Advanced Evaluation of Left Ventricular Function in Degenerative MR

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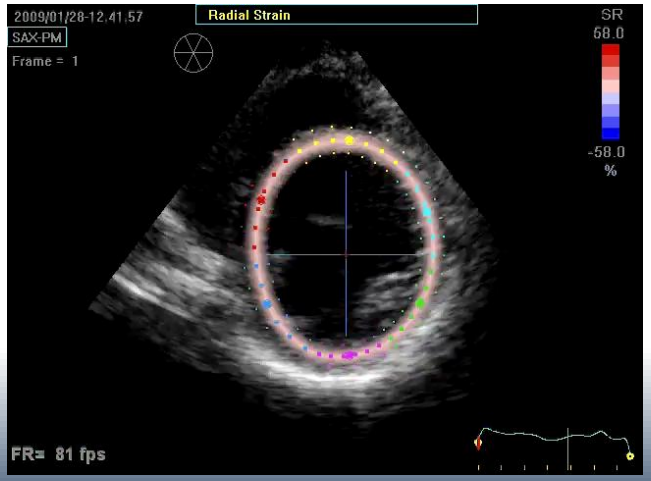
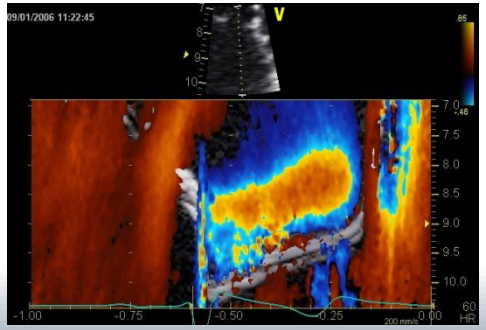
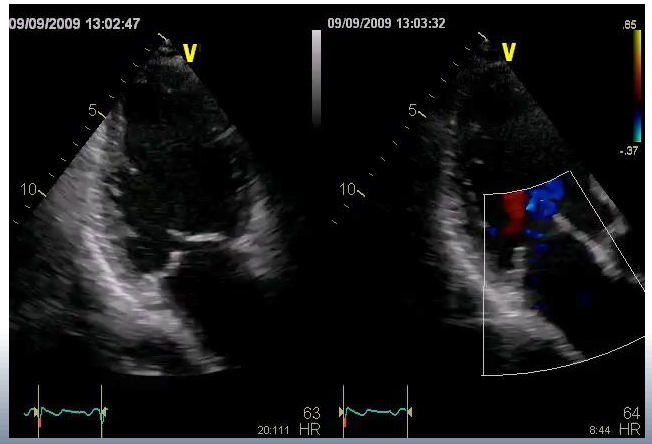






Conflict of Interest Disclosure

None

Case

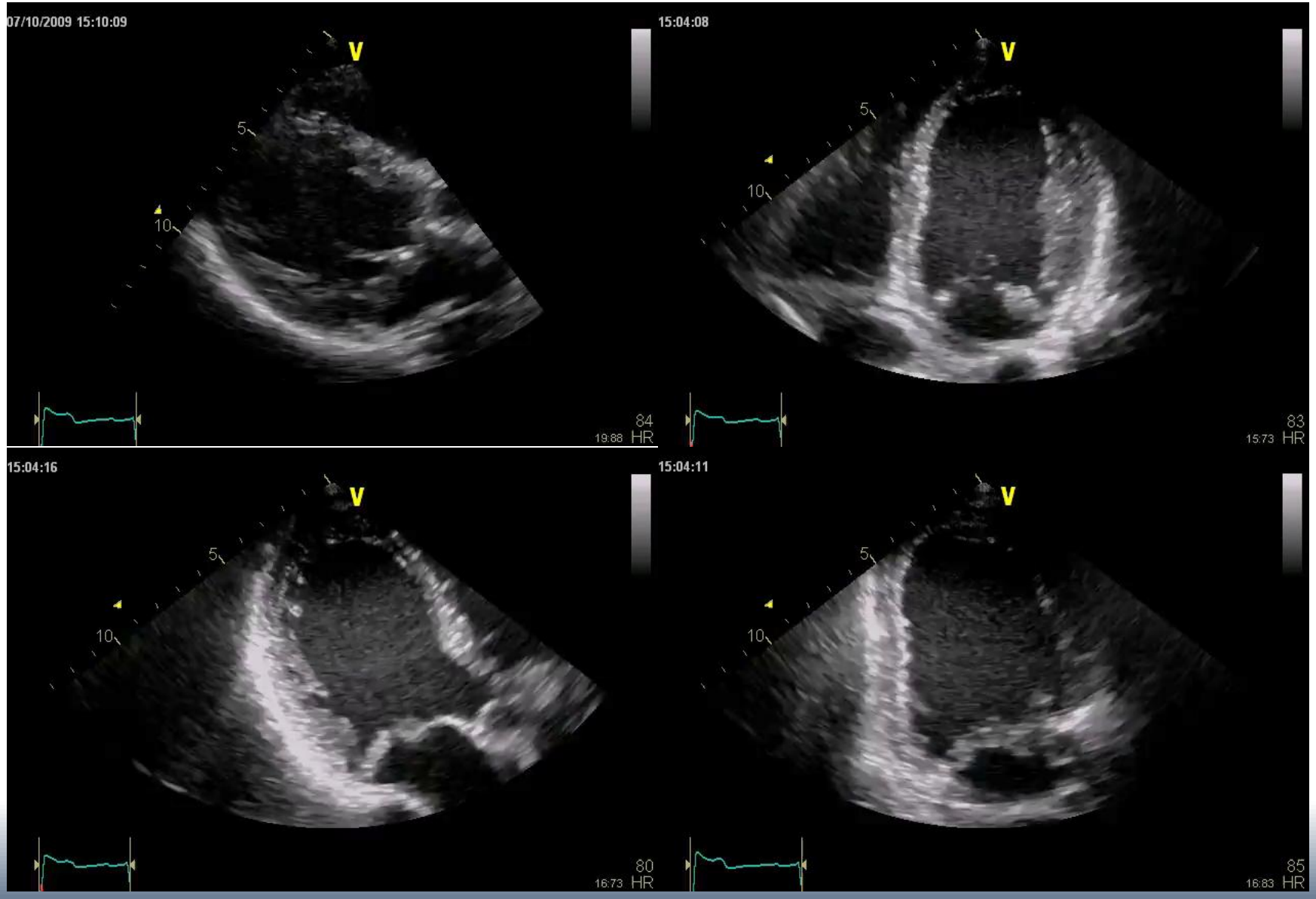
Clinical data

- 42 y.o. man,
- Height: 1.73m, Weight: 57kg
- BMI: 19 Kg/m^2
- Body surface area: 1.68m^2
- Asymptomatic, NYHA I
- Systolic murmur 3/6
- Barlow disease with mitral valve prolapse diagnosed in 2007
- No risk factor
- No medication

