MITRAL VALVE STENOSIS: QUANTITATIVE METHODS

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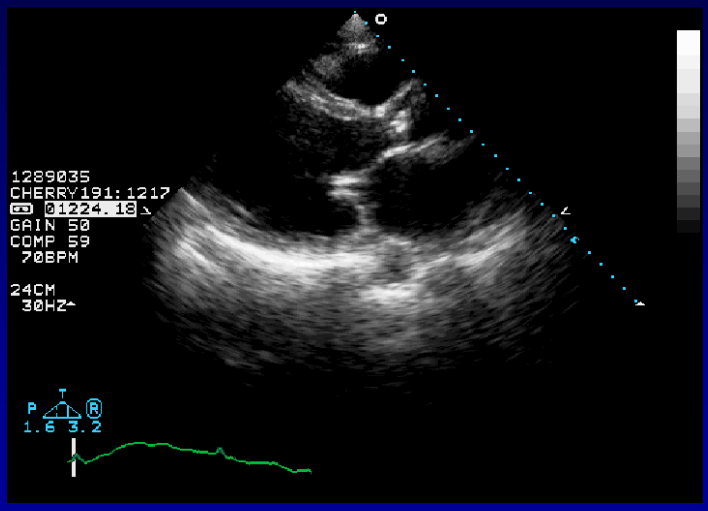
MITRAL STENOSIS

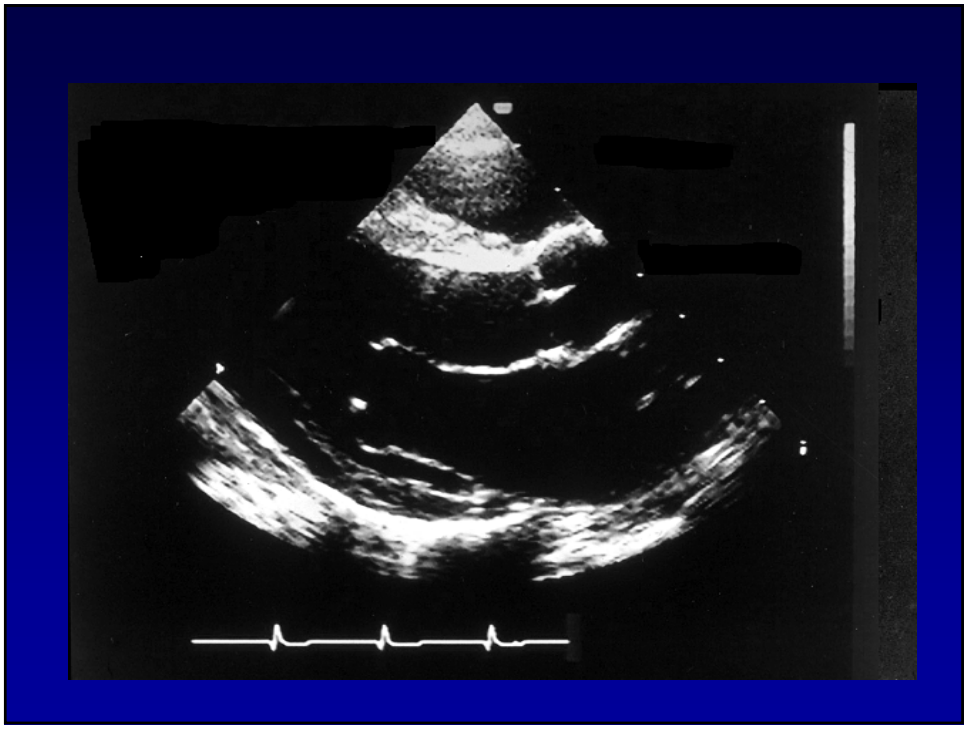
- Diagnosis
- Quantification
- Management

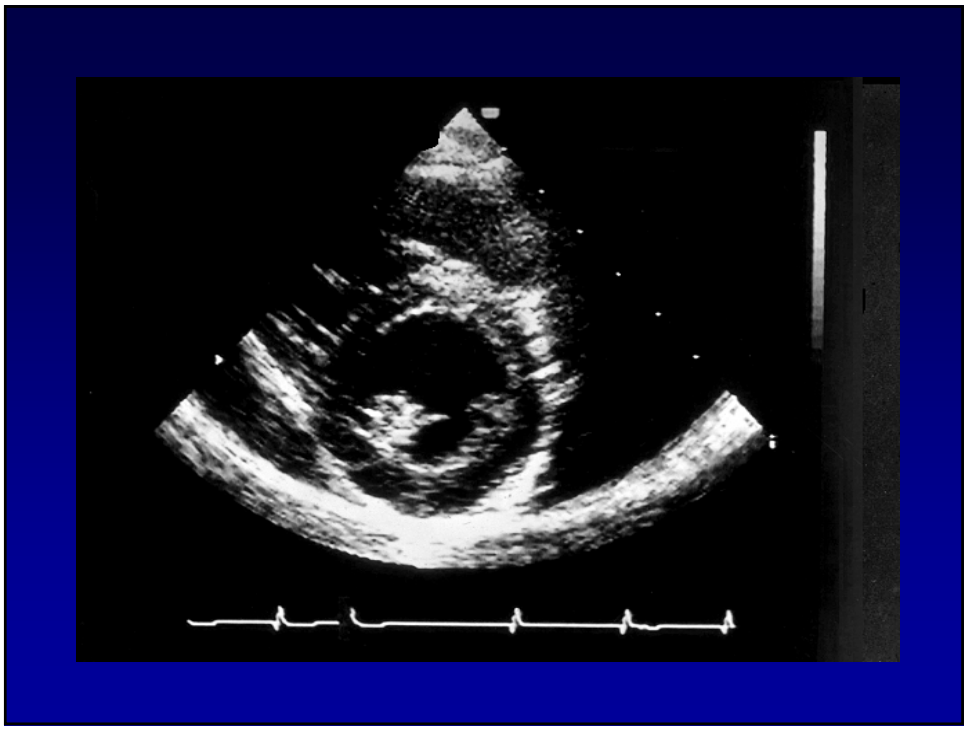
Diastolic mitral leaflet doming concave toward the LA is seen in:

