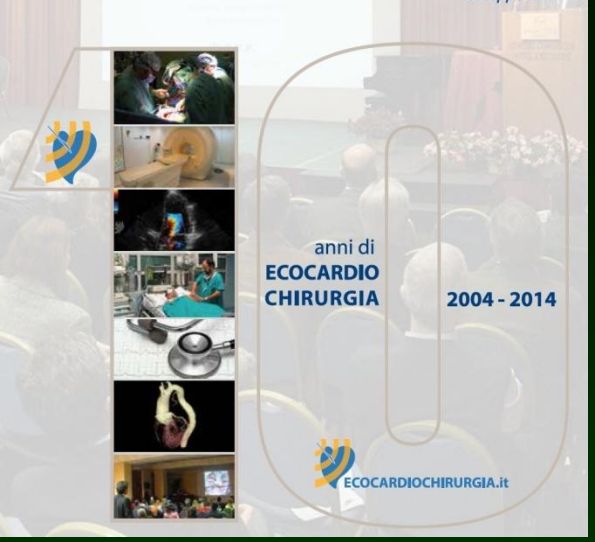
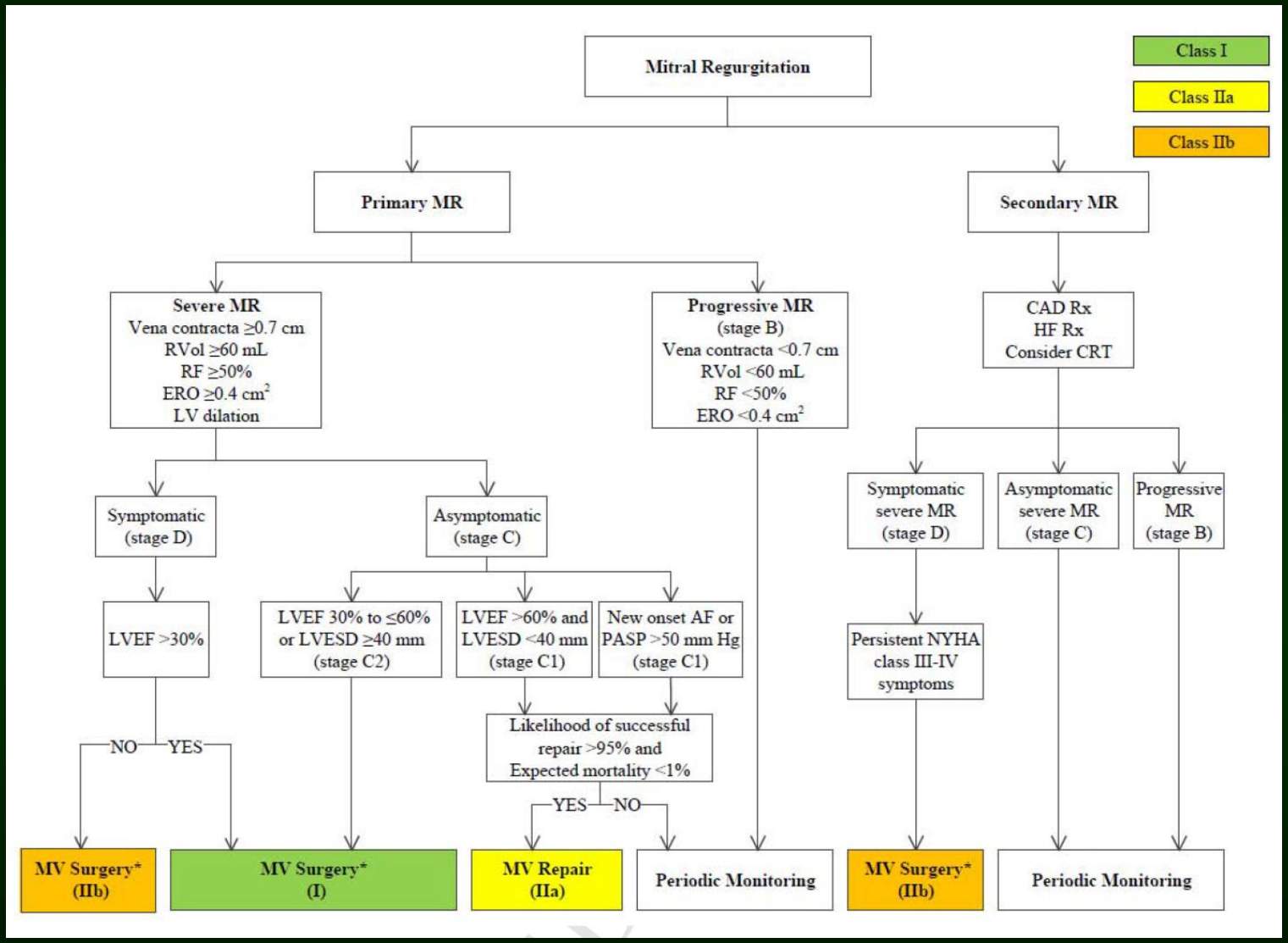


Come valutare la disfunzione associata ad insufficienza mitralica. Un argomento centrale nella scelta del timing chirurgico nel quale i dati storici prevalgono ancora?

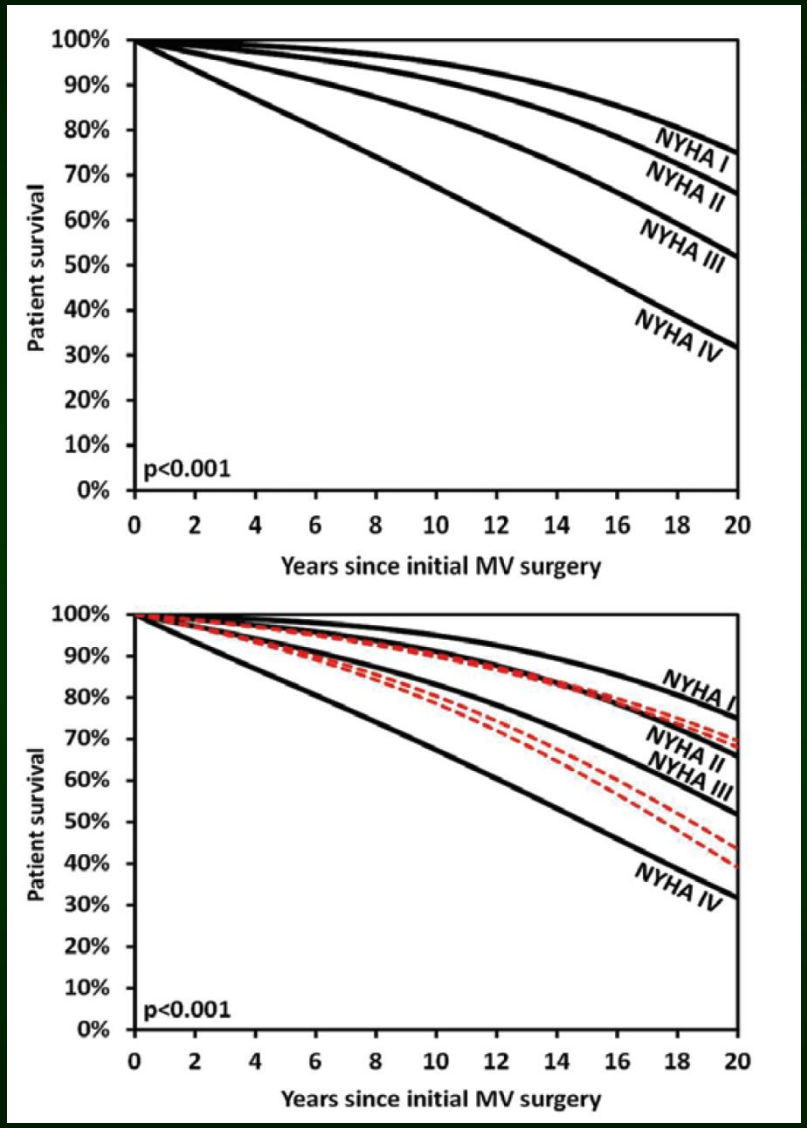
Flavio Bologna

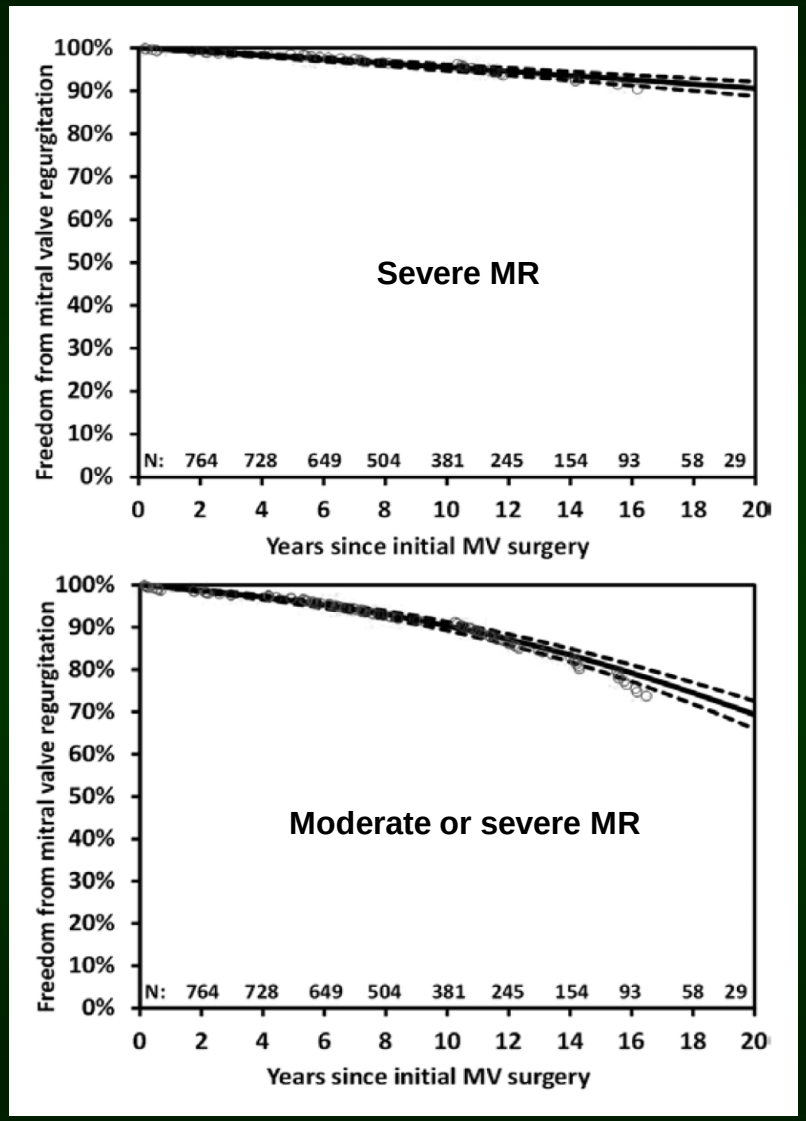
Cardiologia - Rimini

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease



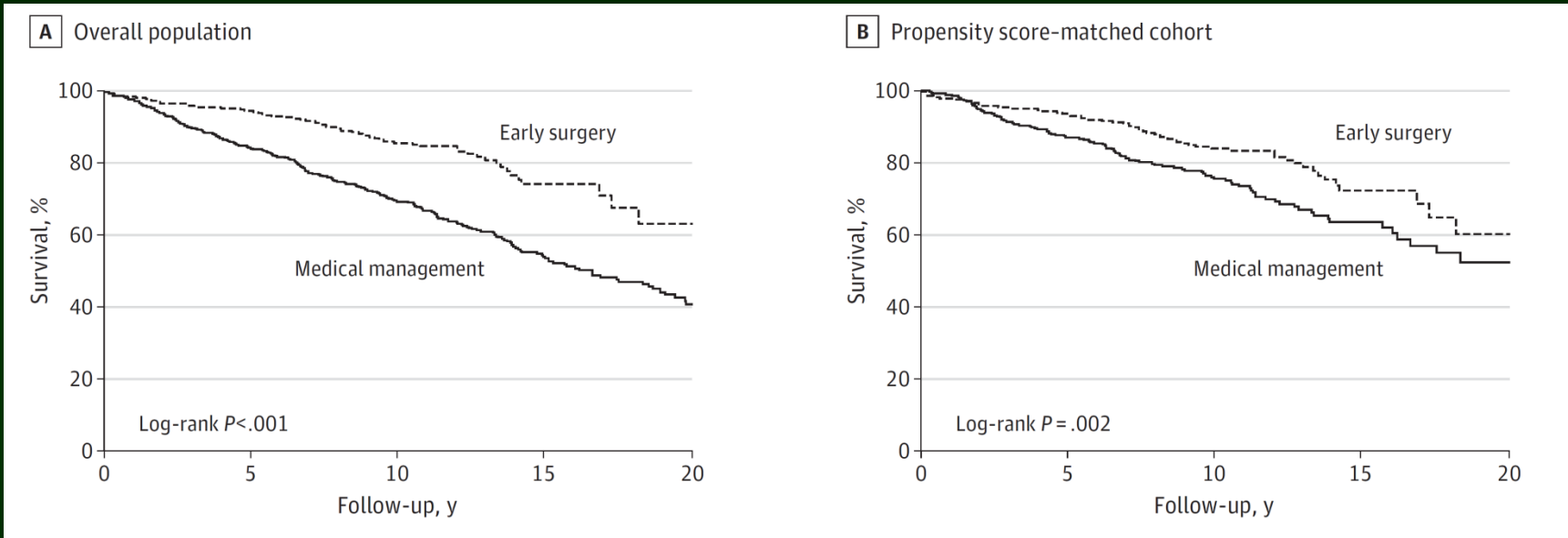
Late Outcomes of Mitral Valve Repair for Mitral Regurgitation Due to Degenerative Disease





Tirone E. David et al. ***Circulation. 2013***

Association Between Early Surgical Intervention vs Watchful Waiting and Outcomes for Mitral Regurgitation Due to Flail Mitral Valve Leaflets



Median follow-up length 10.3 y

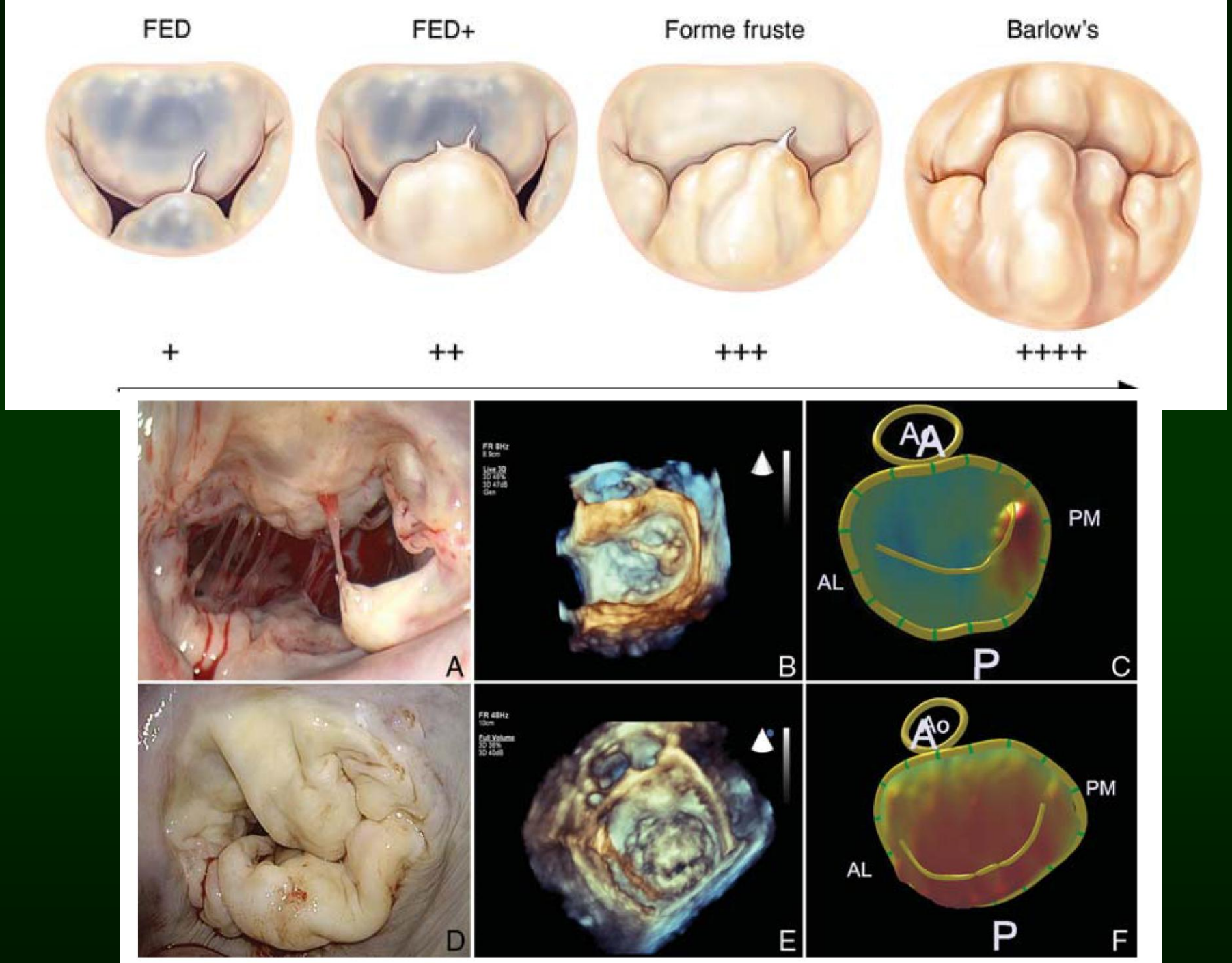
Suri et al. JAMA. 2013

Association Between Early Surgical Intervention vs Watchful Waiting and Outcomes for Mitral Regurgitation Due to Flail Mitral Valve Leaflets

Ejection fraction, mean (SD), %	68.6 (6)
LVESD, mean (SD), mm	32.2 (4)
LVESD/BSA, mean (SD), mm/m^2	17.6 (2.5)

Flail posterior	86.6

Suri et al. JAMA. 2013


FED
FED+
Forme fruste
Barlow's
+
++
+++
++++
A
B
C
D
E
F
AA
PM
AL
P
Ao

Early mitral valve repair versus watchful waiting in patients with severe asymptomatic organic mitral regurgitation; rationale and design of the Dutch AMR trial, a multicenter, randomised trial

Inclusion criteria

Age 18–70 years

Severe organic mitral regurgitation

Absence of symptoms defined as absence of subjective limitations of exercise capacity or complaints expressed by the patient and confirmed by the cardiologist

Likelihood of mitral valve repair (in contrast to replacement) should be >90%

Patients should be fit for surgery

Ejection fraction >60% and left ventricular end-systolic dimension <45 mm

Exclusion criteria

Class I or IIa indication for surgery (including atrial fibrillation and pulmonary hypertension) according to the ESC guidelines [4]

Symptoms

Ejection fraction <60% and left ventricular end-systolic dimension >45 mm

Atrial fibrillation, either on 12-lead ECG or 48-h ECG monitoring

Pulmonary hypertension (RVSP >50 mmHg on echocardiography)

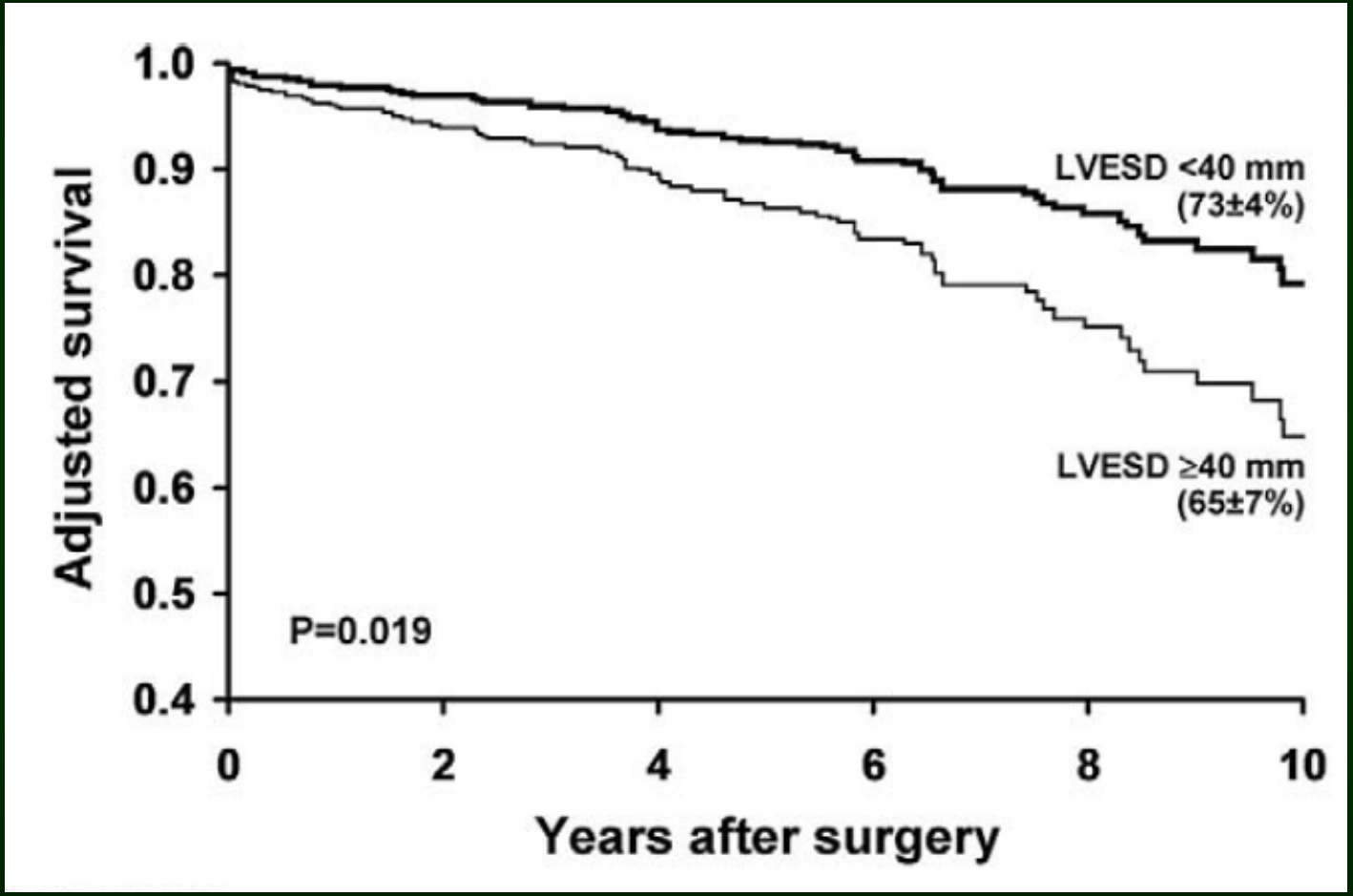
Likelihood of repair <90%

Physical inability to undergo surgery

Signs of heart failure

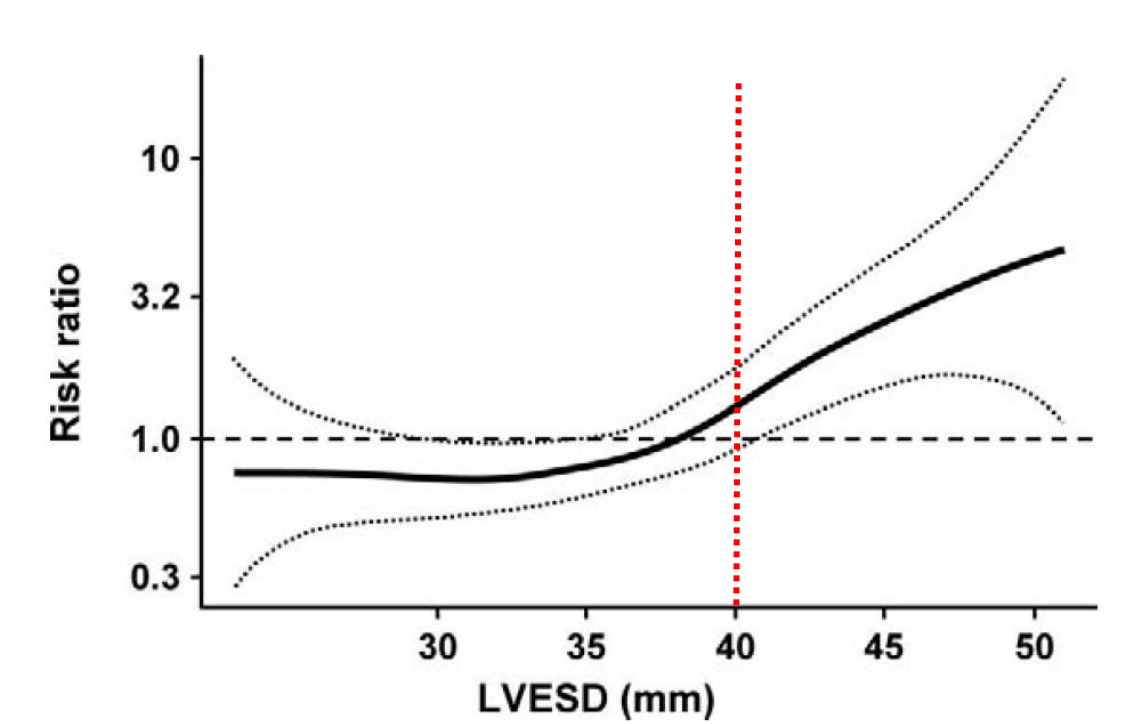
Other life-threatening morbidity

Survival Implication of Left Ventricular End-Systolic Diameter in Mitral Regurgitation Due to Flail Leaflets



Christophe Tribouilloy et al. J Am Coll Cardiol 2009

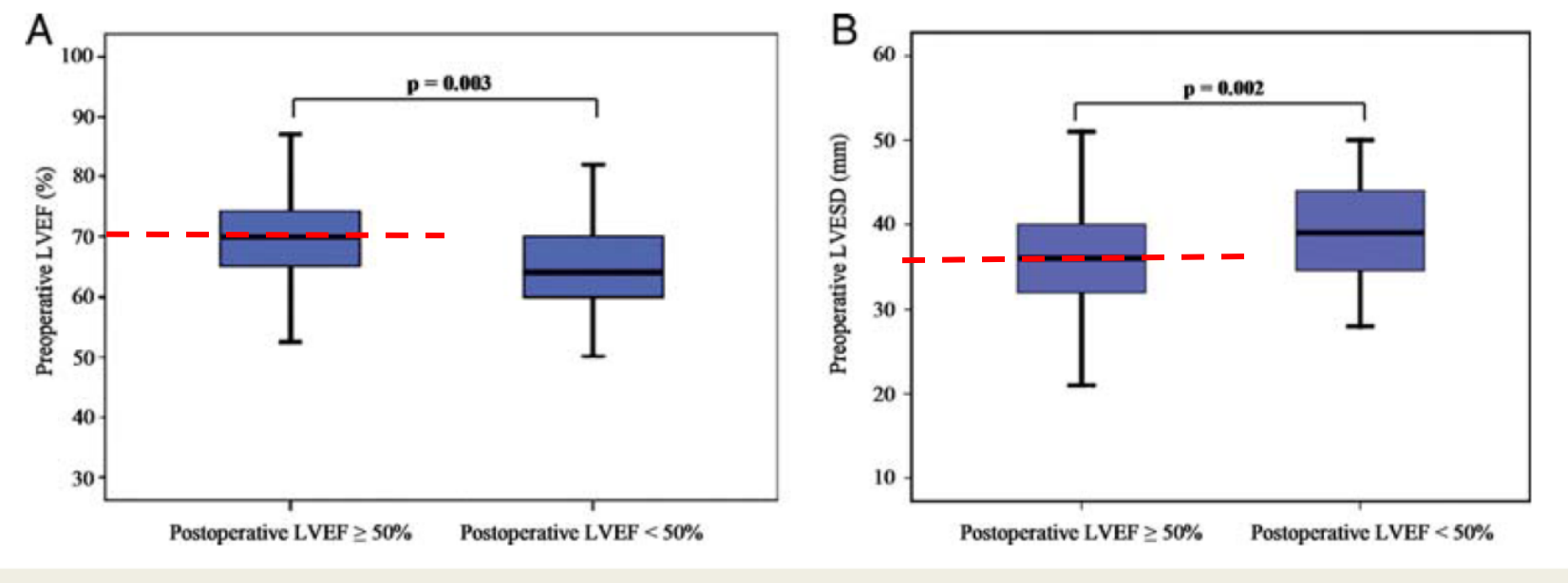
Survival Implication of Left Ventricular End-Systolic Diameter in Mitral Regurgitation Due to Flail Leaflets



