

**MITRAL VALVE
STENOSIS:
QUANTITATIVE METHODS**

**Robert A. Levine, MD
Judy Hung, MD**

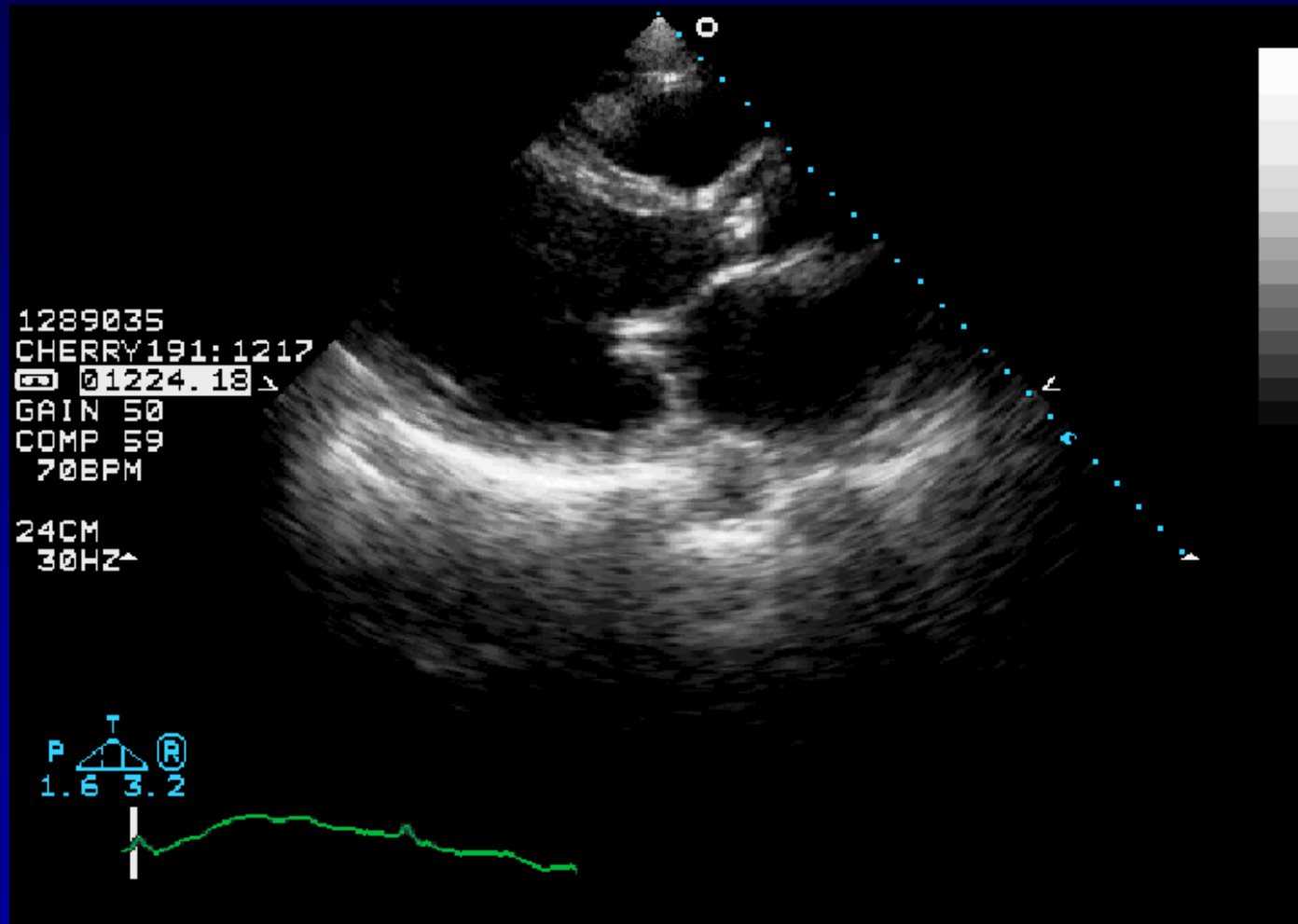
MITRAL STENOSIS

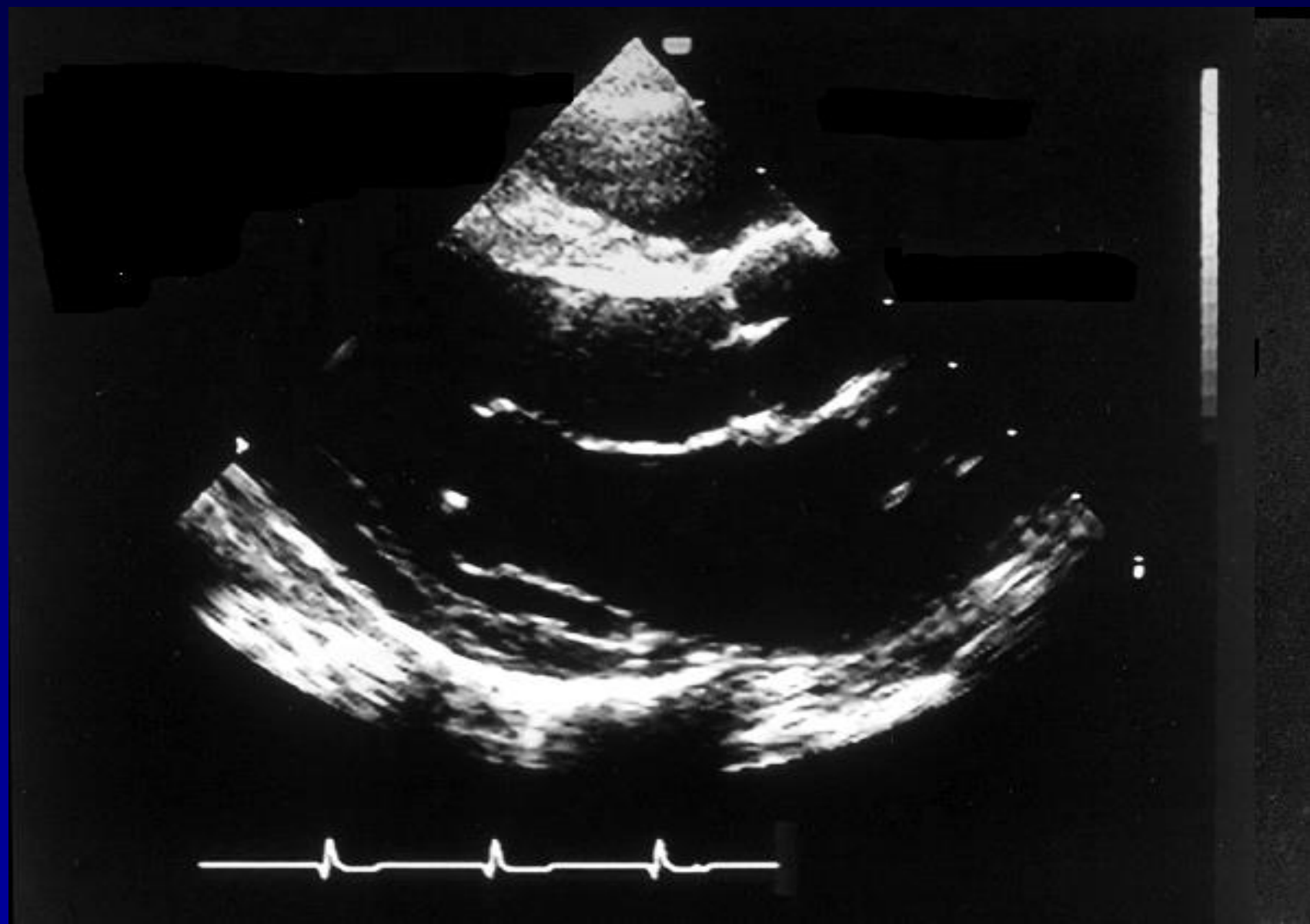
- **Diagnosis**
- **Quantification**
- **Management**

**Diastolic mitral leaflet doming
concave toward the LA is seen in:**

- 1. Only rheumatic MS**
- 2. Rheumatic and calcific MS**
- 3. Rheumatic and congenital MS**
- 4. Rheumatic MS, and AI with
flow impinging on the MV**