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



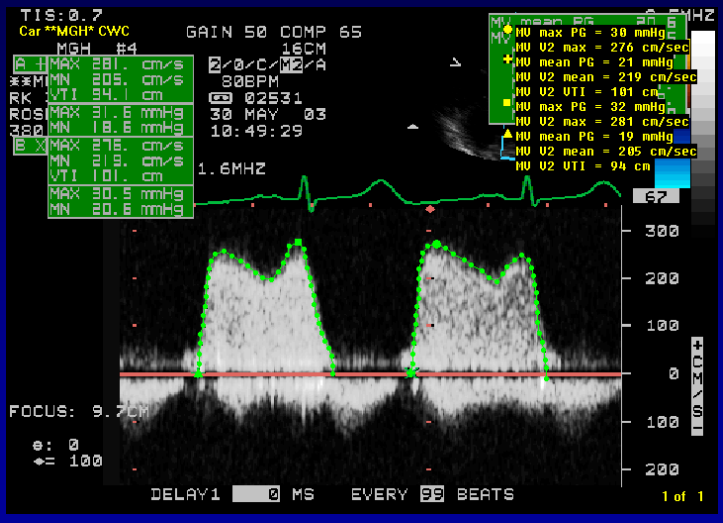


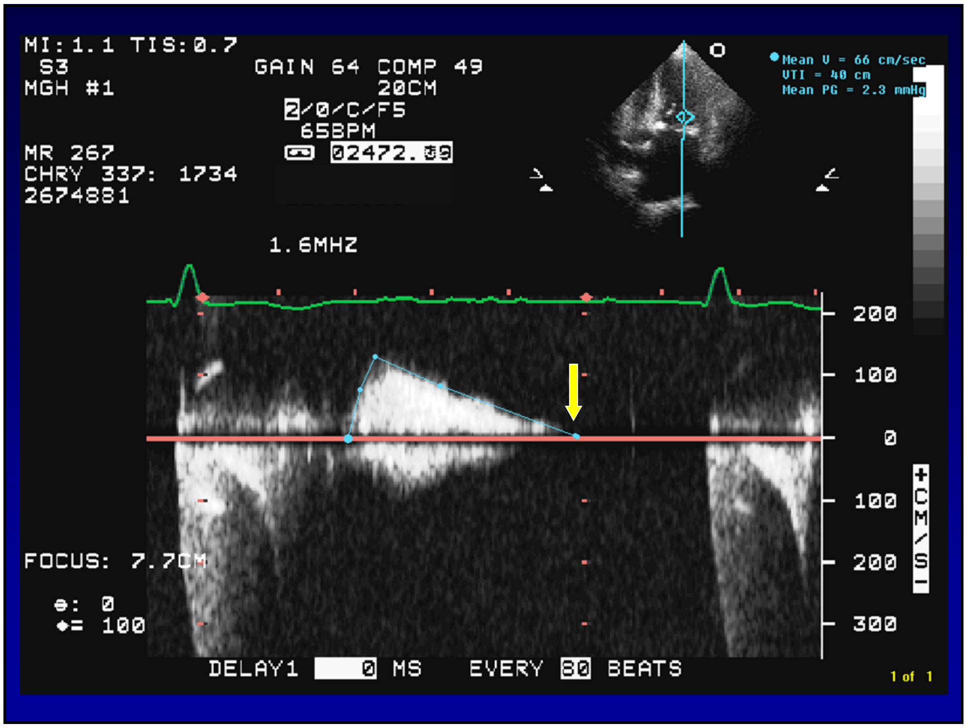


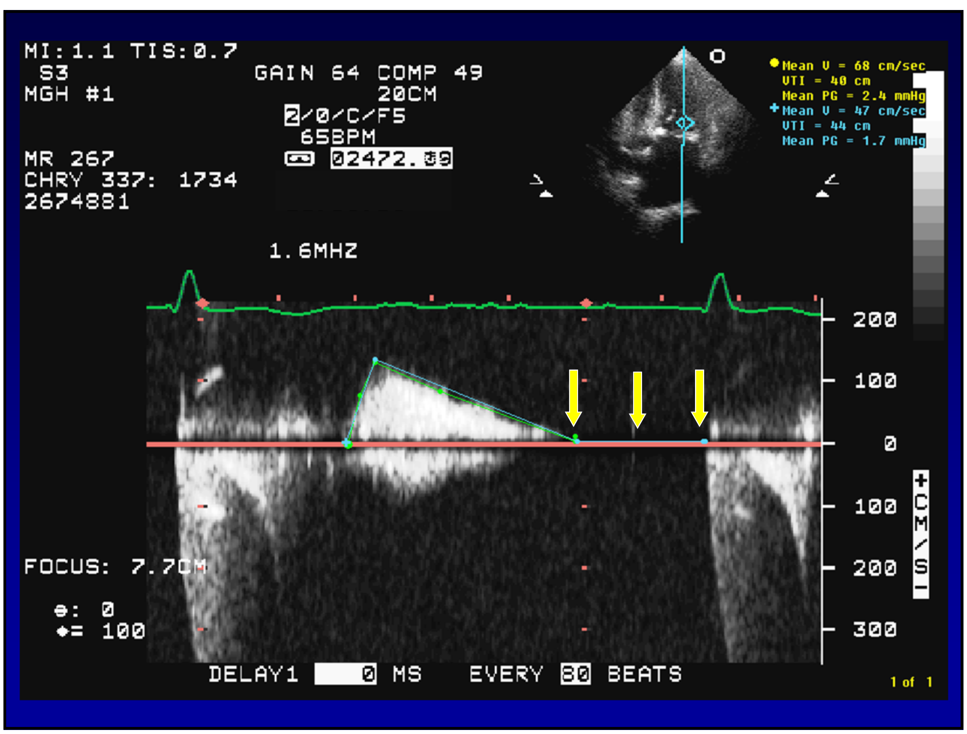
MITRAL STENOSIS

- Diagnosis
- Quantification
- Management

Pressure Gradient




MI:1.1 TIS:0.7
S3
MGH #1
GAIN 64 COMP 49
20CM
2/0/C/F5
65BPM
02472.09
MR 267
CHRY 337: 1734
2674881
Mean V = 66 cm/sec
VTI = 40 cm
Mean PG = 2.3 mmHg
1.6MHZ
200
100
0
100
200
300
+CM/S-
FOCUS: 7.7CM
θ: 0
♦= 100
DELAY1 0 MS EVERY 80 BEATS
1 of 1

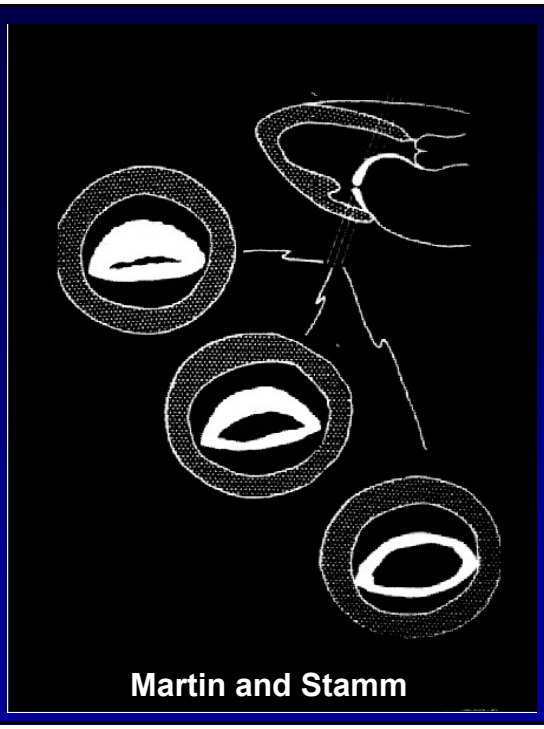

MI:1.1 TIS:0.7
S3
MGH #1
GAIN 64 COMP 49
20CM
2/0/C/F5
65BPM
02472.09
MR 267
CHRY 337: 1734
2674881
Mean V = 68 cm/sec
VTI = 40 cm
Mean PG = 2.4 mmHg
Mean V = 47 cm/sec
VTI = 44 cm
Mean PG = 1.7 mmHg
1.6MHZ
200
100
0
100
200
300
+CM/S-
FOCUS: 7.7CM
θ: 0
♦= 100
DELAY1 0 MS EVERY 80 BEATS
1 of 1

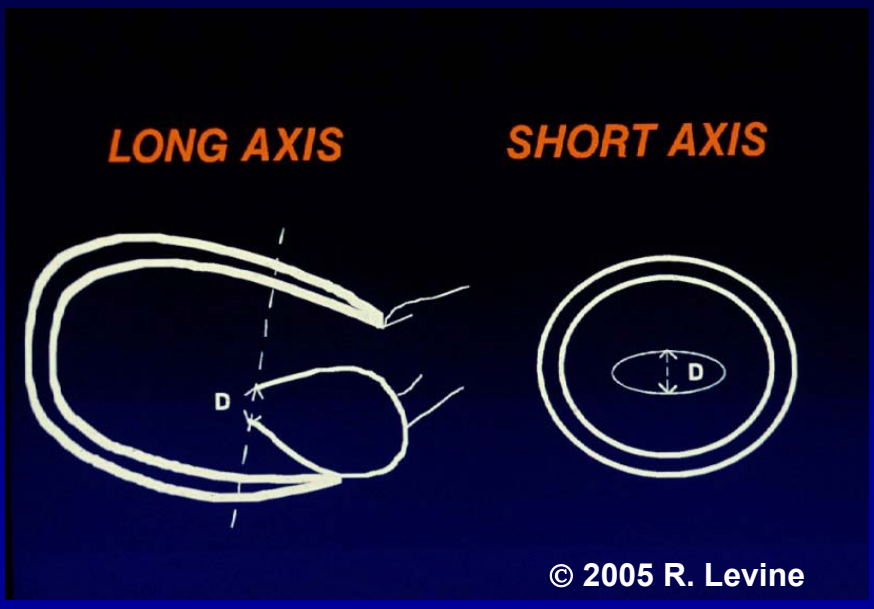
Assessment of Mitral Stenosis

- Mitral valve area measurement
  - > 1.5 cm^2 - Mild
  - 1.1 to 1.5 cm^2 - Moderate
  - < or = 1.0 cm^2 - Severe

