Hemodynamics: essentials for future TAVR and mitral valve disease

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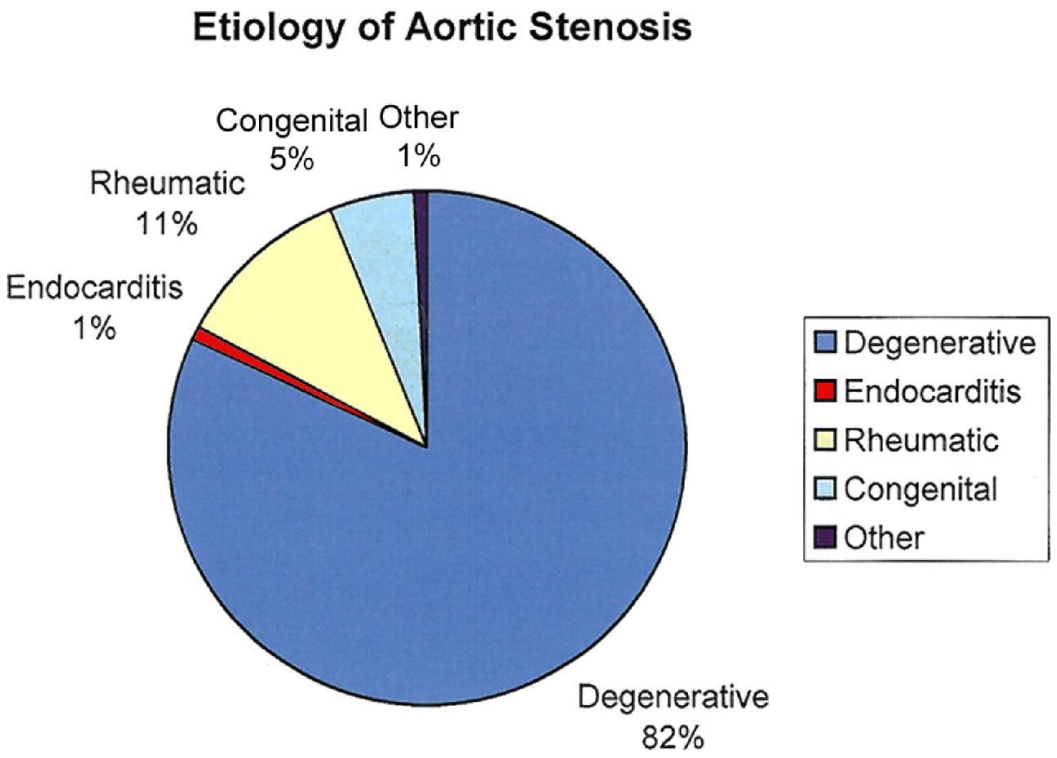
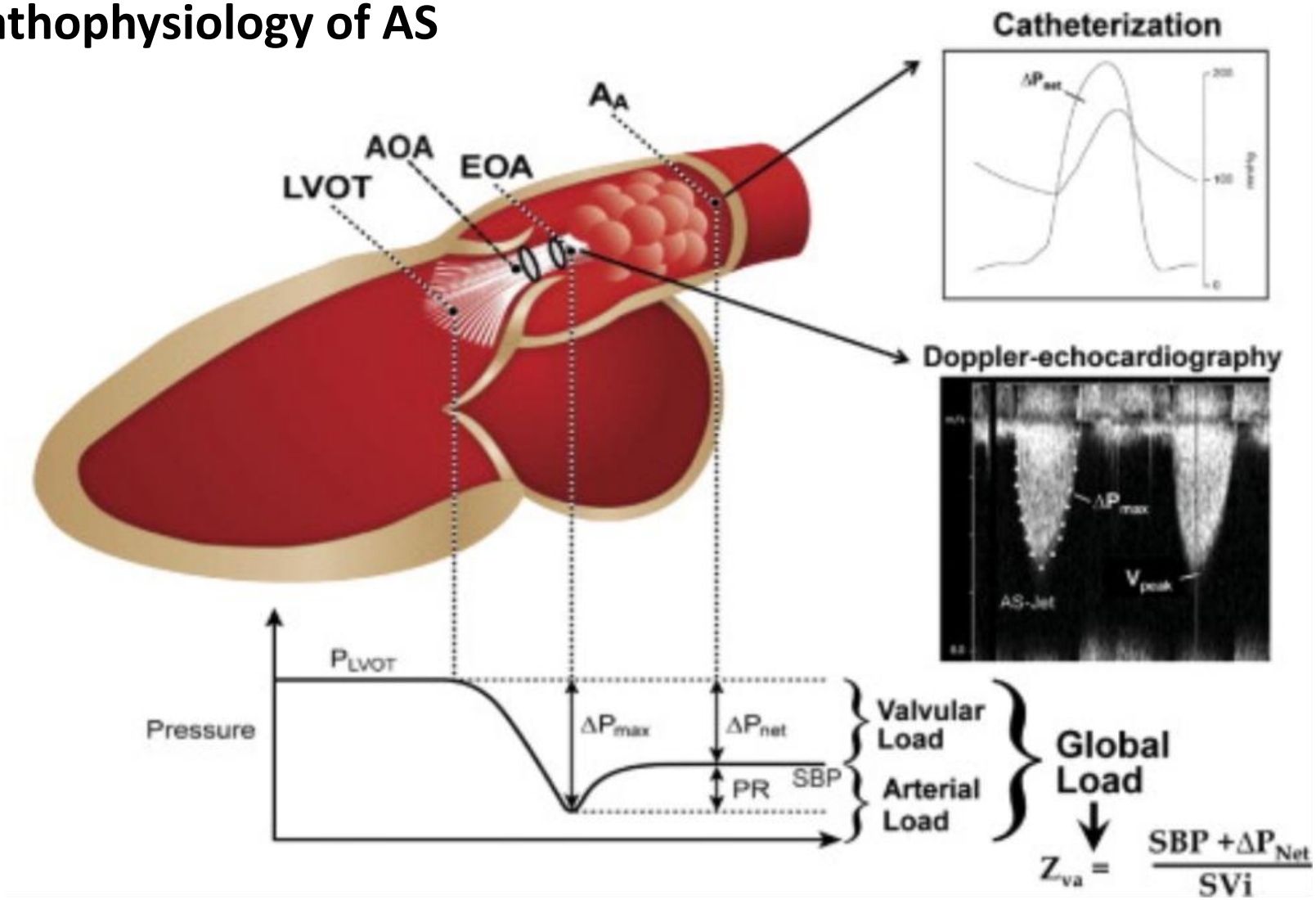
Etiology of Aortic Stenosis From the Euro Heart Survey

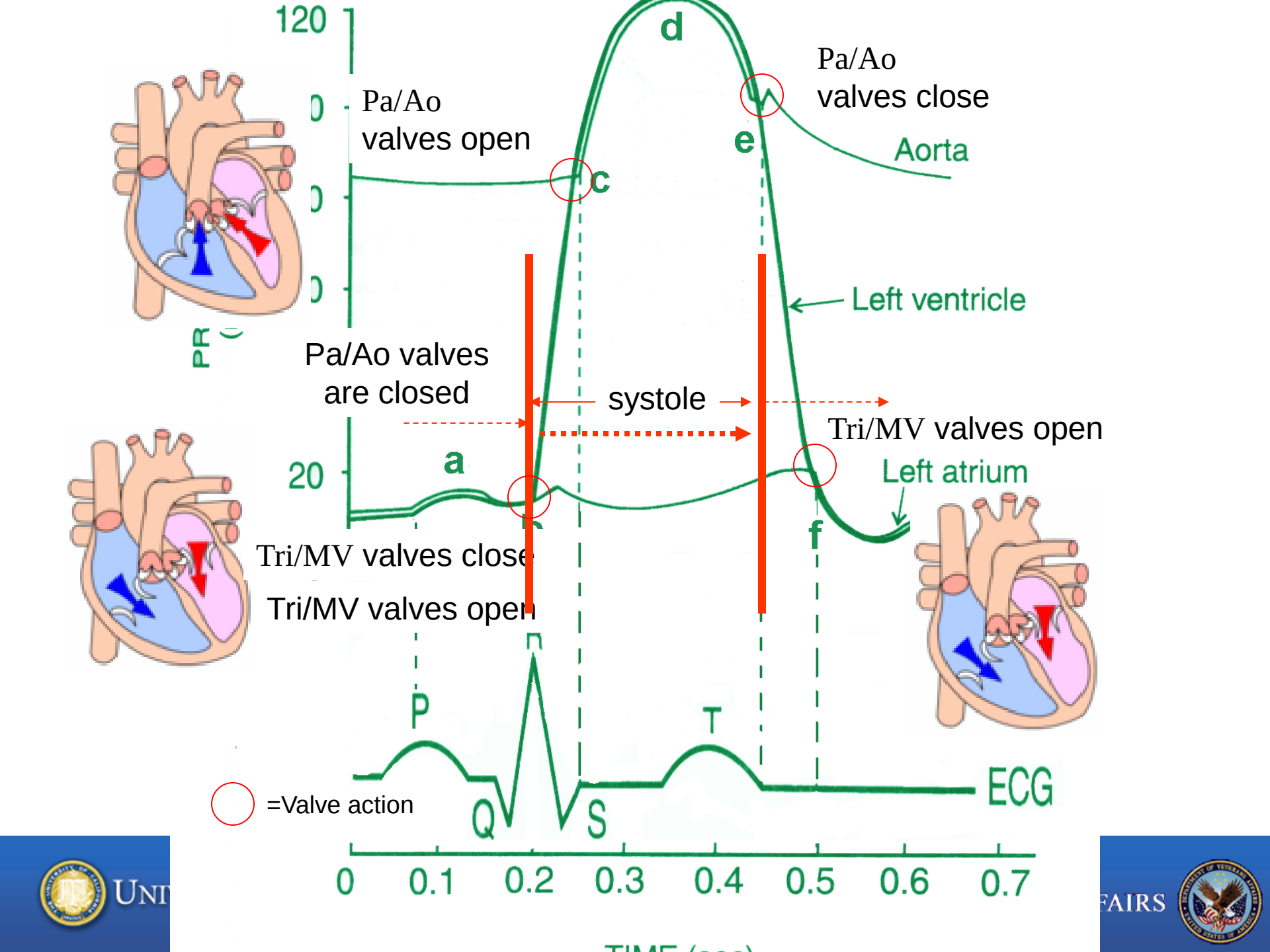


Goldbarg, S. H. et al. J Am Coll Cardiol 2007;50:1205-1213

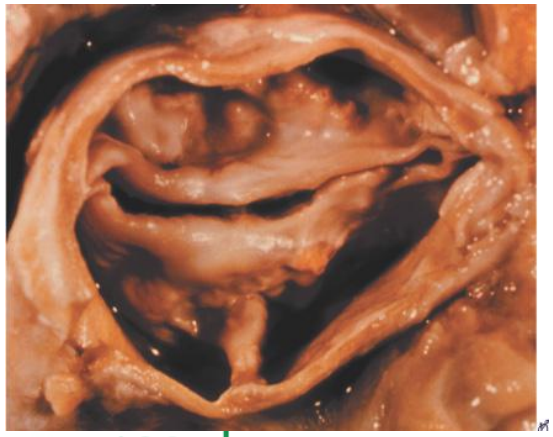
Pathophysiology of AS



J Am Coll Cardiol. 2012;60(3):169-180.

