

CARDIAC REMODELING IN VHD

An iceberg floating in the ocean, used as a metaphor for cardiac remodeling in VHD. The visible tip represents the clinical manifestations, while the submerged part represents the underlying molecular and cellular changes.

HEMODYNAMICS, VOLUMES,

CIRCULATING HORMONES

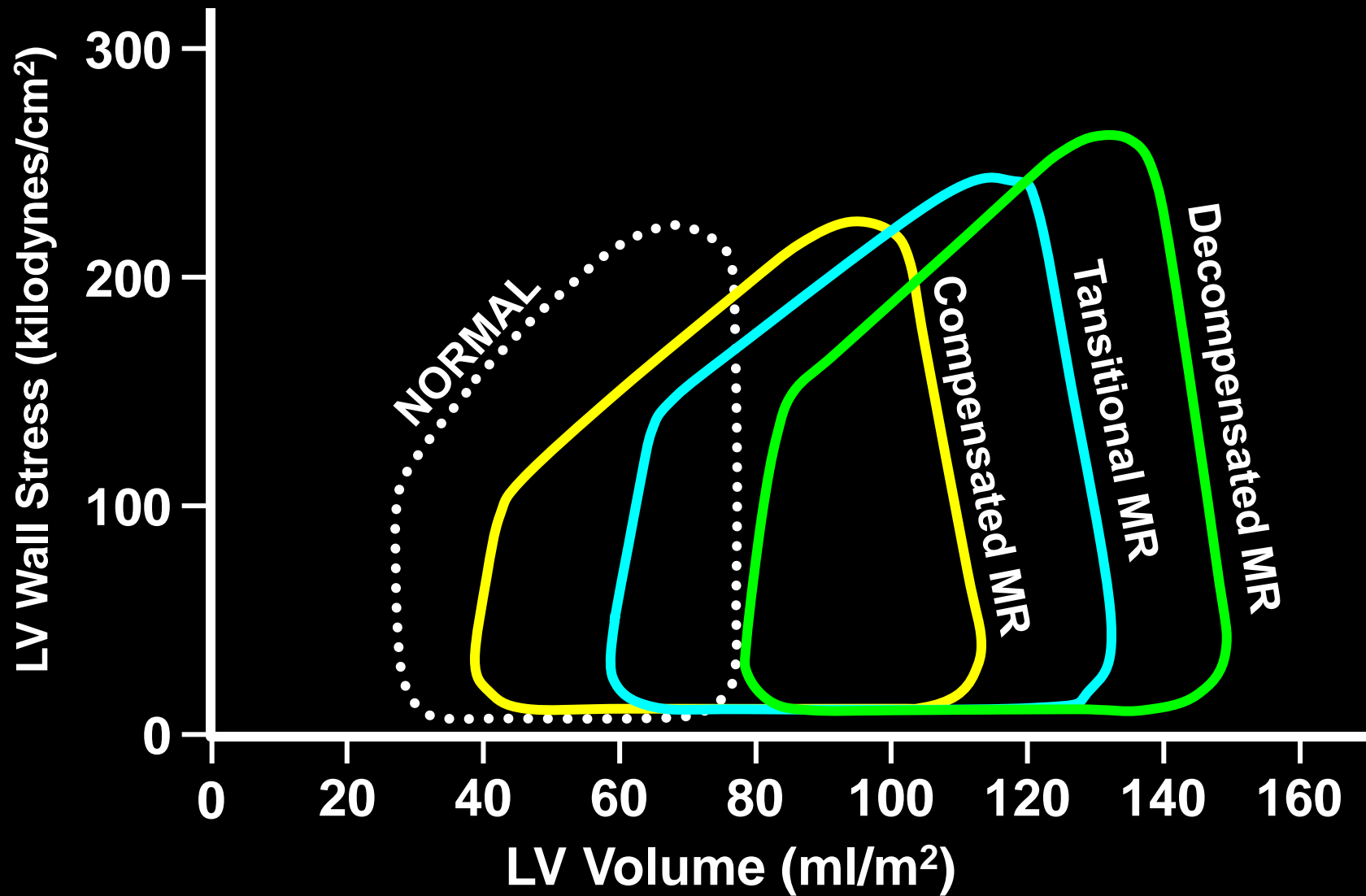
**MYOCARDIAL SUBSTRATE
FIBROSIS**

**PROTEINS, TRANSCRIPTIONAL FACTORS
GENOTYPE**

Cardiac Remodeling in VHD

Critical points, Paradigm shifts, New perspectives

- ✓ **Ventricular vs Valvular Remodeling
(Dynamic essence of valvular disease)**
- ✓ **From ventricular volumes to
myocardial substrate assesement**
- ✓ **From remodeling to reverse remodeling
(TAVI and MitraClip as opportunities to study
reverse remodeling)**
- ✓ **From ventricles to atria**

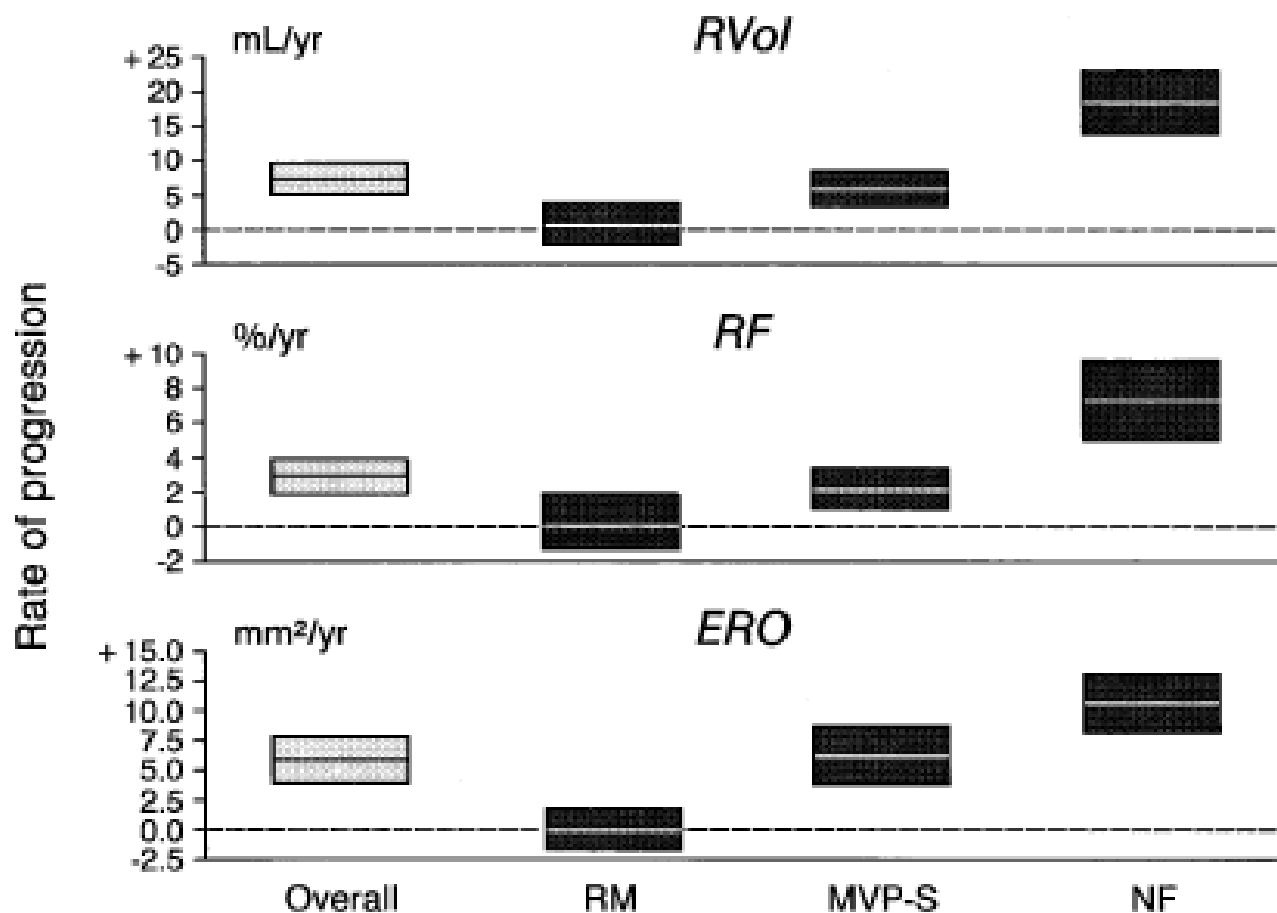


Progression of Mitral Regurgitation

A Prospective Doppler Echocardiographic Study

Maurice Enriquez-Sarano, MD, FACC,* Arsene-Joseph Basmadjian, MD,* Andrea Rossi, MD,*
Kent R. Bailey, PhD,† James B. Seward, MD, FACC,* A. Jamil Tajik, MD, FACC*

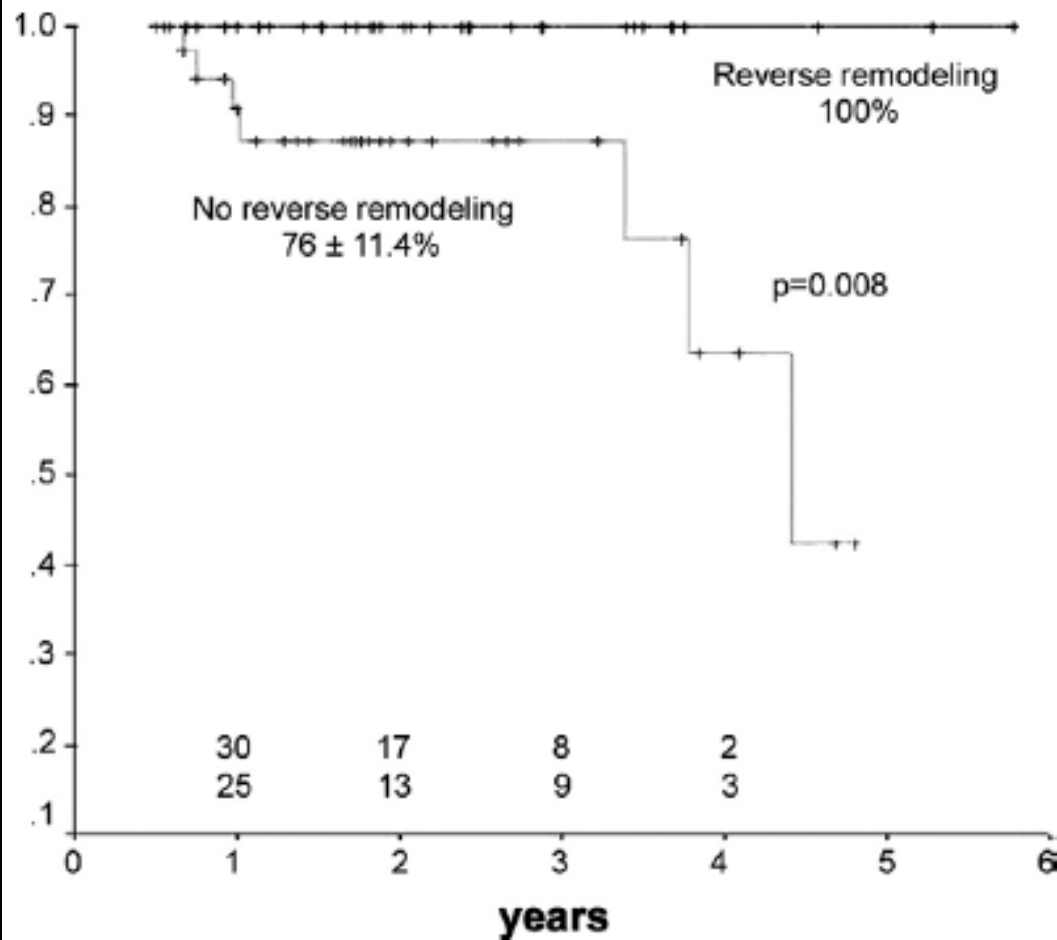
(J Am Coll Cardiol 1999;34:1137-44)