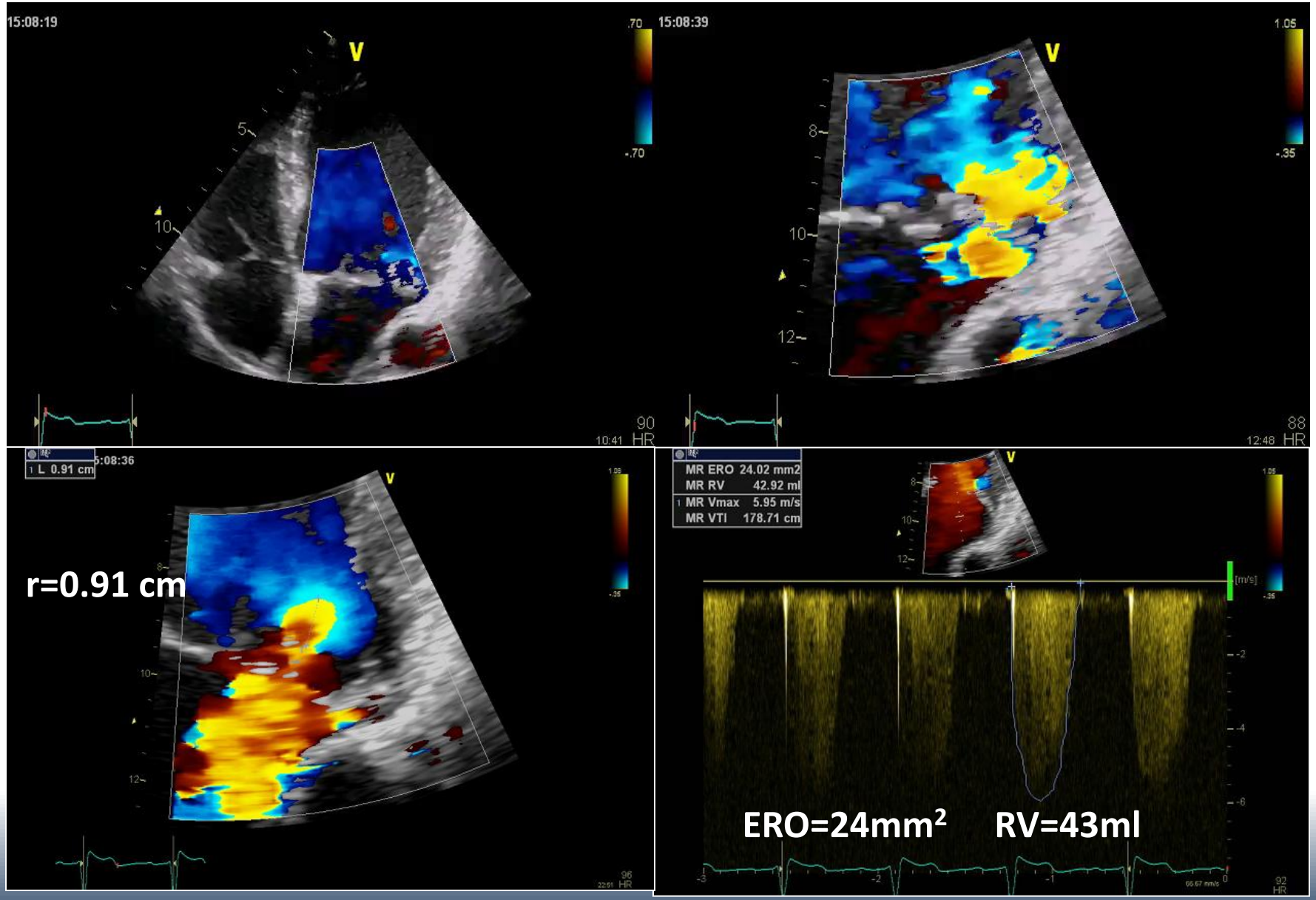
Previous Echocardiography

- LVED D: 35mm, LVES D: 28mm
- LVEF: 65%
- Moderate MR
- Systolic PAP: 38mmHg
- LA volume: 48ml

Resting Echocardiography



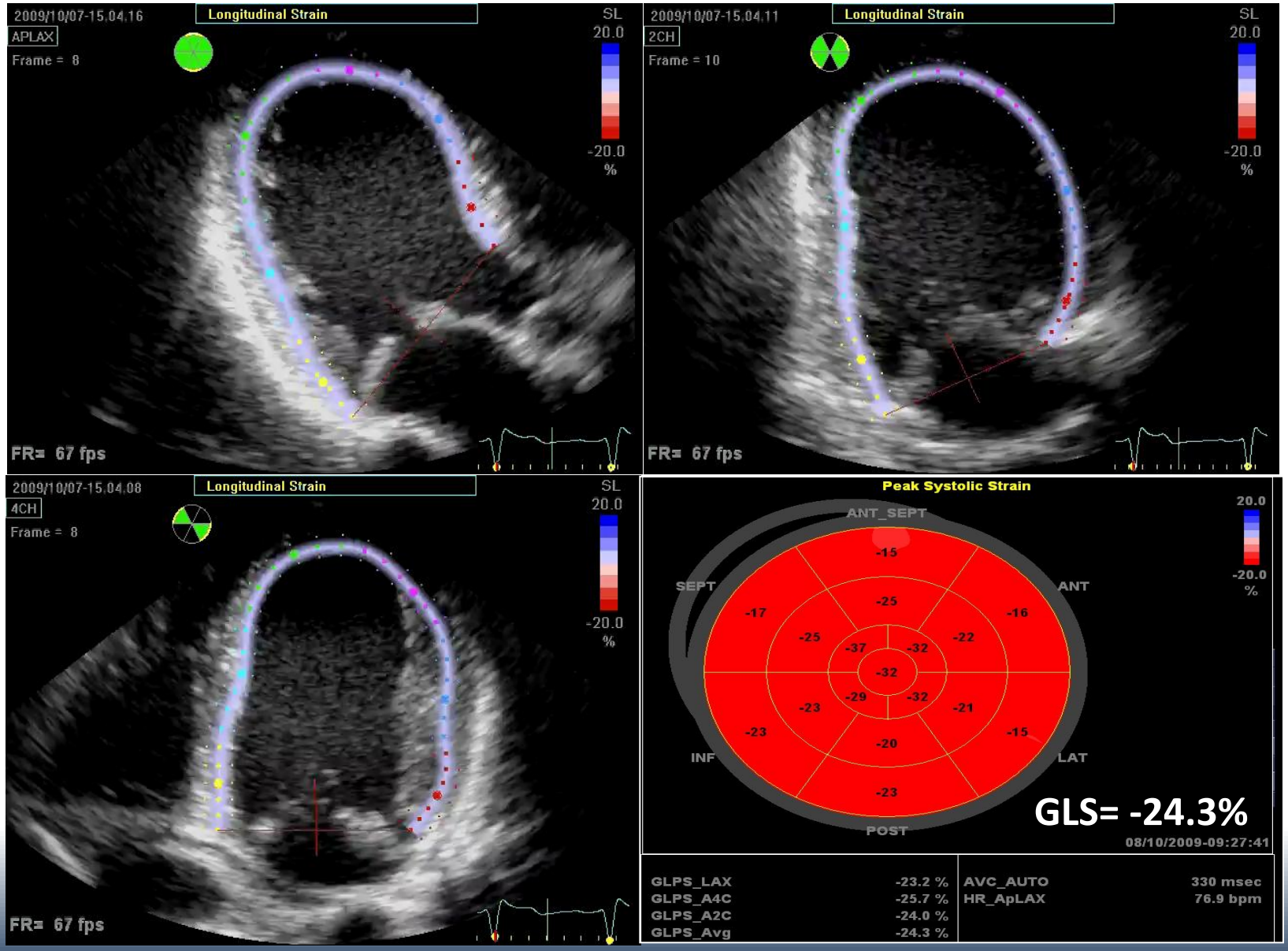
MR Quantification



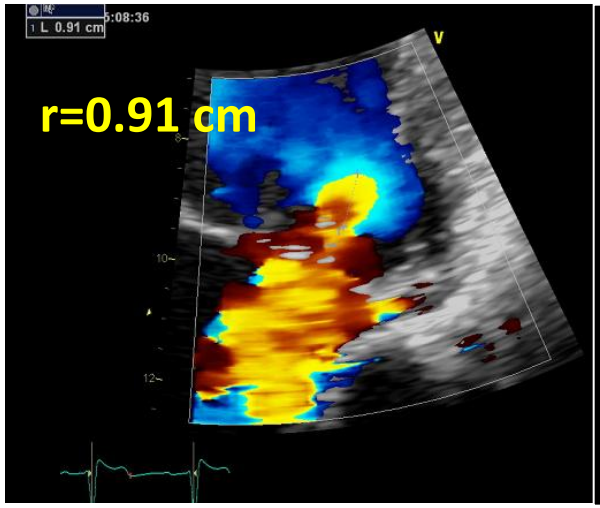
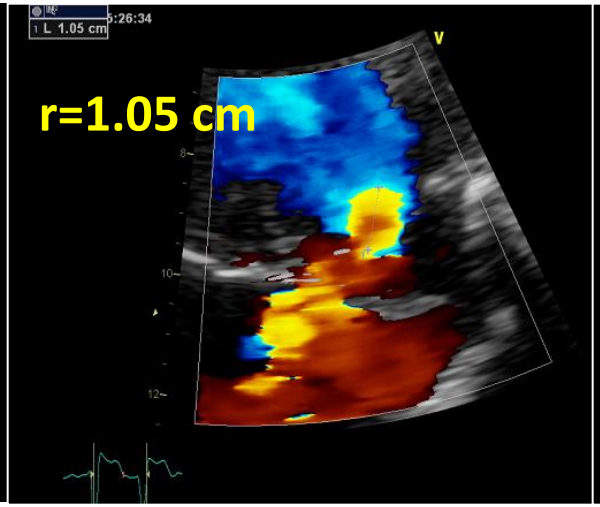
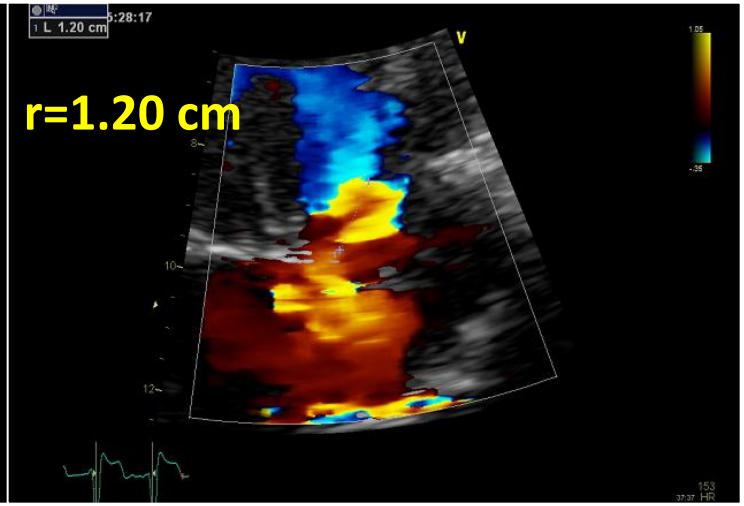
Echo Data