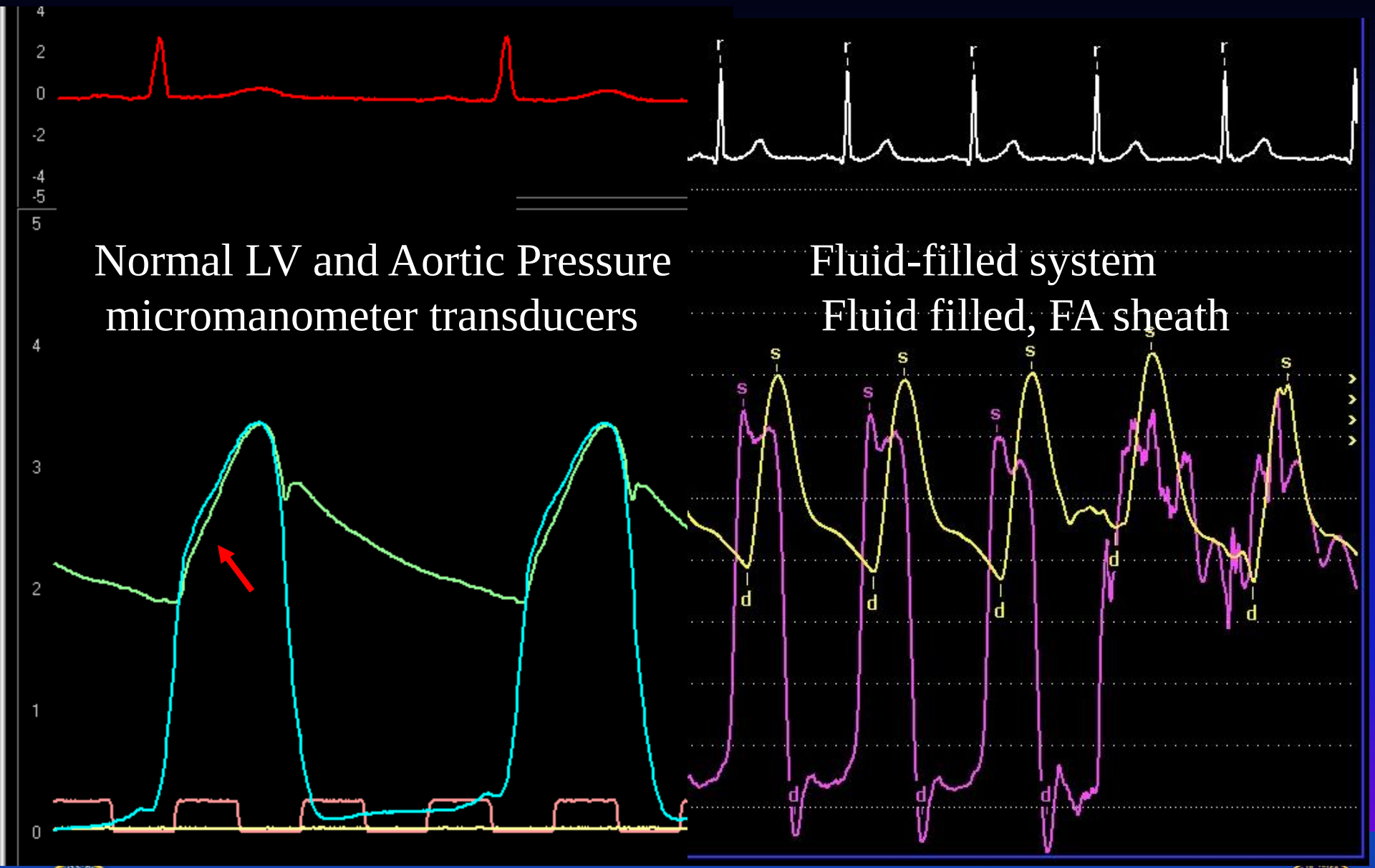

120
0
0
0
Pa/Ao
valves open
d
Pa/Ao
valves close
e
Aorta
c
Left ventricle
Pa/Ao valves
are closed
systole
Tri/MV valves open
Left atrium
20
a
b
f
Tri/MV valves close
Tri/MV valves open
P
R
T
Q
S
ECG
=Valve action
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7

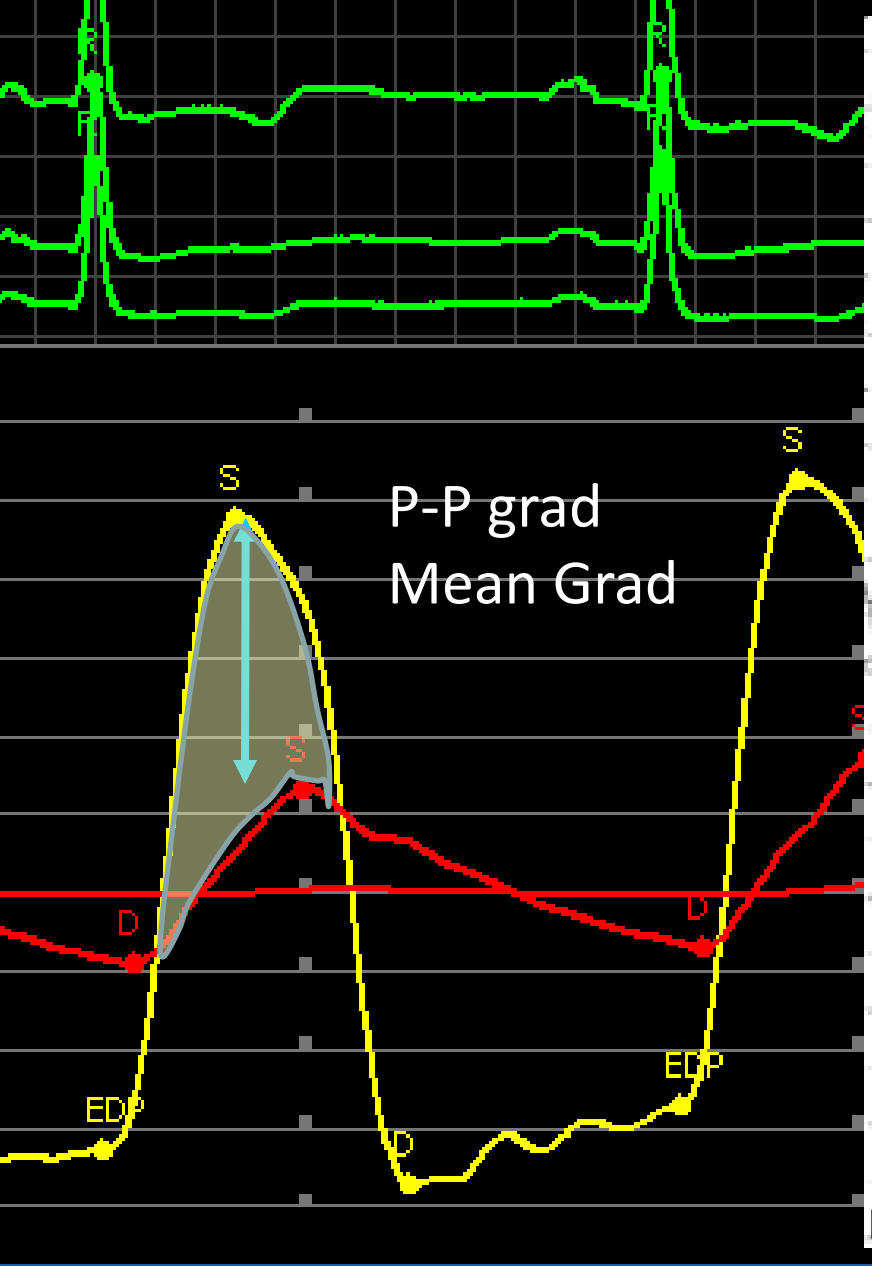
Mechanism of AS: LV-Ao Gradient

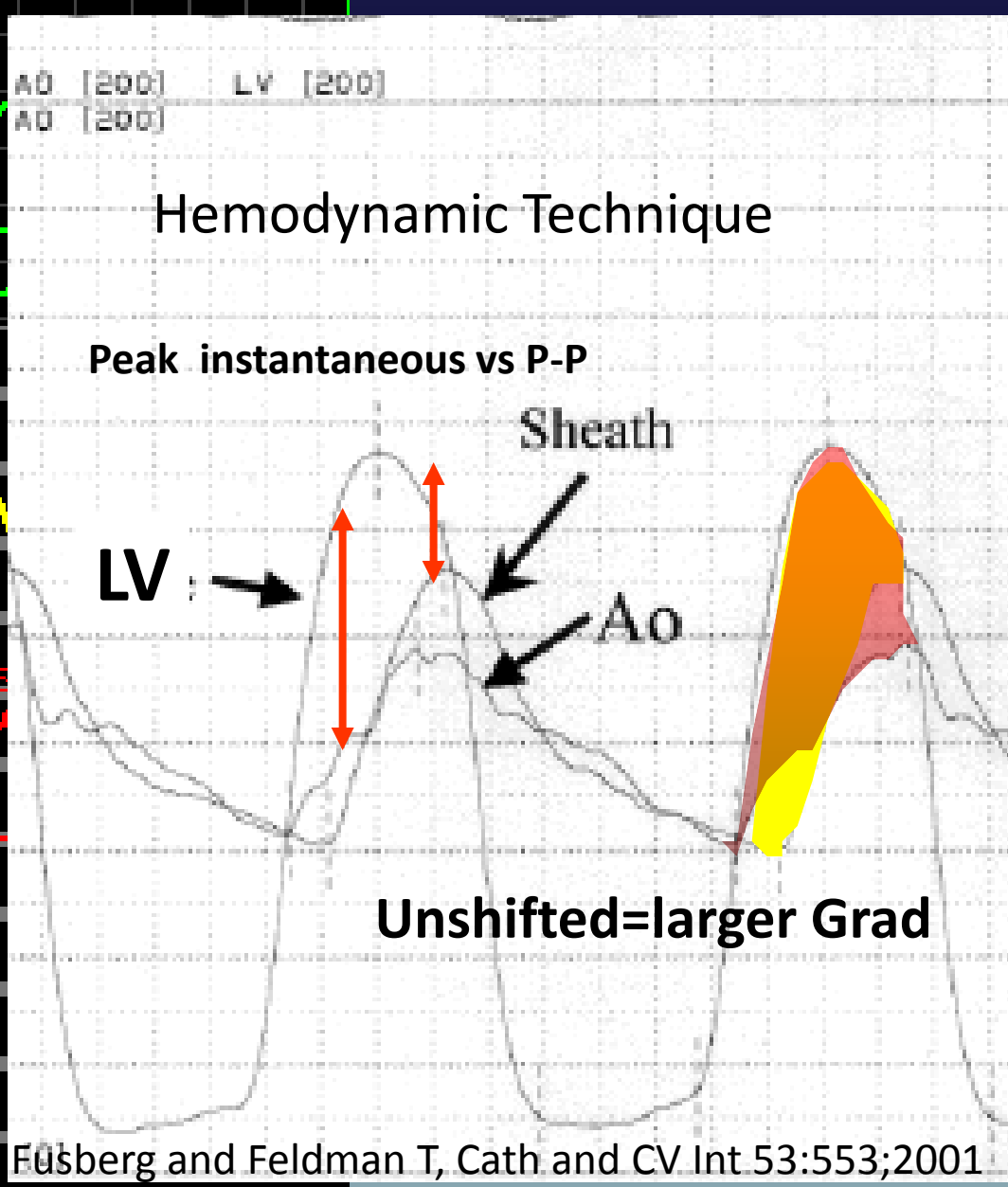


Consequences of LV-Ao Gradient:

1. **late peaking Systolic murmur**
2. **Single A2**
3. **Slow pulse upstroke**


4
2
0
-2
-4
-5
r
5
4
3
2
1
0
s
d
Normal LV and Aortic Pressure
micromanometer transducers
Fluid-filled system
Fluid filled, FA sheath





Fusberg and Feldman T, Cath and CV Int 53:553;2001

Techniques for Aortic Valve Gradient Measurement

- **Single Catheter LV-Ao pullback**
- **LV and Femoral Sheath**
- **LV and Long aortic sheath**
- **Bilateral femoral access**
- **Double-lumen pigtail catheter**
- **Transeptal LV access with ascending Ao**
- **Pressure Guidewire with ascending Ao**
- **Multi-transducer micromanometer catheters**

Fusberg and Feldman T, Cath and CV Int 53:553;2001

Calculating Aortic Valve Area

- AVA: Gorlin equation

$$\text{Valve Area}\,(\text{cm}^2) = \frac{\text{Cardiac Output}\,\left(\frac{\text{ml}}{\text{min}}\right)}{\text{Heart rate}\,\left(\frac{\text{beats}}{\text{min}}\right) \cdot \text{Systolic ejection period}\,(\text{s}) \cdot 44.3 \cdot \sqrt{\text{mean Gradient}\,(\text{mmHg})}}$$