Rheumatic MS



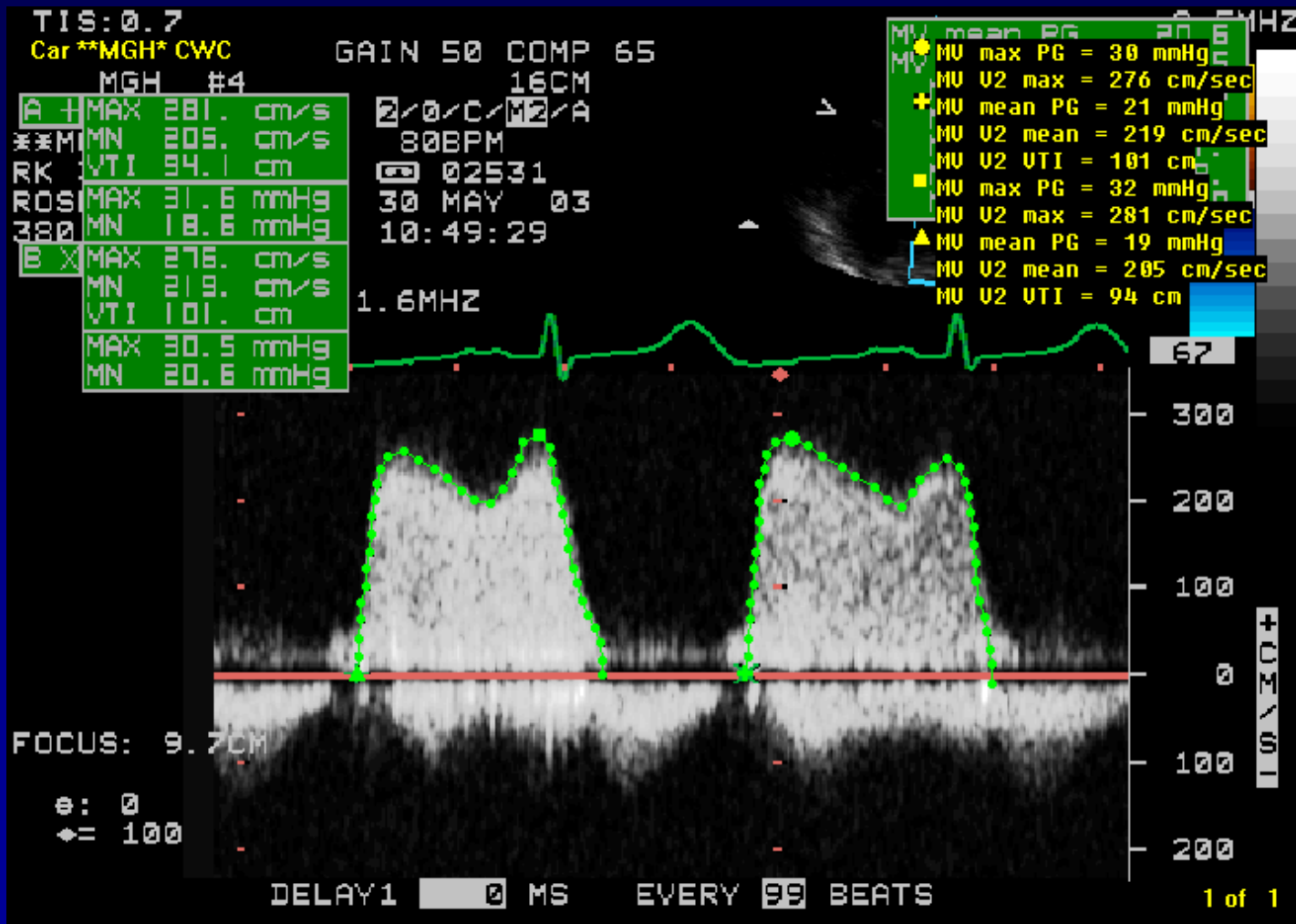




MITRAL STENOSIS

- **Diagnosis**
- **Quantification**
- **Management**

Pressure Gradient



MI: 1.1 TIS: 0.7

S3
MGH #1

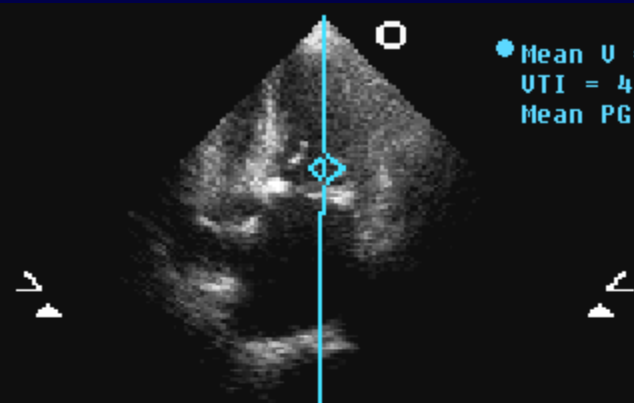
GAIN 64 COMP 49
20CM

2/0/C/F5
65BPM

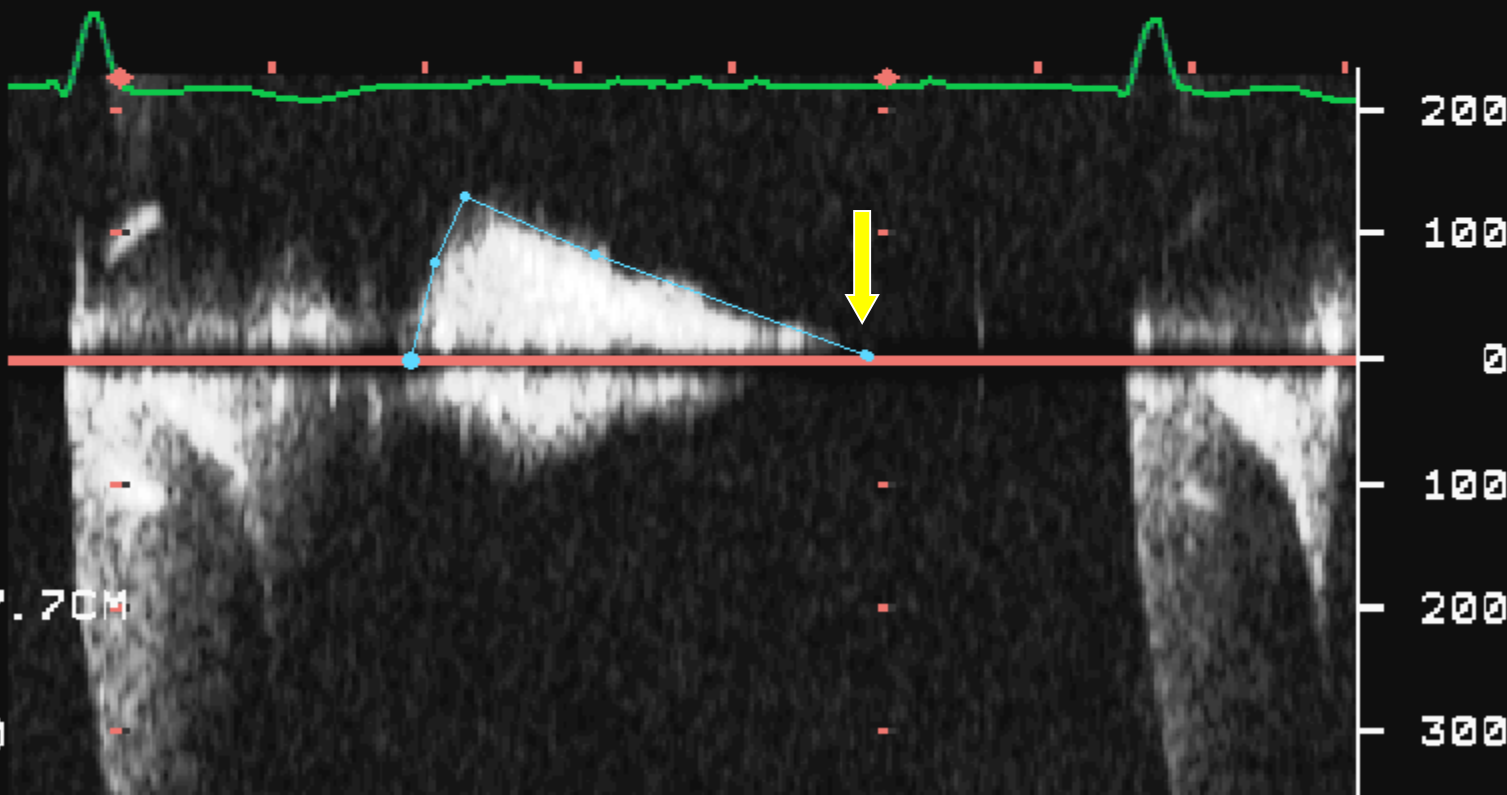
MR 267
CHRY 337: 1734
2674881

02472.09
05 APR 05
11:03:50

Mean U = 66 cm/sec
UTI = 40 cm
Mean PG = 2.3 mmHg



1.6MHZ



FOCUS: 7.7CM

⊖: 0
◆: 100

DELAY1 0 MS EVERY 30 BEATS

MI: 1.1 TIS: 0.7

S3
MGH #1

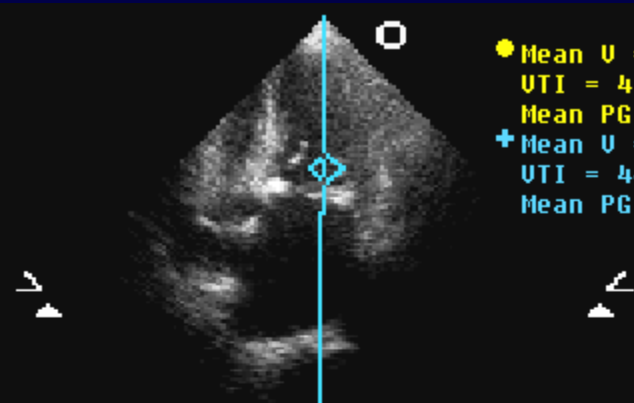
GAIN 64 COMP 49
20CM

2/0/C/F5
65BPM

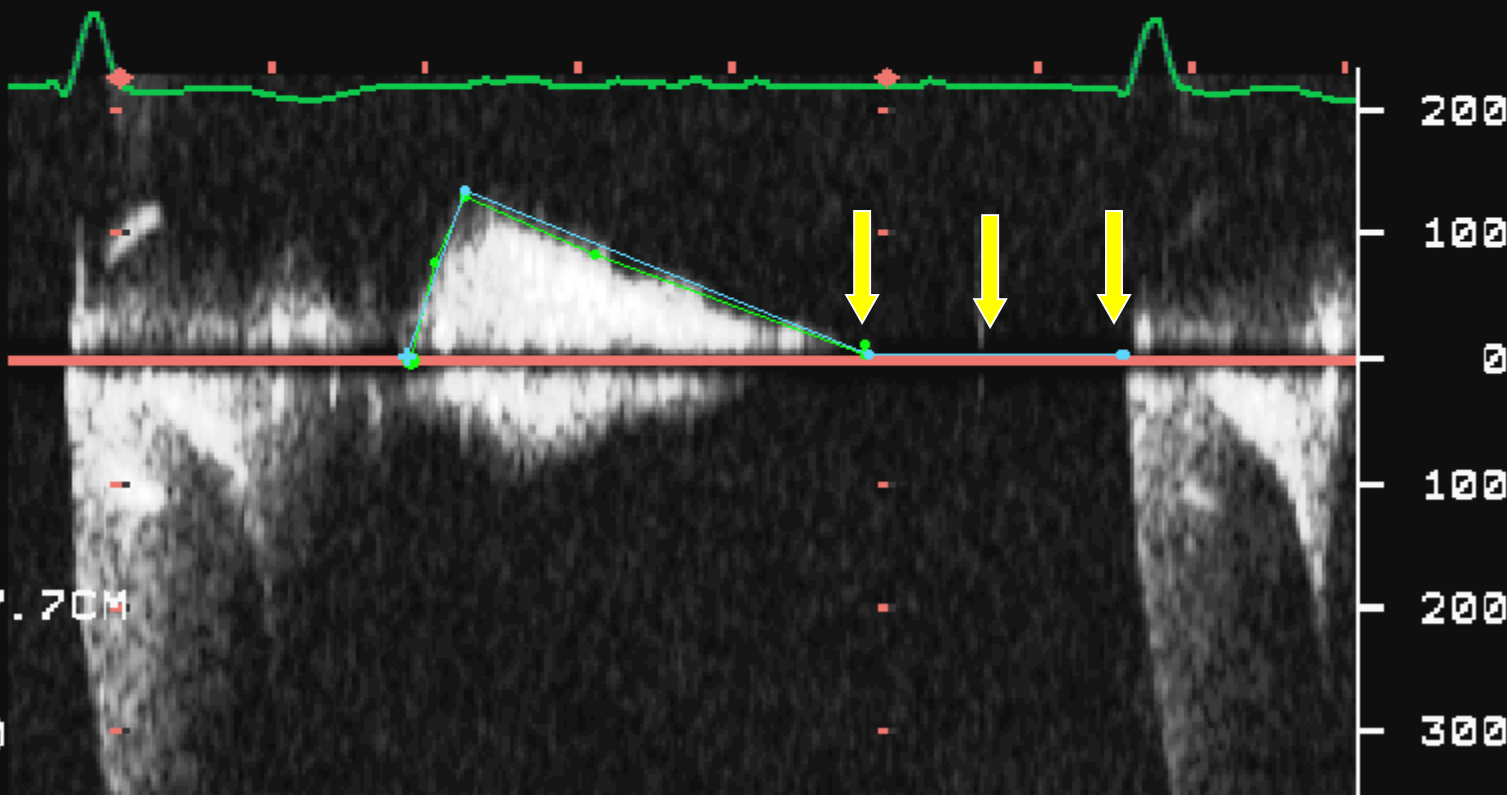
MR 267
CHRY 337: 1734
2674881

02472.09
05 APR 05
11:03:50

● Mean U = 68 cm/sec
UTI = 40 cm
Mean PG = 2.4 mmHg
+ Mean U = 47 cm/sec
UTI = 44 cm
Mean PG = 1.7 mmHg



1.6MHZ



FOCUS: 7.7CM

⊖: 0
◆: 100

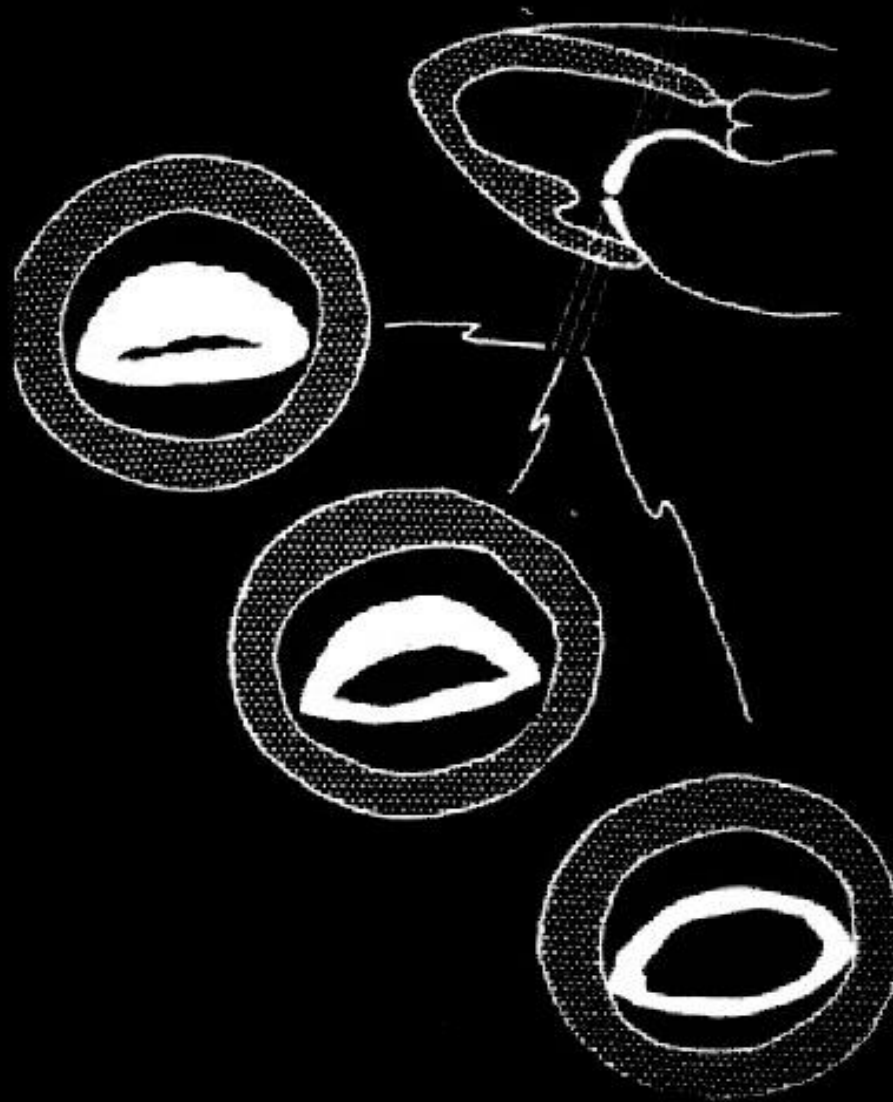
DELAY1 0 MS EVERY 30 BEATS

Assessment of Mitral Stenosis

- **Mitral valve area measurement**
 - **$> 1.5 \text{ cm}^2$ - Mild**
 - **$1.1 \text{ to } 1.5 \text{ cm}^2$ - Moderate**
 - **$< \text{ or } = 1.0 \text{ cm}^2$ - Severe**

Quantification of Mitral Valve Area

- **Direct Planimetry**
- **Pressure Half-Time**
- **Continuity / PISA**



Martin and Stamm

LONG AXIS

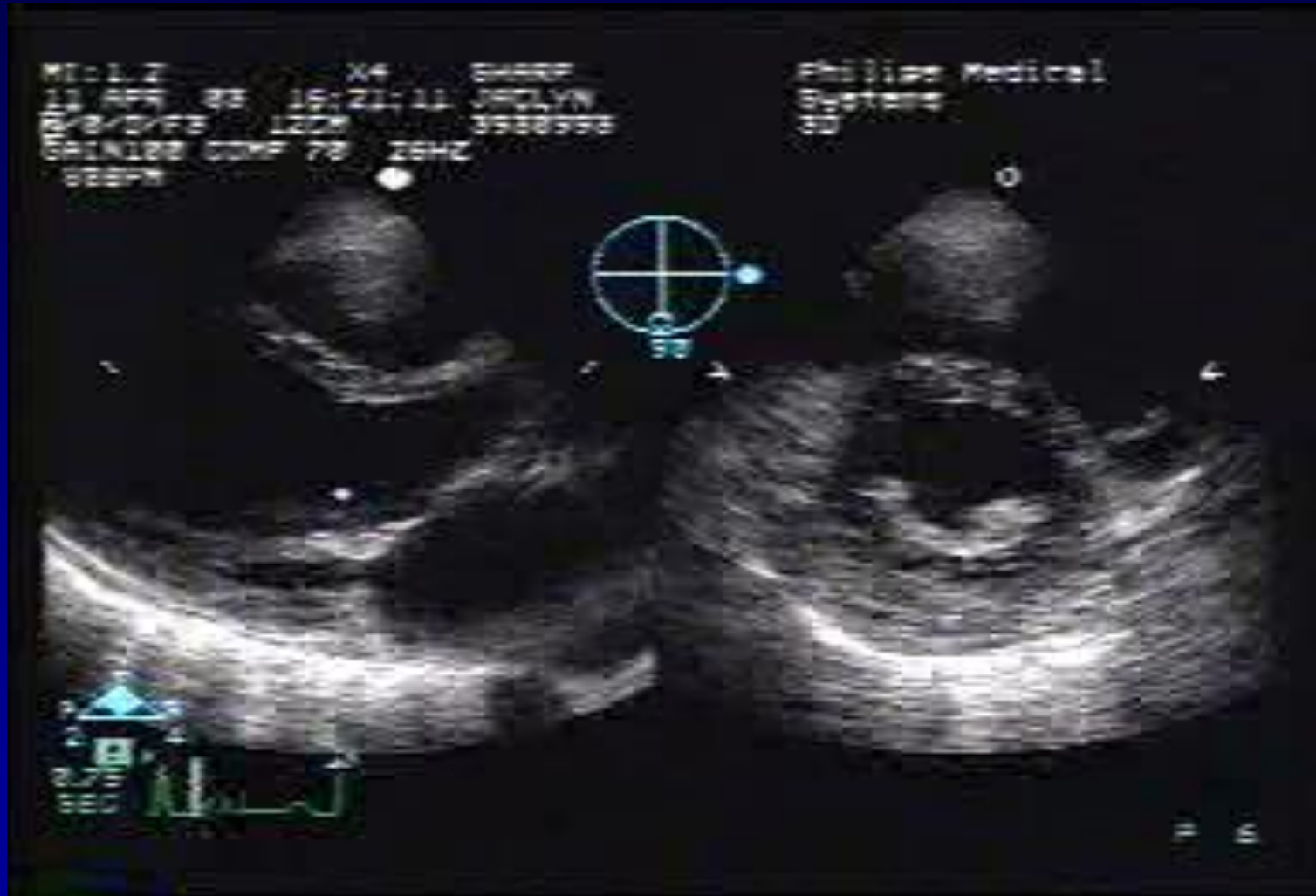


SHORT AXIS



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Real-Time 3D: Biplane Feature