Association Between LVESD and the Risk of Overall Mortality Under Conservative Management

Christophe Tribouilloy et al. J Am Coll Cardiol 2009

Predicting left ventricular dysfunction after valve repair for mitral regurgitation due to leaflet prolapse: additive value of left ventricular end-systolic dimension to ejection fraction



Christophe Tribouilloy, European Journal of Echocardiography (2011)

Survival Implication of Left Ventricular End-Systolic Diameter in Mitral Regurgitation Due to Flail Leaflets

LVESD ≥ 22 mm/m²

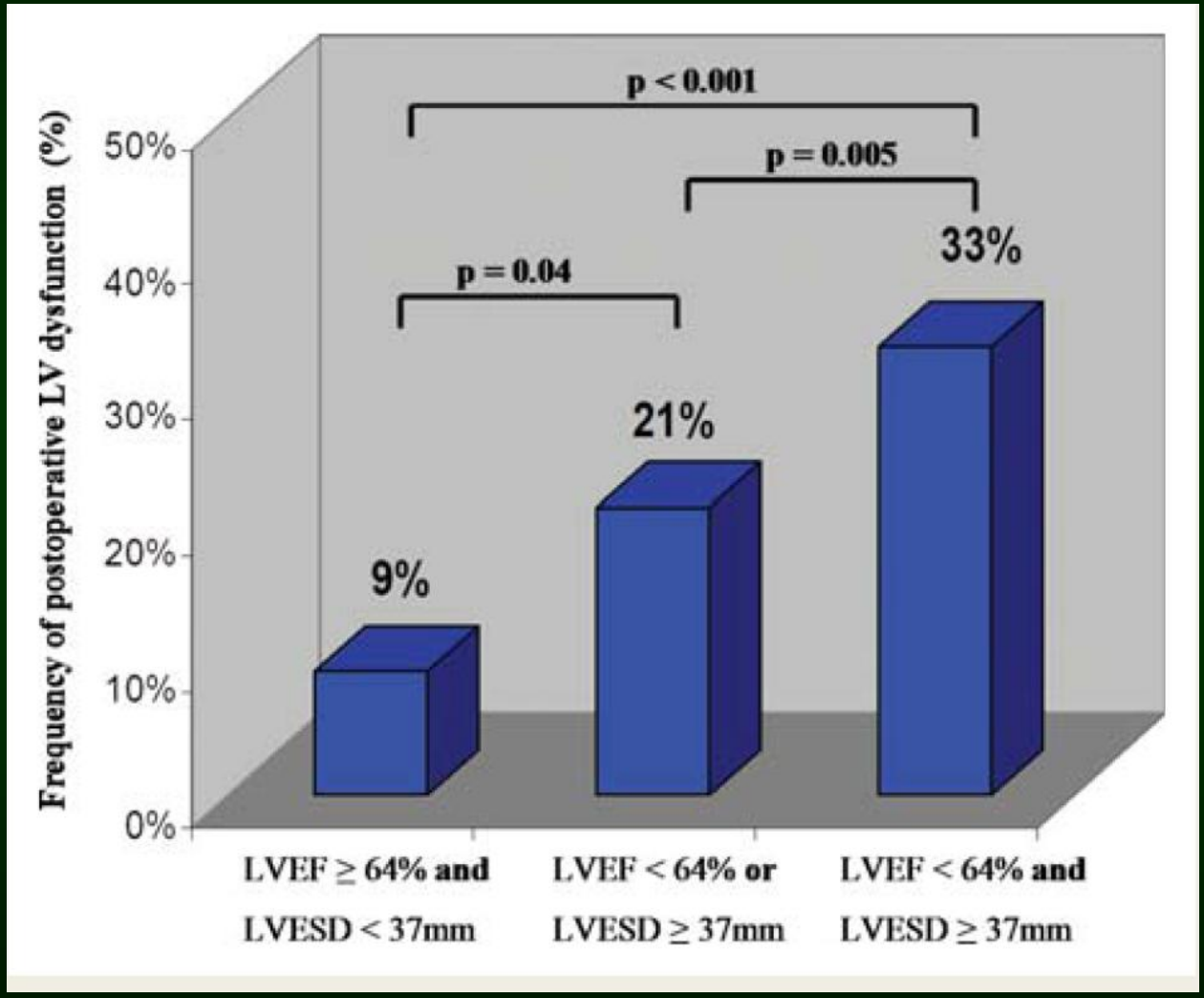
↓

Excess mortality under medical tratment

HR 2.03 95% CI 1.06 to 3.89 P= 0.03

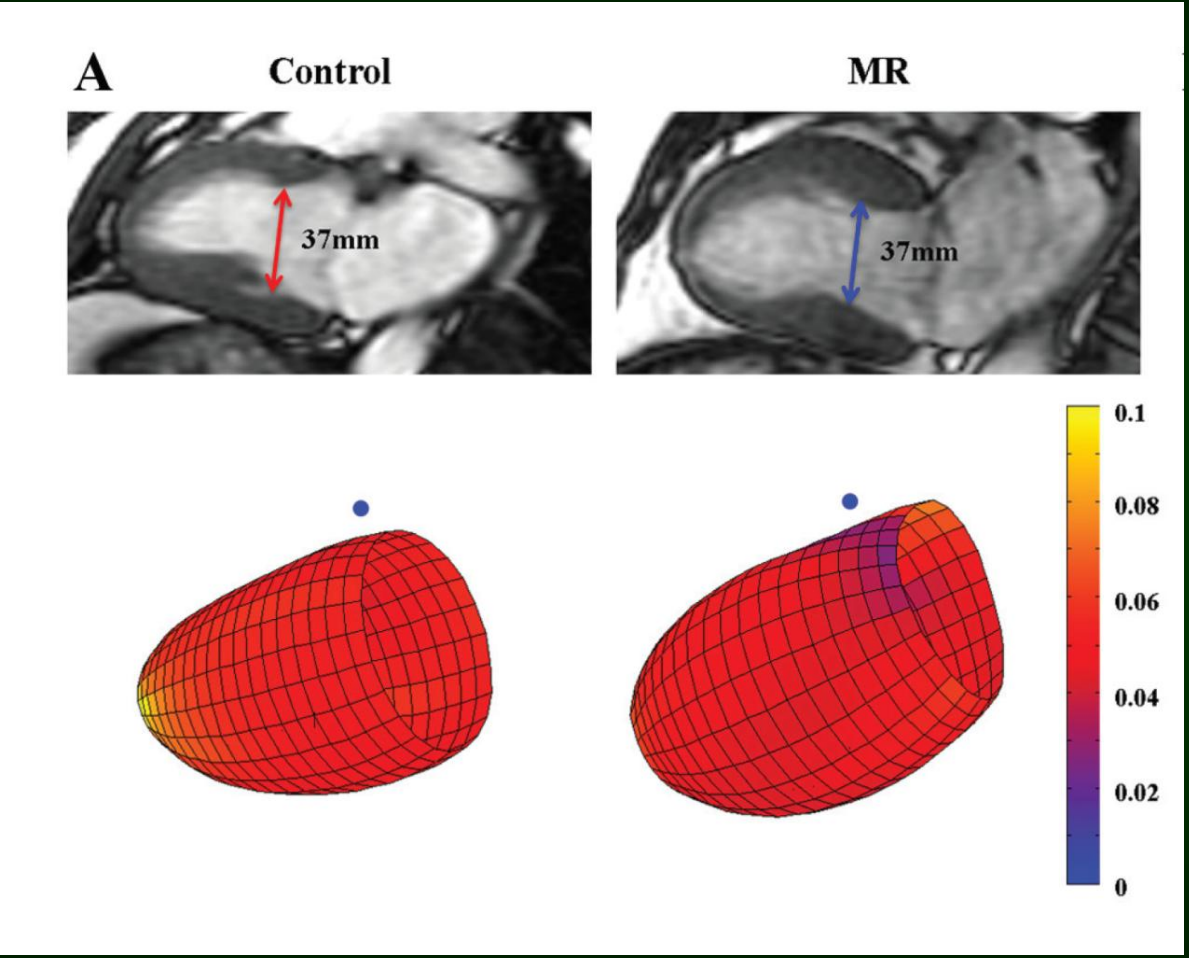
Christophe Tribouilloy et al. J Am Coll Cardiol 2009

Predicting left ventricular dysfunction after valve repair for mitral regurgitation due to leaflet prolapse: additive value of left ventricular end-systolic dimension to ejection fraction



Christophe Tribouilloy, European Journal of Echocardiography (2011)

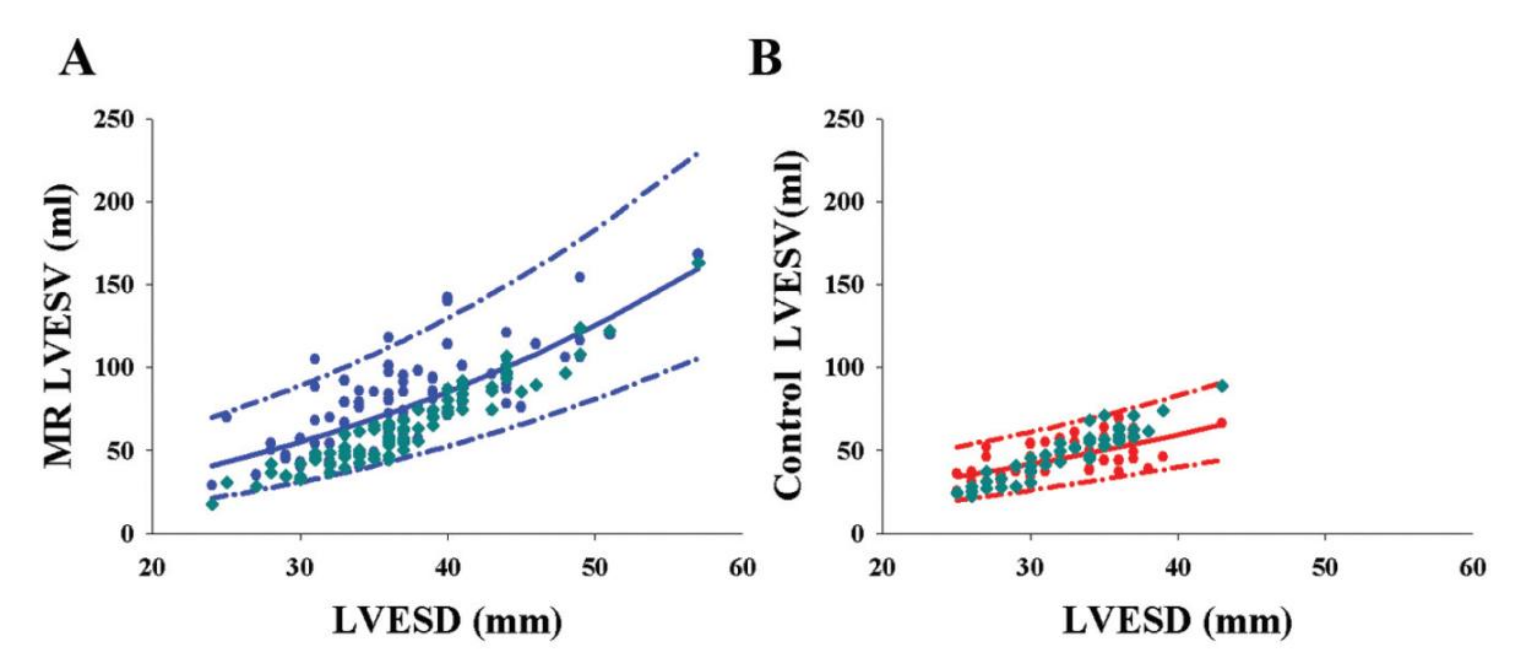
Magnetic Resonance Imaging With 3-Dimensional Analysis of Left Ventricular Remodeling in Isolated Mitral Regurgitation: Implications Beyond Dimensions



Schiros et al. Circulation 2012

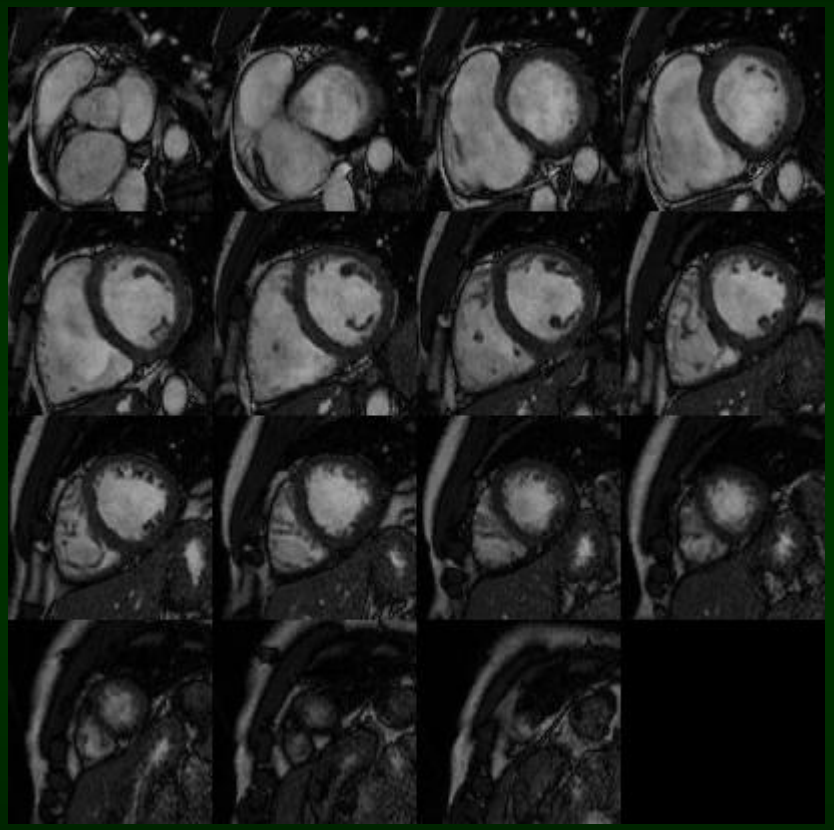
Magnetic Resonance Imaging With 3-Dimensional Analysis of Left Ventricular Remodeling in Isolated Mitral Regurgitation: Implications Beyond Dimensions

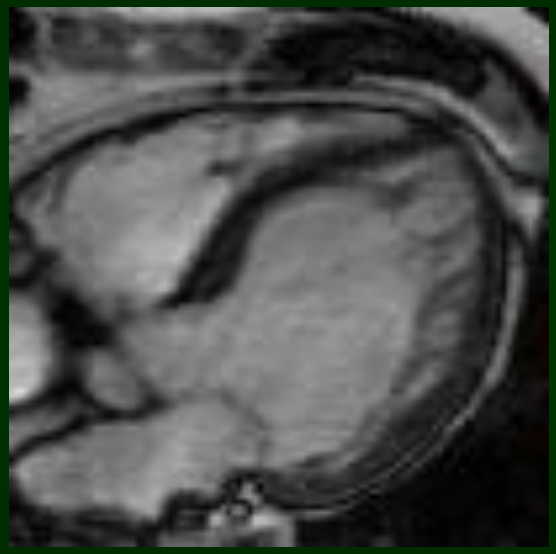
Chun G. Schiros, Louis J. Dell'Italia, James D. Gladden, Donald Clark III, Inmaculada Aban, Himanshu Gupta, Steven G. Lloyd, David C. McGiffin, Gilbert Perry, Thomas S. Denney, Jr and Mustafa I. Ahmed

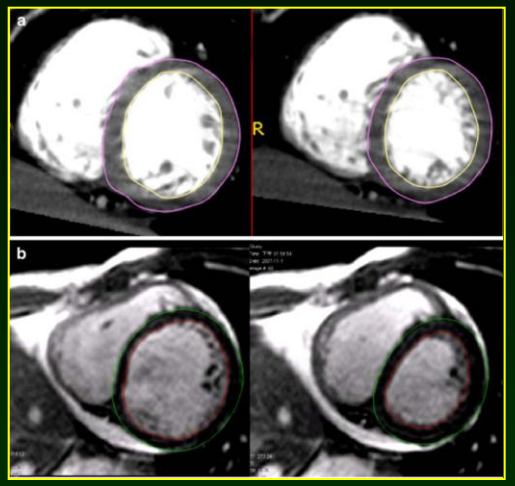


Circulation. 2012;125:2334-2342;

Cardiac MRI







64-slice CT for preoperative evaluation of left ventricular function and mass in patients with mitral regurgitation: comparison with MRI and echocardiography

Table 1 LV function by 64-MDCT compared with MRI (n=51)

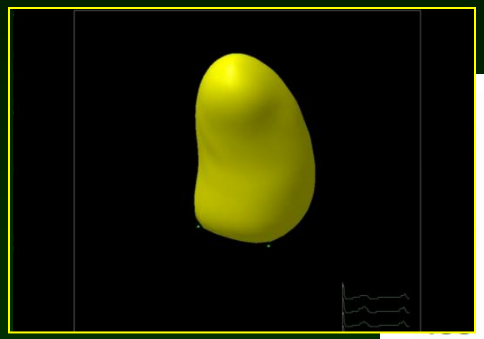
	64-MDCT	MRI	Paired t test (p value)	Pearson's coefficient
EDV (mL)	193.7±77.8	188.0±72.8	0.16	0.93*
ESV (mL)	94.5±44.3	92.9±42.0	0.53	0.92*
SV (mL)	99.4±44.0	94.9±42.6	0.08	0.91*
EF (%)	51.8±10.3	50.5±9.9	0.07	0.89*
Mass (g)	154.3±64.4	155.2±62.2	0.52	0.96*

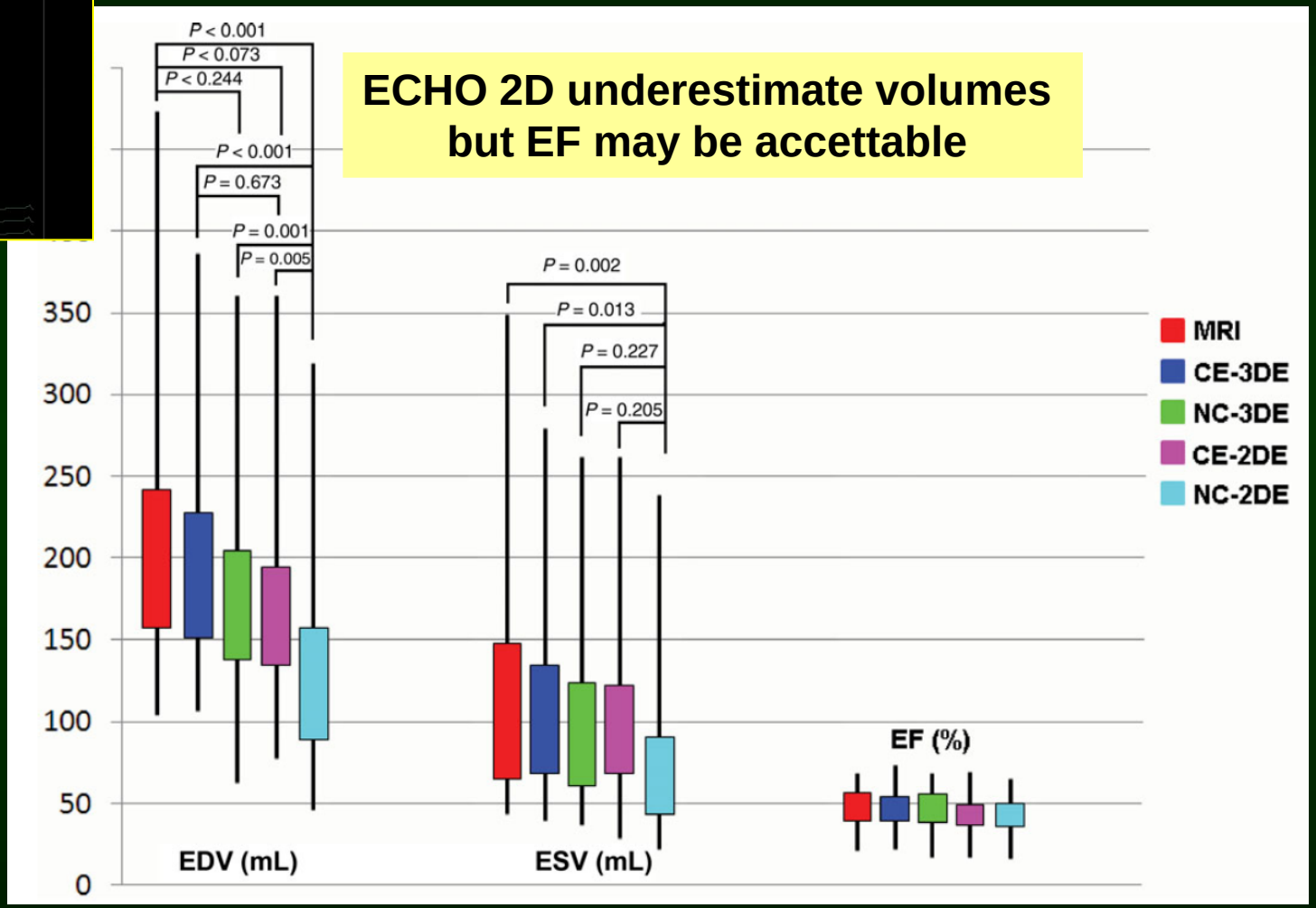
Table 2 LV function by 2DTTE compared with MRI (n=51)

	2DTTE	MRI	Paired t test (p value)	Pearson's coefficient
EDV (mL)	164.9±63.7	188.0±72.7	0.0008	0.78*
ESV (mL)	74.5±30.2	92.9±41.9	0.0003	0.60*
SV (mL)	88.1±39.2	95.9±42.6	0.004	0.81*
EF (%)	54.2±9.5	50.5±9.8	0.003	0.62*

Ying-kun Guo et al. Eur Radiol 2009

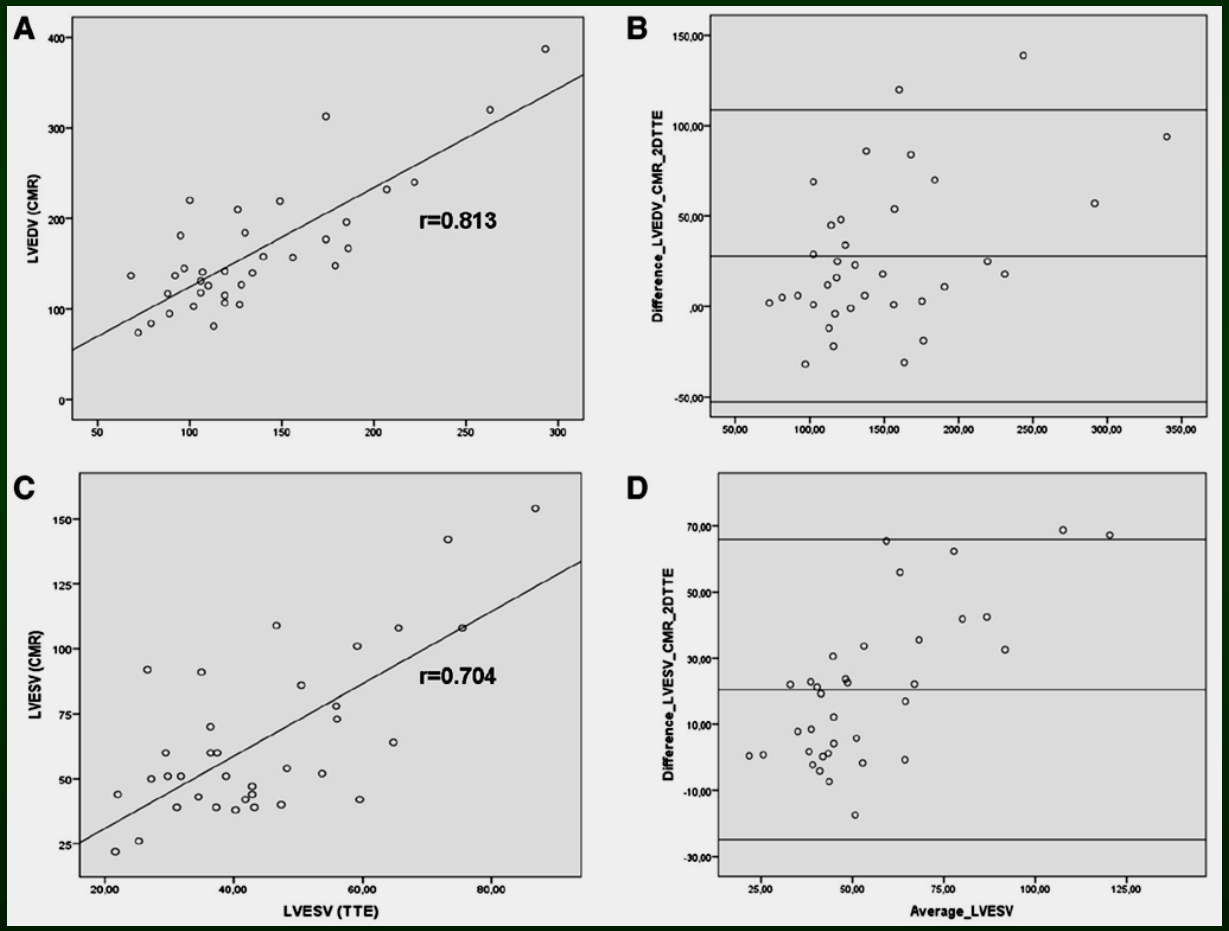
Left ventricular volume measurement with echocardiography comparison of LV opacification, 3D echocardiography or both MRI





Carly Jenkins et al. European Heart Journal 2009

Assessment of left ventricular volumes and primary mitral regurgitation severity by 2D echocardiography and cardiovascular magnetic resonance



Van De Heyning et al. Cardiovascular Ultrasound 2013

Assessment of left ventricular volumes and primary mitral regurgitation severity by 2D echocardiography and cardiovascular magnetic resonance

Table 2 Comparison of 2D TTE and CMR measurements of LV dimensions and MR severity

	2D TTE	CMR	Pearson correlation		
LVEDD (mm)	53 ± 6	53 ± 8	p = 0.9	r = 0.80	p < 0.00001
LVESD (mm)	36 ± 5	36 ± 6	p = 1	r = 0.85	p < 0.00001
LVEF (%) teichholz	64 ± 8	61 ± 7	p = 0.05	r = 0.26	p = 0.1
LVEDV (ml)	136 ± 52	164 ± 70	p = 0.0003	r = 0.81	p < 0.00001
LVESV (ml)	44 ± 16	65 ± 31	p < 0.00001	r = 0.7	p < 0.00001
LVSV (ml)	90 ± 39	99 ± 46	p = 0.06	r = 0.75	p < 0.00001
LVEF (%) simpson	67 ± 5	61 ± 7	p = 0.0004	r = 0.27	p = 0.1
ERO/ARO (mm^2)	48 ± 25	42 ± 17	p = 0.1	r = 0.76	p < 0.0001
RVol (ml) pisa	69 ± 38	39 ± 27	p = 0.001	r = 0.38	p = 0.07
RVol (ml) doppler volumetric method	67 ± 33	28 ± 16	p = 0.003	r = −0.15	p = 0.6

MR = mitral regurgitation; LVEDD = left ventricular end-diastolic diameter; LVESD = left ventricular end-systolic volume; LVEF = left ventricular ejection fraction; LVEDV = left ventricular end-diastolic volume; LVESV = left ventricular end-systolic volume; LVSV = left ventricular stroke volume; ERO = effective regurgitant orifice; ARO = anatomical regurgitant orifice; RVol = regurgitant volume.

