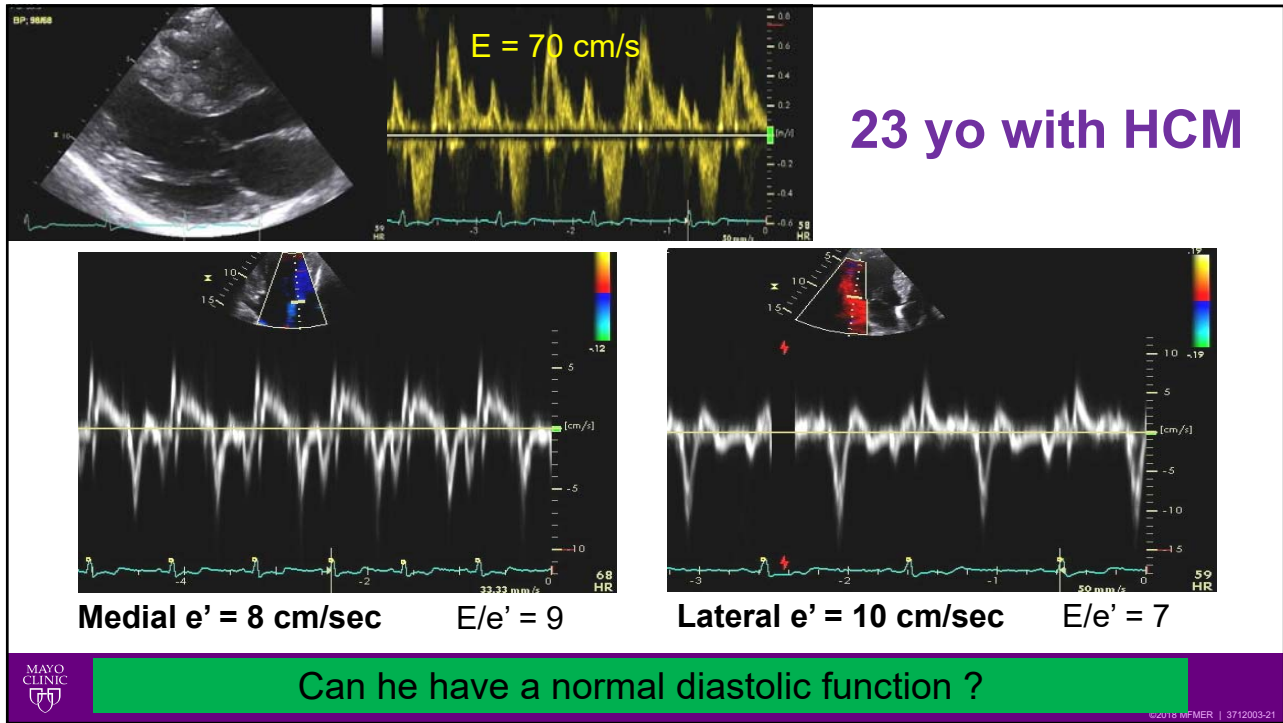
Case # 2 ARS

Grade the diastolic function of 23 YO male with HCM

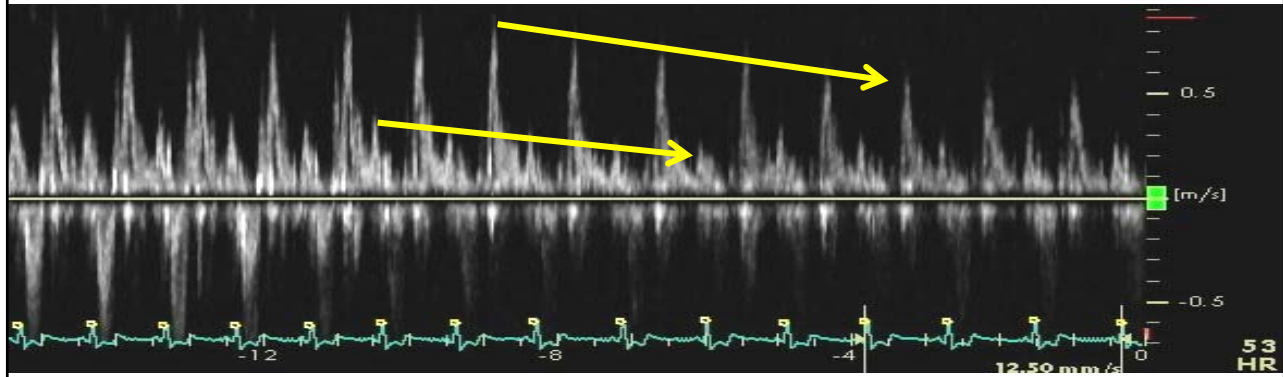
1. **Grade 1**
2. **Grade 2**
3. **Grade 3**
4. **Possibly normal**