Recurrence of Mitral Regurgitation Parallels the Absence of Left Ventricular Reverse Remodeling After Mitral Repair in Advanced Dilated Cardiomyopathy

Michele De Bonis, MD, Elisabetta Lapenna, MD, Alessandro Verzini, MD, Giovanni La Canna, MD, Antonio Grimaldi, MD, Lucia Torracca, MD, Francesco Maisano, MD, and Ottavio Alfieri, MD

Department of Cardiac Surgery, San Raffaele University Hospital, Milan, Italy (Ann Thorac Surg 2008;85:932-9)



Cardiac Remodeling in VHD

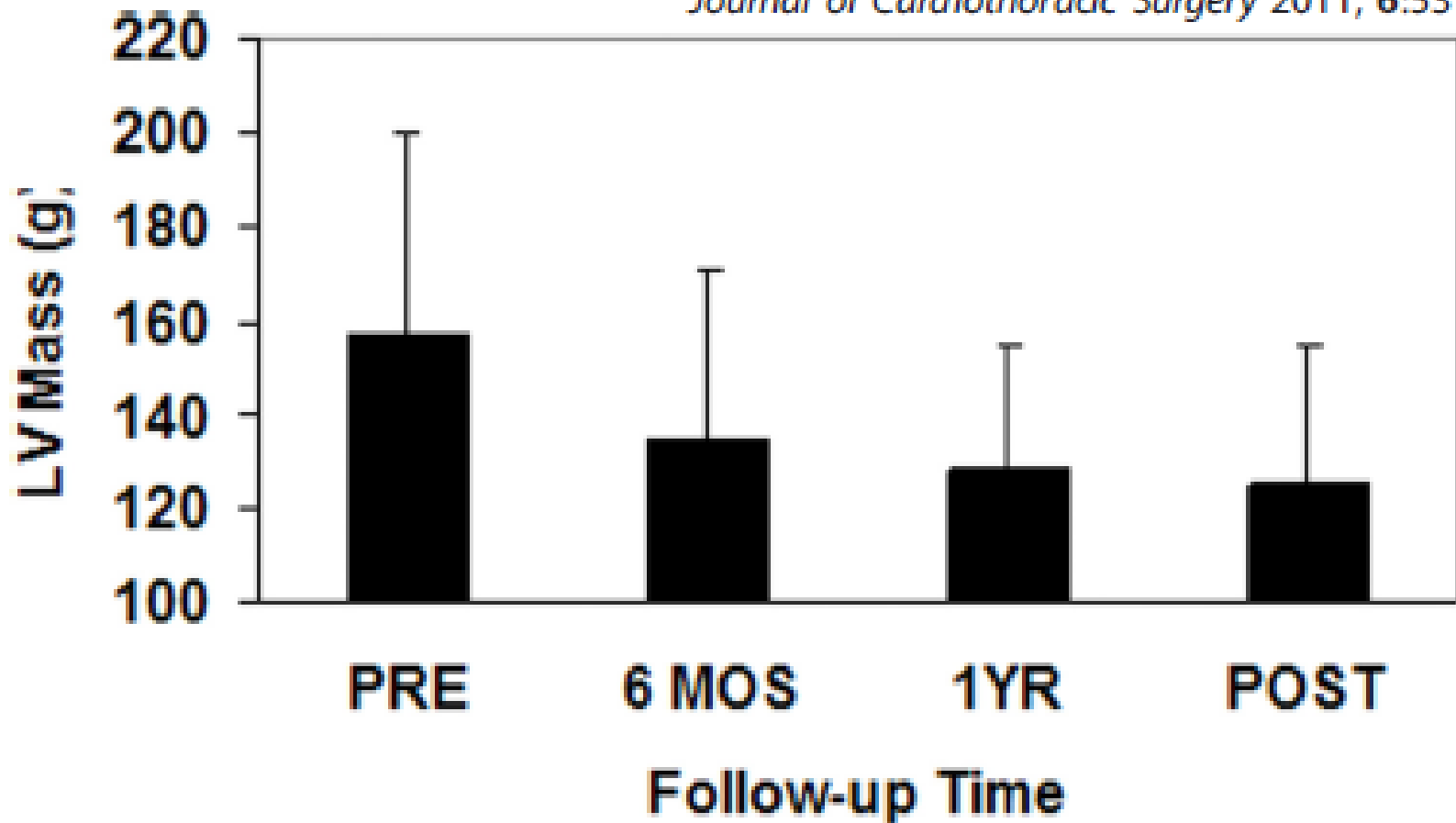
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LV reverse remodeling imparted by aortic valve replacement for severe aortic stenosis; is it durable? A cardiovascular MRI study sponsored by the American Heart Association

Robert WW Biederman^{1*}, James A Magovern³, Sandra B Grant¹, Ronald B Williams¹, June A Yamrozik¹, Diane A Vido¹, Vikas K Rathi¹, Geetha Rayarao¹, Ketheswaram Caruppannan^{1,2} and Mark Doyle¹

Journal of Cardiothoracic Surgery 2011, **6**:53

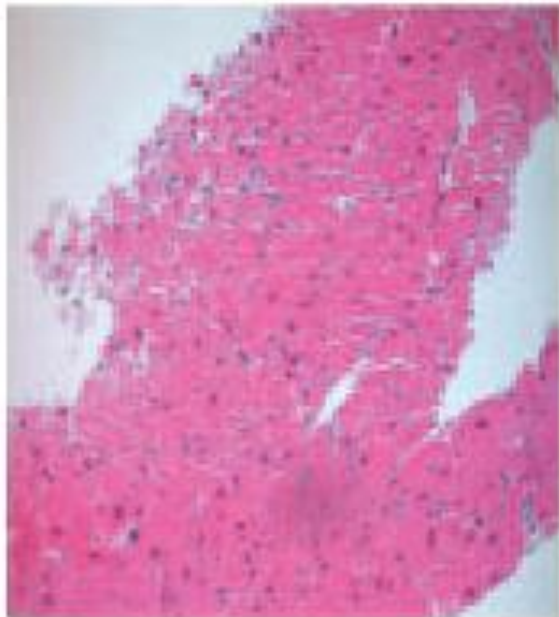


Impact of Myocardial Fibrosis in Patients With Symptomatic Severe Aortic Stenosis

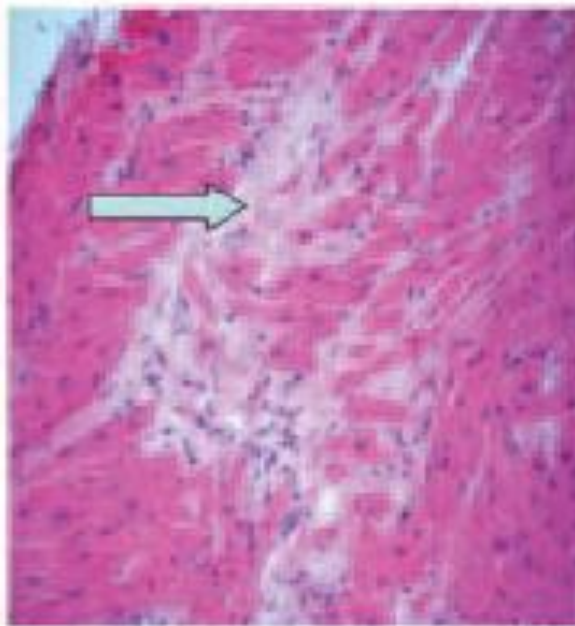
Frank Weidemann, MD*; Sebastian Herrmann*; Stefan Störk, MD; Markus Niemann, MD; Stefan Frantz, MD; Volkmar Lange, MD; Meinrad Beer, MD; Stefan Gattenlöhner, MD; Wolfram Voelker, MD; Georg Ertl, MD; Jörg M. Strotmann, MD