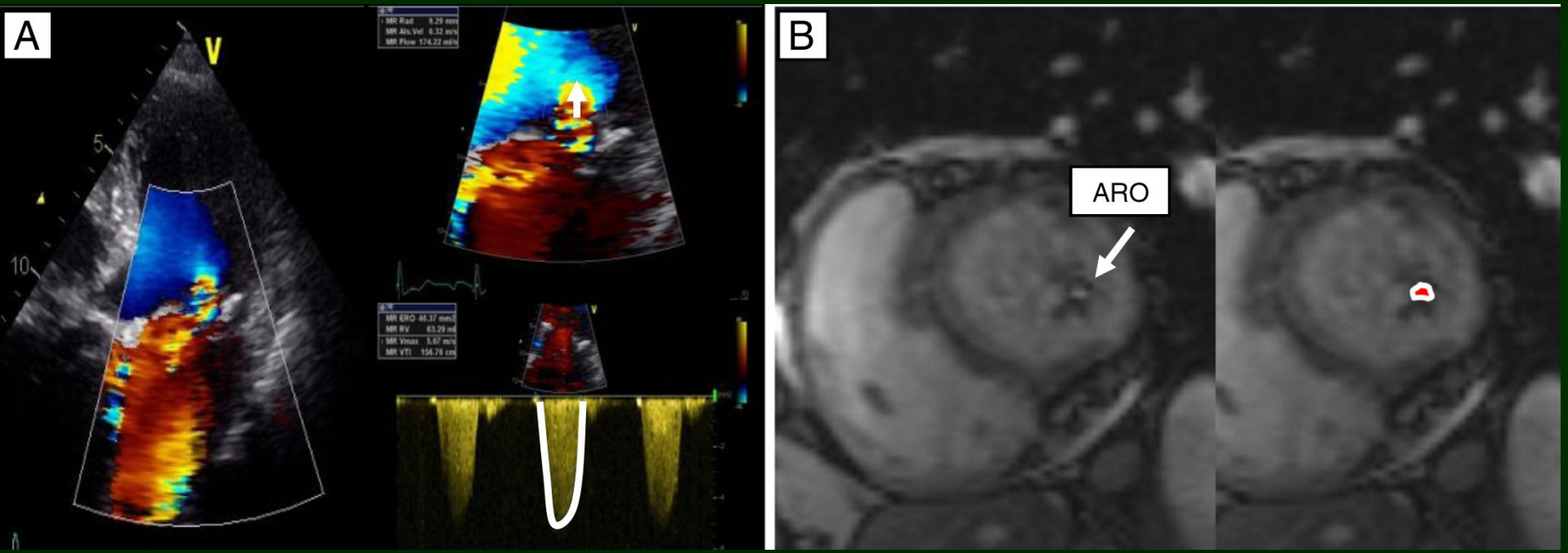
Van De Heyning et al. Cardiovascular Ultrasound 2013

Assessment of left ventricular volumes and primary mitral regurgitation severity by 2D echocardiography and cardiovascular magnetic resonance

33% of patients with Echo LVEF > 60% had MRI LVEF 58-59%

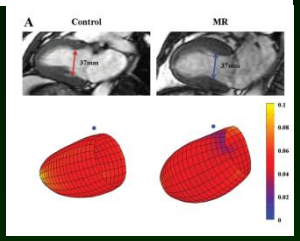
Van De Heyning et al. Cardiovascular Ultrasound 2013

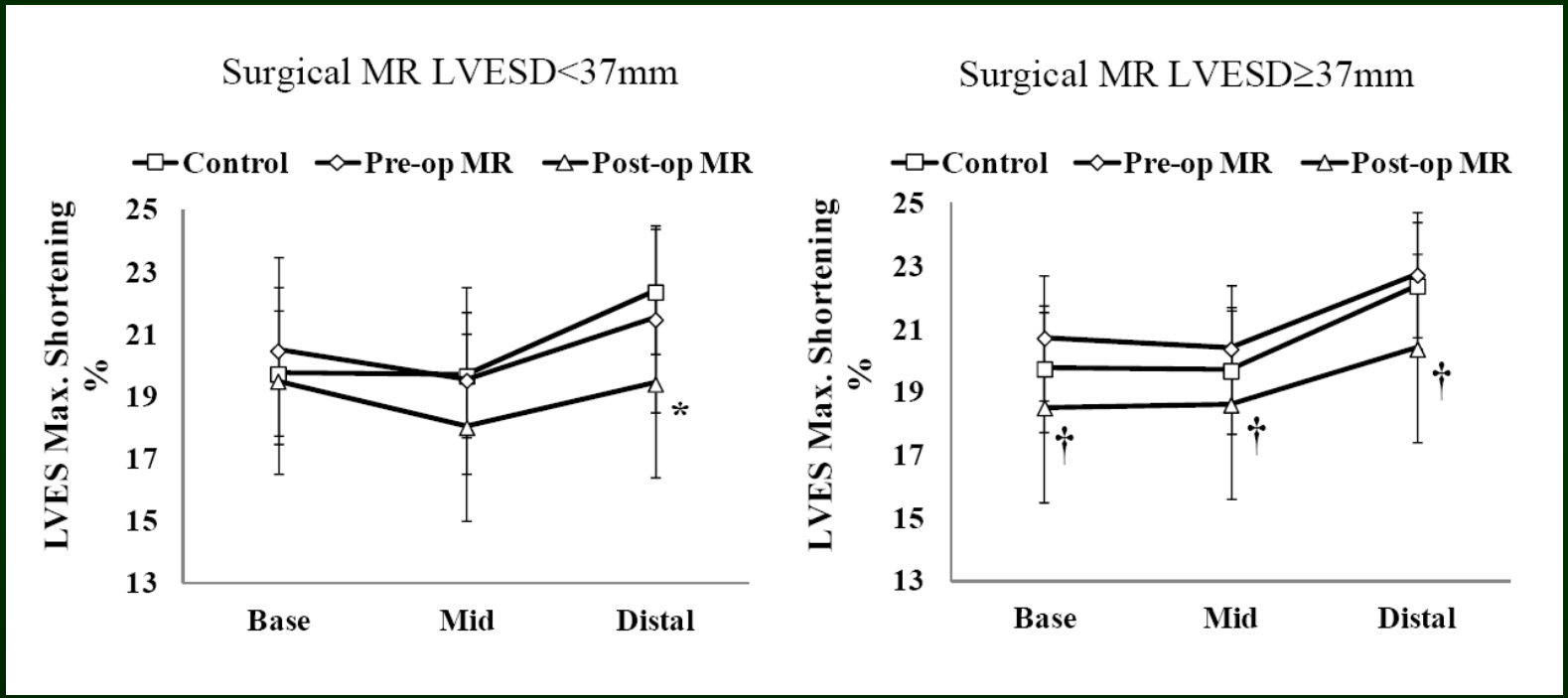
Assessment of left ventricular volumes and primary mitral regurgitation severity by 2D echocardiography and cardiovascular magnetic resonance



Van De Heyning et al. Cardiovascular Ultrasound 2013

Magnetic Resonance Imaging With 3-Dimensional Analysis of Left Ventricular Remodeling in Isolated Mitral Regurgitation: Implications Beyond Dimensions





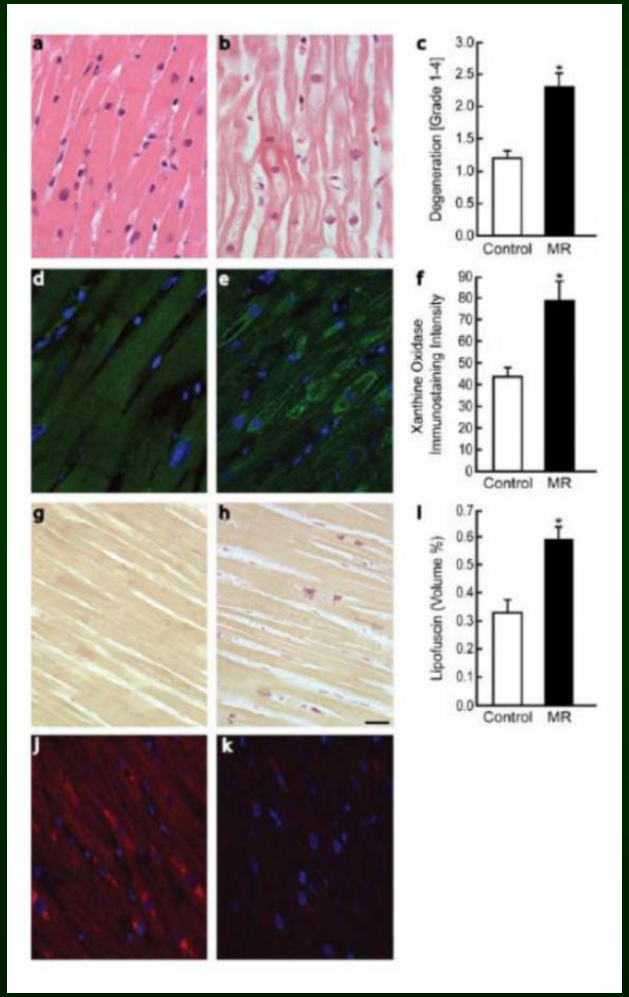
Schiros et al. Circulation 2012

Increased Oxidative Stress and Cardiomyocyte Myofibrillar Degeneration in Patients with Chronic Isolated Mitral Regurgitation and Ejection Fraction > 60%

myofibrillar degeneration

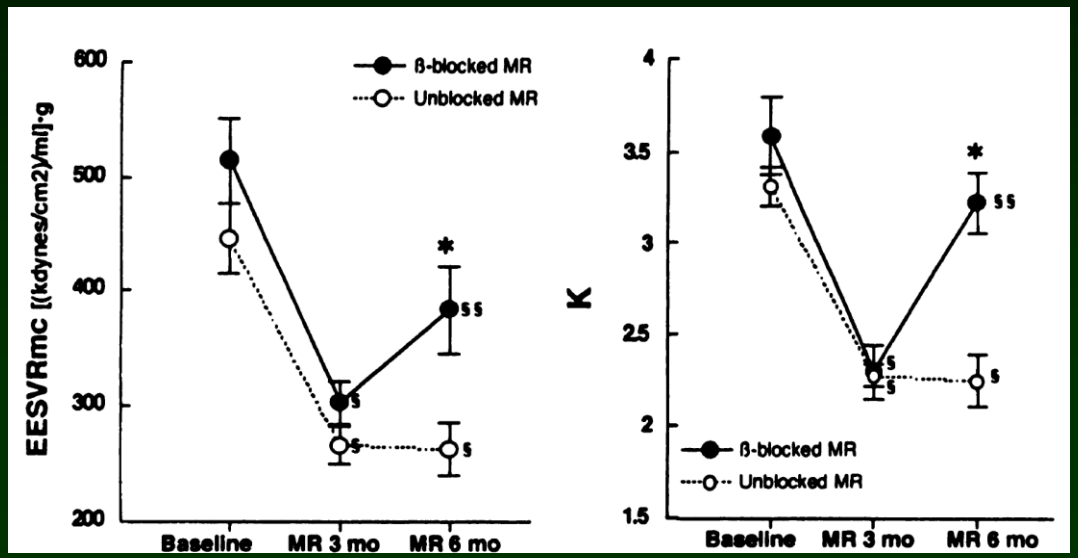
increased xanthine oxidase

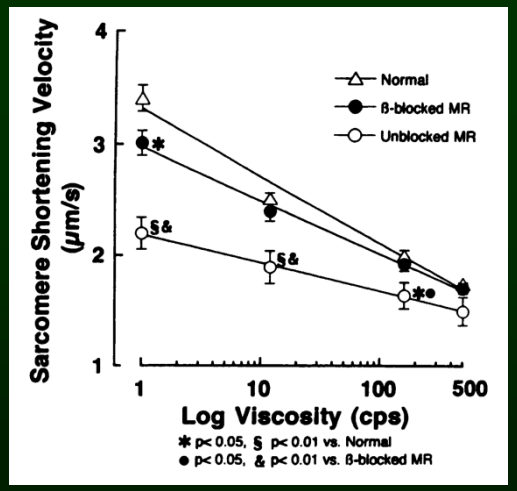
increased lipofuscin

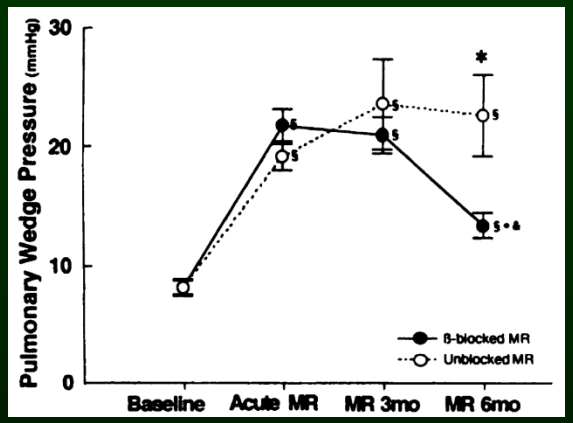


Mustafa I Ahmed et al. J Am Coll Cardiol. 2010

Effects of Chronic β-Adrenergic Blockade on the Left Ventricular and Cardiocyte Abnormalities of Chronic Canine Mitral Regurgitation







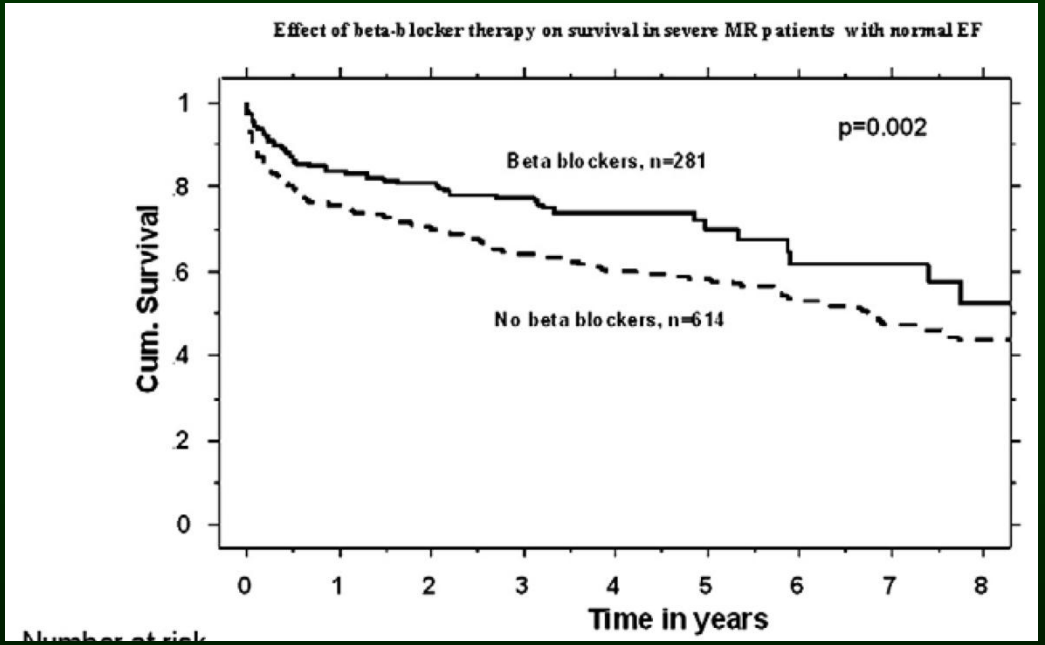
Hiroyuki Tsutsui et al. J Clin Invest. 1994

Effect of Beta-Blocker Therapy on Survival in Patients With Severe Mitral Regurgitation and Normal Left Ventricular Ejection Fraction

Characteristics of patients with and without β-blocker (BB) therapy

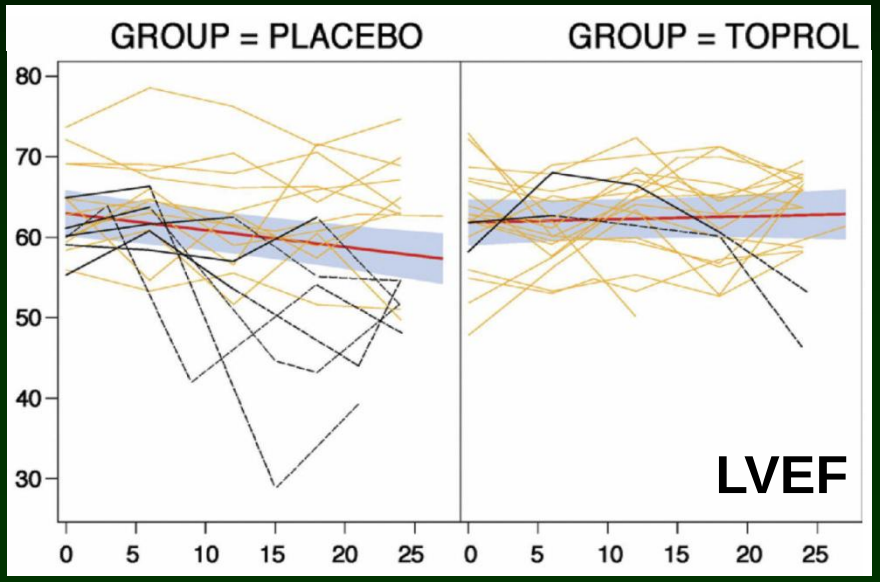
Variables	BB Therapy		p Value
	No (n = 614)	Yes (n = 281)	
Age (yrs)	68 ± 17	67 ± 16	0.55
Men (%)	43%	43%	0.93
Coronary artery disease (%)	1%	46%	<0.0001
Coronary artery bypass grafting (%)	7%	23%	<0.0001
Hypertension (%)	38%	70%	<0.0001
Diabetes mellitus (%)	11%	21%	<0.0001
LVEF (%)	67 ± 7	66 ± 7	0.51
LV end-diastolic diameter (cm)	5.0 ± 0.8	5.1 ± 0.8	0.42
LV end-systolic diameter (cm)	3.1 ± 0.7	3.2 ± 0.7	0.03
Ventricular septum (cm)	1.2 ± 0.3	1.3 ± 0.3	<0.0001
Posterior wall (cm)	1.1 ± 0.2	1.2 ± 0.2	0.01
Pulmonary artery systolic pressure ≥60 mm Hg (%)	4.7%	5.1%	<0.0001
Aspirin (%)	21%	56%	<0.0001
Angiotensin-converting enzyme inhibitor (%)	28%	52%	<0.0001
Statins (%)	8%	30%	<0.0001
Mitral valve surgery (%)	37%	19%	<0.0001

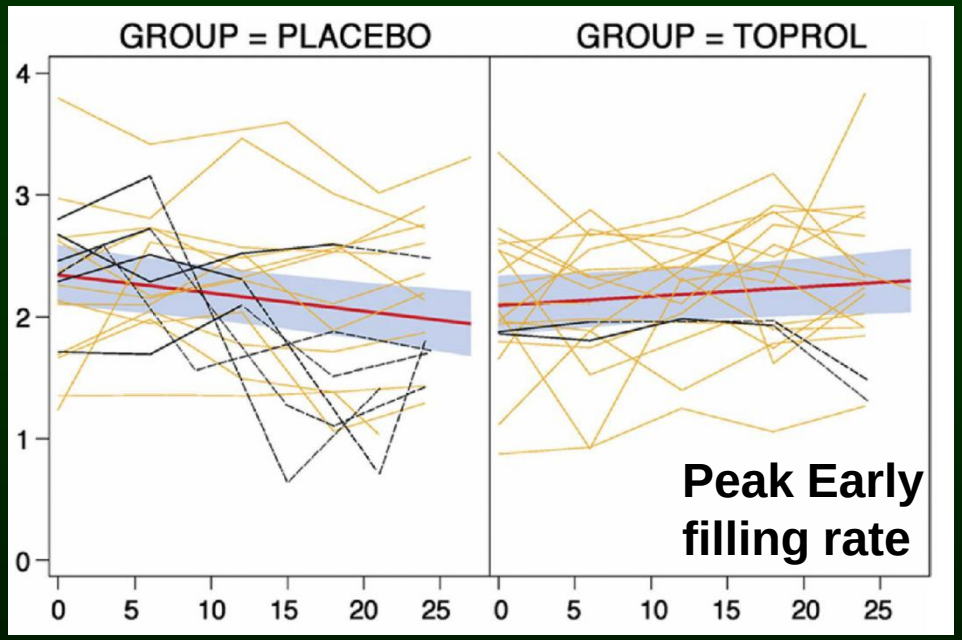
8% mitral valve repair,
17% mitral valve replacement



Padmini Varadarajan et al Am J Cardiol 2008

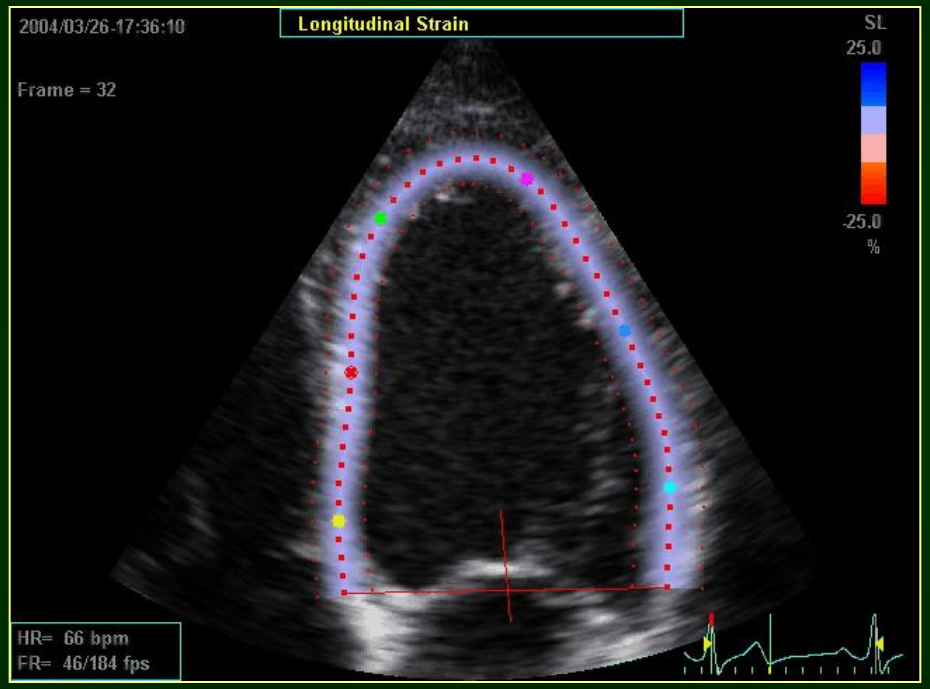
A Randomized Controlled Phase IIb Trial of β_1-Receptor Blockade for Chronic Degenerative Mitral Regurgitation

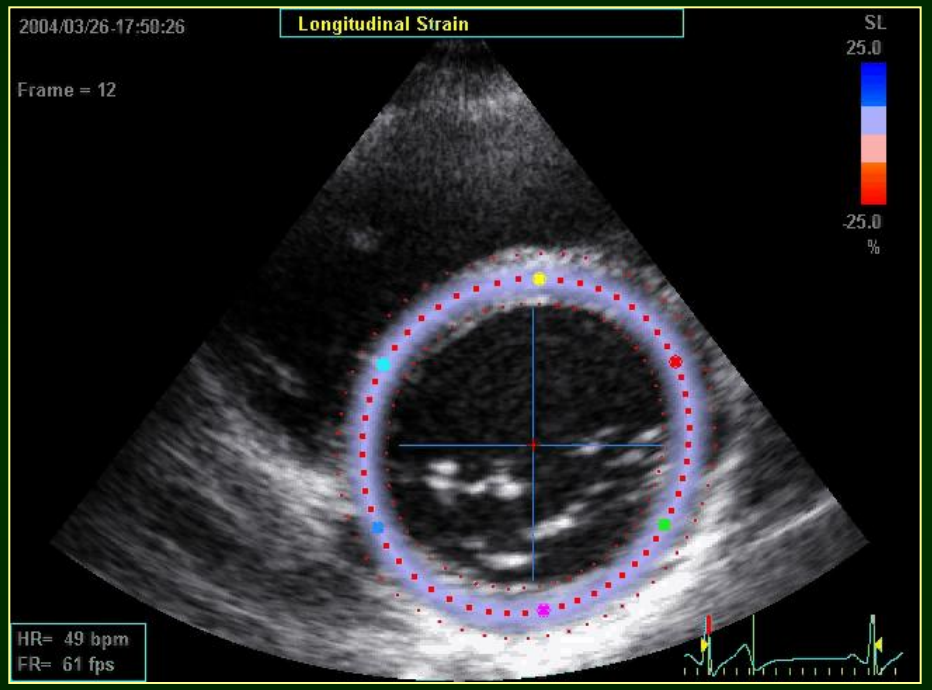




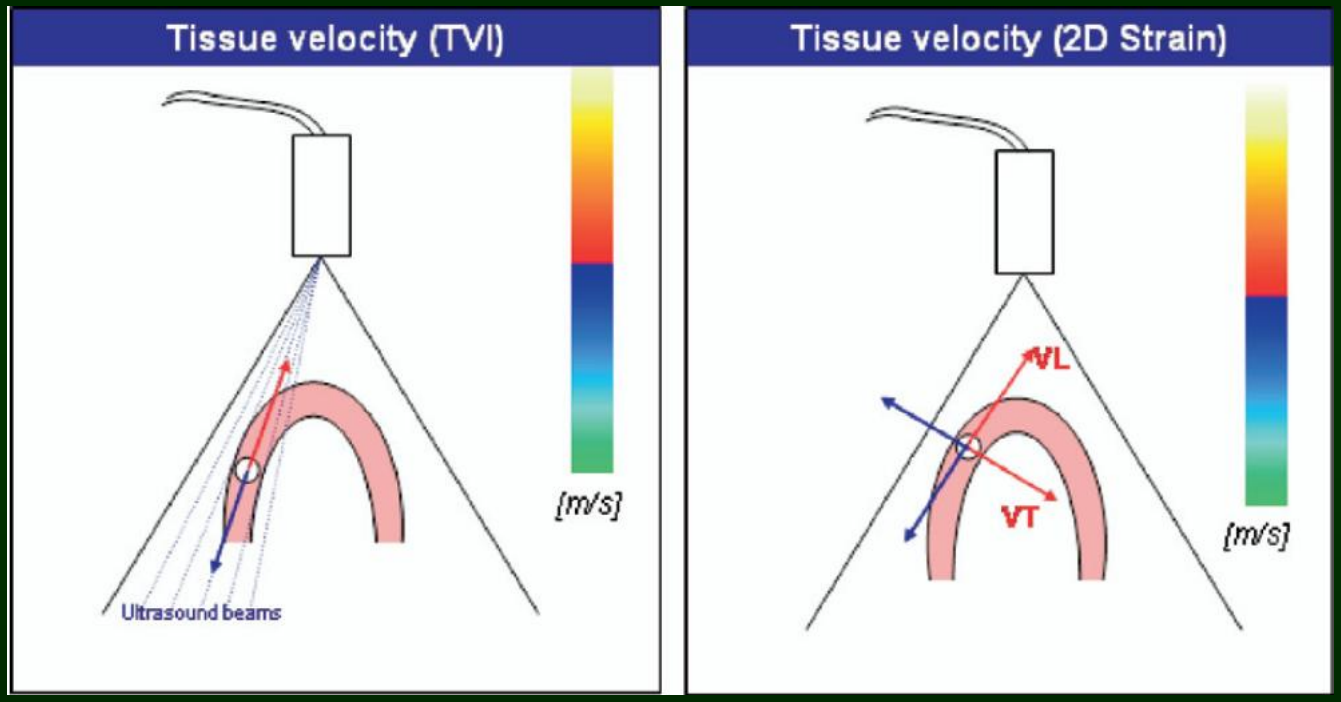
Mustafa I Ahmed et al J Am Coll Cardiol. 2012