	Rest	Low Exercise	Peak Exercise
ERO_{PISA}	24 mm^2		
$ERO_{Doppler}$	30 mm^2		
RV_{PISA}	43 ml		
$RV_{Doppler}$	55 ml		
Average ERO	27 mm^2		
Average RV	49 ml		
SPAP	35 mmHg		
$LVEF_{Simpson}$	63 %		

2D Speckle Tracking



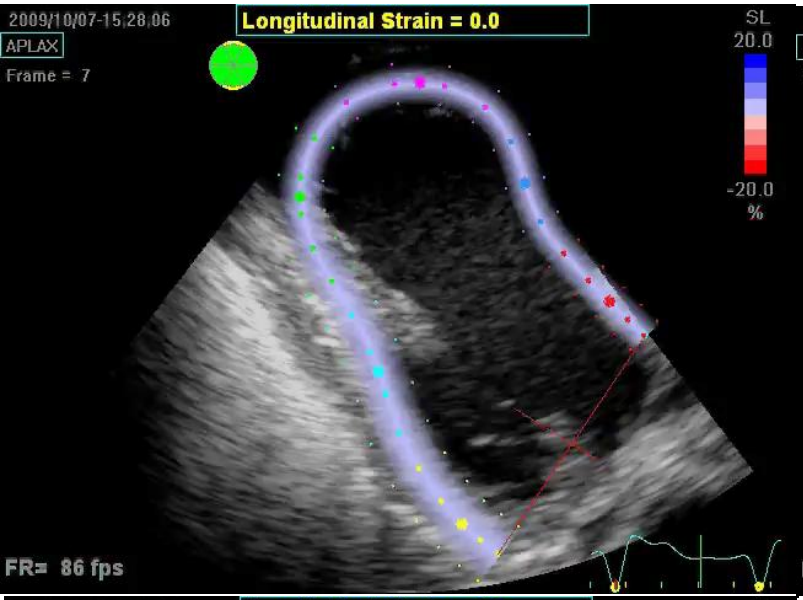
Exercise

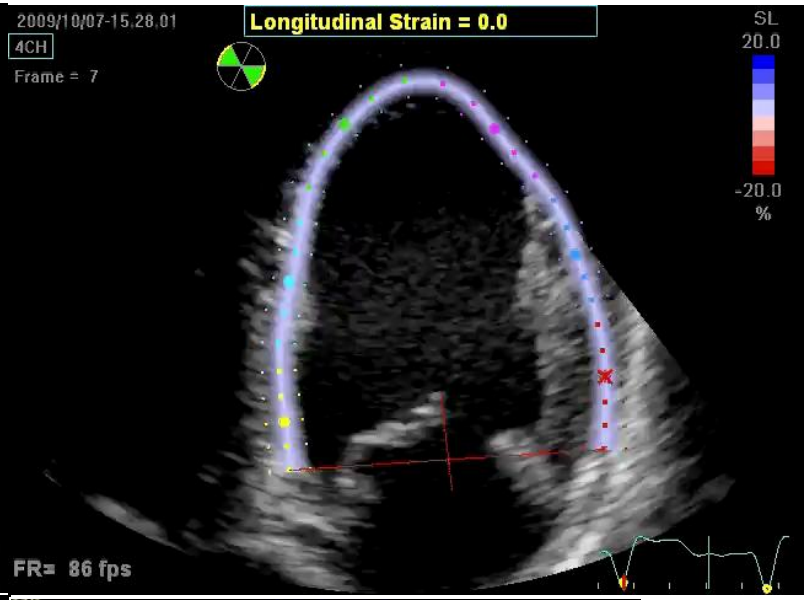
Rest	Low-Exer	Peak-Exer
		
ERO=24mm²	ERO=30mm²	ERO=49mm²
RV=43ml	RV=55ml	RV=74ml
HR=88	HR=115	HR=153

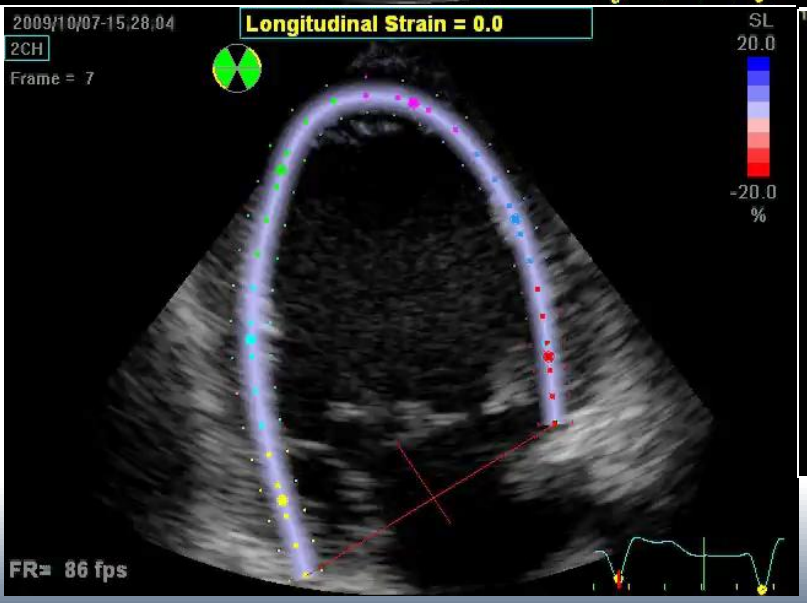
Echo Data

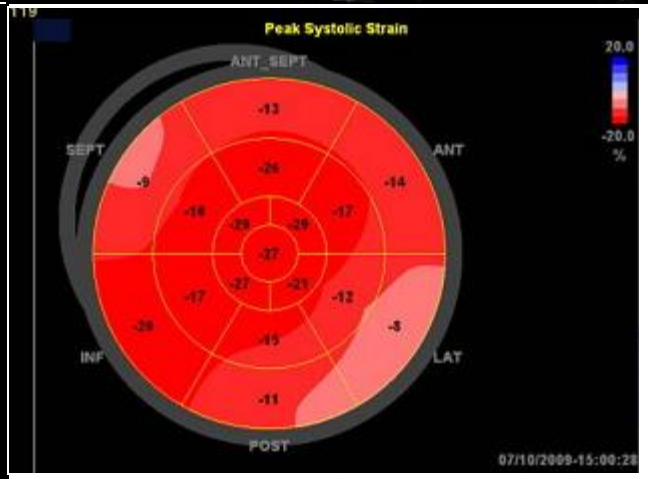
	Rest	Low Exercise	Peak Exercise
ERO_{PISA}	24 mm^2	30 mm^2	49 mm^2
$ERO_{Doppler}$	30 mm^2	34 mm^2	56 mm^2
RV_{PISA}	43 ml	55 ml	74 ml
$RV_{Doppler}$	55 ml	62 ml	80 ml
Average ERO	27 mm^2	32 mm^2	52.5 mm^2
Average RV	49 ml	58.5 ml	77 ml
SPAP	35 mmHg	55 mmHg	76 mmHg
$LVEF_{Simpson}$	63 %	65 %	76 %

