



Lady Davis
Carmel Medical Center



Rappaport
Faculty of Medicine

Mitral Valve Disease

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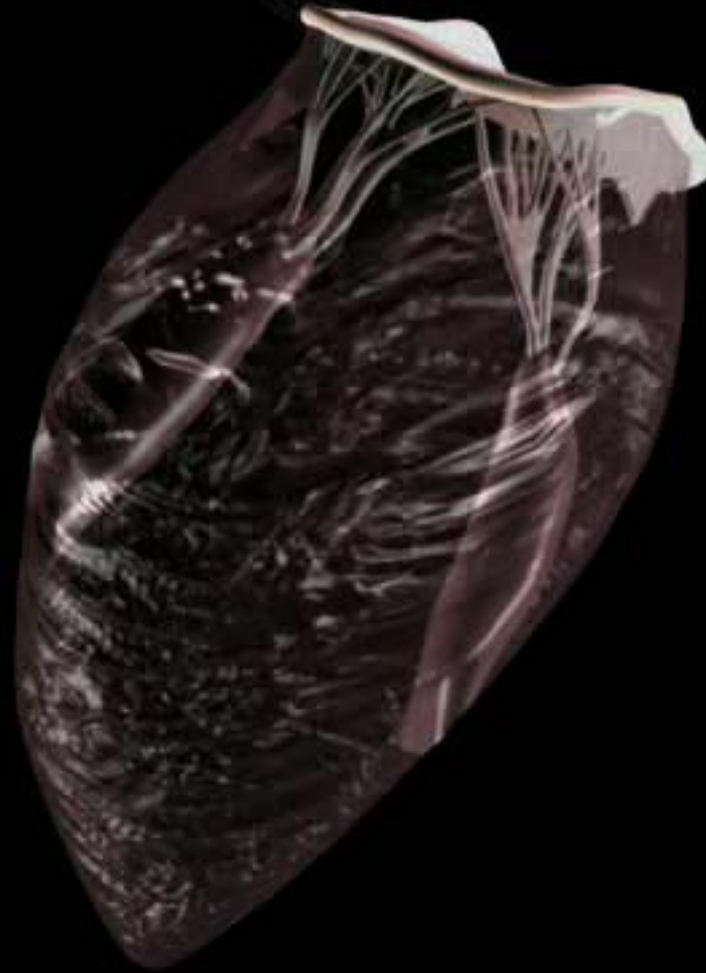
Lady Davis Carmel Medical Center, Technion IIT