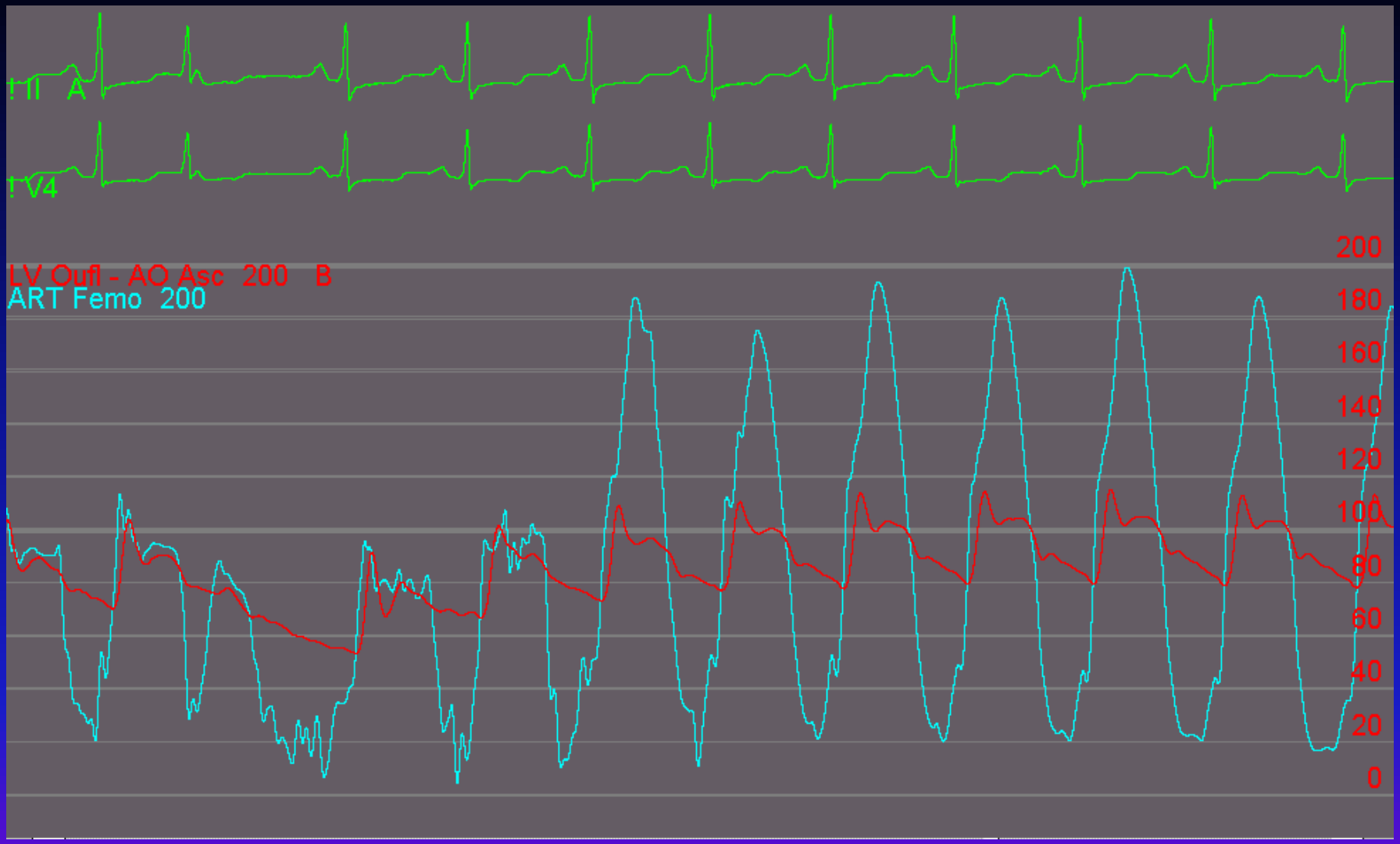
- AVA: Hakke formula ("poor man's Gorlin")
  - Assumes HR*SEP*44.3 = 1000 in most patients
  - Valid for HR ~65-100

AVA = cardiac output (L/min)/$\sqrt{\text{Peak-Peak Pressures}}$

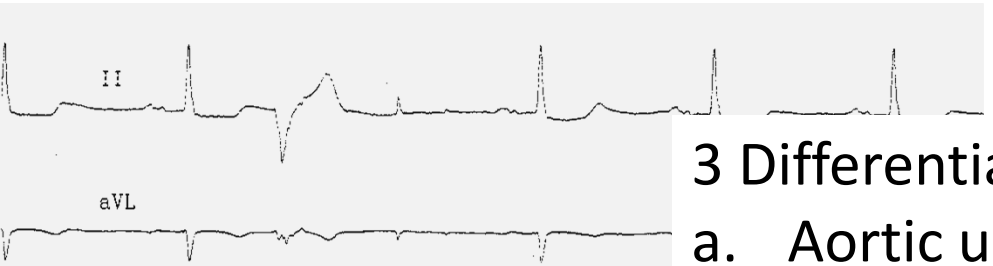
Grading Severity of Aortic Stenosis

Aortic Stenosis	*AVA (cm^2)*	*AVA Index (cm^2/m^2)*
Mild	>1.5	>0.9
Moderate	1.1-1.5	≥0.6-0.9
Severe	≤0.8-1.0	≤0.4-0.6


I
A
V4
LV Outfl - AO Asc 200 B
ART Femo 200
200
180
160
140
120
100
80
60
40
20
0


I II A
V4
LV Outfl - AO Asc 200 B
ART Femo 200
200
180
160
140
120
100
80
60
40
20
0

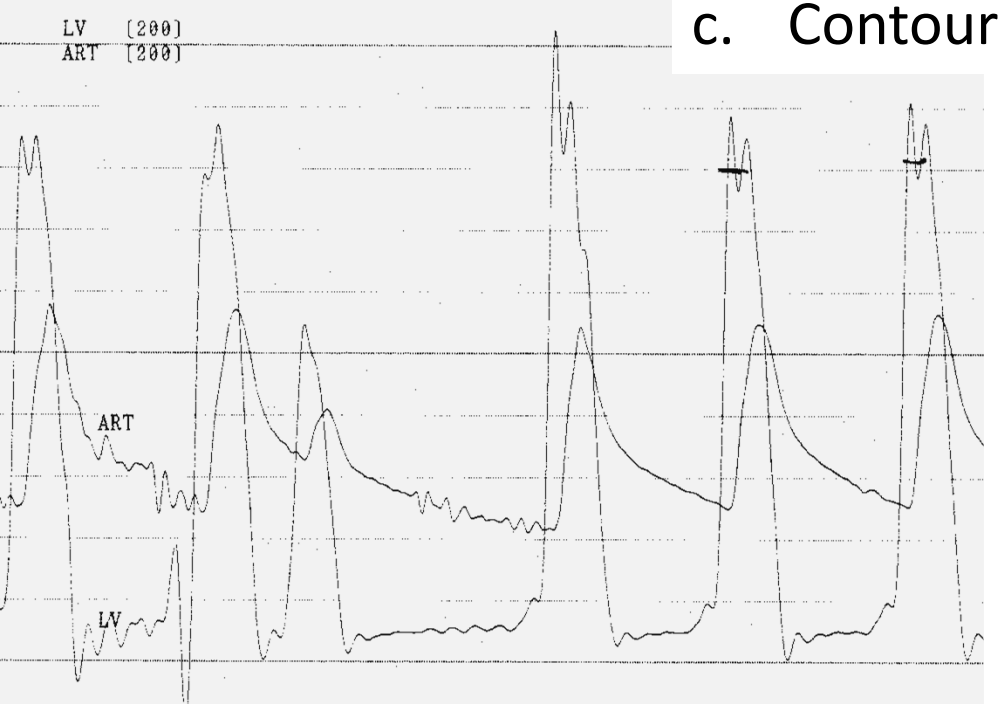
Hemodynamic Differentiation of LVOT Obstruction