Exercise LV Function









GLS_{rest} = -24.3%

BNP: 45pg/mL

$GLS_{exercise}$ = -18%

BNP: 112pg/mL

Indication for Surgery: ESC Guidelines

3 Steps of Evaluation

Severe MR → **ERO ≥40mm²; Rvol ≥60mL**

↓

Asymptomatic → ***Class I Evidence B***

↓

LV function/dilatation → **LVEF ≤60%**
LVES diameter ≥45/40mm

↓ ***Class I Evidence C***

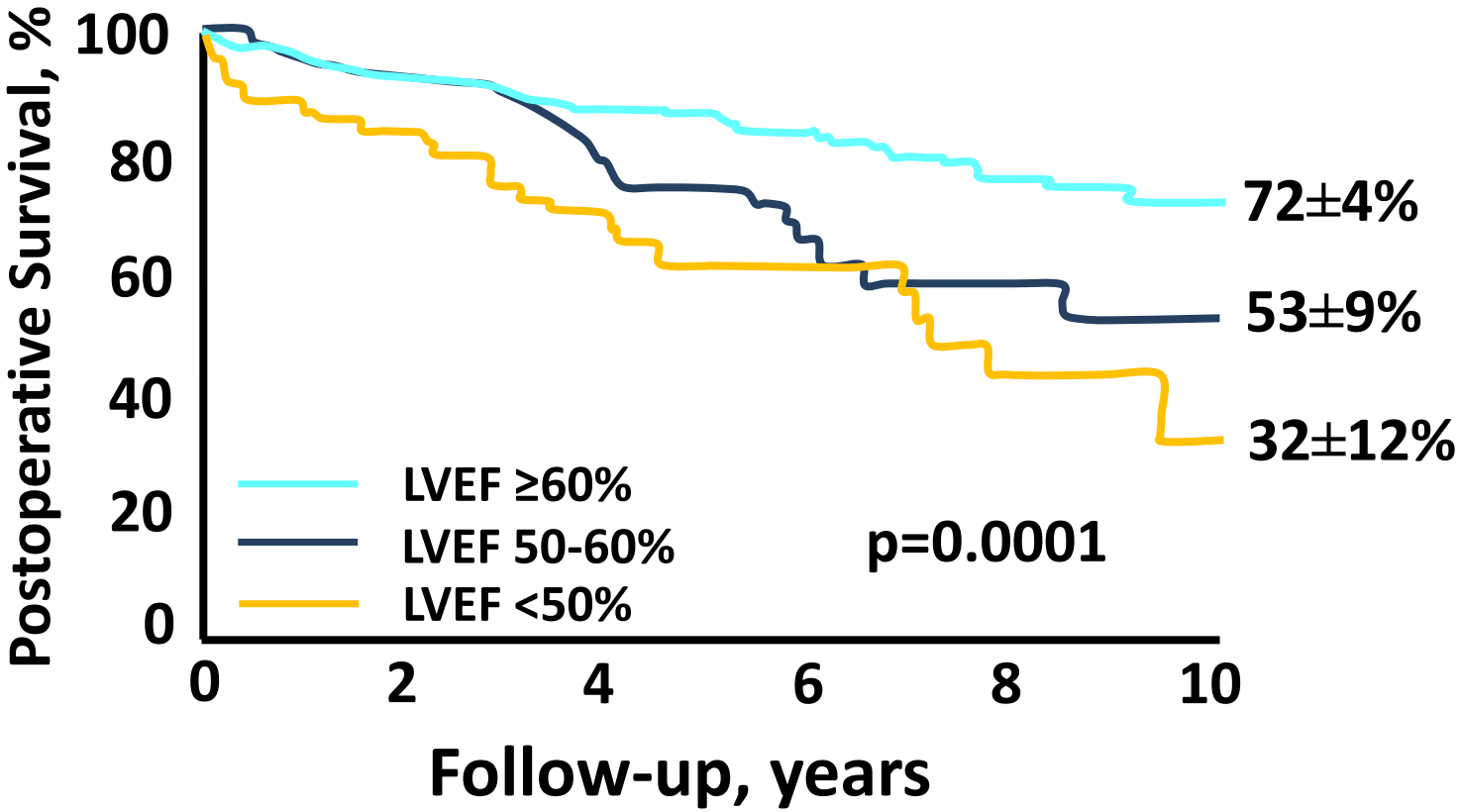
↓ ***Class IIa , C Flail leaflet***

Bonow et al. Circulation, 2006

Vahanian et al. Eur Heart J, 2012

Impact of LVEF on Postoperative Outcome

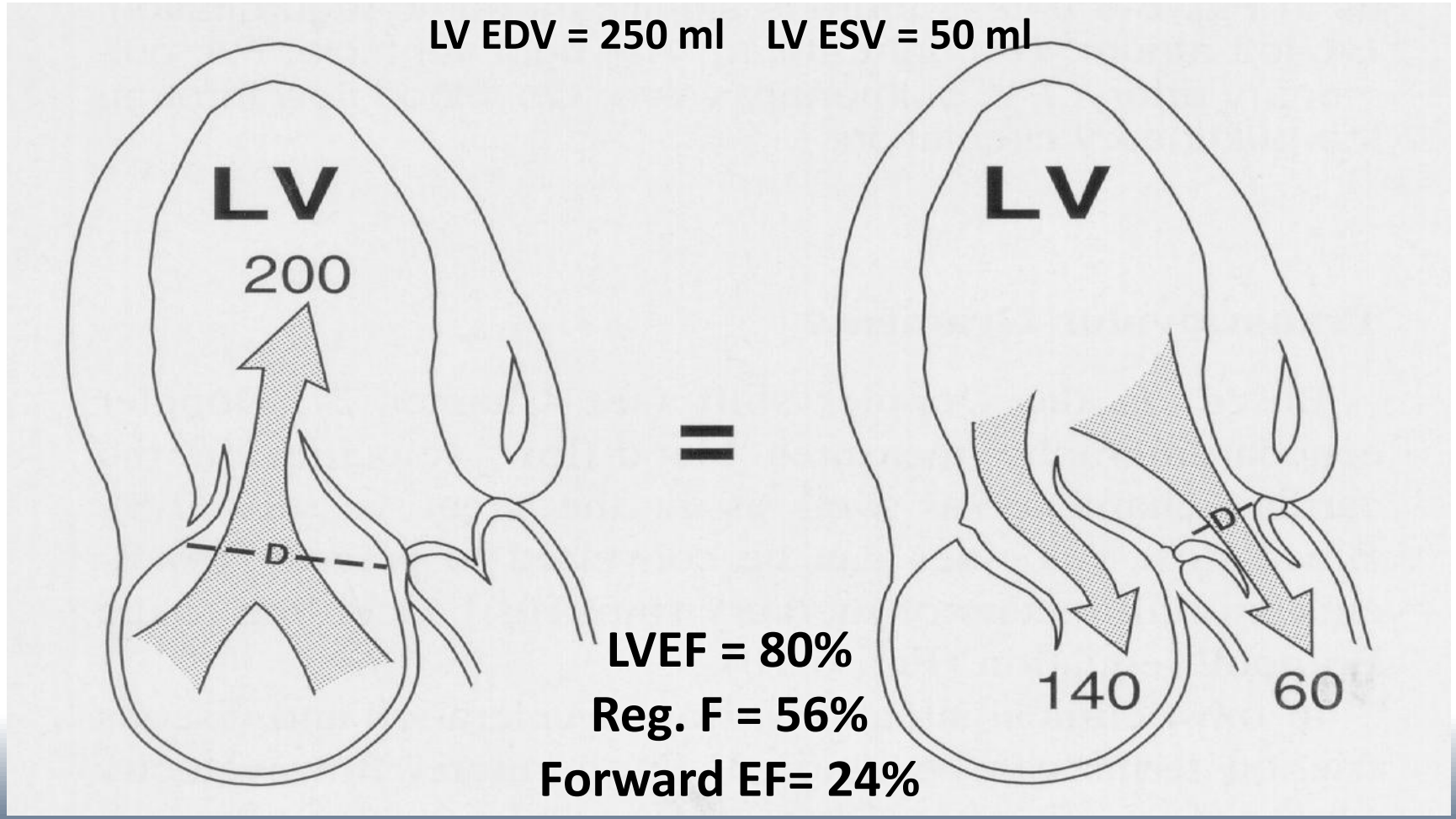
LVEF ≥60% ⇒ Excellent survival as compared to reference population



Enriquez-Sarano et al. Circulation , 1994

LVEF in Patients with MR

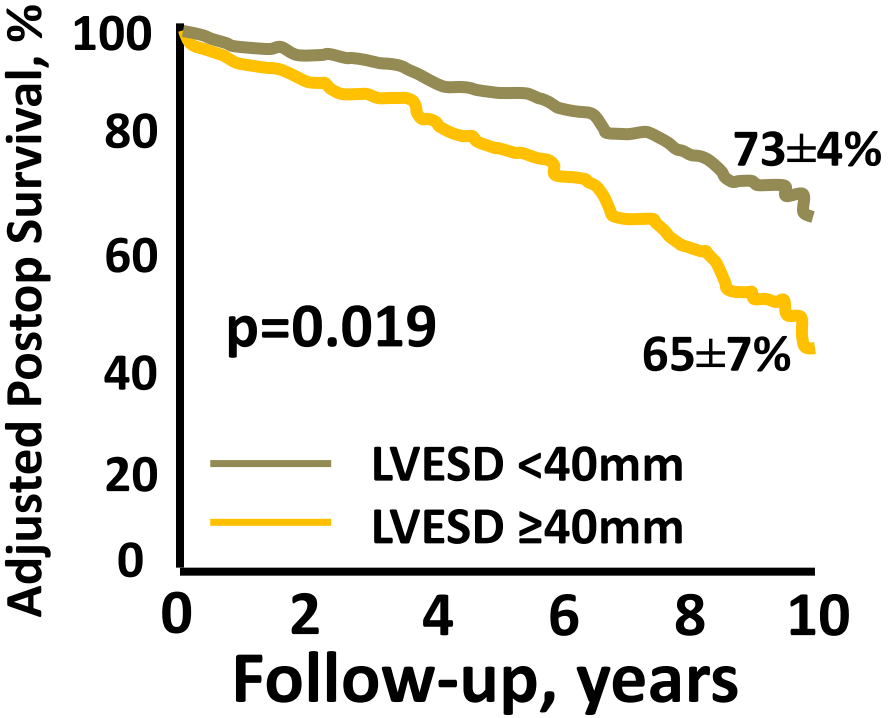
LVEF= Regurgitant fraction + Forward ejection fraction