Caesarea 11/2010

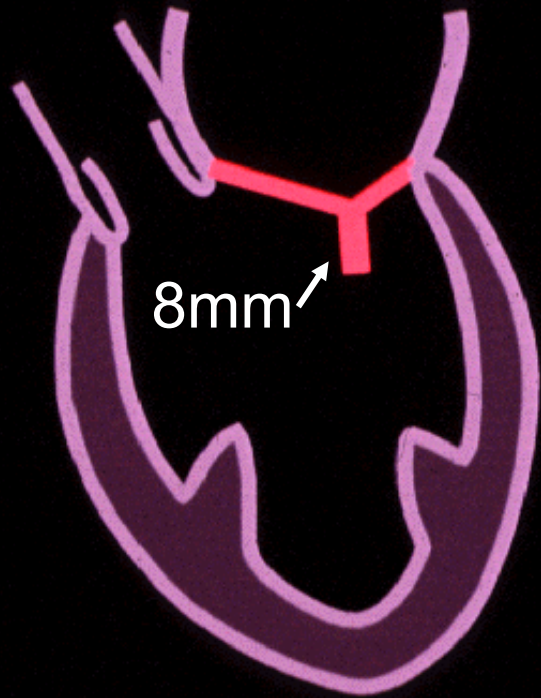
The Burden of MV Disease



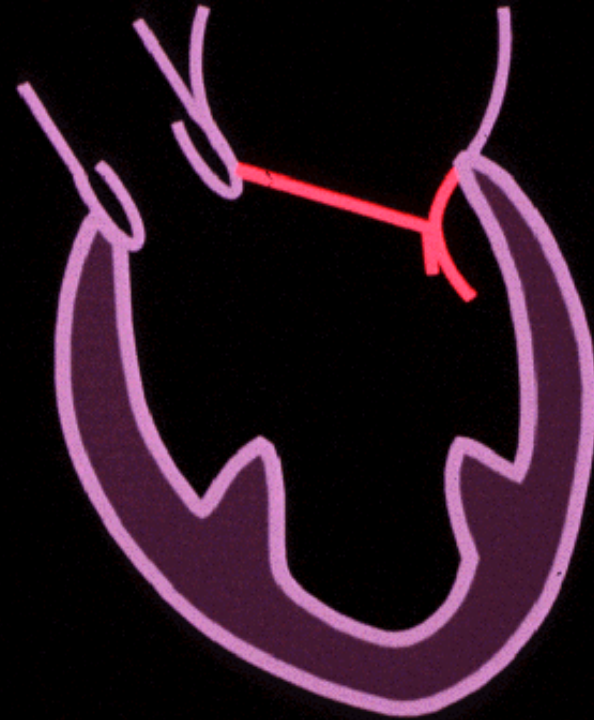
Mitral valve anatomy



Abnormal coaptation

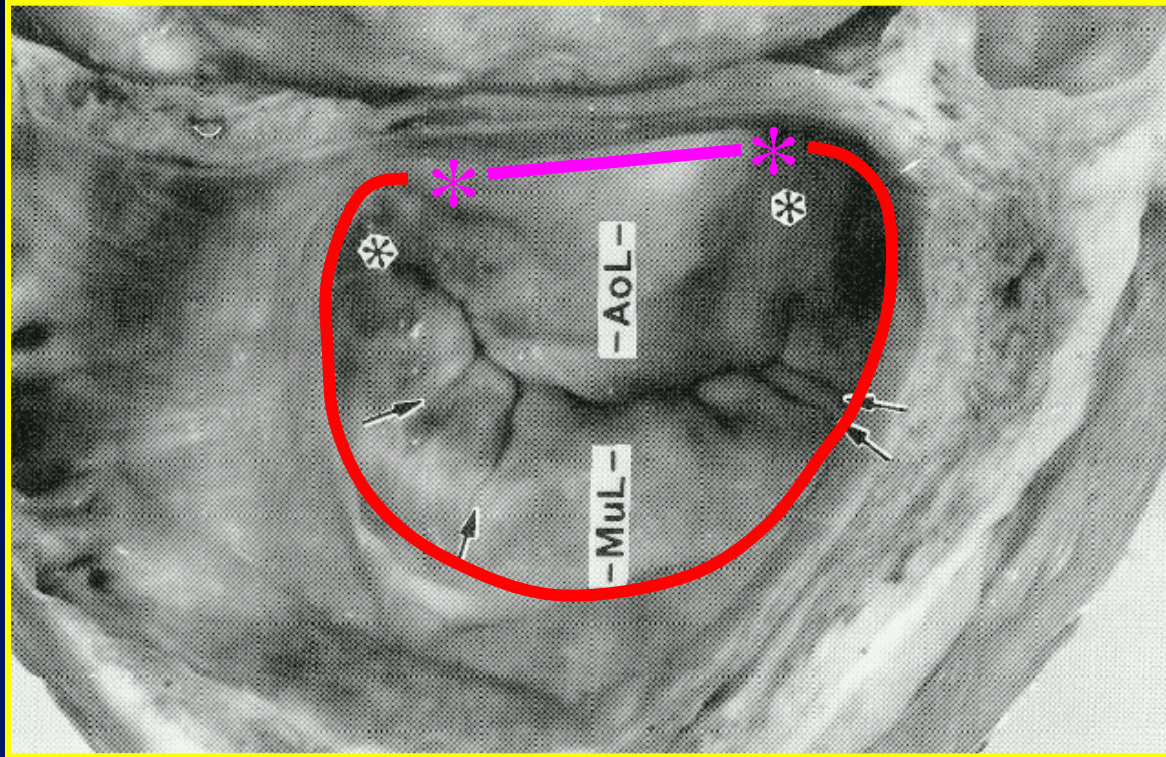


Normal coaptation

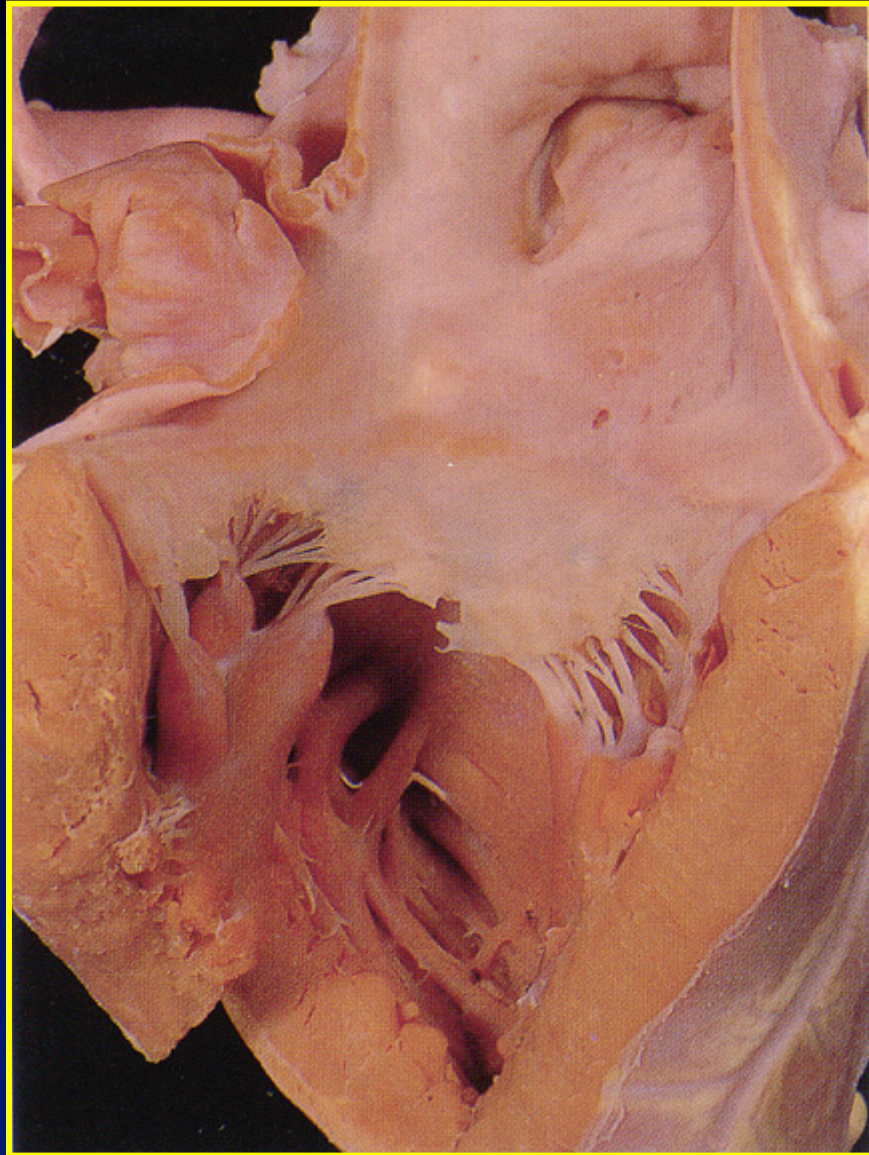


Abnormal coaptation

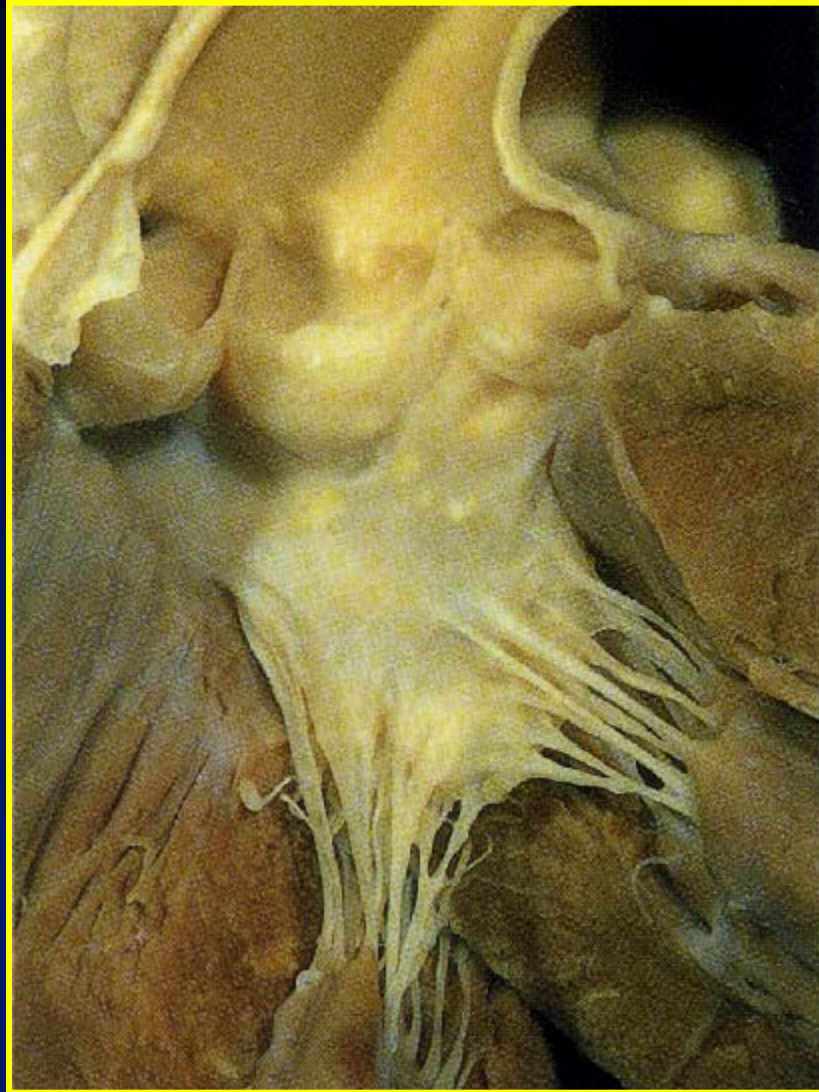
MV annulus



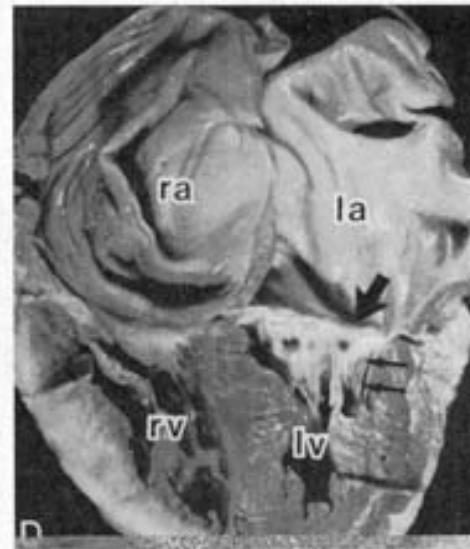
Papillary muscles & chordae



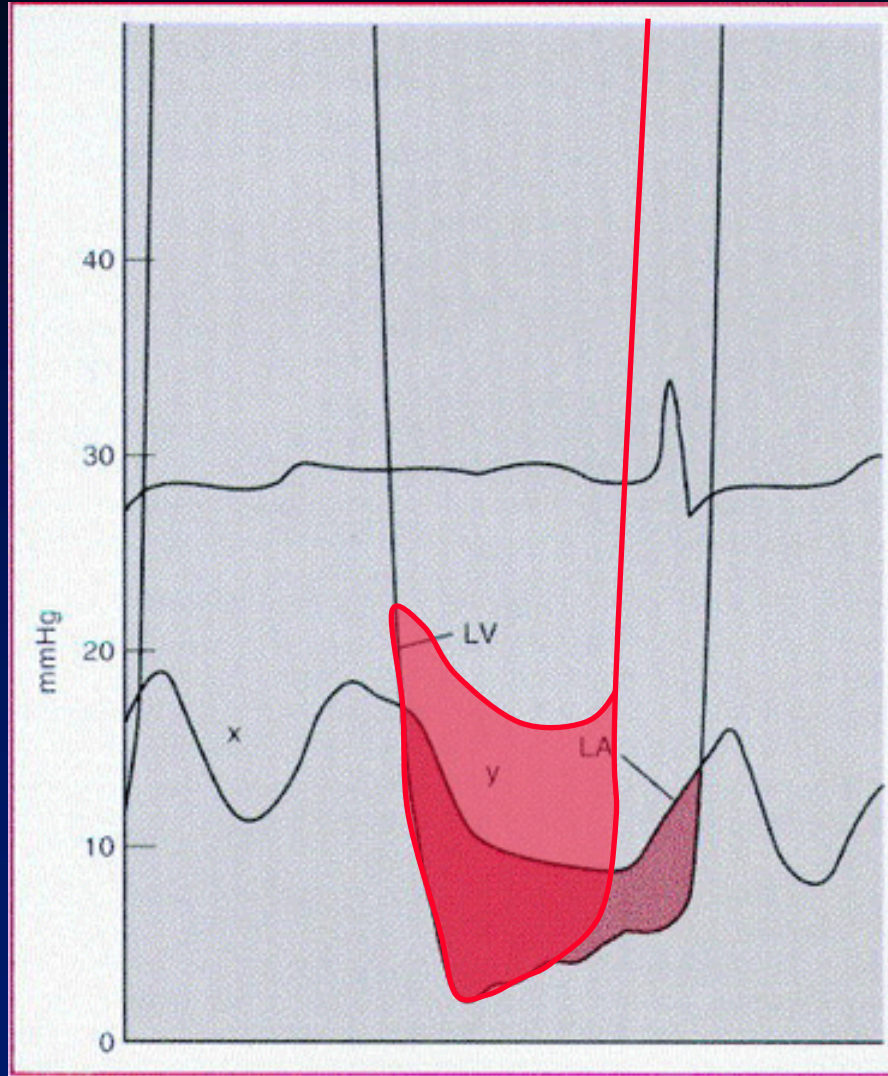
Chordae



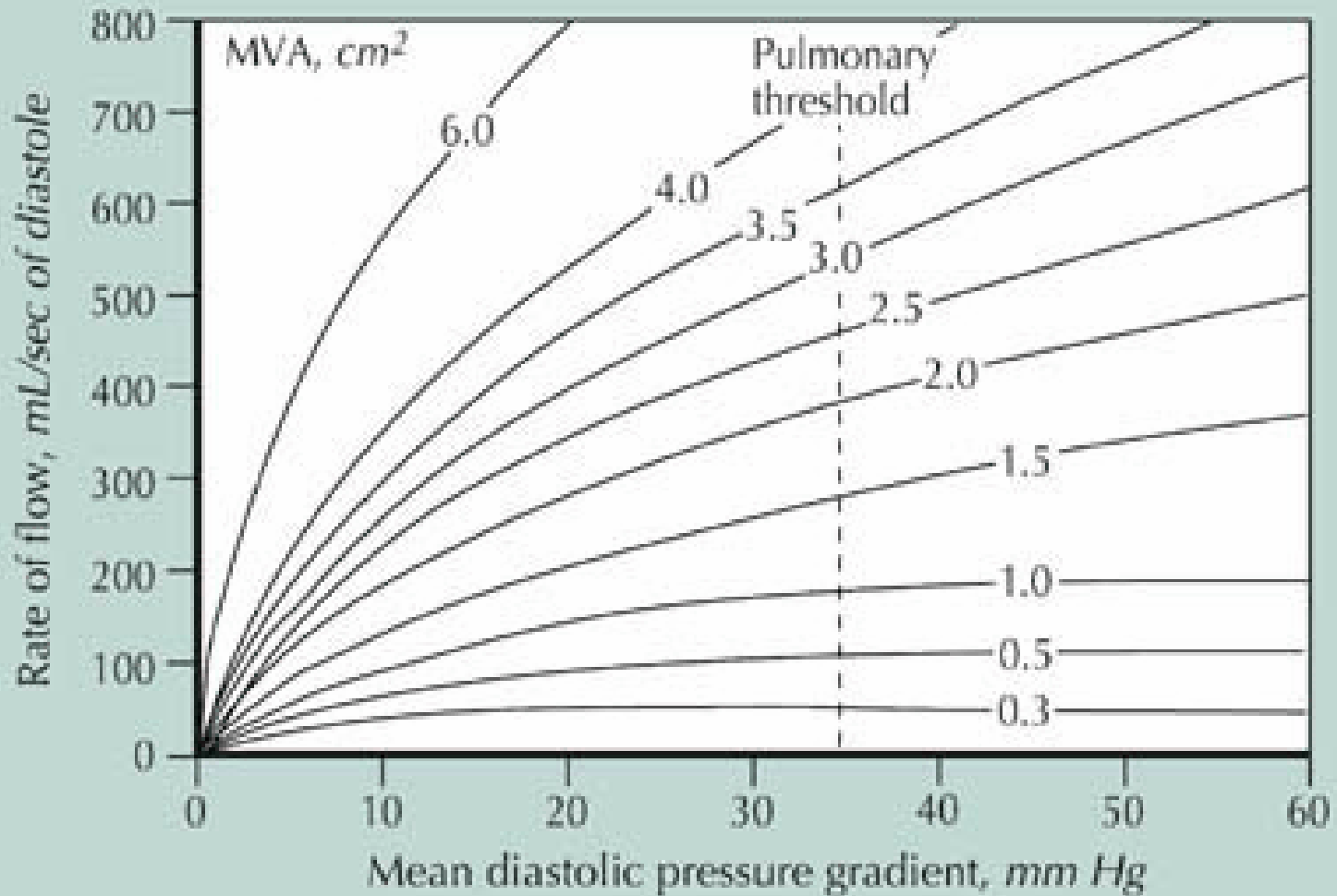
Mitral Stenosis



Pathophysiology



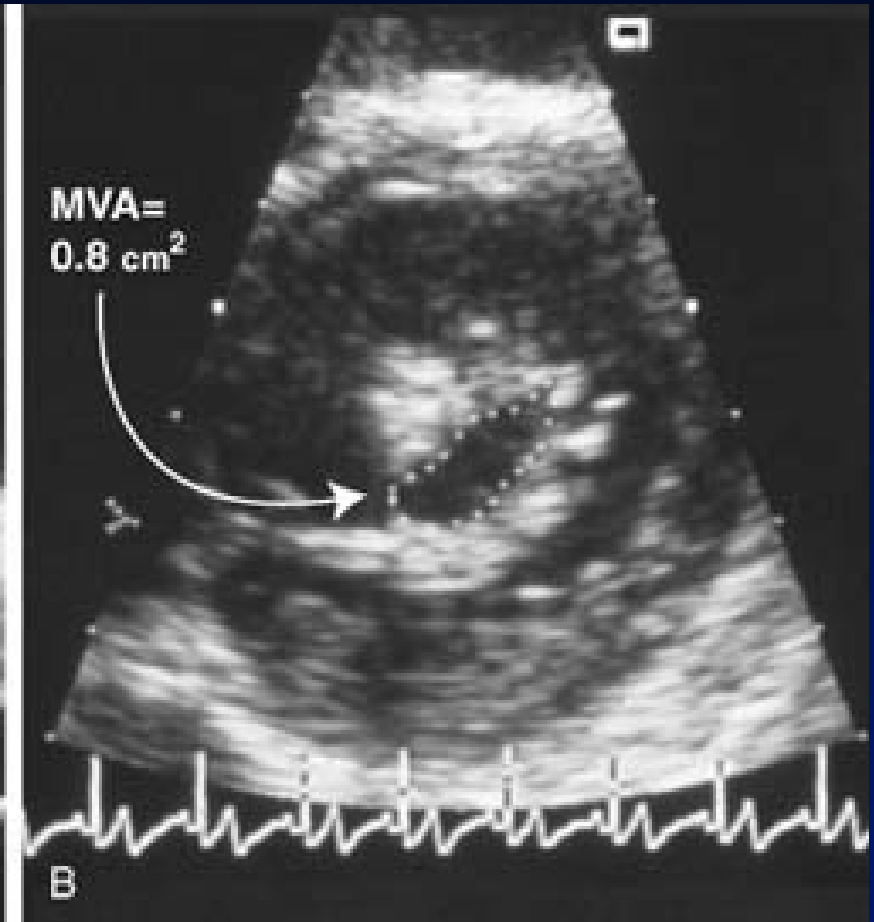
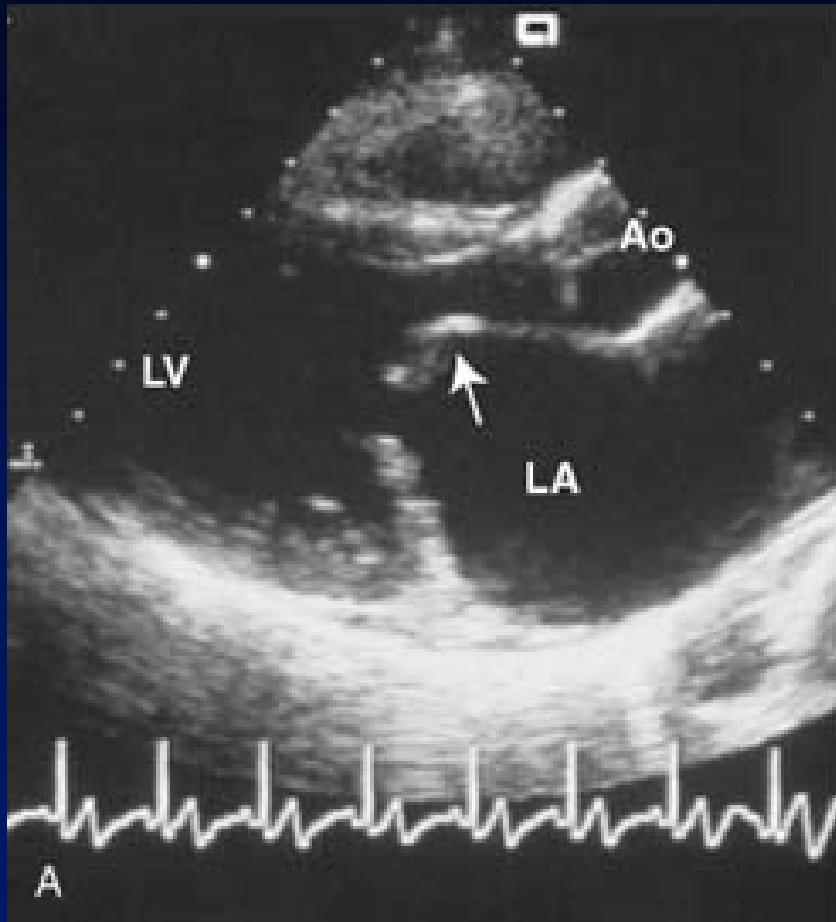
Pathophysiology



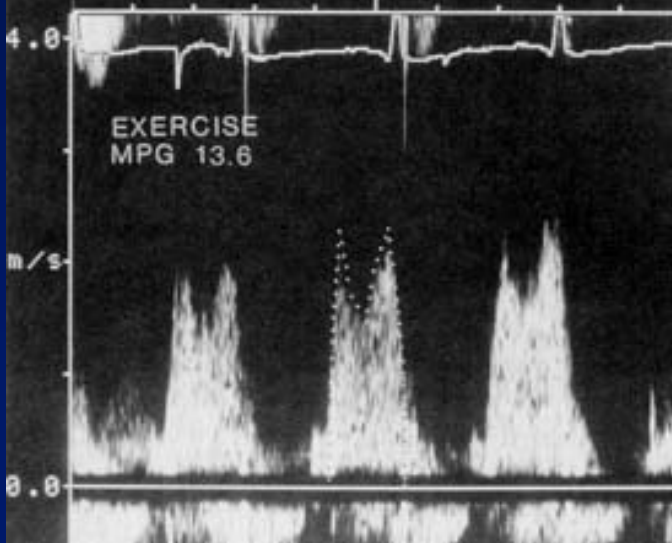
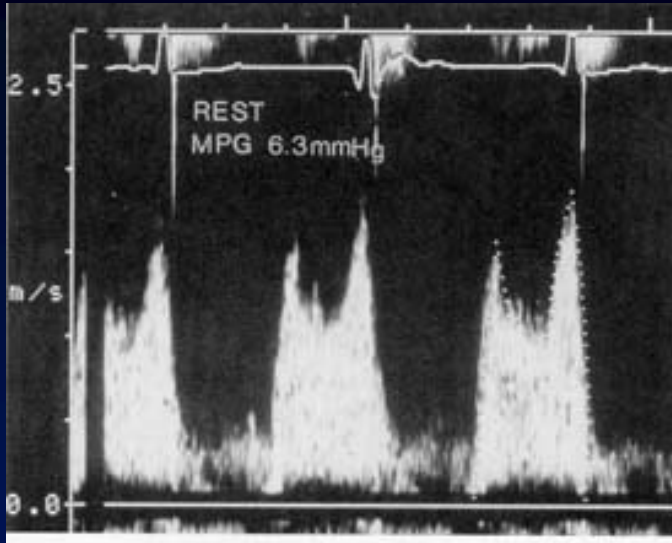
Physical findings

- PMI- normal
- RV lift
- 1st heart sound↑
- Opening snap
- Diastolic murmur – presystolic accentuation
- P₂↑
- TR (TS)
- CHF

Echocardiography- 2D



Echo-Doppler



AR, ASD,
→MVA↑

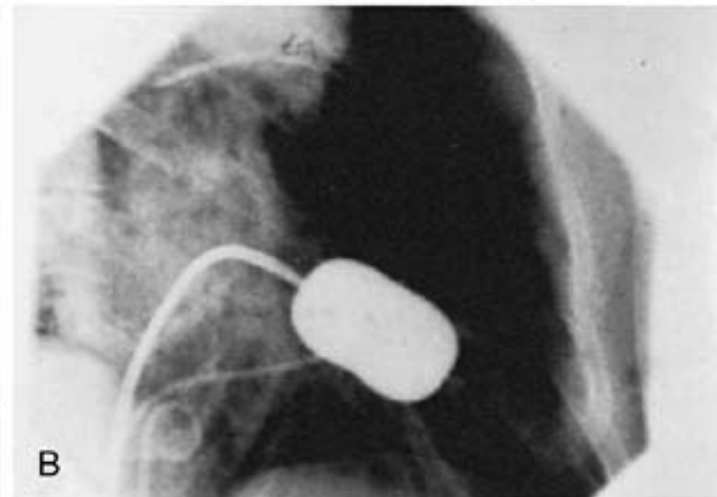
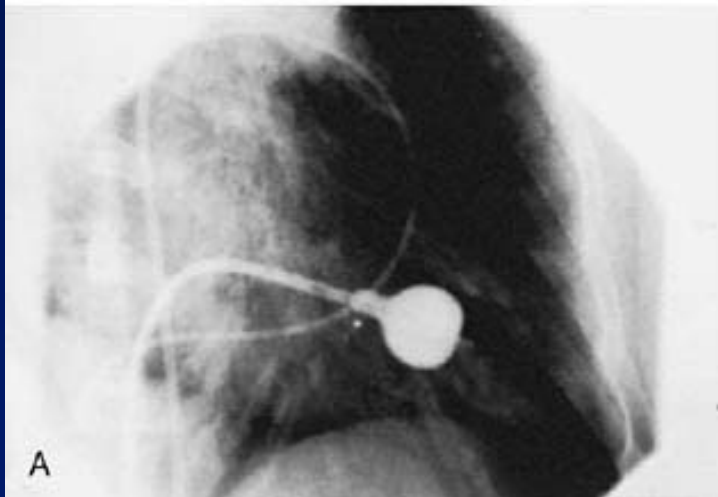
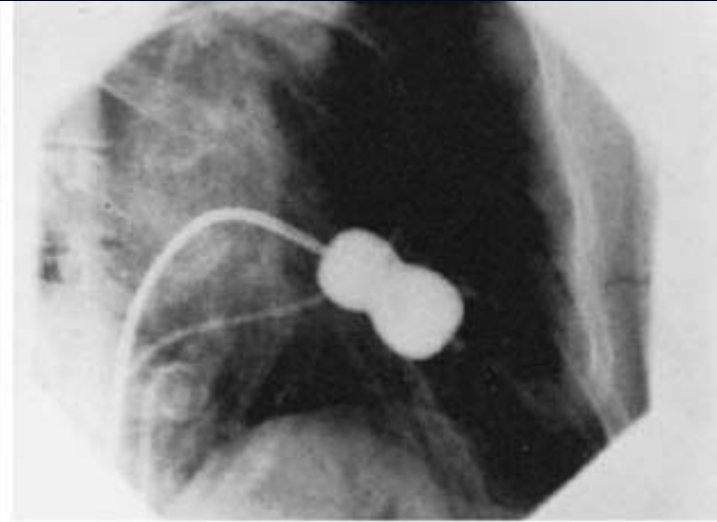
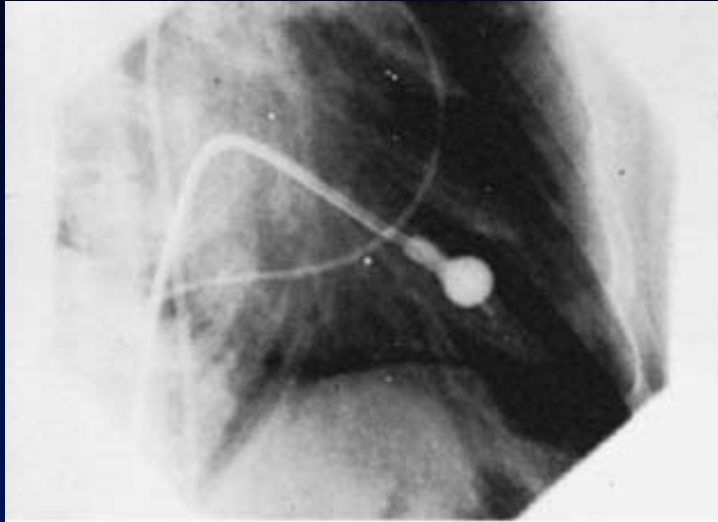
LVH → MVA↓

Not accurate
immediately
after PBMV

Medical treatment

- β blockers (Ca blockers, Digoxin)
- Diuretics
- Anticoagulation
- α arrhythmics/ cardioversion

Balloon Valvuloplasty



A

B

Balloon valvuloplasty ACC/AHA 2008

Class I

- FC II-IV, $MVA \leq 1.5 \text{cm}^2$, favorable anatomy, no thrombus, $MR < +3$
- Asymptomatic with sys PAP > 50 mmHg at rest, > 60 mmHg during exercise

Class IIa

- FC III-IV, calcified valve, high risk surgery

Balloon valvuloplasty ACC/AHA 2008

Class IIb

- FC I, new onset atrial fibrillation
- FC II-IV, MVA > 1.5 cm² but sys PAP > 60 mmHg, PCWP > 25 mmHg or mean ΔP > 15 mmHG during exercise
- FC III-IV, calcified valve

Surgery

- Open commissurotomy
- MVR
- Concomitant tricuspid annuloplasty if >mild TR or tricuspid annulus diameter ≥ 3.5 cm*, A fib, large LA (>6cm)

*Shiran & Sagie, JACC, 2009

Surgery – ACC/AHA 2008

Class I

- FC III-IV, $MVA \leq 1.5 \text{cm}^2$, and PBMV is not an option
- FC III-IV, $MVA \leq 1.5 \text{cm}^2$ and MR+3-4 – MVR unless repairable

Class IIa

- MVR: FC I-II, $MVA \leq 1.0 \text{cm}^2$, sys PAP > 60 mmHg, and PBMV or repair is not an option

Surgery – ACC/AHA 2008

Class IIb

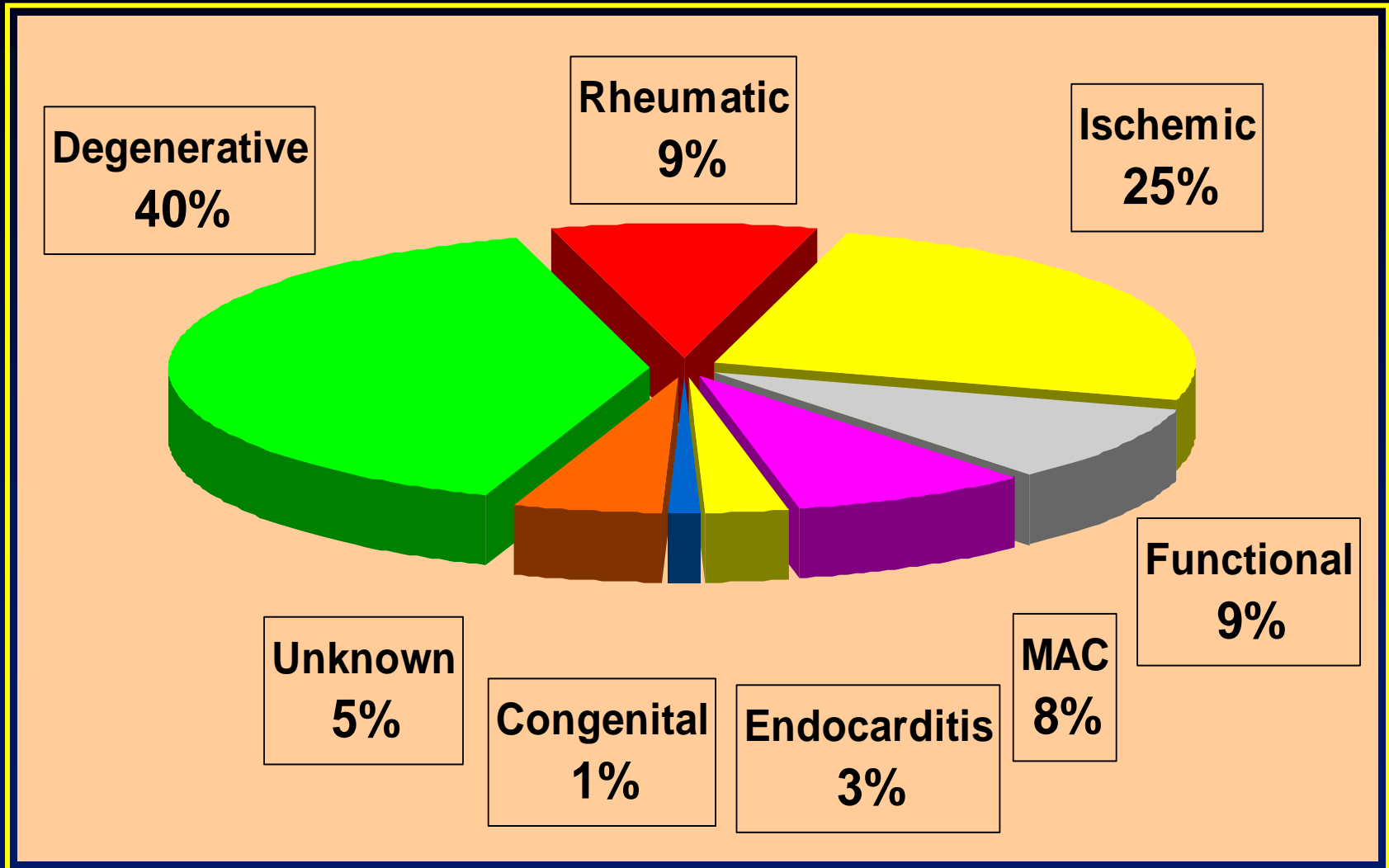
- MV repair for $MVA \leq 1.5 \text{cm}^2$, favorable anatomy and recurrent emboli despite adequate anticoagulation

Acute severe MR

- Etiology: ruptured papillary muscle, acute ischemic MR, BE, MV repair/replacement failure, ruptured chordae
- Clinical presentation: pulmonary edema and cardiogenic shock. Mitral murmur often inaudible
- Diagnosis: immediate echo
- Rx: IABP±mechanical ventilation, immediate TEE, coronary angio and surgery

Chronic Severe Mitral Regurgitation

Etiology of MR (n=180)



Degenerative Mitral Valve Disease

- “Spontaneous” ruptured chordae
- Myxomatous, MVP, Barlow’s disease
 - Can be genetic: Marfan, rarely- familial, x-linked: Filamin A mutation*
 - Incidence 1-2% (≥ 2 mm PLAX)
 - Dynamic mid systolic click late systolic murmur
 - May progress to severe MR, ruptured chordae, at risk for endocarditis

*Kyndt et al, Circ 2007

Ruptured Cordae (n=96)

Non - myxomatous (63%)

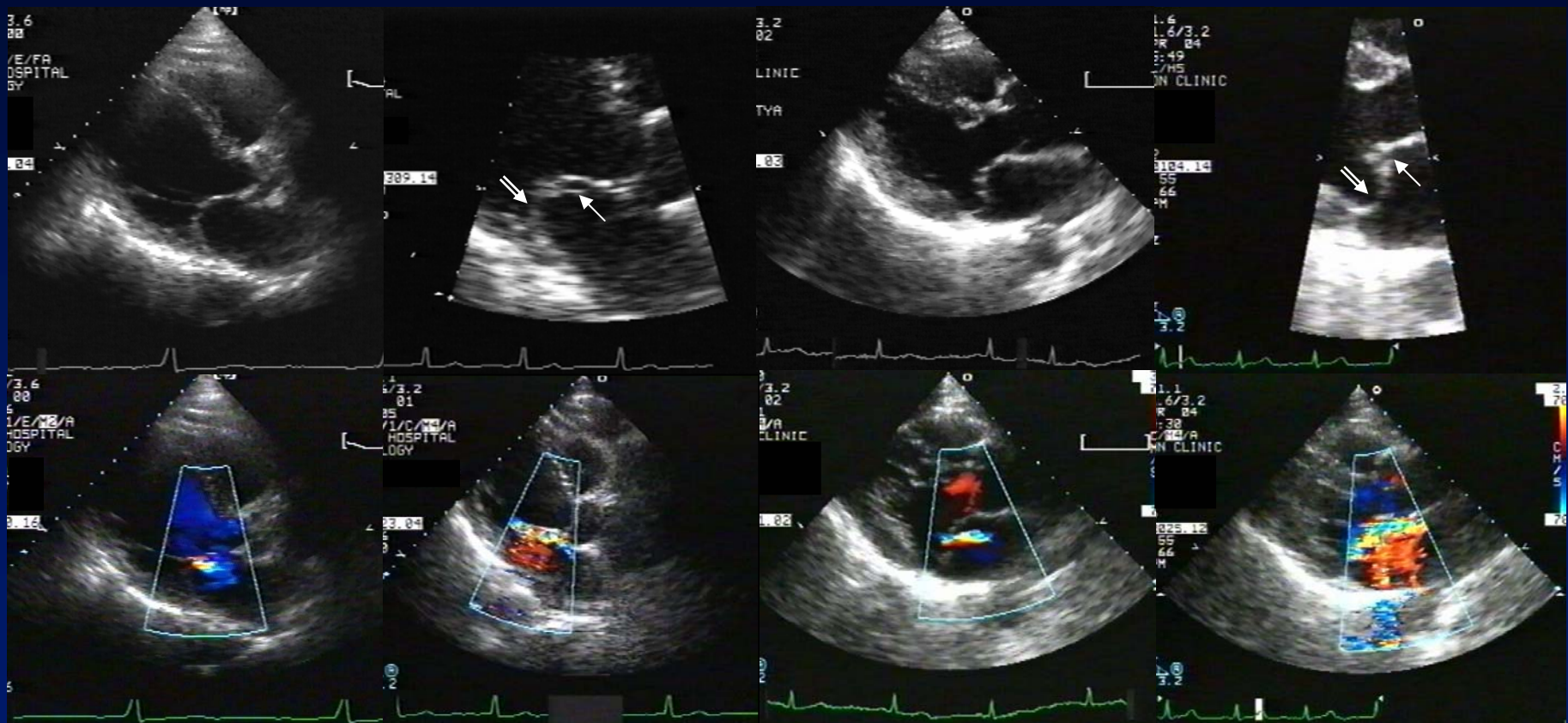
Myxomatous (37%)