E = 70 cm/s A = 30 cm/s
E/A = 2.3



Valsalva in 23 yo HCM Normal filling pressure

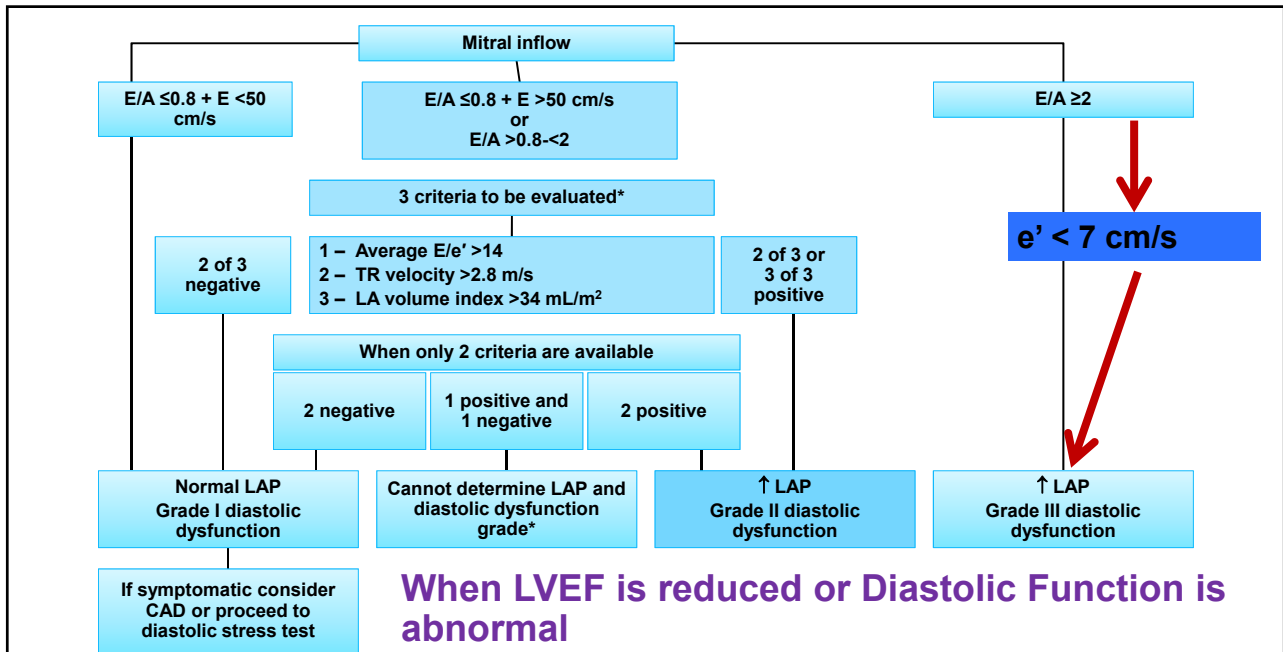


E/A = 2.3

E/A = 2.0

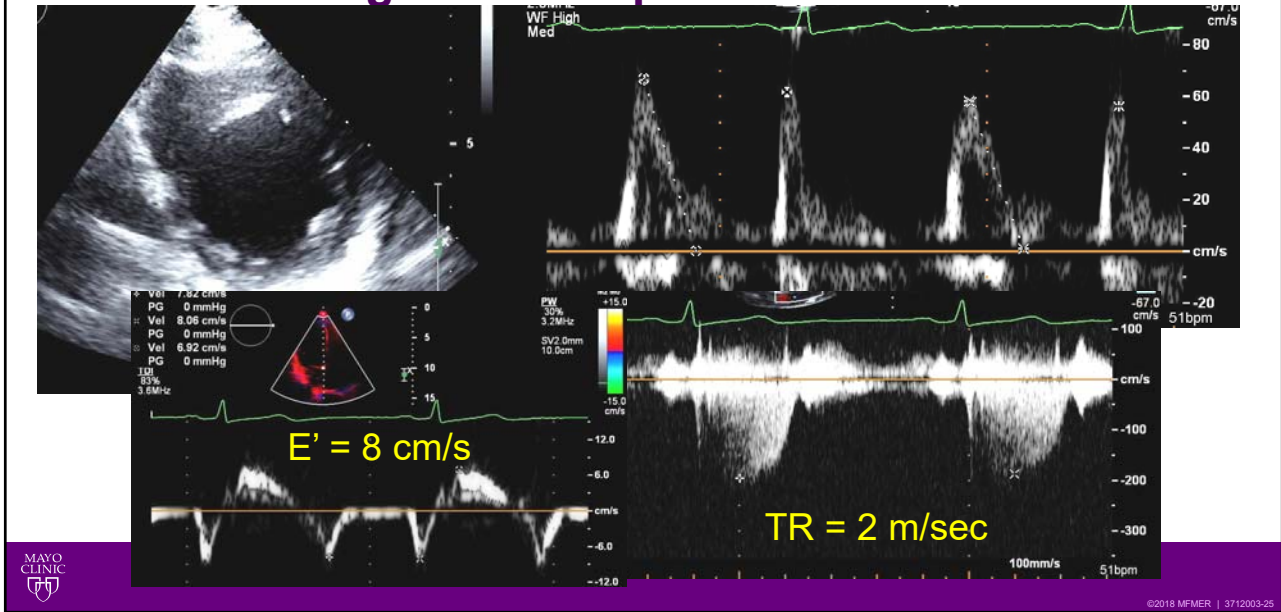


©2018 MFMER | 3712003-23

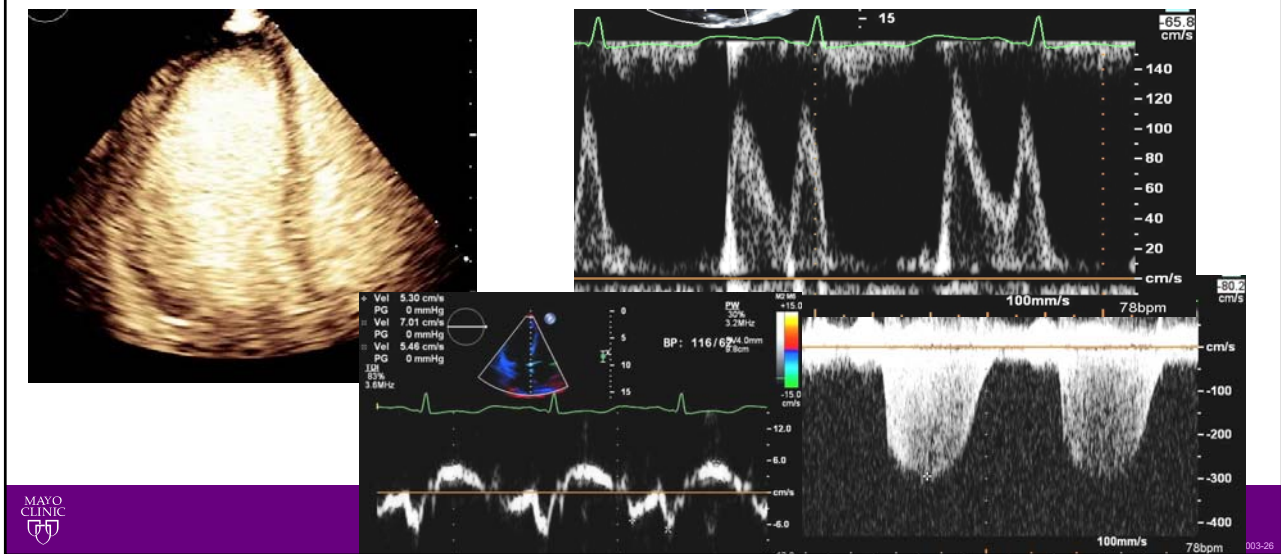


©2018 MFMER | 3712003-24

Prognosis of a patient after AMI

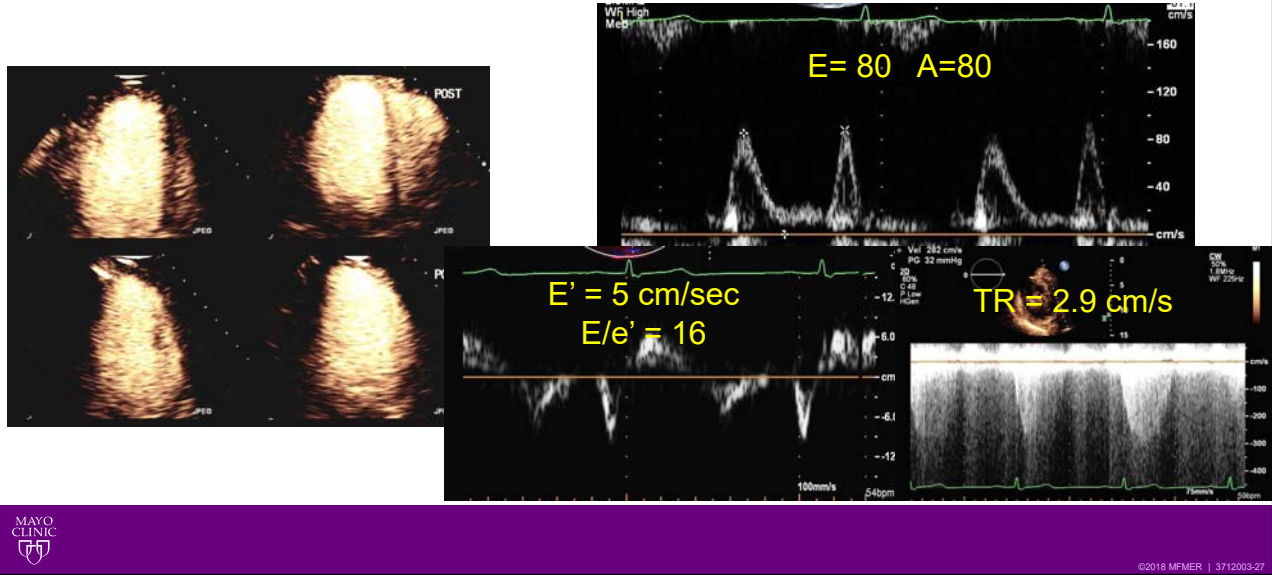


Anterior Wall Myocardial Infarction

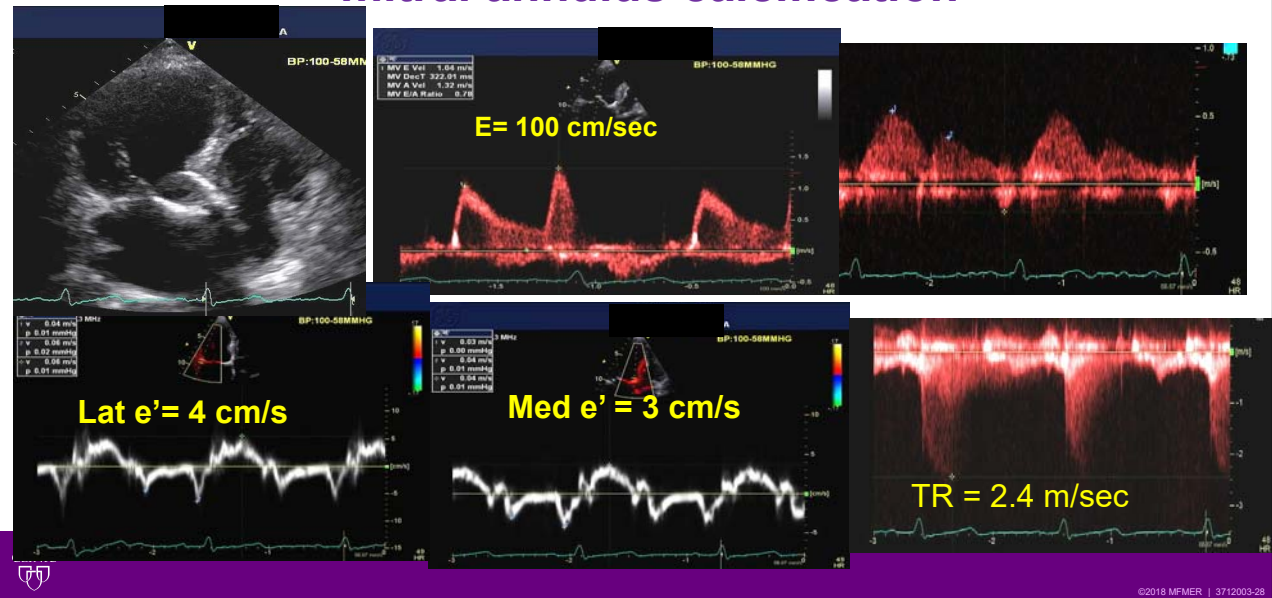


An elderly man with exertional dyspnea

HFpEF



Diastolic function assessment in patients with mitral annulus calcification



Mitral annulus e' velocity vs MAC