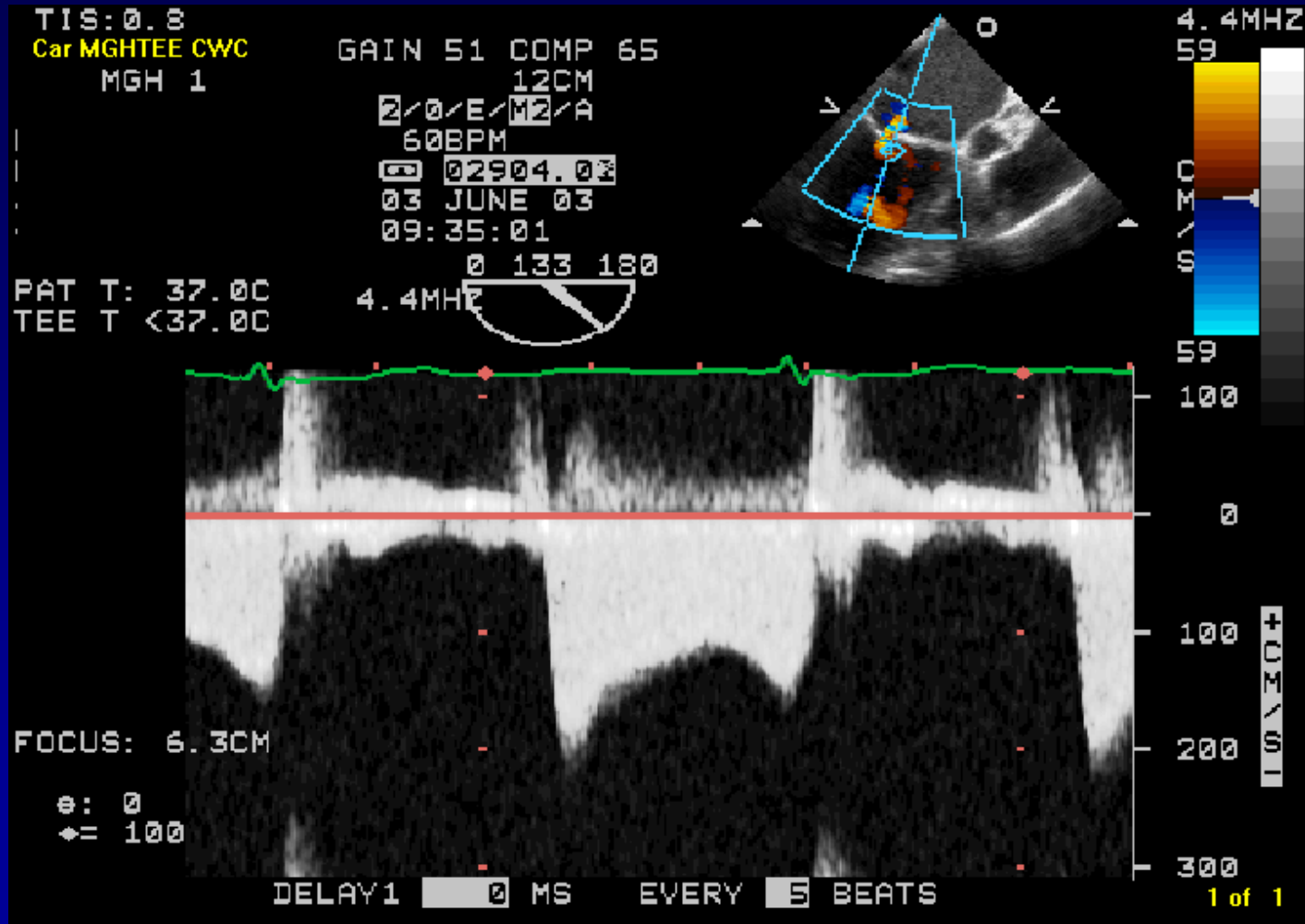


Sebag AJC 2005

Quantification of Mitral Valve Area

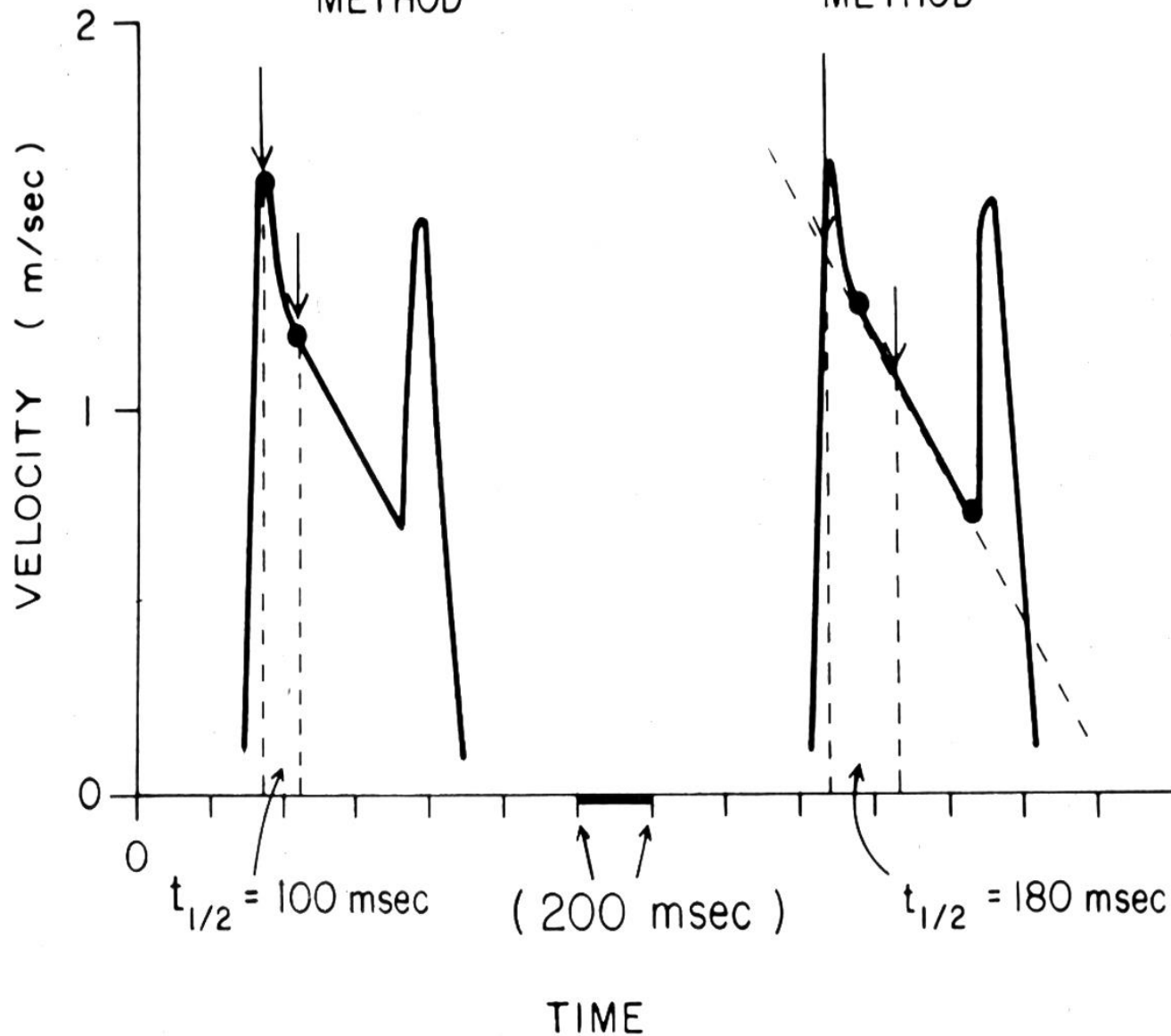
- **Direct Planimetry**
- **Pressure Half-Time**
- **Continuity / PISA**

P1/2: Nonlinear Slope



"DIRECT" MEASUREMENT
METHOD

LINE - DRAWING
METHOD



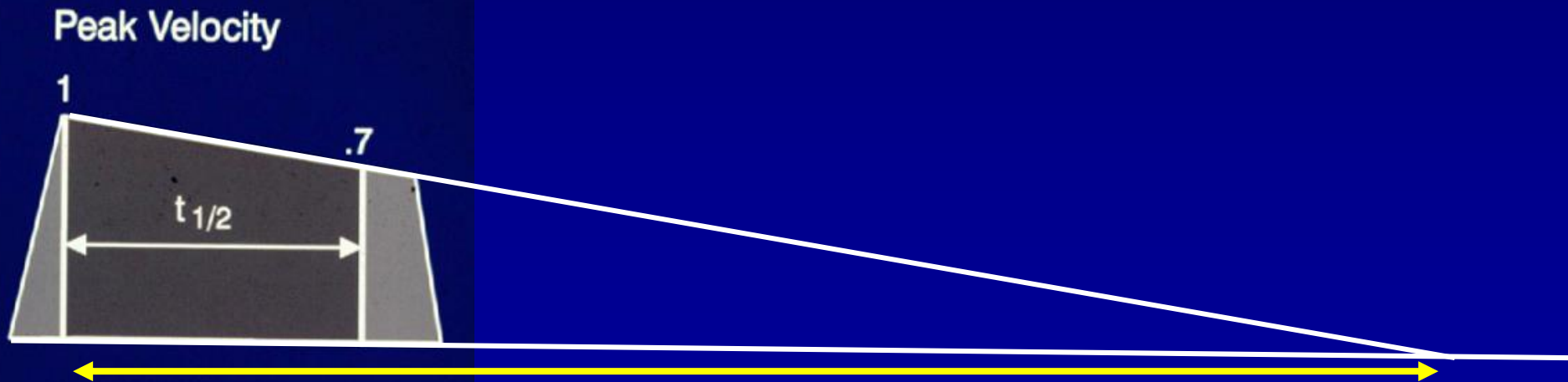
A patient has mitral stenosis with an E-wave deceleration time of 1000 milliseconds. What is the mitral valve area?

- 1. 0.22 cm²**
- 2. 0.75 cm²**
- 3. Depends on cardiac output**
- 4. 1.5 cm²**

PHT = 29% of total deceleration time (DT)

MVA = 220 / Pressure half time

MVA = 750 / Deceleration time



Deceleration time

MITRAL PRESSURE HALF-TIME

Comparison of Formulations

- Empirical formulation:

$$T_{1/2} = 220 / MVA$$

- Theoretical derivation:

$$T_{1/2} = \frac{11.6 C_n \sqrt{P}}{c_c MVA}$$

$T_{1/2}$ = mitral half-time (ms)

MVA = anatomic valve area (cm^2)

C_n = mean net LA and LV compliance (cm^3/mmHg)

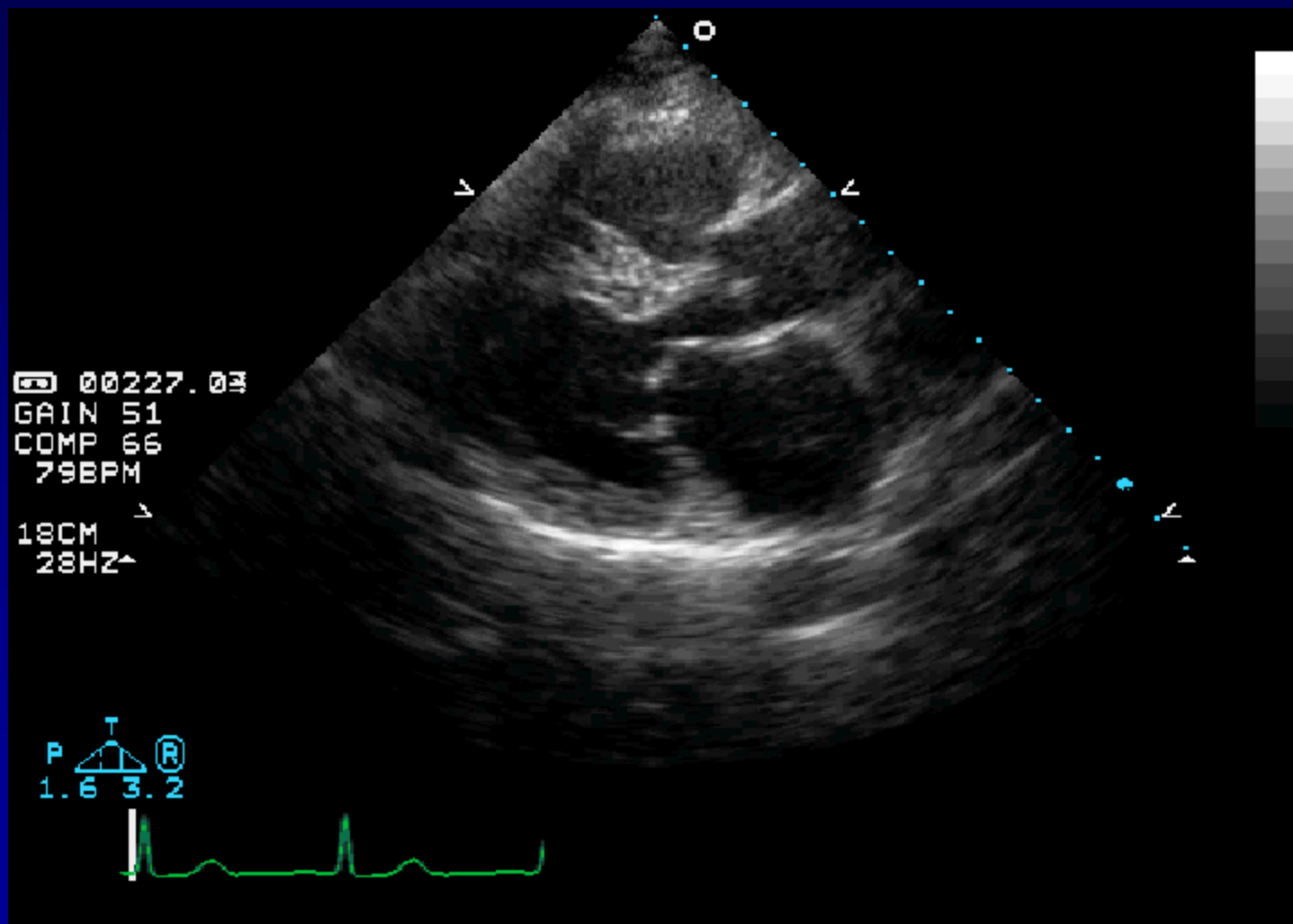
P = peak LA-LV pressure gradient (mmHg)

c_c = coefficient of contraction (about 0.78)

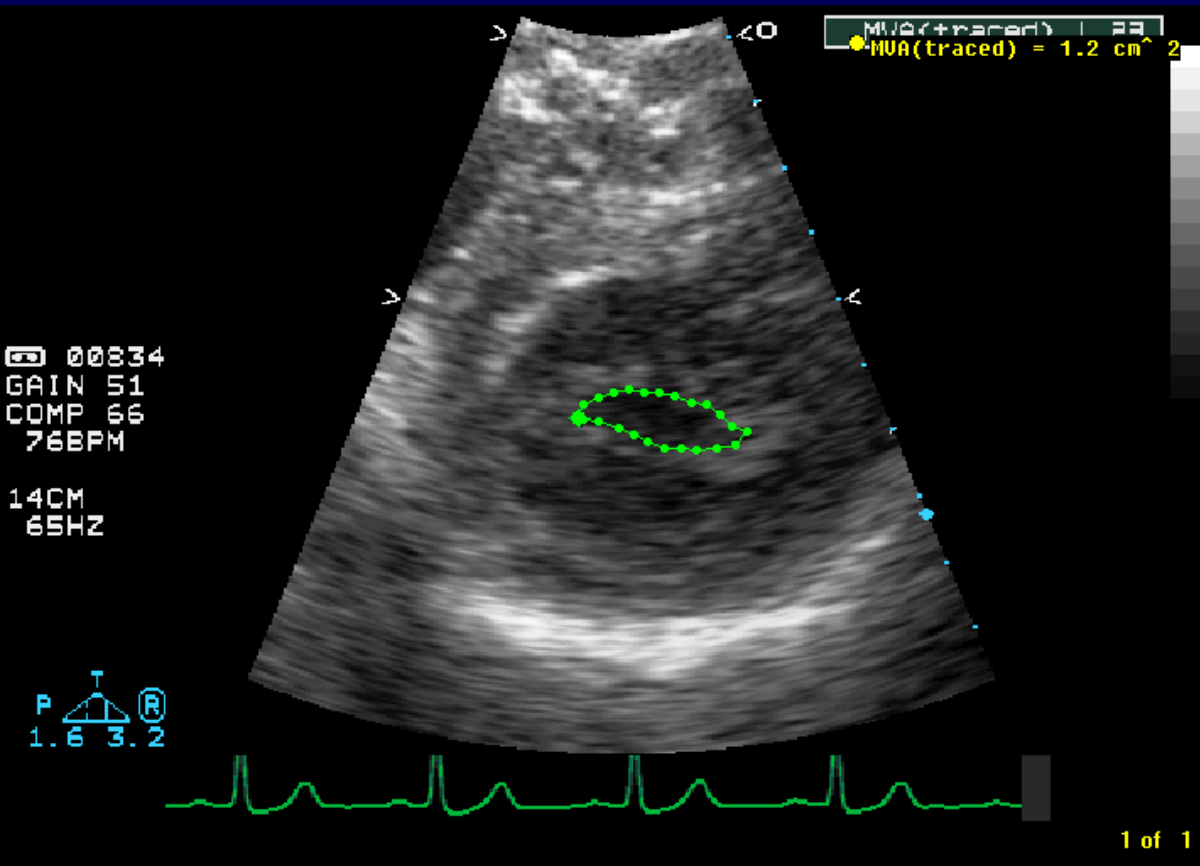
Transmitral E-wave deceleration time varies most consistently with which physiological parameters?