Speckle tracking imaging



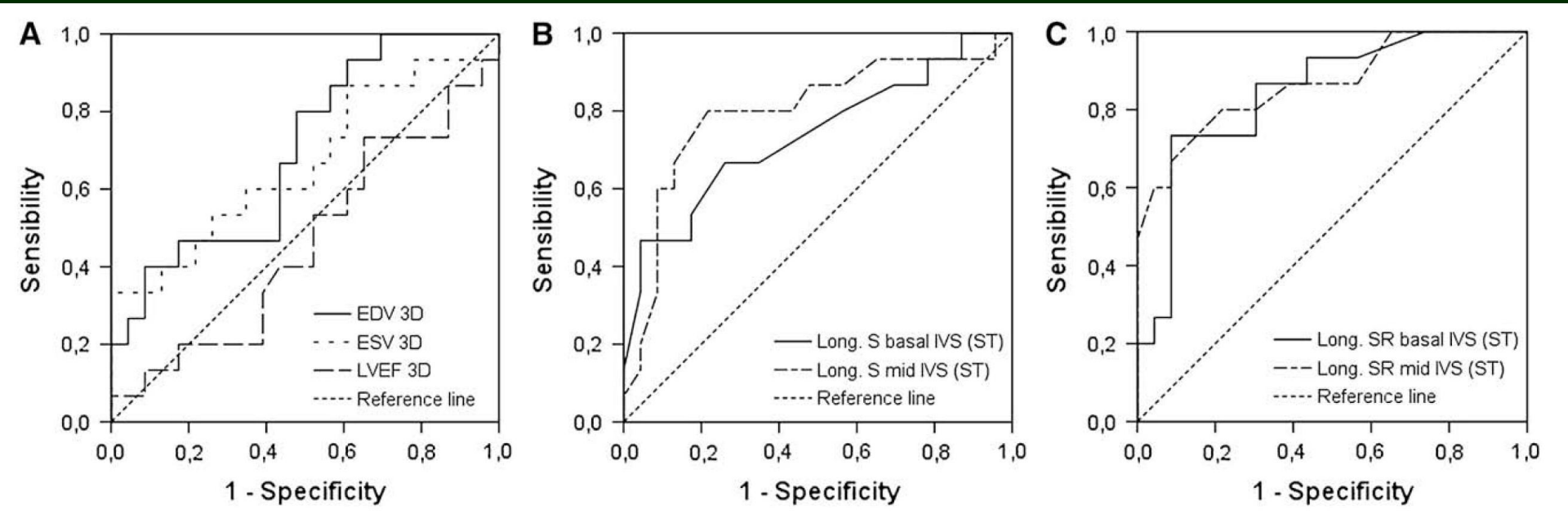


Doppler TDI vs Speckle tracking imaging



Chronic Mitral Regurgitation: A Pilot Study to Assess Preoperative Left Ventricular Contractile Function Using Speckle-Tracking Echocardiography

LVV 3D | **Strain** | **Strain rate**



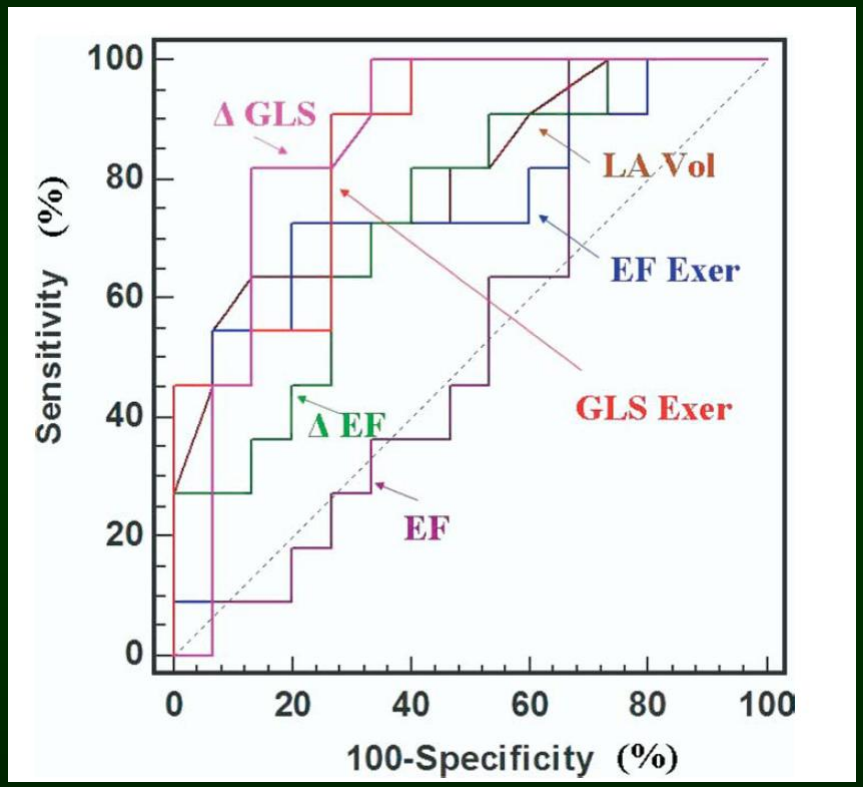
ROC curves for the prediction of LVEF decrease > 10%

De Isla PL et al. J Am Soc Echocardiogr 2009

Importance of Left Ventricular Longitudinal Function and Functional Reserve in Patients With Degenerative Mitral Regurgitation: Assessment by Two-Dimensional Speckle Tracking

Table 3 Determinants of postoperative LV ejection fraction

Data at inclusion	Postoperative LV ejection fraction ≥ 50% (n = 17)	Postoperative LV ejection fraction < 50% (n = 13)	*P* value
Rest			
Left atrial volume (mL)	67 ± 20	94 ± 28	.008
LV ejection fraction (%)	67 ± 6	67 ± 5.5	NS
Peak systolic velocity (cm/s)	6.2 ± 1.7	6.1 ± 1.5	NS
GLS (%)	19.8 ± 3.2	17.9 ± 2.7	.044
Exercise			
LV end-systolic volume (mL)	33 ± 12	42 ± 20	NS
LV ejection fraction (%)	71 ± 9	63 ± 11	.05
Peak systolic velocity	8.9 ± 2.2	7.8 ± 2.3	NS
GLS (%)	23.4 ± 4.7	17.1 ± 4.4	.0009
Exercise-induced changes			
LV ejection fraction (%)	4.3 ± 8.8	−3.2 ± 7.1	.018
Peak systolic velocity (cm/s)	2.7 ± 2.4	1.7 ± 1.5	NS
GLS (%)	3.6 ± 3.9	−0.8 ± 3.9	.005

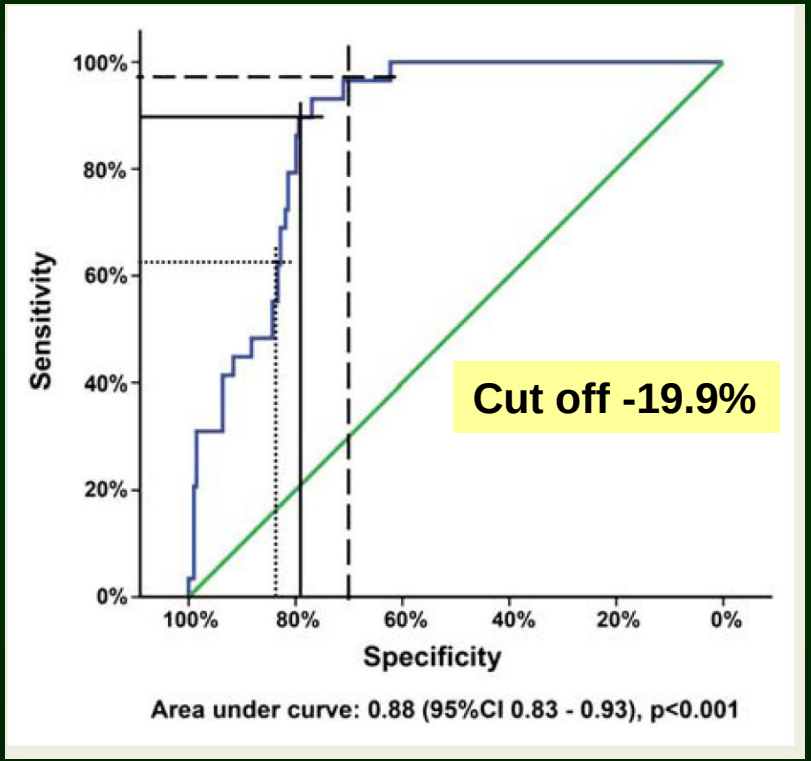


Patrizio Lancellotti et al. J Am Soc Echocardiogr 2008

Global longitudinal strain predicts left ventricular dysfunction after mitral valve repair

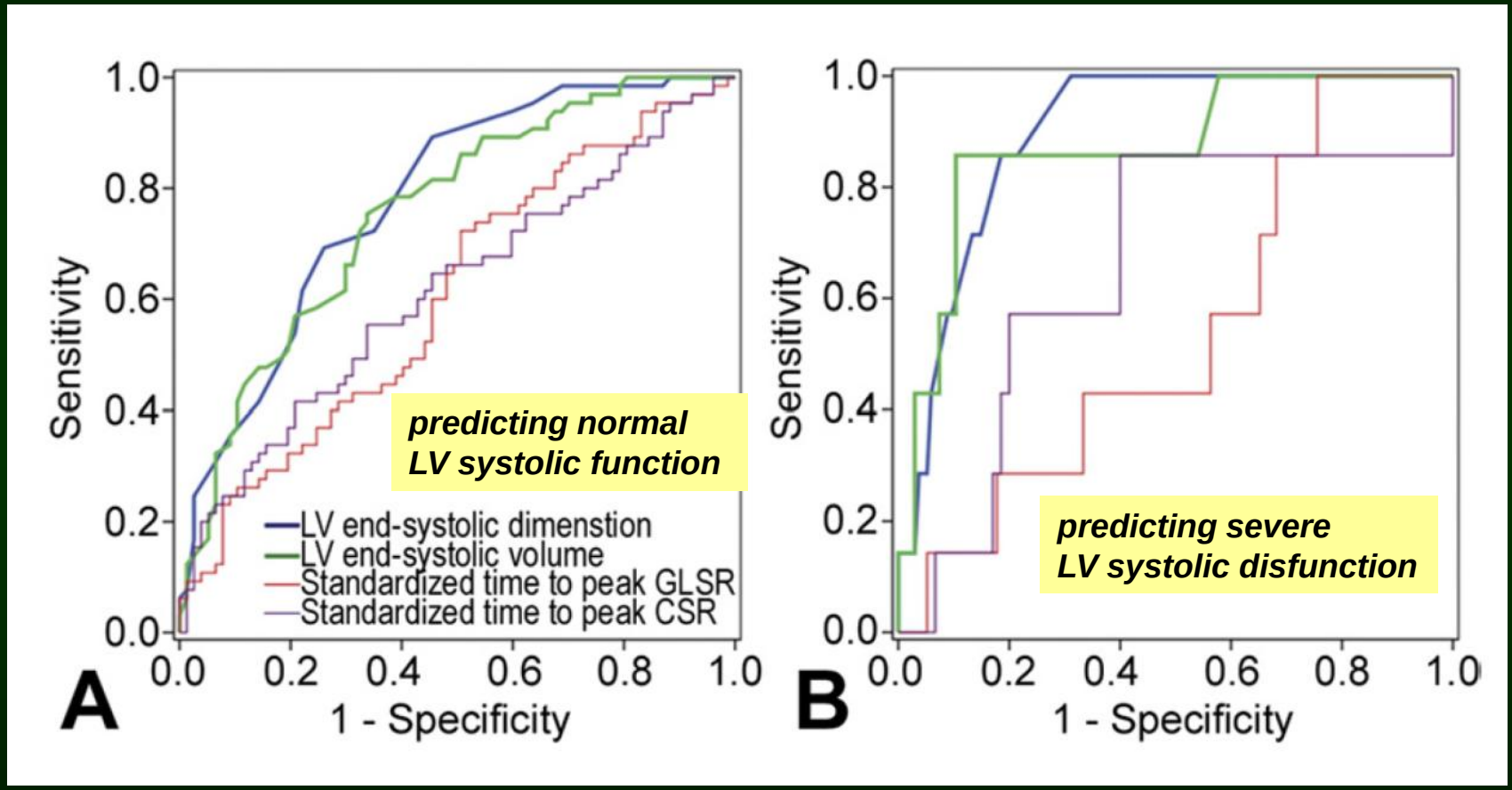
Table I **Baseline clinical and echocardiographic characteristics of the patient population ($n = 233$)**

Age (years)	61 ± 12
Men [*n* (%)]	143 (61)
NYHA class I/II/III/IV [*n* (%)]	82/113/31/7 (35/49/13/3)
Atrial fibrillation [*n* (%)]	73 (31)
Hypertension [*n* (%)]	75 (32)
Diabetes [*n* (%)]	19 (8)
Medical therapy	
ACEI/ARB [*n* (%)]	112 (48)
β-Blockers [*n* (%)]	98 (42)
Diuretics [*n* (%)]	70 (30)
Digoxin [*n* (%)]	19 (8)
Echocardiography	
LV ejection fraction (%)	66 ± 9
LV end-diastolic diameter (mm)	52 ± 6
LV end-systolic diameter (mm)	31 ± 6
LV end-systolic diameter index (mm/m^2)	16 ± 3
LV end-diastolic volume index (mL/m^2)	70 ± 18
LV end-systolic volume index (mL/m^2)	23 ± 8
LV forward ejection fraction (%)	34 ± 8
Right ventricular systolic pressure (mmHg)	44 ± 15
LV global longitudinal strain (%)	−21.8 ± 4.1



Witkowski TG et al Europ Heart J.-Cardiovascular Imaging - (2013)

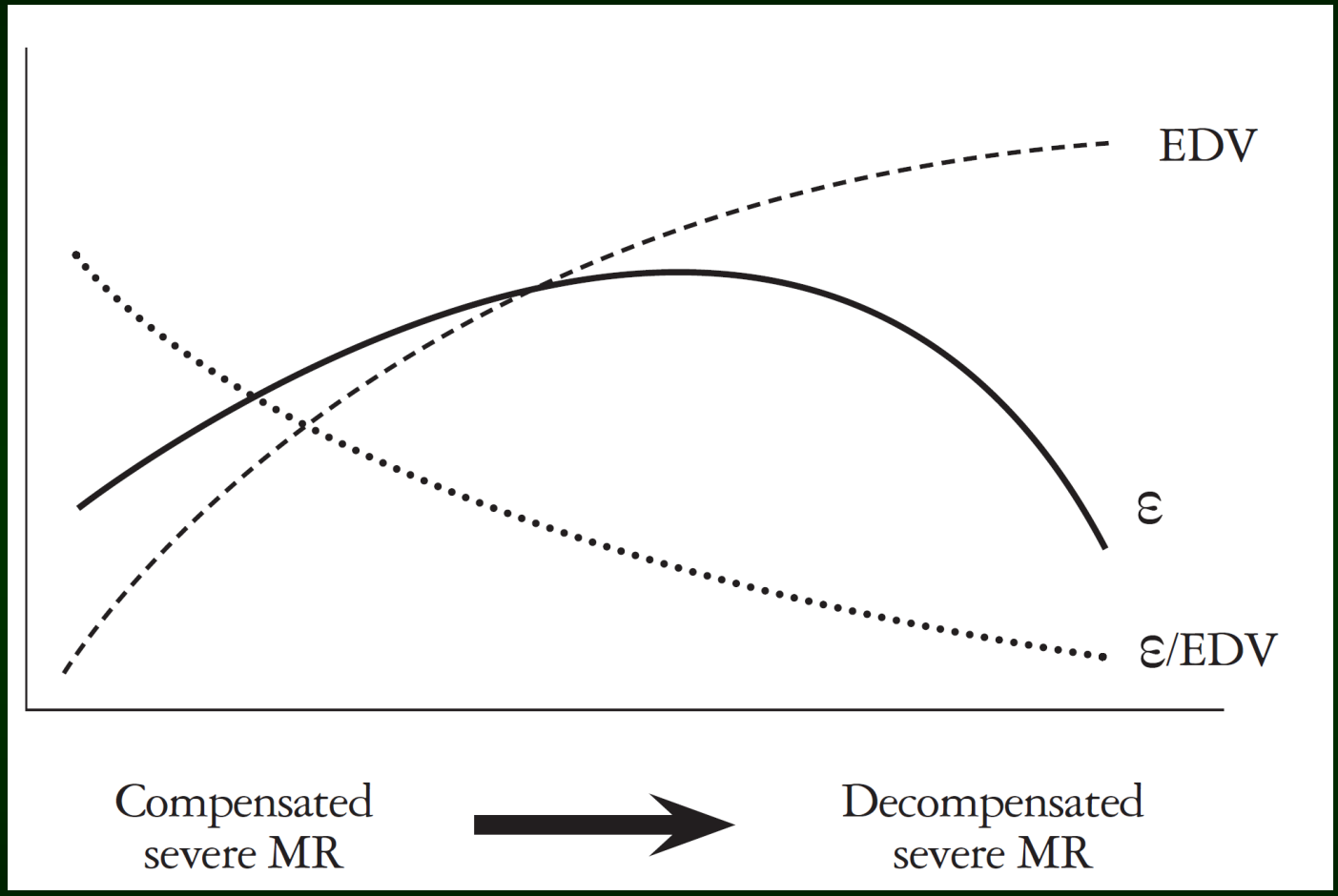
Echocardiographic Predictors of Left Ventricular Function and Clinical Outcomes After Successful Mitral Valve Repair: Conventional Two-Dimensional Versus Speckle-Tracking Parameters



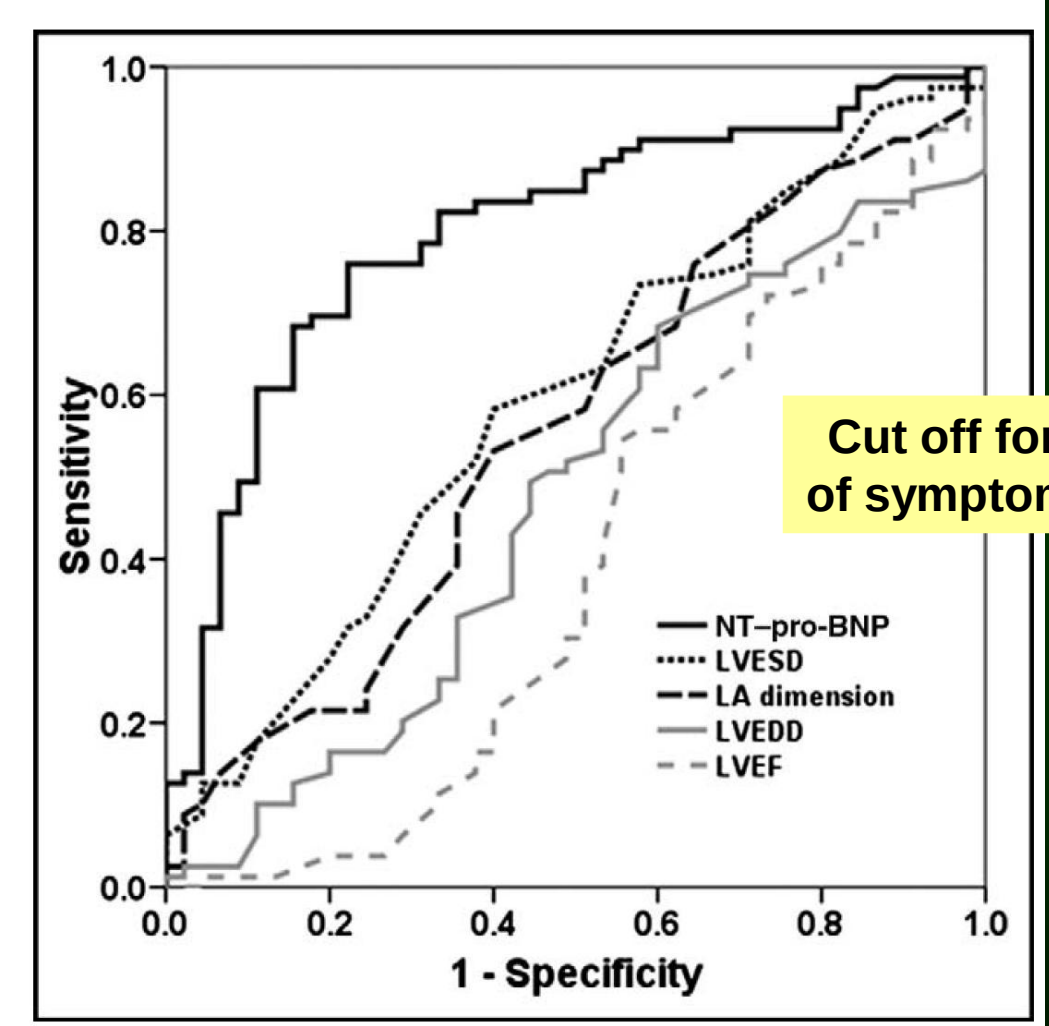
Song J-M et al Ann Thorac Surg 2011

Speckle tracking imaging

- **La necessità di immagini di alta qualità limita l'applicabilità clinica routinaria in tutti i pazienti**
- **Il frame rate ottimale è 50-70 FPS con problemi di undersampling se alta FC o durante stress**
- **Differenti algoritmi di tracking proprietari possono portare a risultati non comparabili**


EDV
ε
ε/EDV
Compensated severe MR
Decompensated severe MR

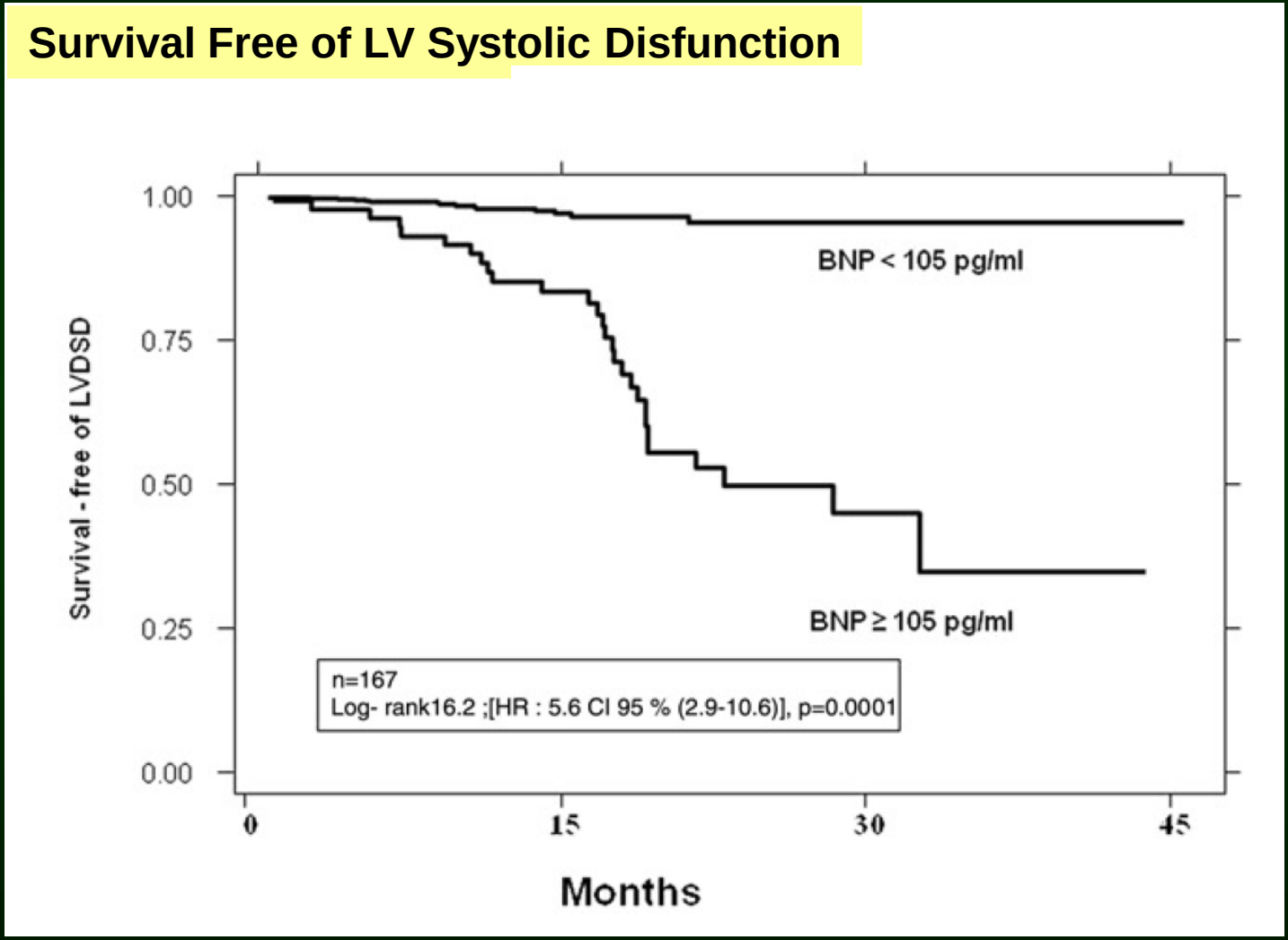
Relation of N-Terminal Pro-B-Type Natriuretic Peptide to Symptoms, Severity, and Left Ventricular Remodeling in Patients With Organic Mitral Regurgitation