Pre

Post rupture

Pre

Post rupture



Adawi et al, JHVD 2006

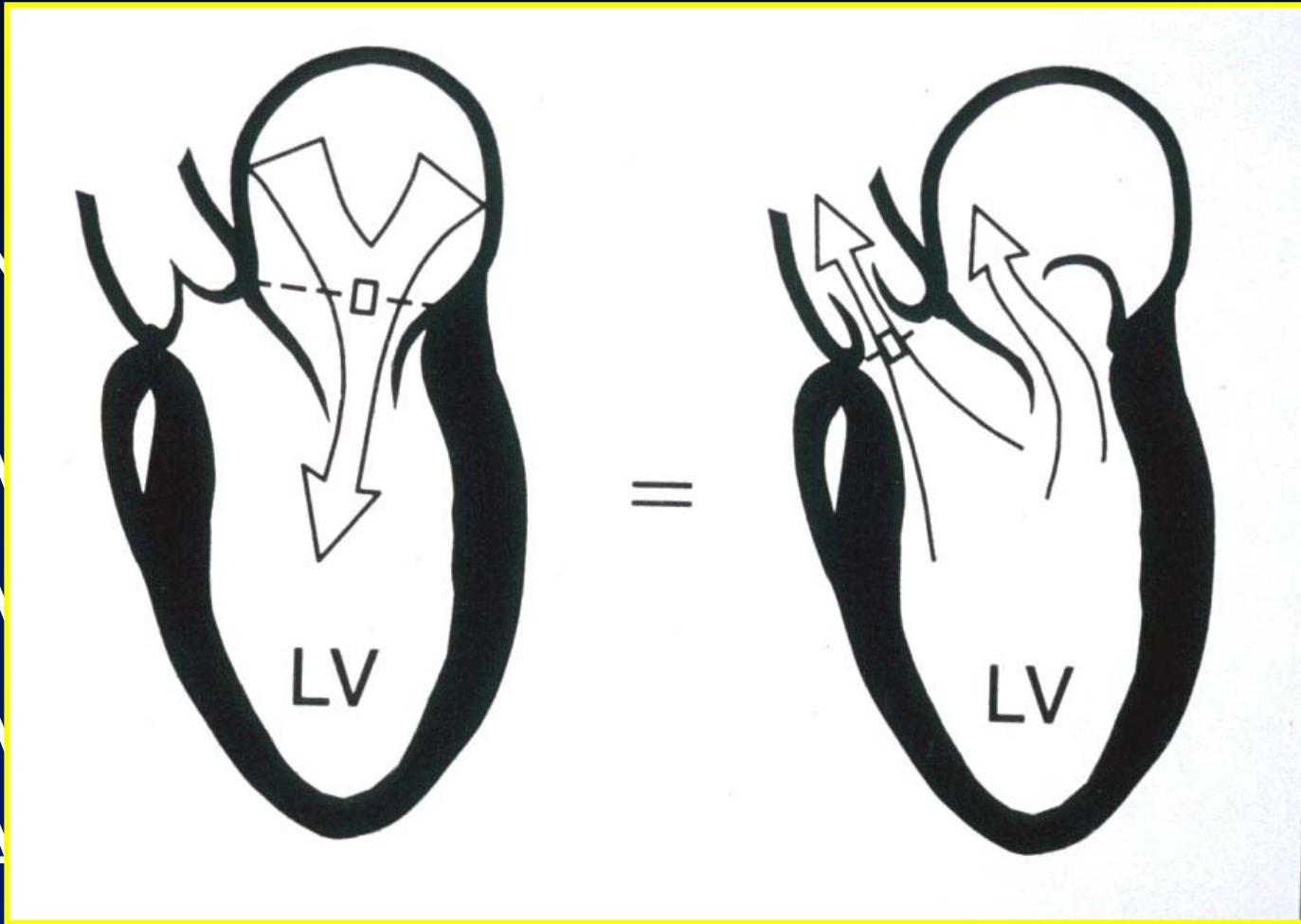
Pathophysiology of MR

- LV volume overload



Pathophysiology of MR

- M
- LA
- LA
- LA
- PA



ge

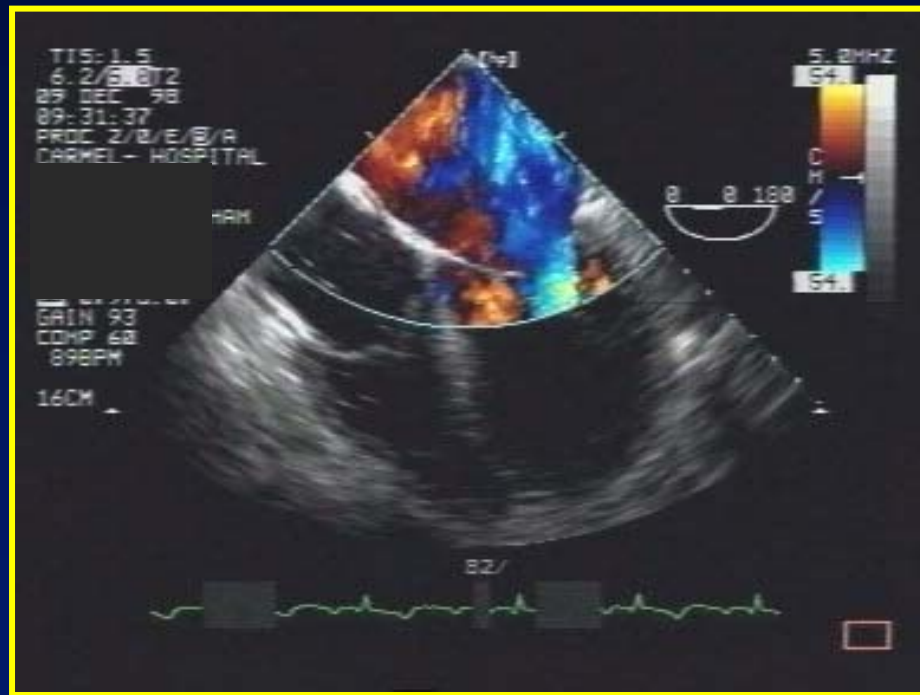
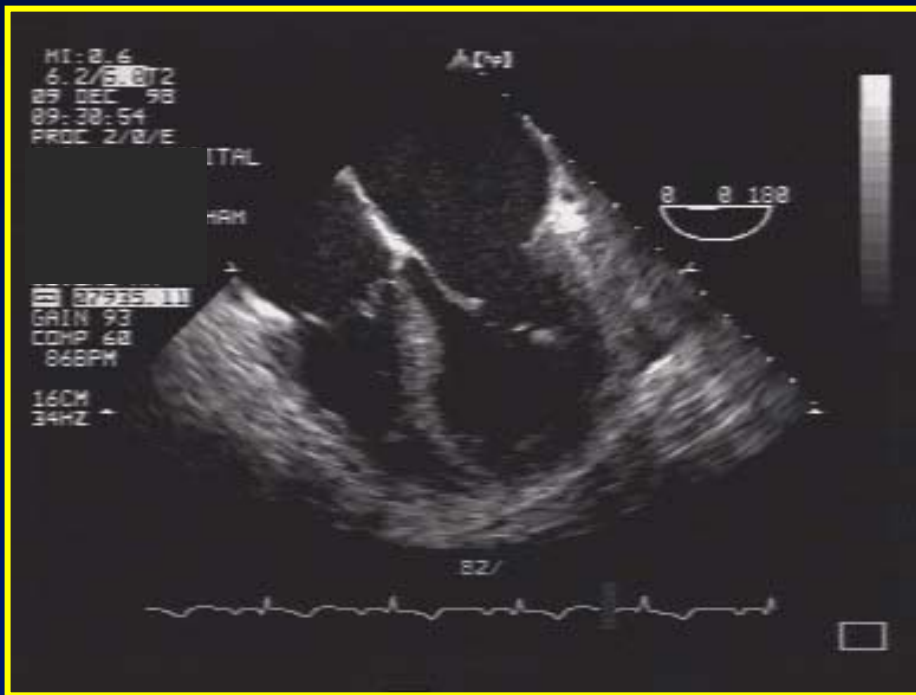
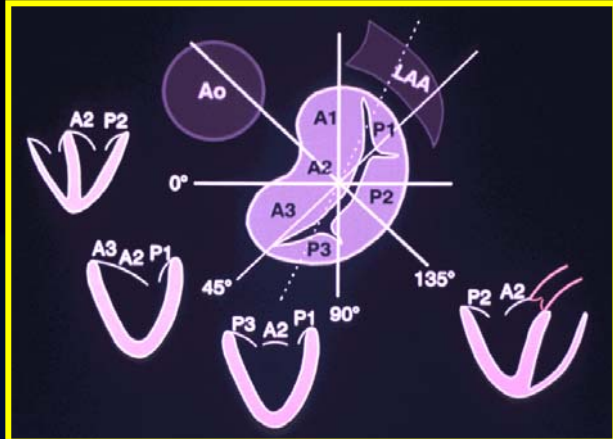
Physical Examination

- Hyperdynamic/displaced PMI
- LA lift (late systolic)
- S1↓ P2↑ III
- Holosystolic apical murmur
 - Radiates to axilla/LSB
 - Intensity does not necessarily correlate with MR severity
- Diastolic “functional” apical murmur
- TR

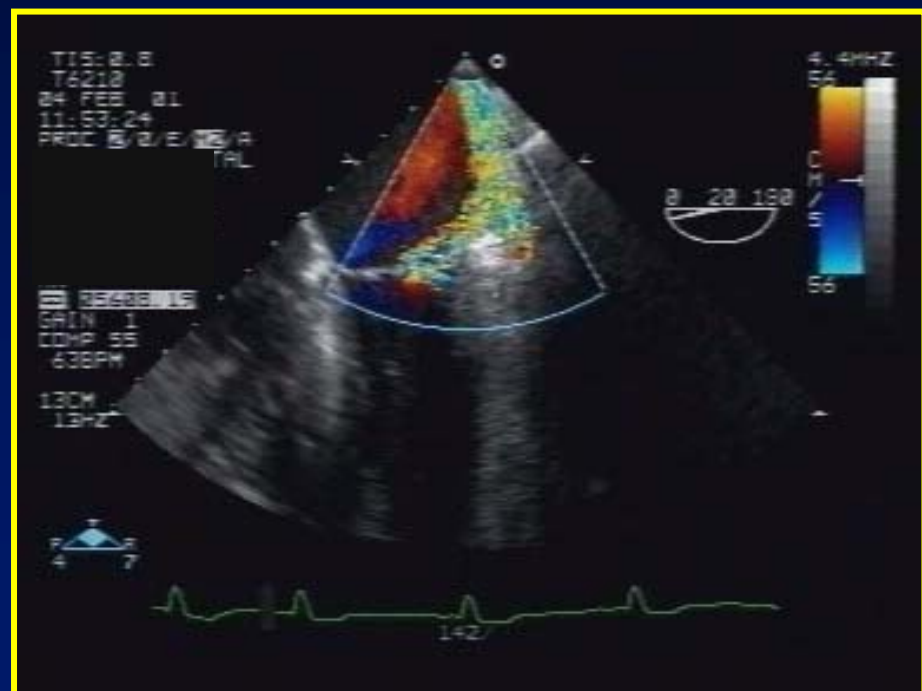
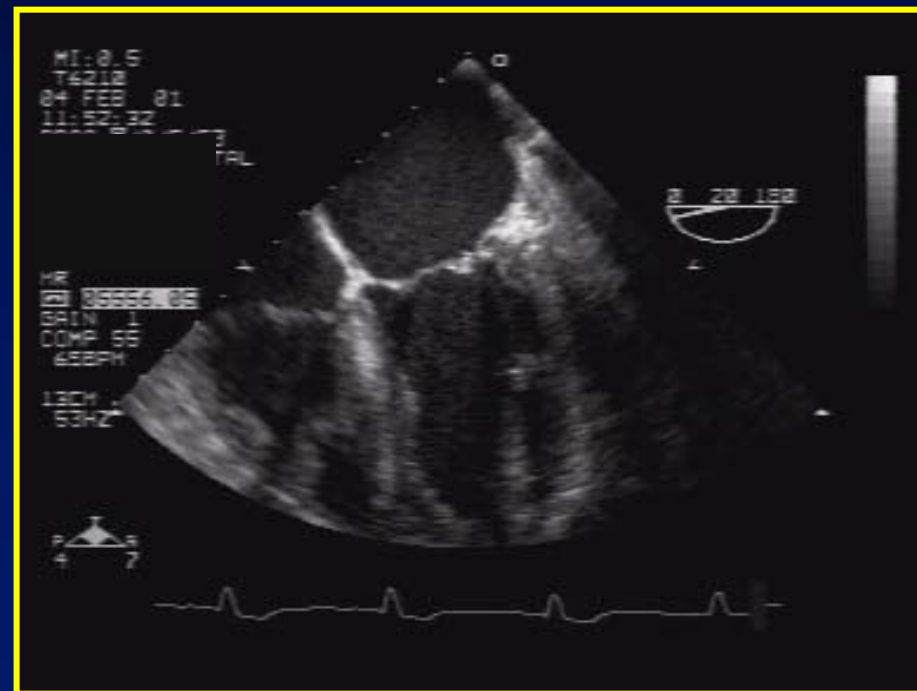
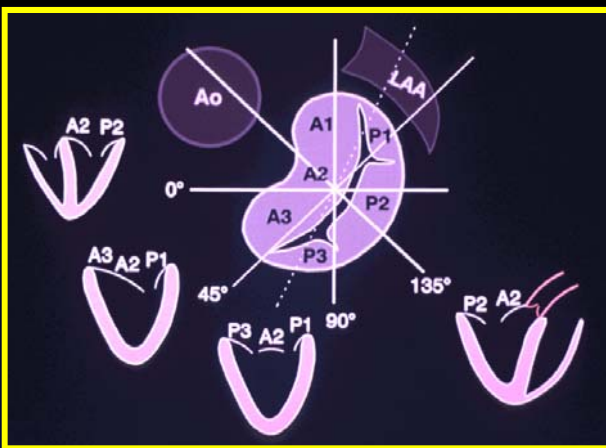
Assessment of the Severity of MR

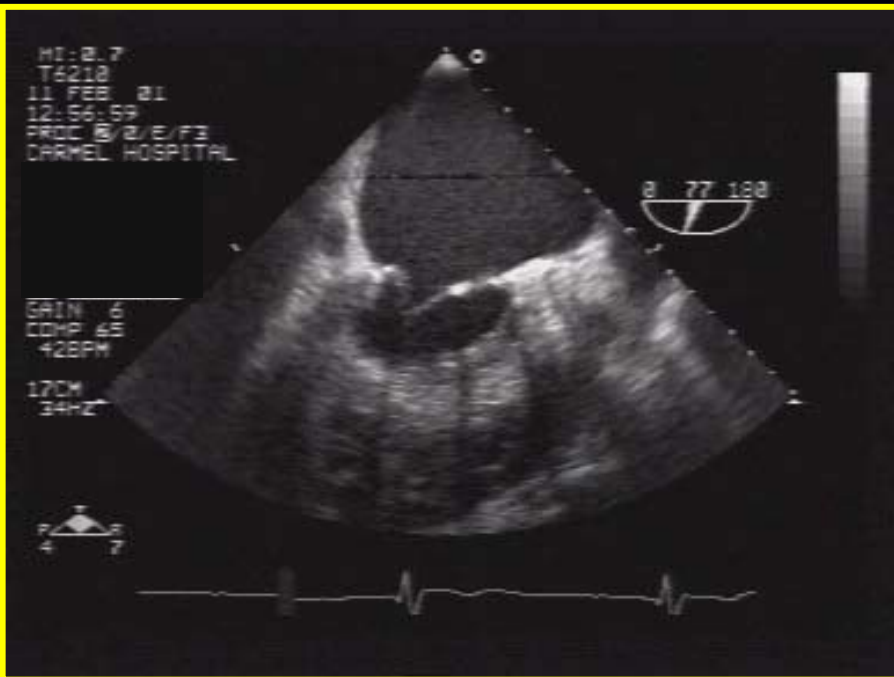
	<u>Mild</u>	<u>Moderate</u>	<u>Severe</u>
LA & LV	normal	LA↑	LA & LV↑
Jet area	< 4 cm ²	4-10 cm ²	≥10 cm ²
PV sys flow	normal	blunting	reversal
RV	<30 ml	30-59 ml	≥ 60 ml
EROA	<0.2 cm ²	0.2-0.4 cm ²	≥0.4 cm ²
RF	<20%	20-50%	≥50%
Vena contracta	<0.3 cm		≥0.7 cm

Flail P2

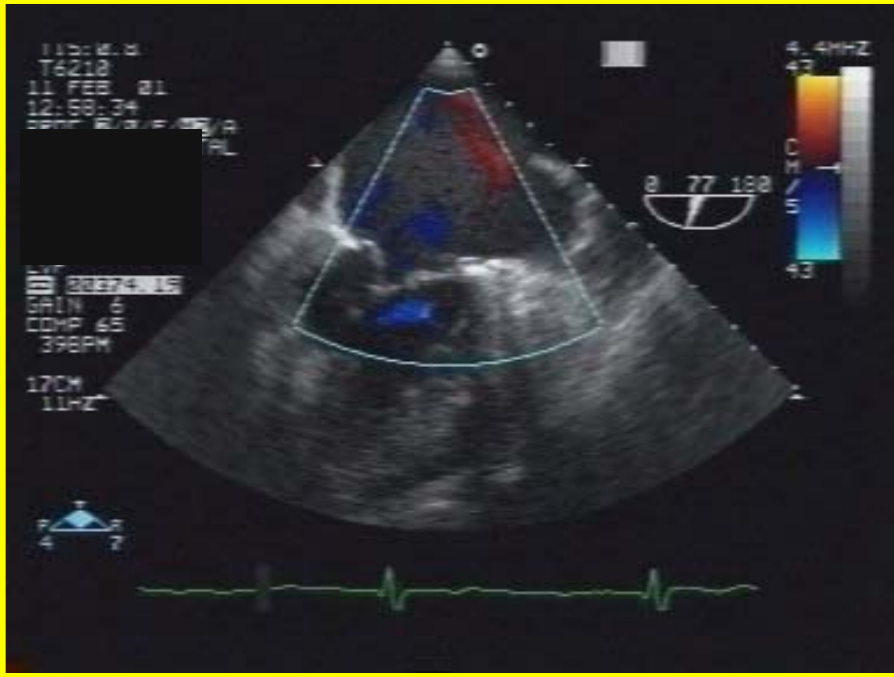
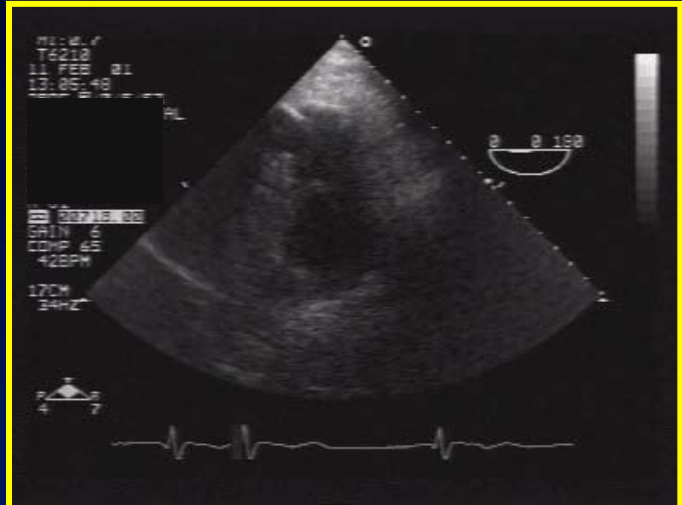
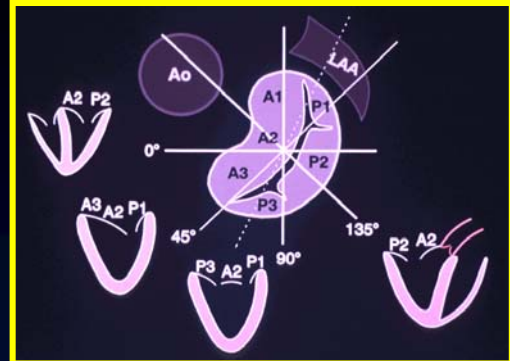