- 1. Directly with mitral valve area, directly with ventricular stiffness**
- 2. Directly with mitral valve area, inversely with ventricular stiffness**
- 3. Inversely with mitral valve area, directly with ventricular stiffness**
- 4. Inversely with mitral valve area, inversely with ventricular stiffness**

Rheumatic Mitral Valve Stenosis: Case

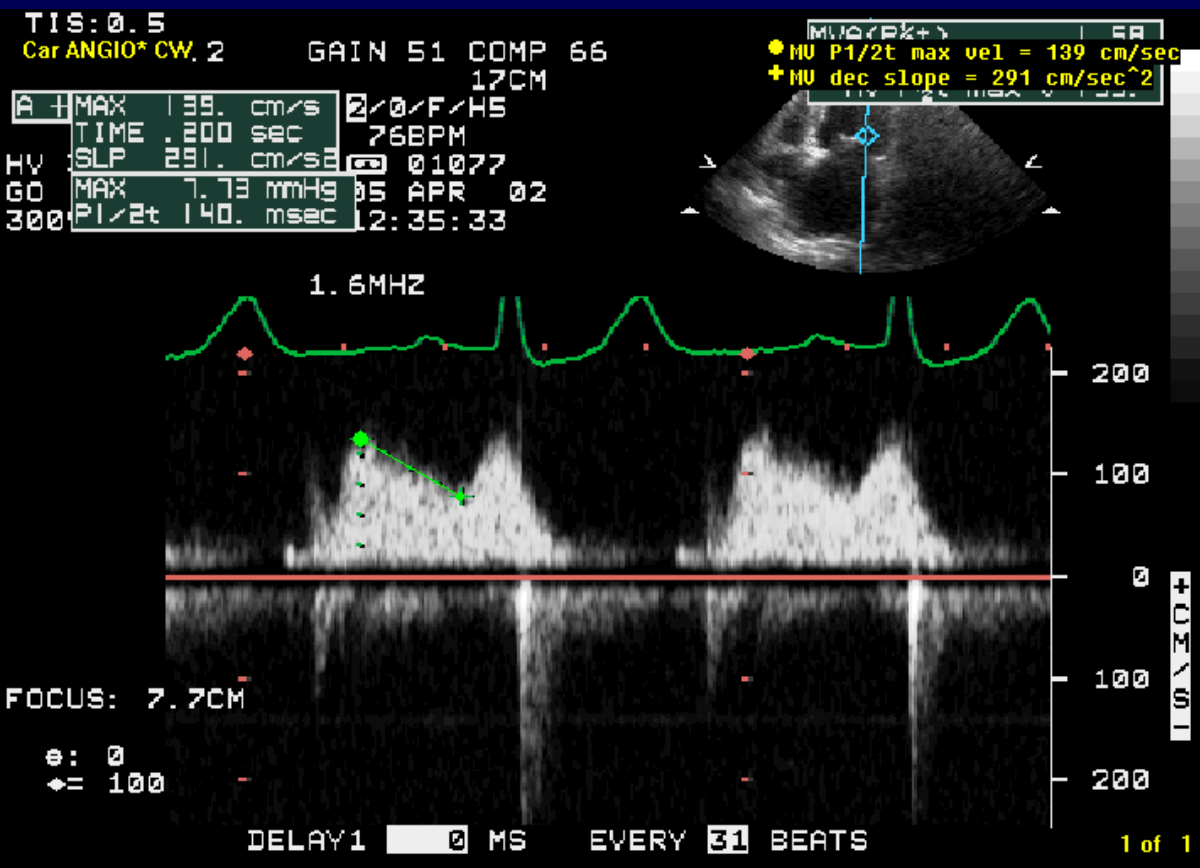


Rheumatic Mitral Valve Stenosis



**MVA by
Planimetry =
1.2 cm²**

Rheumatic Mitral Valve Stenosis



**MVA by P $\frac{1}{2}$ t =
1.6 cm²**

**45-year-old woman with
mitral stenosis, dyspnea
and fatigue**

WCHS 2.5MHZ-M 60HZ 1ZCM

IOC 2/2/C

JUN 88 11:01:47

MODE: PCC

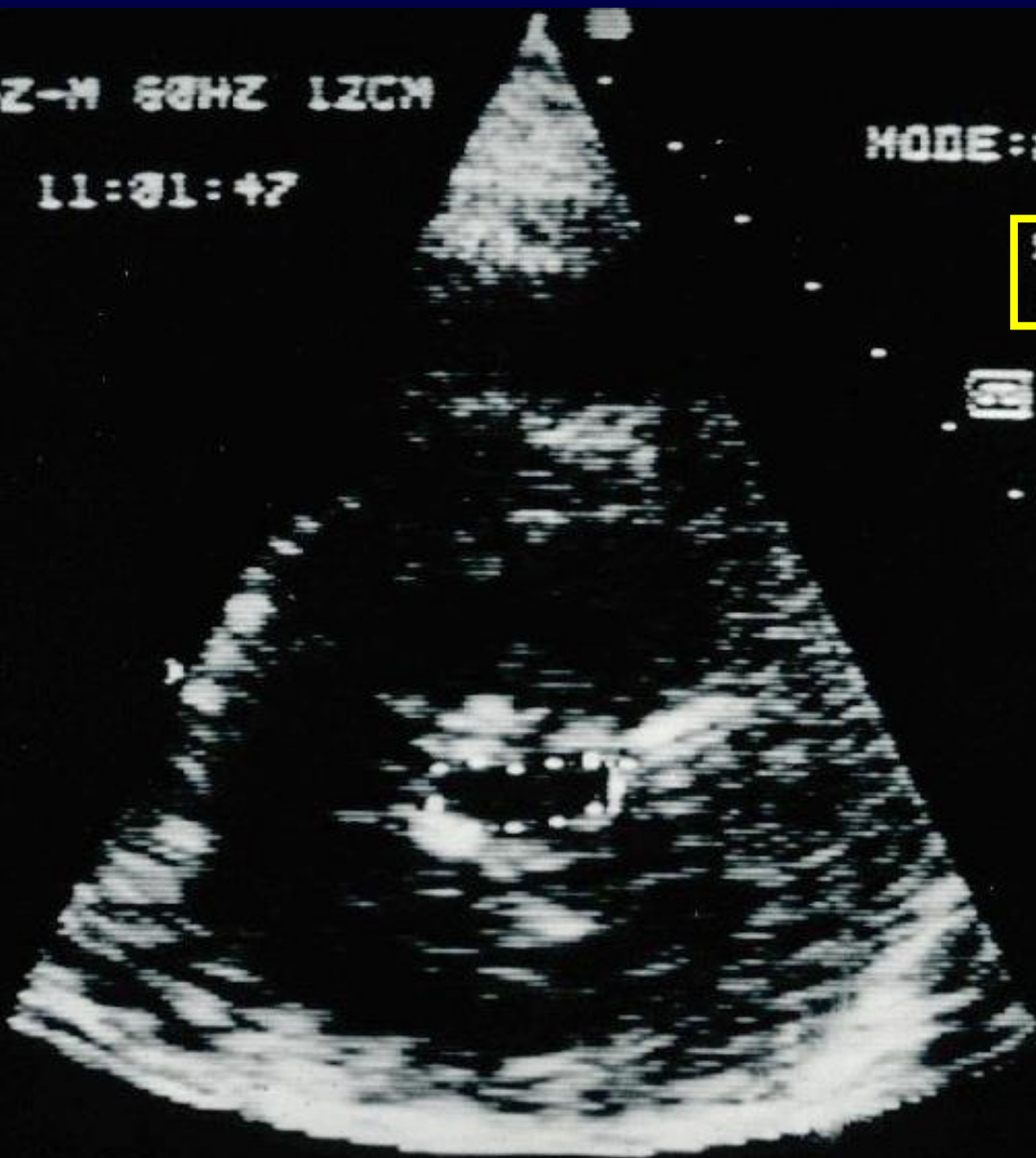
1:3L

9-15-13

340

AREA	CIRC
1.86	4.65

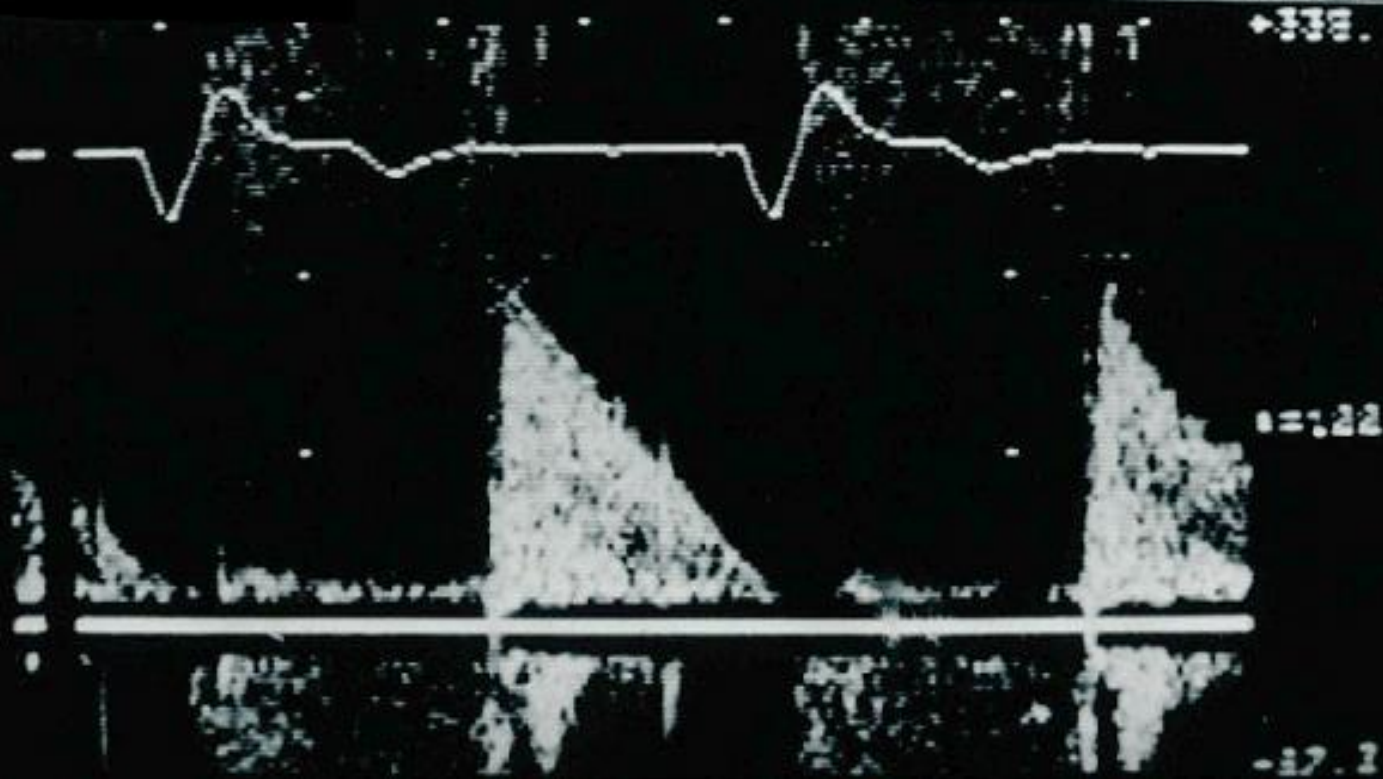
00735:13



SEC CM/S ACC
.155 .133. 495.
MODE:200
PRESSURE HALFTIME
MITRAL VALVE
RR HALFTIME = 121
MV AREA = 2.8

17

APEX MV

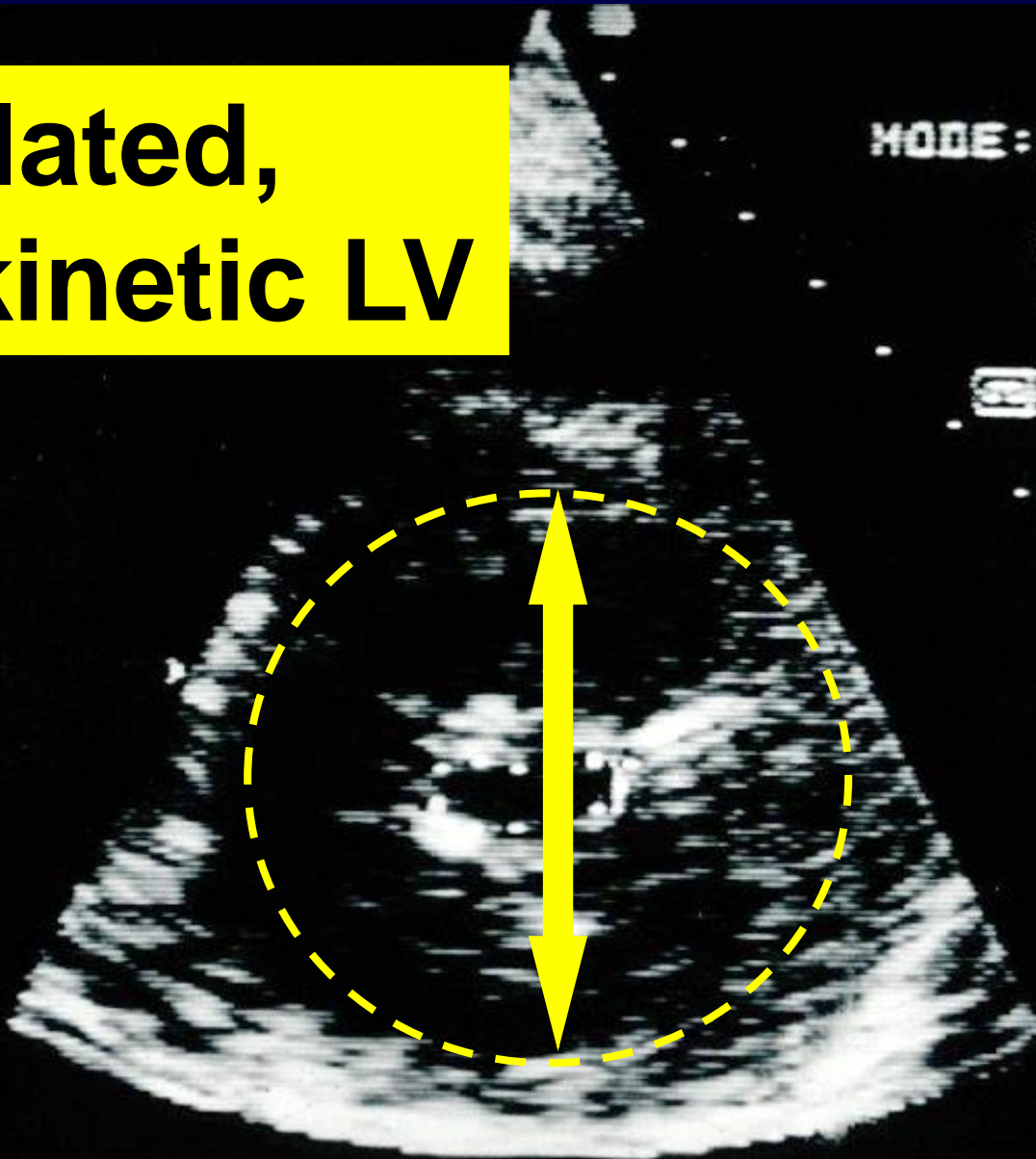