Mean age 73 years

Variable	Group 1 n=79 no MAC	Group 2 n=38 mild MAC	Group 3 n=38 mod-severe MAC	P for trend
Agatston Score	0	1-119	>119	
Septal e'	5.96±1.82	5.15±1.56	5.05±1.93	0.01
Lateral e'	7.37±2.44	6.89±2.71	6.28±1.81	0.01
Average e'	6.63±2	6.02±1.79	5.67±1.69	0.01
E/avg e' ratio	13±4.93	15±8.95	18±8.26	<0.001

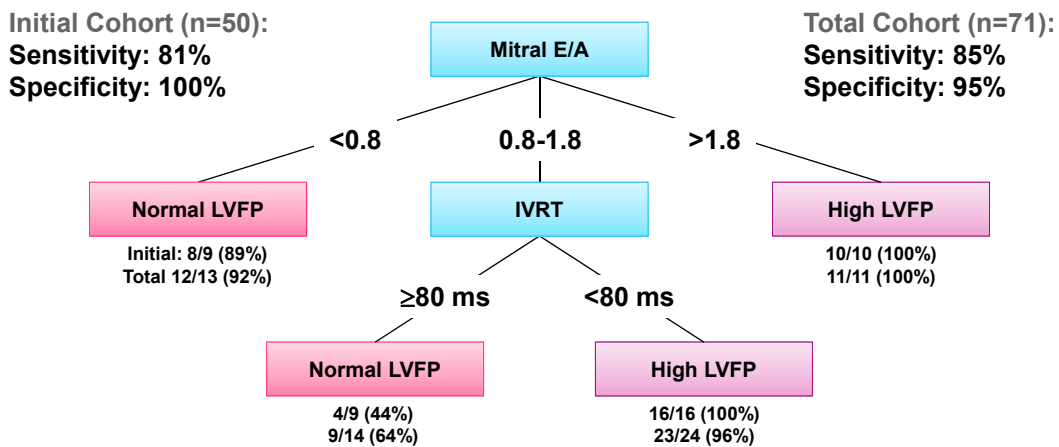
LV diastolic parameters are altered in the presence of MAC. This could be due to direct effects of MAC or might reflect truly reduced diastolic function. Interpretation of diastolic parameters in patients with MAC should be performed with caution.