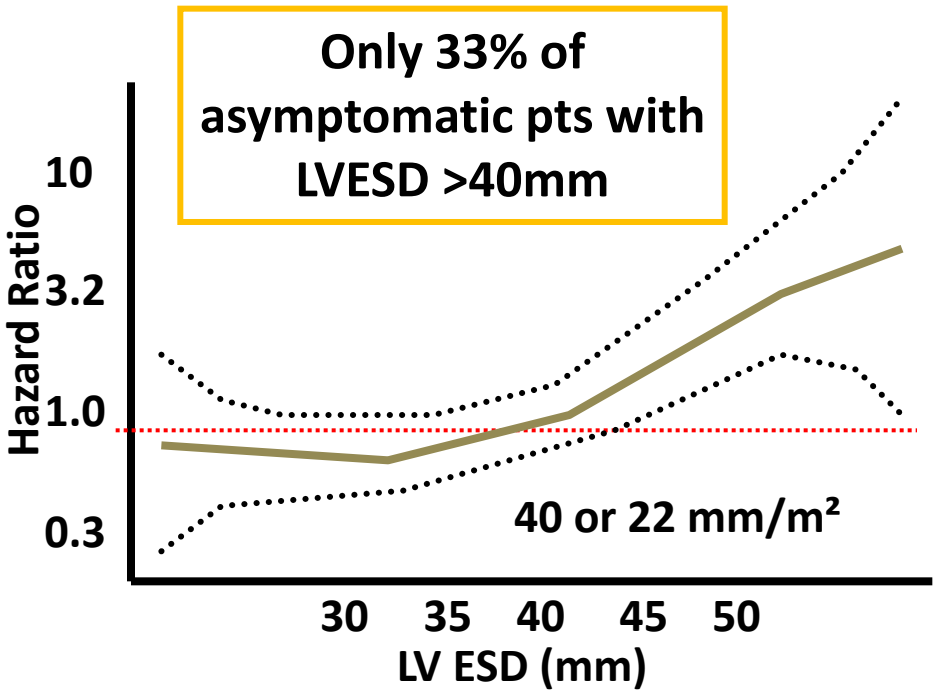


Impact of LV Dilatation on Survival

MIDA registry

739 patients with flail leaflet, follow-up: 6.1±3.7 years



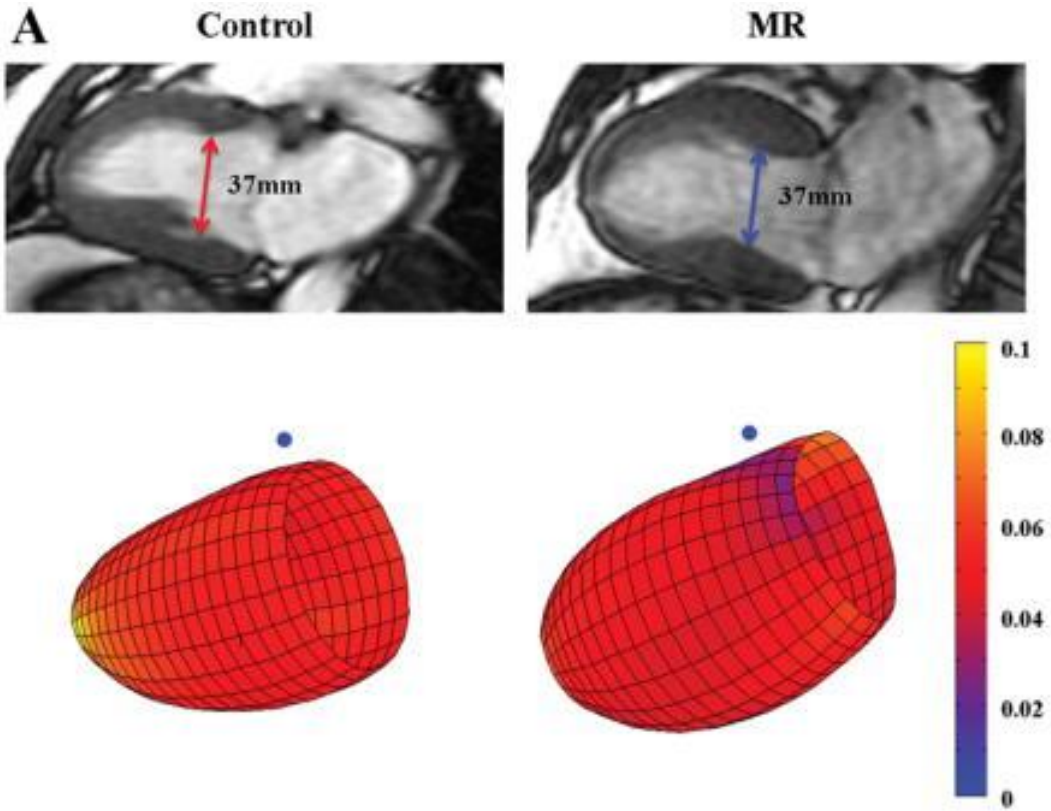


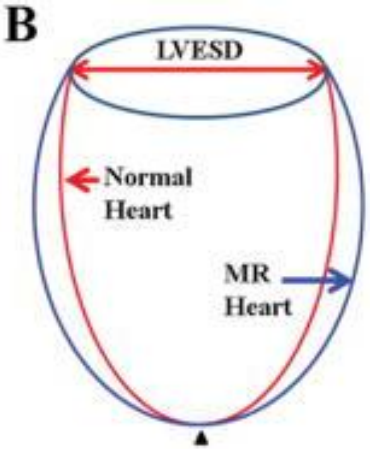
Tribouilloy et al. JACC, 2009;54:1961–8

Editorial: Pierard and Magne, JACC, 2009

LV Remodeling in Primary MR

n=94 MR patients, LVEF>60%, LVES d<40mm
Control group: n=51





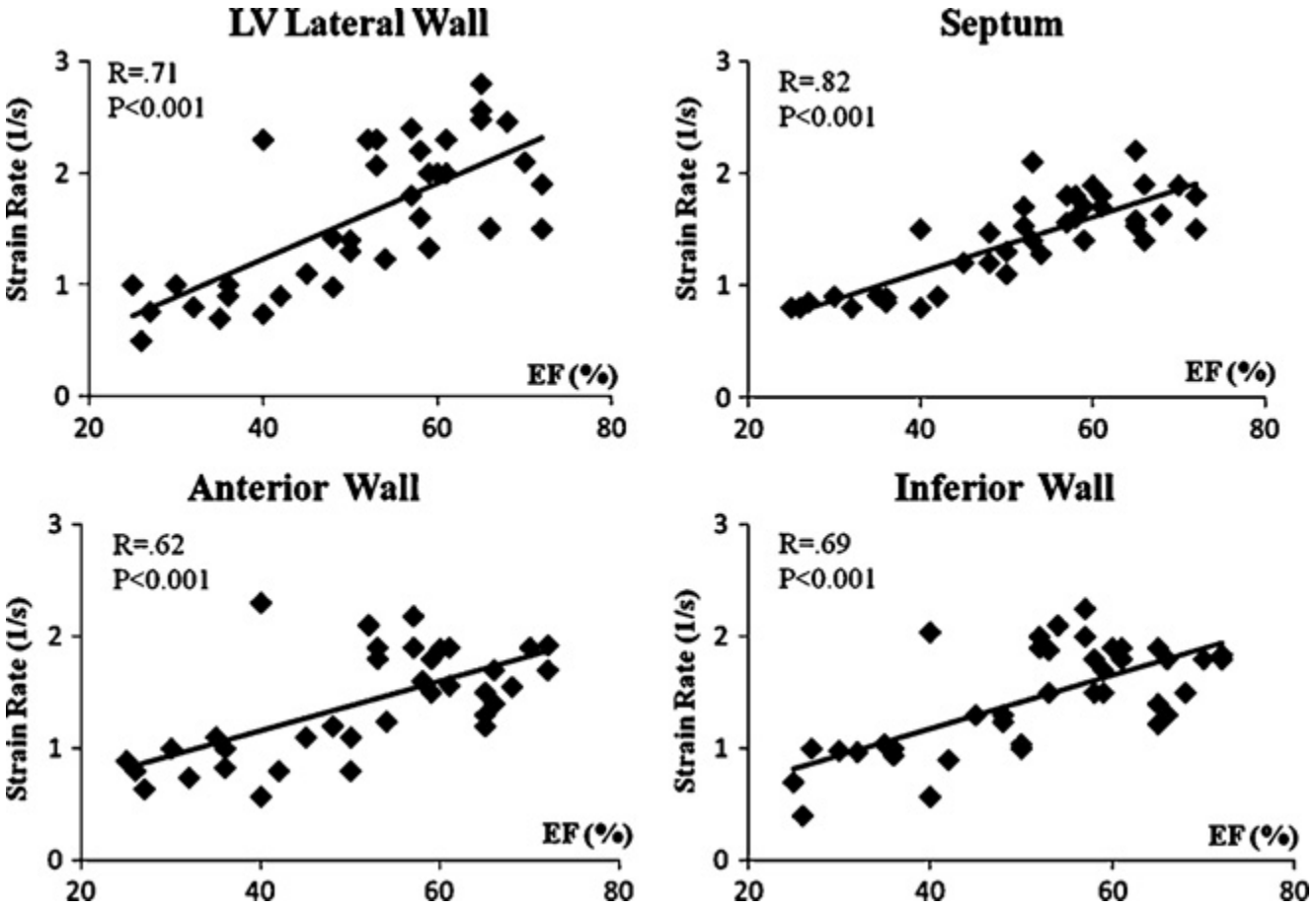
	Control (n=51)	LVES Dimension <37 mm (n=48)
LVES length, cm	6.81±0.86	6.73±0.87
LVES sphericity index	1.95±0.26	1.82±0.23*
LVES volume index, mL/m^2	25±6	34±9*
2D LV apex curvature, 1/cm‡	2.93±1.13	1.89±0.48*