**Dilated,
hypokinetic LV**

MODE: PCC

AREA CIRC
1.86 4.65

00735: 13



348

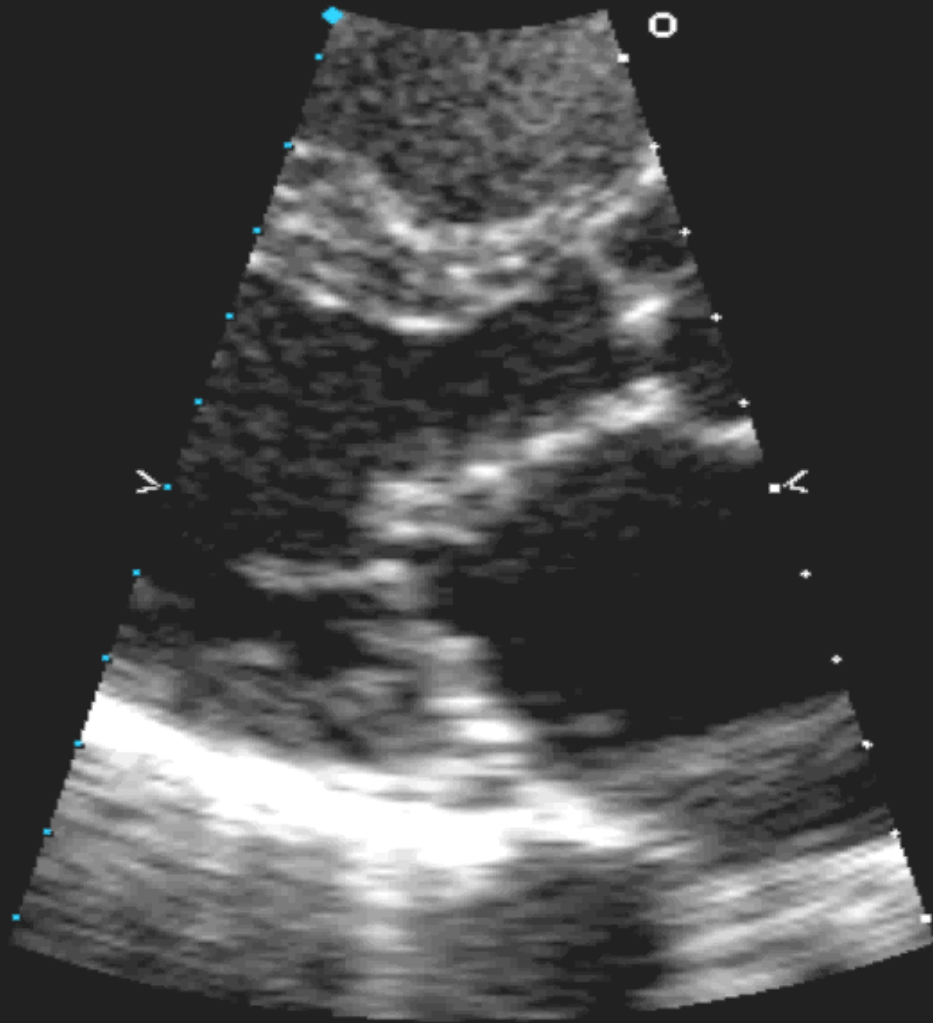
MI: 1.6
S3
12 SEP 06
11:41:36
2/0/C/H5
MGH #20

MGH
PM 4229230

4229230

02365
GAIN 51
COMP 59
123BPM

16CM
120HZ



T
P 1.6 3.2 R



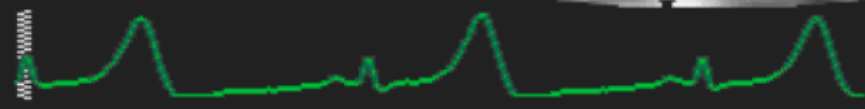
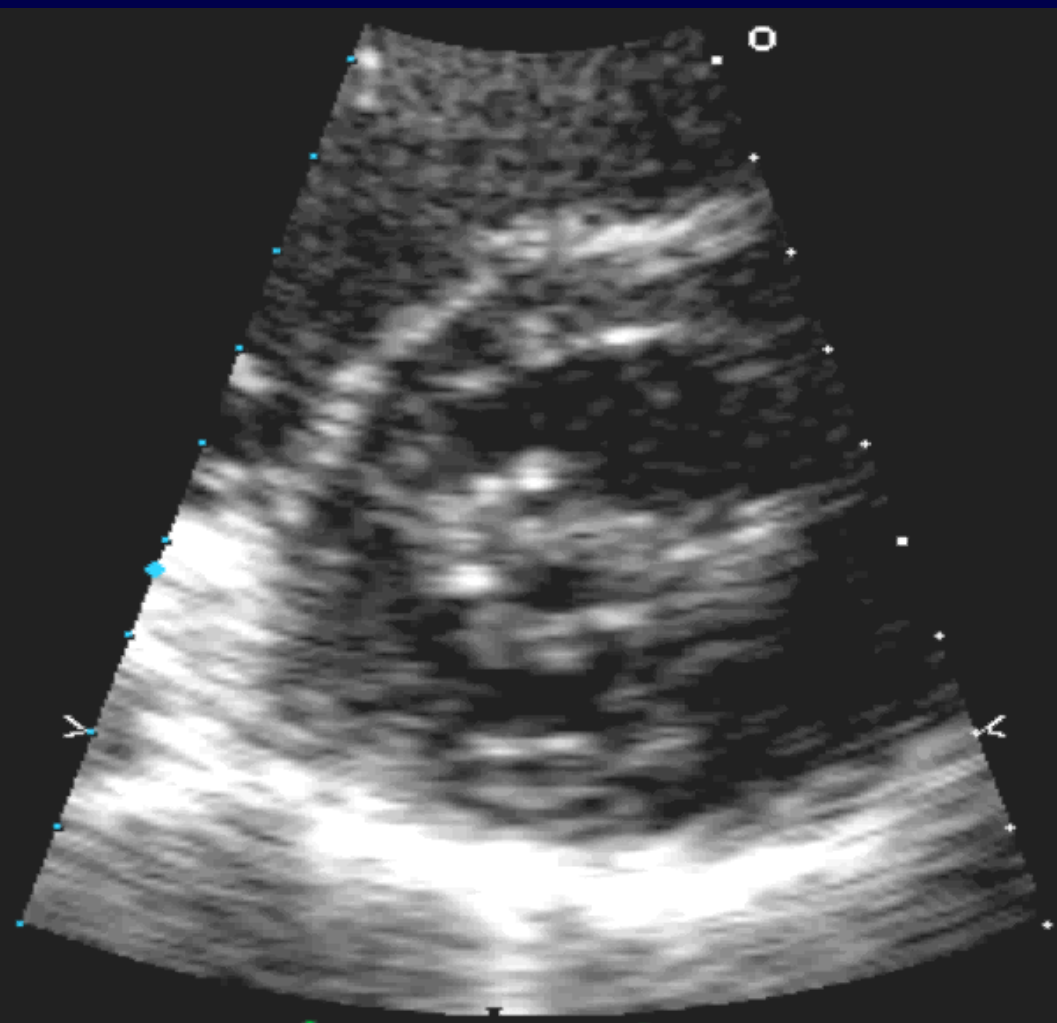
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12 SEP 06
11:52:01
2/0/C/H5
MGH #20

MGH
PM 4229230

4229230

02365
GAIN 51
COMP 59
97BPM

14CM
121HZ



MVA = 0.66 cm²

MVA(traced) = 0.66 cm²

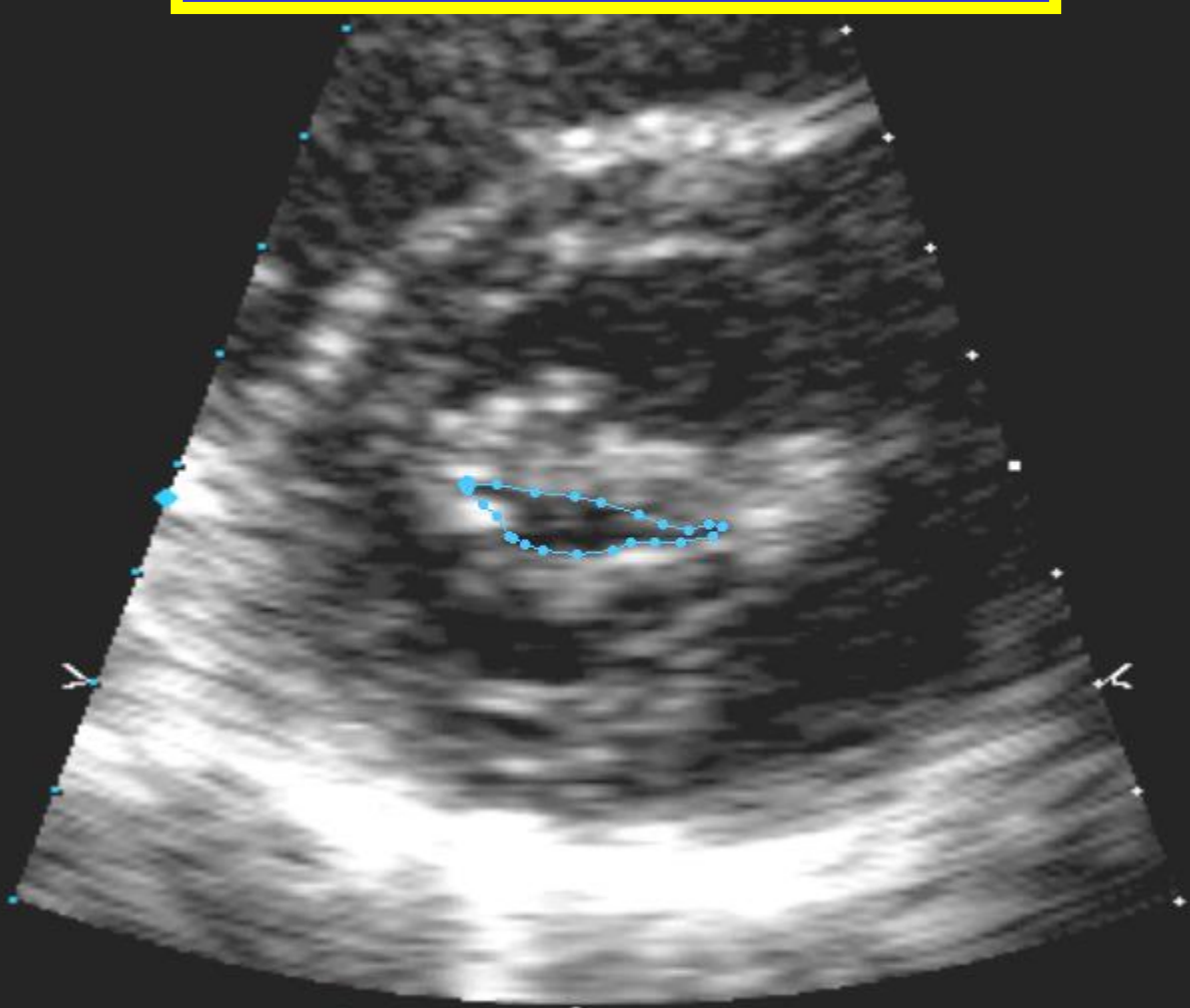
MI: 1.6
S3
12 SEP 06
11:52:03
2/0/C/H5
MGH #20

MGH
PM 4229230

4229230

02365
GAIN 51
COMP 59
92BPM

14CM
121HZ



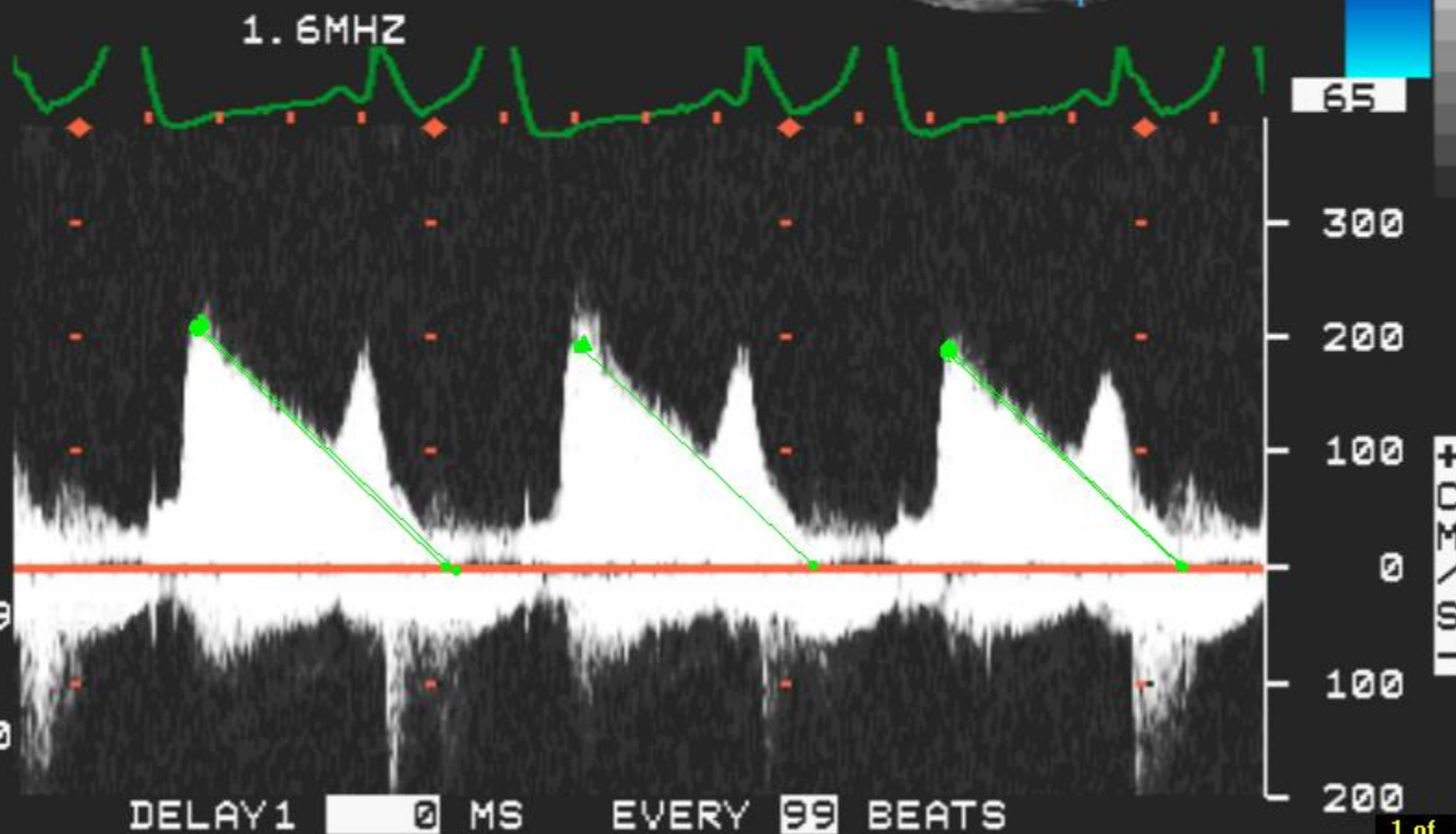
MI: 1.1 TIS: 0.7

GAIN 51 COMP 59

2.5 MHz

MU dec slope = 301 cm/sec²
MU P1/2t max vel = 216 cm/sec

$$\begin{aligned} \text{MVA} &= 750 / \text{Deceleration time} \\ &= 750 / 660 = 1.14 \text{ cm}^2 \end{aligned}$$