Codolosa et al: Am J Cardiol 2016;117:847-852

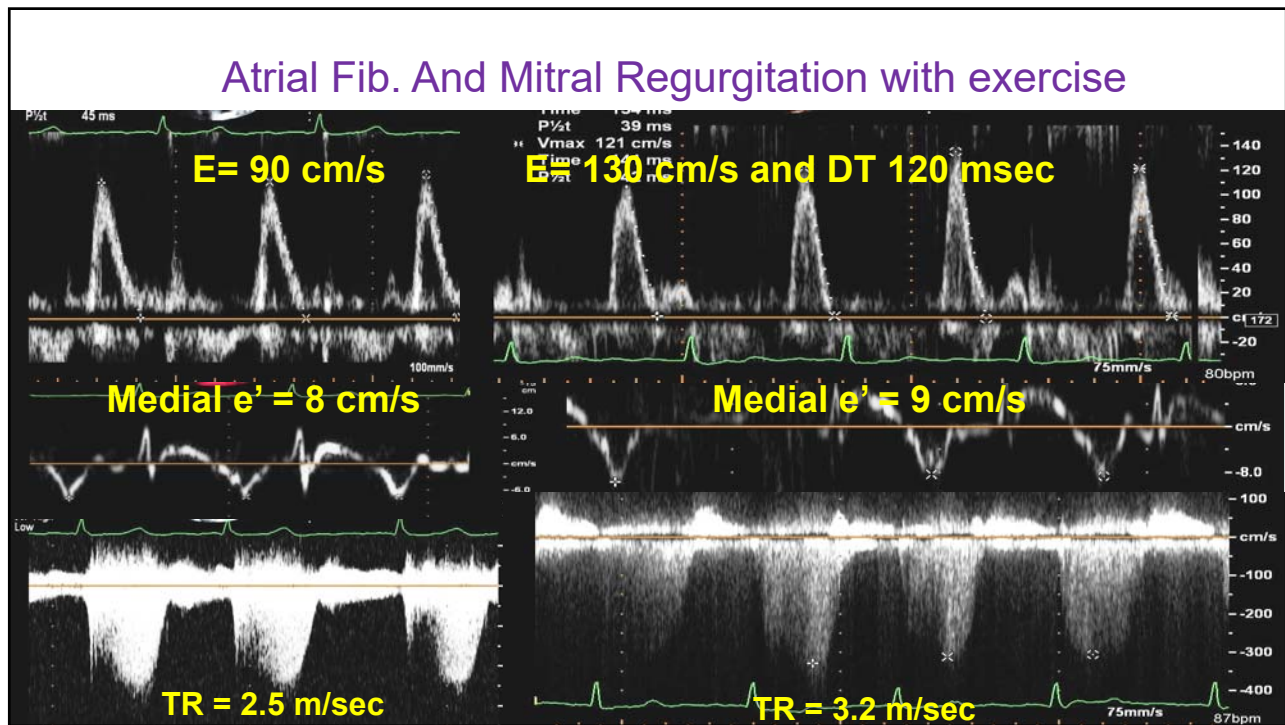
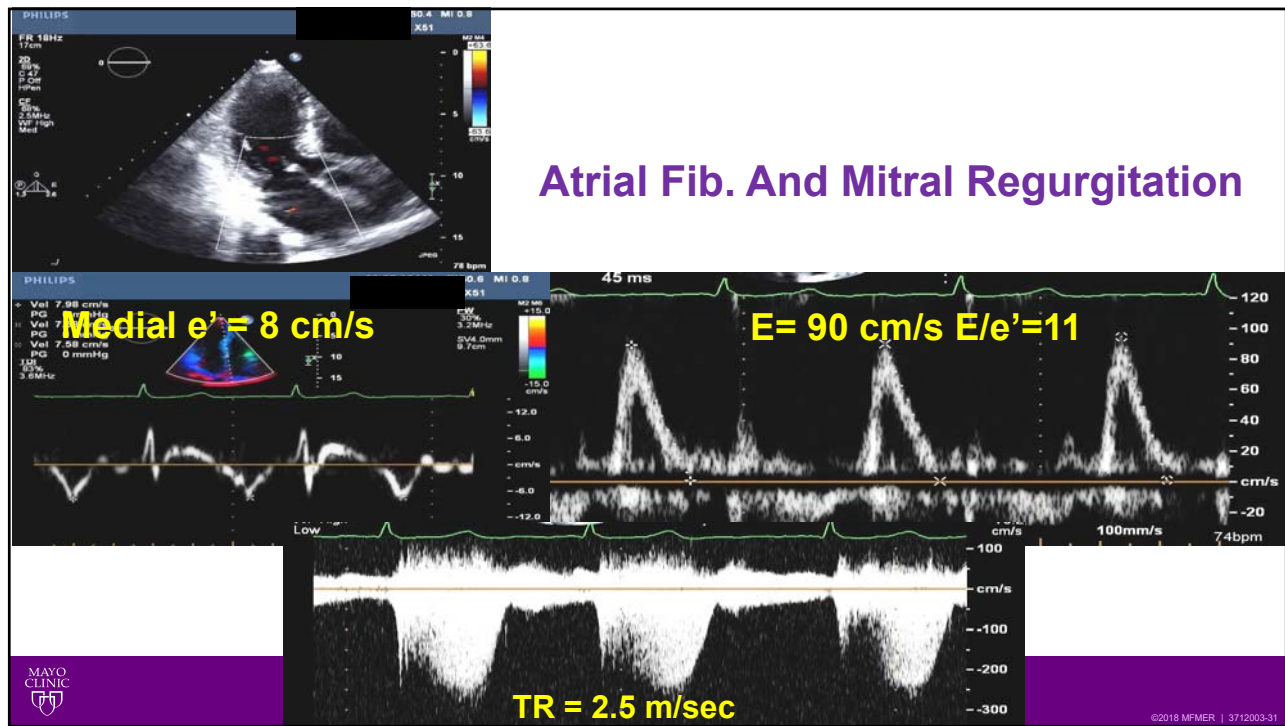
©2018 MFMR | 3/7/2003-20

Proposed Clinical Algorithm for Estimation of Left Ventricular Filling Pressure in Subjects With Mitral Annular Calcification



Abudiab et al: Am Coll Cardiol Img, 2017

©2018 MFMR | 3/7/2003-30



Diastolic Function in A. Fib

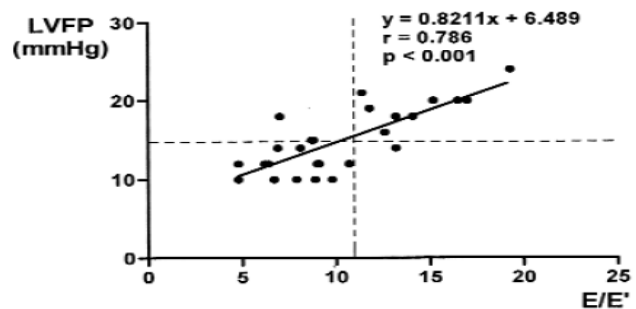
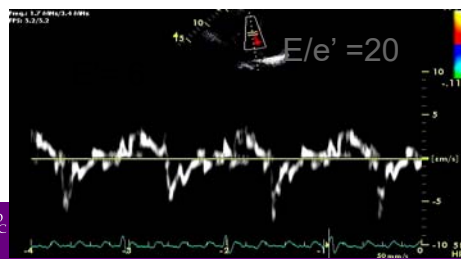
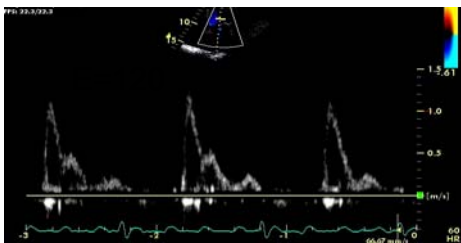
- DT < 160 msec (with reduced EF)
- DT < 130 msec poor survival (Hurley, Oh)
- Other measurements
 - E acceleration > 1900 cm/sec²
 - IVRT ≤ 65 msec
 - E/e' ≥ 11
 - IVRT/ T E-e'
 - TR velocity



©2018 MFMER | 3712003-33

Mitral Annulus Velocity in the Evaluation of Left Ventricular Diastolic Function in Atrial Fibrillation