Flail A2

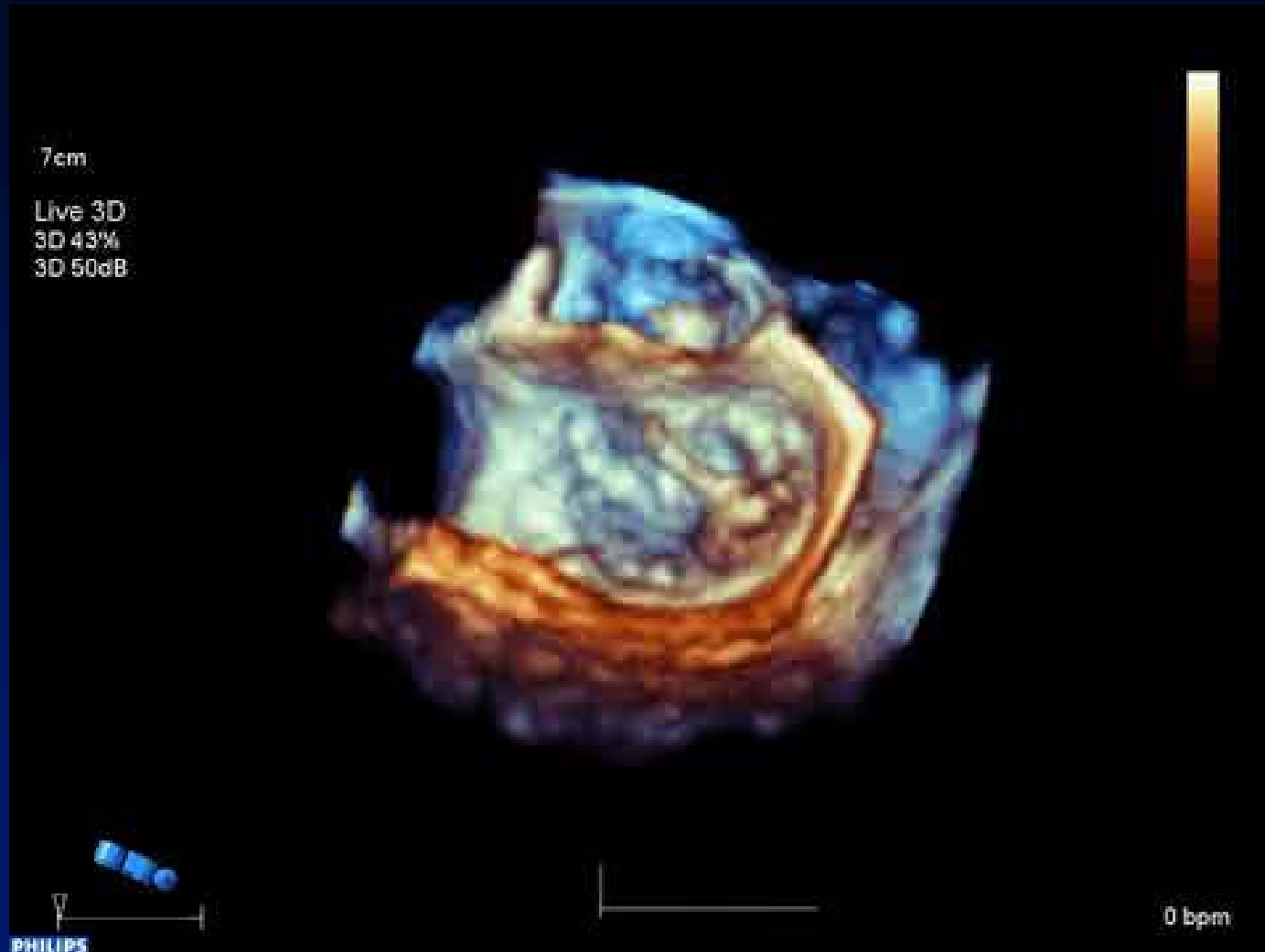




Flail P3



Flail P3 – 3D



Management

Surgery

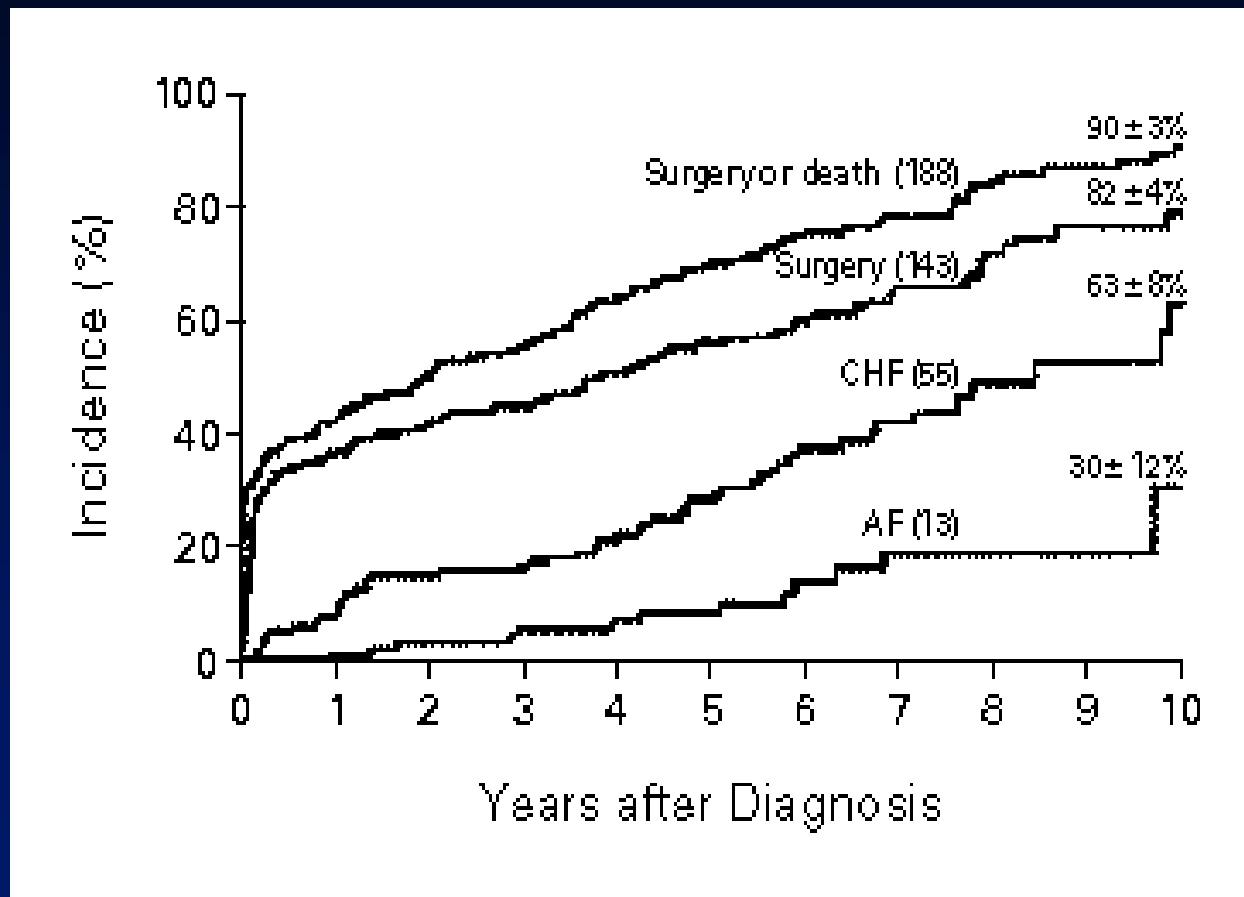


Medical
Treatment

Afterload Reduction in MR

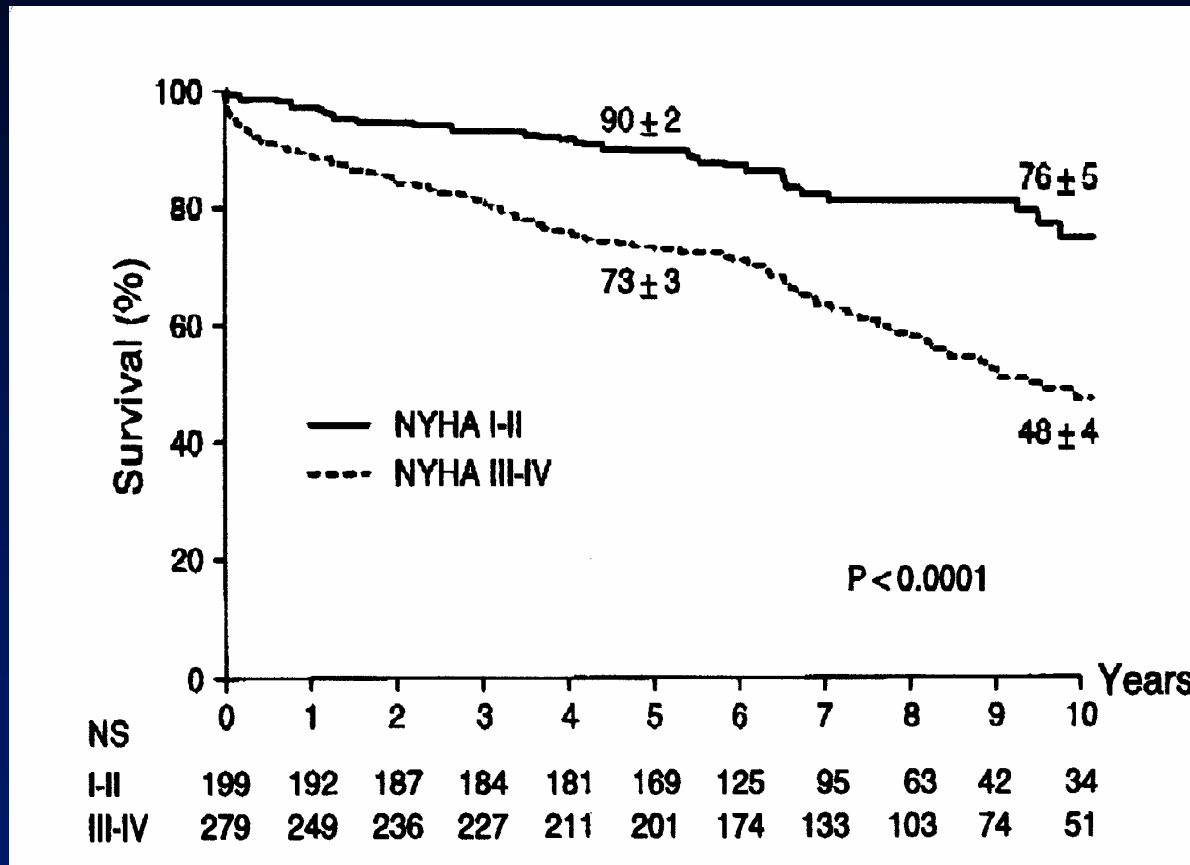
- Role in acute MR
- Role in patients with CHF, LV dysfunction, hypertension
- No data to support use in chronic asymptomatic MR

Clinical Outcome of Mitral Regurgitation Due to Flail Leaflet



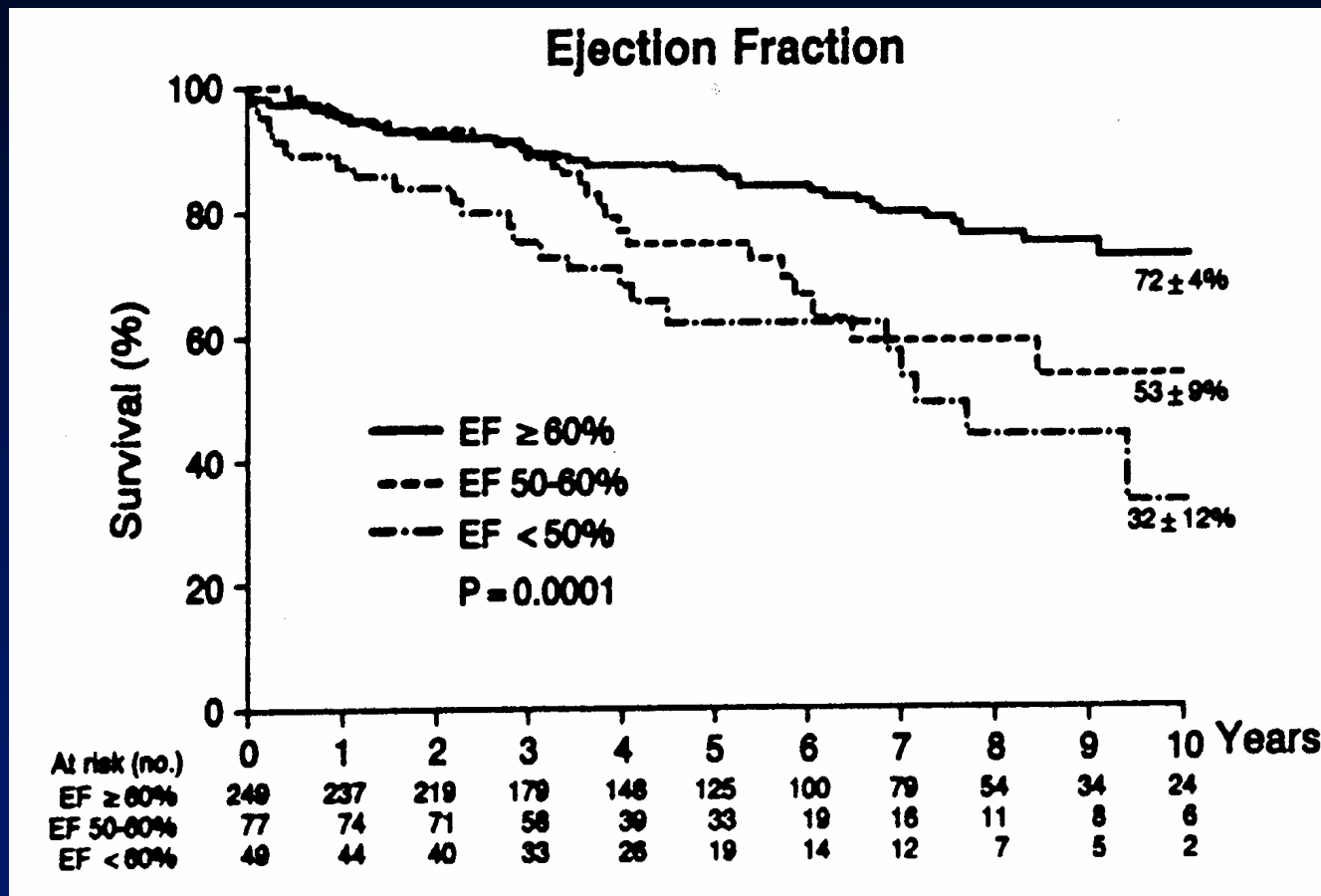
Ling et al, NEJM 96 (Mayo Clinic)

Impact of Preoperative Symptoms on Survival After Surgical Correction of Non-ischemic MR



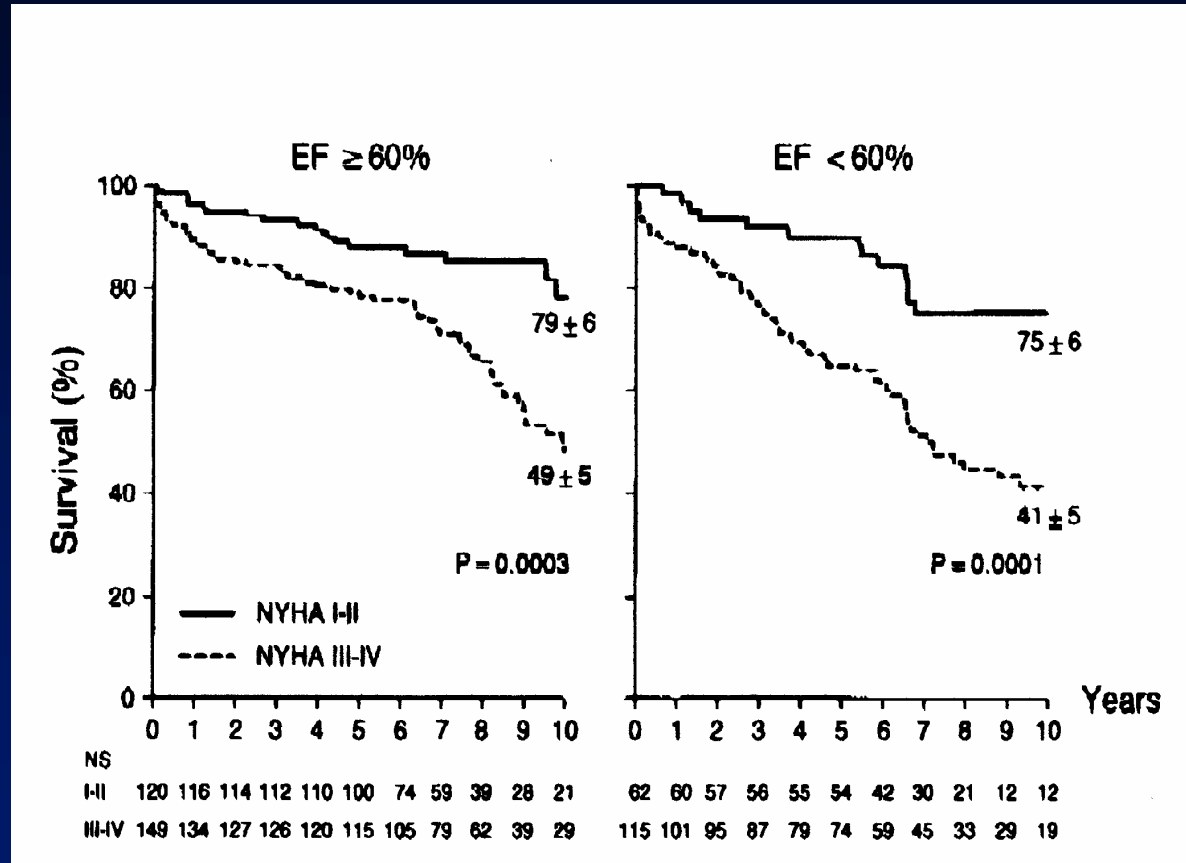
Tribouilloy et al, Circ 99 (Mayo Clinic)

Survival After Surgical Correction of Non-ischemic MR by Preoperative EF



Enriquez-Sarano et al, Circ 94 (Mayo Clinic)

Survival After Surgical Correction of Non-ischemic MR by Preoperative EF and Symptoms



Tribouilloy et al, Circ 99 (Mayo Clinic)

When to Operate?

- **Symptoms ($F_c \geq II$)**
- **EF < 60%**

MV Surgery ACC/AHA 2008

Class I

- **Acute symptomatic severe MR**
- **Chronic severe MR, FC \geq 2, EF \geq 30% and/or LVEDD $<$ 55MM**
- **Asymptomatic chronic severe MR, EF 30-60%, LVEDD \geq 40mm**
- **Repair is better than replacement**

MV Surgery ACC/AHA 2008

Class IIa

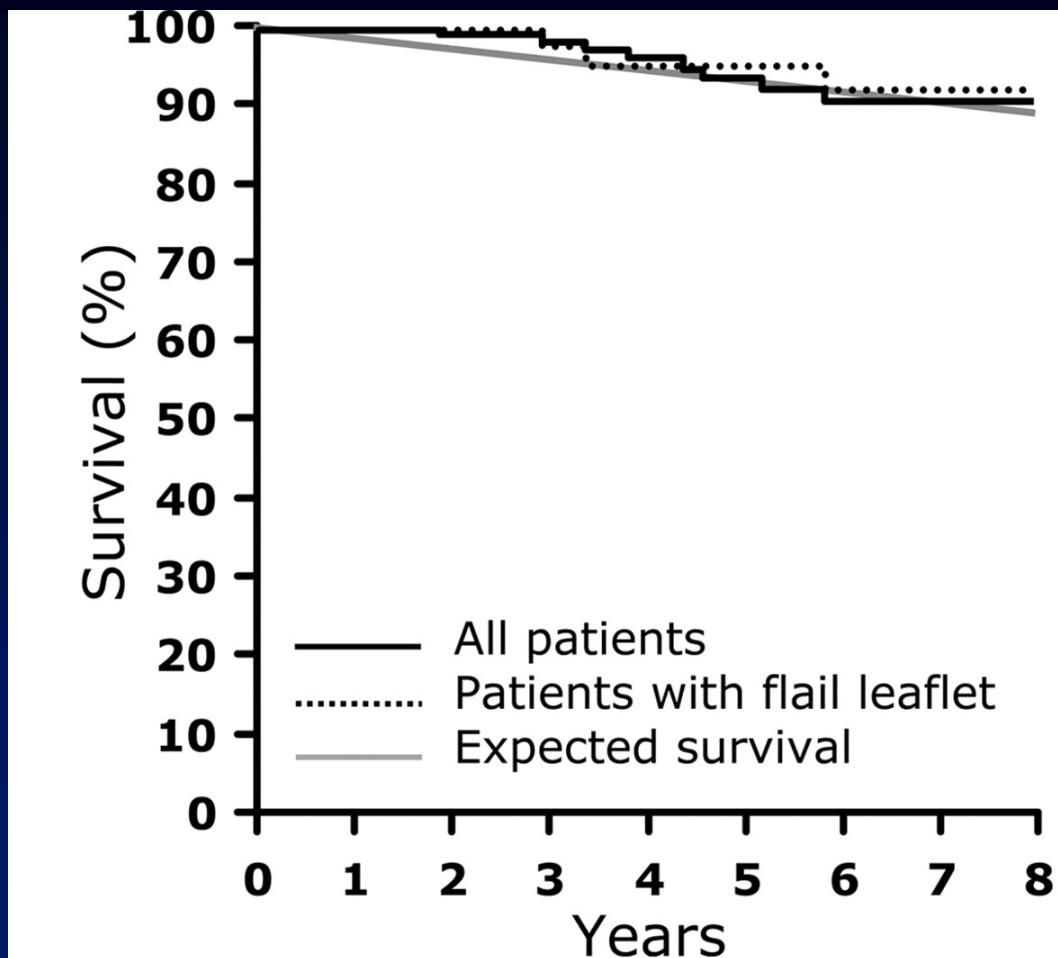
- MV repair for asymptomatic severe MR, EF>60%, repair success>90% (IIb Eu)
- New onset AF
- Sys PAP>50mmHg at rest, >60mmHg during exercise
- Chronic severe MR (primary), FC 3-4, EF<30% or LVEDD>55mm and repair is highly likely

MV Surgery

Class IIb

- MV repair for secondary severe MR, FC 3-4 despite optimal therapy (+CRT), EF<30% (IIa Eu)

Survival of Asymptomatic Severe MR with Watchful Waiting According to Guidelines



All patients

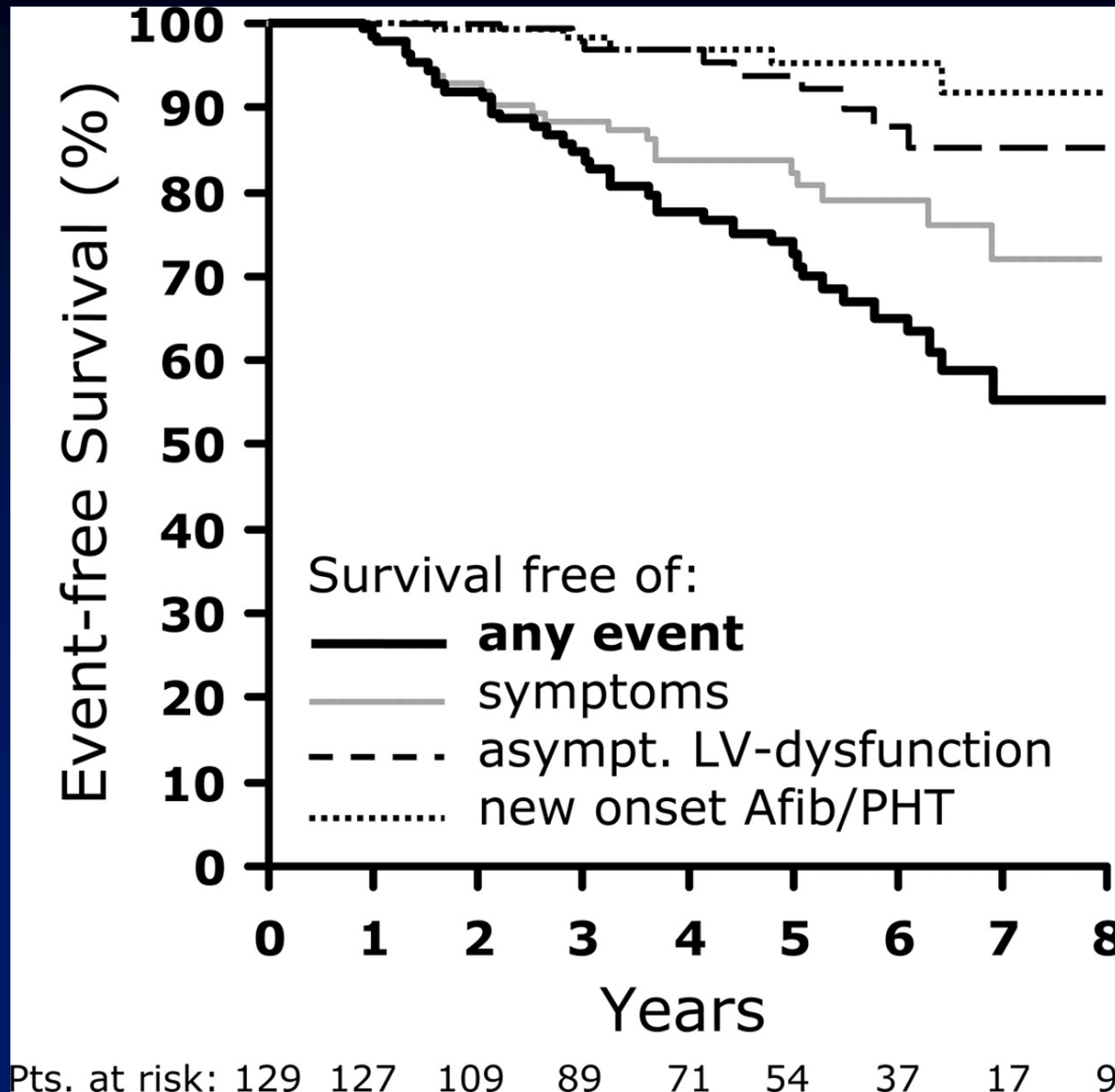
Pts. at risk: 129 129 118 103 87 70 53 24 10