MI:1.0 TIS:1.0

S3
12 SEP 06
12:20:41
2/0/C/M2/A
MGH #20

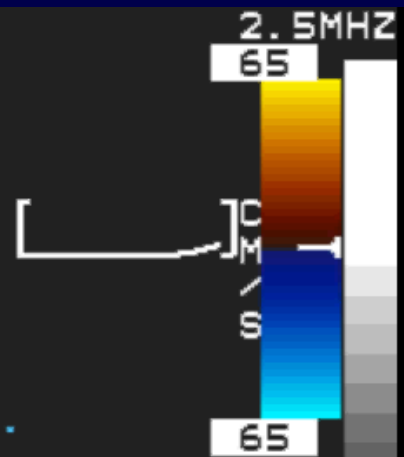
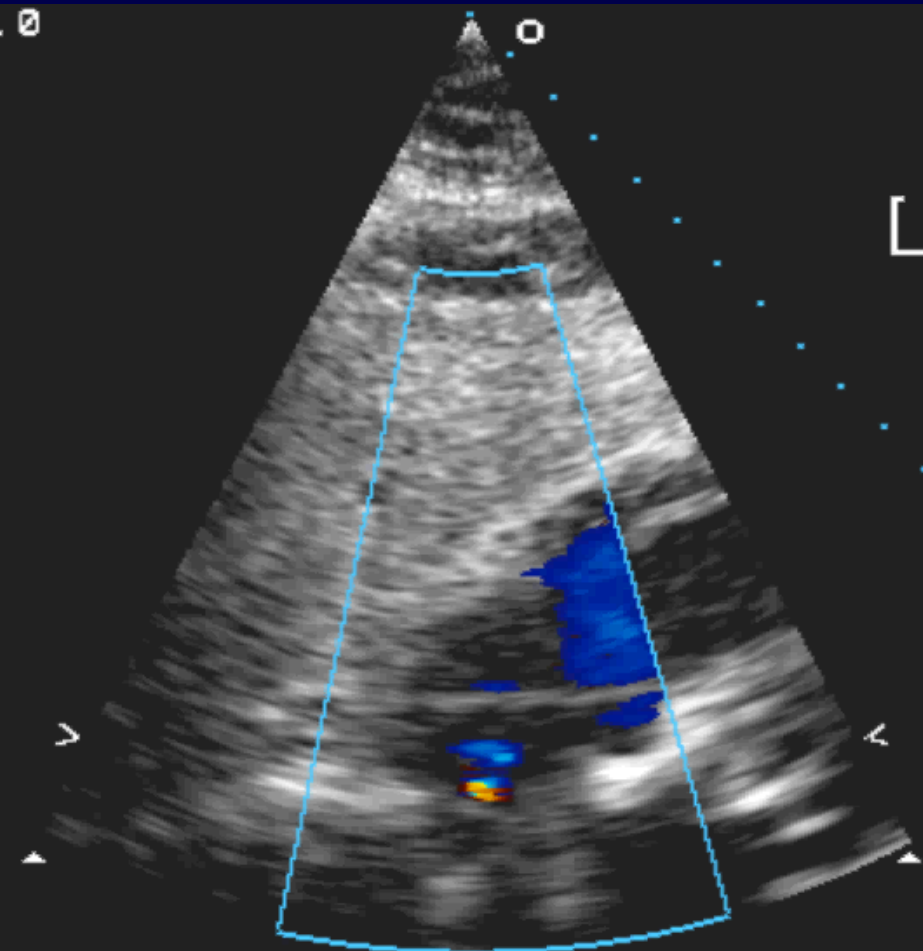
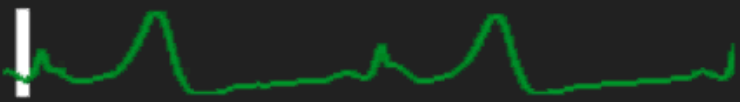
MGH
PM 4229230

4229230

02365
GAIN 51
COMP 59
113BPM

16CM

T
P 1.6 3.2 R



Take Home Message

- **Rely on planimetry, esp. biplane**
- **Pressure half time area can be falsely elevated because of noncompliant (stiff) LA or LV, AI (at least moderate), or ASD.**

Quantification of Mitral Valve Area

- **Direct Planimetry**
- **Pressure Half-Time**
- **Continuity / PISA**

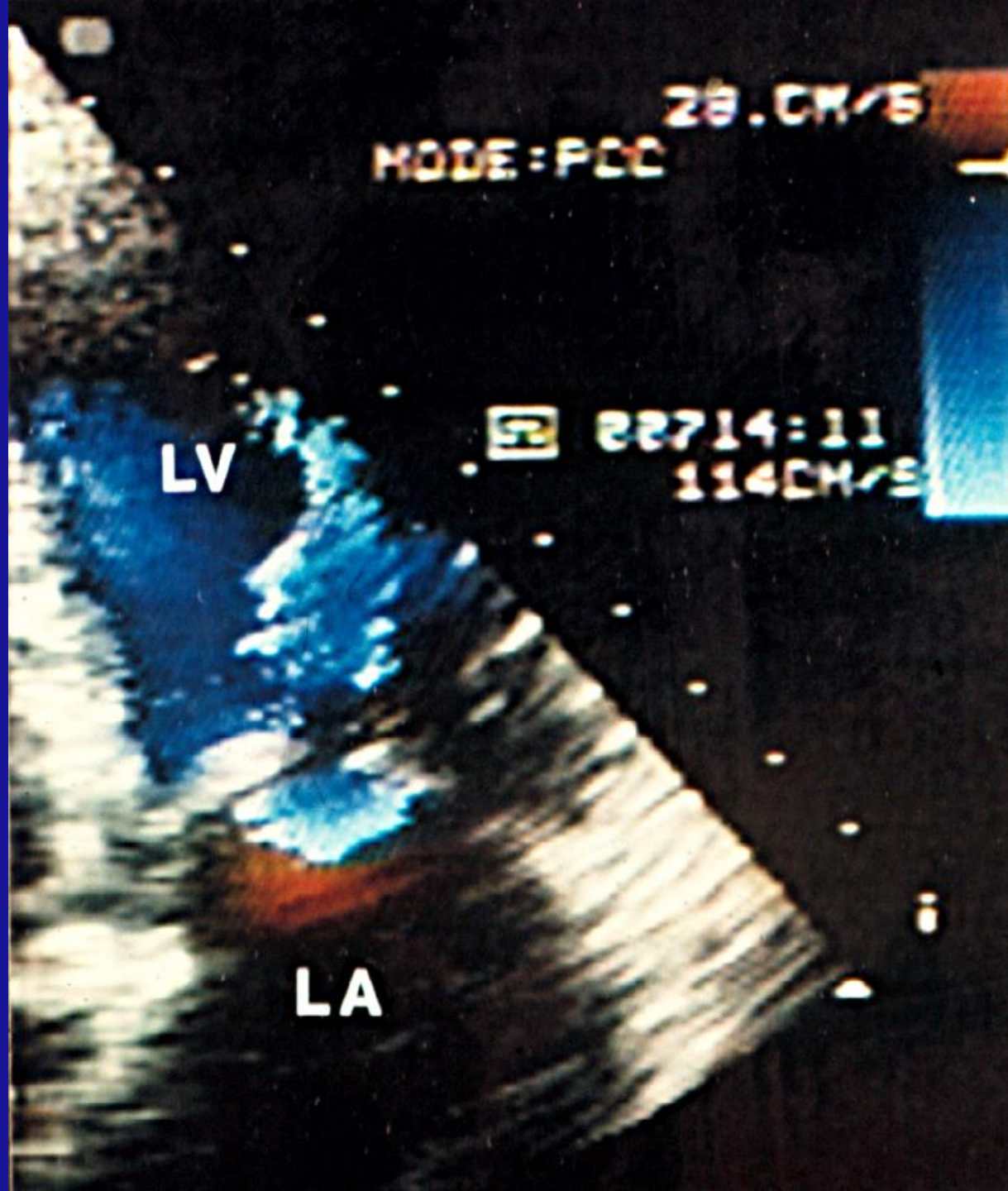
AREA = Flow rate / velocity

28. CM/S
MODE: PCC

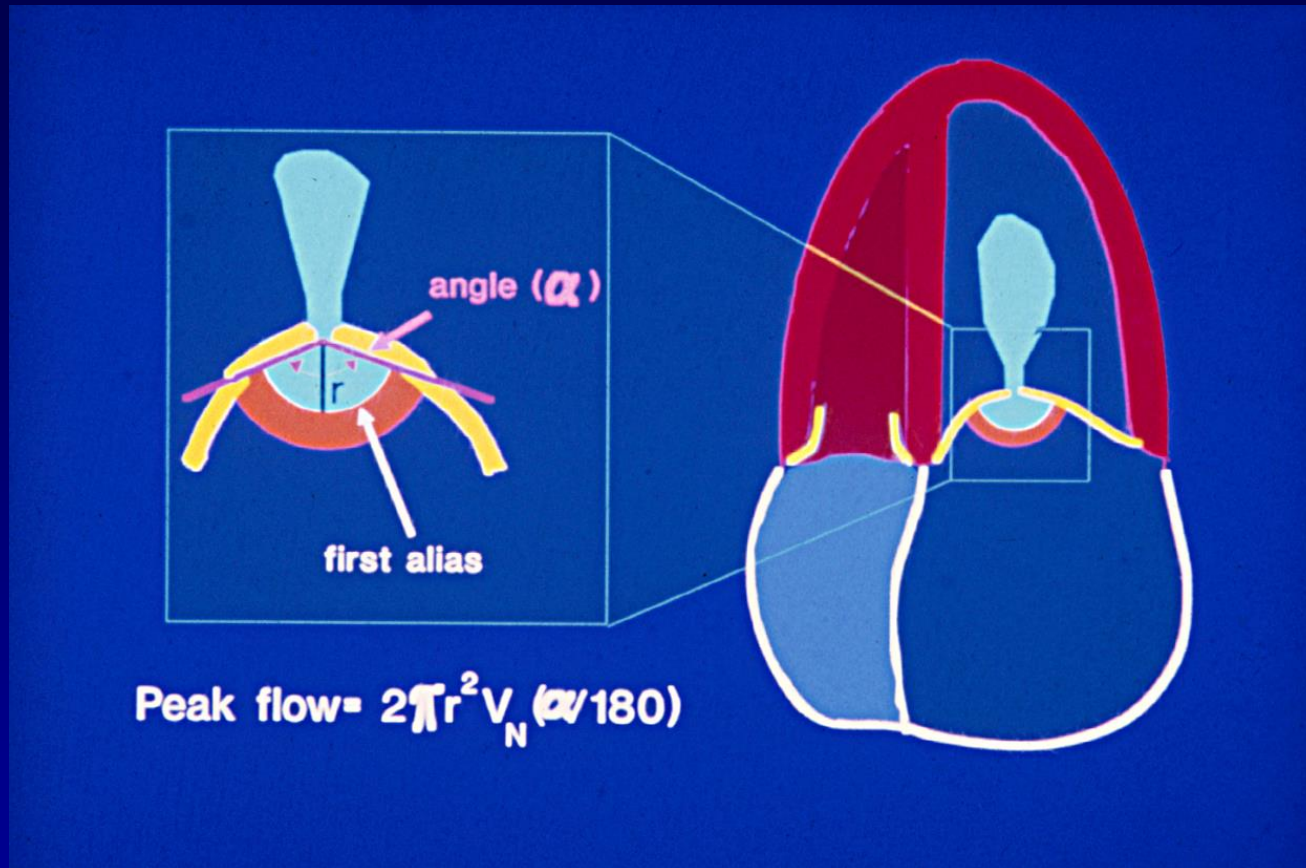
LV

22714:11
114CM/S

LA



PISA Method



MVA = Peak Flow/Peak MS velocity

Leonardo Rodriguez

$v = 38 \text{ cm/sec}$

52MM/S 2.5MHZ-M 15HZ 12CM
PRDC 2/2/0/0/F
26 DEC 88 18:35:22

ID:FT
3289358
22222

MODE:PC

38.0CM/S

22577:25
125CM/S

$r = 1.06 \text{ cm}$
 $\alpha = 110^\circ$



$$\text{Peak flow rate} = 2\pi r^2 v (\alpha / 180)$$

$$r = 1.06 \text{ cm}$$

$$v = 38 \text{ cm/sec}$$

$$\alpha = 110^\circ$$

$$\text{Peak flow rate} = 164 \text{ cm}^3 / \text{sec}$$

$$\begin{aligned} \text{MVA} &= \text{Peak flow rate} / \text{Peak velocity} \\ &= (164 \text{ cm}^3 / \text{sec}) / (200 \text{ cm/sec}) \\ &= 0.82 \text{ cm}^2 \end{aligned}$$