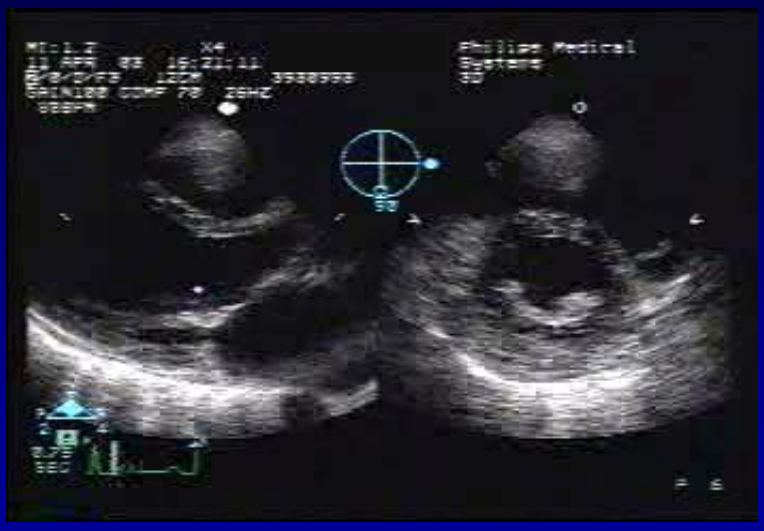
Quantification of Mitral Valve Area

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


Martin and Stamm


LONG AXIS
SHORT AXIS
D
D
© 2005 R. Levine

Real-Time 3D: Biplane Feature

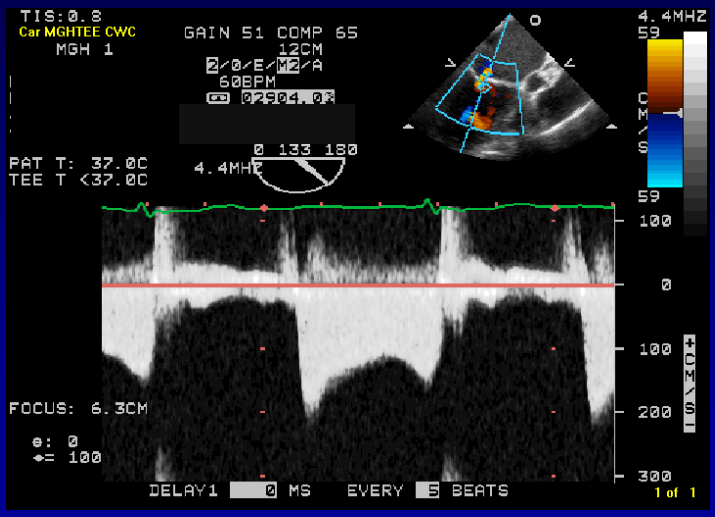


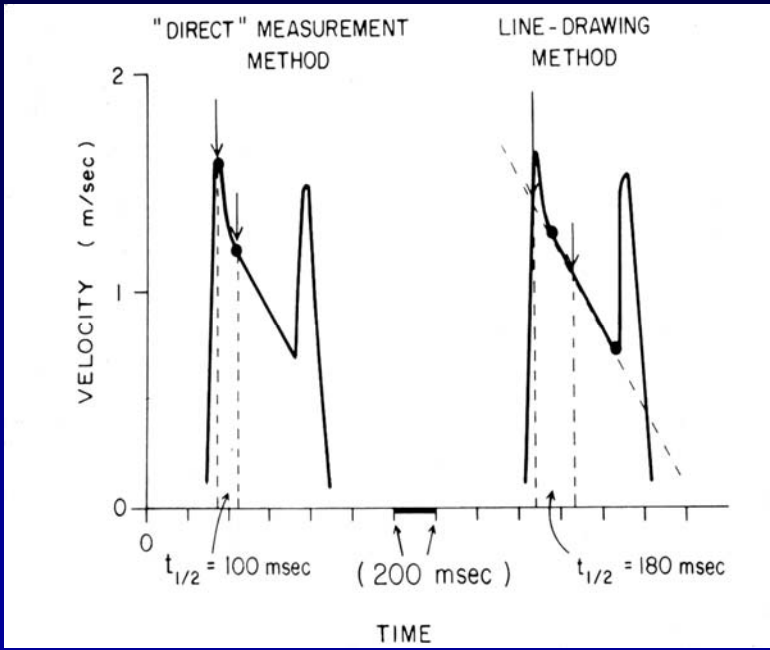
Sebag AJC 2005

Quantification of Mitral Valve Area

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

P1/2: Nonlinear Slope





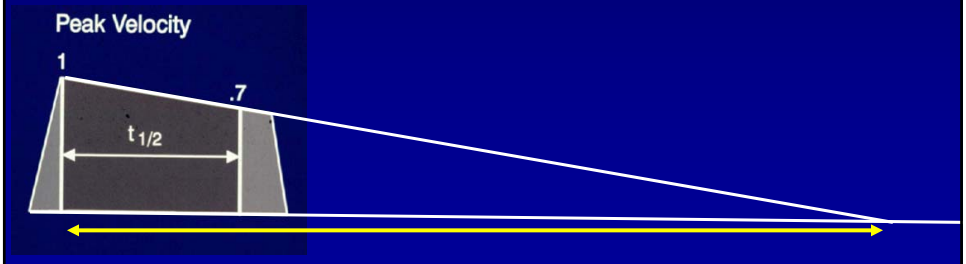
A patient has mitral stenosis with an E-wave deceleration time of 1000 milliseconds. What is the mitral valve area?

1. 0.22 cm^2
2. 0.75 cm^2
3. Depends on cardiac output
4. 1.5 cm^2

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:

  $T1/2 = 220/MVA$

- Theoretical derivation:

$$T1/2 = \frac{11.6\ C_n \sqrt{P}}{c_c\ MVA}$$

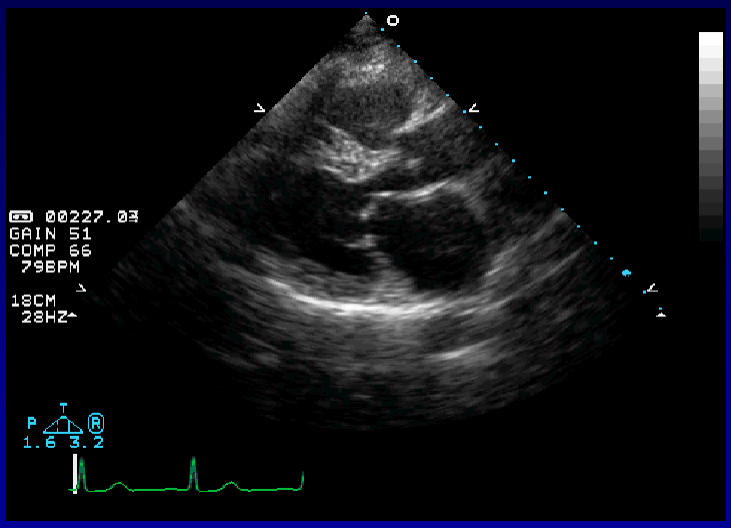
$T1/2$ = mitral half-time (ms)
MVA = anatomic valve area (cm^2)
C_n = mean net LA and LV compliance ($cm^3/mmHg$)
P = peak LA-LV pressure gradient (mmHg)
c_c = coefficient of contraction (about 0.78)

James Thomas

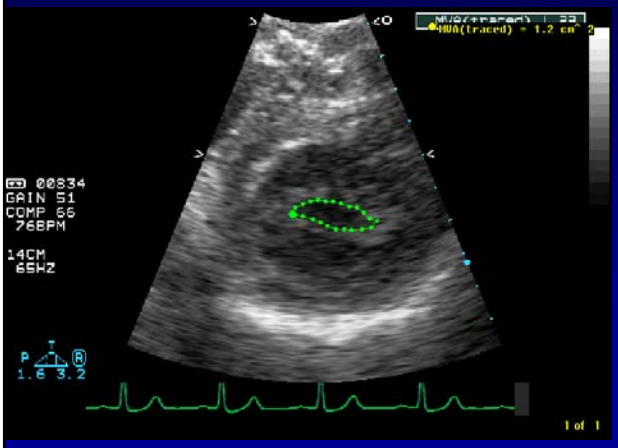
Transmitral E-wave deceleration time varies most consistently with which physiological parameters?