Dae-Won Sohn, MD, Jong-Min Song, MD, Joo-Hee Zo, MD, In-Ho Chai, MD, Hyo-Soo Kim, MD, Hong-Gu Chun, MA, and Hec-Chan Kim, PhD, *Seoul, Korea*

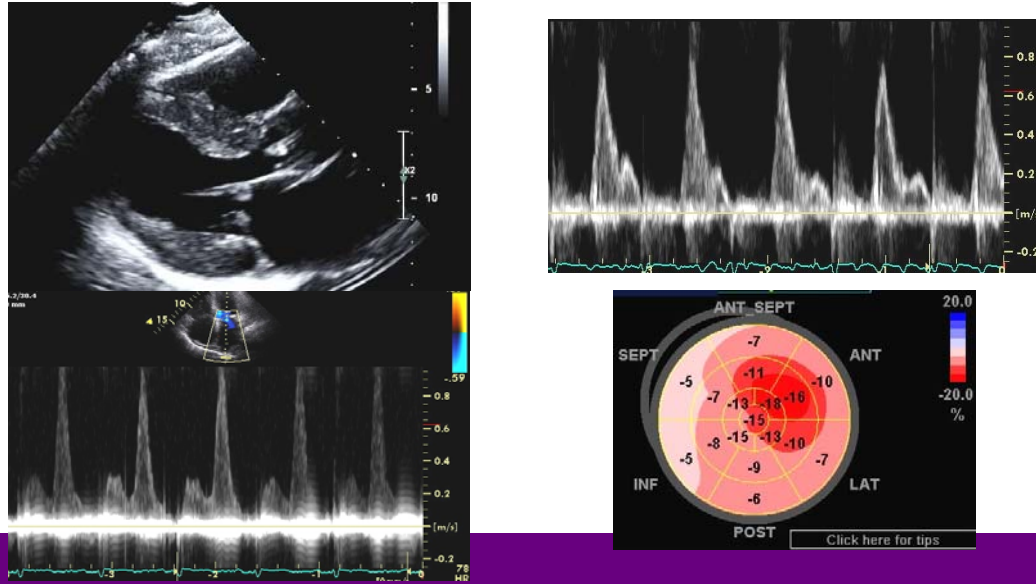


JASE 1999



©2018 MFMER | 3712003-34

An elderly patient with worsening dyspnea



©2018 MFMER | 3712003-35

Take-home message Part 1

- Abnormal LV relaxation is one of the first manifestation of diastolic dysfunction
- Mitral annulus e' velocity is a clinically reliable parameter for LV relaxation
- Diastolic function and filling pressure can be assessed by simple Echo-Doppler parameters at rest and with exercise
- $E/e' \geq 15$ is specific for increased filling pressure



©2018 MFMER | 3712003-36

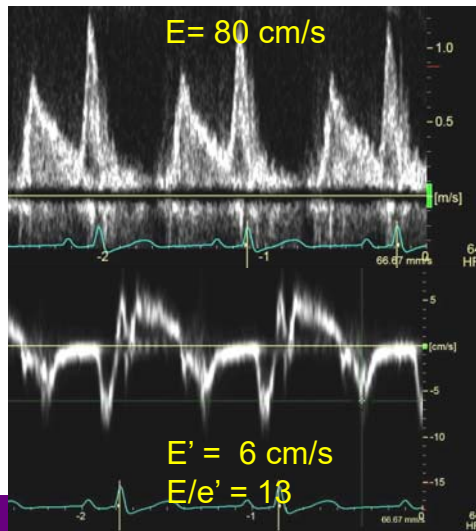
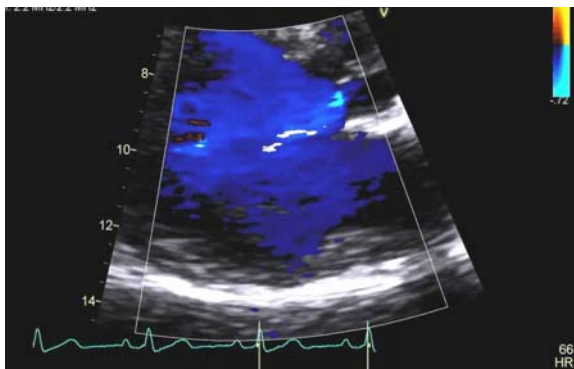


Thanks for listening!
oh.jae@mayo.edu



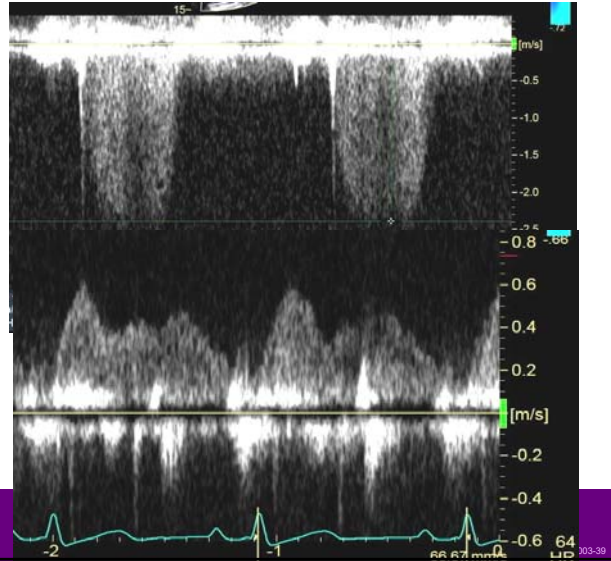
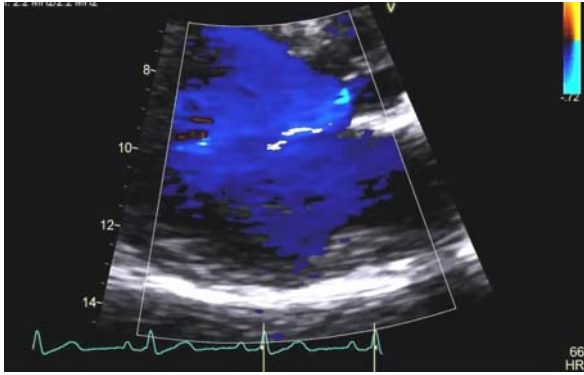
©2018 MFMER | 3712003-37