Schiros et al. Circulation, 125:2334-2342; 2012

Predictors of Postoperative LV Systolic Dysfunction

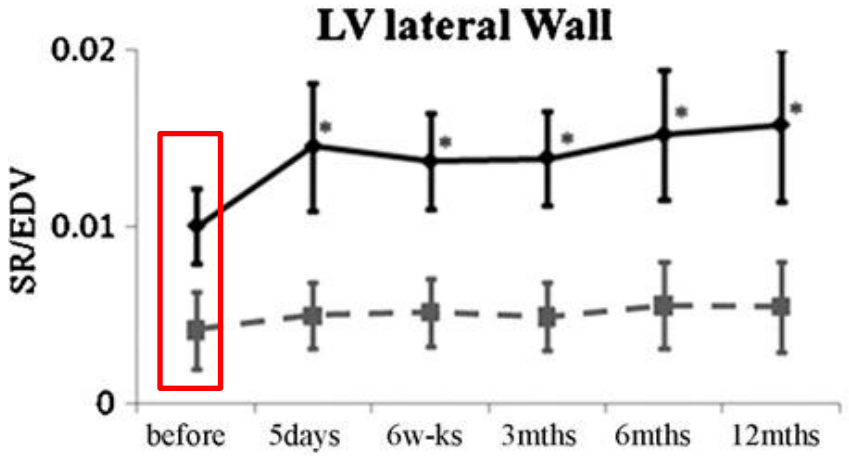
Preoperative useful of LV Longitudinal function

- 62 chronic severe organic MR
- 75% of NYHA class I-II
- MV repair
- 2 groups (Postop LVEF >50%)



Marciniak et al. Eur JTCS, 2011

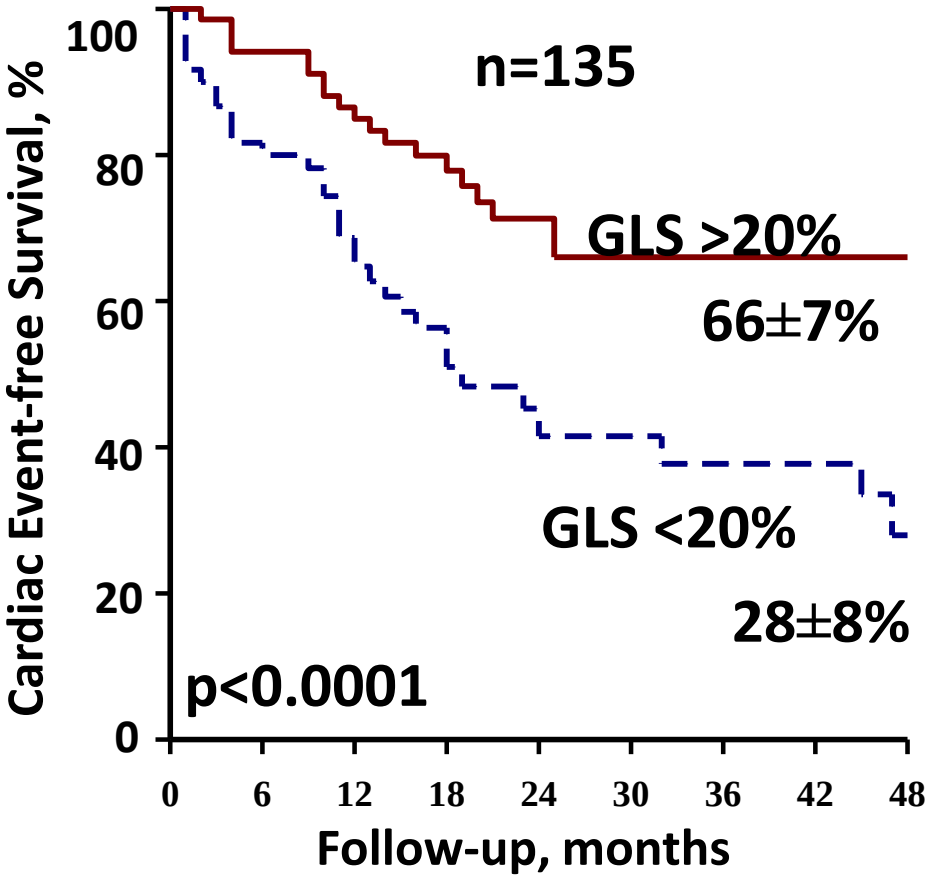
LV Longitudinal Function and Outcome



Marciniak et al. Eur JTCS, 2011

Parameter	Threshold value	Area under the curve	Sensitivity	Specificity
LA volume (mL/m^2)	60	0.66	60%	78%
LVESD (mm/m^2)	22	0.71	53%	78%
sPAP (mm Hg)	50	0.65	27%	93%
LV GLS (%)	−18	0.76	53%	79%

n=88, 17% of postop LV dysfunction at 6-month (82% of MVRp)

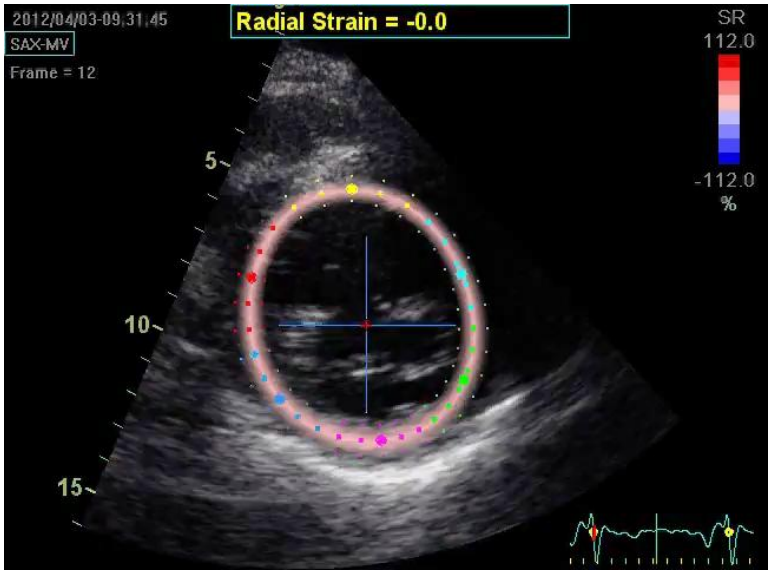


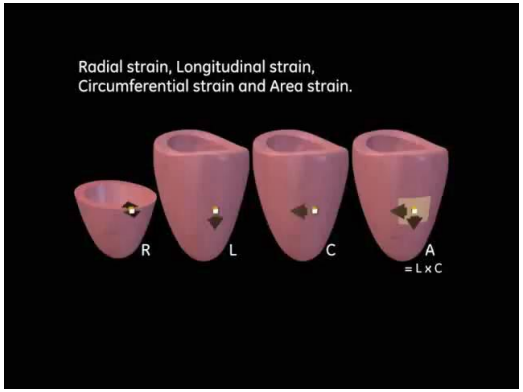
Adjusted HR=3.3 (1.1-9.9) p=0.03

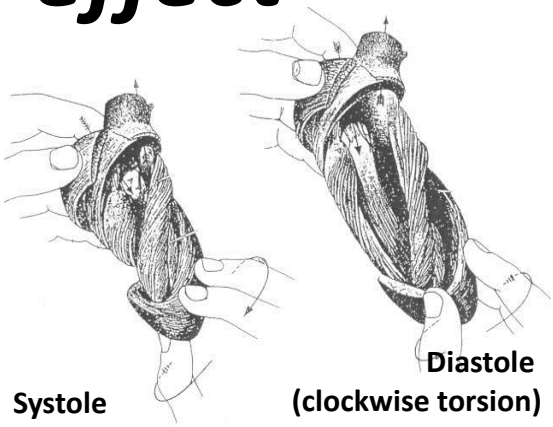
Mascle, Donal et al. JASE, 2012

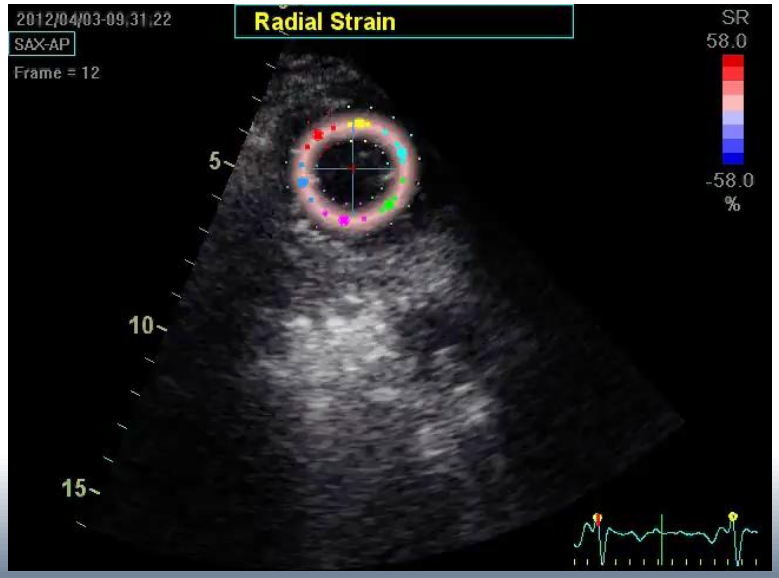
Magne, Pibarot, Pierard, Lancellottiet al. Heart 2012