Circulation 2009;120:577-84

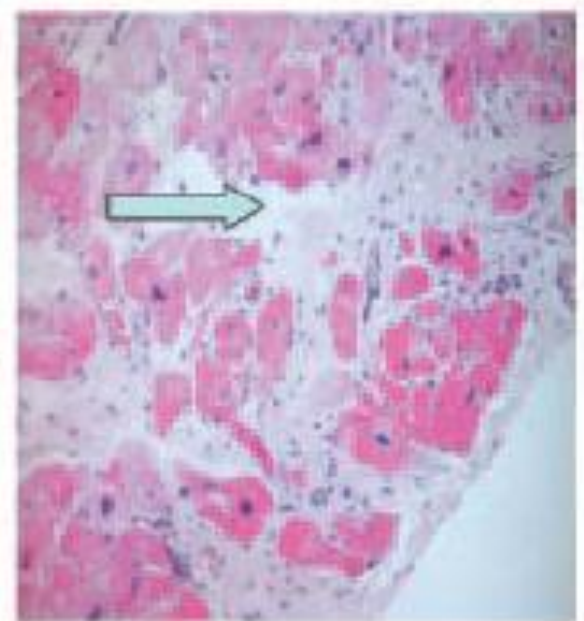
No Fibrosis



Mild Fibrosis



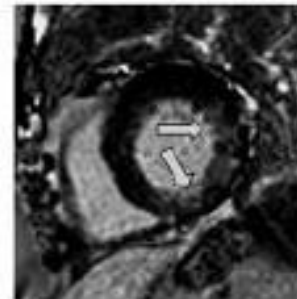
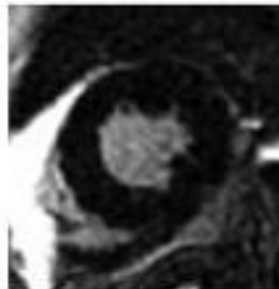
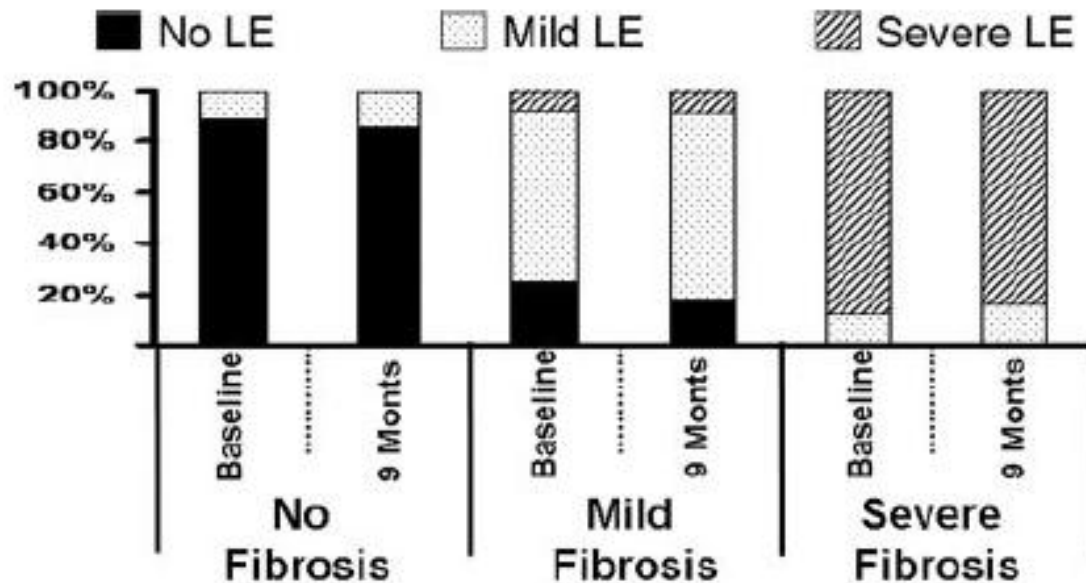
Severe Fibrosis



Impact of Myocardial Fibrosis in Patients With Symptomatic Severe Aortic Stenosis

Frank Weidemann, MD*; Sebastian Herrmann*; Stefan Störk, MD; Markus Niemann, MD; Stefan Frantz, MD; Volkmar Lange, MD; Meinrad Beer, MD; Stefan Gattenlöhner, MD; Wolfram Voelker, MD; Georg Ertl, MD; Jörg M. Strotmann, MD

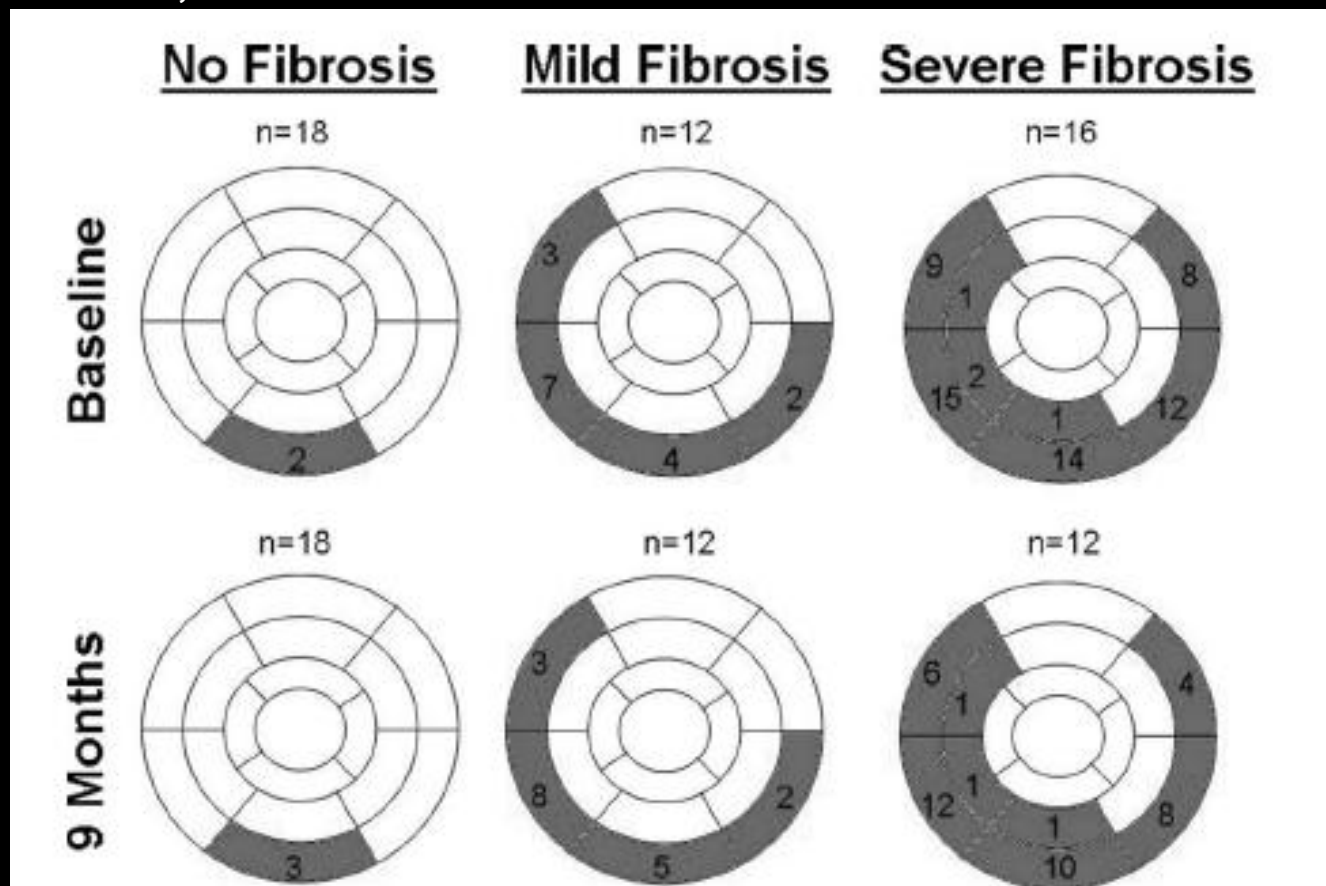
Circulation 2009;120:577-84



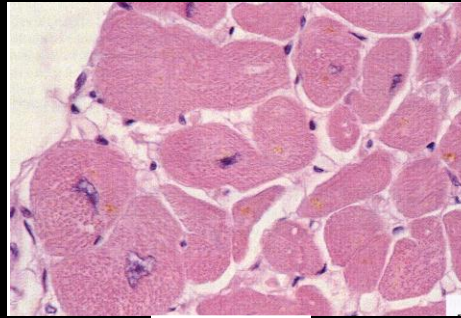
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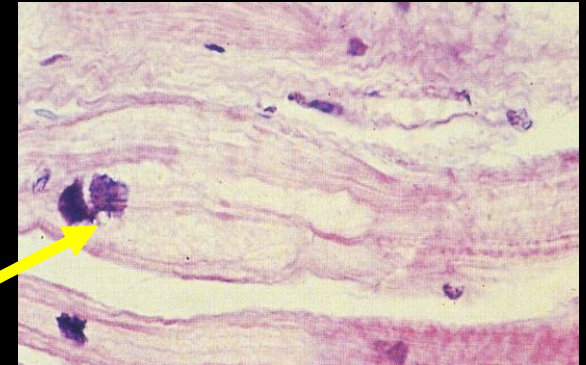
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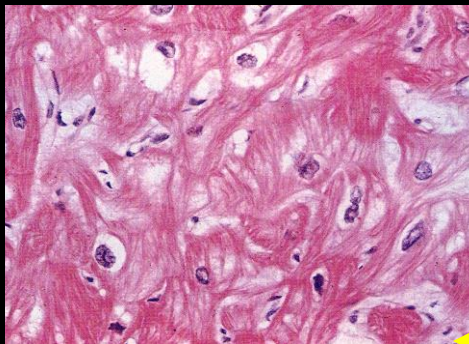
intact membrane