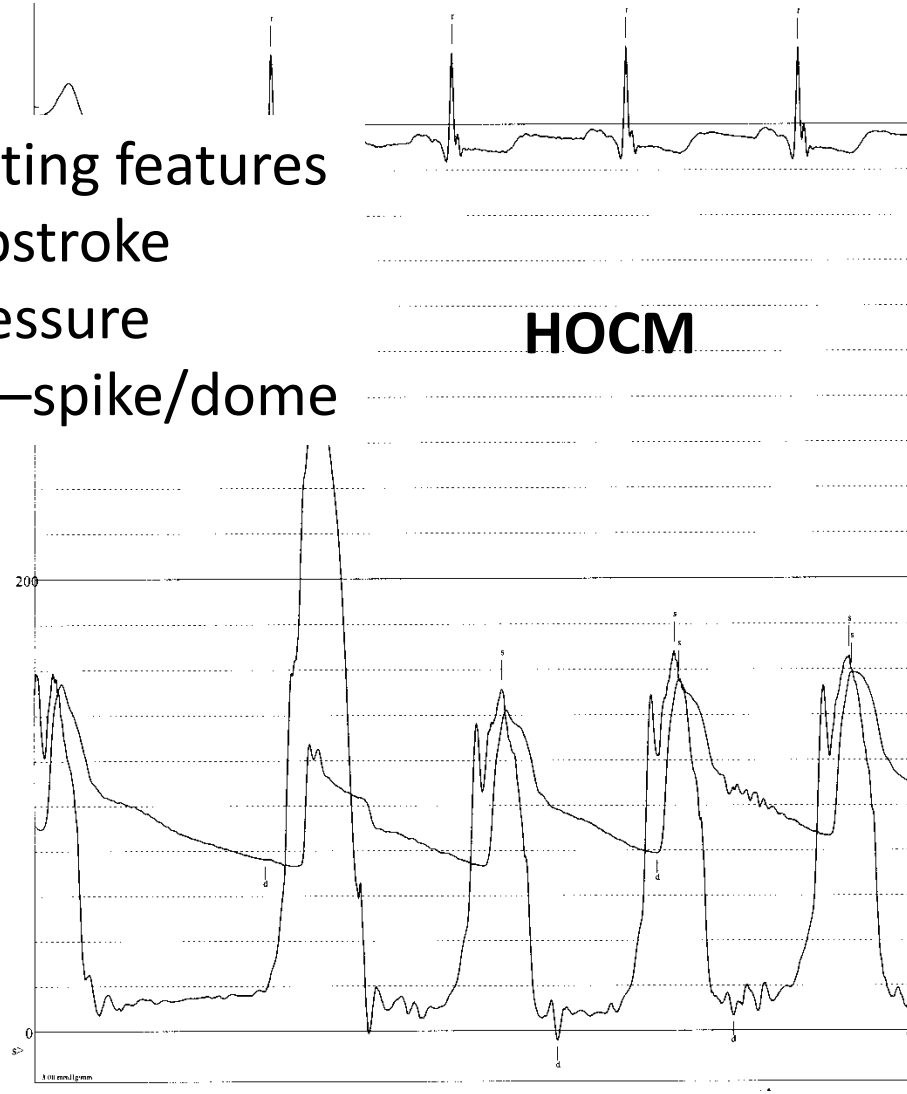
3 Differentiating features

a. Aortic upstroke
b. Pulse pressure
c. Contour –spike/dome

AS

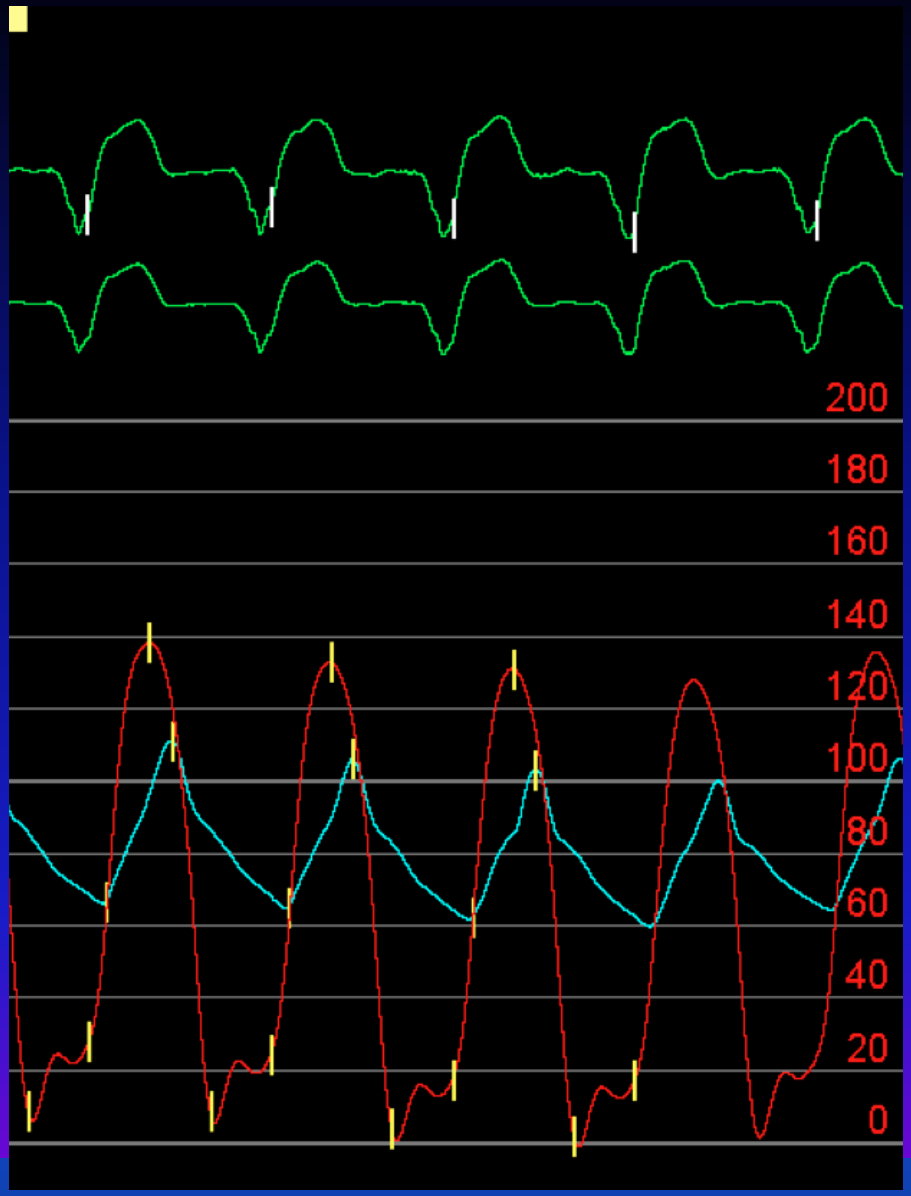


HOCM

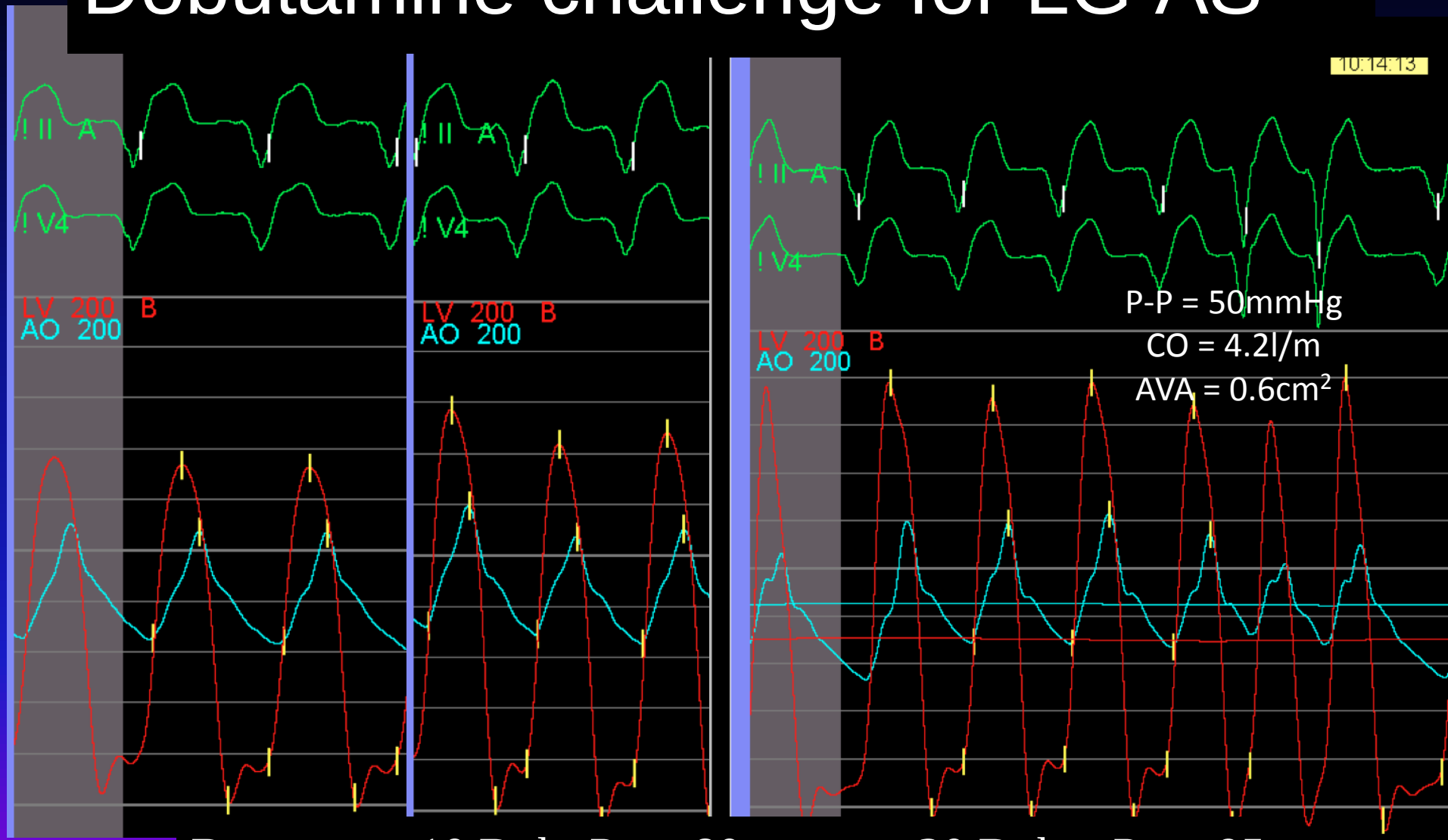


Low Gradient, Low EF AS?

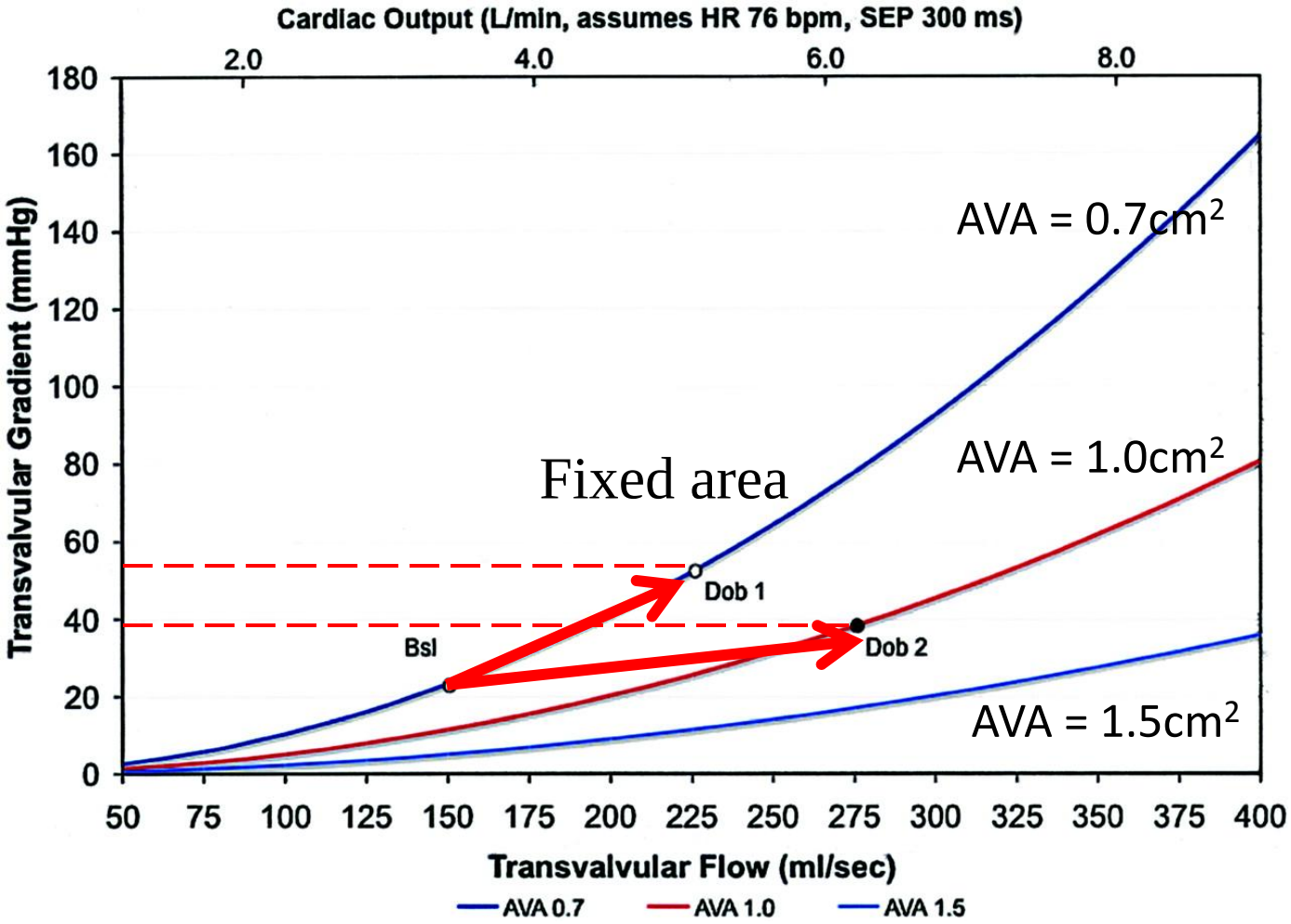
LVEF 25%
P-P gradient 30mmHg
CO = 3.2l/m Fick
AVA = 0.7cm^2



Dobutamine challenge for LG AS

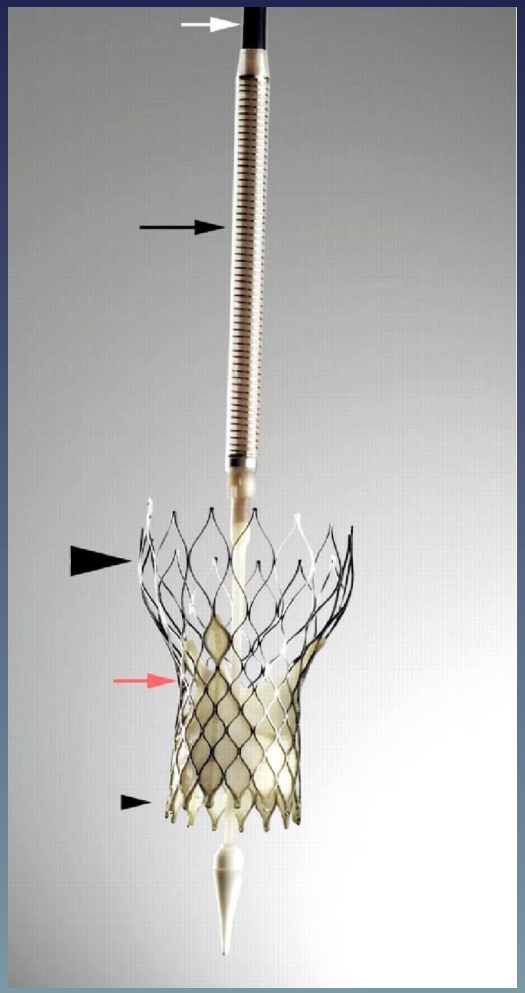


What should you do with Symptomatic AS patient, low gradient, low flow?
The Dobutamine Challenge