Mitral Regurgitation and Diastolic Function

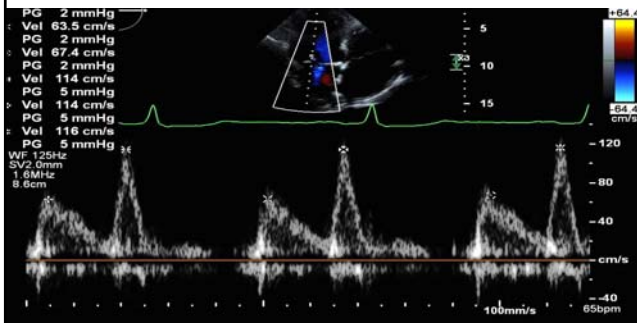


©2018 MFMER | 3712003-38

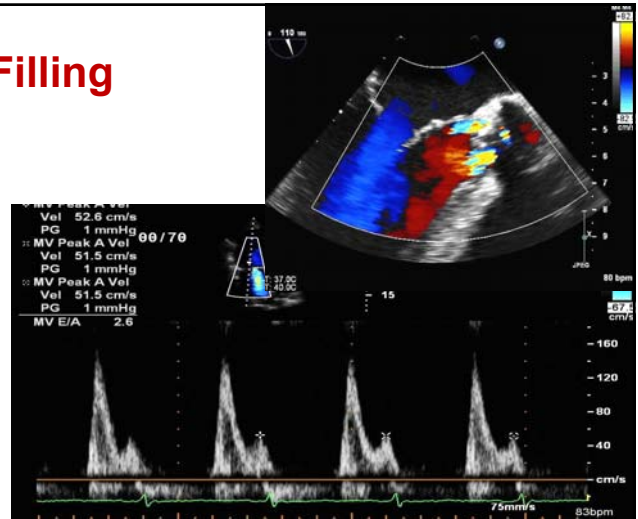
Mitral Regurgitation and Diastolic Function



Assessment of Diastolic Filling Before and after TAVR



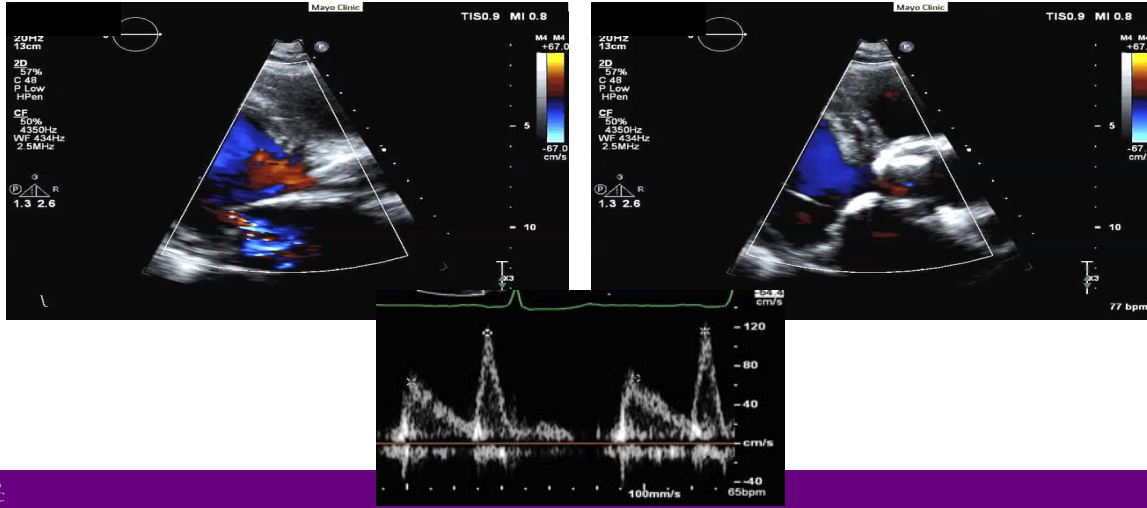
Baseline Normal Filling Pressure



Post TAVR with PVAR
Increase in FP

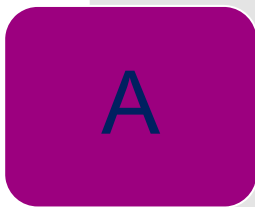


89 year old with TAVR 4 year follow-up



©2018 MFMER | 3712003-41

Stages of Heart Failure 2013/14 HF Guideline



At high risk for HF W/O SHD or symptoms



Structural Heart Disease W/O symptoms or signs



Structural Heart Disease W/ symptoms or signs



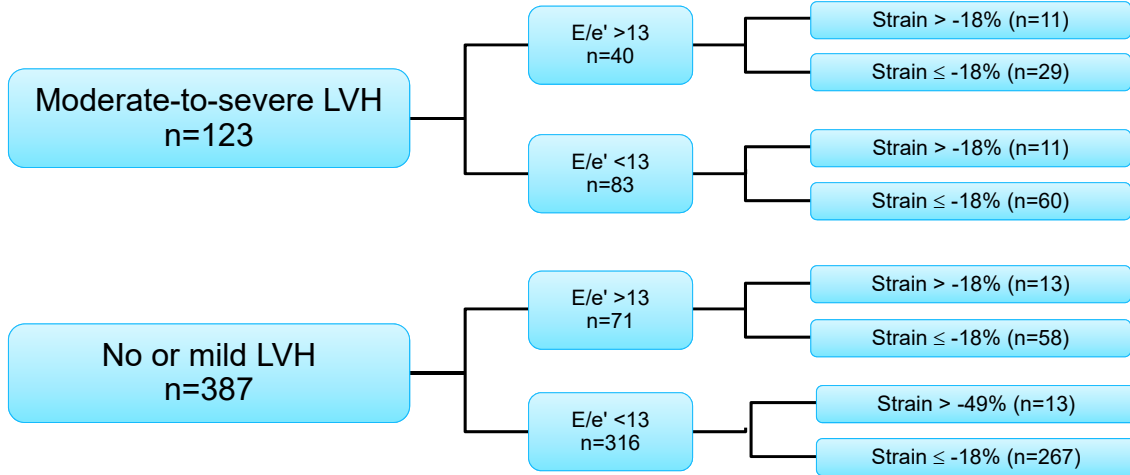
Refractory Heart Failure



©2018 MFMER | 3712003-42

Exercise Limitation Associated With Asymptomatic Left Ventricular Impairment Analogy With Stage B Heart Failure

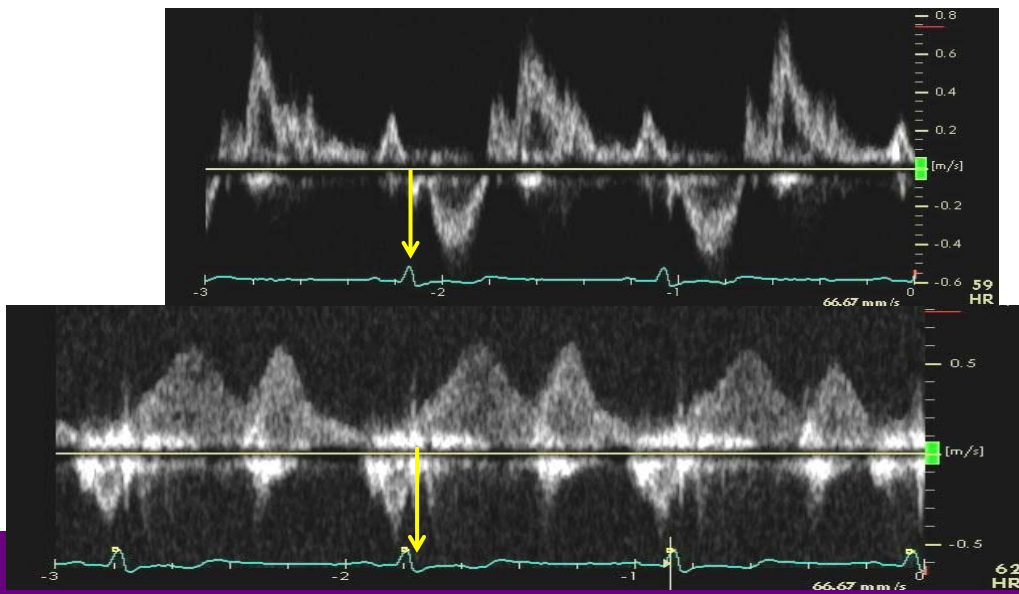
Wojciech Kosmala, MD, PhD,*† Christine L. Jellis, MD, PhD,‡ Thomas H. Marwick, MBBS, PhD, MPH‡