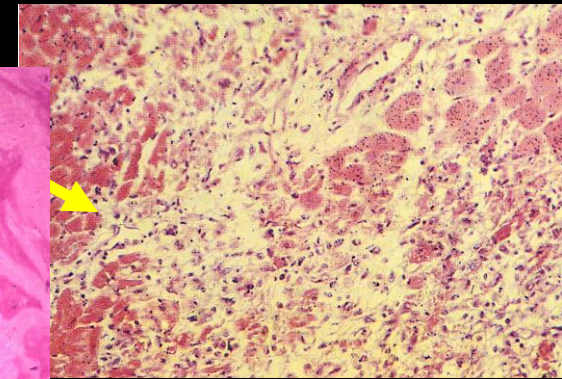
**necrotic cell
disrupted membrane**



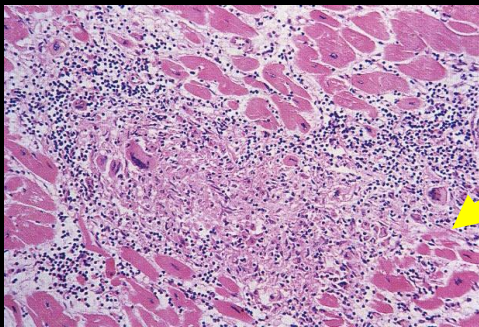
interstitial fibrosis



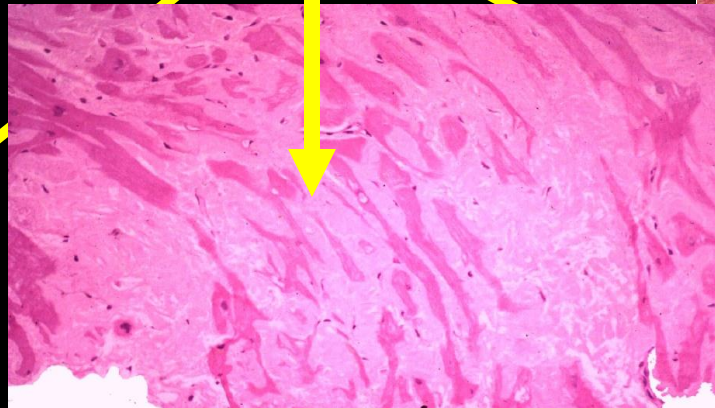
post MI scar



Myocarditis



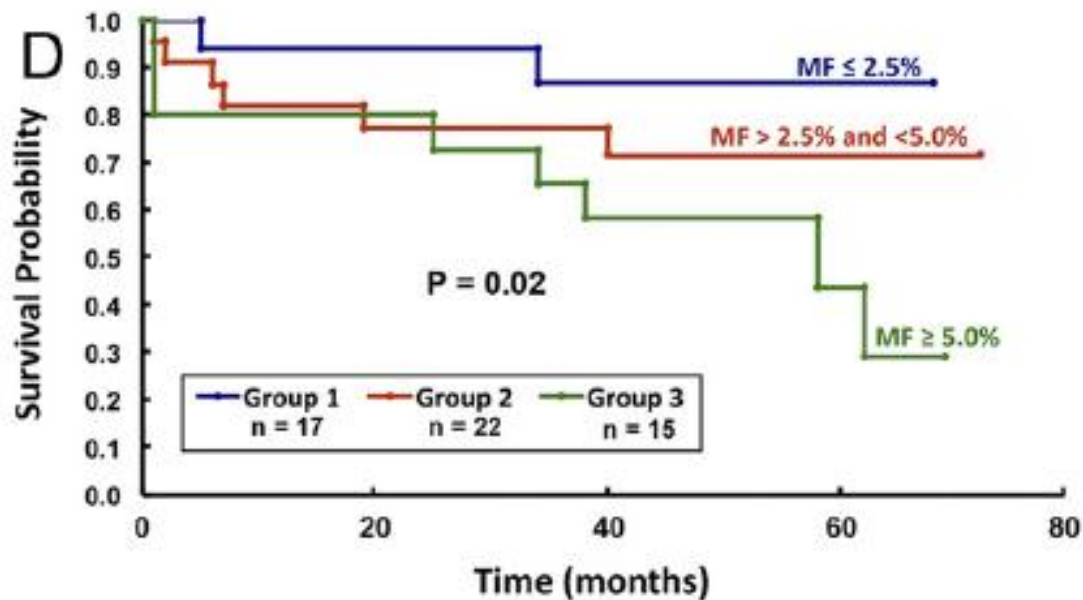
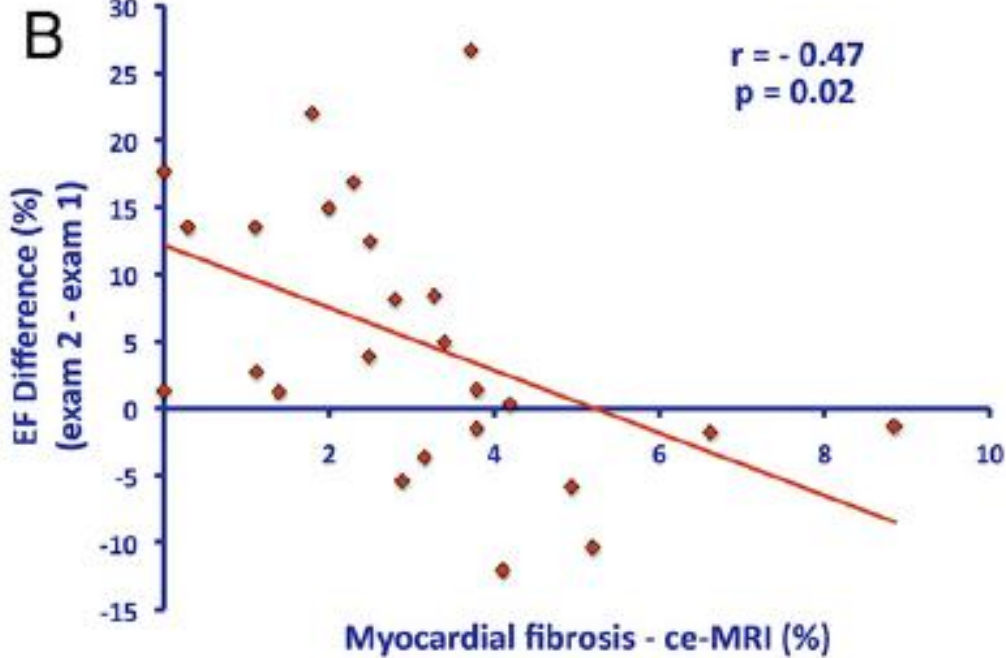
Amyloidosis





Prognostic Value of Myocardial Fibrosis by Histopathology and Cardiac Imaging

Clerio F. A.
Guilherme
Carlos Edu
São Paulo,

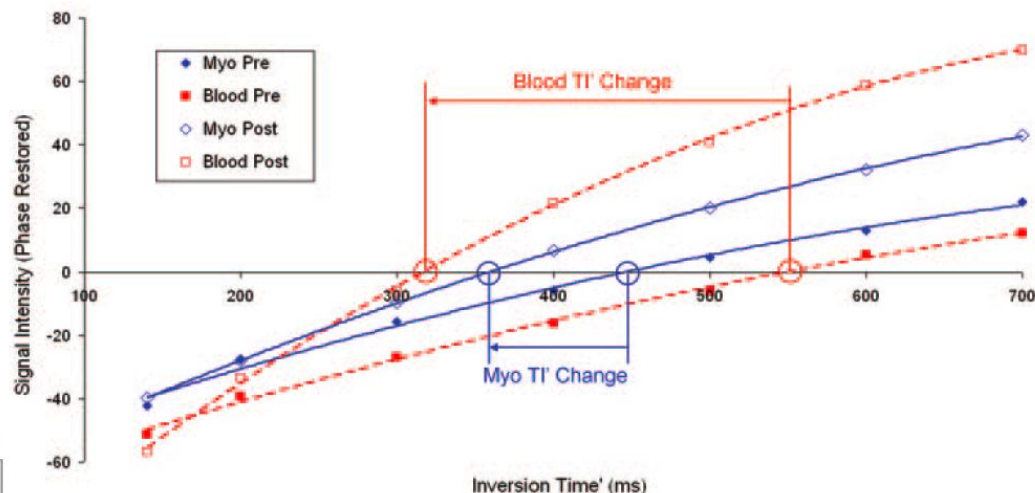
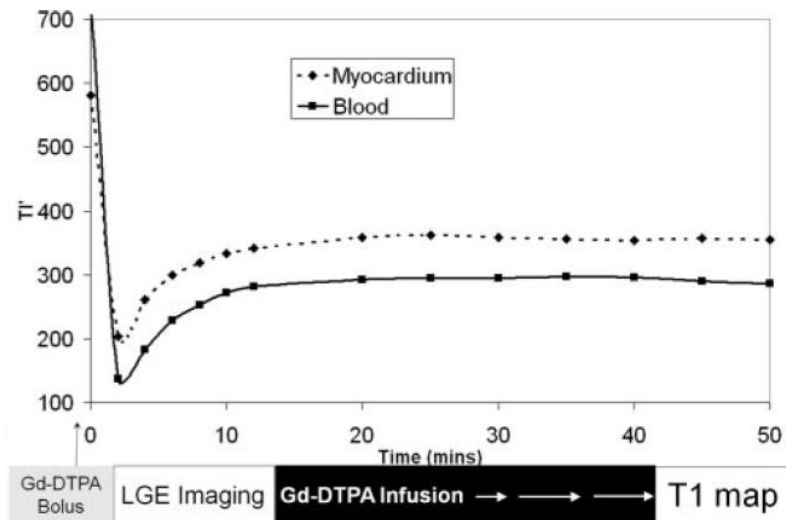
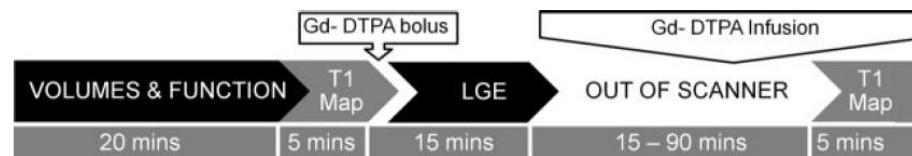


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antzeff, MD,
berg, MD,

;56:278-87)

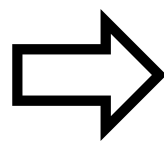
Equilibrium-Contrast CMR



$$Vd_{(m)} = (1 - \text{hematocrit}) \times \frac{(1/T1)_{\text{myo.post}} - (1/T1)_{\text{myo.pre}}}{(1/T1)_{\text{blood.post}} - (1/T1)_{\text{blood.pre}}}$$

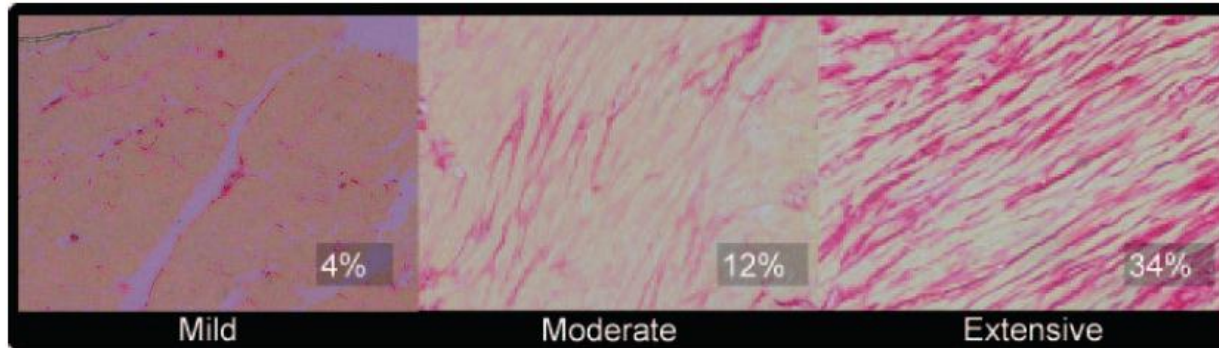
Key features:

- a bolus of Gadolinium followed by continuous infusion to achieve blood:myocardial contrast equilibrium
- a blood test to measure blood contrast
- volume of distribution (1-hematocrit)
- T1 measurement before and after contrast equilibrium to calculate changes in tissue signal

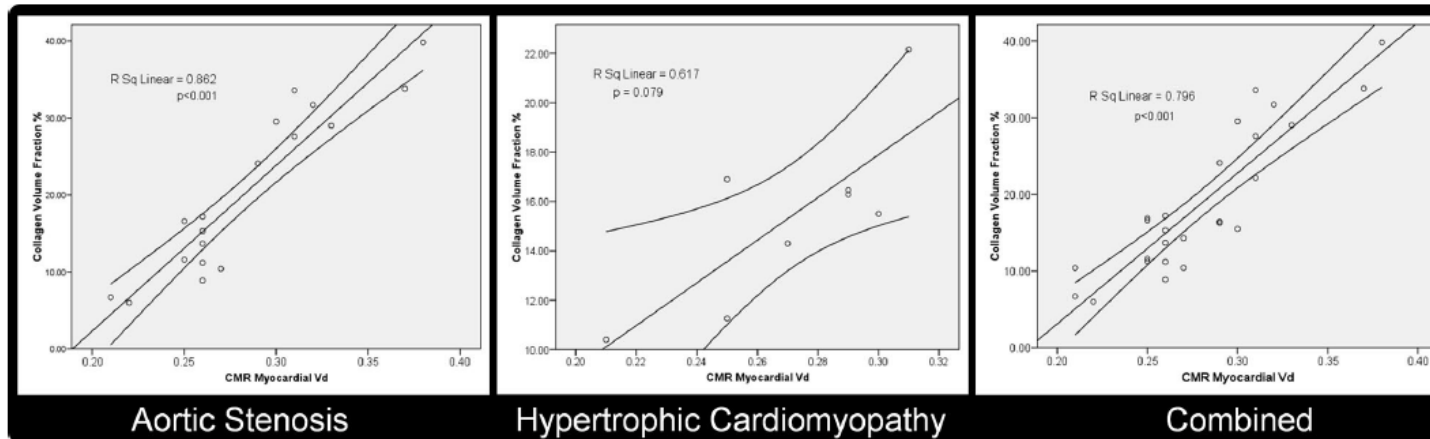


Precise estimation of myocardial contrast volume of distribution

Equilibrium-Contrast CMR



Histology in 3 biopsies from aortic stenosis patients. This demonstrates the range of fibrosis in aortic stenosis. Red is collagen (fibrosis), and the yellow counter stain is myocytes.