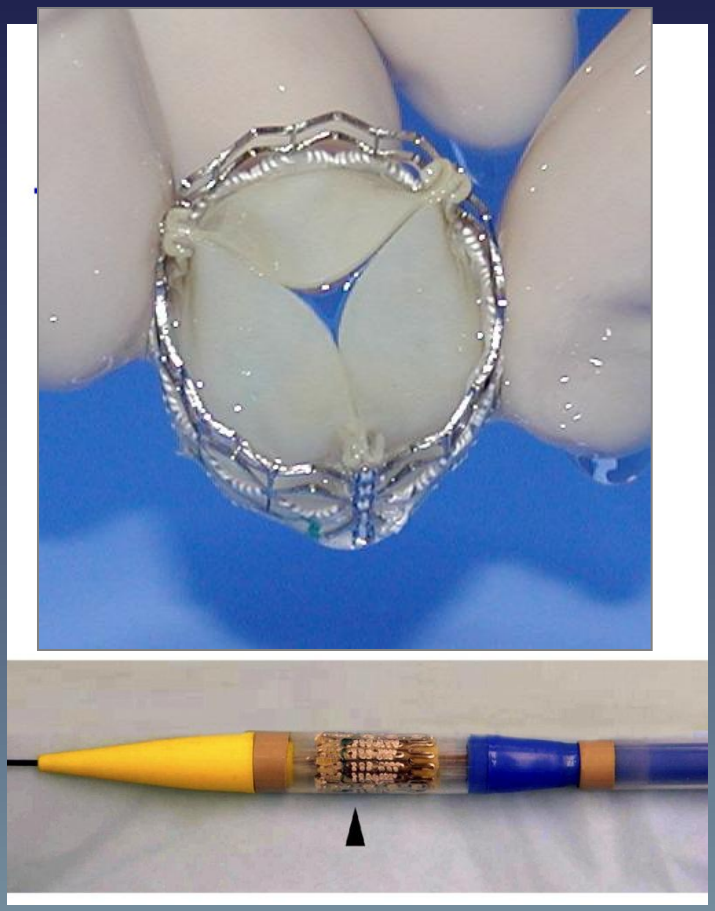


Grayburn, P. A. Circulation 2006;113:604-606

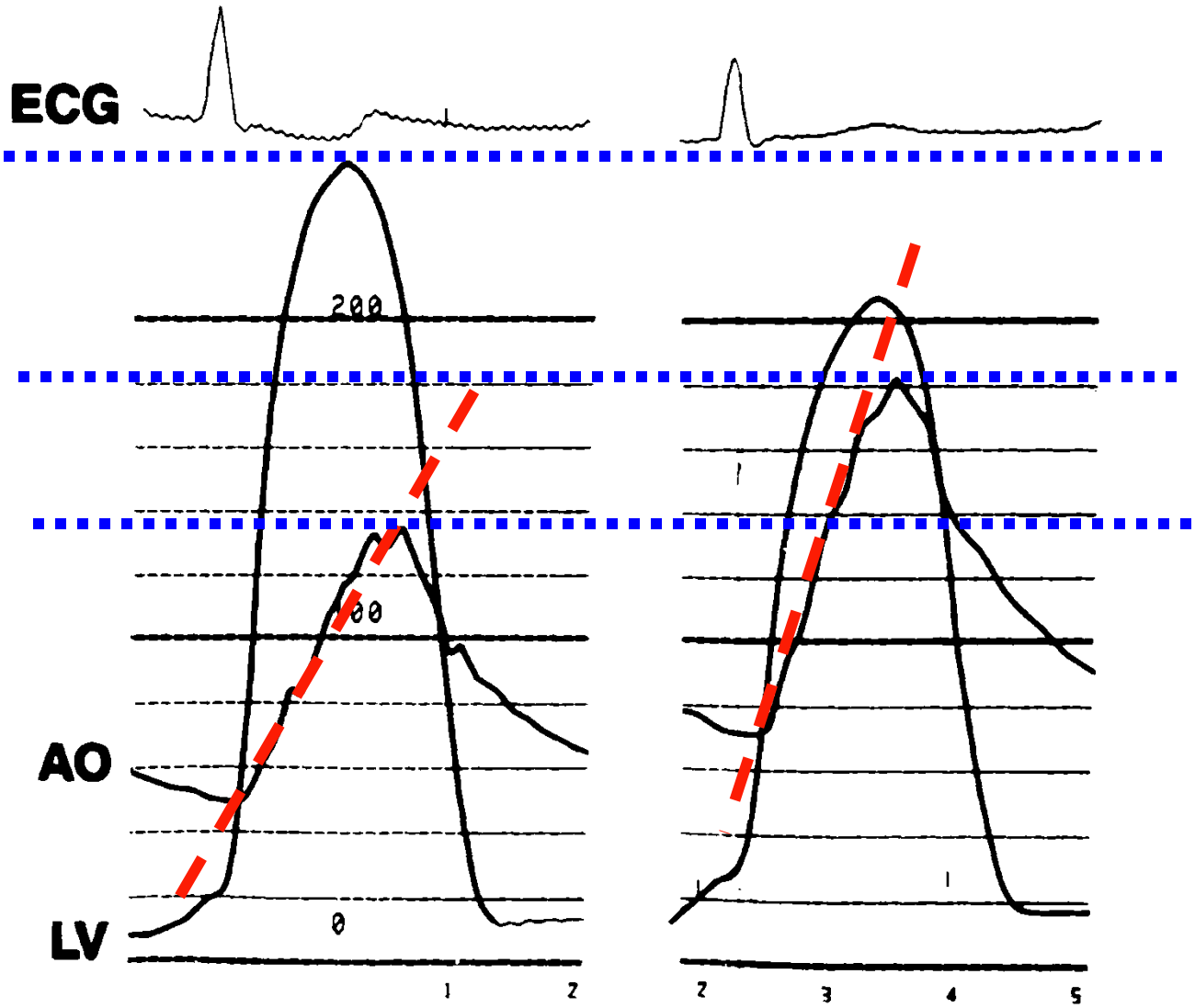
CoreValve PHV

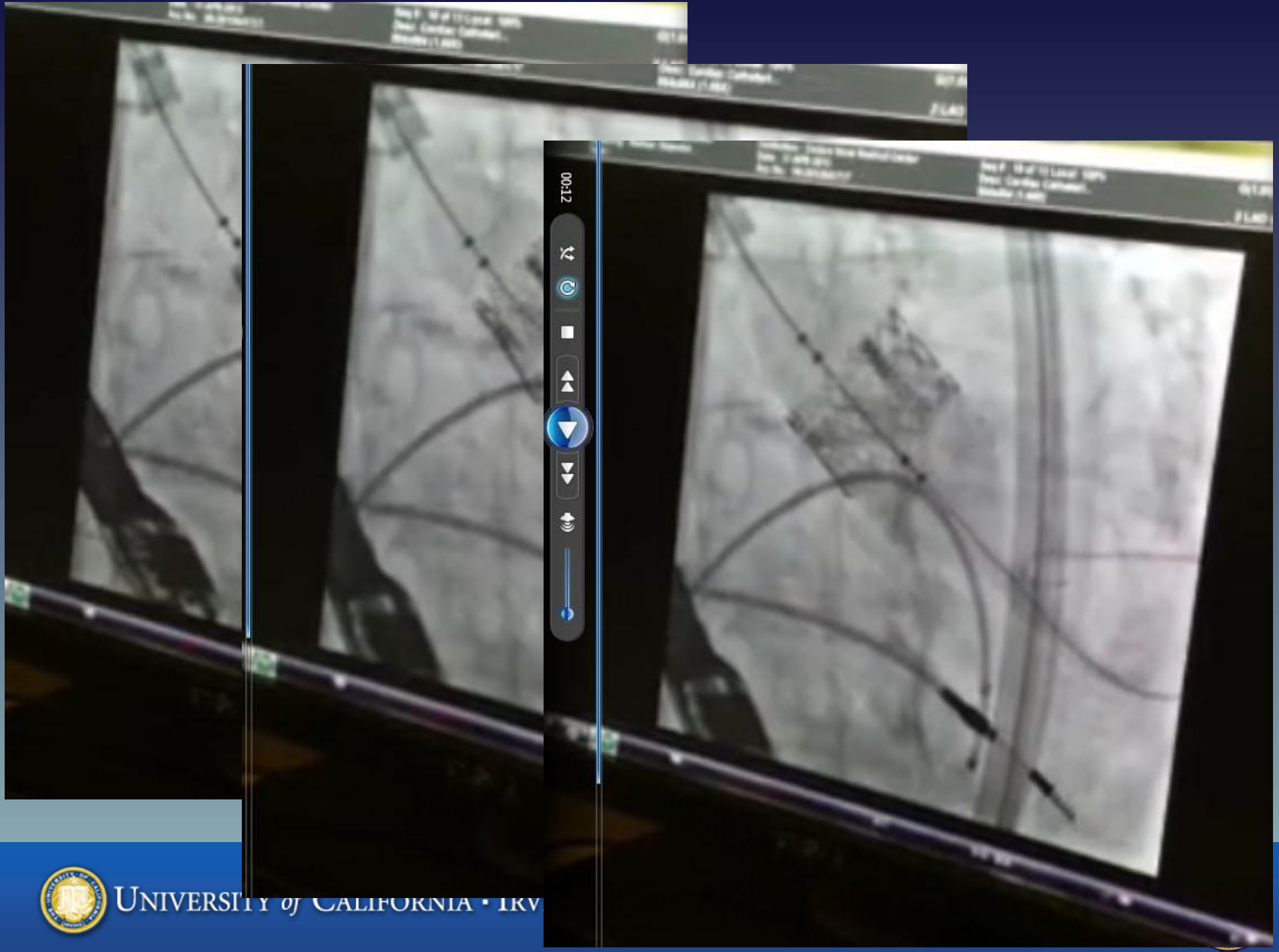


Edwards-Sapien PHV

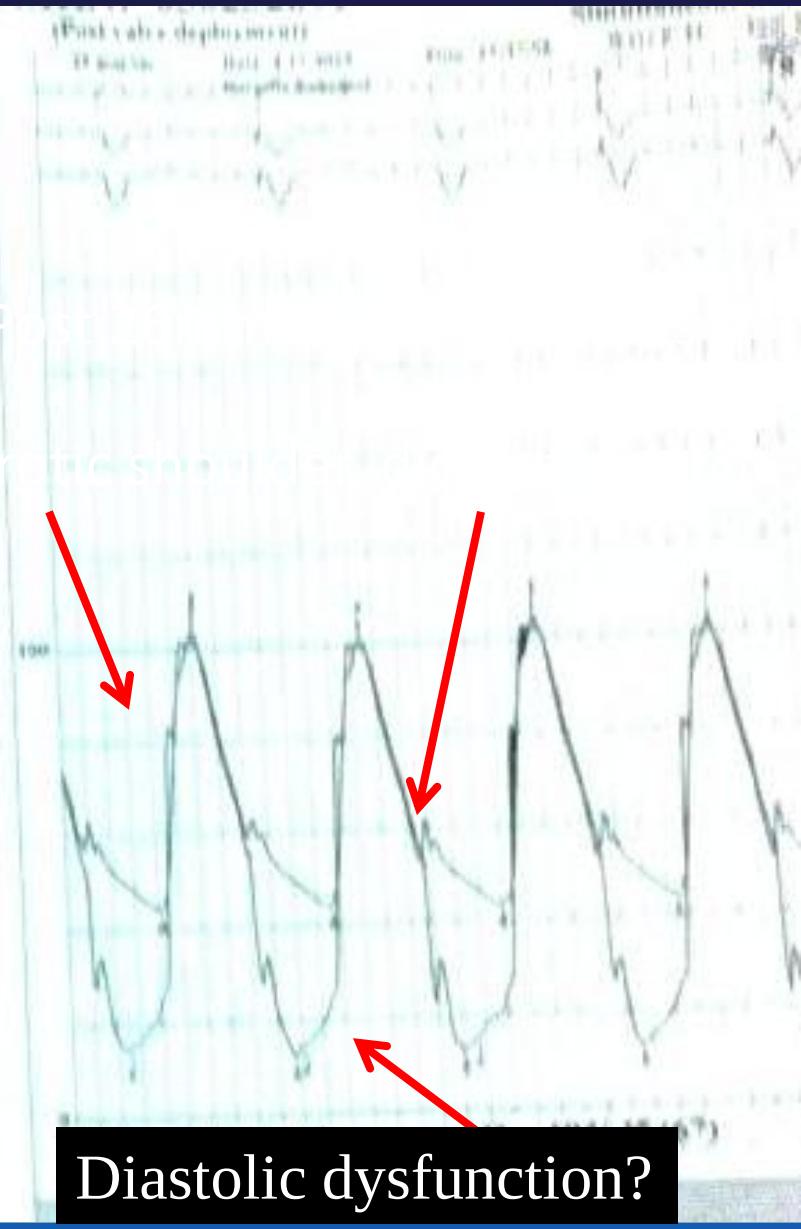


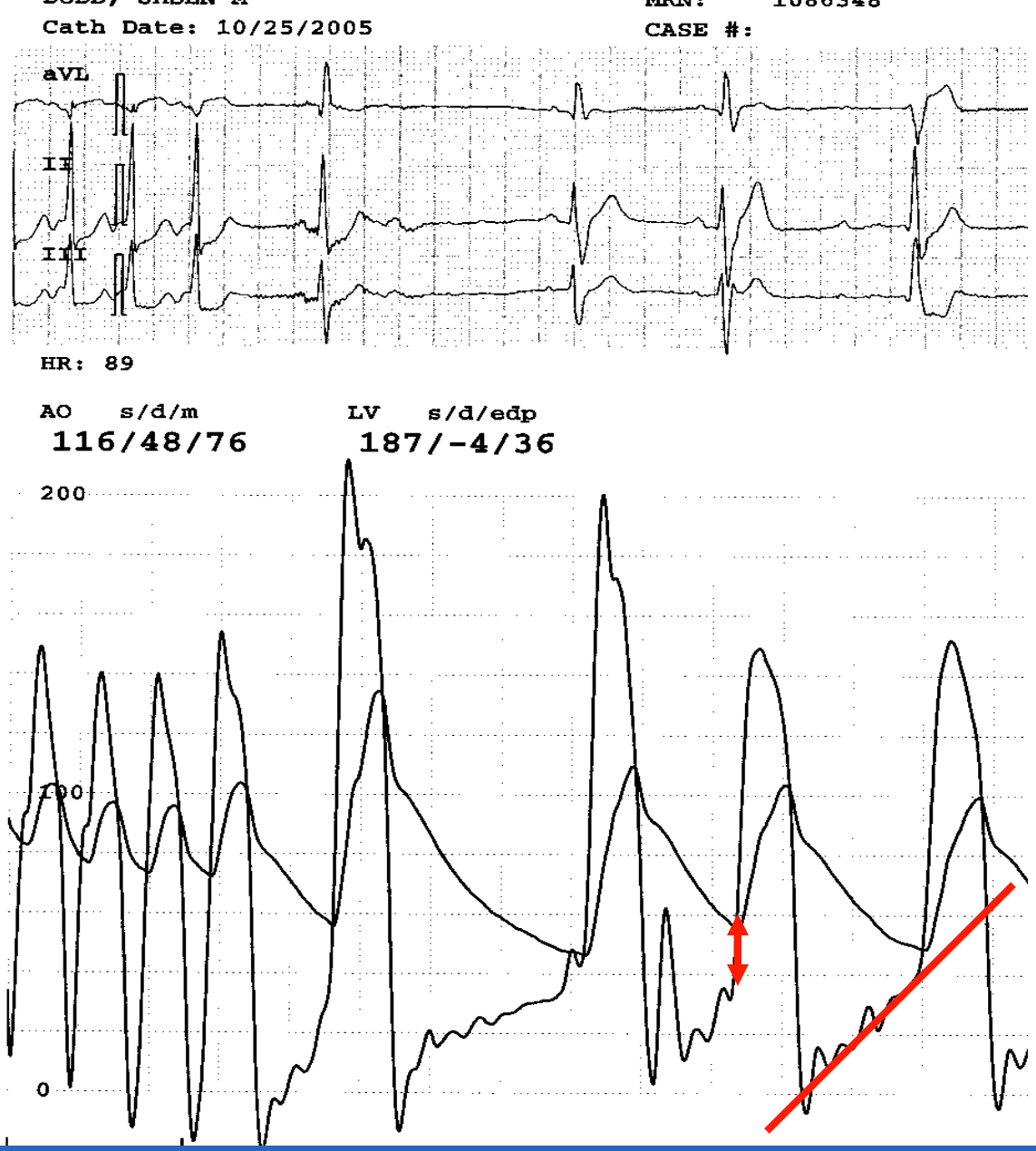
Chiam, P. T.L. et al. J Am Coll Cardiol Intv 2008;1:341-350