52MM/9 2.5MHZ-M 12CM
PRUG 2/8/0
26 DEC 89 12:19:11

10:FT
7838368
22222

MODE:FTT



AREA CIRC
.521 3.83

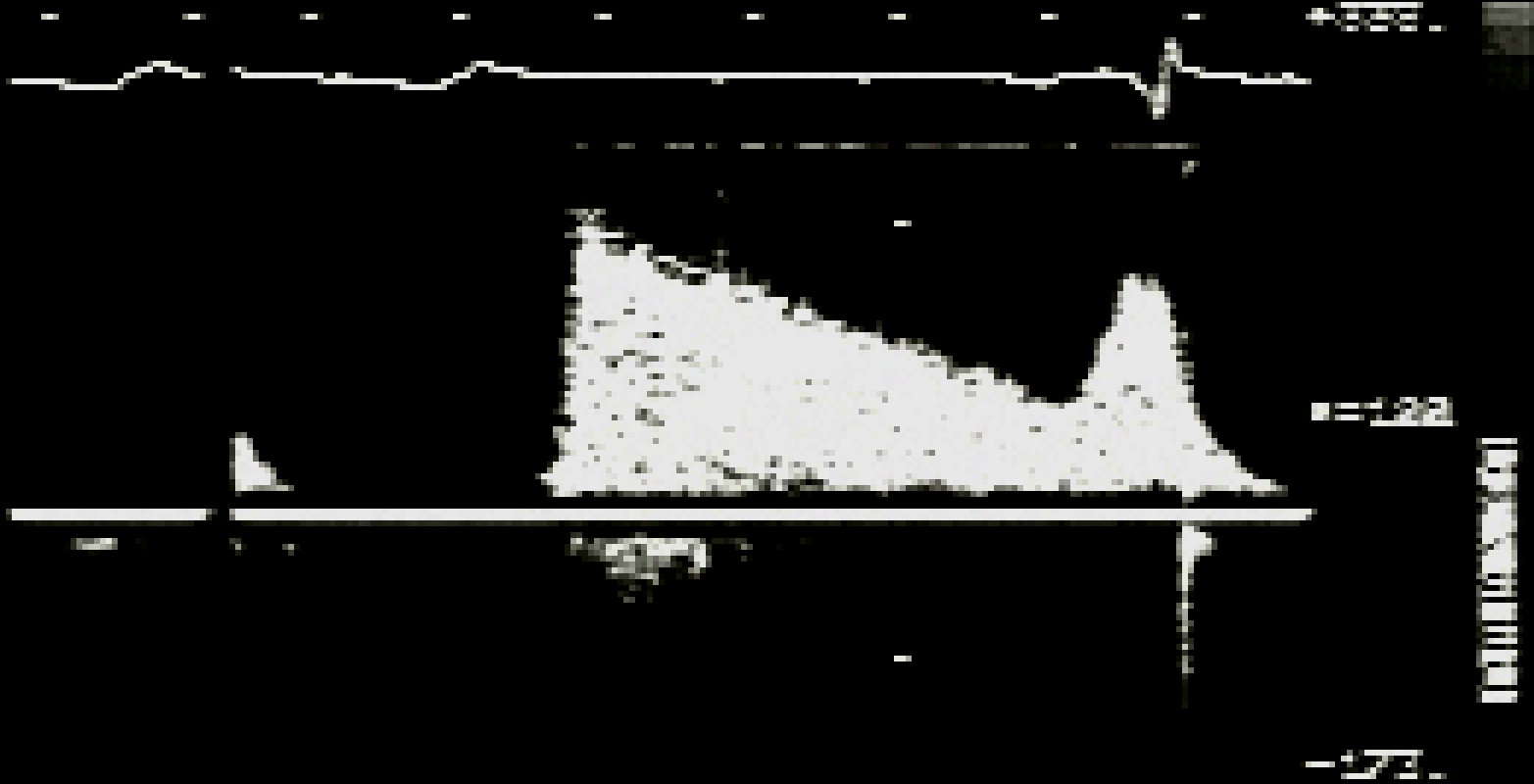
22255:81



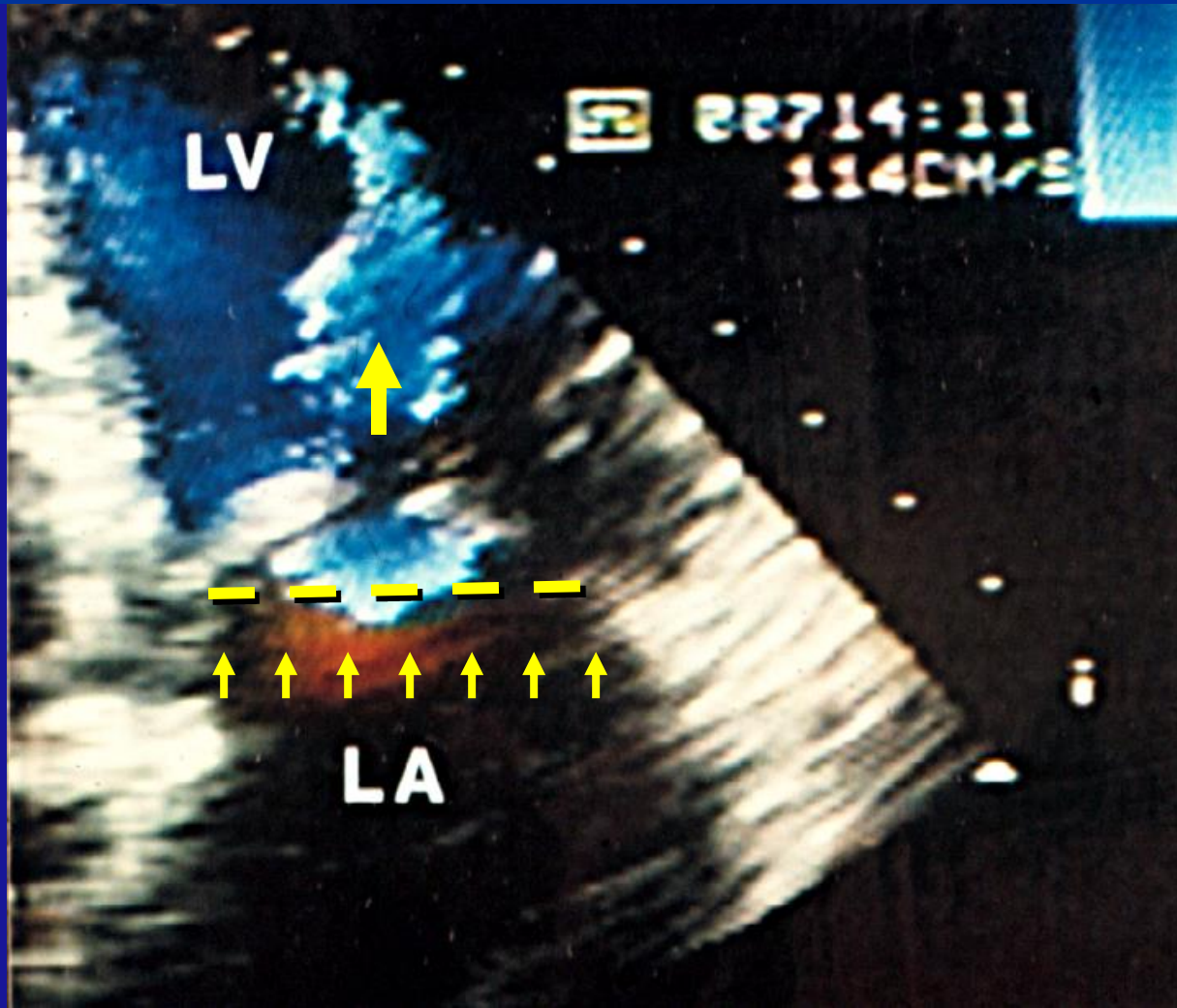
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000

DELETE LAST
REPORT
SOURCE MENU

**MV AREA
= 0.80**



Can we apply the continuity equation as we do across the aortic valve?



CONTINUITY EQUATION

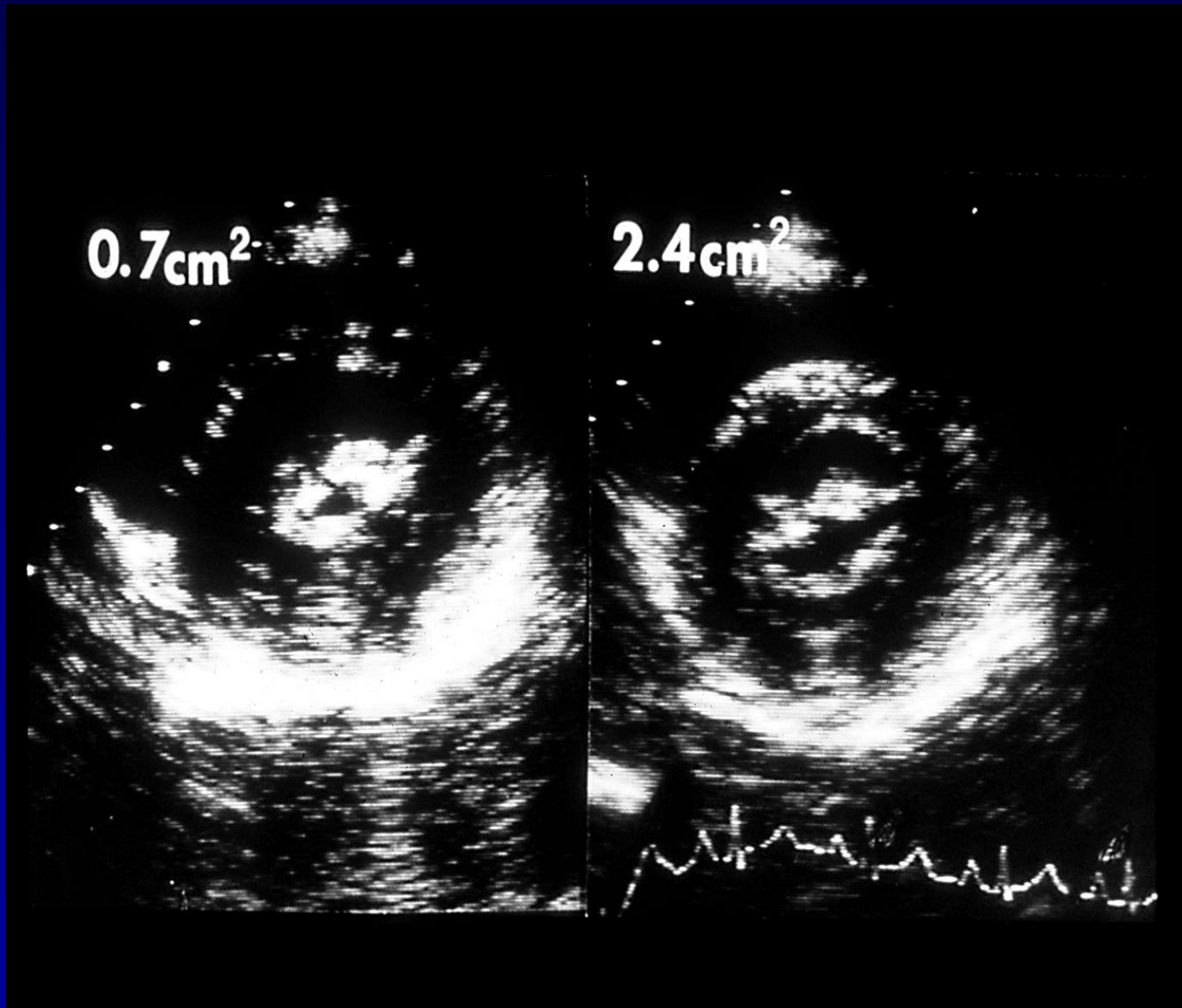
$$\text{MVA Area} = \frac{\text{Forward flow}}{\text{Velocity}}$$
$$= \frac{\text{Systolic flow (AV, PV)}}{\text{Mitral CW time-velocity integral}}$$

- No important MR
- No important AR (PR)

MITRAL STENOSIS

- **Diagnosis**
- **Quantification**
- **Management**

Commissural splitting



METHODS

Echocardiography

BEFORE PMV:

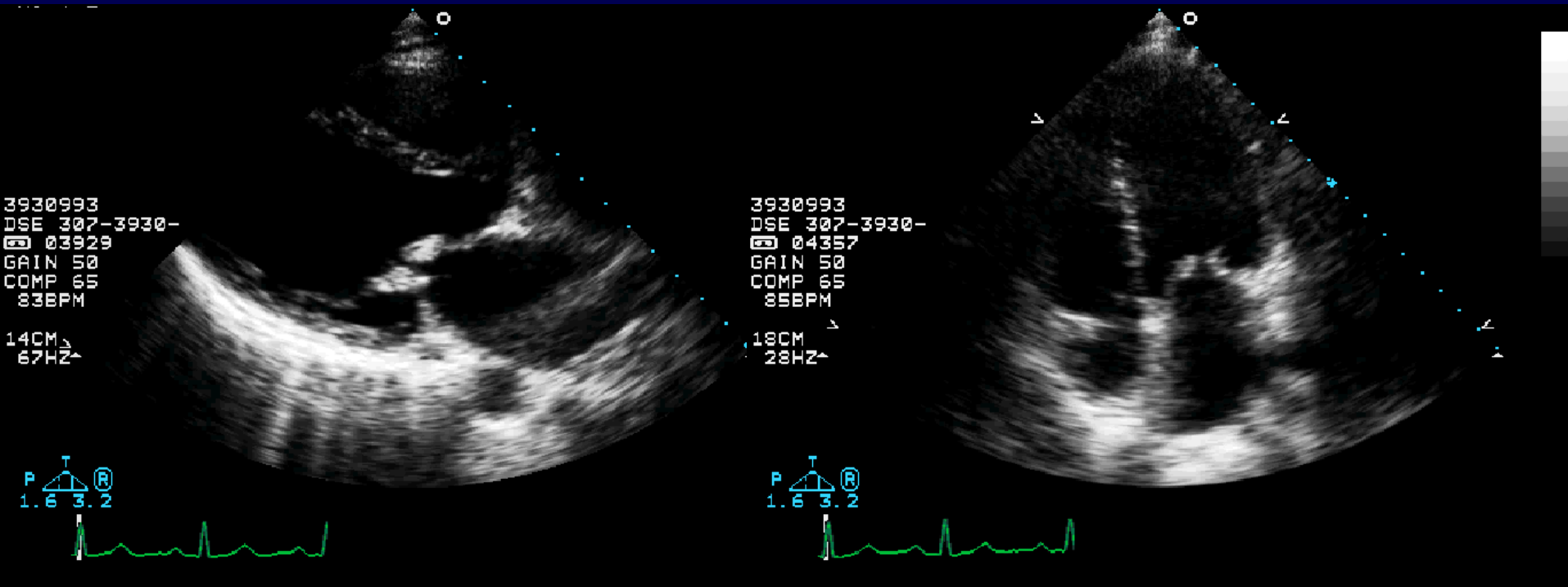
Echocardiographic Examination

- Standard Views
- Echocardiographic Score of Valve Morphology:

Mobility	0 - 4
Thickening	0 - 4
Calcification	0 - 4
Sub-Valvular	<u>0 - 4</u>
Total	0 -16

**Echo score < 8 associated with
greater success of percutaneous
mitral valvuloplasty**

Mitral Stenosis-Low Echo Score-4



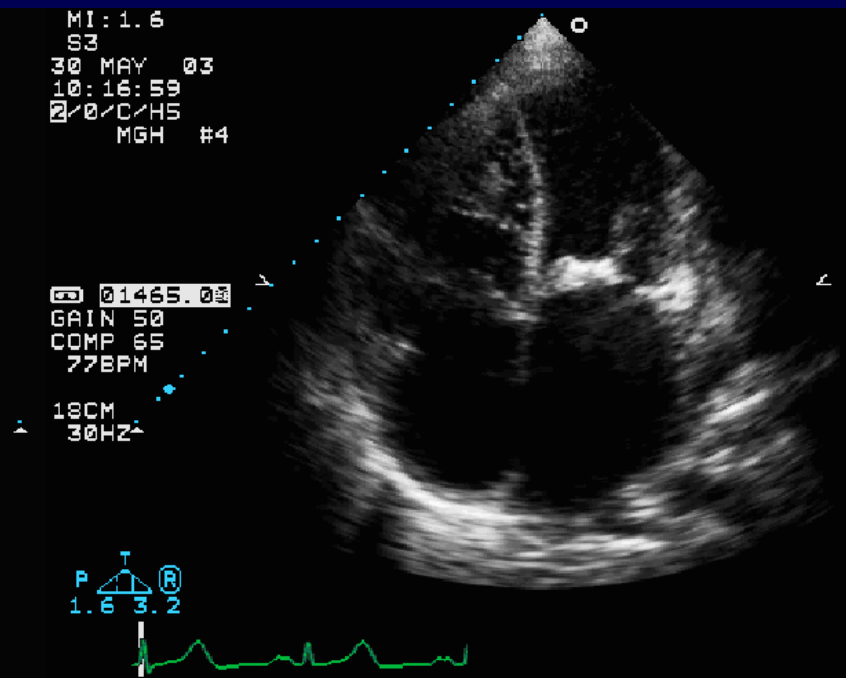
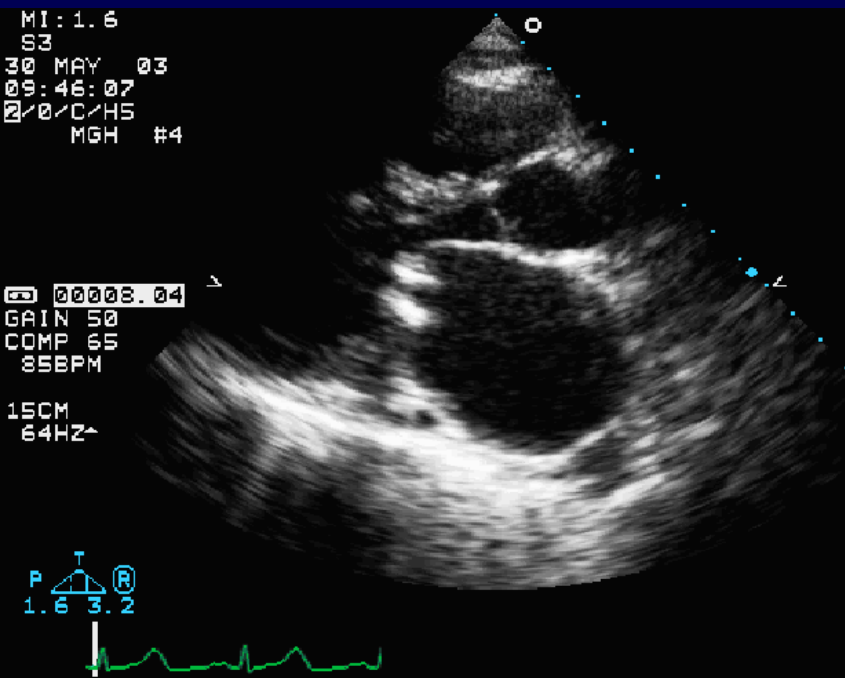
Mobility = 1