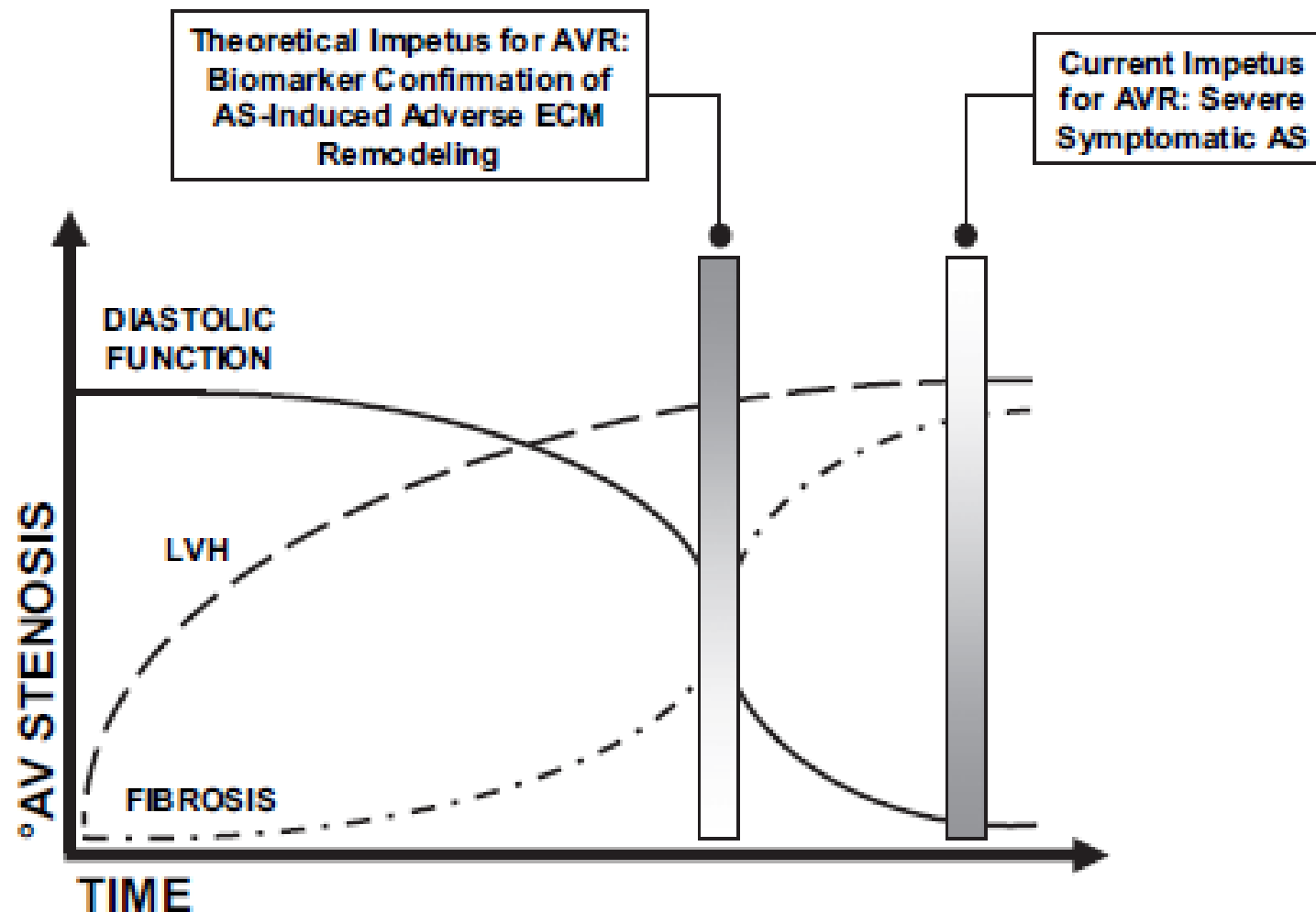
MRI-measured myocardial volume of distribution against histological CVF. Vd(m) correlates with CVF in aortic stenosis (left, n18), hypertrophic cardiomyopathy (middle, n8), and the combined population (right, n26).

Flett et al. Circulation. 2010 Jul 13;122(2):138-44.

Diffuse fibrosis could not be detected with standard LGE sequences. The contrast of the images relies on the signal difference between normal and fibrotic myocardium. In case of diffuse fibrosis this difference can be very tiny because of the widespread process of fibrosis and would result in images with homogeneous grey areas.

Myocardial remodeling with aortic stenosis and after aortic valve replacement: Mechanisms and future prognostic implications

William M. Yarbrough, MD,^a Rupak Mukherjee, PhD,^a John S. Ikonomidis, MD, PhD,^a
Michael R. Zile, MD,^{b,c} and Francis G. Spinale, MD, PhD^{a,c} J Thorac Cardiovasc Surg 2012;143:656-64



...other consequences of severe
LVH with reduced cavity volumes

Paradoxical Low-Flow, Low-Gradient Severe Aortic Stenosis Despite Preserved Ejection Fraction Is Associated With Higher Afterload and Reduced Survival

Zeineb Hachicha, MD; Jean G. Dumesnil, MD; Peter Bogaty, MD; Philippe Pibarot, DVM, PhD

(*Circulation*. 2007;115:2856-2864.)

- indexed AVA $< < 0.6 \text{ cm}^2/\text{m}^2$,
- EF $> 50\%$,
- SVi $< 35 \text{ mL}/\text{m}^2$
- a higher level of global LV haemodynamic load reflected by higher valvulo-arterial impedance (Zva);
- smaller and relatively thicker ventricles;
- lower values for LV mid-wall radius shortening

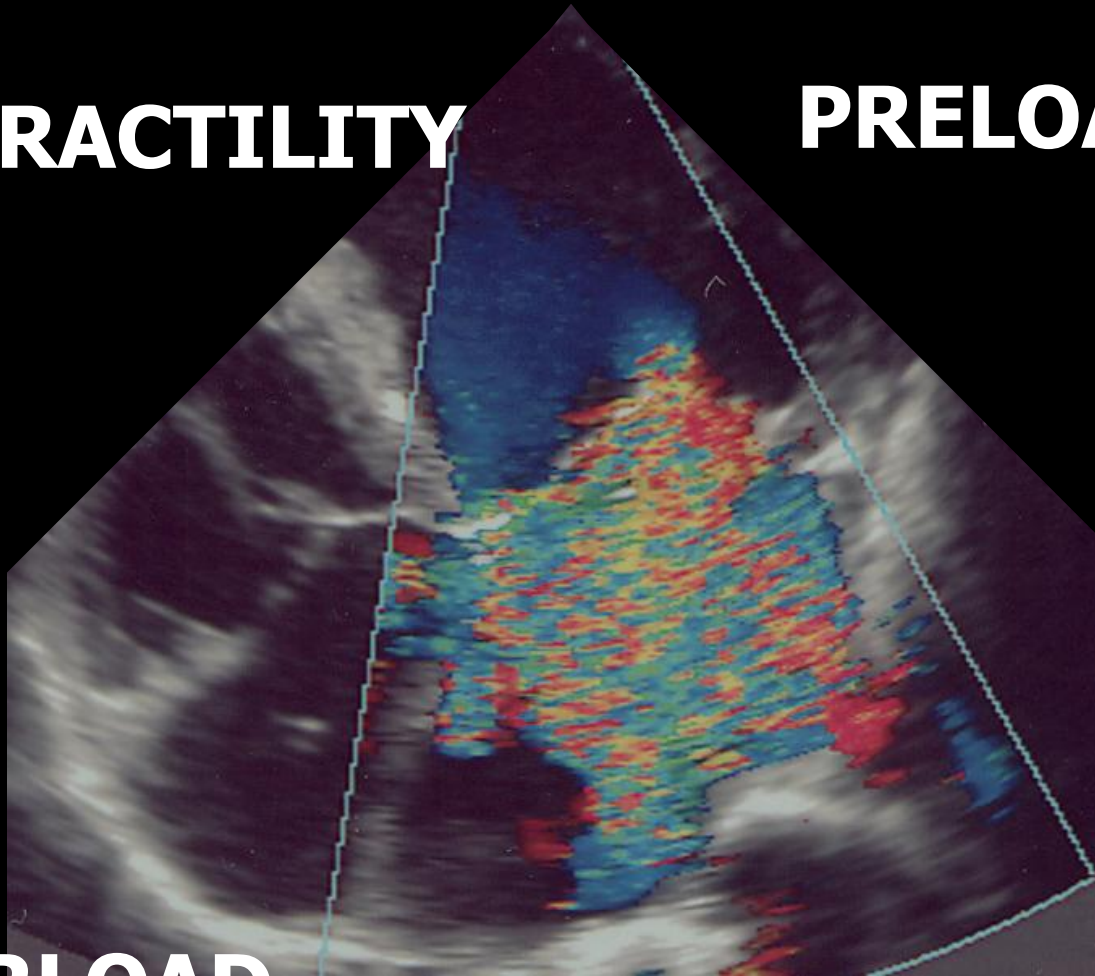
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CONTRACTILITY