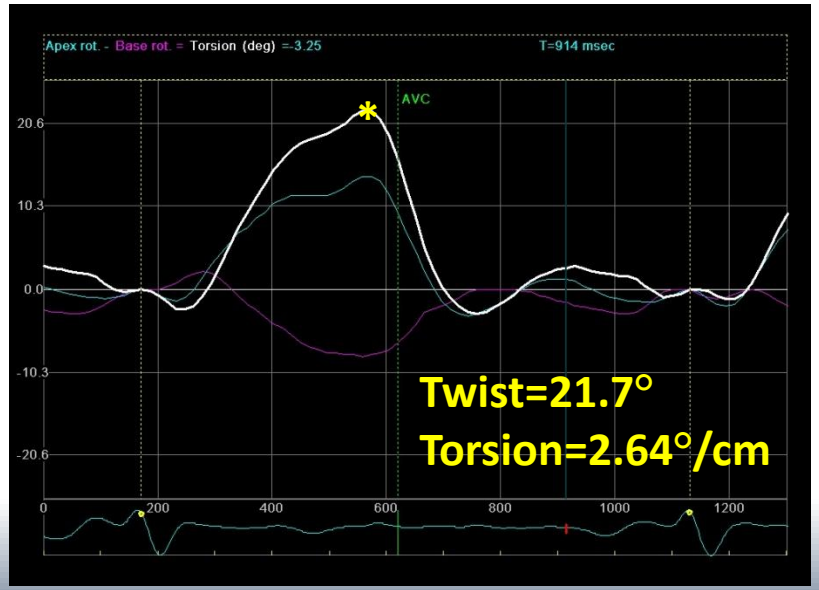
LV Torsion: The floorcloth effect





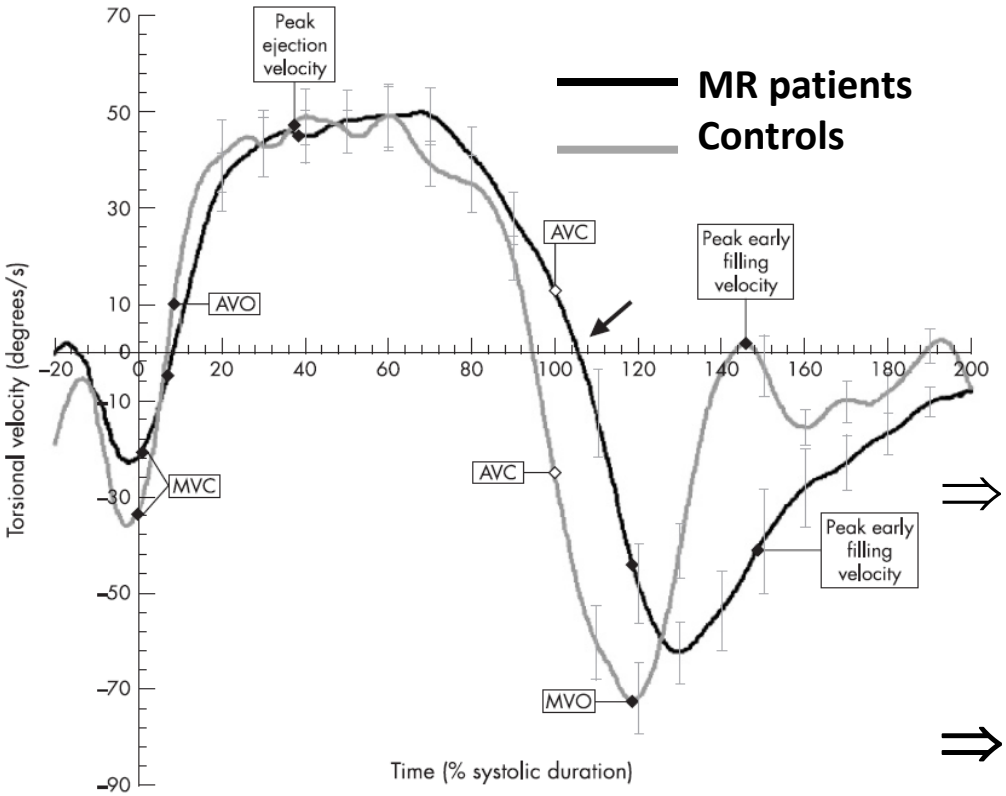






Impact of MR on LV Torsion

- **35 patients with chronic organic MR (moderate to severe) compared to 30 age-matched healty controls**



Torsional variable	LV indices	Correlation
Peak systolic torsion	LVIDs	−0.40
	LVEF	0.38
	Mitral regurgitant volume	−0.345
	Systolic sphericity index	−0.40
	LV mass index	−0.42
Peak untwisting velocity	LVIDs	−0.44
	Mitral regurgitant volume	−0.38
Time to onset of untwisting	LVIDd	0.368
	Mitral regurgitant volume	0.43
Time to peak untwisting velocity	Mitral regurgitant volume	0.511

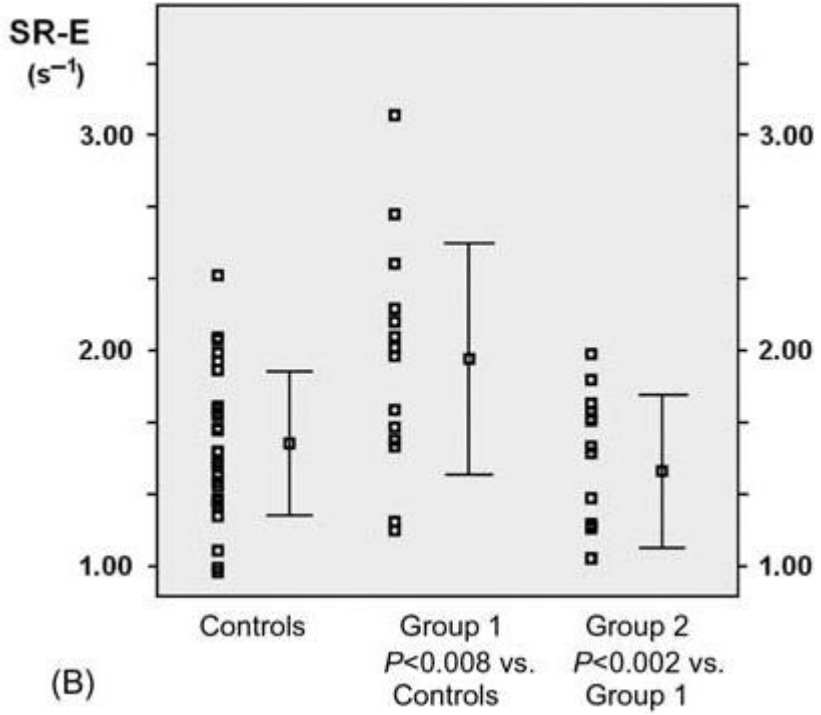
⇒ **Chronic MR results in significant delay and slowing of LV untwisting**

⇒ **MR severity is correlated with torsional parameters: Early LV dysfunction?**

Borg et al. Heart, 2008

Impact of MR on LV Torsion: Biphasic Pattern

	Controls ($n = 41$)	Mild MR ($n = 22$)	Moderate MR ($n = 12$)	Severe MR ($n = 9$)	ANOVA *P*-value
Endocardial rotation					
ROT-API (°)	6.58 ± 3.17***	7.47 ± 3.11	10.77 ± 4.32**	6.11 ± 4.39*	0.003
ROT-BAS (°)	−6.06 ± 2.91	−7.81 ± 2.76	−7.07 ± 2.50	−5.33 ± 4.64	0.1
Twist (base-apex) (°)	12.65 ± 5.19	15.28 ± 4.08	17.83 ± 5.20‡	11.43 ± 6.09†	0.005
Torsion (°/cm)	1.6 ± 0.71	1.83 ± 0.62	2.26 ± 0.66¥	1.39 ± 0.80‖	0.015
LVEF, %	**65±5**	**63±3**	**62±3**	**65±5**	**NS**