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

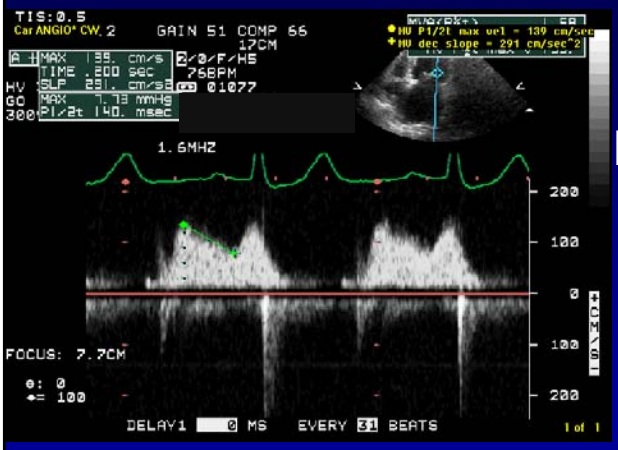


Rheumatic Mitral Valve Stenosis



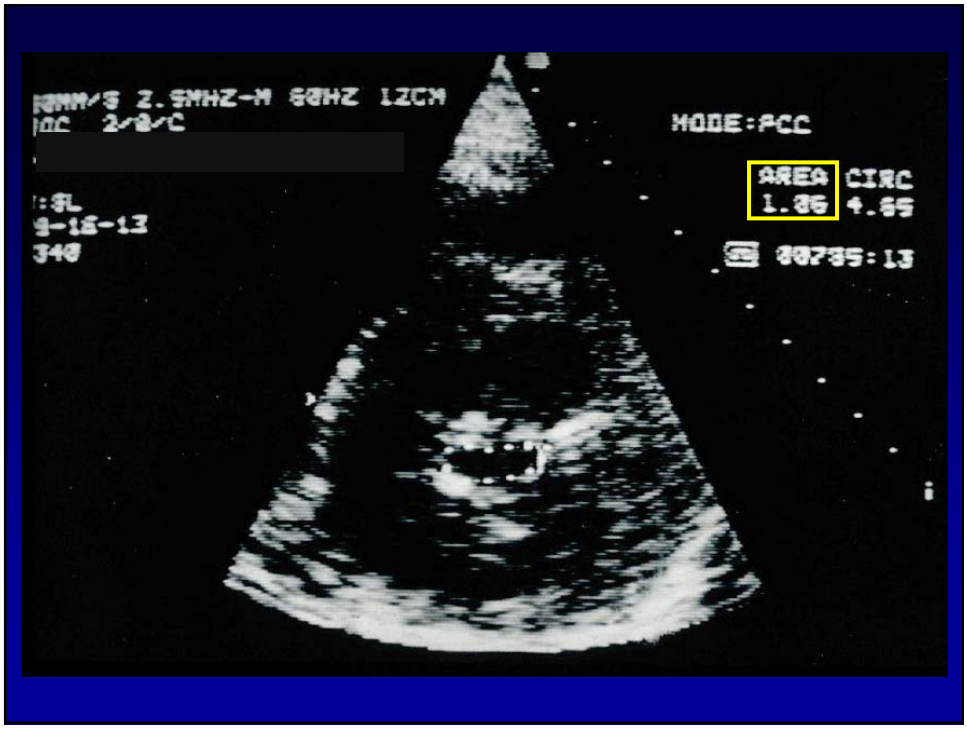
MVA by Planimetry = 1.2 cm2

Rheumatic Mitral Valve Stenosis

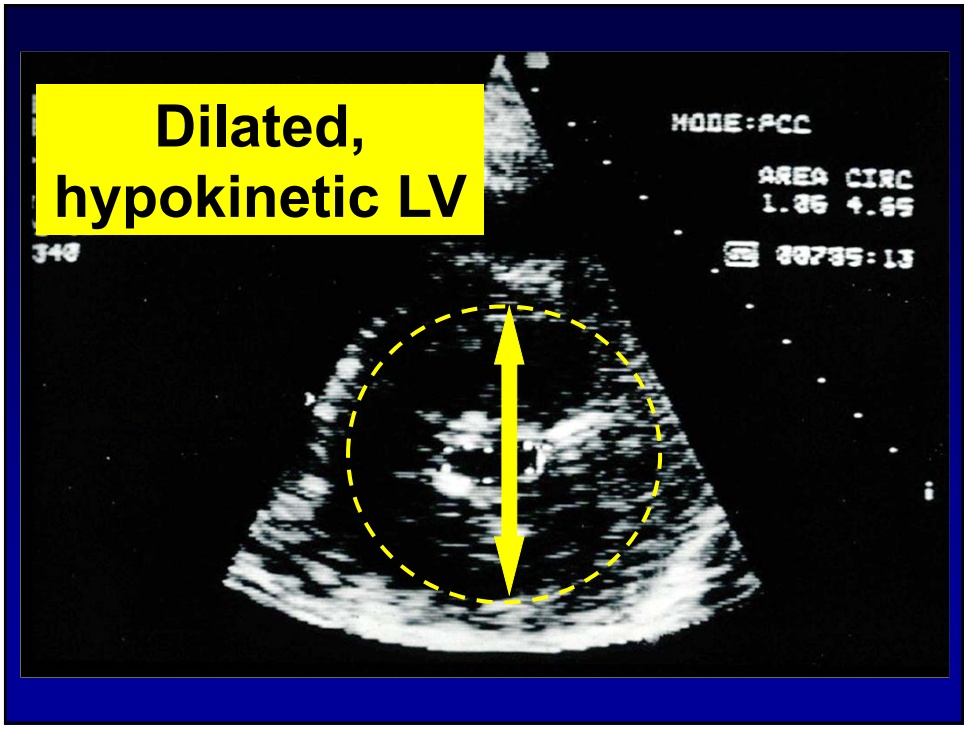


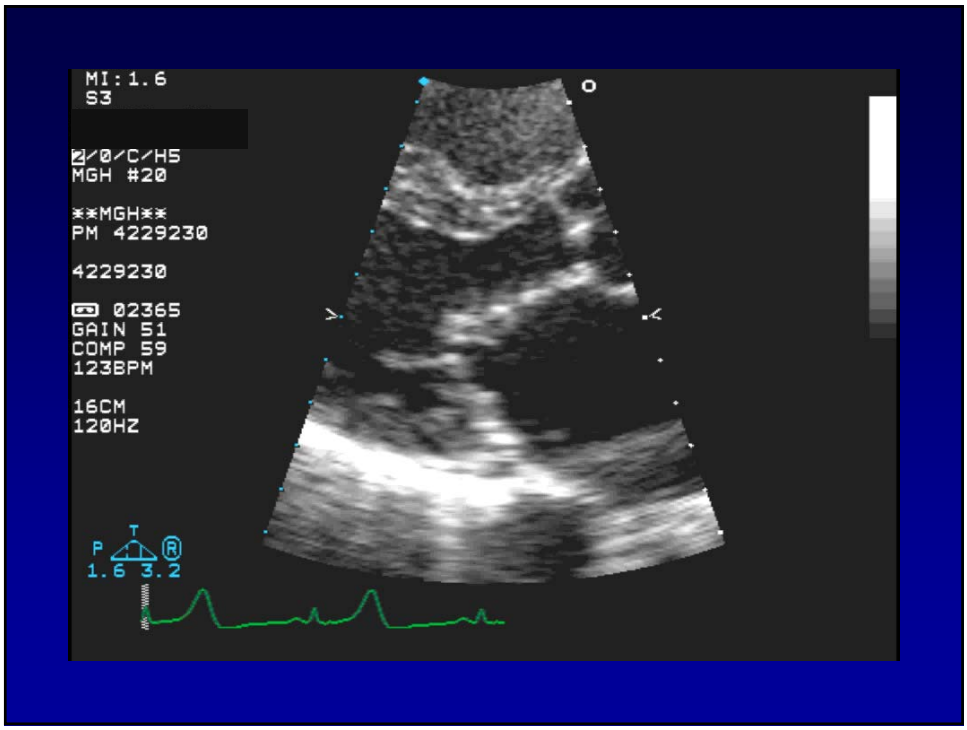
MVA by P ½ t = 1.6 cm2

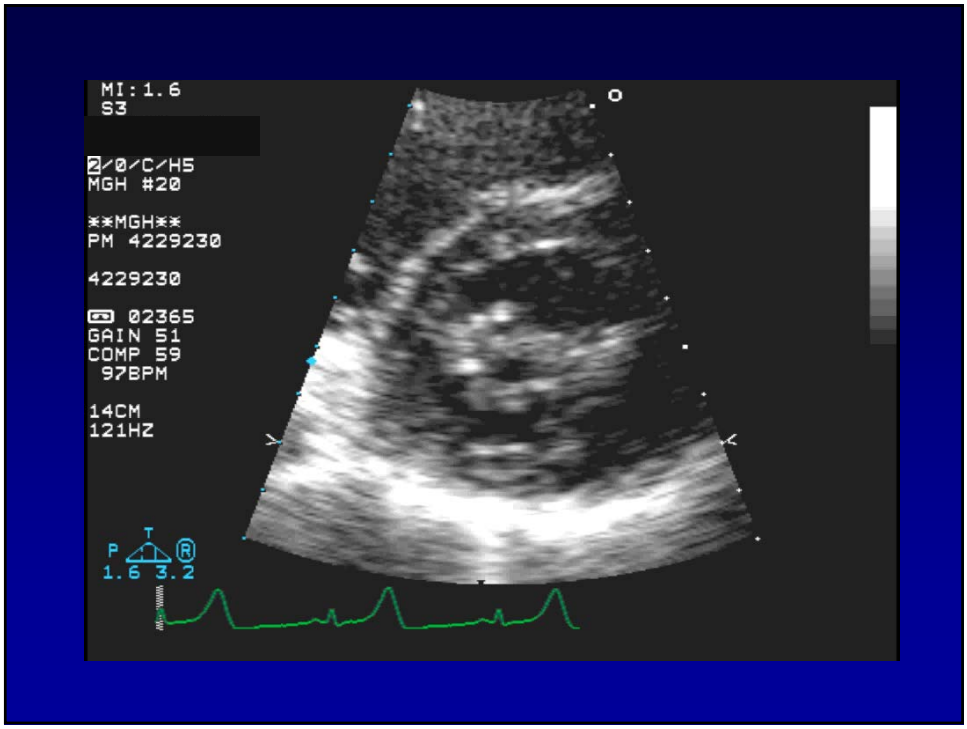
45-year-old woman with mitral stenosis, dyspnea and fatigue