PRELOAD



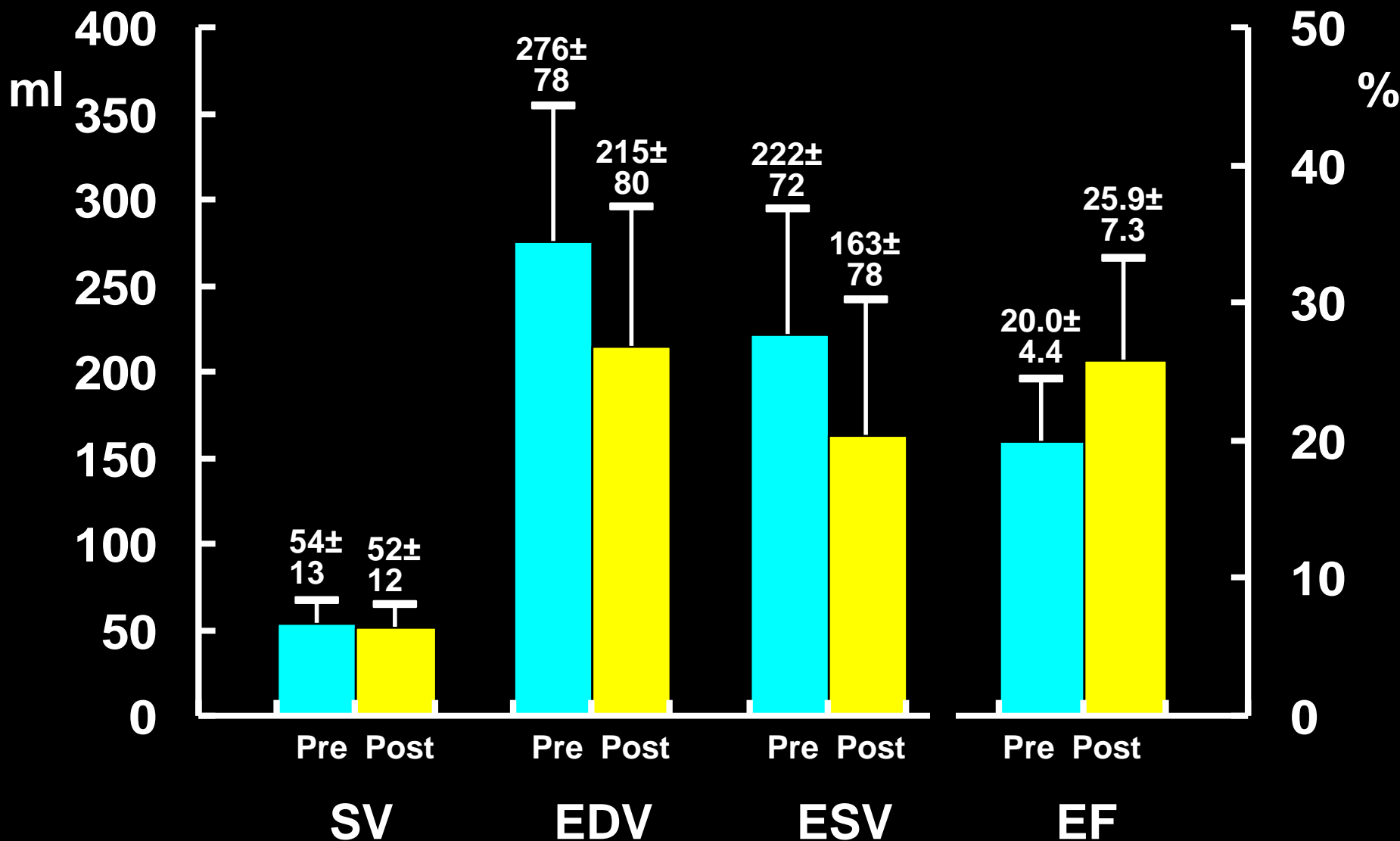
AFTERLOAD

**LV systolic wall stress
arterial & LA impedance (hydraulic load)**

Improvement Following Correction of Secondary Mitral Regurgitation in End-Stage Cardiomyopathy With Mitral Annuloplasty

David S. Bach, MD, and Steven F. Bolling, MD

Am J Cardiol 1996; 78: 966-969

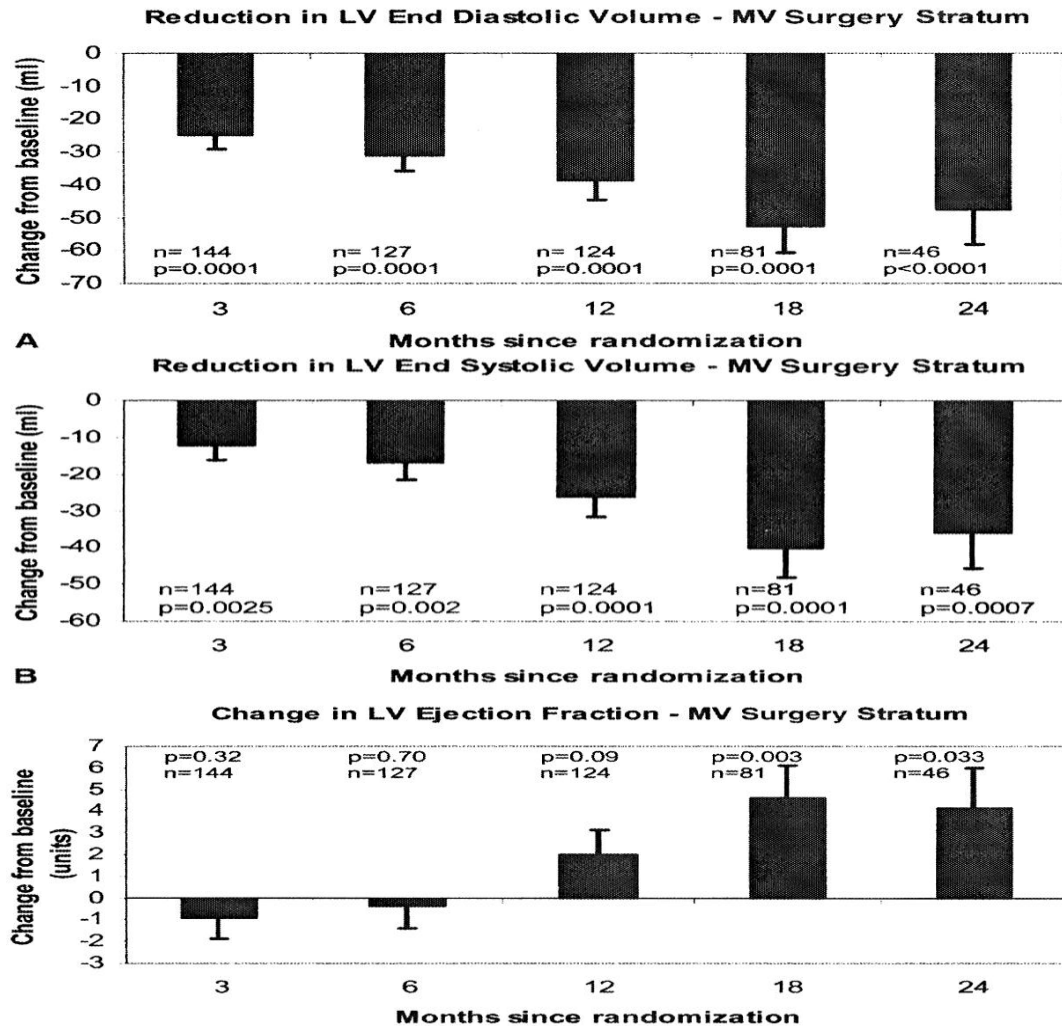


Mitral valve surgery in heart failure: Insights from the Acorn Clinical Trial

Michael A. Acker, MD,^a Steven Bolling, MD,^b Richard Shemin, MD,^c James Kirklin, MD,^d Jae K. Oh, MD,^e Douglas L. Mann, MD,^f Mariell Jessup, MD,^g Hani N. Sabbah, PhD,^h Randall C. Starling, MD,ⁱ and Spencer H. Kubo, MD,^j for the Acorn Trial Principal Investigators and Study Coordinators

J Thorac Cardiovasc Surg 2006; 132: 569-577

Basal Values: EDV 270 ± 12 ; EF 24 ± 9



Acute and 12-Month Results With Catheter-Based Mitral Valve Leaflet Repair

The EVEREST II (Endovascular Valve
Edge-to-Edge Repair) High Risk Study

Patrick L. Whitlow, MD,* Ted Feldman, MD,† Wes R. Pedersen, MD,‡ D. Scott Lim, MD,§
Robert Kipperman, MD,|| Richard Smalling, MD, PhD,¶ Tanvir Bajwa, MD,#
Howard C. Herrmann, MD,** John Lasala, MD, PhD,†† James T. Maddux, MD,‡‡
Murat Tuzcu, MD,* Samir Kapadia, MD,* Alfredo Trento, MD,§§ Robert J. Siegel, MD,§§
Elyse Foster, MD,|||| Donald Glower, MD,¶¶ Laura Mauri, MD,## Saibal Kar, MD,§§
on behalf of the EVEREST II Investigators

(J Am Coll Cardiol 2012;59:130–9)

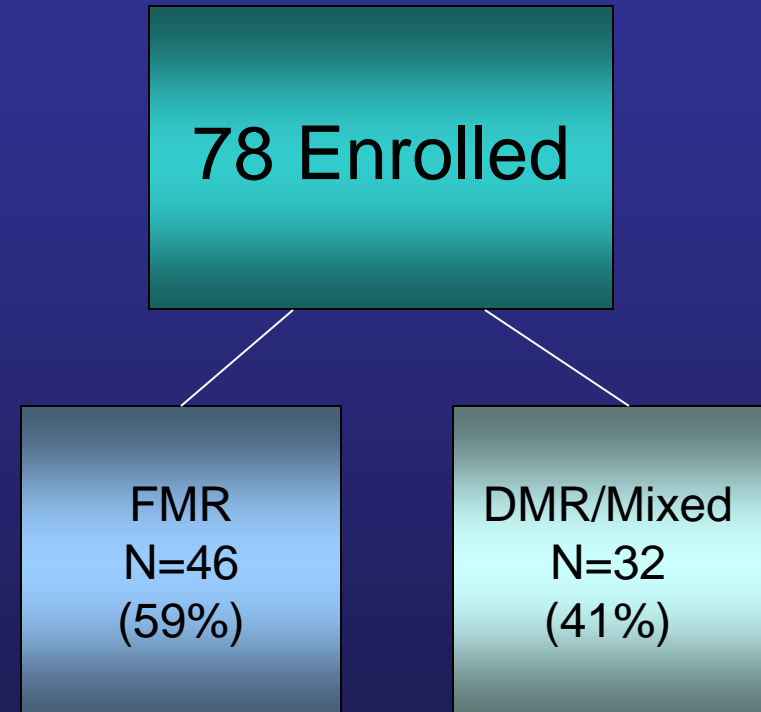
EVEREST II HRR: Study Algorithm

KEY INCLUSION CRITERIA

- Predicted procedural mortality risk $\geq 12\%$ (STS calculated or Surgeon estimated based on pre-specified co-morbidities)
- Symptomatic 3+ or 4+ MR
- Degenerative or Functional