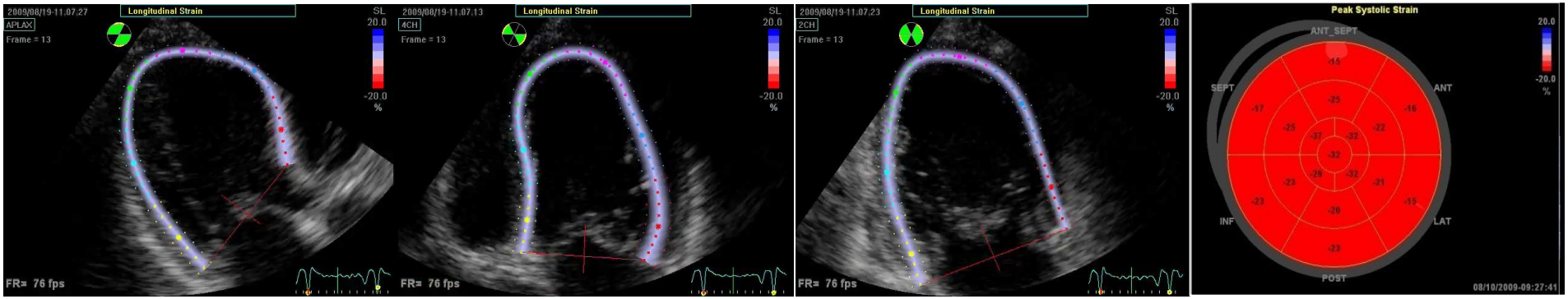
- **Severe MR and normal LV systolic function demonstrated the lowest LV rotational profile: early subclinical LV systolic dysfunction**
- **Moderate MR revealed the highest rotational profile: hyperdynamic or supranormal LV systolic function**
- **Biphasic pattern also in LV diastolic function?**

Moustafa et al. Eur J Echo, 2011
Borg et al. Eur J Echo, 2010

LV Longitudinal Function and Contractile Reserve

Rest

PSLA view **4ch view** **2ch view** **GLS= -24.3%**



EDV=140ml, ESV=51ml LVEF= 64%

Exercise

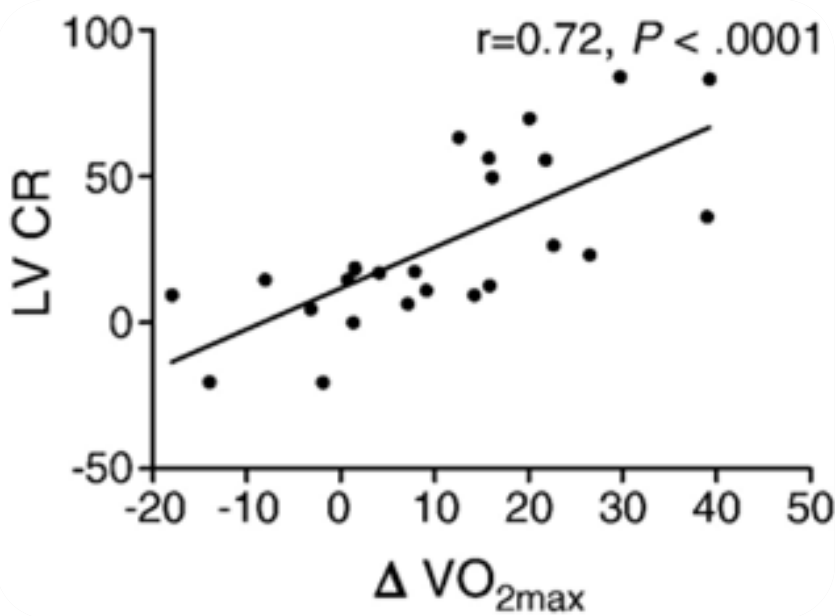
GLS = -18%

EDV=153ml, ESV=36ml LVEF= 76%

Asymptomatic MR and LV Contractile Reserve

LV contractile reserve is the best predictor of postop. LV systolic dysfunction and exercise capacity

Data at inclusion	Cutoff value	AUC	Sensitivity	Specificity
Rest				
Left atrial volume (ml)	78	0.79	63.6%	86.7%
LV ejection fraction	67%	0.48	92.3%	29.4%
GLS	18.1%	0.69	76.9%	76.5%
Exercise				
LV ejection fraction	70.4%	0.72	69.2%	70.4%
GLS	18.5%	0.82	84.6%	76.5%
Exercise-induced changes				
LV ejection fraction	6.6%	0.74	92.3%	52.9%
GLS	1.9%	0.80	92.3%	73.6%

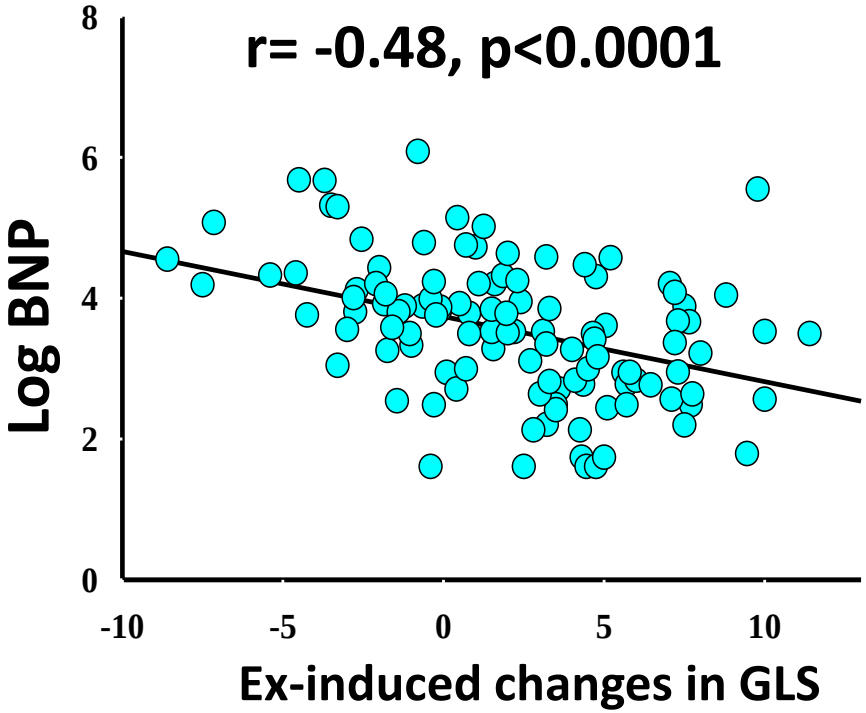


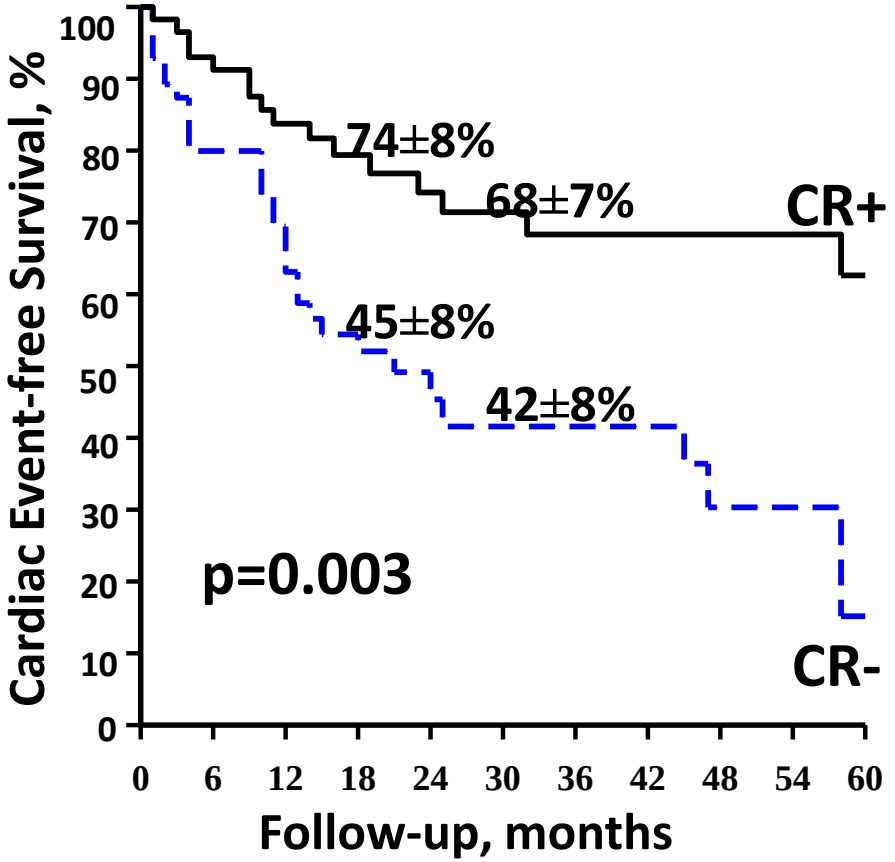
Lancellotti et al. JASE, 2008

Madaric et al. Am H J, 2007

LV Contractile Reserve: BNP and Outcome

Exercise-induced changes in GLS





Adjusted HR=2 (1.0-4.1) p=0.04

Magne, Pibarot, Pierard, Lancellottiet al. submitted

Take Home Messages!

- **In asymptomatic patients with severe MR, the evaluation of LV geometry and function, as recommended by current guidelines, is mandatory**
- **Nevertheless, in the vast majority of cases, more advanced evaluation of patients provides incremental prognostic value**
- **In this regard, LV longitudinal function assessment may be useful in asymptomatic MR with no LV dysfunction/dilatation**
- **Finally, stress echocardiography may be useful to identify absence of LV contractile reserve and to unmask early and latent LV dysfunction**

Thank you for your attention.

Fonds Léon Fredericq

"In these matters the only certainty is that nothing is certain."

Pliny The Elder, 23 AD-79 AD

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