Cut off for prediction of symptoms 257 pg/ml

Mihael Potocki et al. Am J Cardiol 2009

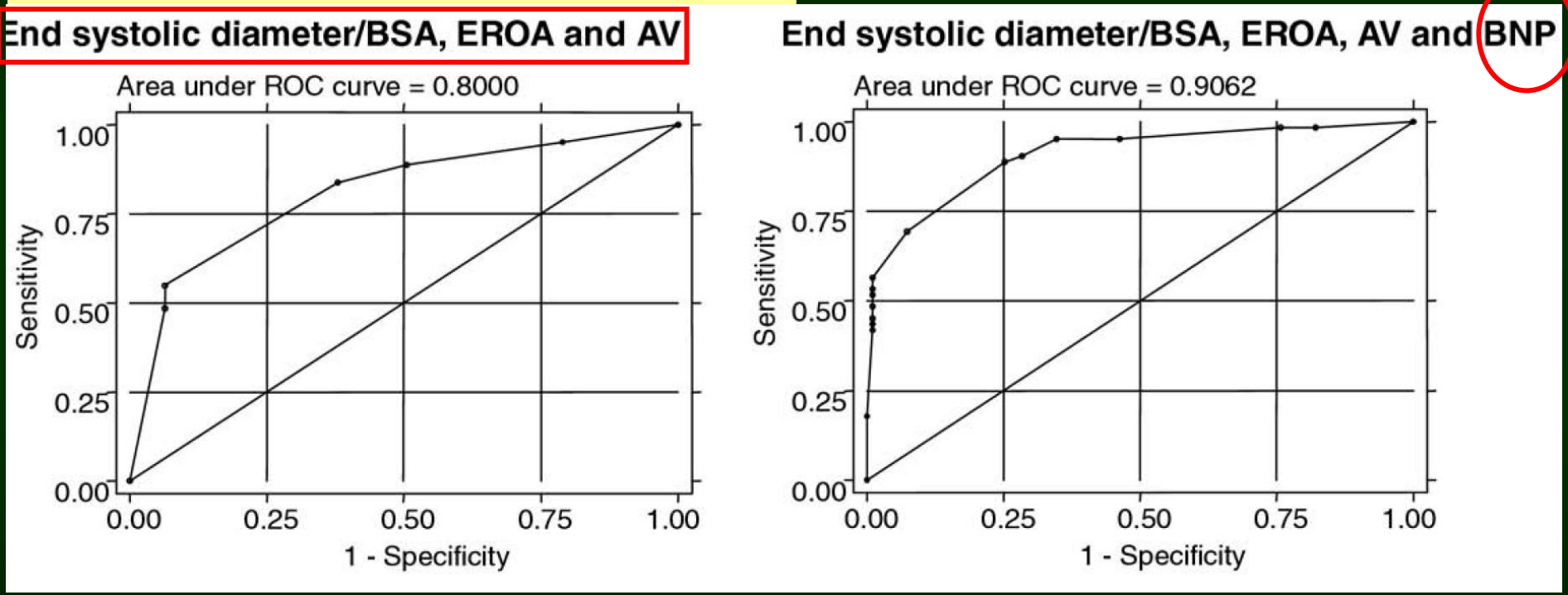
Prospective Validation of the Prognostic Usefulness of Brain Natriuretic Peptide in Asymptomatic Patients With Chronic Severe Mitral Regurgitation



Pizarro R et al. J Am Coll Cardiol 2009

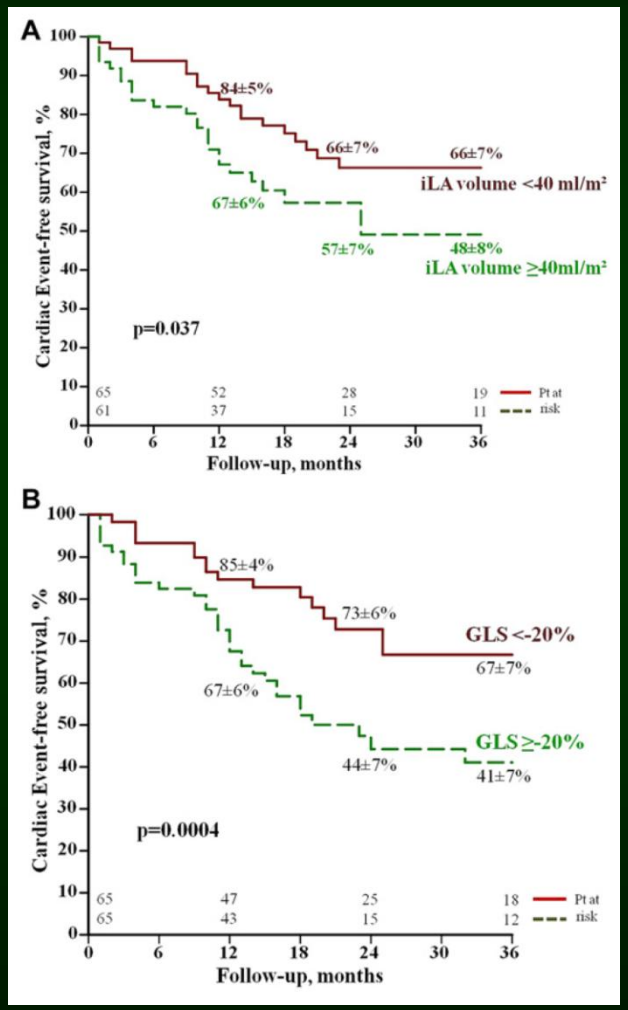
Prospective Validation of the Prognostic Usefulness of Brain Natriuretic Peptide in Asymptomatic Patients With Chronic Severe Mitral Regurgitation

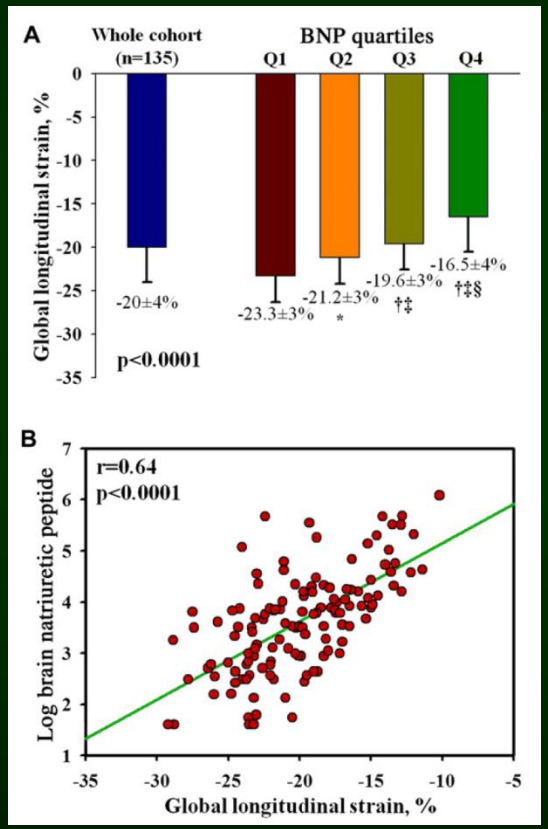
Survival Free of LV Systolic Disfunction

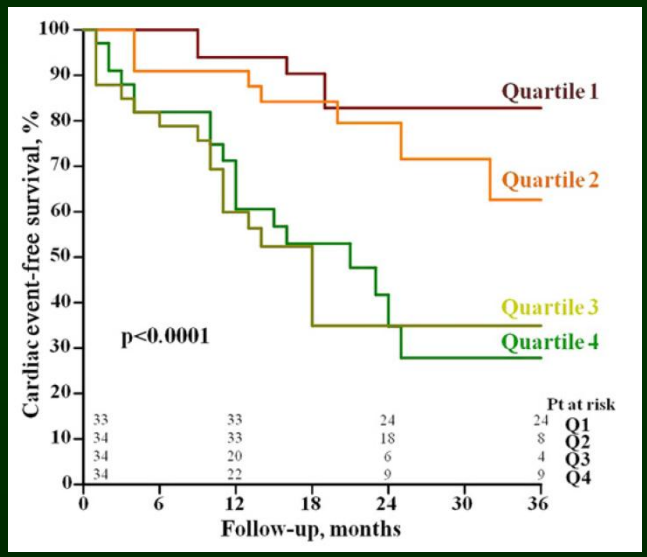


Pizarro R et al. J Am Coll Cardiol 2009

Prognostic importance of brain natriuretic peptide and left ventricular longitudinal function in asymptomatic degenerative mitral regurgitation







Julien Magne et al Heart 2012

Conclusioni

- ✓ **La funzione ventricolare in pazienti con insufficienza mitralica severa può essere efficacemente preservata con l'intervento di riparazione precoce.**
- ✓ **L'ampio spettro delle situazioni cliniche costringe tuttavia spesso ad una attenta valutazione del timing chirurgico**
- ✓ **Non abbiamo un parametro affidabile per definire la disfunzione sistolica ventricolare sn subclinica e quindi è ancora necessaria una attenta valutazione clinico-strumentale poliparametrica**

Association Between Early Surgical Intervention vs Watchful Waiting and Outcomes for Mitral Regurgitation Due to Flail Mitral Valve Leaflets

Table 1. Baseline Characteristics by Treatment Cohort

Characteristic, %	Overall			
	Medical Management (n = 575)	Early Surgery (n = 446)	Total (n = 1021)	*P* Value
Age, mean (SD), y	67 (13)	62 (13)	65 (13)	<.001
Men	72.1	73.0	72.8	.56
Charlson index, mean (SD)	0.9 (1.2)	0.8 (1.1)	0.8 (1.2)	.05
Minimal subjective manifestation	32.5	52.2	41.1	<.001
Ejection fraction, mean (SD), %	68.6 (6)	68.7 (6)	68.7 (6)	.65
Hypertension	37.4	36.5	37.0	.78
Atrial fibrillation	10.0	12.4	11.0	.21
Pulmonary hypertension	11.8	16.8	14.0	.02
Class II indication	19.1	27.1	22.6	.002
Heart rate, mean (SD), beats/min	75 (14)	74 (16)	74 (15)	.28
LVEDD, mean (SD), mm	56.0 (6.1)	57.7 (5.9)	56.7 (6.1)	<.001
LVESD, mean (SD), mm	32.2 (4)	33.5 (4)	32.8 (4)	<.001
LVESD/BSA, mean (SD), mm/m^2	17.6 (2.5)	17.9 (2.6)	17.7 (2.6)	.04
LA diameter, mean (SD), mm	48.0 (8.0)	49.2 (7.6)	48.5 (7.9)	.03
Flail posterior	86.0	87.4	86.6	.52

Suri et al. JAMA. 2013

Association Between Early Surgical Intervention vs Watchful Waiting and Outcomes for Mitral Regurgitation Due to Flail Mitral Valve Leaflets

Of note, in thewatch-
ful waiting group, 339 (59%) underwent subsequent mitral valve surgery at a median of 1.65 years after the initial diagnosis of a flail leaflet.

Otto

The study
group is atypical compared with most patients with chronic
severemitral regurgitation seen in clinical practice

Otto

Suri et al. JAMA. 2013

Global longitudinal strain predicts left ventricular dysfunction after mitral valve repair

Table I **Baseline clinical and echocardiographic characteristics of the patient population ($n = 233$)**

Age (years)	61 ± 12
Men [*n* (%)]	143 (61)
NYHA class I/II/III/IV [*n* (%)]	82/113/31/7 (35/49/13/3)
Atrial fibrillation [*n* (%)]	73 (31)
Hypertension [*n* (%)]	75 (32)
Diabetes [*n* (%)]	19 (8)
Medical therapy	
ACEI/ARB [*n* (%)]	112 (48)
β-Blockers [*n* (%)]	98 (42)
Diuretics [*n* (%)]	70 (30)
Digoxin [*n* (%)]	19 (8)
Echocardiography	
LV ejection fraction (%)	66 ± 9
LV end-diastolic diameter (mm)	52 ± 6
LV end-systolic diameter (mm)	31 ± 6
LV end-systolic diameter index (mm/m^2)	16 ± 3
LV end-diastolic volume index (mL/m^2)	70 ± 18
LV end-systolic volume index (mL/m^2)	23 ± 8
LV forward ejection fraction (%)	34 ± 8
Right ventricular systolic pressure (mmHg)	44 ± 15
LV global longitudinal strain (%)	−21.8 ± 4.1

Witkowski TG et al Europ Heart J.-Cardiovascular Imaging - (2013)

Global longitudinal strain predicts left ventricular dysfunction after mitral valve repair

Table 4 Predictors of LV dysfunction (LVEF <50%) at long-term follow-up after mitral valve corrective surgery: uni- and multi-variate logistic regression analysis

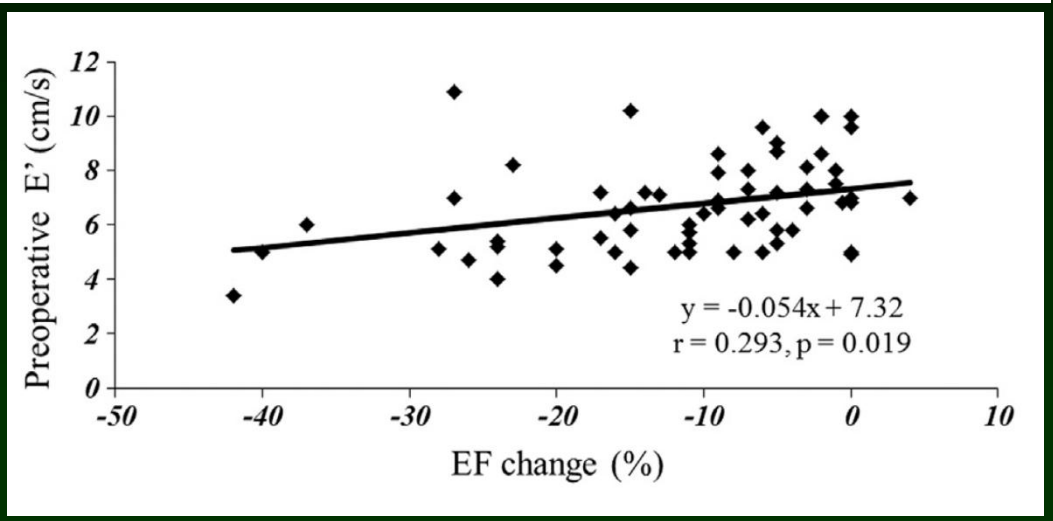
	Univariate analysis				Multivariate analysis		
	χ^2	Odds ratio	95% CI	*P*-value	Odds ratio	95% CI	*P*-value
Atrial fibrillation	4.2	2.29	1.04–5.05	0.039	2.00	0.68–5.95	0.210
Presence of symptoms	5.18	2.91	1.07–7.94	0.037	2.38	0.70–8.14	0.165
LV ejection fraction ≤60%	19.9	6.61	2.90–15.07	<0.001	2.64	0.93–7.48	0.069
LV end-systolic diameter ≥40 mm	21.6	9.58	3.83–23.96	<0.001	6.71	1.91–23.52	0.003
LV global longitudinal strain > −19.9 %	48.9	24.11	7.95–73.05	<0.001	23.16	6.53–82.10	<0.001
						$\chi^2 = 69.1$, $P < 0.001$	

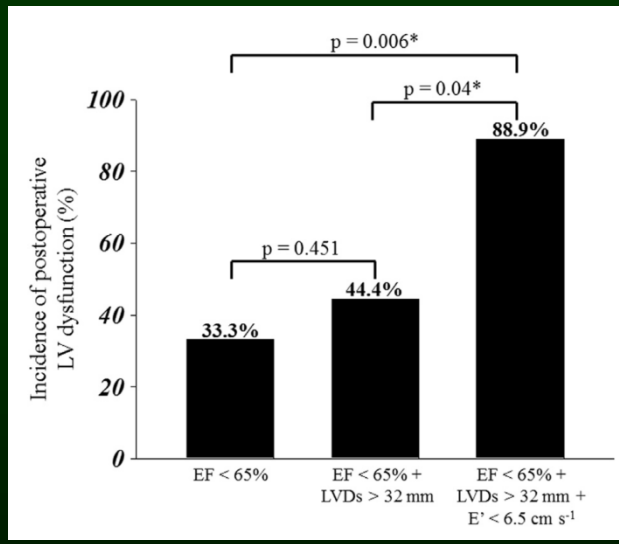
Witkowski TG et al Europ Heart J.-Cardiovascular Imaging - (2013)

Detection of Left Ventricular Dysfunction Using Early Diastolic Mitral Annular Velocity in Patients Undergoing Mitral Valve Repair for Mitral Regurgitation

Table 1. Perioperative Characteristics in Studied Patients

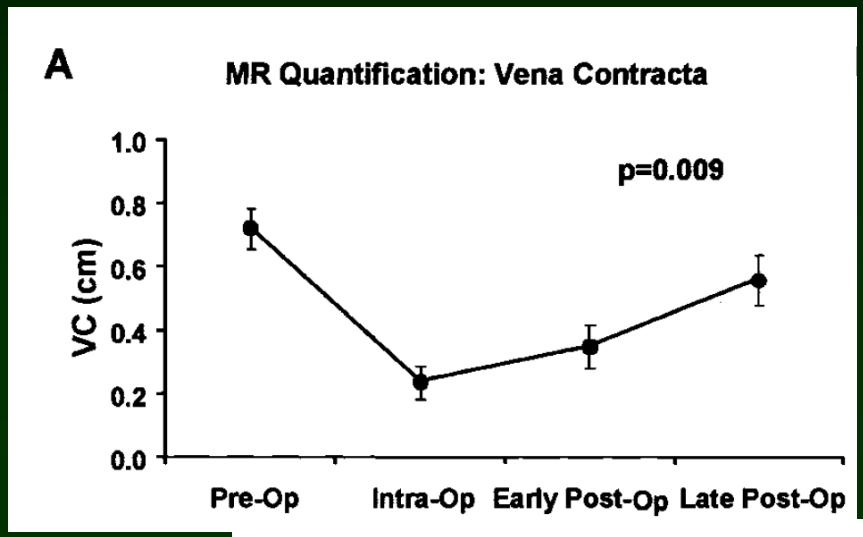
	D group (n = 20)	N group (n = 43)	p Value
Age (yr)	65.3 ± 12.5	65.5 ± 10.9	0.927
Gender (M/F)	13/10	26/14	0.505
Height (cm)	159 ± 11.2	161 ± 9.9	0.458
Body weight (kg)	54.9 ± 15.0	57.8 ± 11.6	0.451
NYHA classification I/II/III/IV	2/11/7/0	12/26/5/0	0.06
Preoperative complication			
Hypertension, n (%)	12 (60)	19 (44)	0.243
Diabetes mellitus, n (%)	1 (5.0)	4 (9.3)	0.556
Atrial fibrillation, n (%)	6 (30)	13 (30)	0.985
Angina, n (%)	1 (5.0)	1 (2.3)	0.573
Echocardiography data			
Preoperative LV EF (%)	64.4 ± 5.8	64.8 ± 4.8	0.775
Prolapse			
Anterior/Posterior leaflet	4/13	7/27	0.835
Both leaflets	3	9	
LV end-diastolic diameter (mm)	58.2 ± 6.8	54.7 ± 7.7	0.09
LV end-systolic diameter (mm)	35.3 ± 8.5	30.7 ± 5.6	0.035*
E (cm/s)	120 ± 37.2	117 ± 37.0	0.755
E′ (cm/s)	5.69 ± 1.67	7.21 ± 1.54	p < 0.001*
E / E′	21.8 ± 7.43	16.9 ± 5.63	0.005*
E-wave deceleration time (ms)	194 ± 58.5	206 ± 38.3	0.438
MR regurgitation volume (mL)	71.8 ± 14.9	65.3 ± 13.2	0.09
Systolic PAP (mmHg)	43.2 ± 14.8	41.3 ± 15.0	0.645
Anesthesia time (min)	342 ± 70.1	350 ± 62.8	0.661
Surgery time (min)	277 ± 62.0	279 ± 54.0	0.924
CPB time (min)	175 ± 42.7	173 ± 38.3	0.841
Cross-clamp time (min)	130 ± 33.1	136 ± 35.1	0.532