Patients with flail leaflet

Pts. at risk: 56 55 53 43 37 32 28 10 4

Rosenhek et al,
Circ 2006

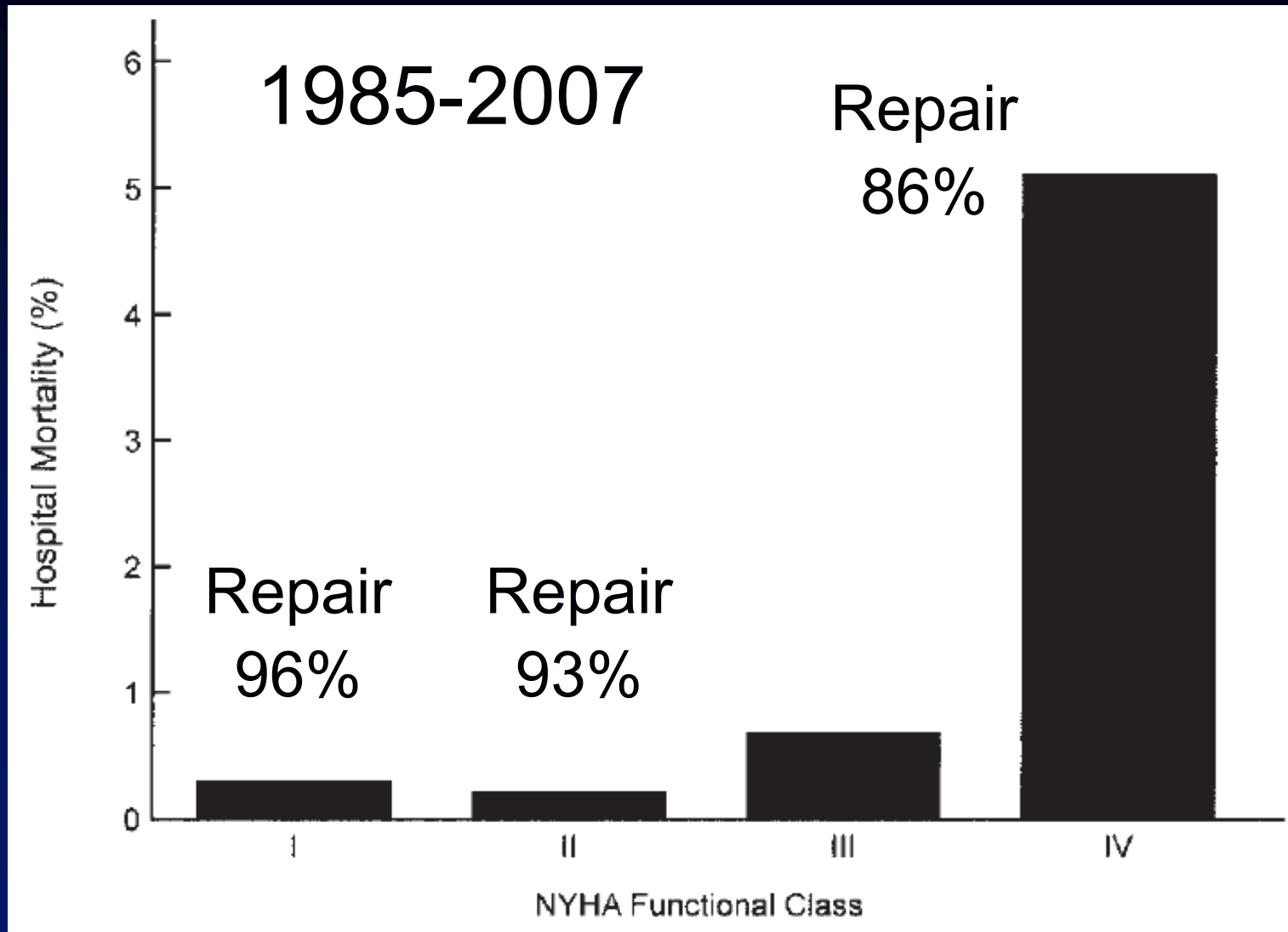
Event-Free Survival of Asymptomatic Severe MR with Watchful Waiting



24/38 pts with events had symptoms

Rosenhek et al, Circ 2006

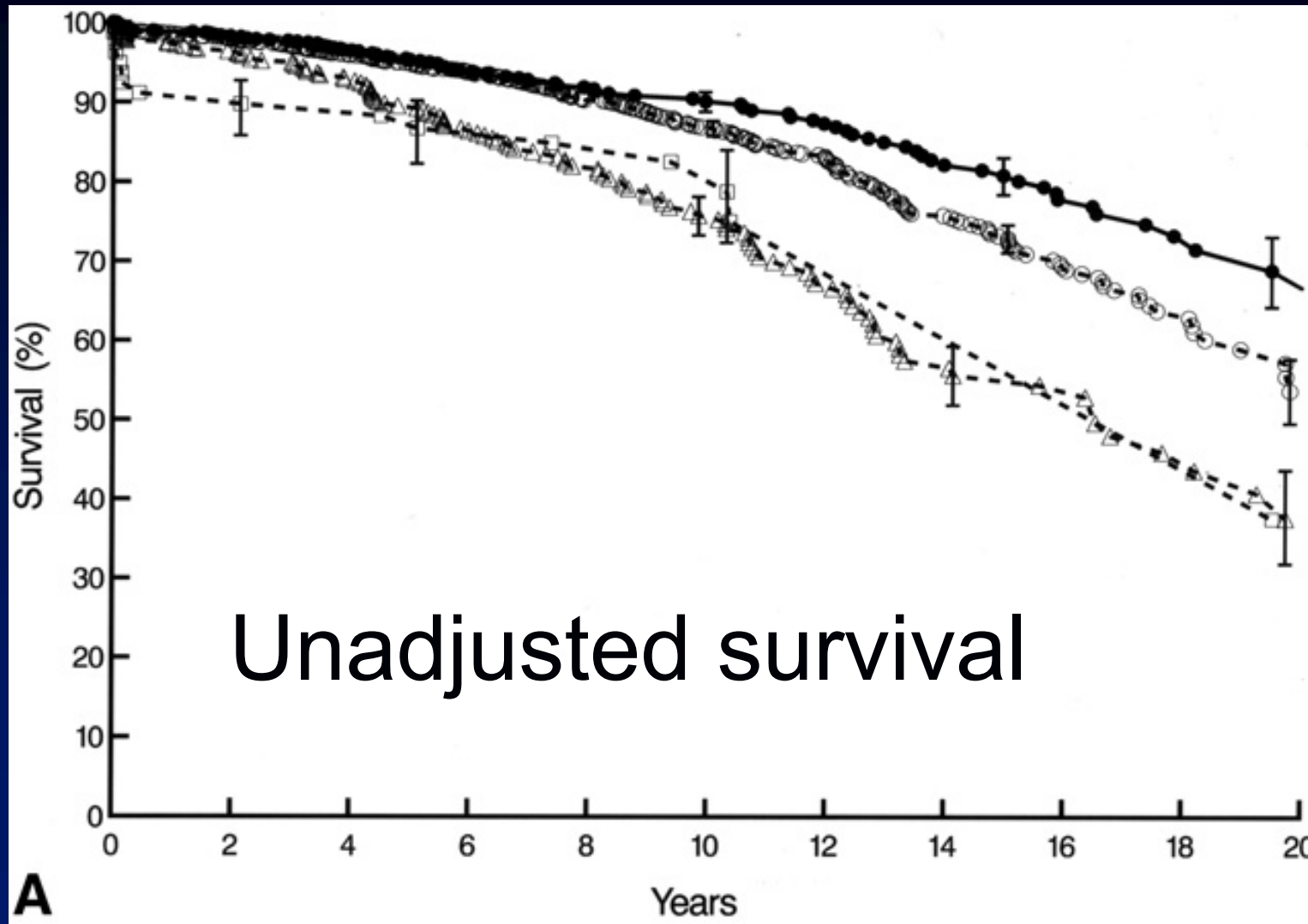
Should Patients With Severe Degenerative MR Delay Surgery Until Symptoms Develop? (n=4,586)



Gillinov et al (Cleveland), Ann Thorac Surg 2010

Characteristic	NYHA Class I (n = 1,363)		NYHA Class II (n = 2,546)	
	n ^a	No. (%) or Mean ± SD	n ^a	No. (%) or Mean ± SD
Demography				
Age, years	1,363	56 ± 12	2,546	58 ± 13
Female	1,363	308 (23)	2,546	874 (34)
Cardiac structure and function				
Mitral valve prolapse	1,363		2,546	
Posterior		1,097 (80)		1,951 (77)
Anterior		65 (4.8)		176 (6.9)
Bileaflet		159 (12)		356 (14)
Mitral valve calcification	1,363	247 (18)	2,546	601 (24)
Severe tricuspid regurgitation	1,136	8 (0.70)	2,037	30 (1.5)
Atrial fibrillation/flutter	1,363	115 (8.4)	2,546	424 (17)
LA diameter, cm	1,170	4.8 ± 0.83	2,141	4.9 ± 0.92
LV inner diameter in diastole, cm	1,226	5.8 ± 0.75	2,228	5.7 ± 0.81
LV inner diameter in systole, cm	1,216	3.4 ± 0.67	2,218	3.4 ± 0.74
LV ejection fraction, %	1,323		2,440	
Mean		57 ± 7.0		56 ± 8.1
Median		60		55
Noncardiac comorbidity				
COPD	1,102	92 (8.3)	1,900	250 (13)
Hypertension	1,336	427 (32)	2,461	975 (40)
Treated diabetes mellitus	1,343	17 (1.3)	2,475	44 (1.8)
Peripheral arterial disease	1,292	88 (6.8)	2,404	208 (8.7)
History of stroke	1,363	28 (2.1)	2,546	54 (2.1)

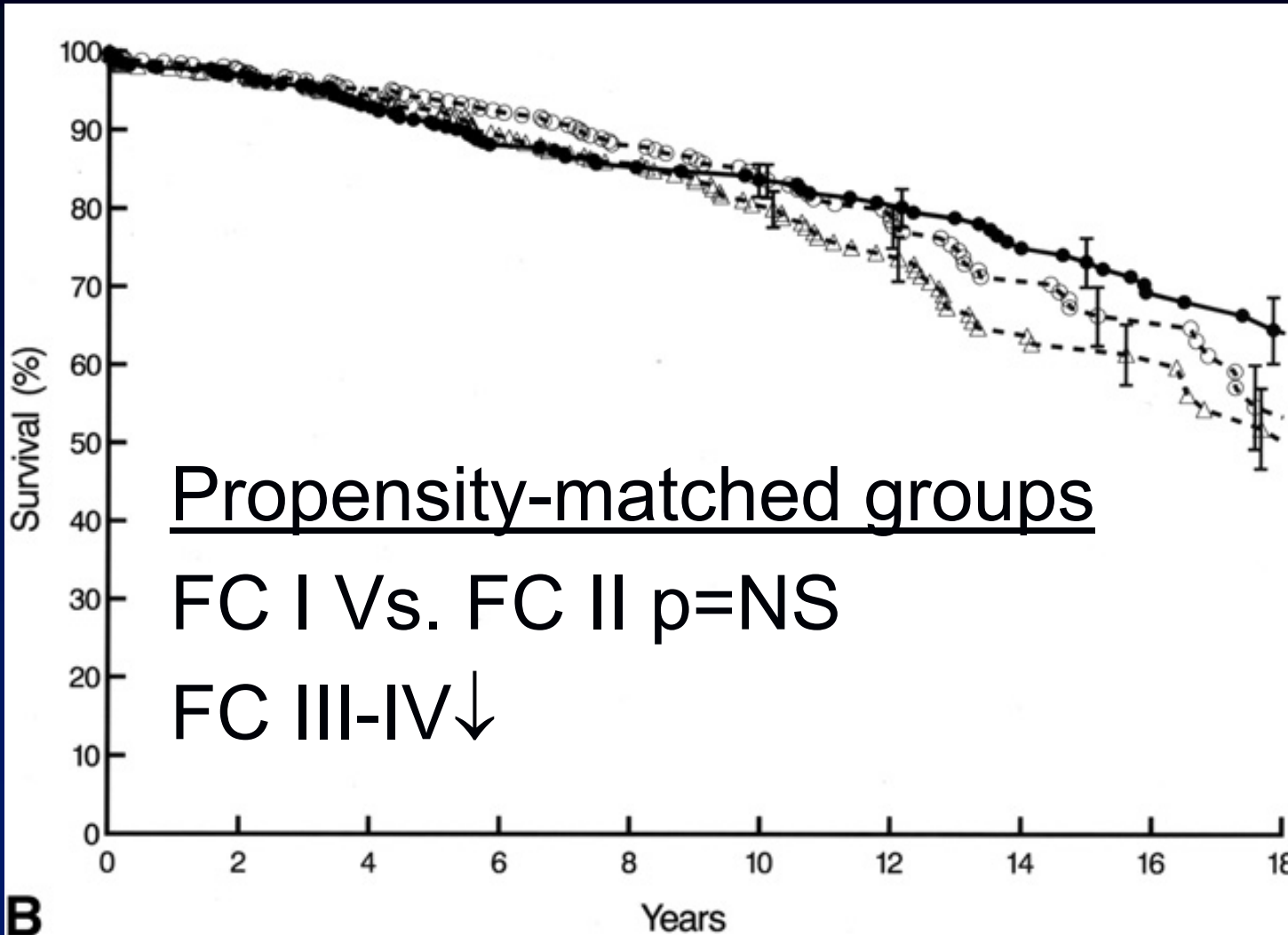
Should Patients With Severe Degenerative MR Delay Surgery Until Symptoms Develop? (n=4,586)



FC I
FC II
FC III-IV

Unadjusted survival

Should Patients With Severe Degenerative MR Delay Surgery Until Symptoms Develop? (n=4,586)

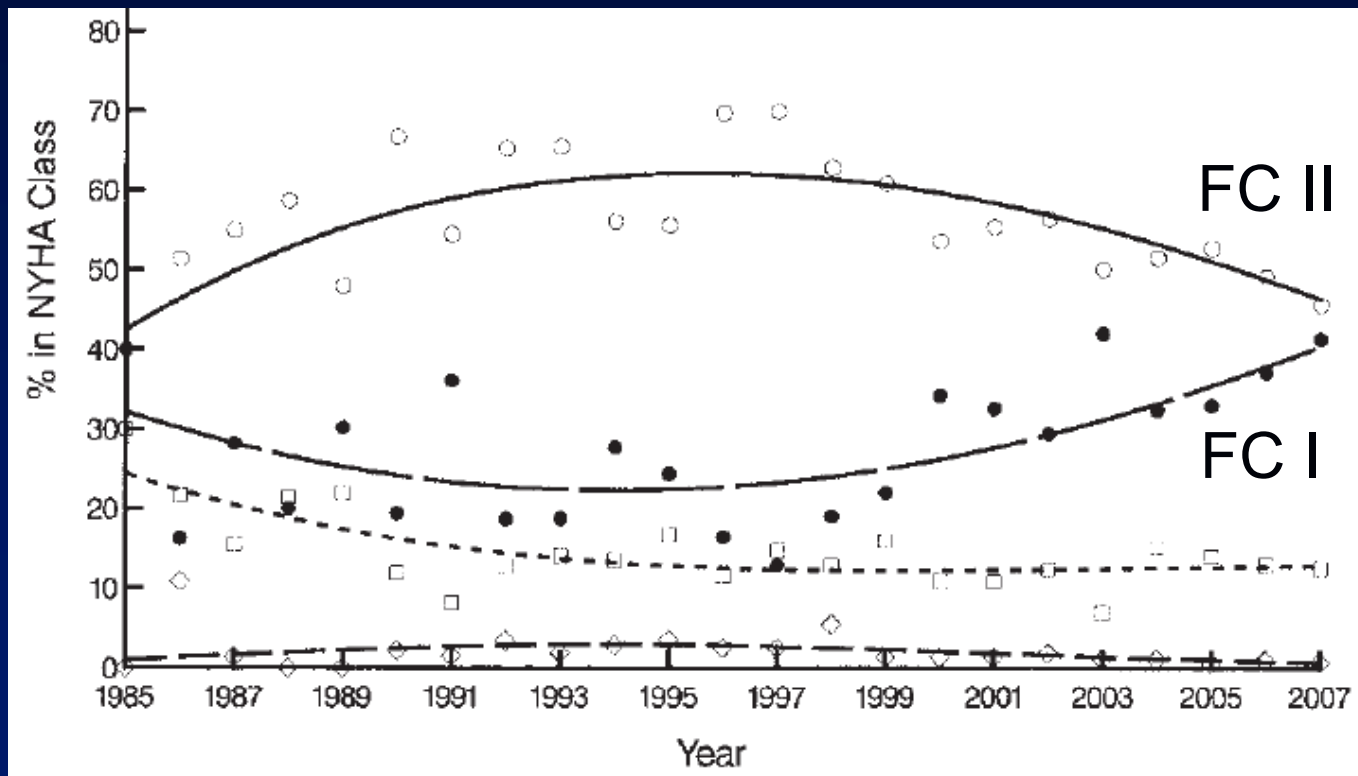


FC I
FC II
FC III-IV

B

Author's Conclusion

- “early surgery is justified in asymptomatic patients with degenerative disease and severe MR”



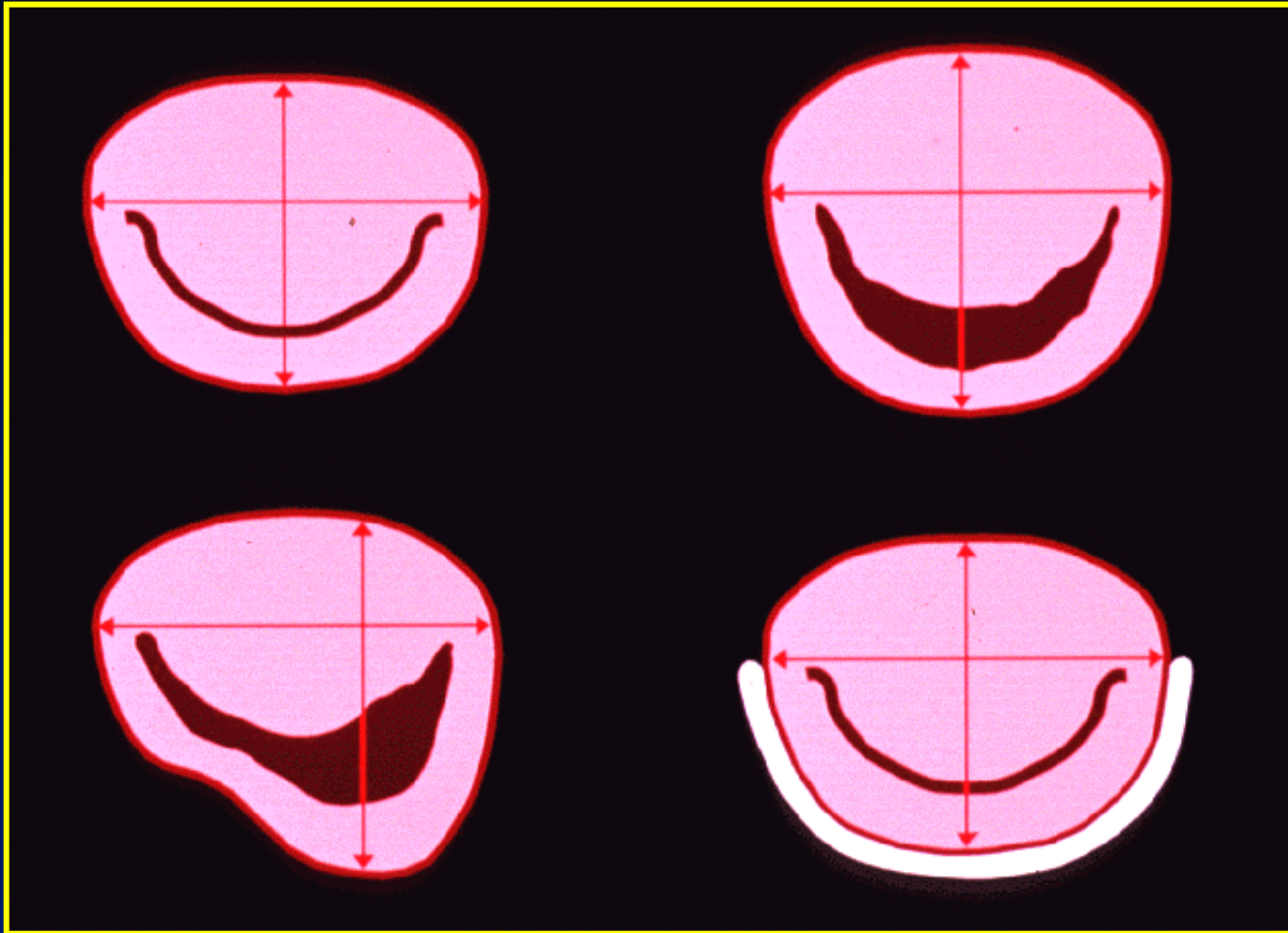
What should be the operative mortality threshold for asymptomatic MR?

- Dr. Gillinov: “under 1%. If you are taking the asymptomatic patient.. the operation must be extremely safe”
- (and >90% probability of repair)

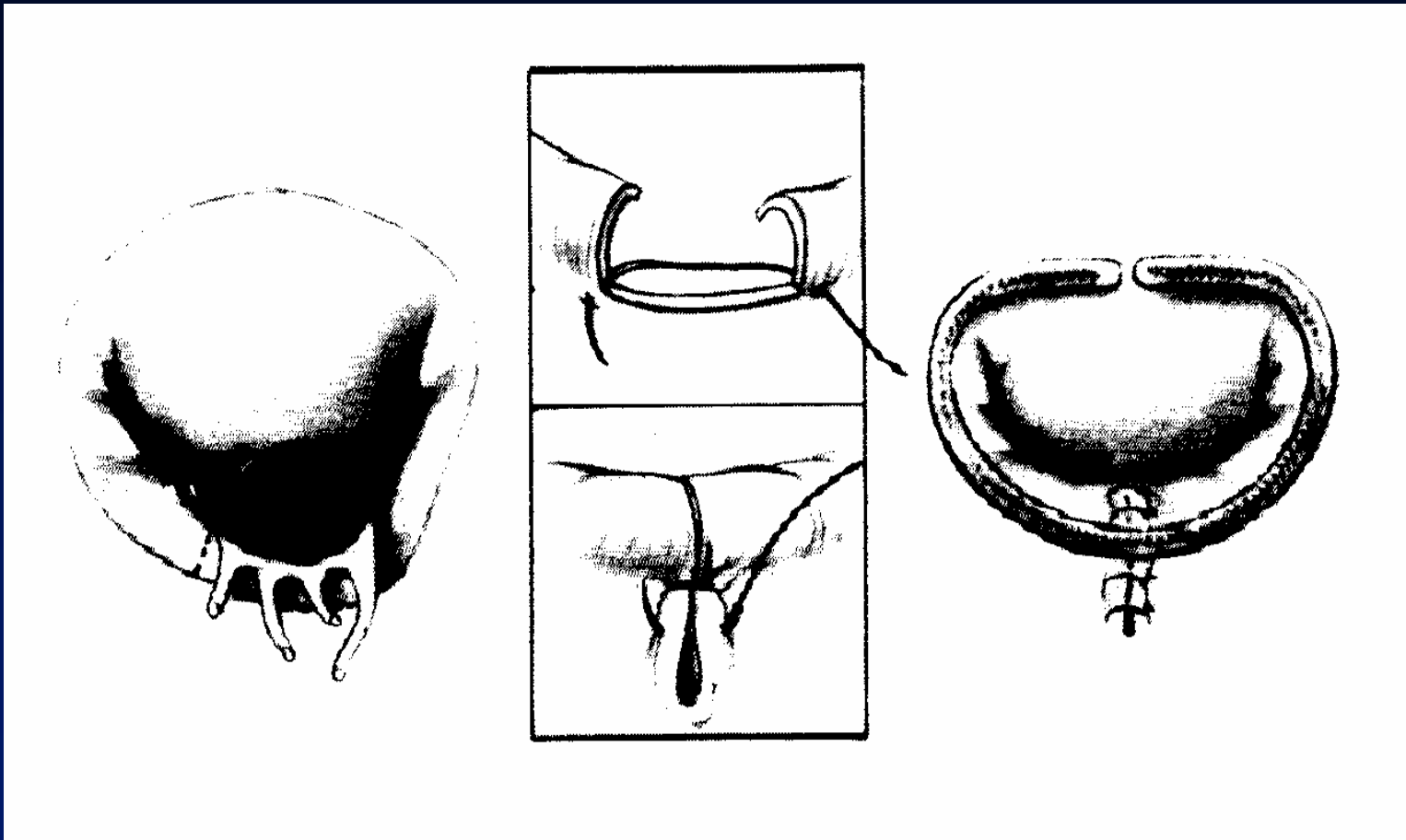
Why Repair?