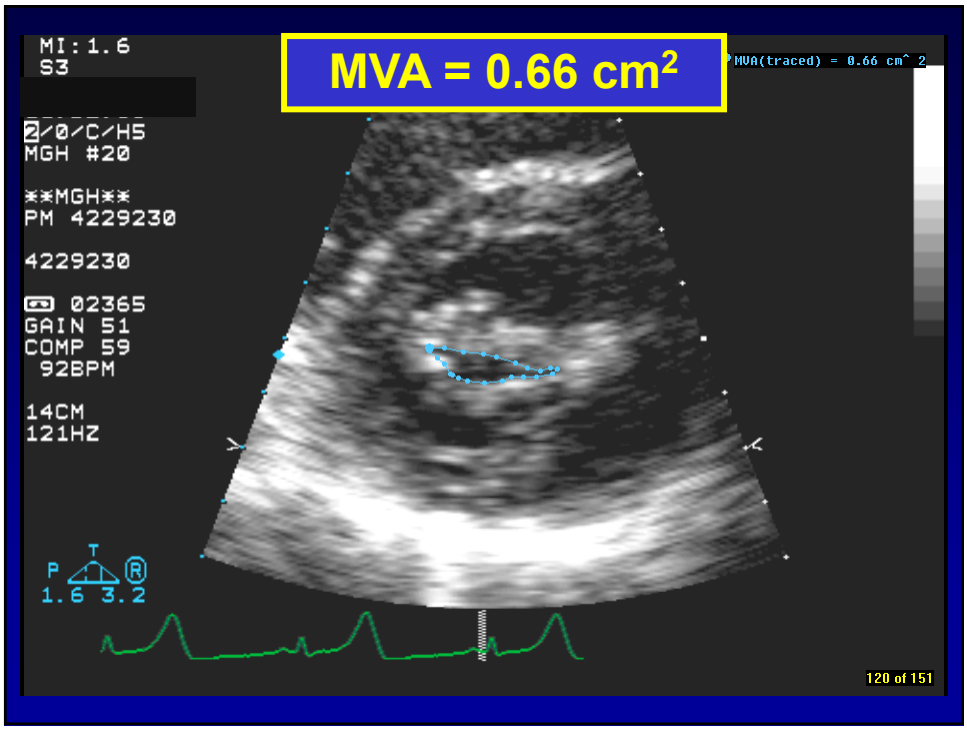

MODE:PCC
AREA
1.86
CIRC
4.65

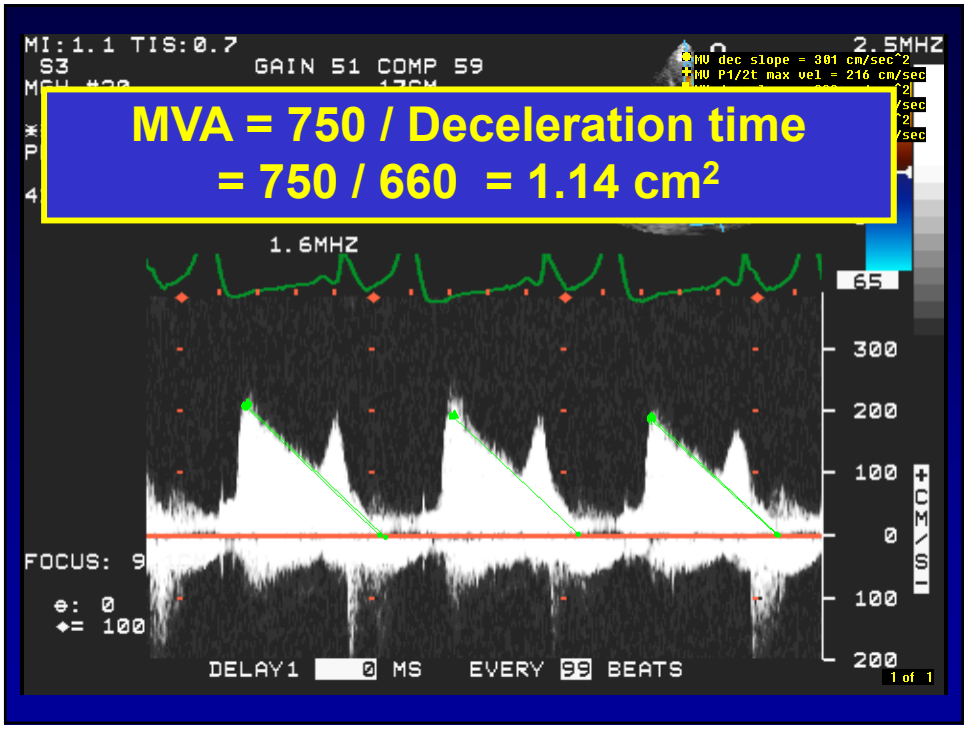

MODE:200
MV AREA
APEX MV

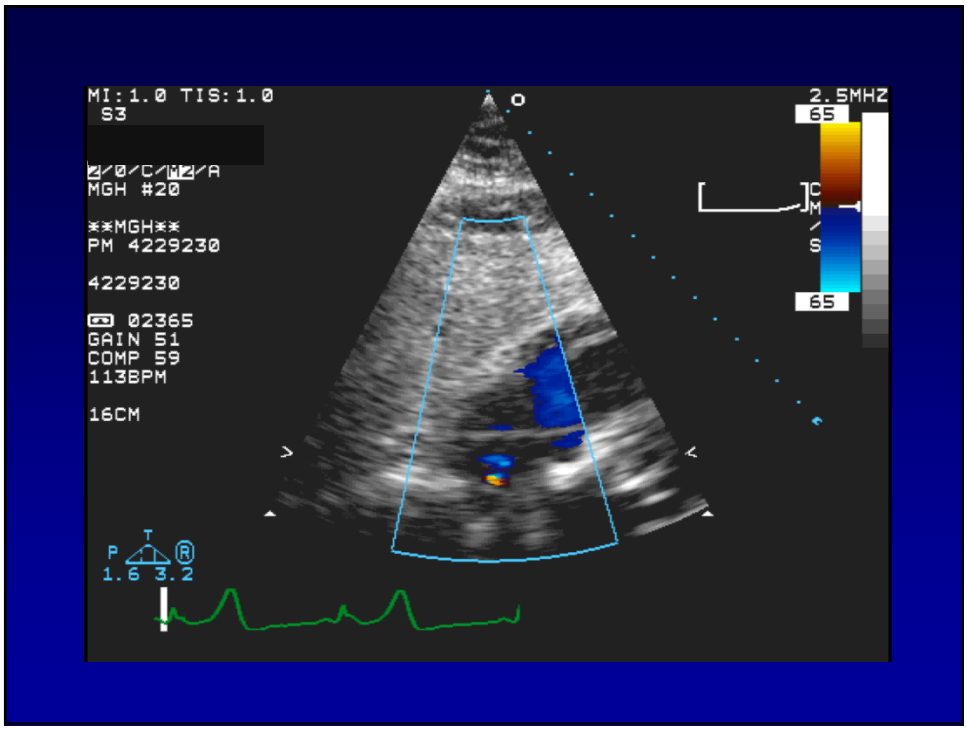

Dilated,
hypokinetic LV
MODE:PCC
AREA CIRC
1.86 4.65
340


MI:1.6
S3
2/0/C/H5
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
123BPM
16CM
120HZ
P
T
R
1.6 3.2


MI:1.6
S3
2/0/C/H5
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
97BPM
14CM
121HZ
P
T
R
1.6 3.2


MVA = 0.66 cm2
MVA(traced) = 0.66 cm^ 2
MI:1.6
S3
2/0/C/H5
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
92BPM
14CM
121HZ
P
T
R
1.6 3.2
120 of 151


MI:1.1 TIS:0.7
S3
GAIN 51 COMP 59
2.5MHZ
MV dec slope = 301 cm/sec^2
MV P1/2t max vel = 216 cm/sec
MVA = 750 / Deceleration time
= 750 / 660 = 1.14 cm2
1.6MHZ
65
300
200
100
0
100
200
CM/S
FOCUS: 9
0: 0
100
DELAY1 0 MS EVERY 99 BEATS
1 of 1


MI:1.0 TIS:1.0
S3
MGH #20
MGH
PM 4229230
4229230
02365
GAIN 51
COMP 59
113BPM
16CM
2.5MHZ
65
65
1.6 3.2

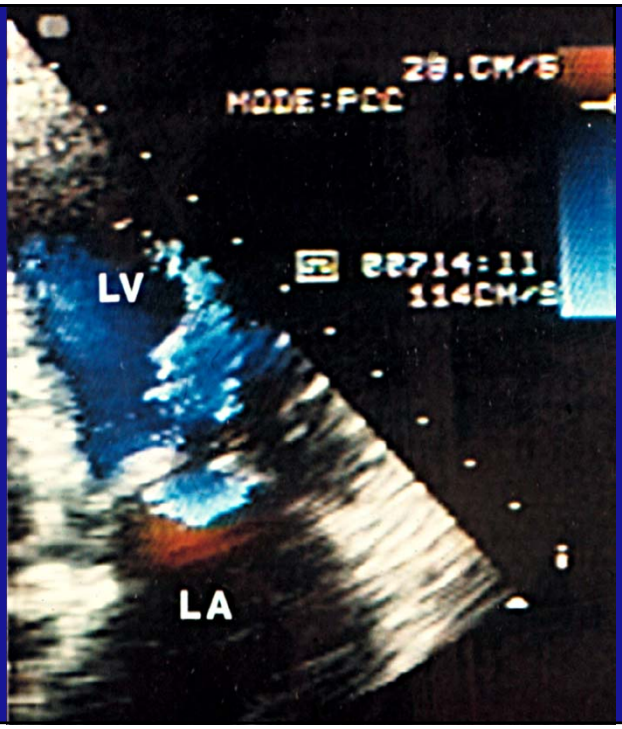
Take Home Message

- 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.