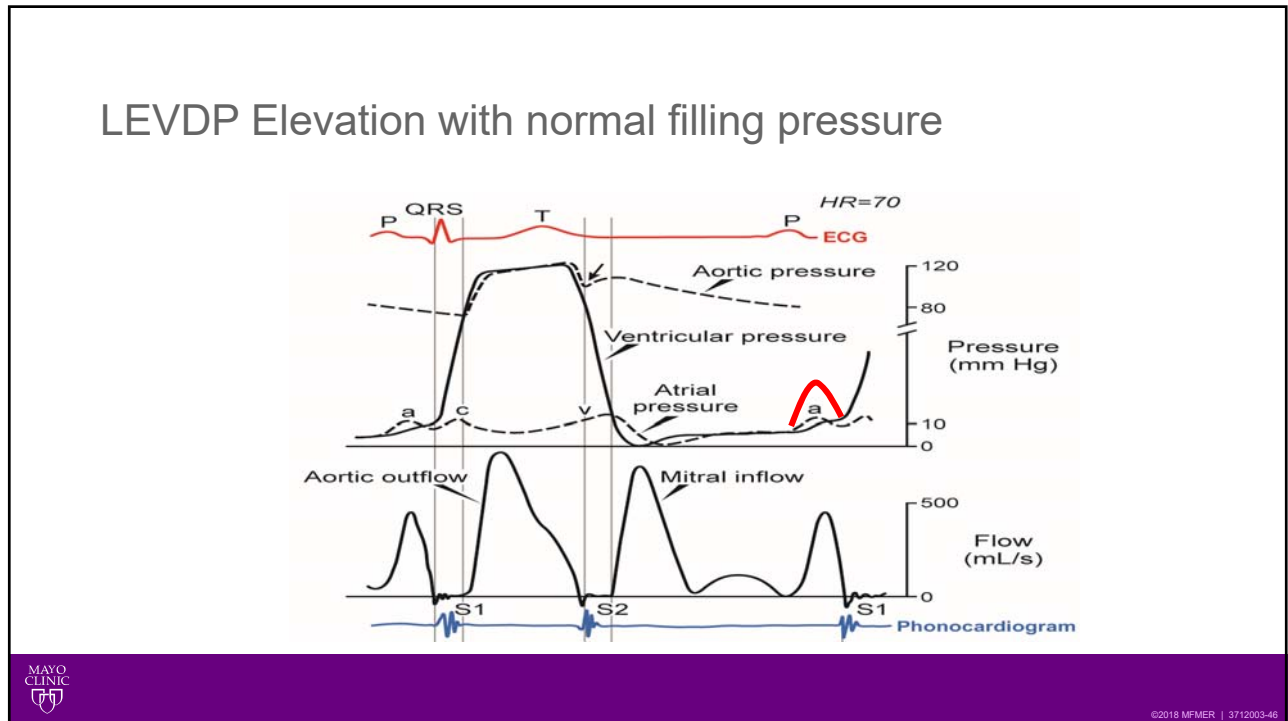
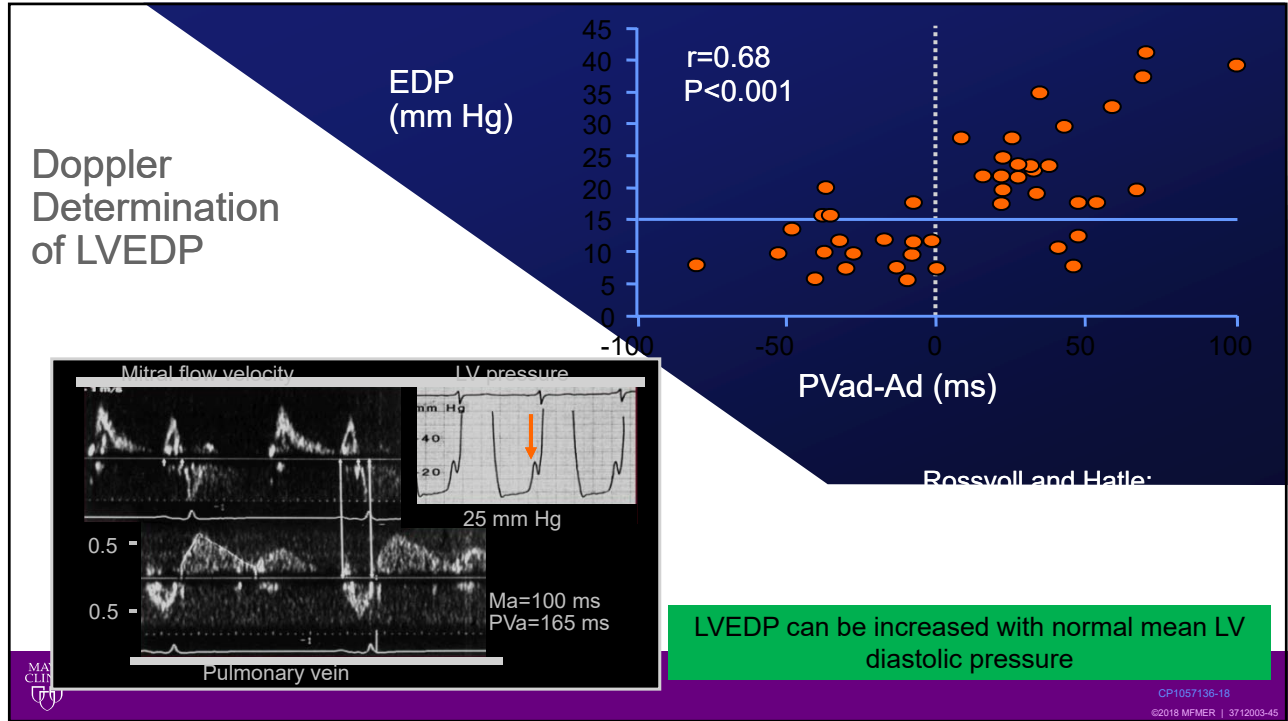
Kosmala W et al: JACC 65:257-266, 2015