“Valve replacement is simply exchanging one disease with another”

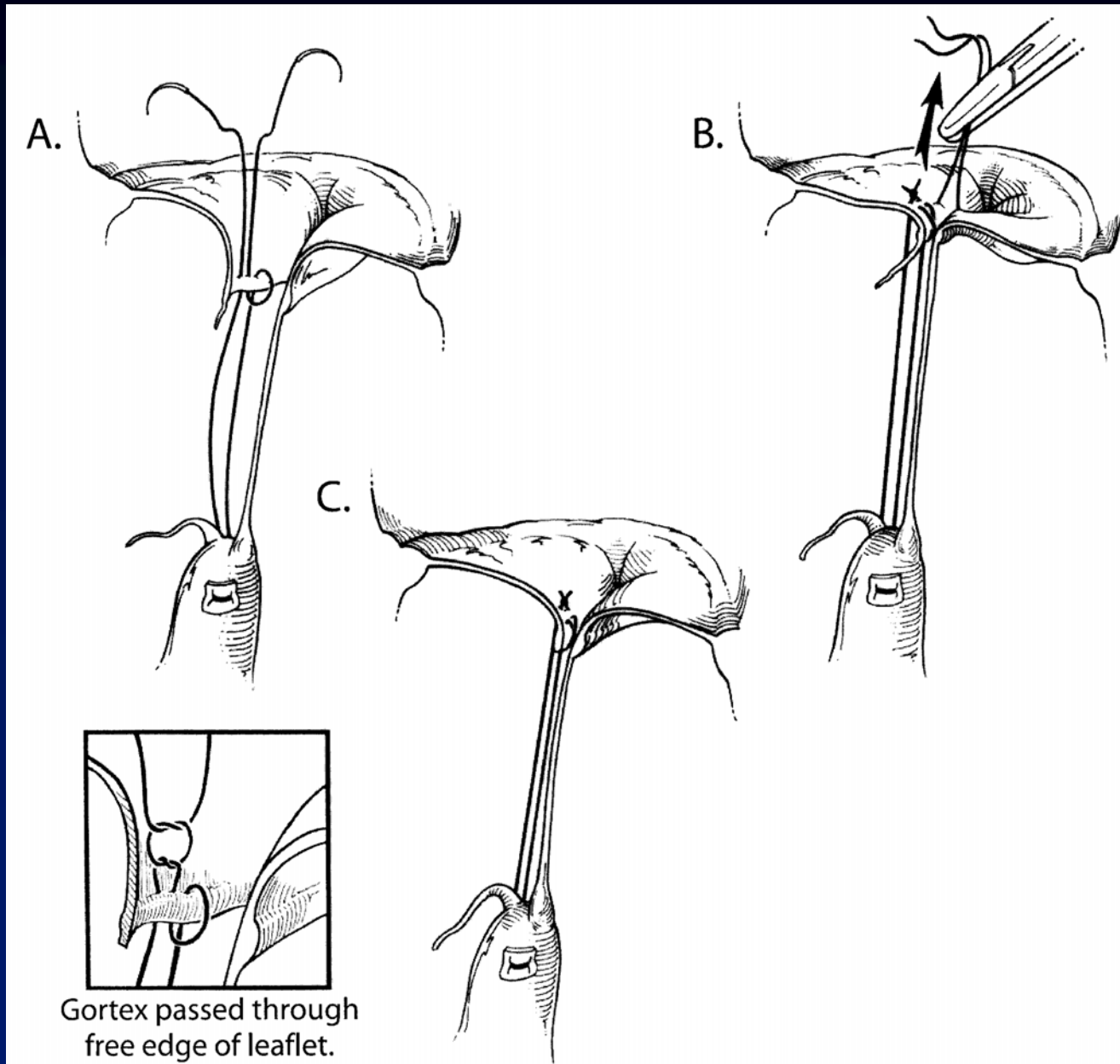
Mitral Prosthetic Ring Annuloplasty



Posterior Leaflet Repair With Quadrangular Resection



Anterior Leaflet Repair with Artificial Chords



Low Probability of Successful Repair

- Extensive bileaflet prolapse
- Extensive anterior leaflet involvement
- Posterior leaflet involvement >50%
- Significant MAC
- Papillary muscle rupture
- Rheumatic MR
- Congenital
- Prior repair

Intraoperative TEE for Mitral Valve Repair

Preop:

- Assess severity of MR
- Define mechanism of MR and anatomy of MV
- Detect associated important findings (TR, AV dis, etc.)

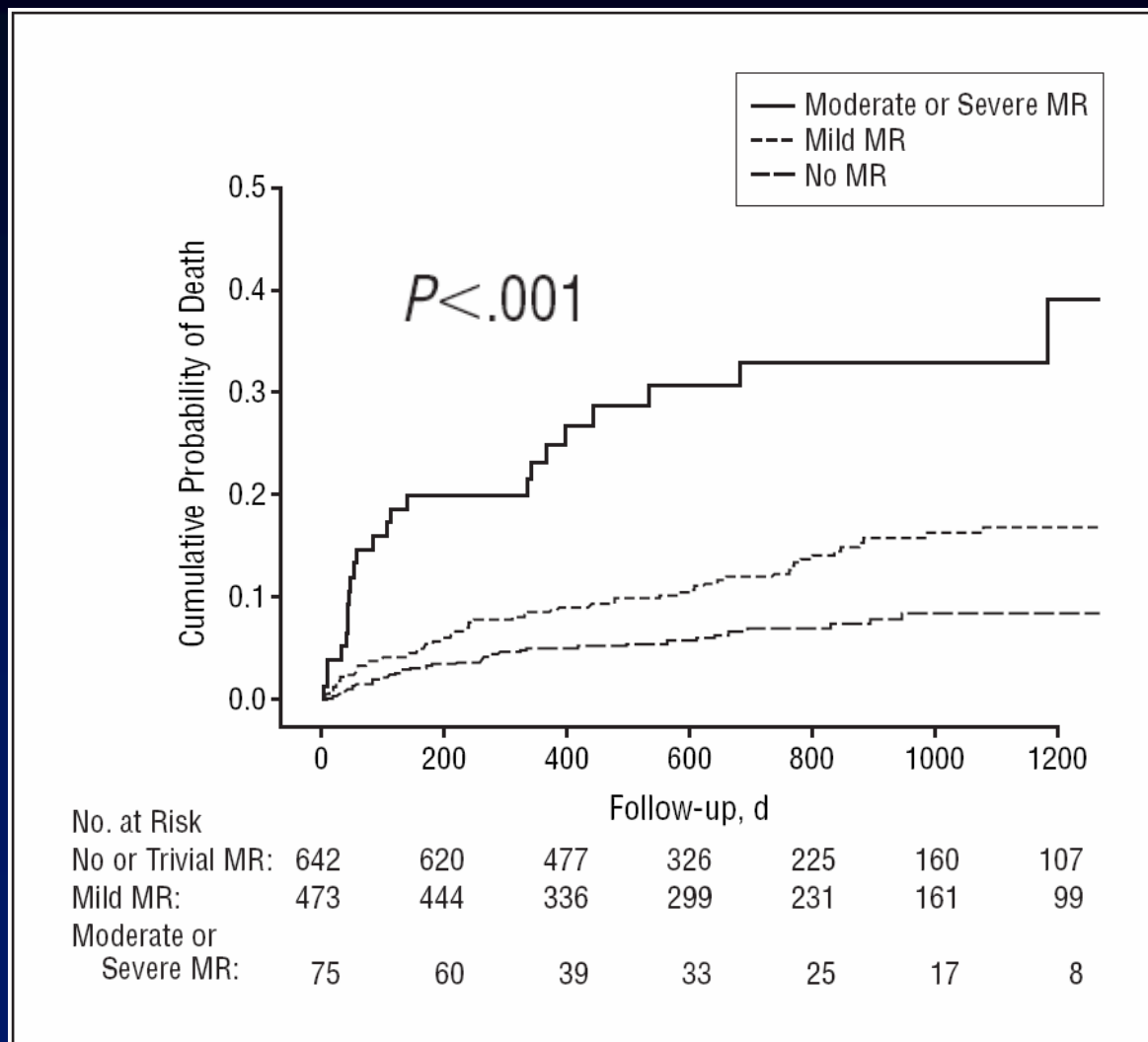
Postop:

- Detect residual MR/ Assess anatomical adequacy
- Detect outflow tract obstruction
- Residual air, LVF, volume status, others

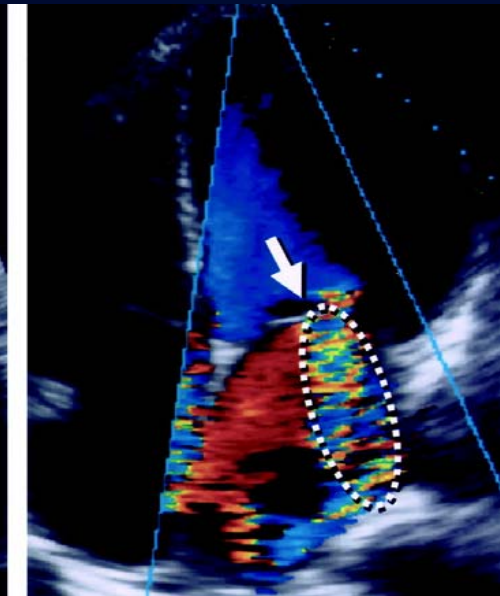
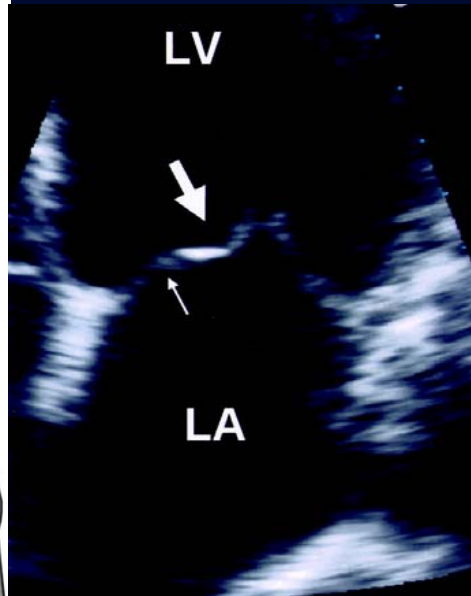
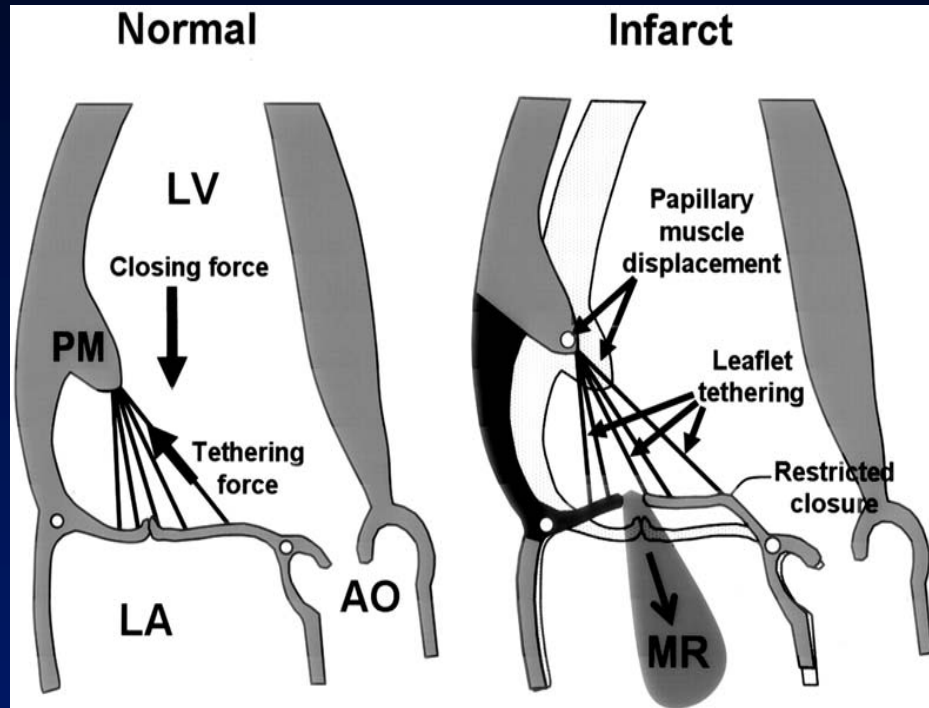
Ischemic Mitral regurgitation

- Dynamic, not static
- Predicts poor survival and CHF
- Increased operative mortality (11%-28%)
- Indication for surgery?
- Type of surgery?

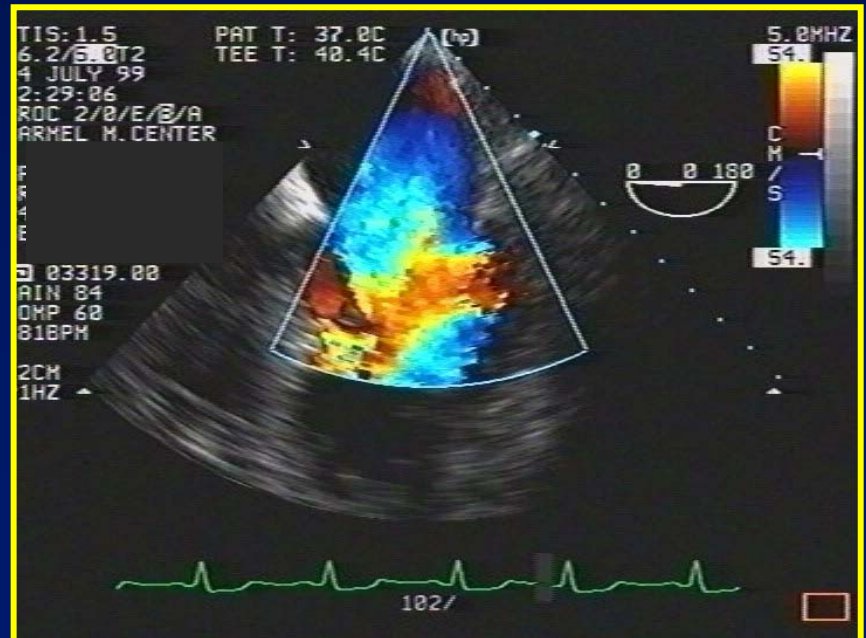
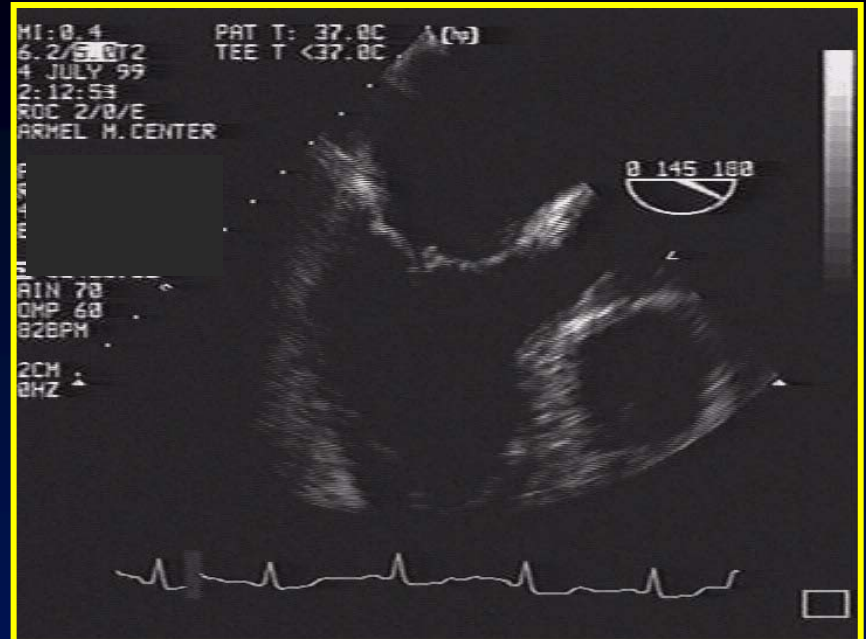
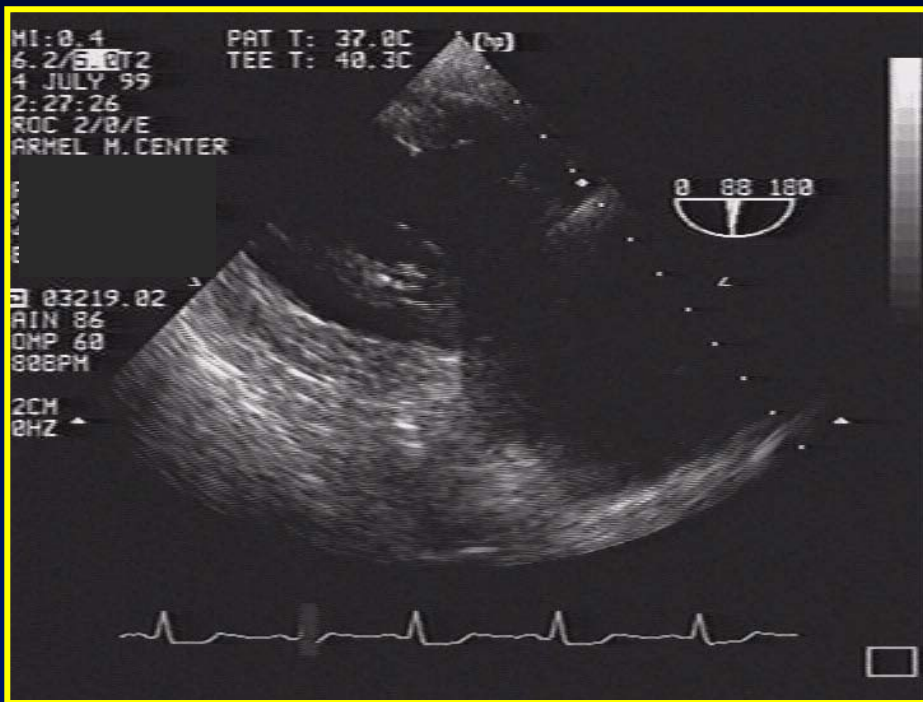
Ischemic MR predicts post MI outcome (n=1190)



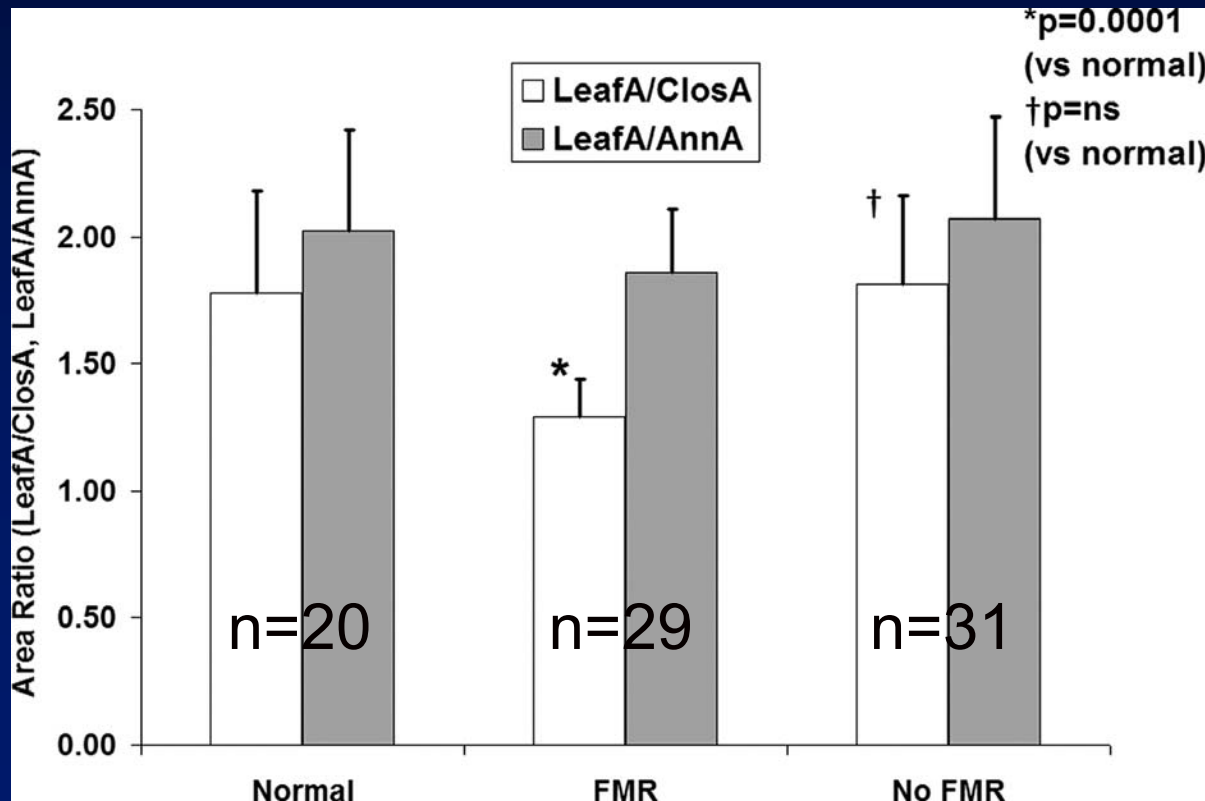
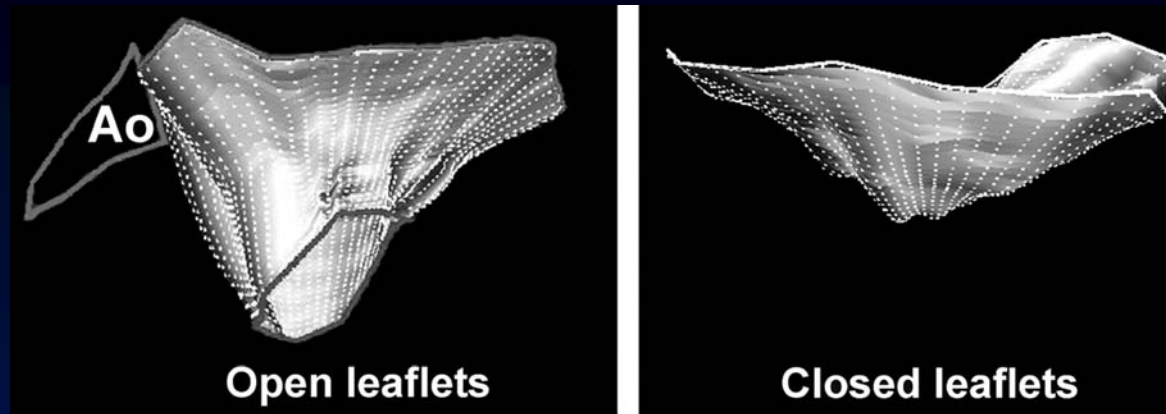
Pathophysiology of Ischemic MR