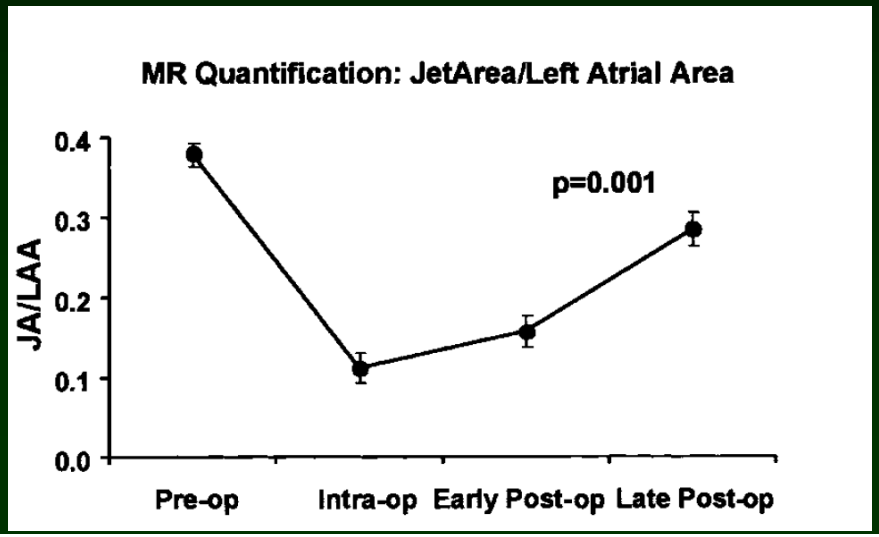


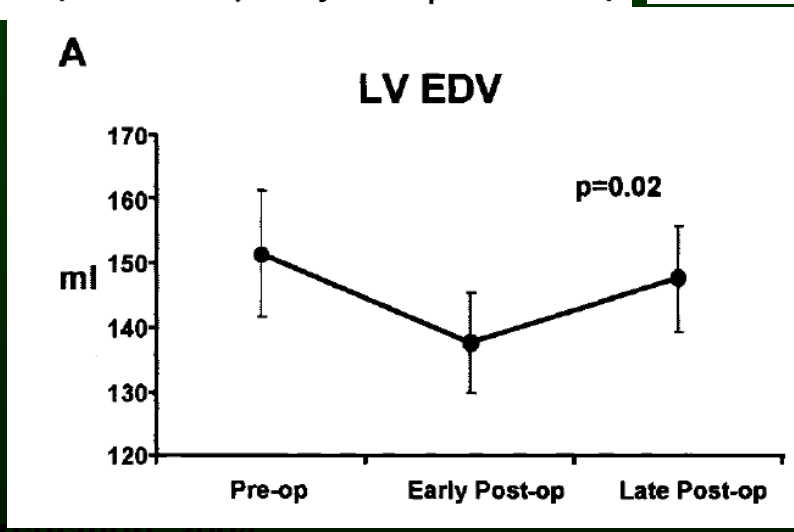


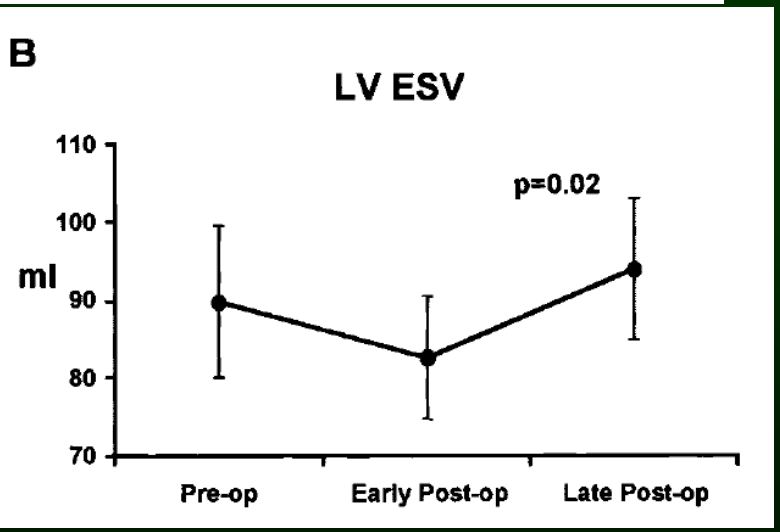
Koichi Suehiro et al. 2014

Mechanism of Recurrent IMR After Annuloplasty



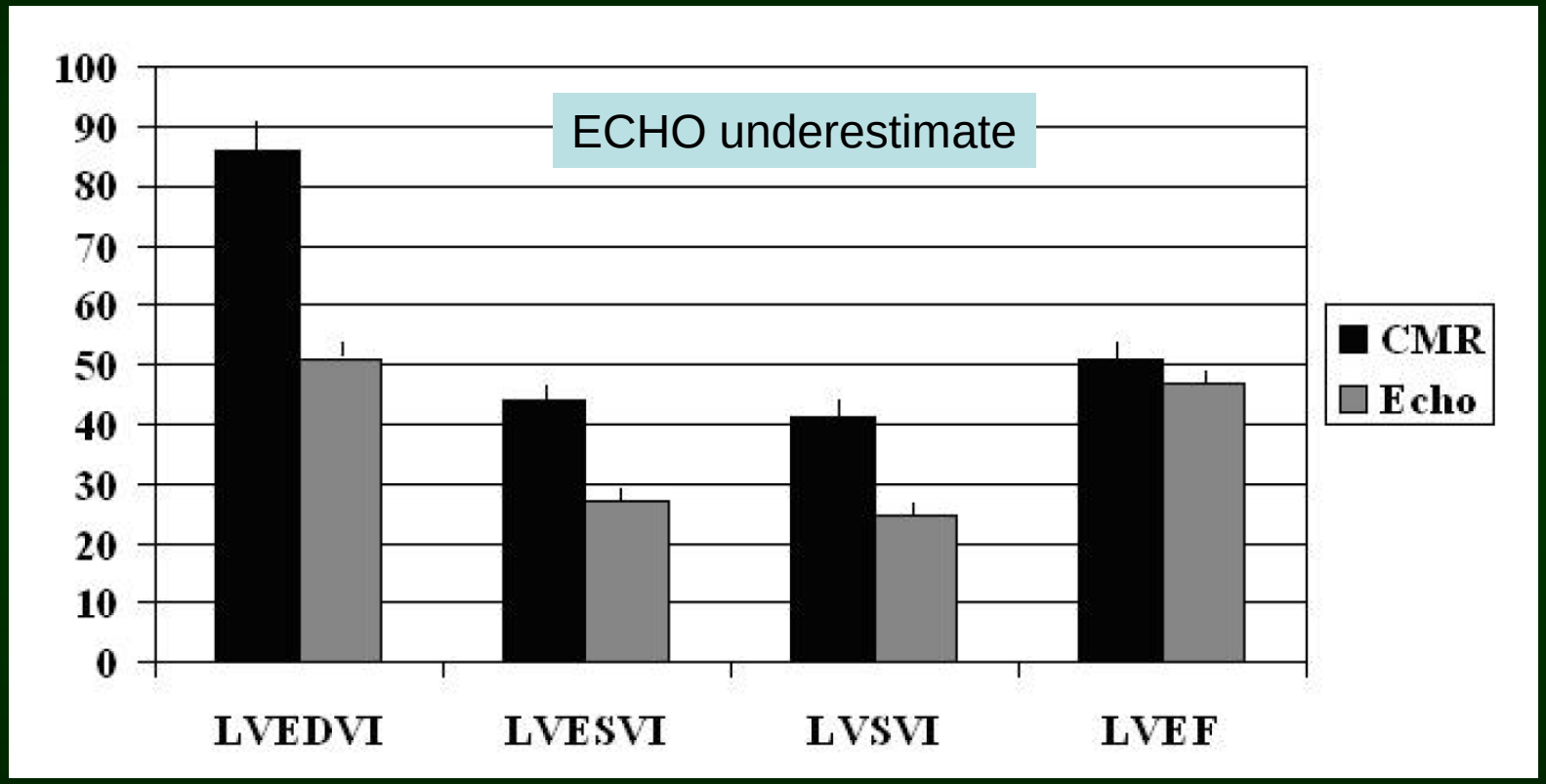






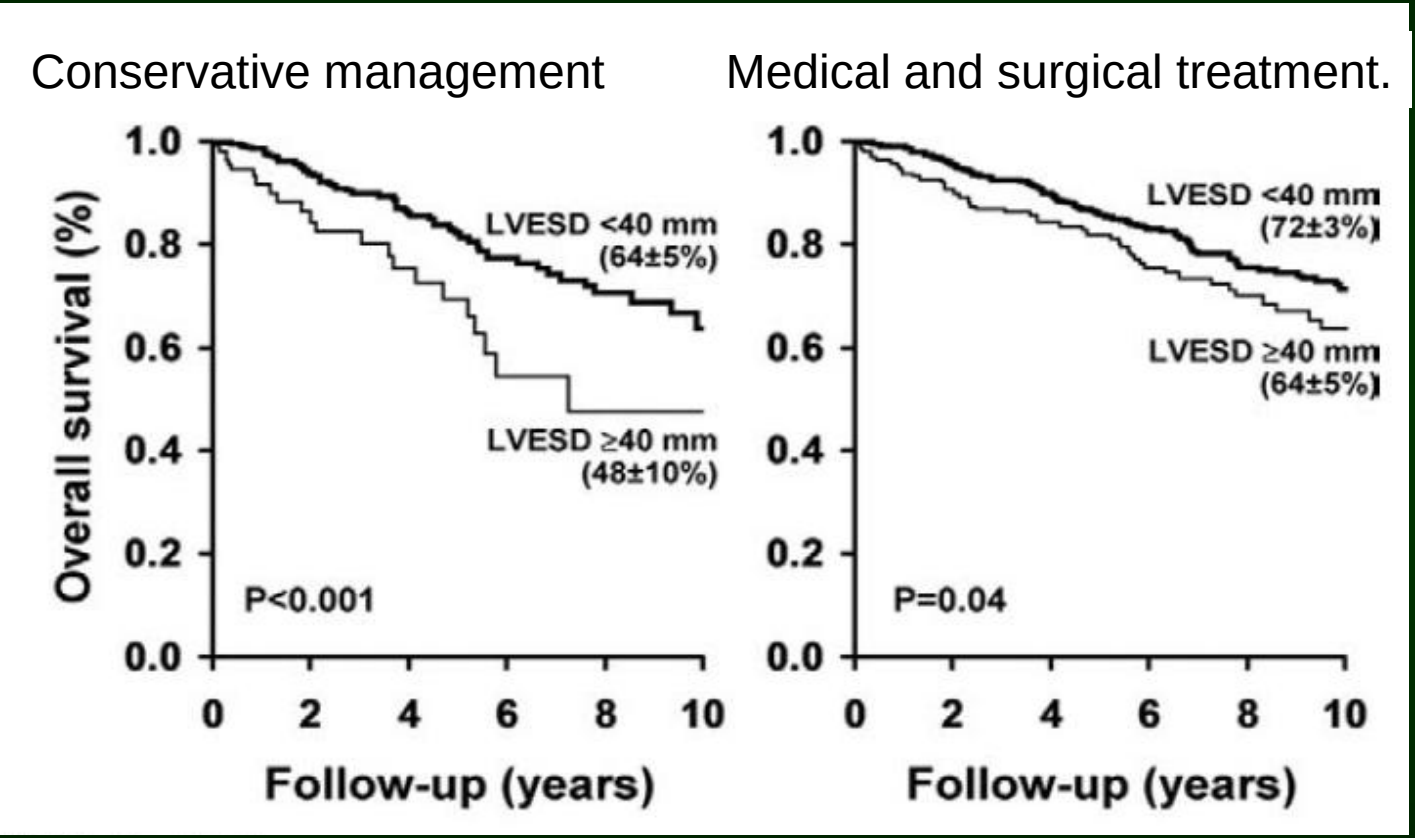
Hung et al Circulation. 2004

Cardiac magnetic resonance versus transthoracic echocardiography for the assessment of cardiac volumes and regional function after myocardial infarction: an intrasubject comparison using simultaneous intrasubject recordings

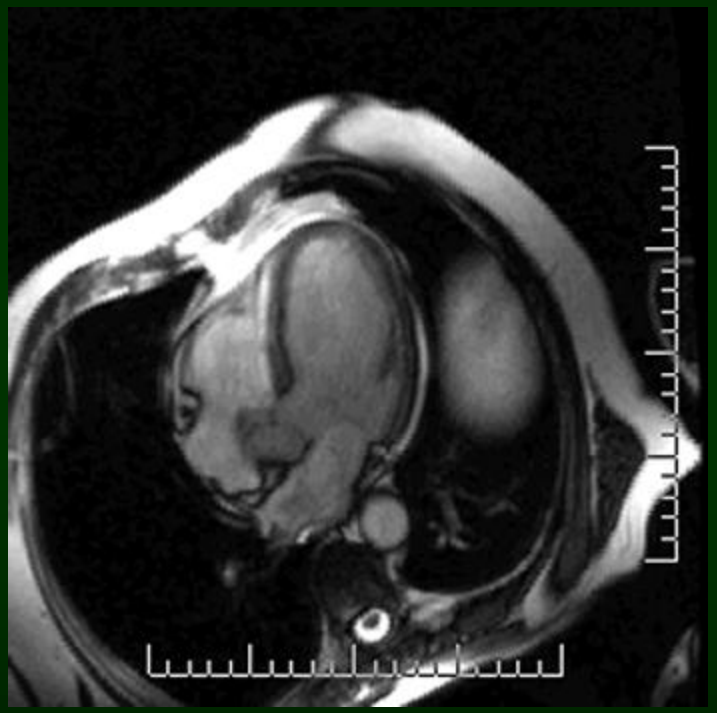


Blake I Gardner *Cardiovascular Ultrasound* 2009,

Survival Implication of Left Ventricular End-Systolic Diameter in Mitral Regurgitation Due to Flail Leaflets



Christophe Tribouilloy et al. J Am Coll Cardiol 2009

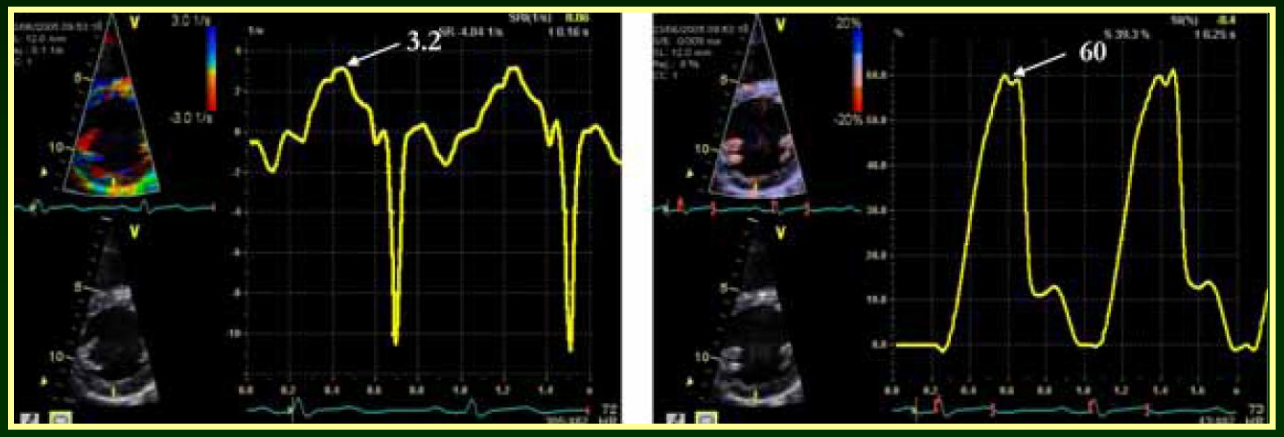


Quantitative assessment of left ventricular volume
and ejection fraction using two-dimensional speckle tracking echocardiography

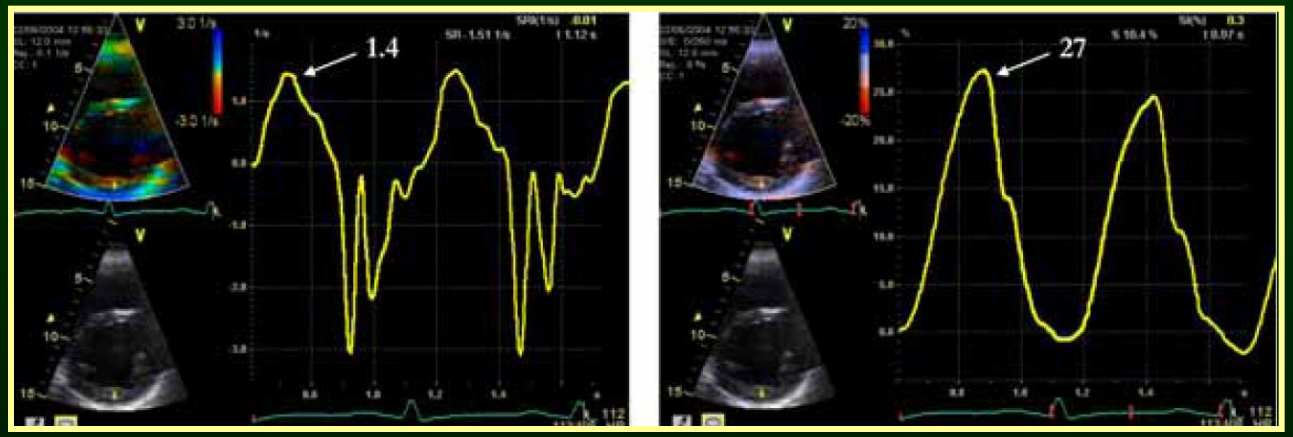
2d speckle tracking mild underestimate volumes and ef but low inter/intra-observer variability

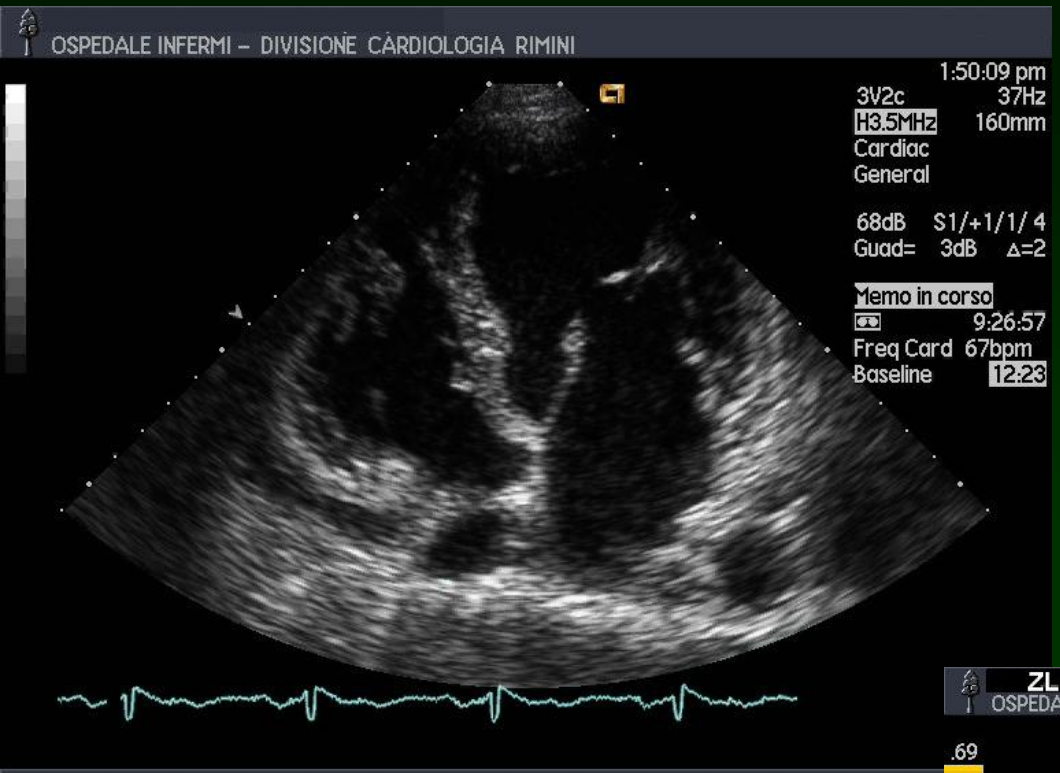
Tomoko Nishikage et al European Journal of Echocardiography (2009)

Normal



Severe MR




OSPEDALE INFERMI – DIVISIONE CARDIOLOGIA RIMINI
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3V2c 37Hz
H3.5MHz 160mm
Cardiac
General
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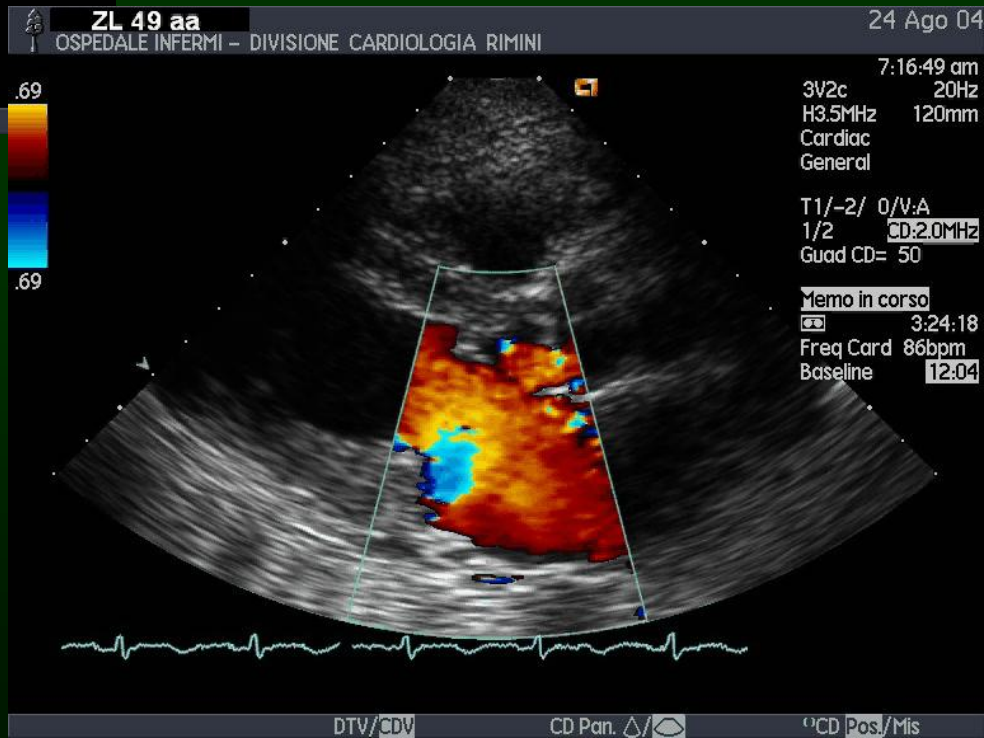
Guad= 3dB Δ=2
Memo in corso
9:26:57
Freq Card 67bpm
Baseline 12:23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OSPEDALE INFERMI – DIVISIONE CARDIOLOGIA RIMINI
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H3.5MHz 120mm
Cardiac
General
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Guad CD= 50
Memo in corso
3:24:18
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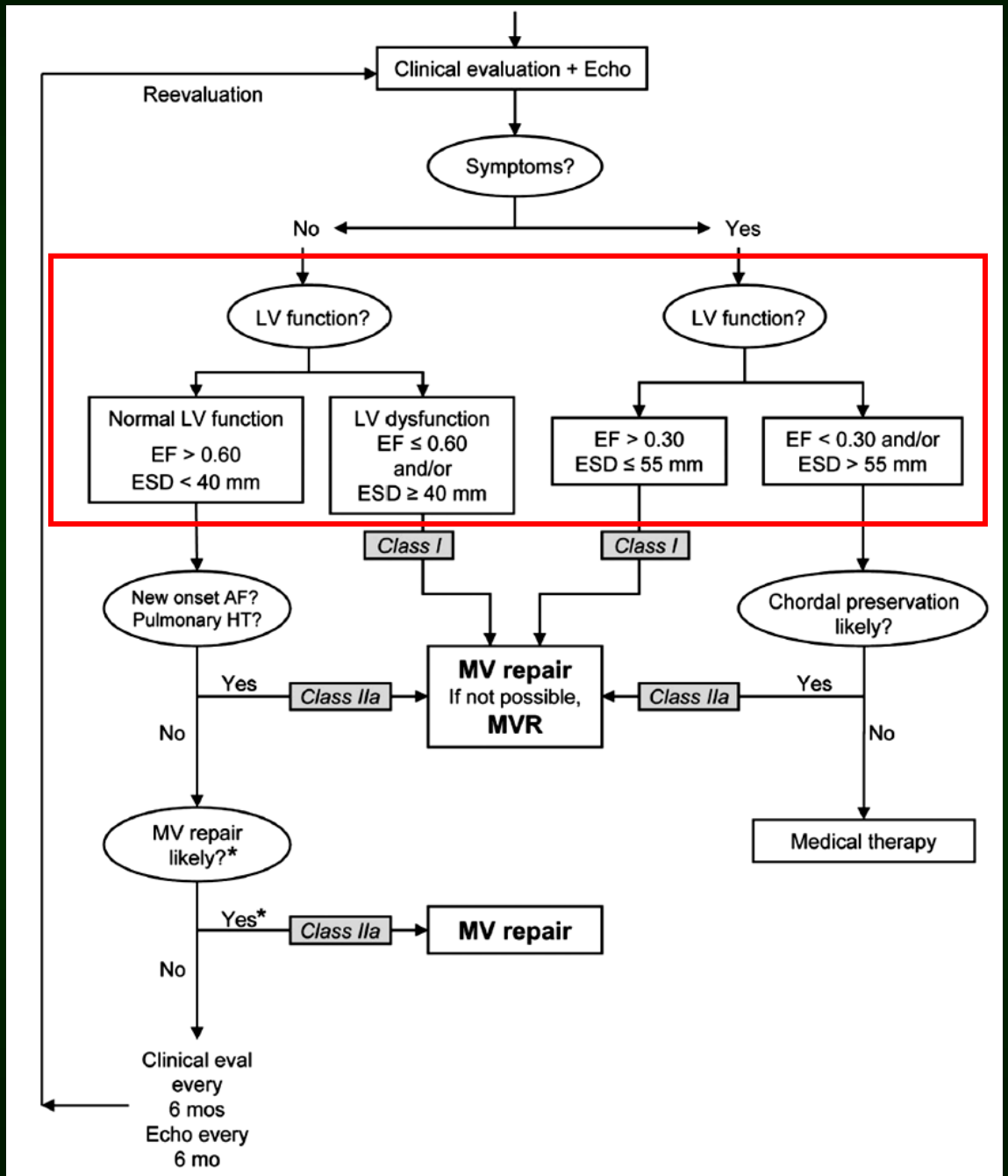
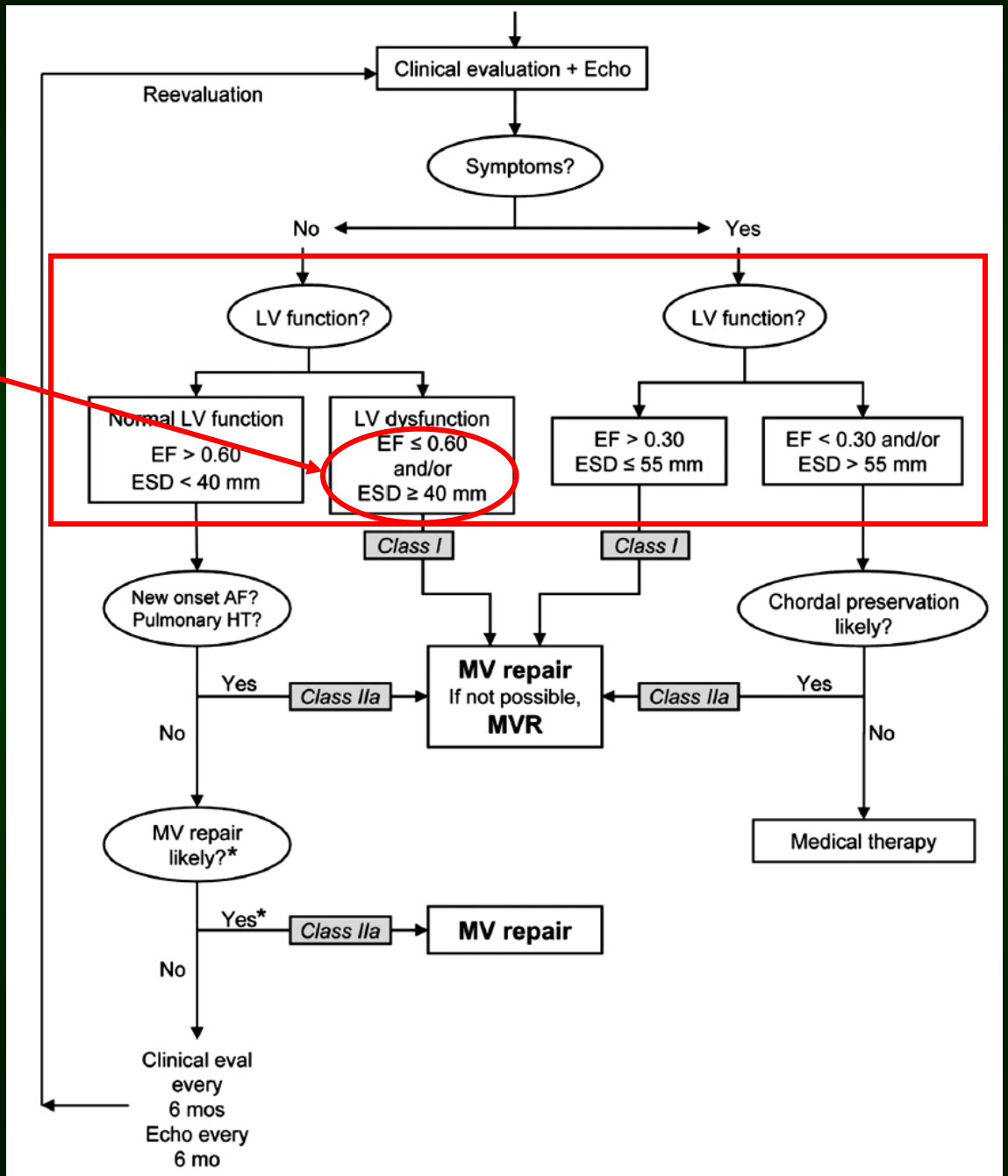
DTV/CDV
CD Pan. △/⬭
CD Pos./Mis

ACC/AHA 2006 Guidelines Chronic severe mitral regurgitation

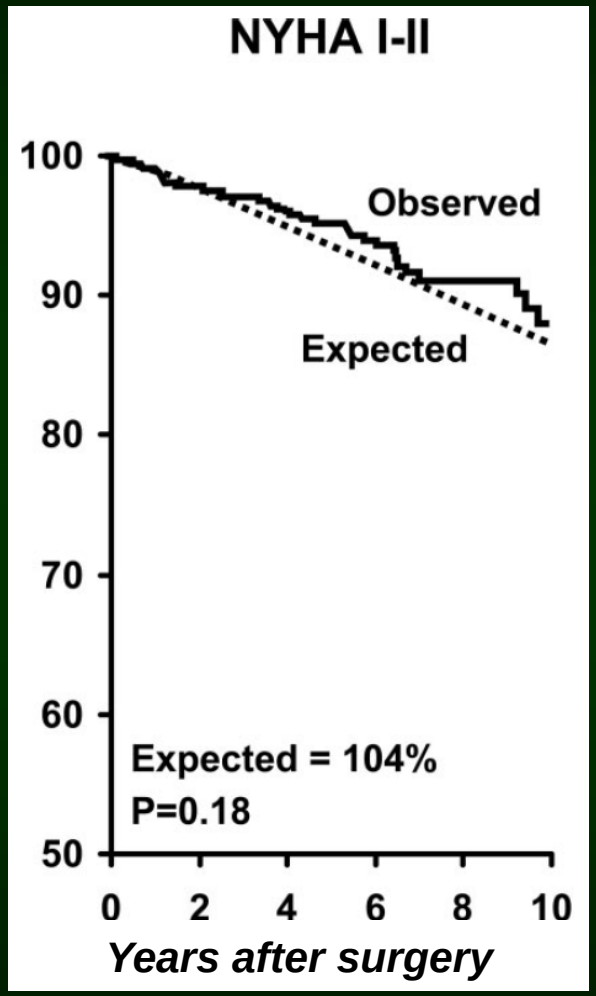


ACC/AHA 2006 Guidelines Chronic severe mitral regurgitation

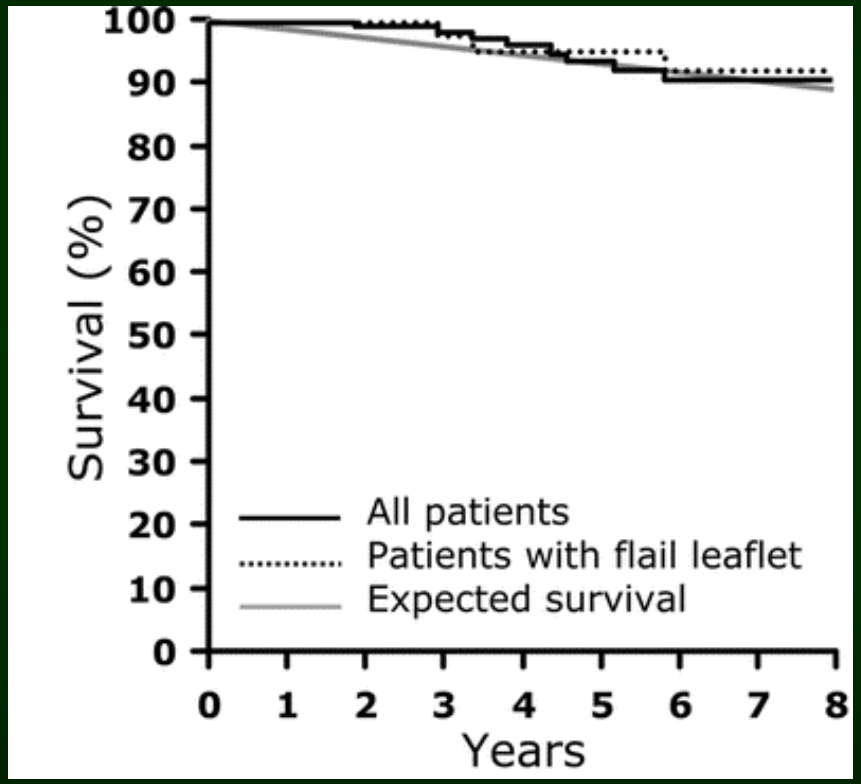
ESC 45 mm



Survival in asymptomatic patients with organic severe mitral regurgitation



Enriquez-Sarano M et al. Circulation 1994



Rosenhek R et al. Circulation 2006

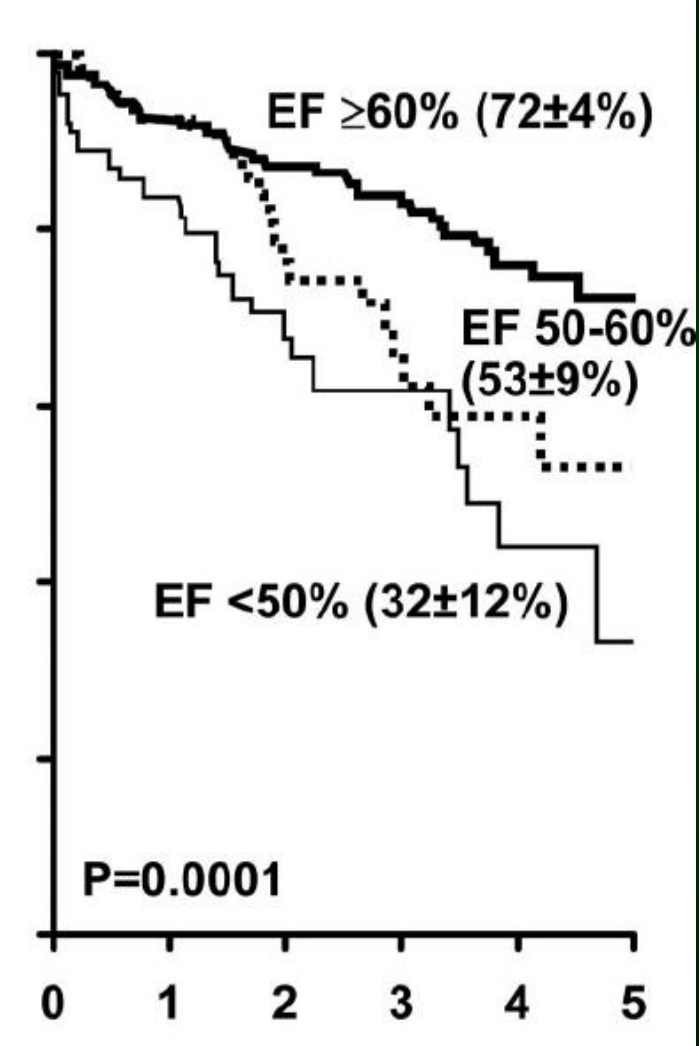
Outcomes in Mitral Regurgitation Due to Flail Leaflets
A Multicenter European Study