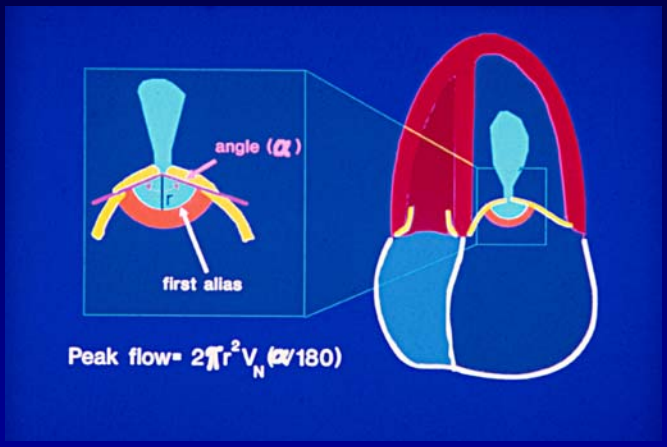
Quantification of Mitral Valve Area

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

AREA = Flow rate / velocity

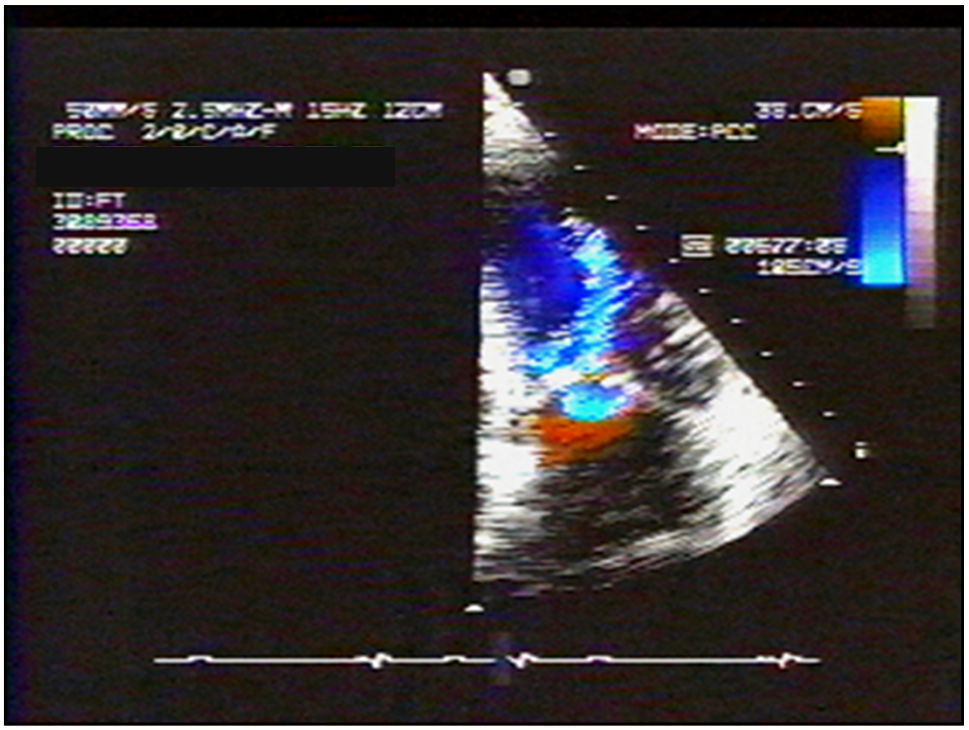


PISA Method



MVA = Peak Flow/Peak MS velocity

Leonardo Rodriguez



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

r = 1.06 cm

v = 38 cm/sec

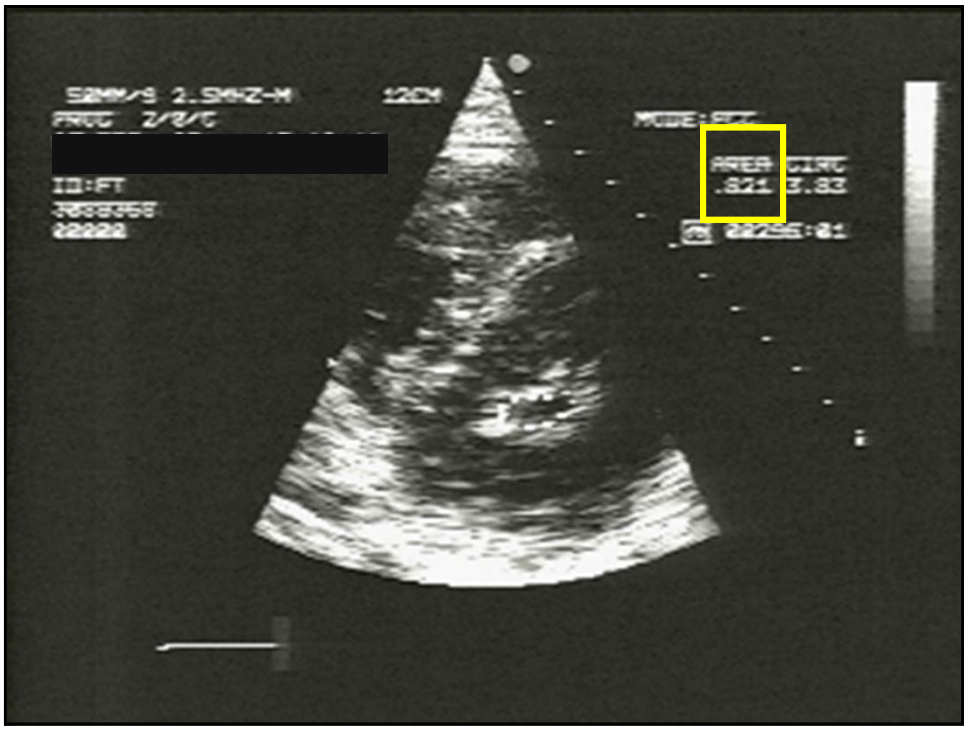
$\alpha = 110°$

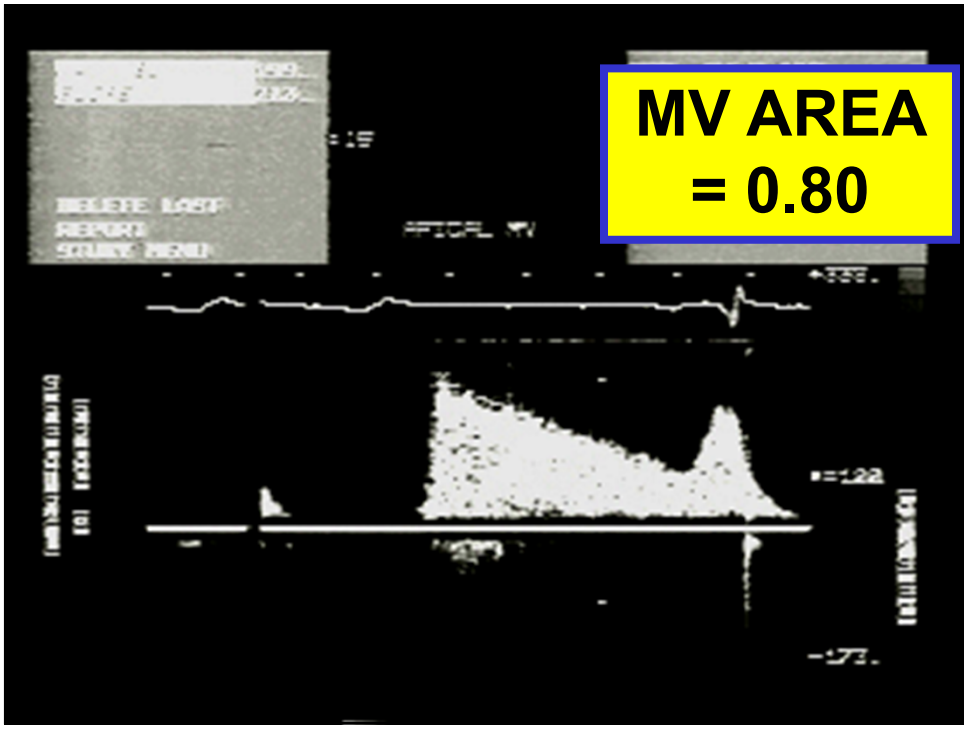
Peak flow rate = 164 cm^3 /sec

MVA = Peak flow rate / Peak velocity

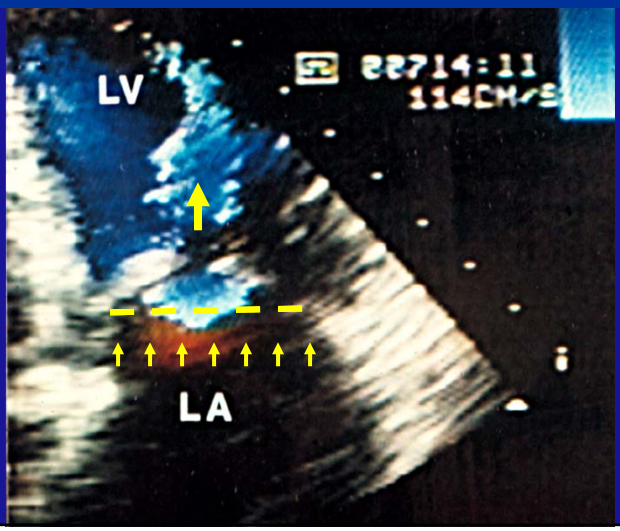