ECG
200
00
AO
LV
0
1
2
2
3
4
5
Before
After

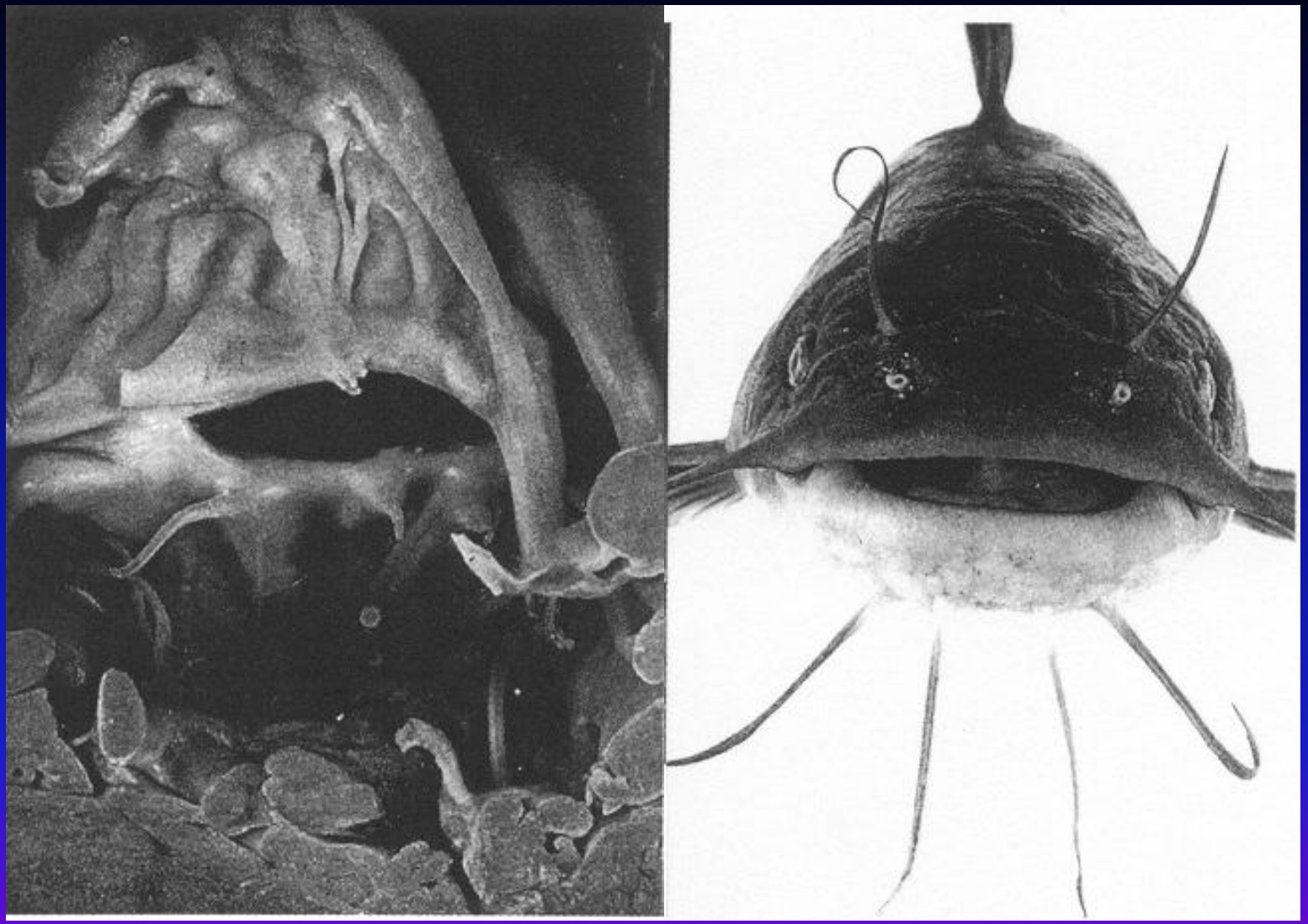

00:12

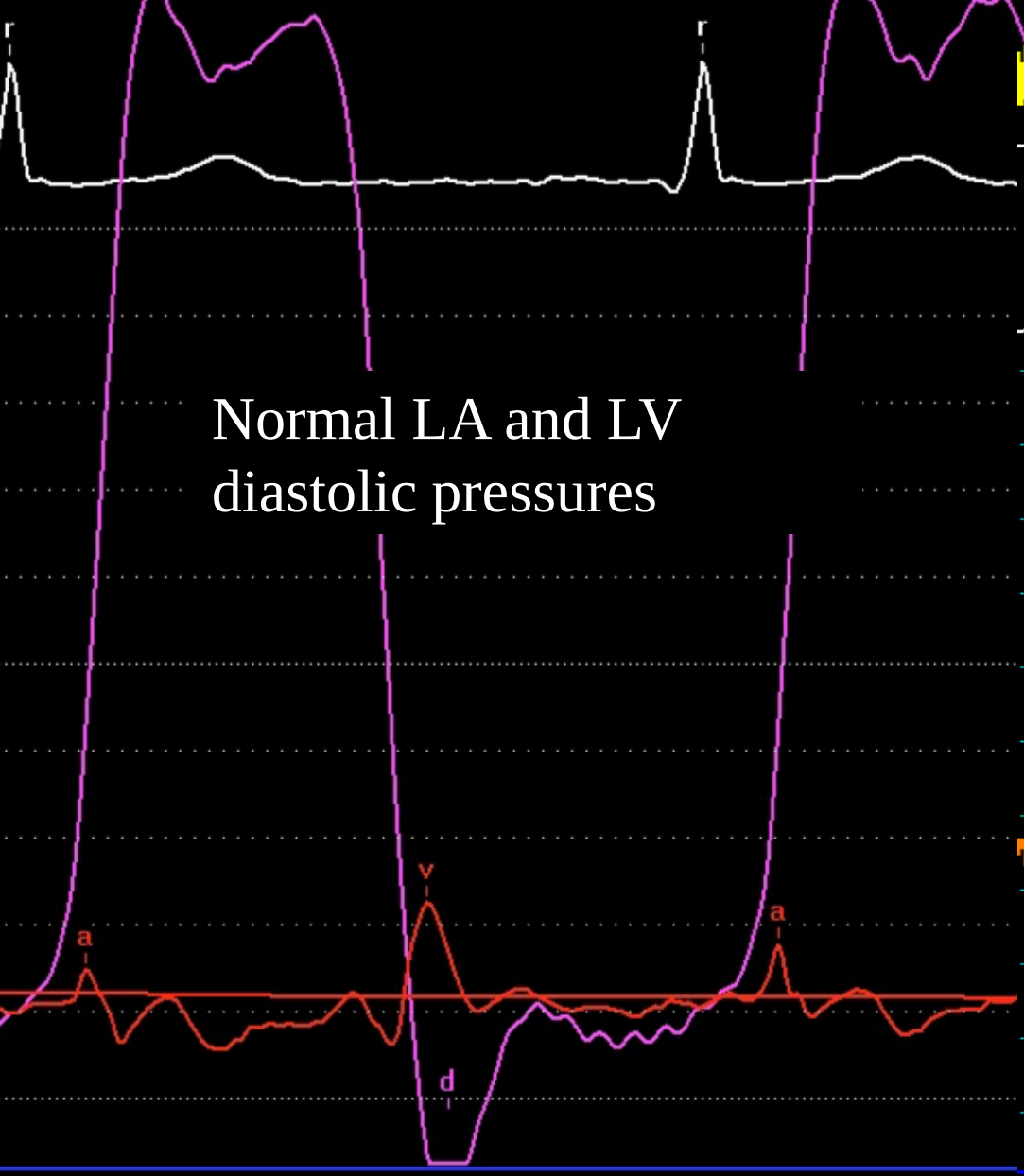

Pre-
Delayed upslope


Diastolic dysfunction?

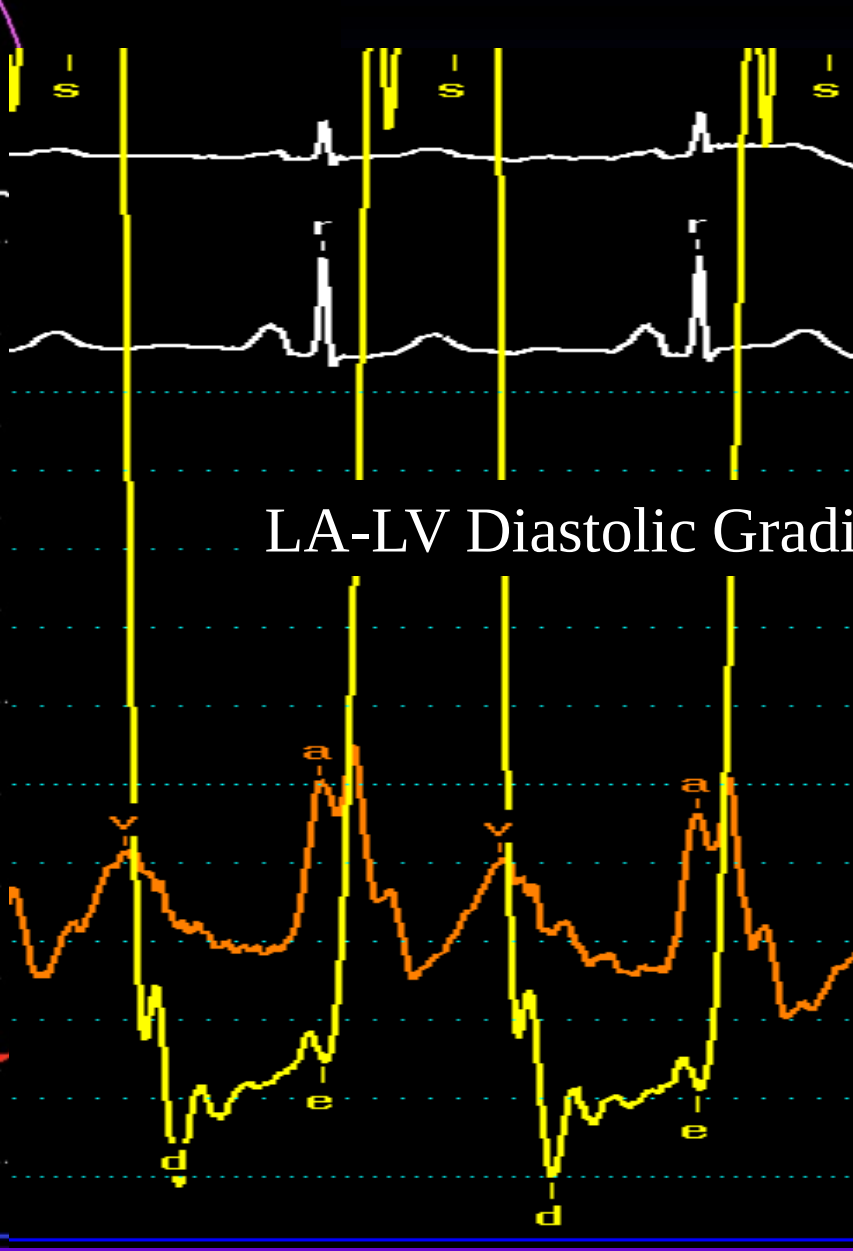

Cath Date: 10/25/2005
CASE #:
aVL
II
III
HR: 89
AO s/d/m
116/48/76
LV s/d/edp
187/-4/36
200
100
0