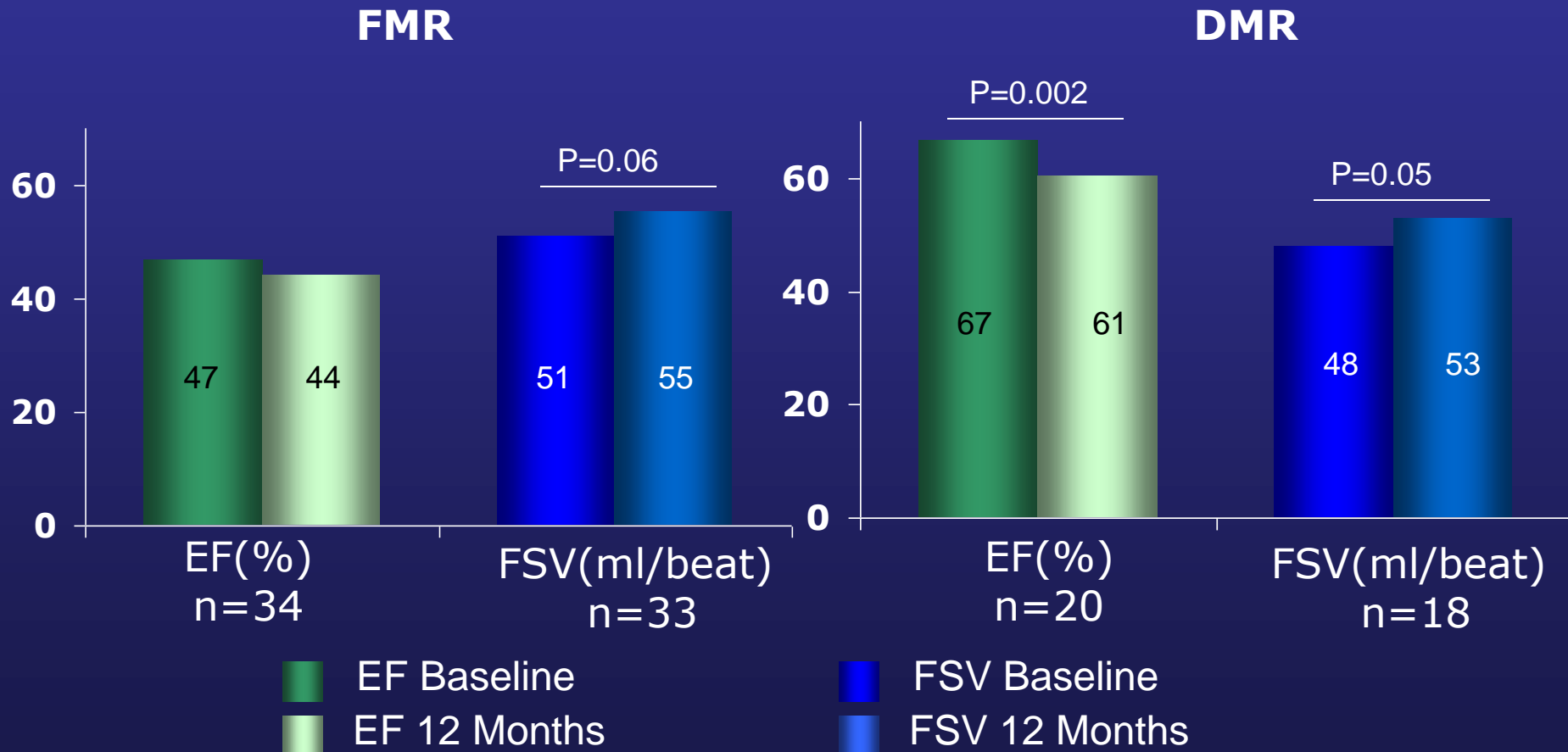
KEY EXCLUSION CRITERIA

- $EF \leq 20\%$ and/or LVESD $> 60\text{mm}$
- MVA $< 4\text{cm}^2$
- Leaflet anatomy unsuitable for MitraClip device



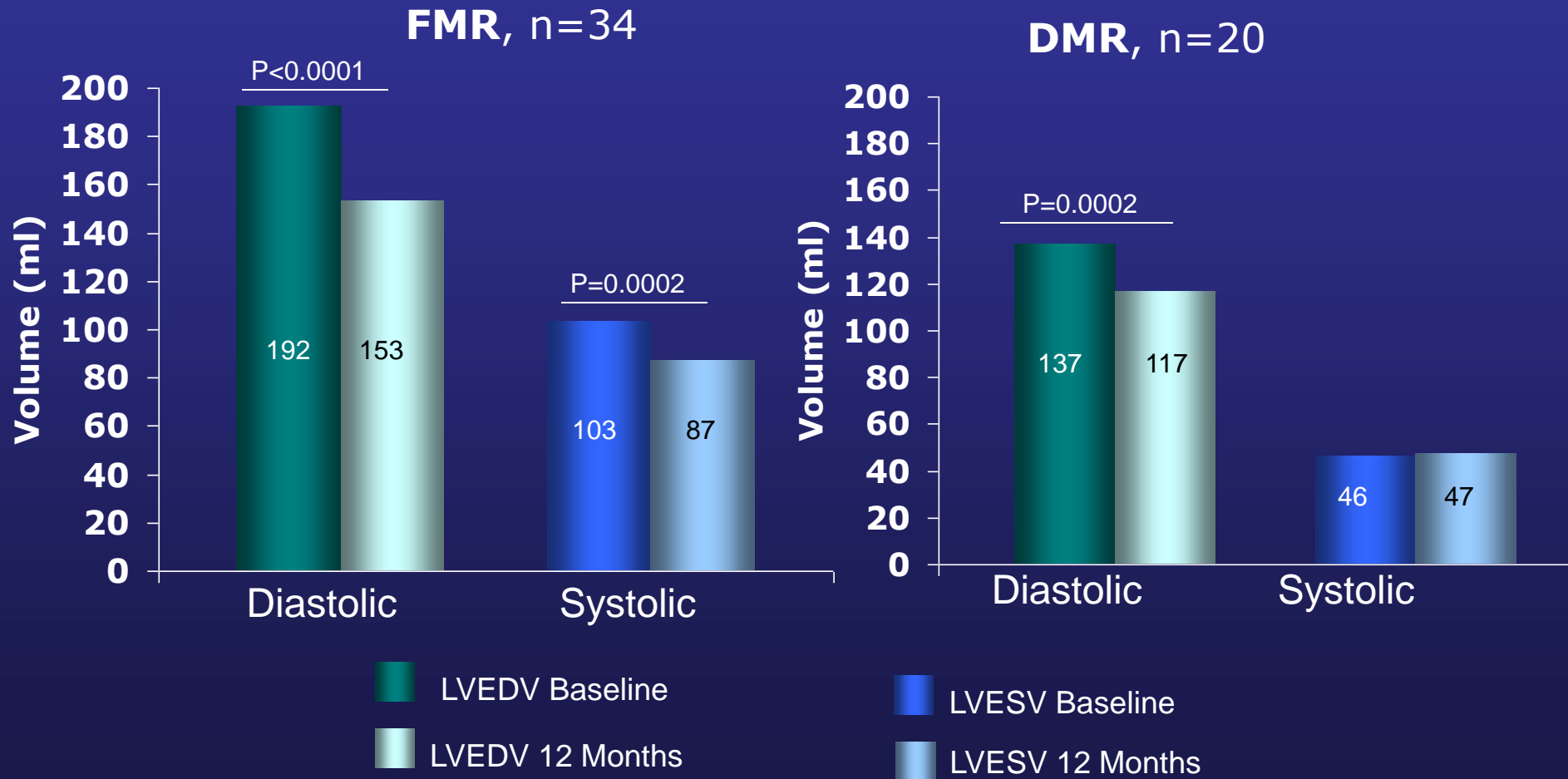
HRR: Ejection Fraction/Forward Stroke Volume

MitraClip therapy results in Improved LV Efficiency



HRR: LV Volume

MitraClip therapy results in reverse LV remodeling



12 month Matched data

Cardiac Remodeling in VHD

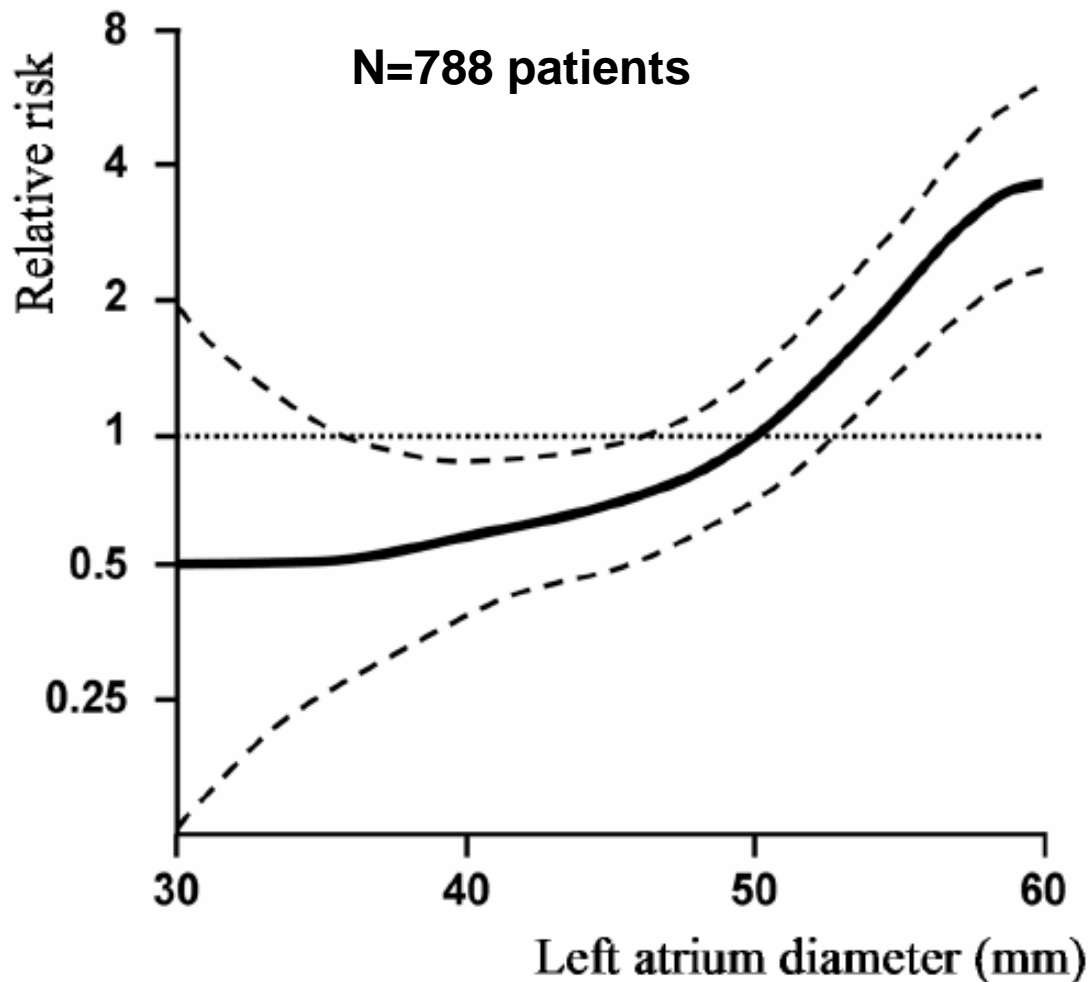
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Left Atrial Size Is a Potent Predictor of Mortality in Mitral Regurgitation Due to Flail Leaflets