Sottogruppo di 102 pazienti asintomatici con normale funzione sistolica del ventricolo sn
Follow up 5 anni

✓ Sopravvivenza	97%
✓ Fibrillazione atriale	4.0%
✓ Scompenso	5.7%

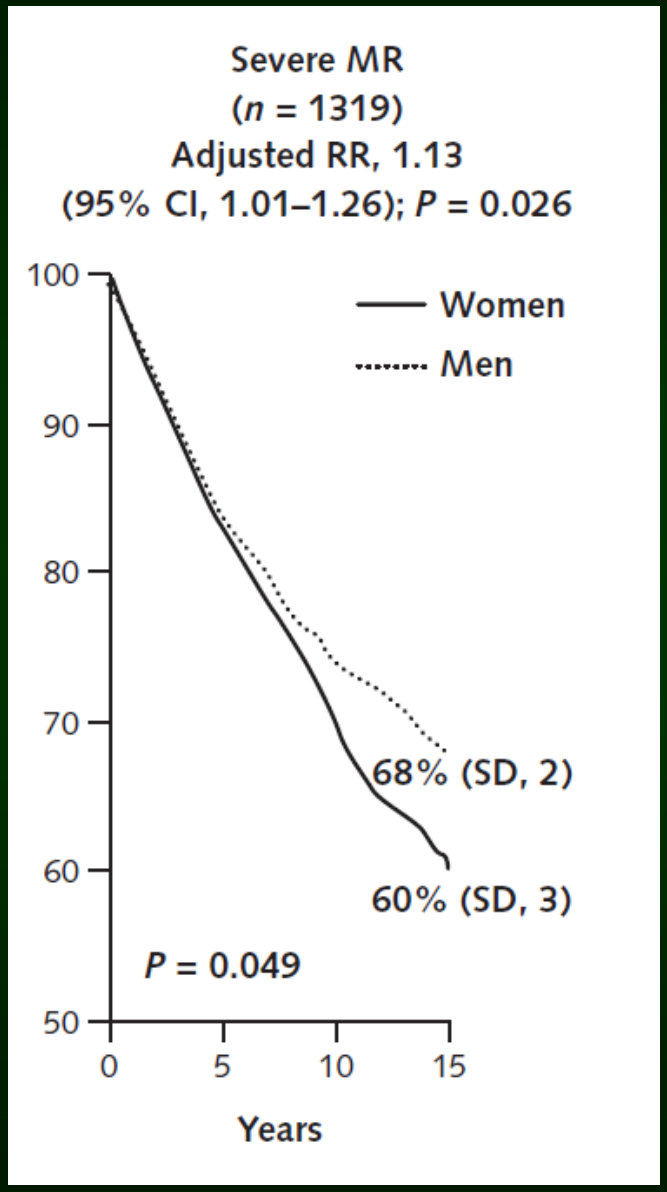
Grigioni F. et al. J Am Coll Cardiol Img 2008

Echocardiographic prediction of survival after surgical correction of organic mitral regurgitation



Enriquez-Sarano M et al. Circulation 1994

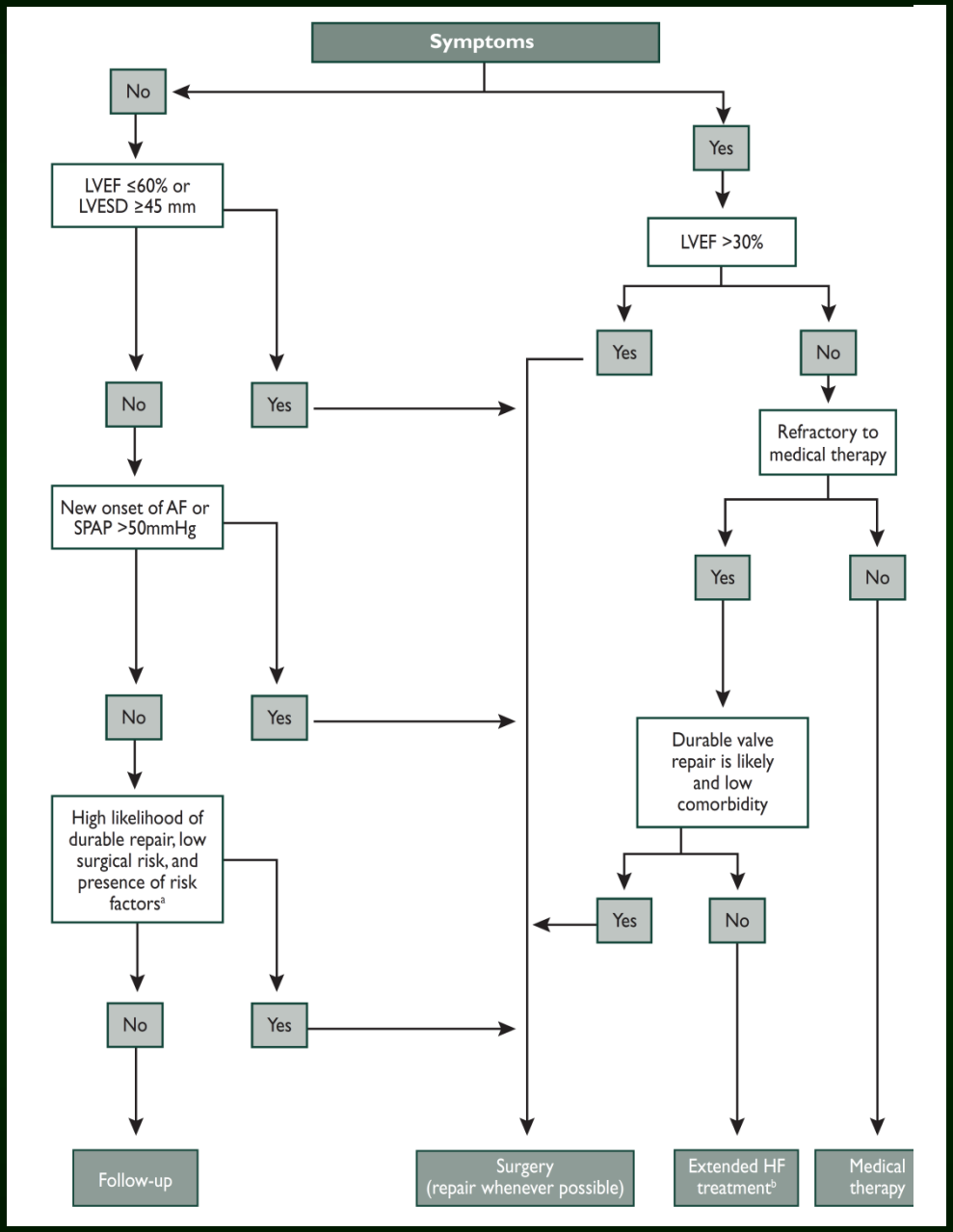
Sex Differences in Morphology and Outcomes of Mitral Valve Prolapse



Avierinos JF et al. Ann Intern Med. 2008

EUROPEAN SOCIETY OF CARDIOLOGY®

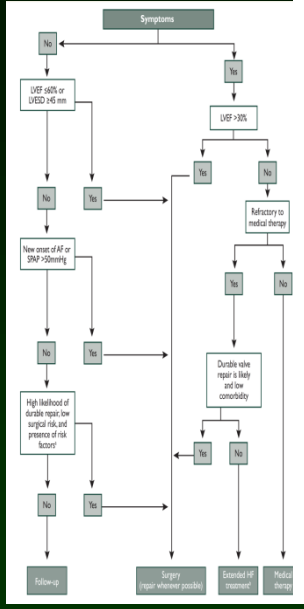
2012



EUROPEAN SOCIETY OF CARDIOLOGY®

2012

When there is a high likelihood of durable valve repair at a low risk, valve repair should be considered (IIaC) in patients with flail leaflet and LVESD ≥40 mm; valve repair may be considered (IIbC) if one of the following is present: LA volume ≥60 mL/m² BSA and sinus rhythm or pulmonary hypertension on exercise (SPAP ≥60 mmHg).



Surgery should be considered in asymptomatic patients with preserved LV function, high likelihood of durable repair, low surgical risk and flail leaflet and LVESD ≥40 mm.	IIa	C

Intervento precoce

Argomenti a favore

- In pazienti con IM organica severa l'intervento è quasi sempre inevitabile
- Le indicazioni in classe I sono gravate da pessimo outcome
- La riparazione della valvola è oggi possibile nei paesi occidentali nella maggioranza dei pazienti
- I markers tradizionali (sintomi e funzione ventricolare sn) sono poco sensibili.

Argomenti contro

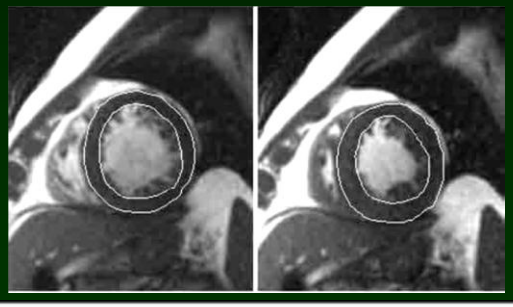
- La chirurgia non è inevitabile, almeno nel medio termine
- La predizione di riparabilità è imperfetta
- La mortalità e morbidità perioperatoria è bassa ma non assente
- La riparazione non ha sempre un risultato permanente
- Pittfalls nella gradazione di severità del rigurgito

L'Ecocardiogramma bidimensionale ha una ripetibilità limitata ?

Misurazioni ripetute possono differire per la scarsa qualità delle immagini,a problemi legati ai calcoli volumetrici, alla esecuzione di proiezioni off-axis con taglio della porzione apicale del ventricolo sn ed a variazioni nel carico emodinamico.

La "visual estimation" della frazione di eiezione, molto utilizzata, è utile nella singola determinazione ma non è sufficientemente ripetibile per un utilizzo sequenziale.

Effect of Endocardial Trabeculae on Left Ventricular Measurements and Measurement Reproducibility at Cardiovascular MRI



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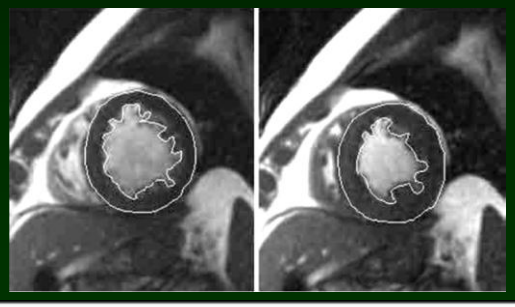

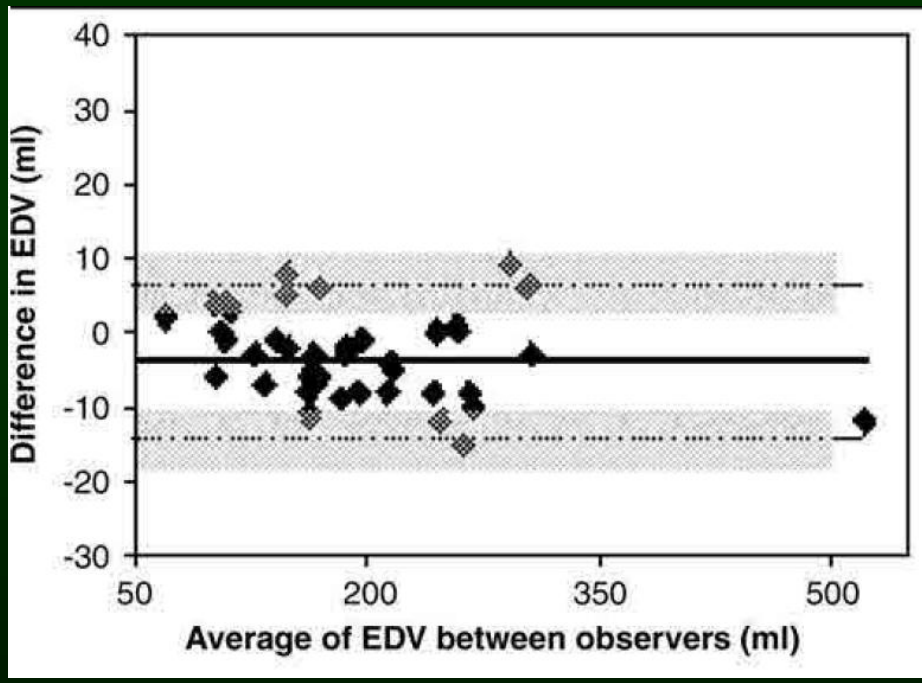

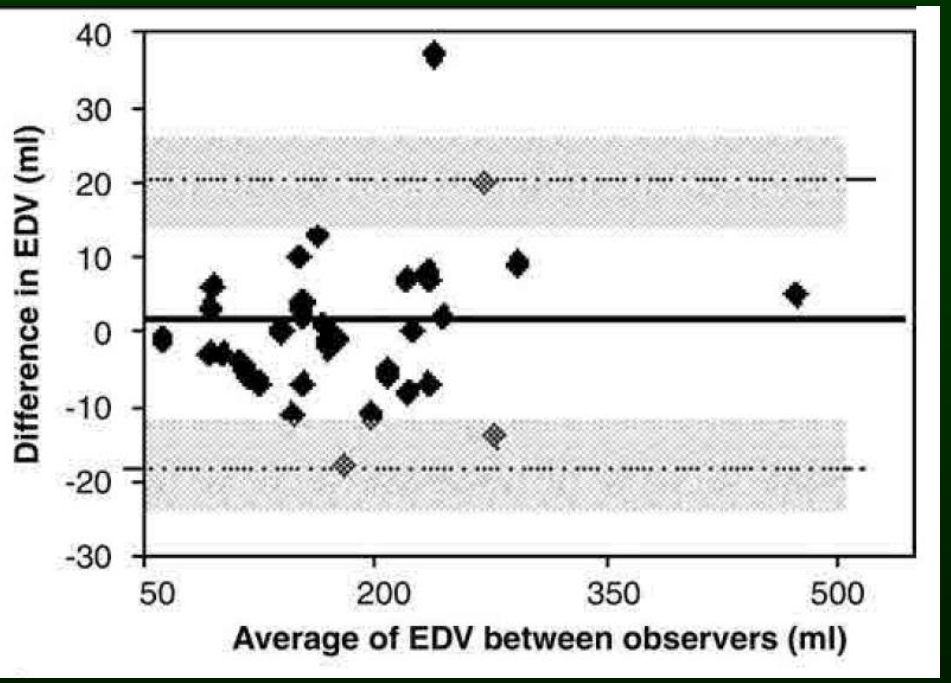

Theano Papavassiliu et al. Radiology 2005

Reproducibility and Accuracy of Echocardiographic Measurements of Left Ventricular Parameters Using Real-Time Three-Dimensional Echocardiography

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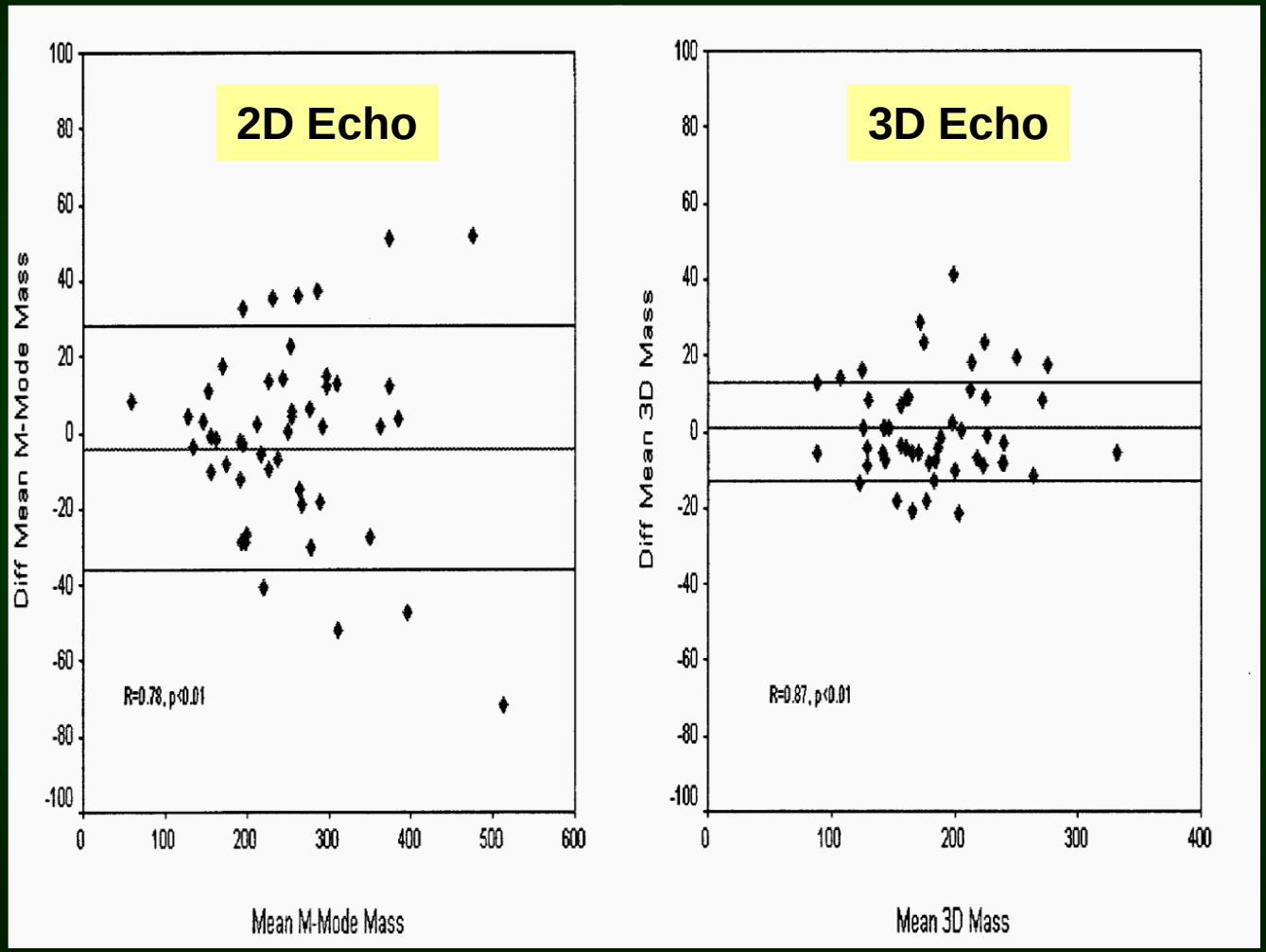

Jenkins C et al. J Am Coll Cardiol 2004

Reproducibility and Accuracy of Echocardiographic Measurements of Left Ventricular Parameters Using Real-Time Three-Dimensional Echocardiography

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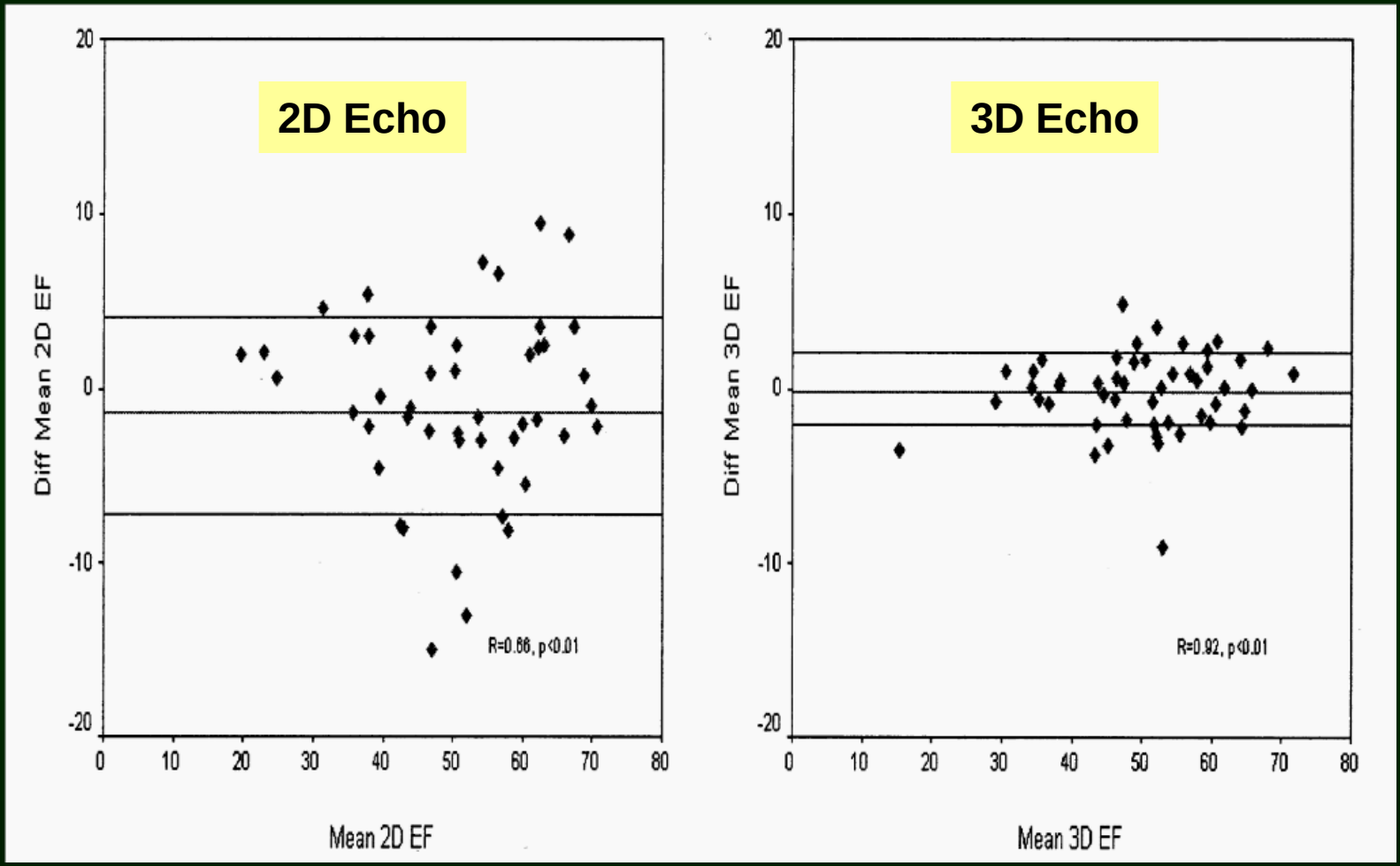
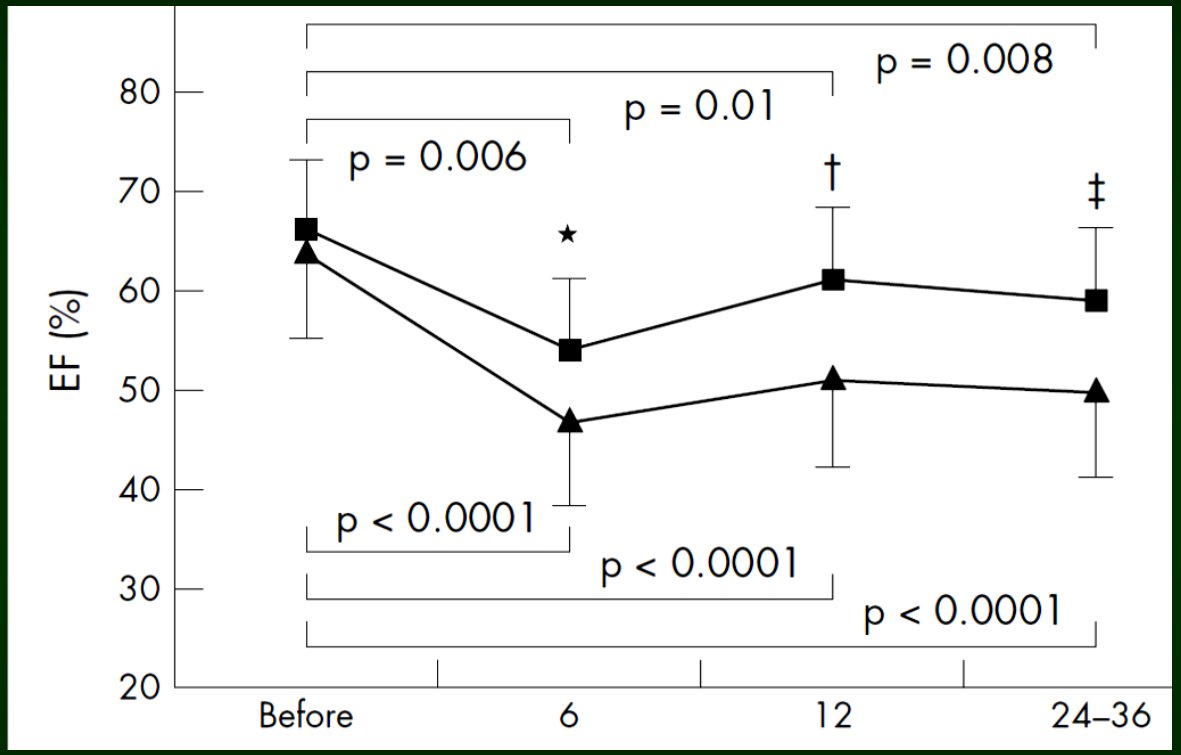