©2018 MFMR | 3712003-43

Mitral A duration is shorter than PV AR Increased LVEDP

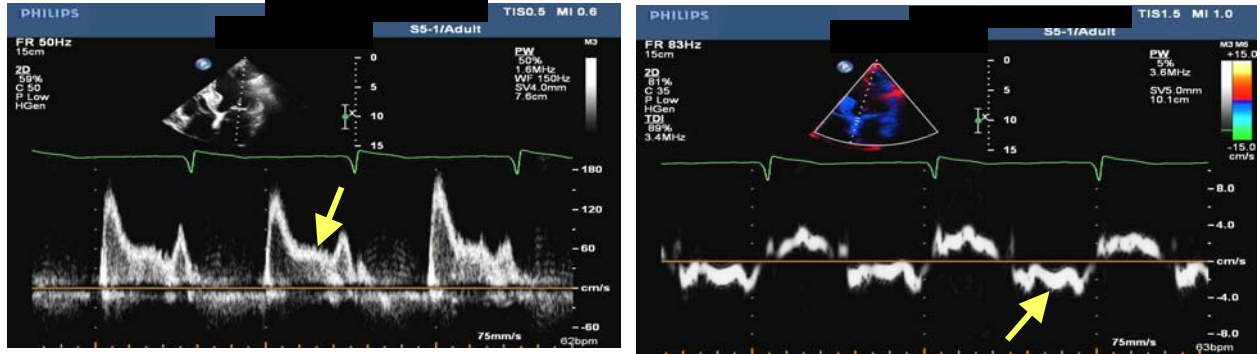


©2011 MFMR | slide44
©2018 MFMR | 3712003-44



“L” Wave

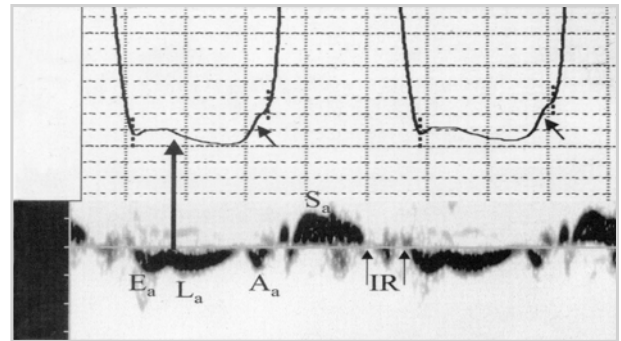
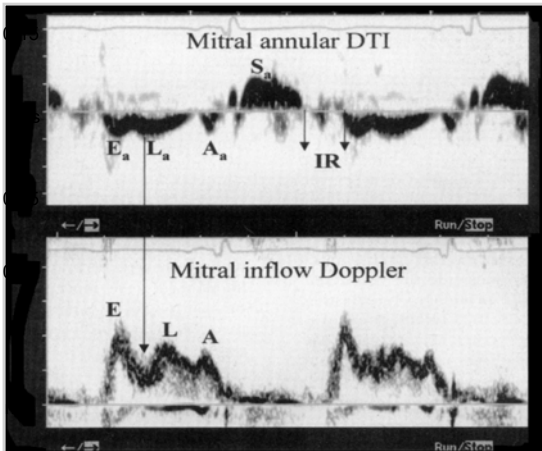
Delayed Relaxation + Increased Filling Pressure



©2018 MFMER | 3712003-47

Mid-diastolic mitral flow (L)

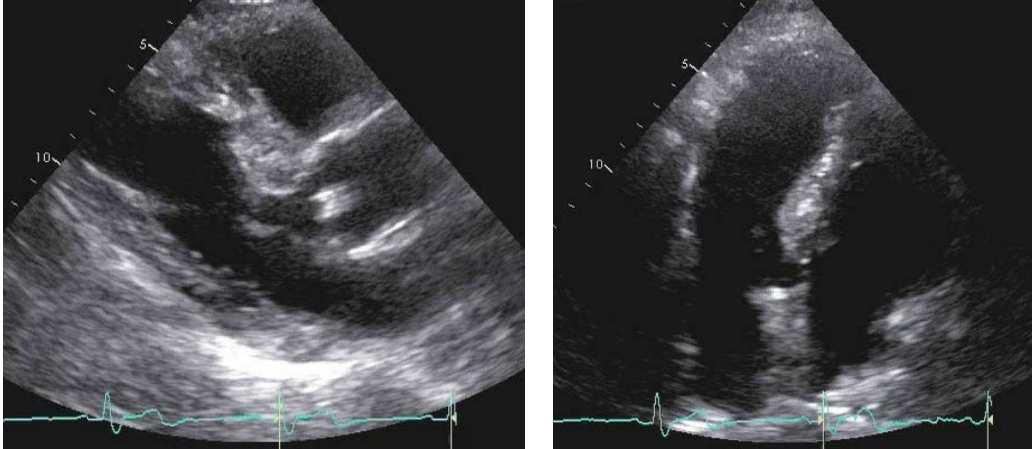
Delayed relaxation



Frommelt et al: JASE 16:176, 2003

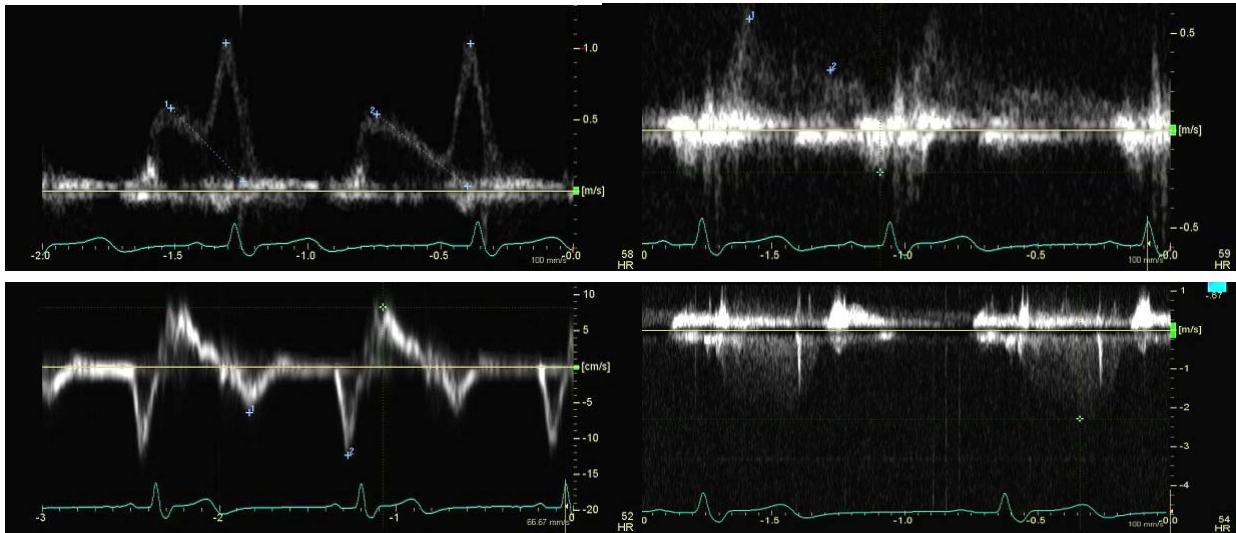
CP1100934-2
©2018 MFMER | 3712003-48

95 year old woman



©2018 MFMR | 3712003-49

95 year old woman



©2018 MFMR | 3712003-50