= (164 cm^3 /sec) / (200 cm/sec)

= 0.82 cm^2





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



CONTINUITY EQUATION

$$\text{MVArea} = \frac{\text{Forward flow}}{\text{Velocity}}$$

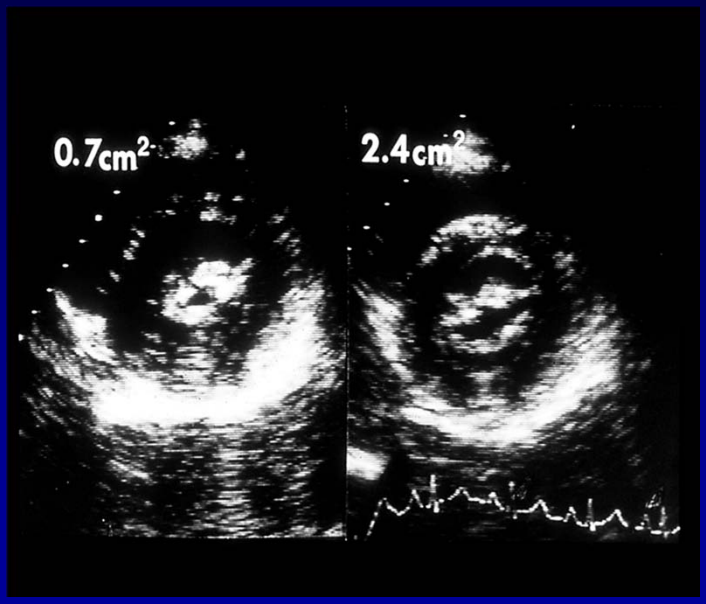
$$= \frac{\text{Systolic flow (AV, PV)}}{\text{Mitral CW time-velocity integral}}$$

- No important MR
- No important AR (PR)

MITRAL STENOSIS

- Diagnosis
- Quantification
- Management

Commissural splitting



METHODS

Echocardiography

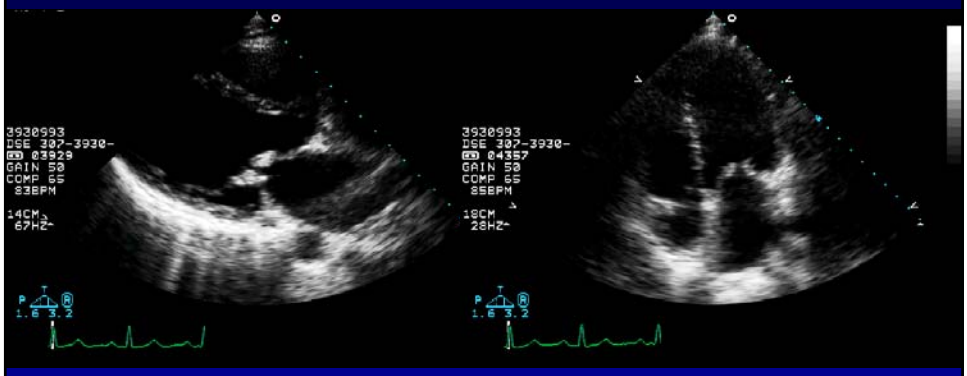
BEFORE PMV:
Echocardiographic Examination