Jenkins C et al. J Am Coll Cardiol 2004

Detecting subclinical (latent) LV dysfunction in the asymptomatic patient

LV d*p*/d*t* (from CW Doppler of MR jet)	Technically difficult to measure
LV end-systolic wall stress/end-systolic volume	Invasive (incur risk to patient)
LV peak elastance	Invasive (incur risk to patient)

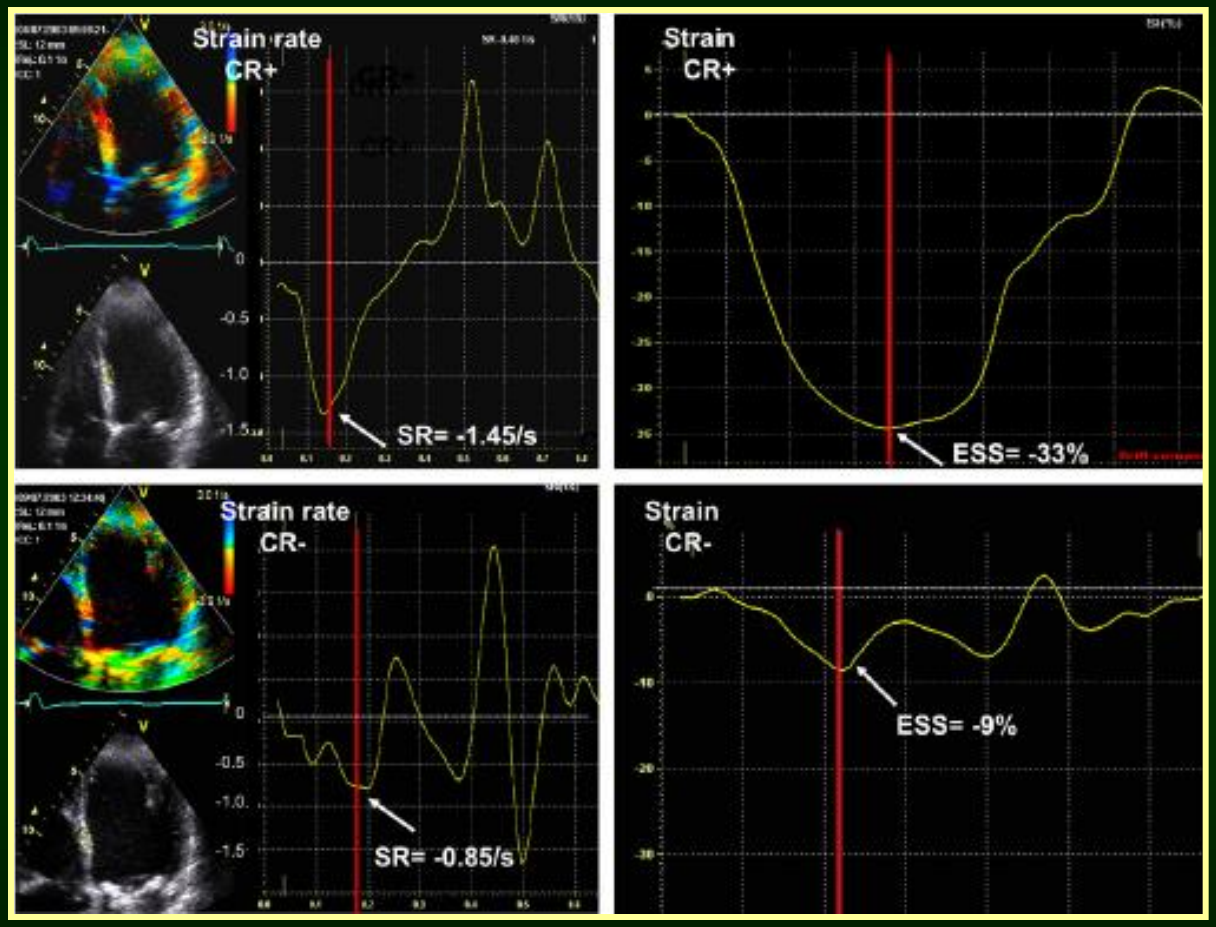
Functional and prognostic implications of left ventricular contractile reserve in patients with asymptomatic severe mitral regurgitation



Surgically treated

R Lee et al. Heart 2005

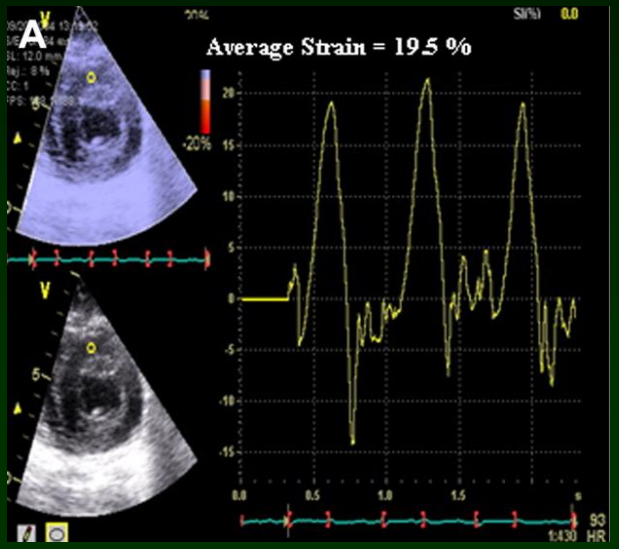
Prediction of subclinical left ventricular dysfunction with strain rate imaging in patients with asymptomatic severe mitral regurgitation

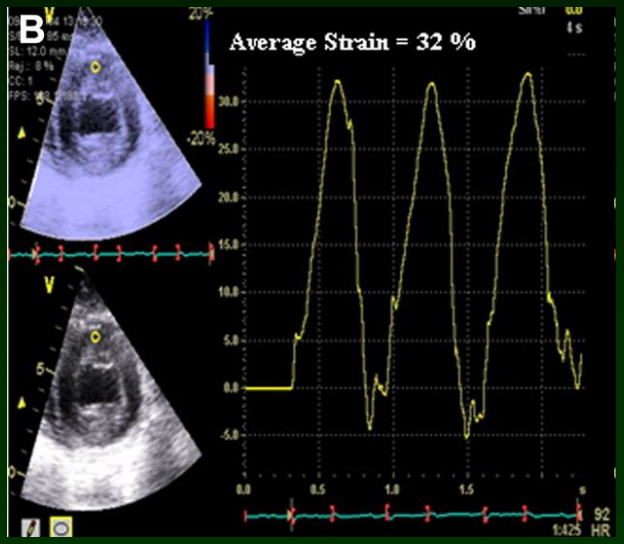


Lee R et al. Am J Cardiol 2004

Progressive nature of chronic mitral regurgitation and the role of tissue Doppler-derived indexes

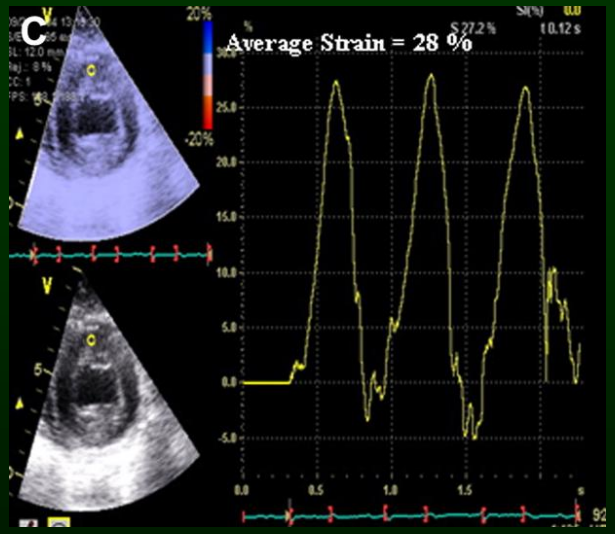
Pre

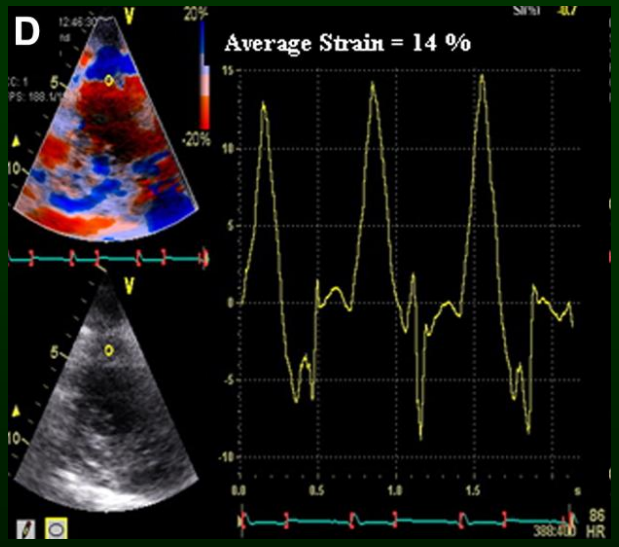




Post

1 month

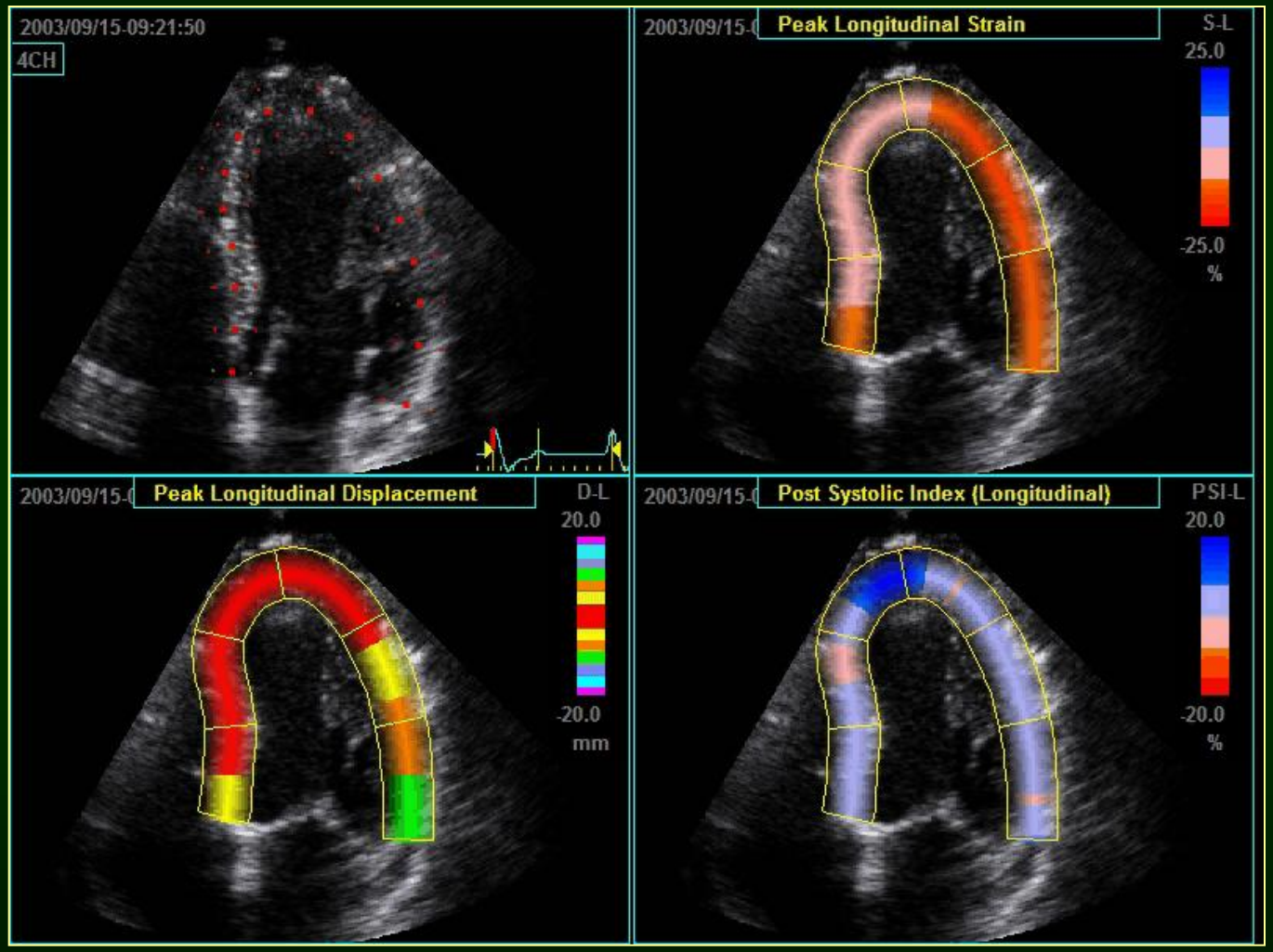




2 month

Tomas G. Neilan Am J Physiol Heart Circ Physiol 2008

Speckle tracking imaging



A Randomized Controlled Phase IIb Trial of β_1-Receptor Blockade for Chronic Degenerative Mitral Regurgitation

This randomized trial demonstrates that the administration of beta1-receptor blockade in patients with chronic degenerative mitral regurgitation improves left ventricular (LV) function over a 2-year follow-up. Those are preliminary results that require confirmation by a large multicenter study. Nevertheless, those data are important for several reasons:

1) They confirm that, in presence of mitral regurgitation (MR), there is an increased reflex sympathetic activity that progressively leads to myocardial damage and that this increased catecholamine state can be effectively counteracted pharmacologically, with beneficial clinical effects.
2) Particularly in asymptomatic patients with severe chronic degenerative MR, the assessment of this adrenergic overactivation could become a marker of risk for poor outcome once it is not anymore effectively controlled by a specific medical therapy as the one used in this study. This might suggest the opportunity for prompt surgical referral before more advanced myocardial damage occurs.

Mustafa I Ahmed et al J Am Coll Cardiol. 2012

A Randomized Controlled Phase IIb Trial of β_1-Receptor Blockade for Chronic Degenerative Mitral Regurgitation

Variable Mean (SD) or count (% N)	Placebo	Toprol	p-value
Total Patients (N)	19	19	
Sex (Female)	9 (47%)	11 (58%)	0.7459
Race (Caucasian)	19 (100%)	16 (84%)	0.2297
Age, years	56(9.2)	52.9* (9.1)	0.3101
Systolic Blood Pressure, mm Hg	121 (14)	125 (14)	0.3859
Diastolic Blood Pressure, mm Hg	75 (11)	75 (8)	0.8905
Heart rate, beats/min	67 (12)	66 (11)	0.8238
NYHA Functional class I	17 (90%)	18 (95%)	~1
MRI variables			
LVEDV/BSA, ml/m^2	92 (17)	96 (20)	0.4964
LVED Mass/LVEDV, gm/ml	0.61 (0.13)	0.61 (0.12)	0.9720
LVED Radius/Wall Thickness	4.76 (0.92)	4.69 (0.92)	0.8001
LVEF, %	63 (5)	62 (6)	0.7820
LVESV/BSA, ml/m^2	34 (7)	36 (8)	0.4258
Peak Systolic Longitudinal Strain Rate, %/sec	88 (27)	83 (29)	0.5619
Peak Early Filling Rate, EDV/sec*	2.27 (0.61)	2.12 (0.57)	0.4139

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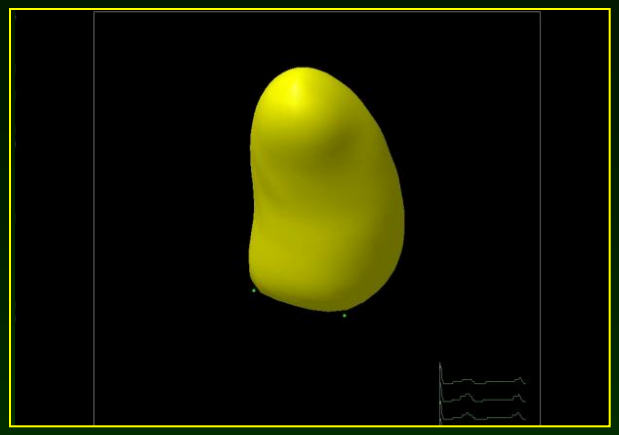
Mustafa I Ahmed et al J Am Coll Cardiol 2012

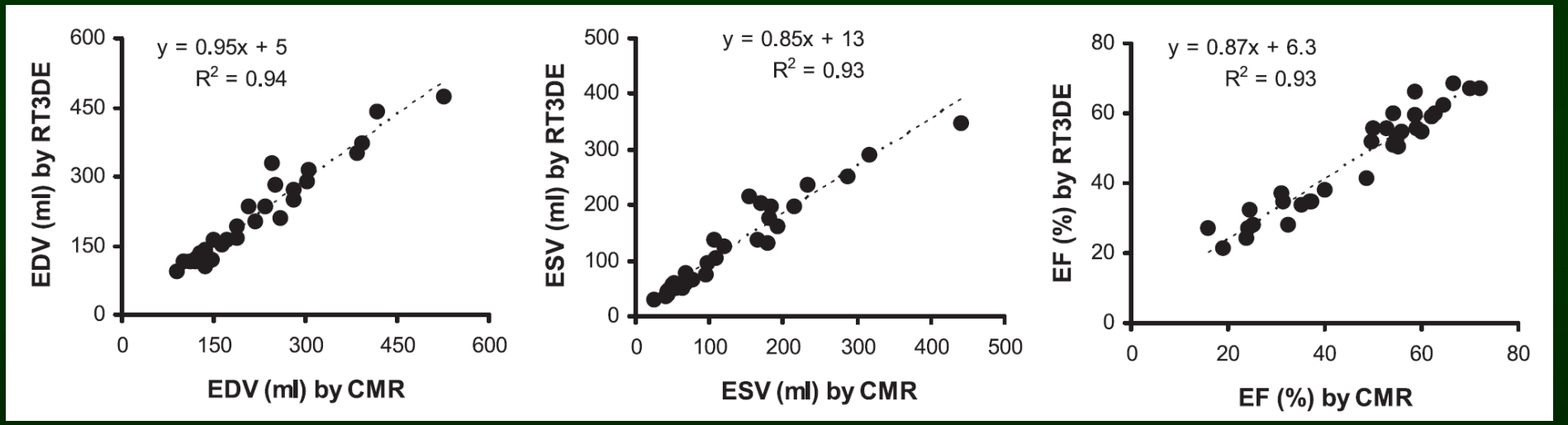
Conclusioni

- ✓ **La funzione sistolica del ventricolo sinistro è il maggiore determinante della sopravvivenza dei pazienti con insufficienza mitralica organica severa**
- ✓ **I limiti ecocardiografici utilizzati per l'indicazione chirurgica sono attualmente sottoposti a rivalutazione critica**
- ✓ **Sono in corso ricerche per la validazione di parametri indicativi di disfunzione sistolica latente**



Side-by-Side Comparison of Real-Time 3D Echocardiography With MRI Reference

?



Lissa Sugeng Circulation. 2006

Magnetic Resonance Imaging With 3-Dimensional Analysis of Left Ventricular Remodeling in Isolated Mitral Regurgitation: Implications Beyond Dimensions

?

It is important
to note that even in patients with MRI-derived LVEF60% beforeMVrepair, directional changes after surgery remained the same (Table I and Figures I–III in the online-only Data Supplement). The decrease in LVEF and LV maximum strain from preoperative to postoperative values persisted in patients with MRI-derived LVEF 60% before MV repair (Table I and Figure III in the online-only Data Supplement). We have recently reported the finding of excessive cardiomyocyte oxidative stress, myofibrillar degeneration, and lipofuscin accumulation, which collectively may result in irreversible cardiomyocyte dysfunction in patients with preoperative LVEF 60%.6 Taken together, the presence of adverse LV remodeling before MV surgery is associated with decreased maximal shortening 1 year after surgery.

Schiros et al. Circulation 2012

Chronic Mitral Regurgitation: A Pilot Study to Assess Preoperative Left Ventricular Contractile Function Using Speckle-Tracking Echocardiography

Variable	Group 1 (postoperative LVEF decrease < 10%)	Group 2 (postoperative LVEF decrease > 10%)	*P*
n	23 (60.5%)	15 (39.4%)	
Mean age (y)	62.9 ± 10.8	57.0 ± 10.4	.1
Men (%)	8 (34.8%)	6 (40%)	.74
LA diameter (cm)	5.4 ± 0.8	5.7 ± 1.8	.41
IVS (cm)	1.1 ± 0.18	1.0 ± 0.26	.66
Posterior wall (cm)	0.97 ± 0.16	0.97 ± 0.24	.97
EDV (3D) (mL)	87. 6 ± 35.4	122.8 ± 55.9	.023
ESV (3D) (mL)	32.5 ± 15.2	48.3 ± 28.2	.032
LVEF (3D)	62.5 ± 7.9	61.7 ± 9	.77
ERO (cm^2)	0.38 ± 0.15	0.53 ± 0.33	.06
Etiology			
Degenerative	7 (30.4%)	8 (53.3%)	
Rheumatic	15 (65.2%)	6 (40.0%)	.31
Endocarditis	1 (4.3%)	1 (6.7%)	
LV dP/dt	1626 ± 661	1191 ± 387	.028
PASP (mm Hg)	50.3 ± 14.6	46.8 ± 18.0	.51
Atrial fibrillation	18 (78%)	10 (66%)	.42
Bioprosthesis	4 (17.4%)	0 (0%)	.08

EDV, End-diastolic volume; *ESV*, end-systolic volume; *LA*, left atrial; *PASP*, pulmonary artery systolic pressure.

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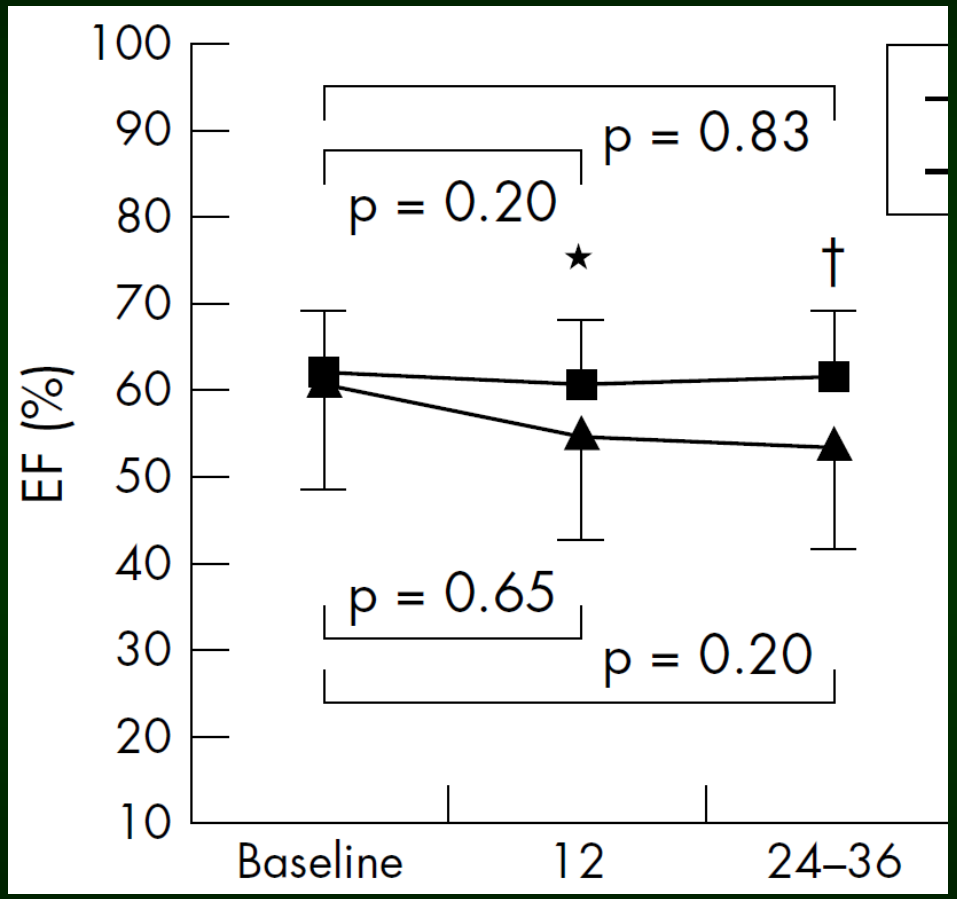
De Isla PL et al. J Am Soc Echocardiogr 2009

Functional and prognostic implications of left ventricular contractile reserve in patients with asymptomatic severe mitral regurgitation

Post-exercise
EF increment of > 4%

⇩

Contractile reserve +



Medically treated

R Lee et al. Heart 2005

Prognostic importance of brain natriuretic peptide and left ventricular longitudinal function in asymptomatic degenerative mitral regurgitation

Table 2 Echocardiographic data

Variables	Whole cohort (n=135)	BNP <40 pg/ml (n=67, 50%)	BNP ≥40 pg/ml (n=68, 50%)	p Value
LV dimensions				
LVES diameter, mm	34±6	33±6	34±6	0.30
LVED diameter, mm	55±3	55±9	54.5±9	0.71
iLVES diameter, mm/m^2	18±3	18±3	19±3	0.18
iLVED diameter, mm/m^2	30±5	30±5	30±4	0.98
LVES volume, ml	121±46	121±43	120±48	0.86
LVED volume, ml	39±17	38±14	40±19	0.62
iLVES volume, ml	65±23	65±21	65±26	0.91
iLVED volume, ml	21±9	21.6±10	20.5±7.5	0.46
LV systolic function				
LV stroke volume, ml	74±19	74.5±20	73±19	0.60
LV cardiac output, l/min	5.5±1.7	5.6±1.8	5.3±1.6	0.38
LV ejection fraction, %	69±6	69±6	68±5	0.18
LV global longitudinal strain, %	−20±4	−22±3	−18±3	<0.0001
LV diastolic function				
E-wave velocity, m/s	1.08±0.3	1.03±0.3	1.13±0.3	0.10
E/A ratio	1.5±0.6	1.6±0.5	1.5±0.7	0.94
E/Ea ratio	13.8±5	12.9±4.6	14.8±6	0.049
Deceleration time, ms	186±41	175±28	197±49	0.0045
LA dimensions				
LA volume, ml	79±31	68±23	89±34	0.0001
iLA volume, ml/m^2	43±17	37±13	48±18	0.0001
MR severity				
Effective regurgitant orifice area, mm^2	43±23	42±18	44±26	0.58
Regurgitant volume, ml	71±30	69±25	72±34	0.64
Systolic pulmonary arterial pressure, mm Hg	39±9	37±9	41±9	0.03

Julien Magne et al Heart 2012