Ischemic MR



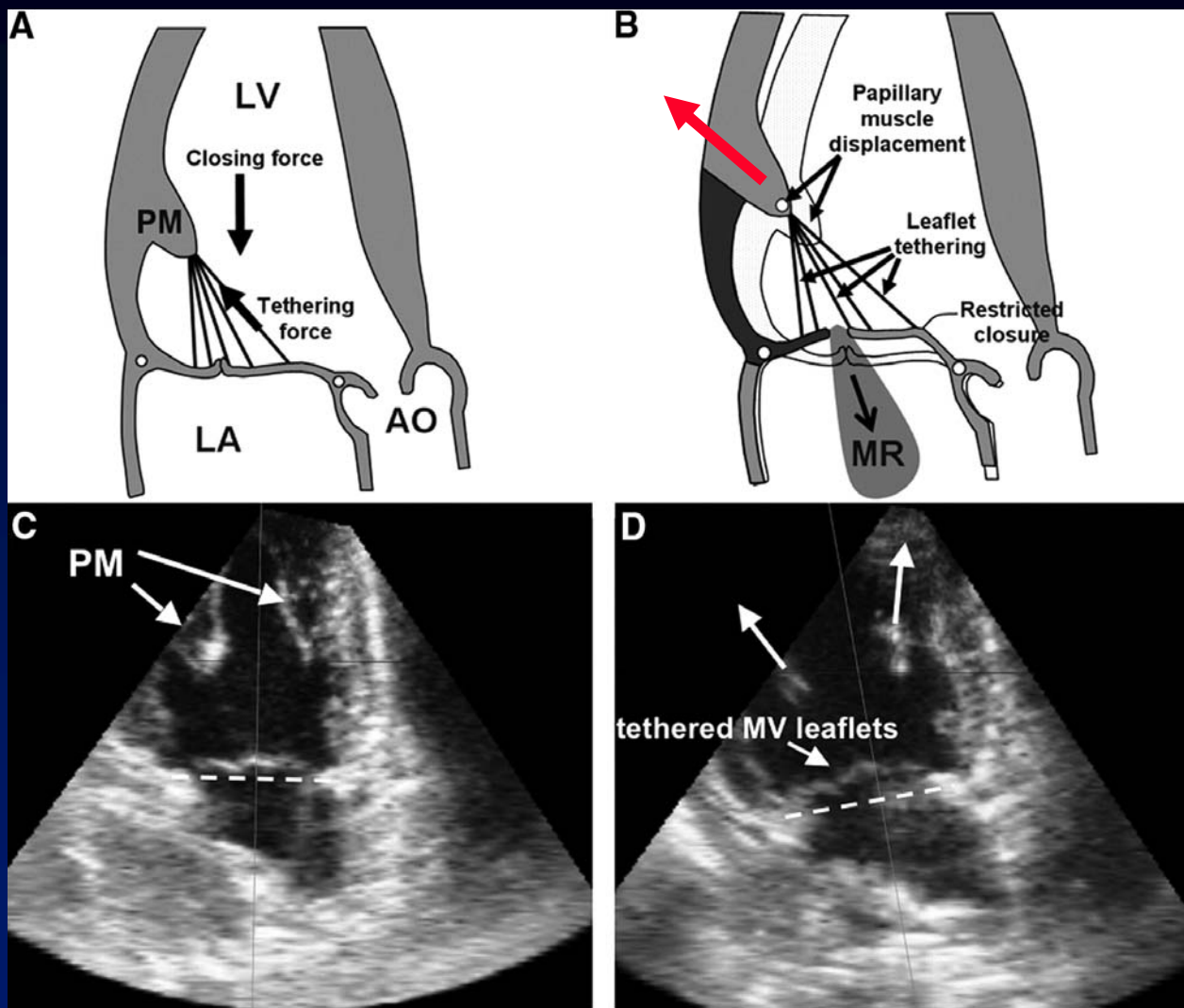
Insufficient Leaflet Area in Functional MR



32.5% increase in diastolic MVA in FMR

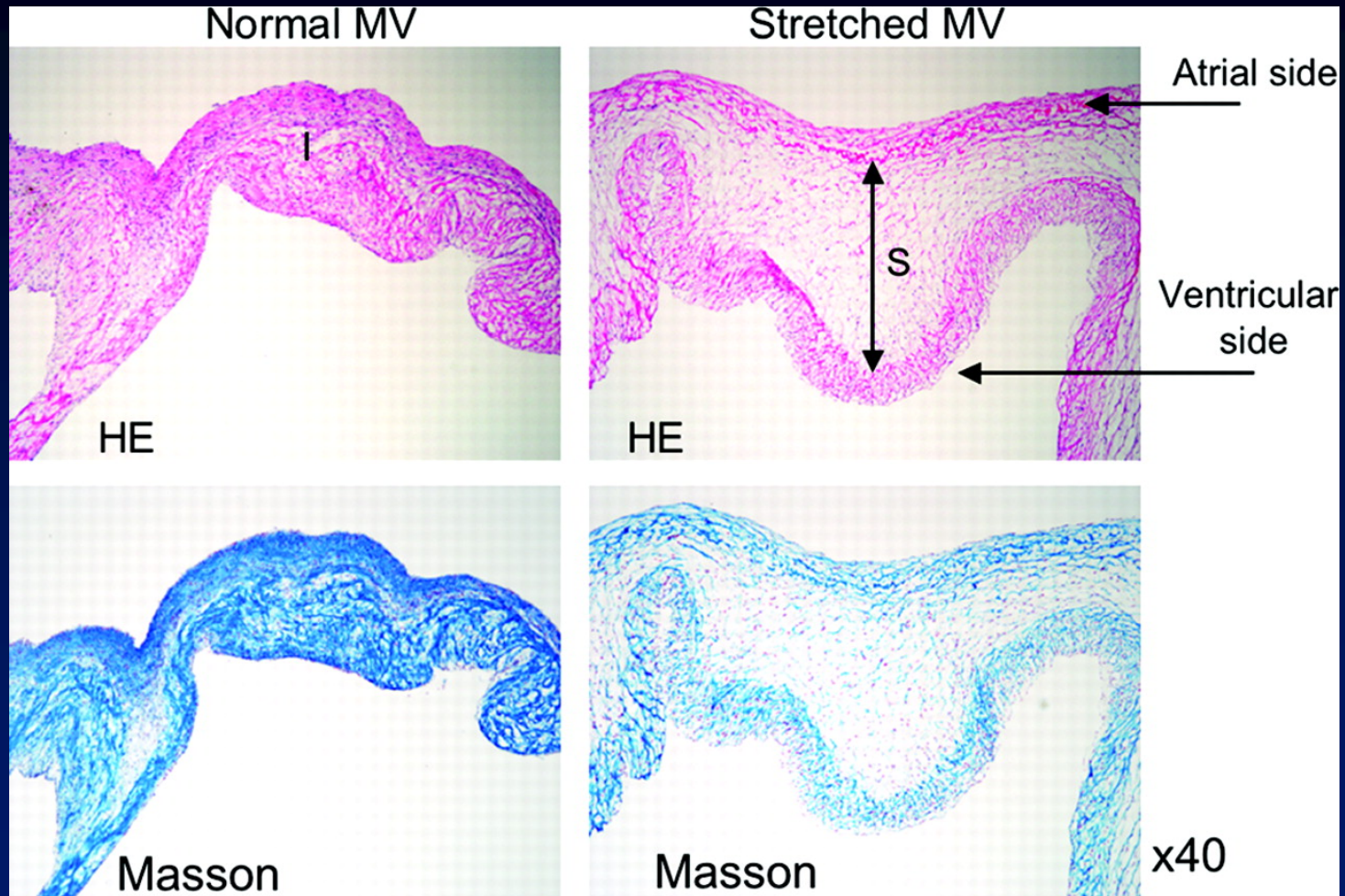
Chaput et al, Circ 2008

Mechanism of Active MV Adaptation

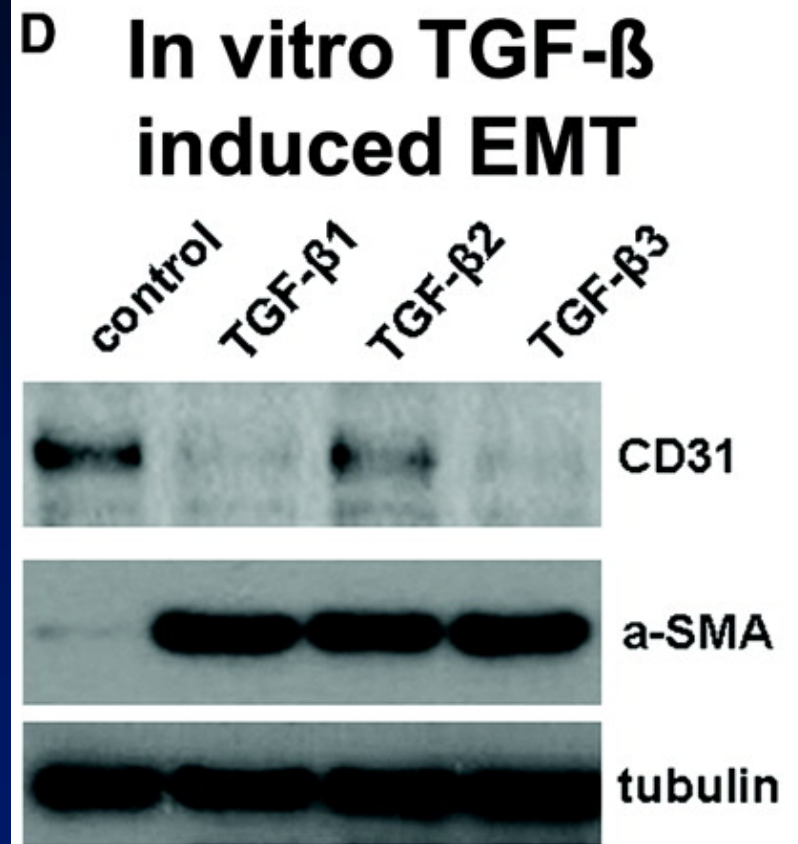
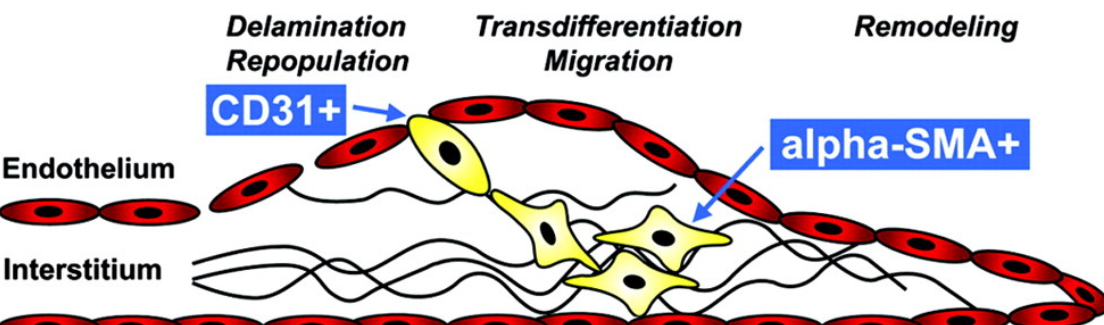
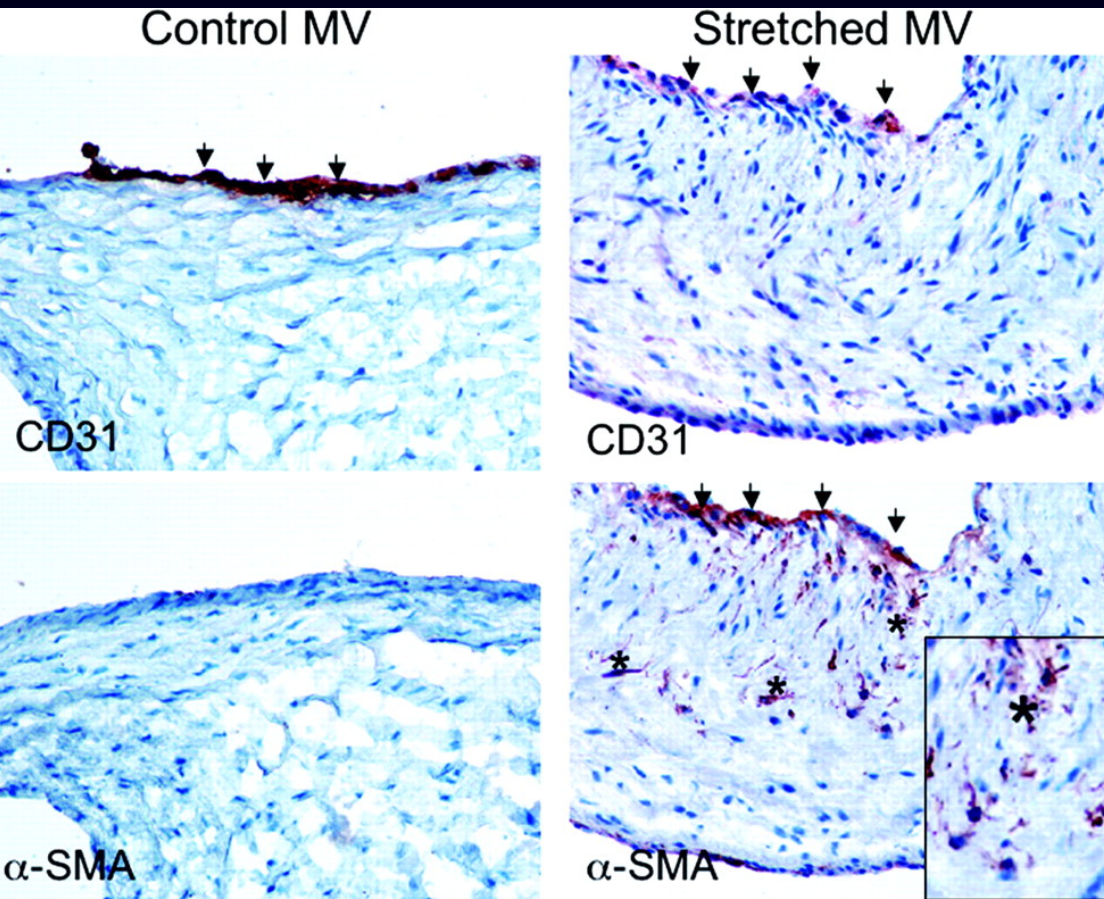


6 sheeps (6 cont')
with tethered MV
had 17% increase
in diastolic MVA in
2m

Mechanism of Active MV Adaptation



Endothelial-Mesenchymal Transdifferentiation

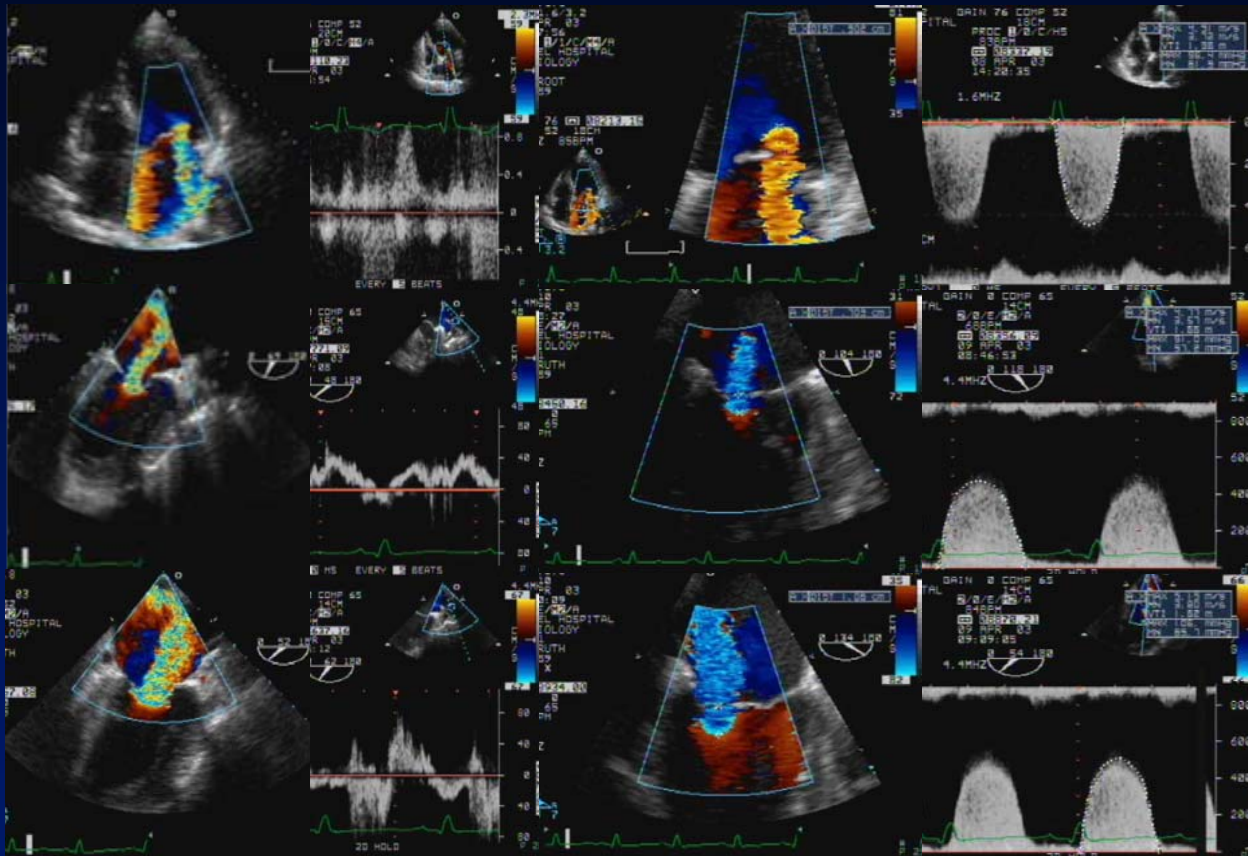


Intra-operative Assessment of Ischemic MR

Pre-Op TTE
BP 124/81 mmHg

TEE1
BP 92/45 mmHg
PAOP 11 mmHg

TEE2
BP 160/92 mmHg
PAOP 23 mmHg



MR +4
EROA=0.36 cm²
RVol=50 cc

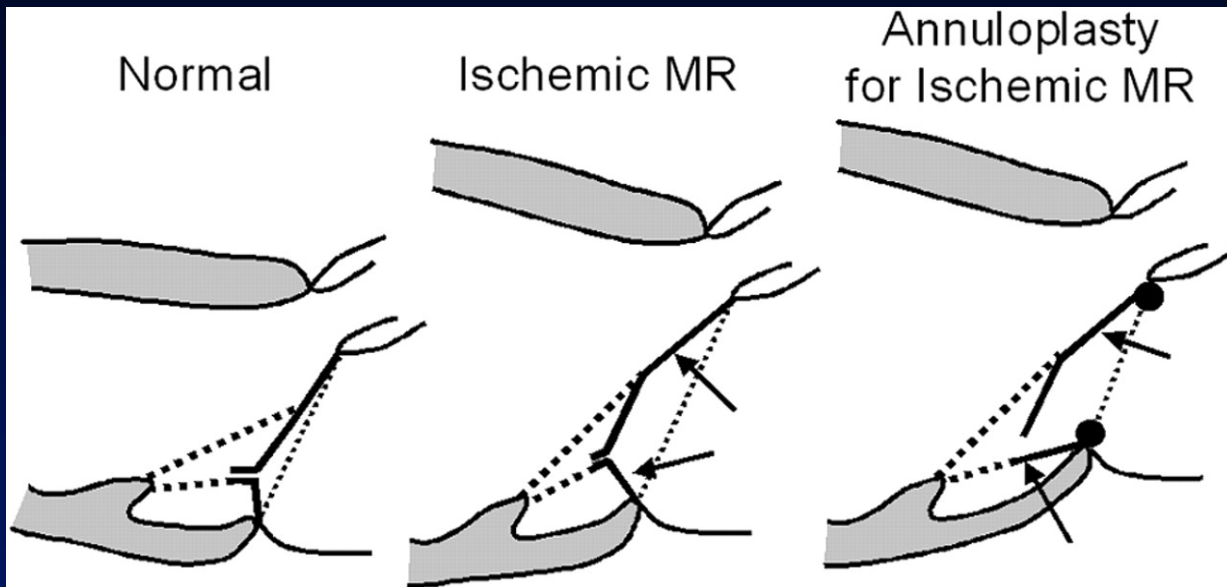
MR +3
EROA=0.21 cm²
RVol=34 cc

MR +4
EROA=0.46 cm²
RVol=74 cc

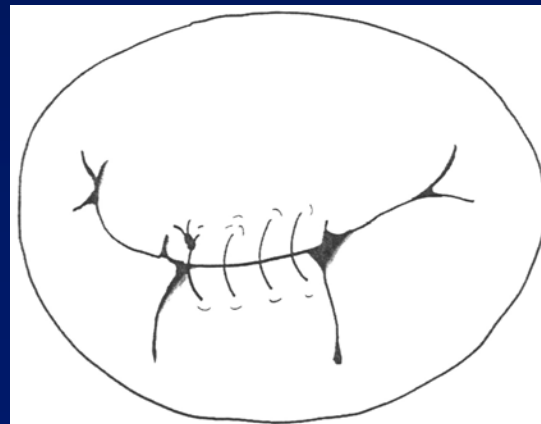
Shiran et al, JASE 2007

Repair or replacement?