- Standard Views
- Echocardiographic Score of Valve Morphology:

Mobility	0 - 4
Thickening	0 - 4
Calcification	0 - 4
Sub-Valvular	0 - 4
Total	0 -16

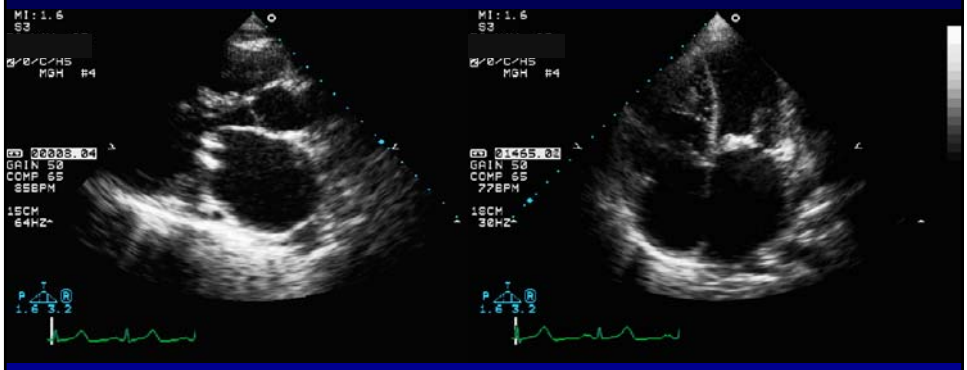
Echo score < 8 associated with greater success of percutaneous mitral valvuloplasty

Mitral Stenosis-Low Echo Score-4



Mobility = 1
Thickening = 1
Calcification = 1
Subvalvular = 1

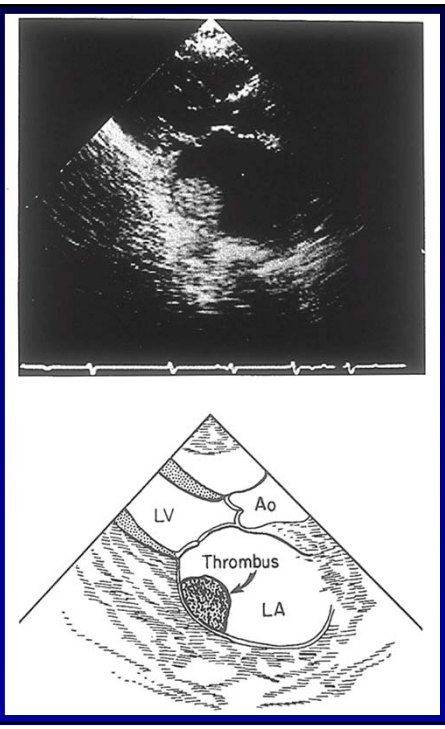
Rheumatic Mitral Valve Stenosis
High Echo Score-11

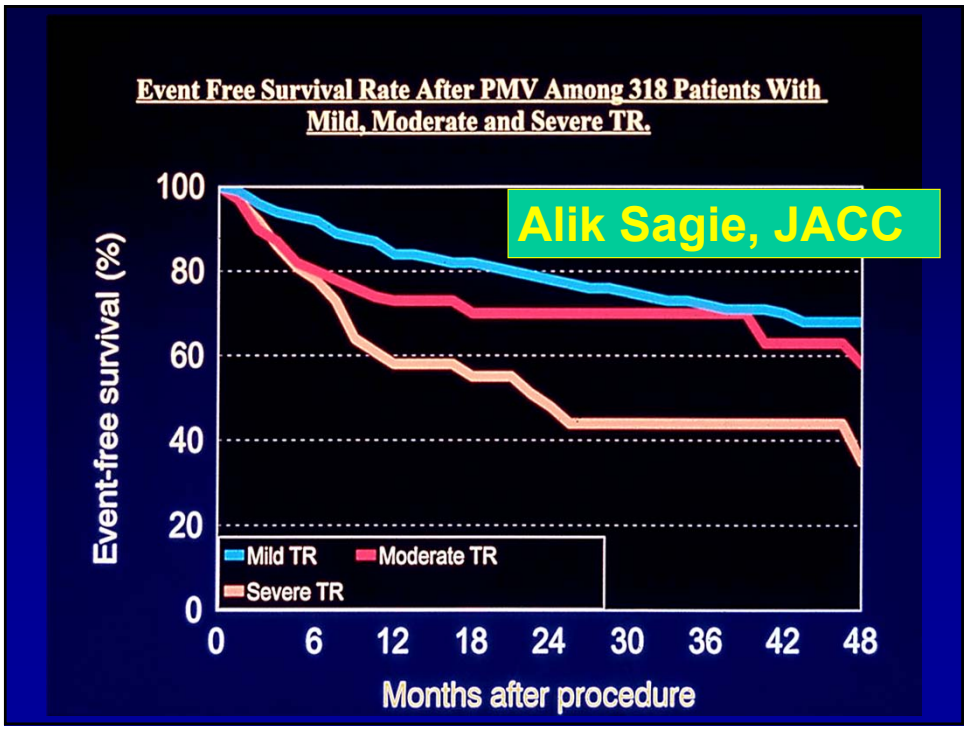


Mobility = 2
Thickening = 2
Calcification = 3
Subvalvular = 4

DON'T DO IT!

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




Event Free Survival Rate After PMV Among 318 Patients With Mild, Moderate and Severe TR.
Alik Sagie, JACC
Event-free survival (%)
100
80
60
40
20
0
Mild TR
Moderate TR
Severe TR
0
6
12
18
24
30
36
42
48
Months after procedure

MITRAL STENOSIS

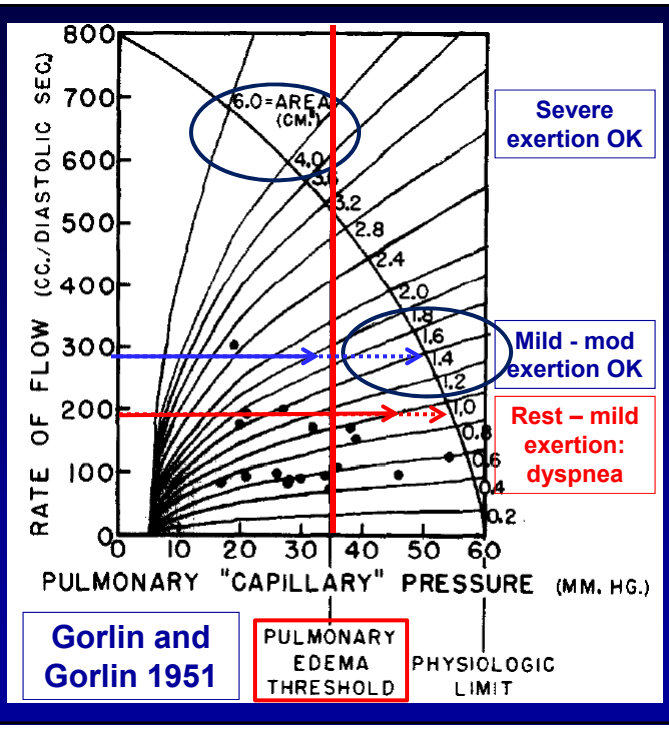
- Diagnosis
- Quantification
- Management

2014 AHA/ACC Guideline for the Management of Patients With Valvular Disease (Nishimura)

- > 1.5 cm^2 – "Progressive"
- 1.1 to 1.5 cm^2 – "Severe"
- ≤ 1.0 cm^2 – "Very severe"

Based on symptoms and improvement with intervention

But MVA ≤ 1.5 cm^2 may be as'xic!



Echo and Hydrodynamic Assessment of Mitral Stenosis

- Mitral valve area measurement
  - > 1.5 cm^2 - Mild
  - 1.1 to 1.5 cm^2 - Moderate
  - < or = 1.0 cm^2 - Severe