AS+AI



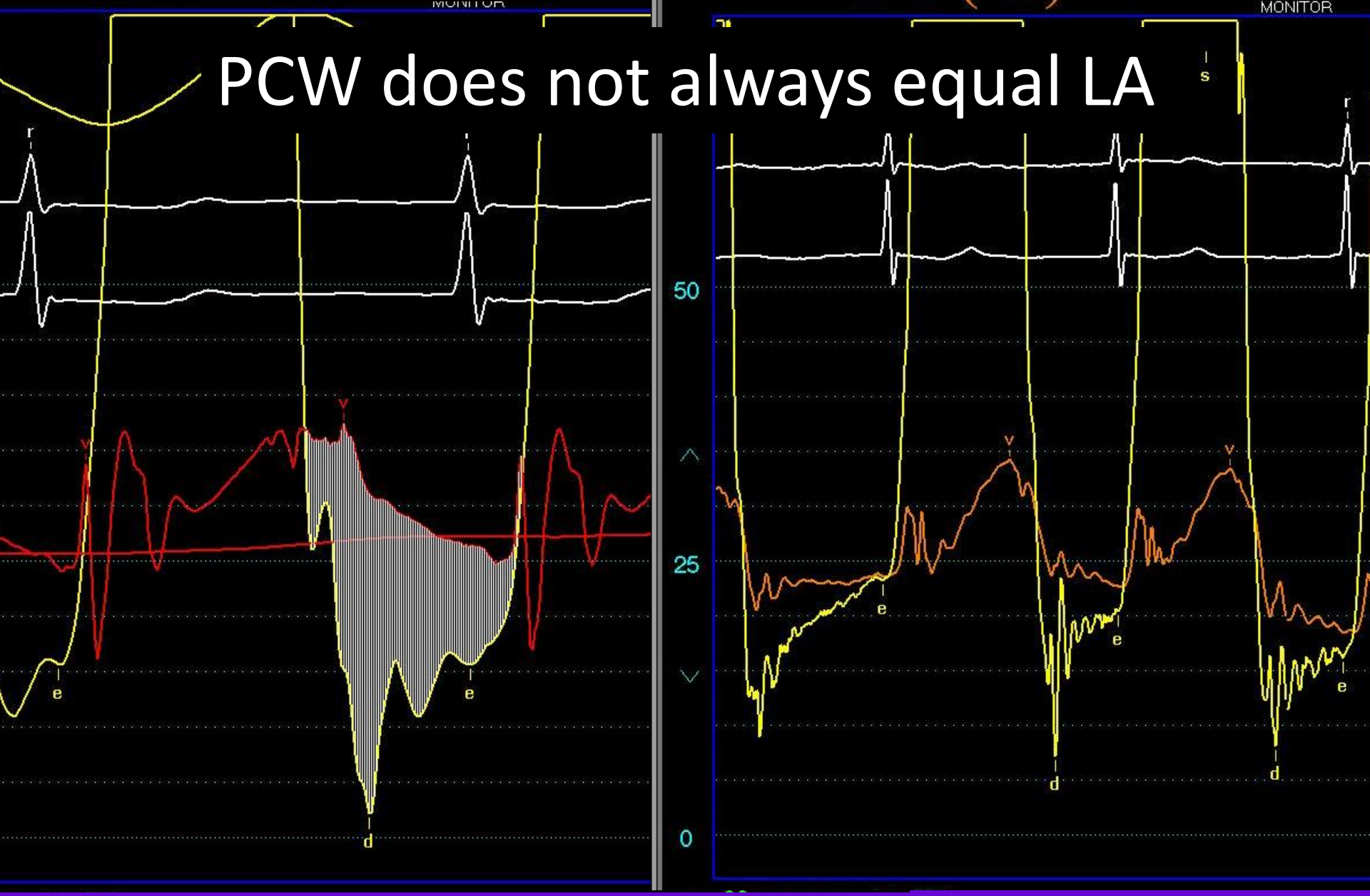


Normal LA and LV diastolic pressures

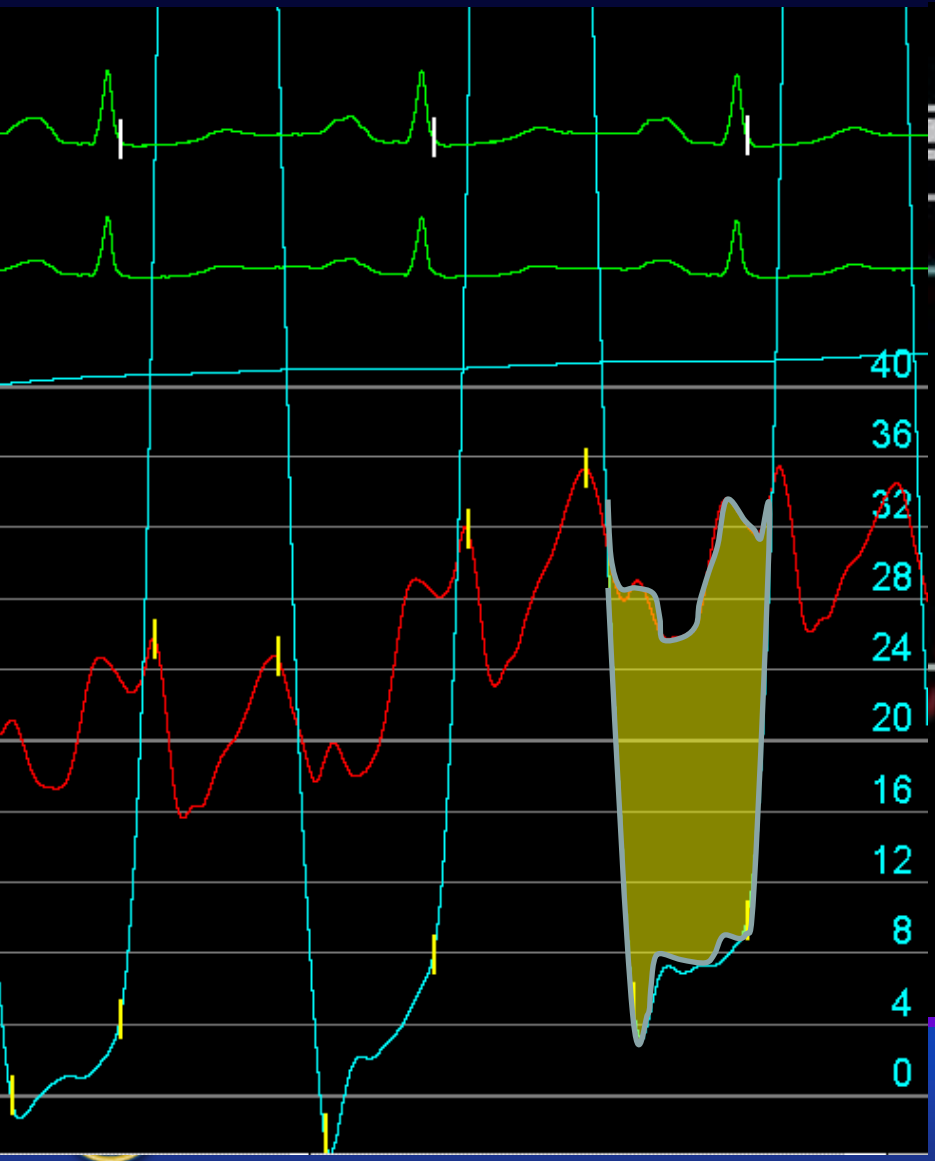


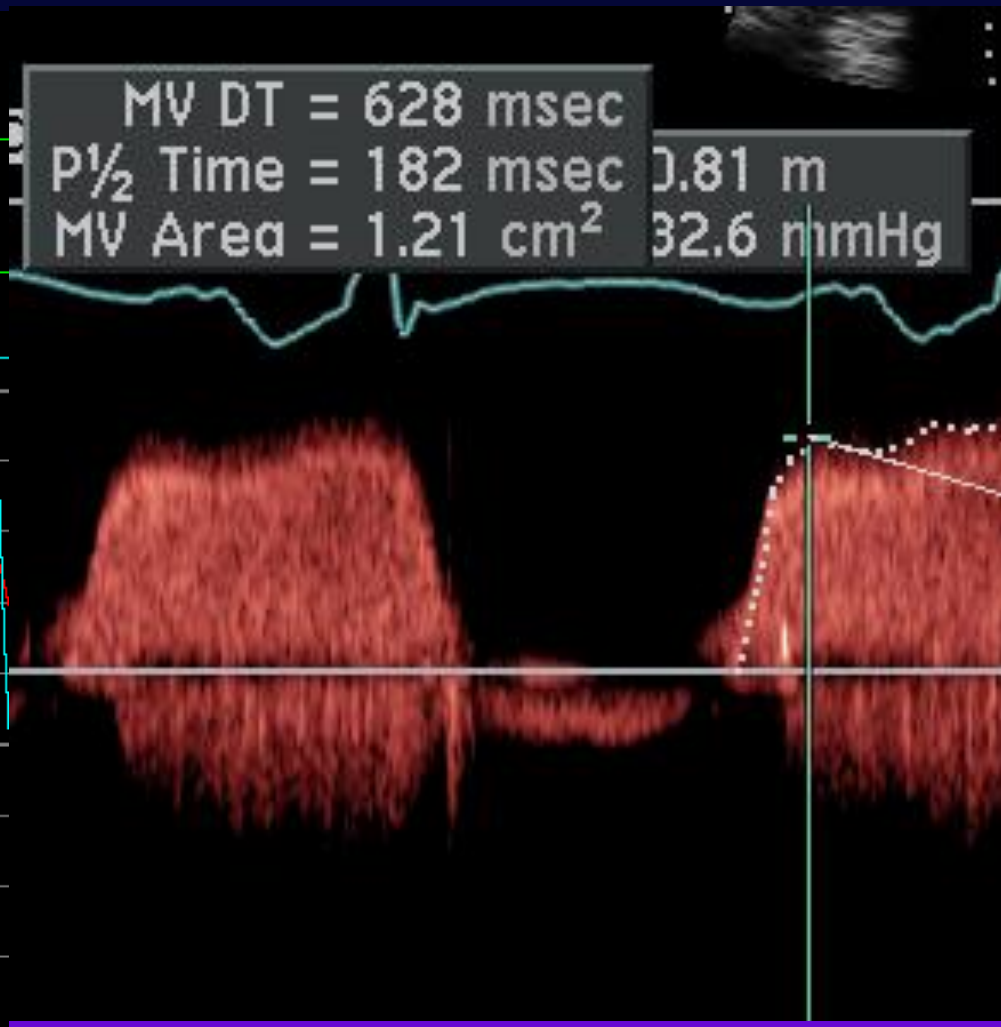
LA-LV Diastolic Gradi

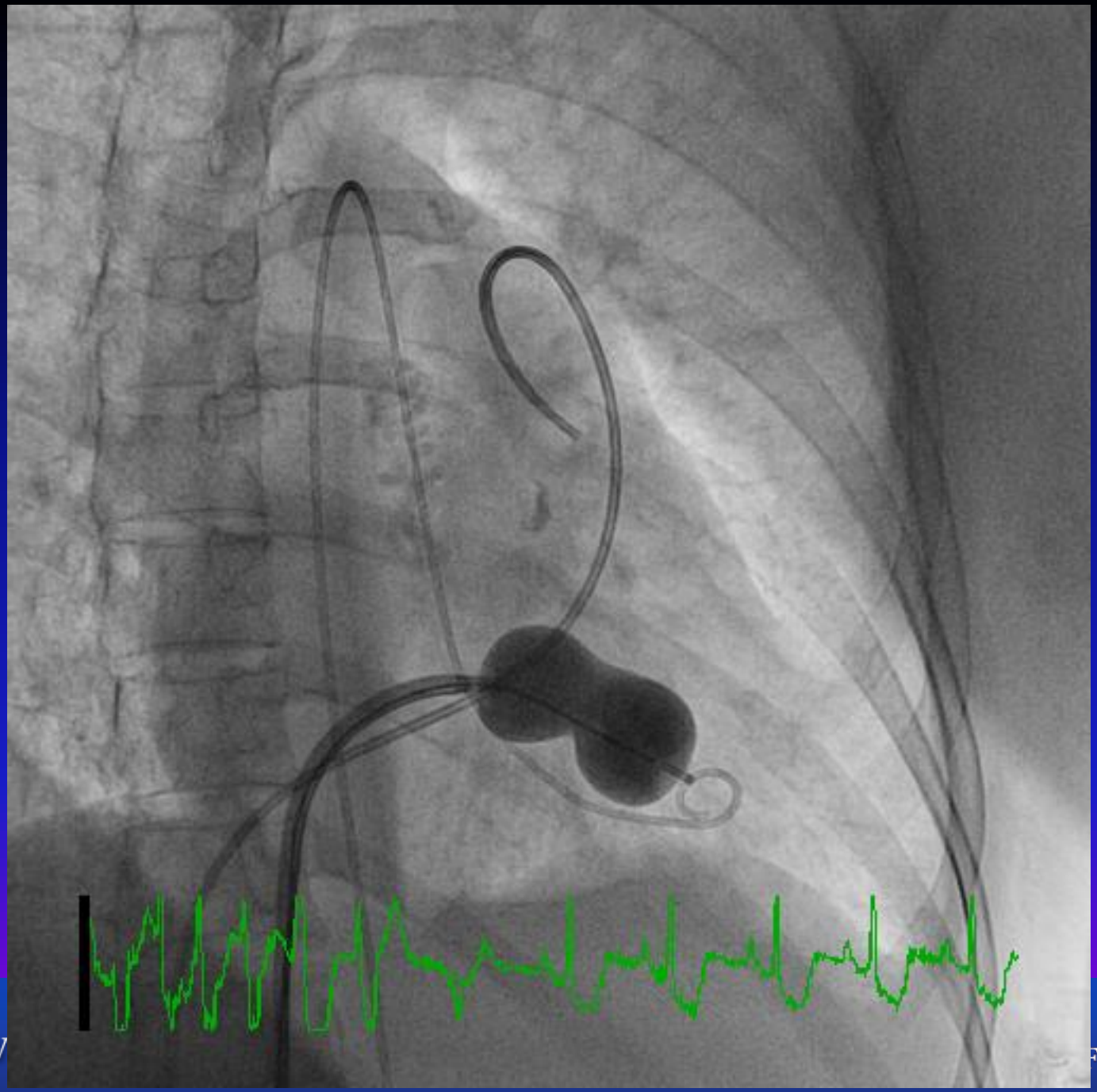
PCW does not always equal LA



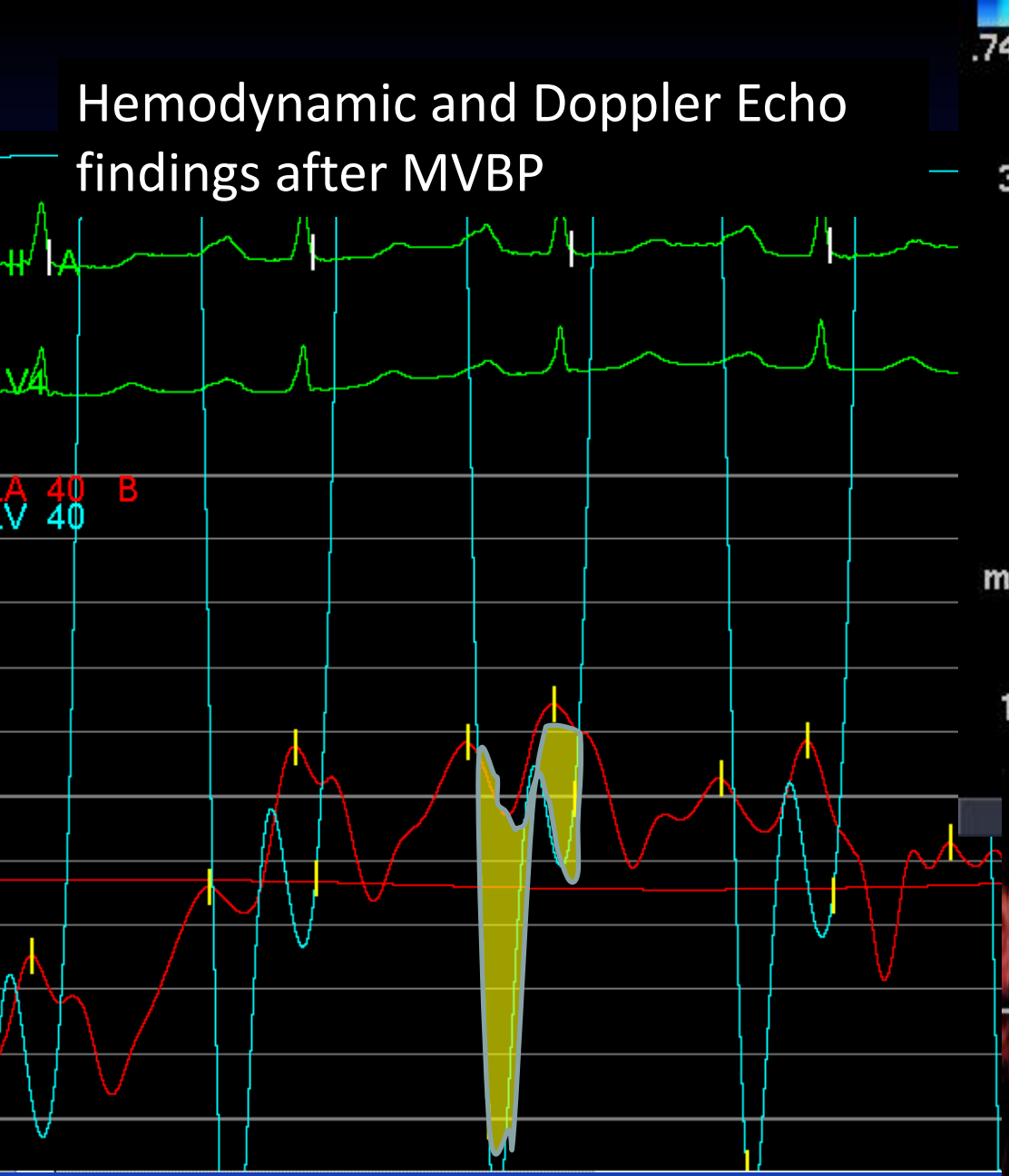
Hemodynamics and Doppler Echo findings before MVBP

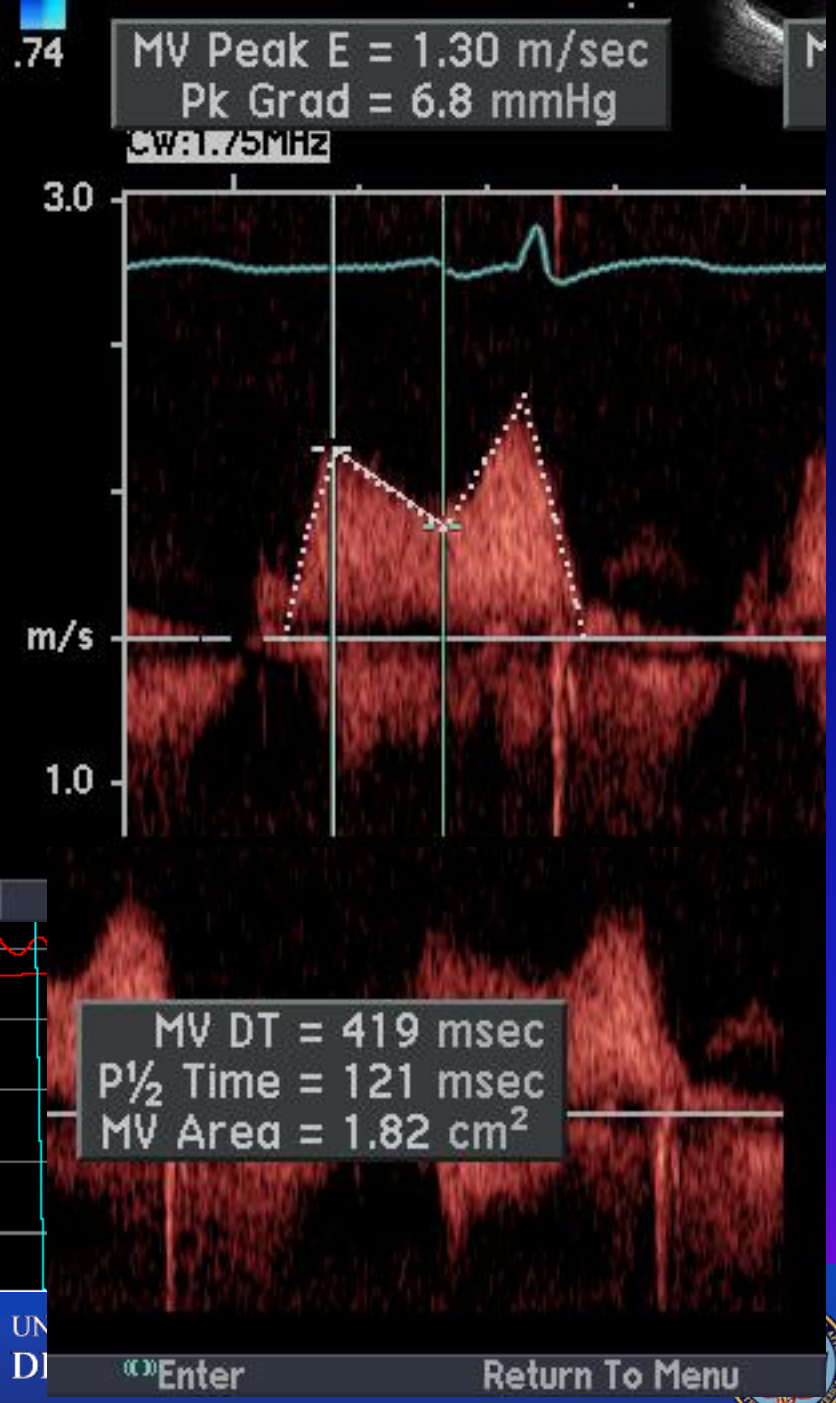