Thickening = 1

Calcification = 1

Subvalvular = 1

Rheumatic Mitral Valve Stenosis High Echo Score-11



Mobility = 2

Thickening = 2

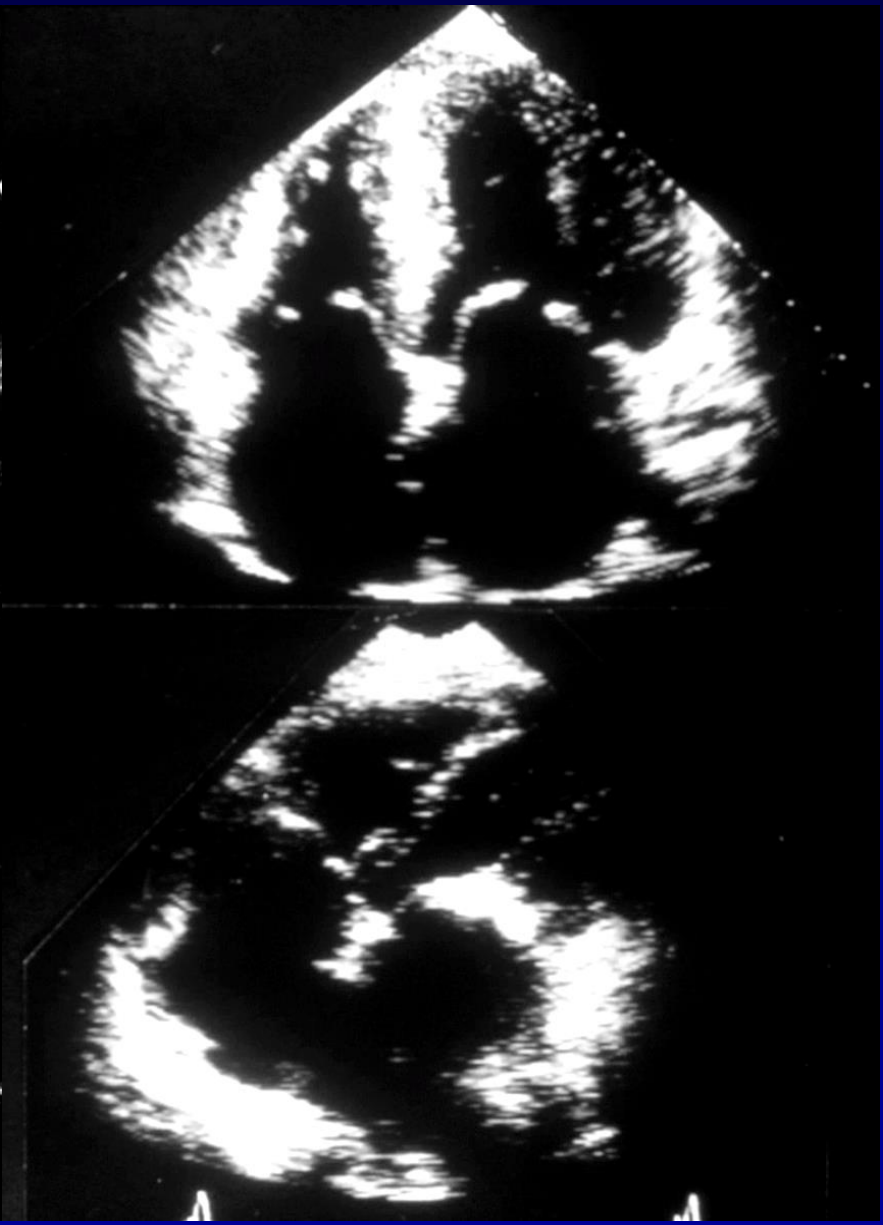
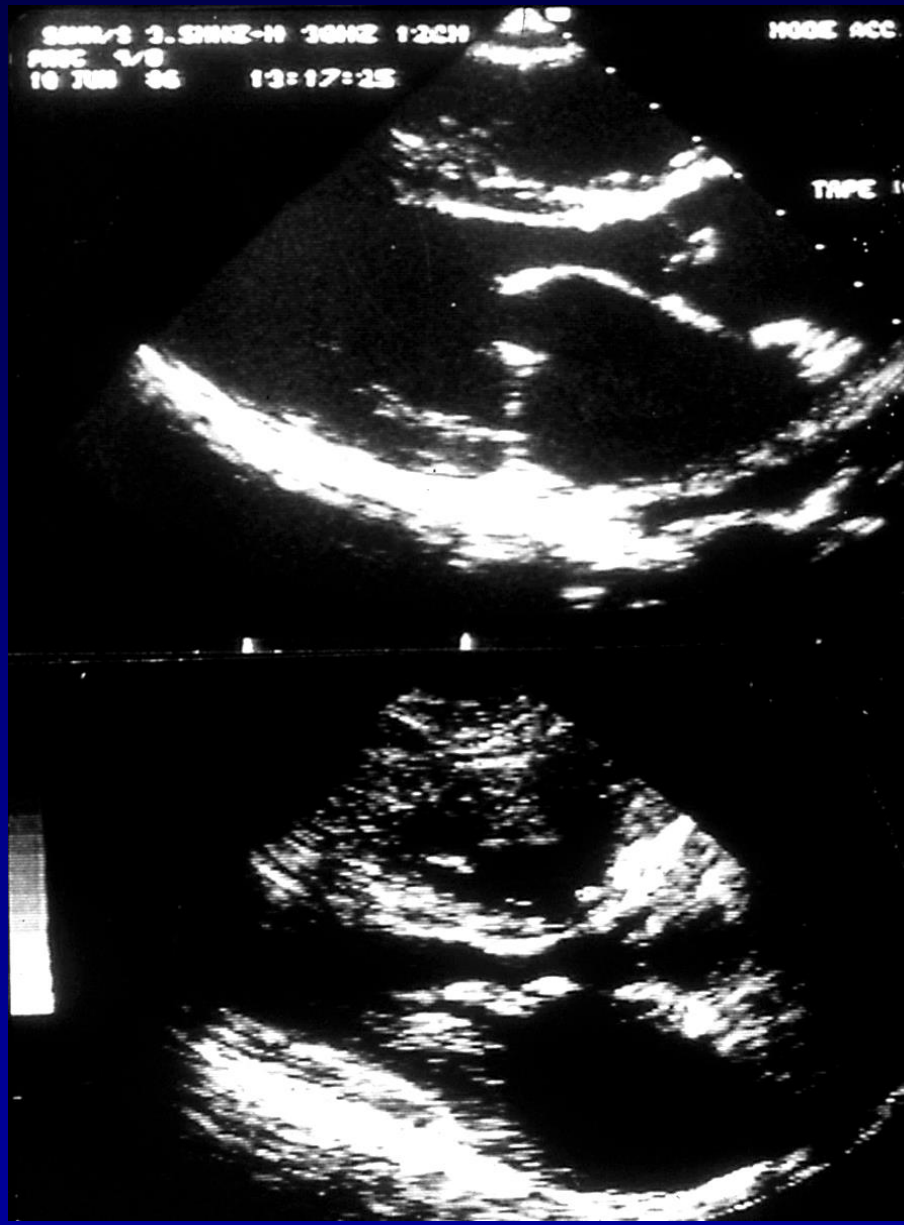
Calcification = 3

Subvalvular = 4

8000/2 3.5MHz-10 30MHz 12CH
PAGE 1/8
10 JUN 86 13:17:25

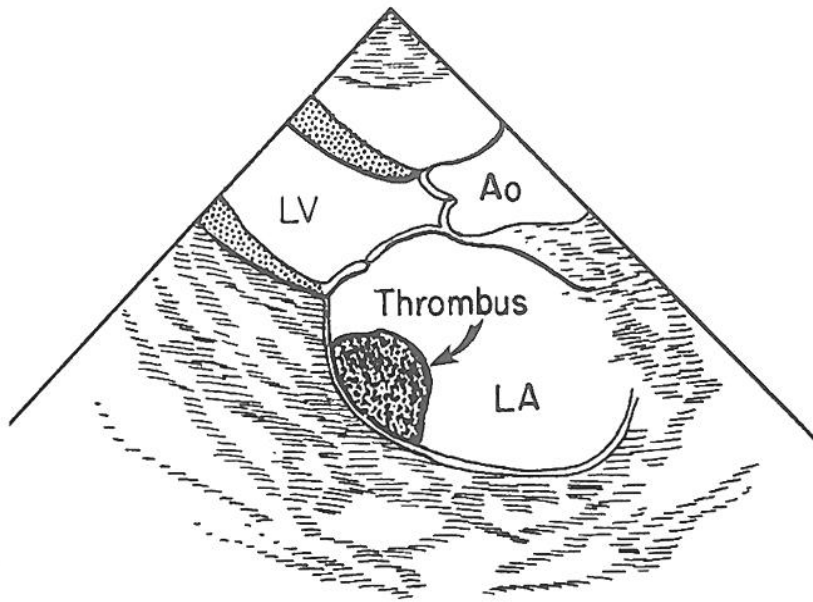
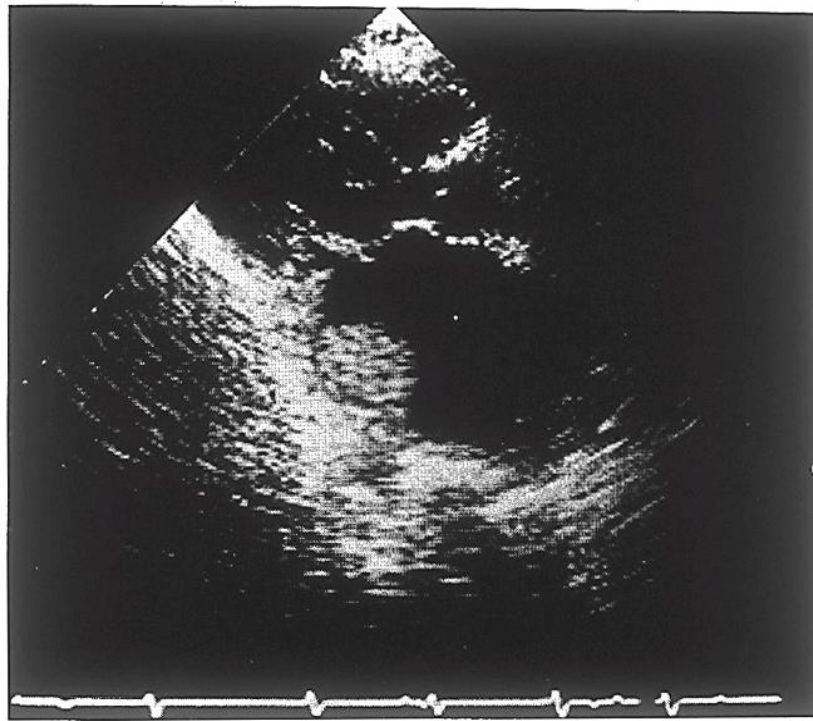
MODE ACC

TYPE II



DON'T DO IT!

- **Calcific MS**
- **Moderate MR**
- **High score**
- **LA thrombus**
- **Likely to tear**
- **Severe TR**



CONV/E 2.0M42-W

12CM

MODE:POC

PROC 3/2/C

25 MAY 84 18:33:55

NAME GENERAL 3

ID:75

334.78 54

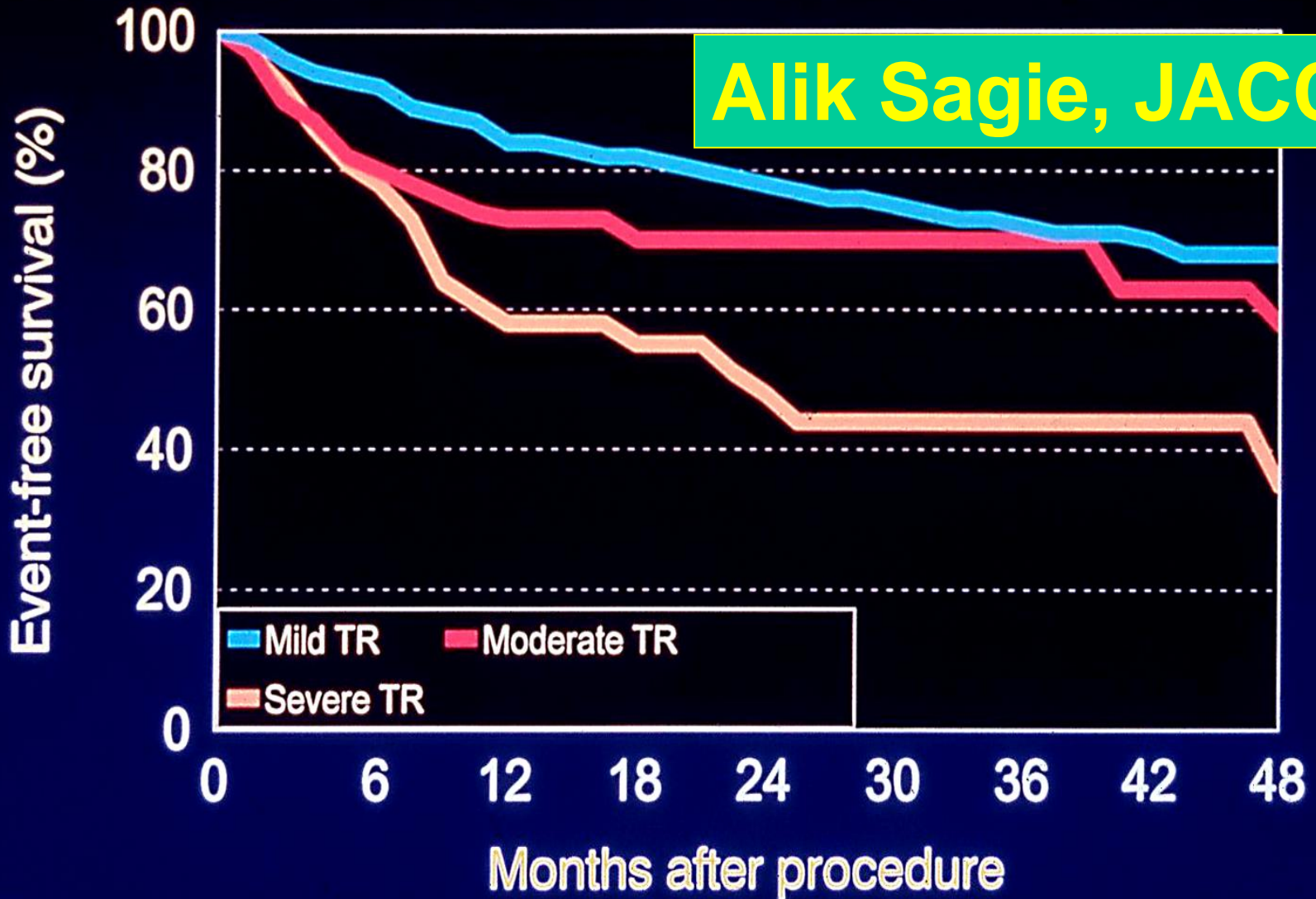
84533

85188-15



Event Free Survival Rate After PMV Among 318 Patients With Mild, Moderate and Severe TR.

Alik Sagie, JACC



MITRAL STENOSIS

- **Diagnosis**
- **Quantification**
- **Management**