Repair of Ischemic MR

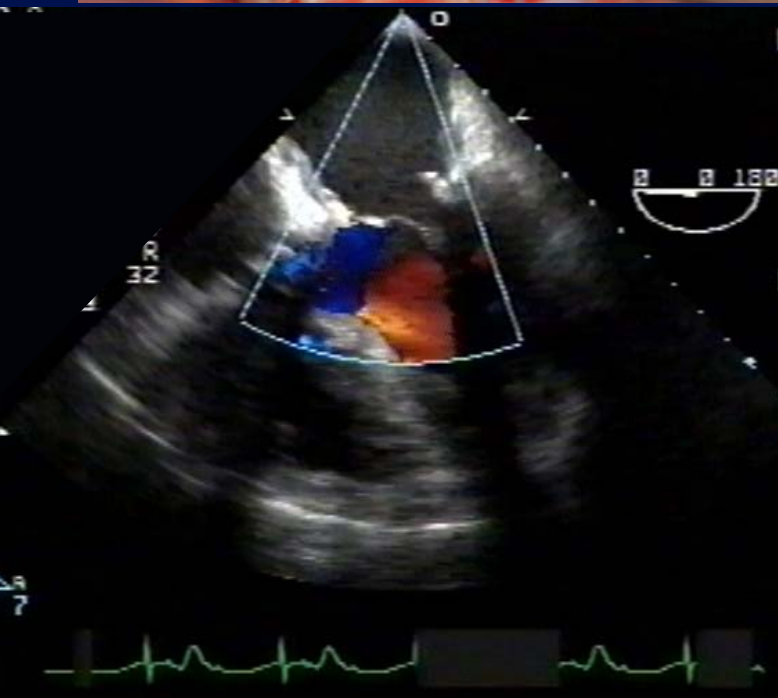
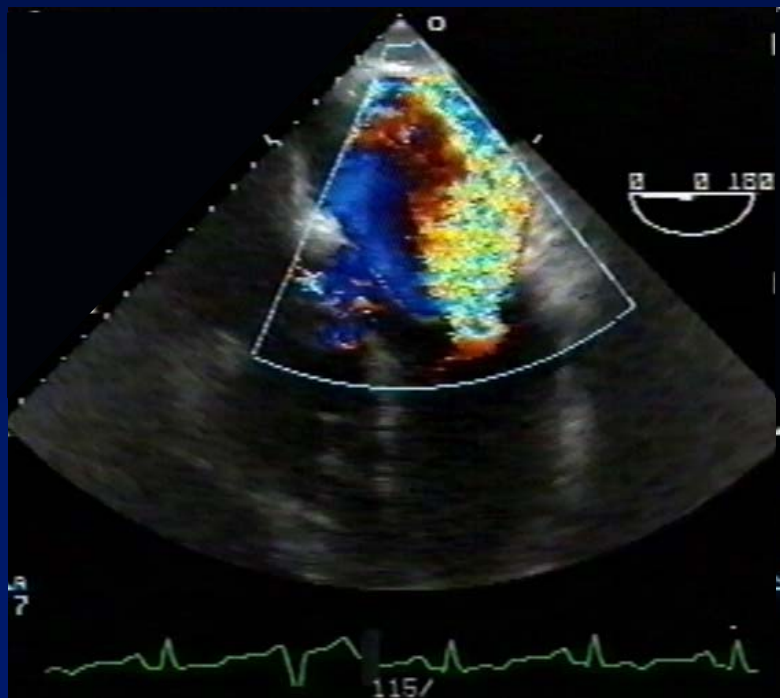
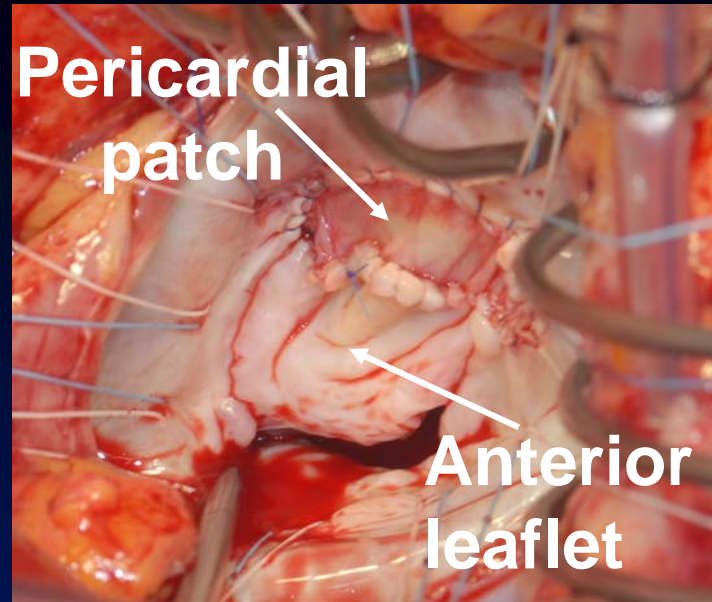
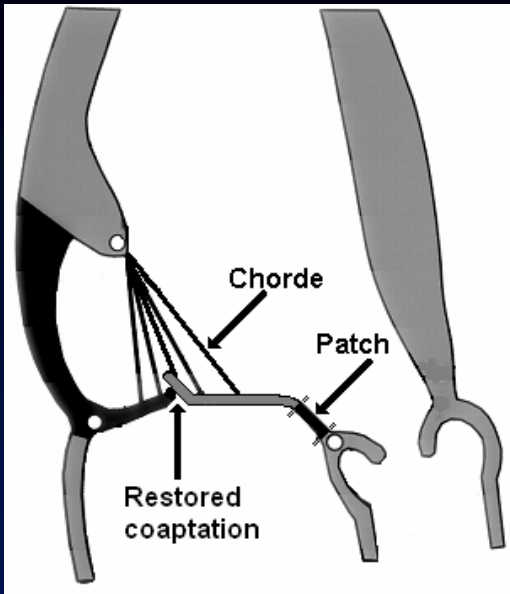


Undersized ring annuloplasty

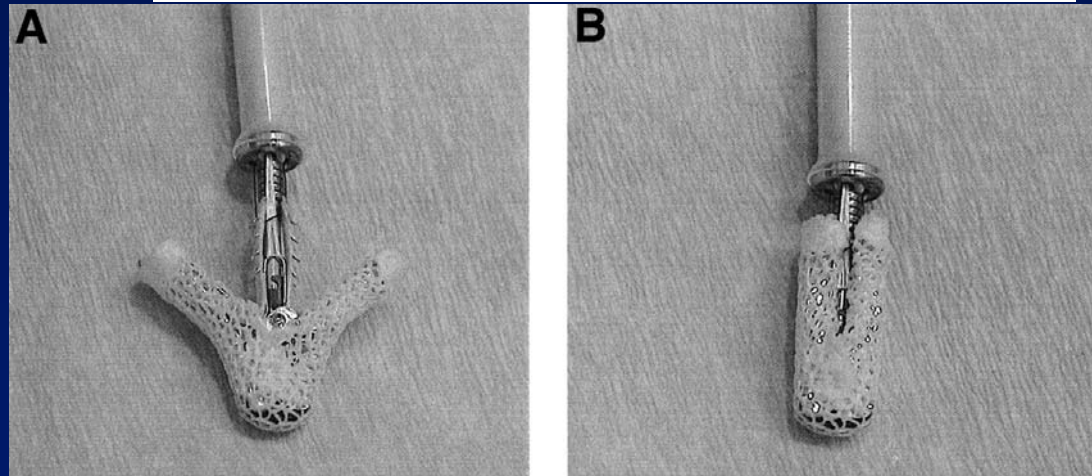
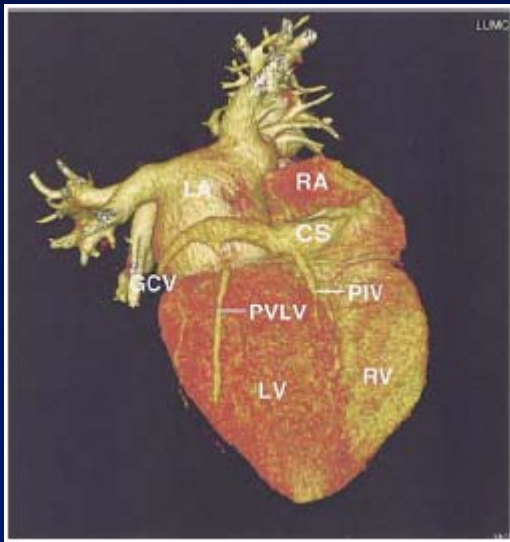
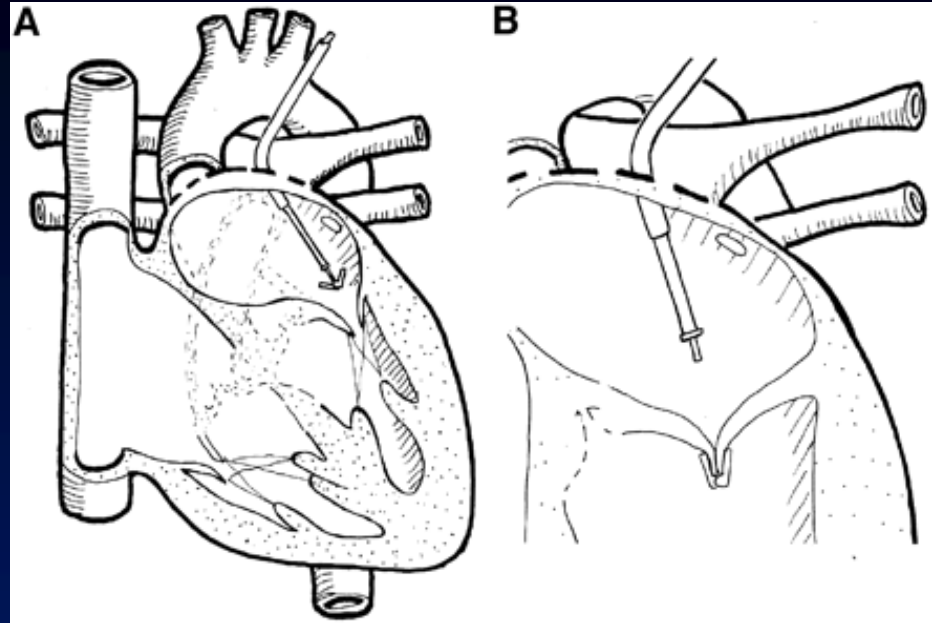
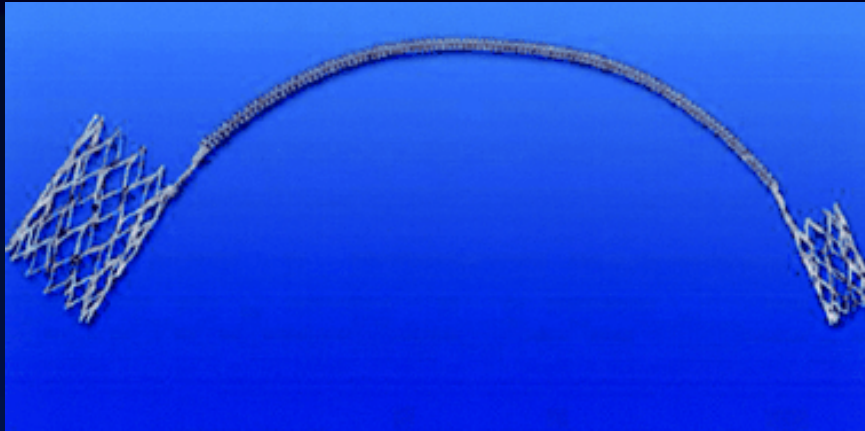


Alfieri edge to edge repair

Anterior Leaflet Augmentation



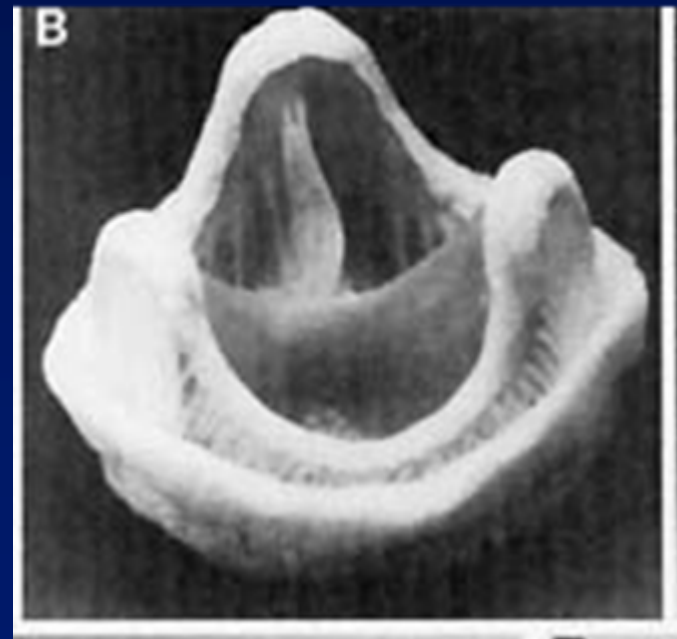
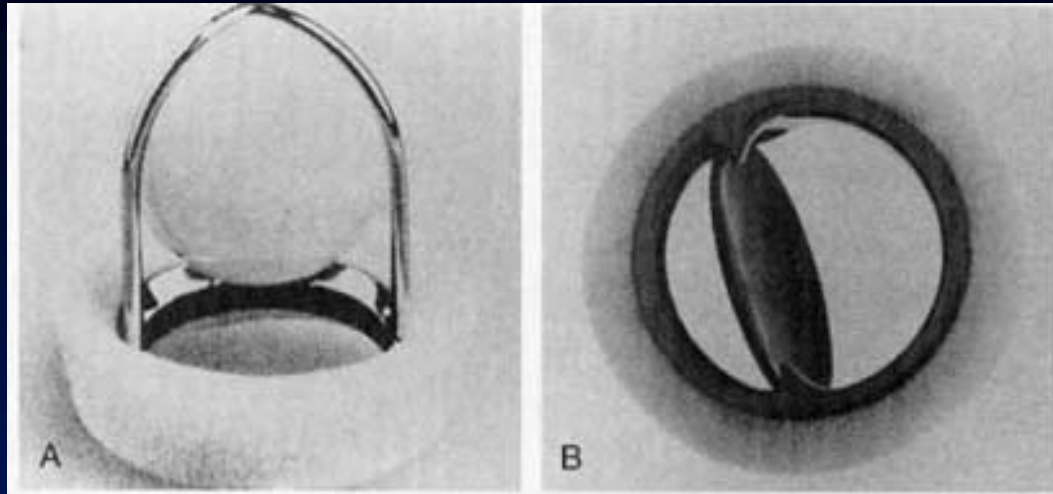
Percutaneous MV Repair



Webb et al, Circ 2005

Mitraclip (EVEREST II)

Prosthetic Mitral Valve



Mechanical Valves

- Durable (>40 years with SE valves)
- Thrombogenic – requires life long anticoagulation: INR 2.5-3.5 ± aspirin



Safety

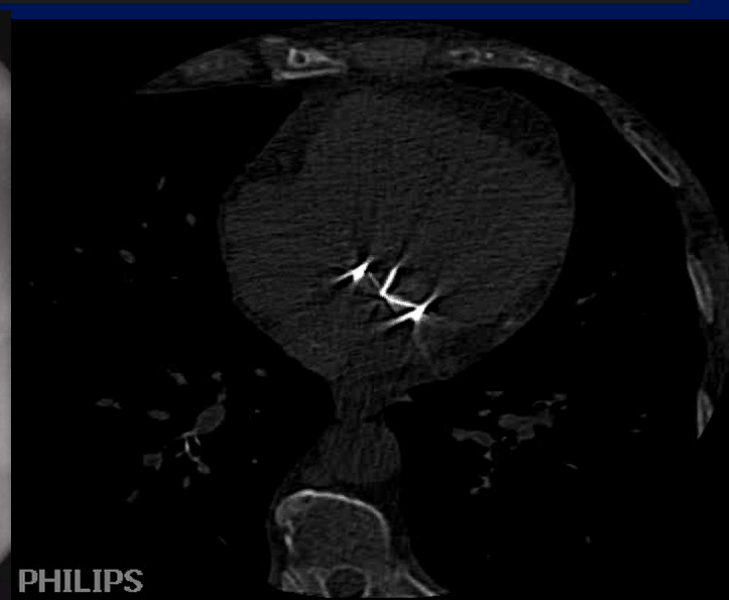
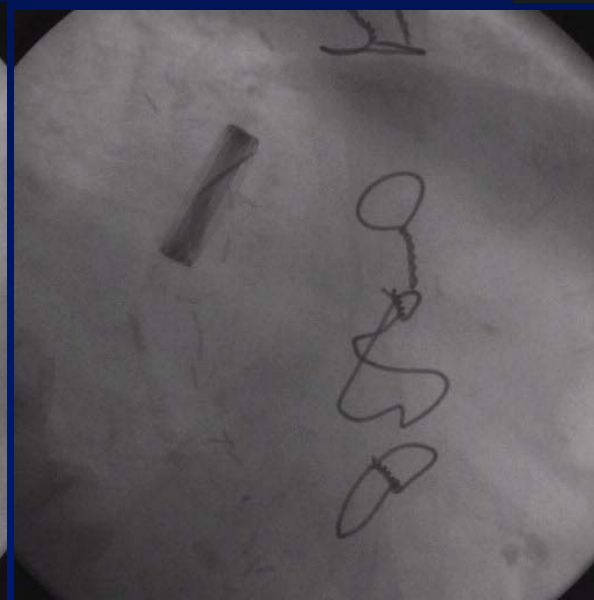
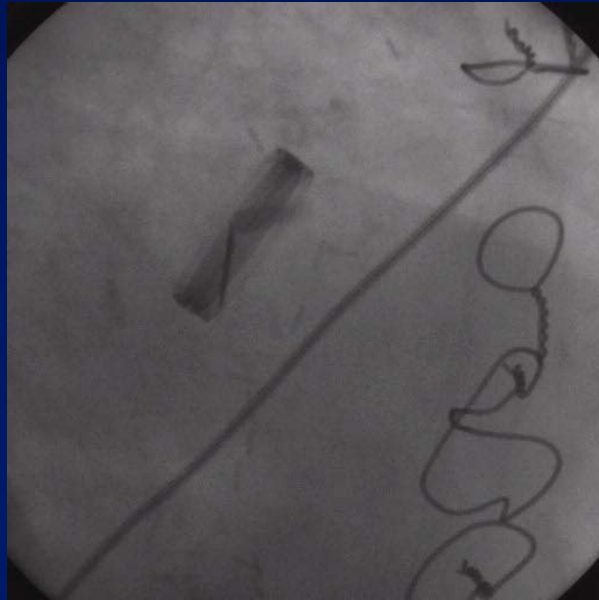
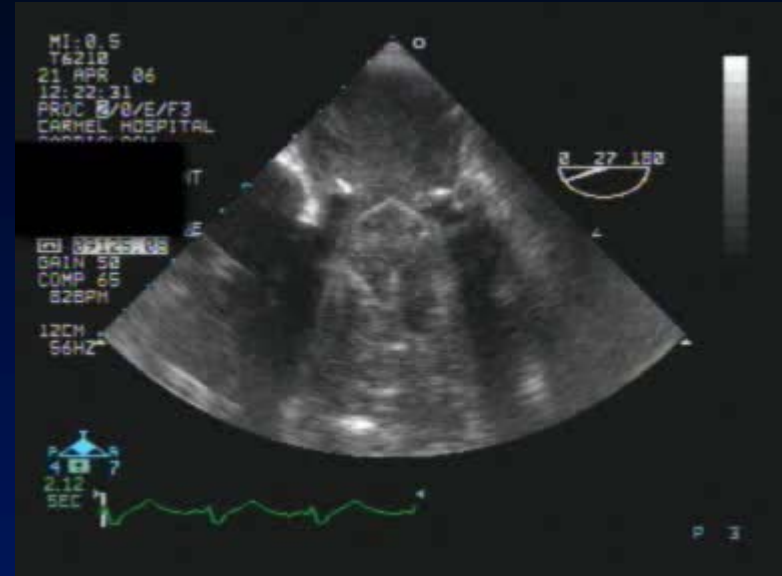
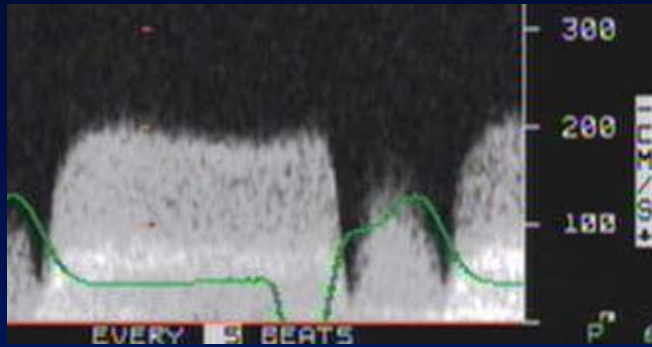


Complications

- Major bleeding: 0.2-2.2%/y
- Thromboembolism: 2-3%/y
- PV thrombosis (stuck valve): 0.35%/y

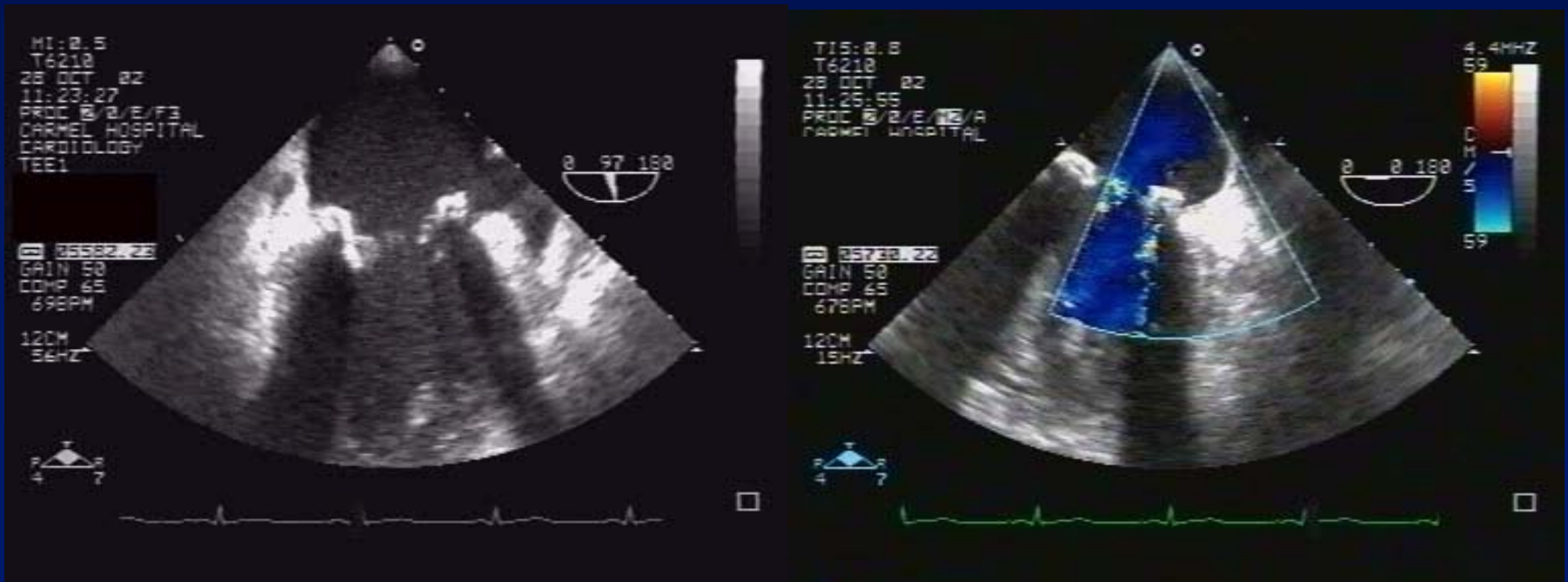
Stuck Prosthetic Valve

- High suspicion (INR↓, dyspnea/CHF)
- Echo (TEE), fluoroscopy
- Thrombolysis or surgery



Other PV Complications

- “The dark side of the moon” (TEE necessary)
- Leaks (paravalvular usually)
- Hemolysis
- Endocarditis
- Rare mechanical failure



Valve Selection

- Mechanical valve
 - Desire of informed patient
 - Long expected lifetime (age < 65 years)
 - No contraindication for anticoagulation
 - Anticoagulation required anyway (mechanical prosthesis, AF?)
 - High risk for redo surgery?

Valve Selection

- Bioprosthesis
 - Desire of informed patient
 - Young woman contemplating pregnancy
 - Short expected lifetime (age \geq 65 years)
 - Unavailable good quality anticoagulation
 - Redo for thrombosed mechanical valve & poor anticoagulation
 - Hemodialysis?