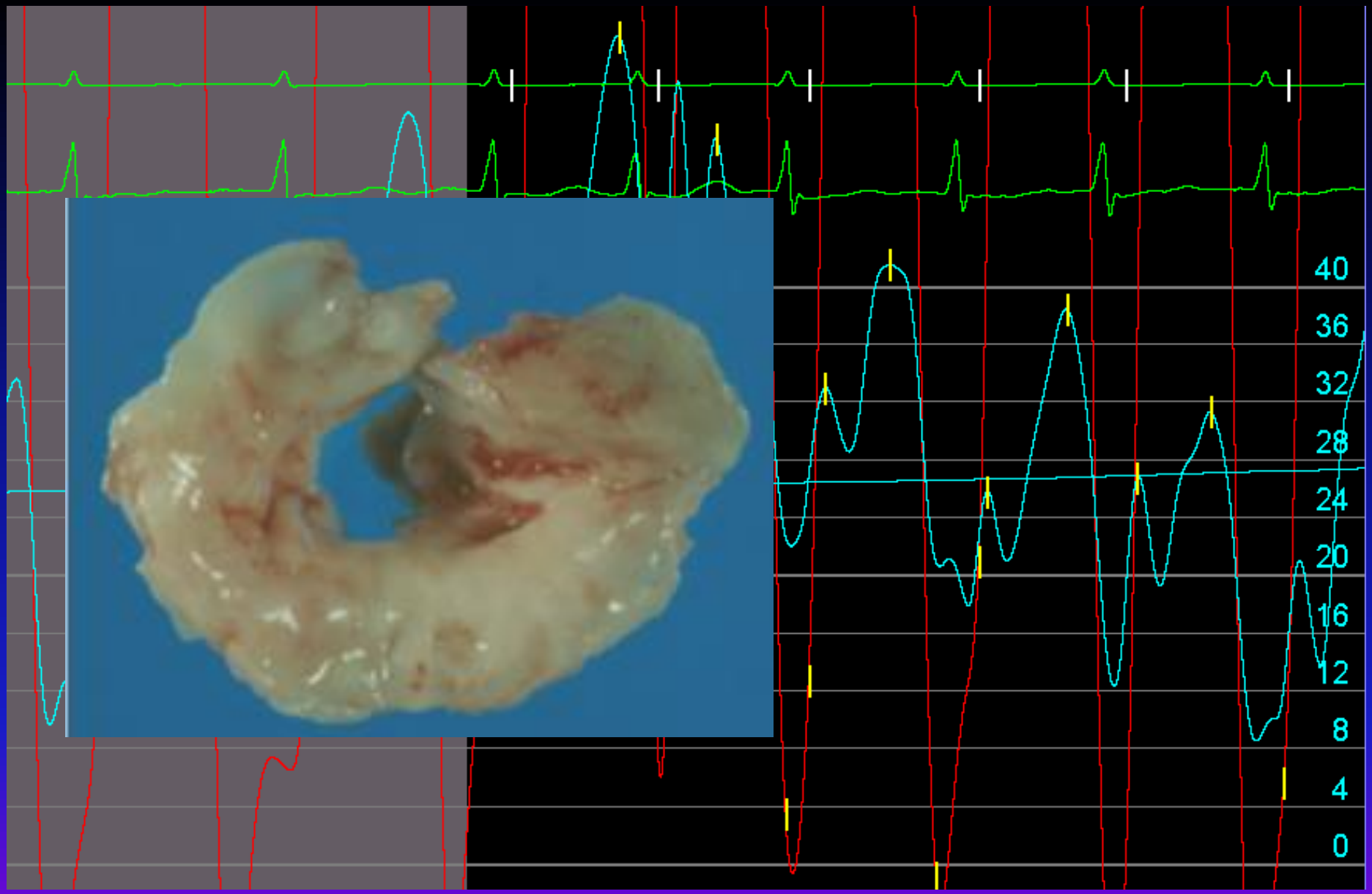




Hemodynamic and Doppler Echo findings after MVBP






40
36
32
28
24
20
16
12
8
4
0

Hemodynamics for Structrual Heart Disease

Low Gradient AS
Complications of AVP – AI
AS vs. HOCM
Mitral Regurgitation after MVP for MS
Diastolic CHF – constrictive v Restrictive
Tamponade

For your own review consider Intracardiac Shunts