Results From a Large International Multicenter Study

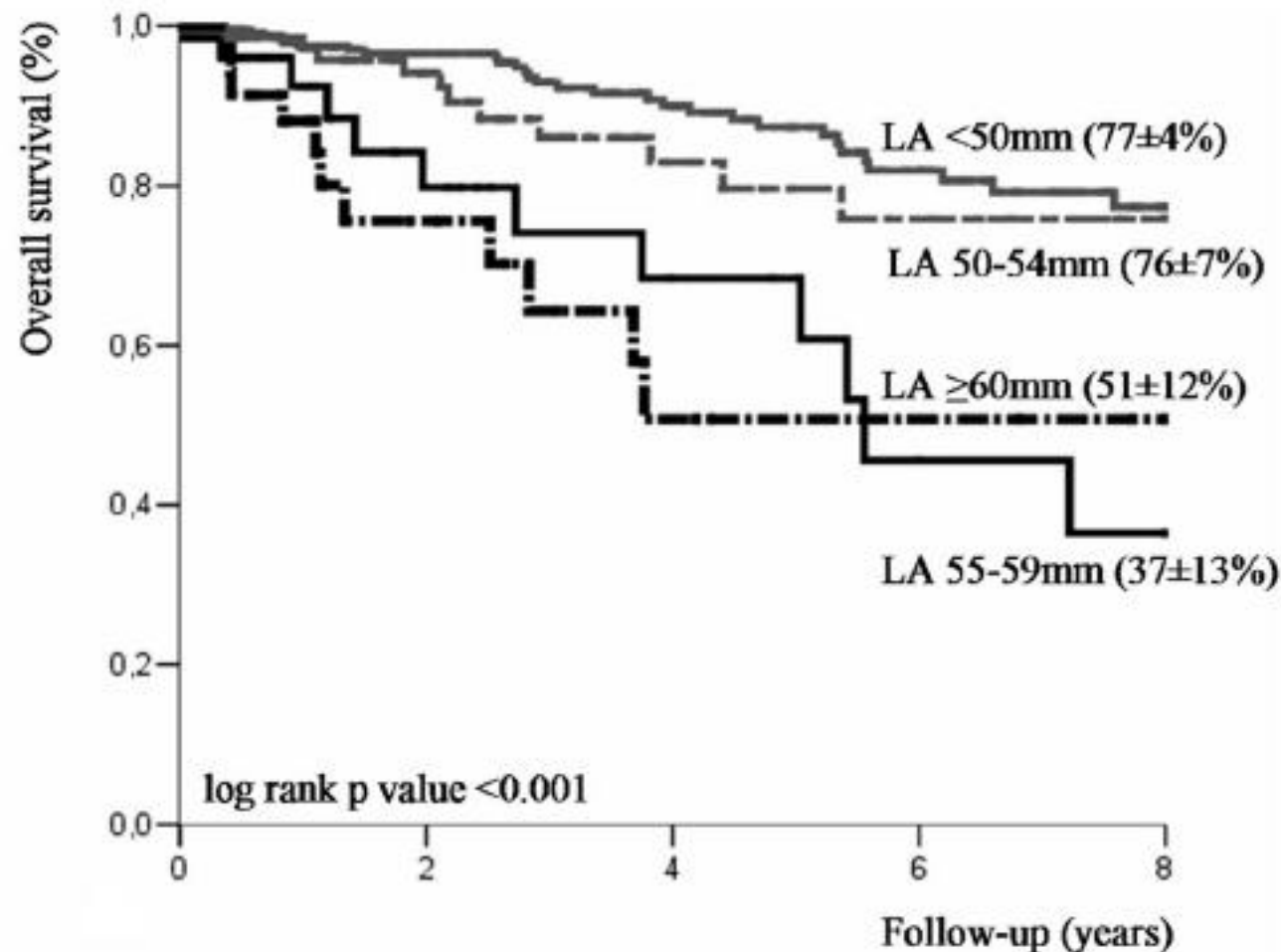
Dan Rusinaru, et al on behalf of the Mitral Regurgitation International Database (MIDA) Investigators
(*Circ Cardiovasc Imaging*. 2011;4:473-481.)



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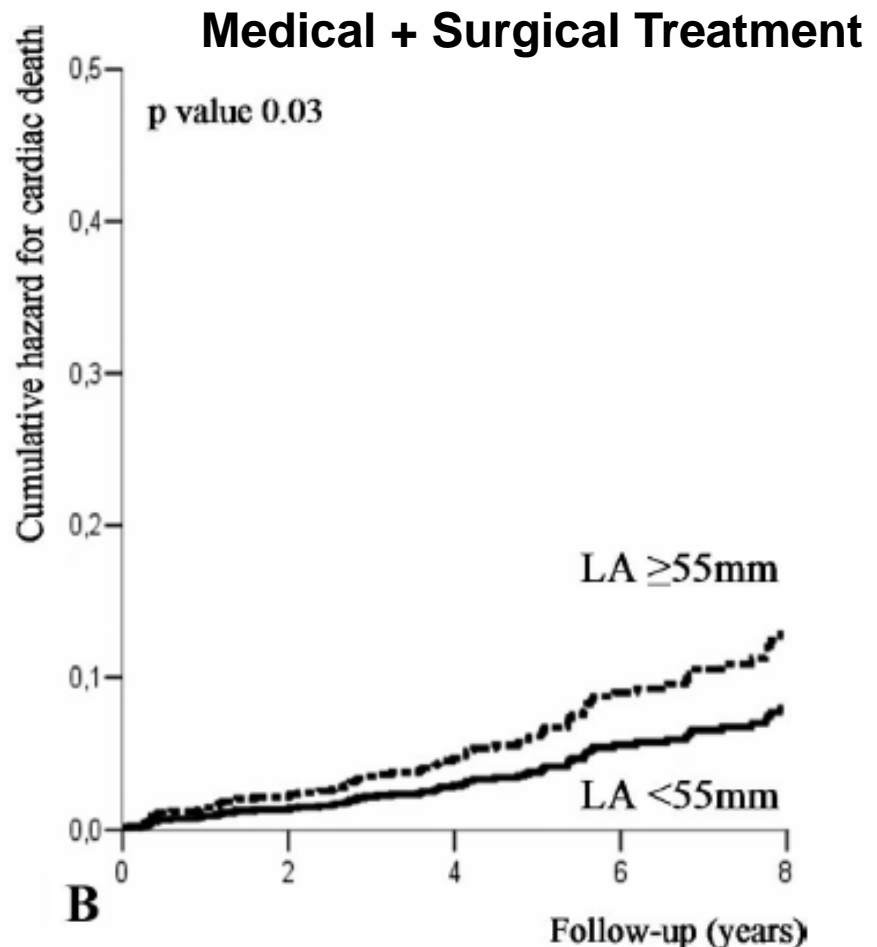
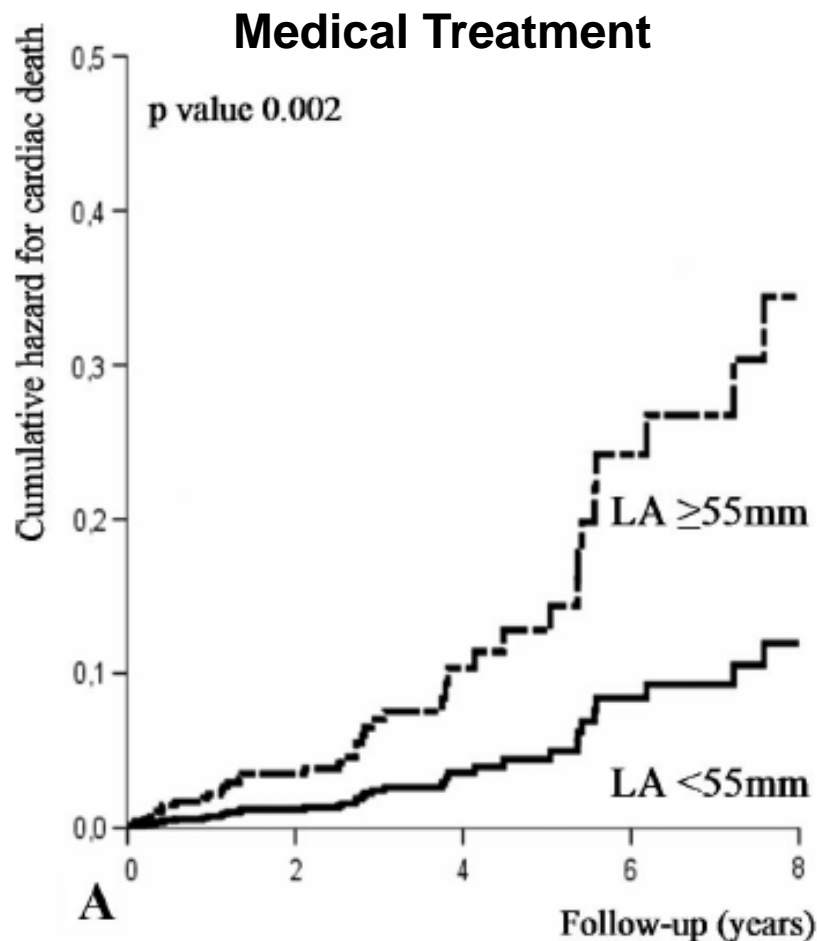
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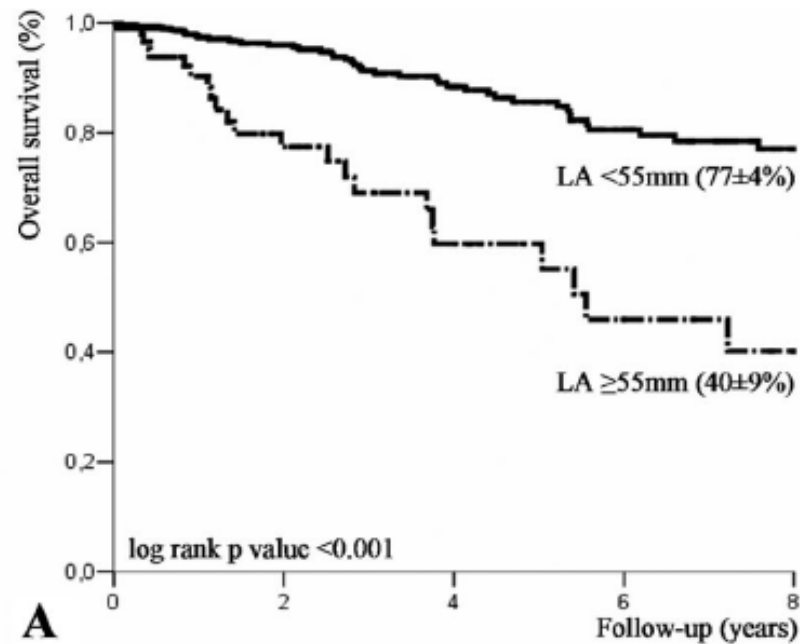
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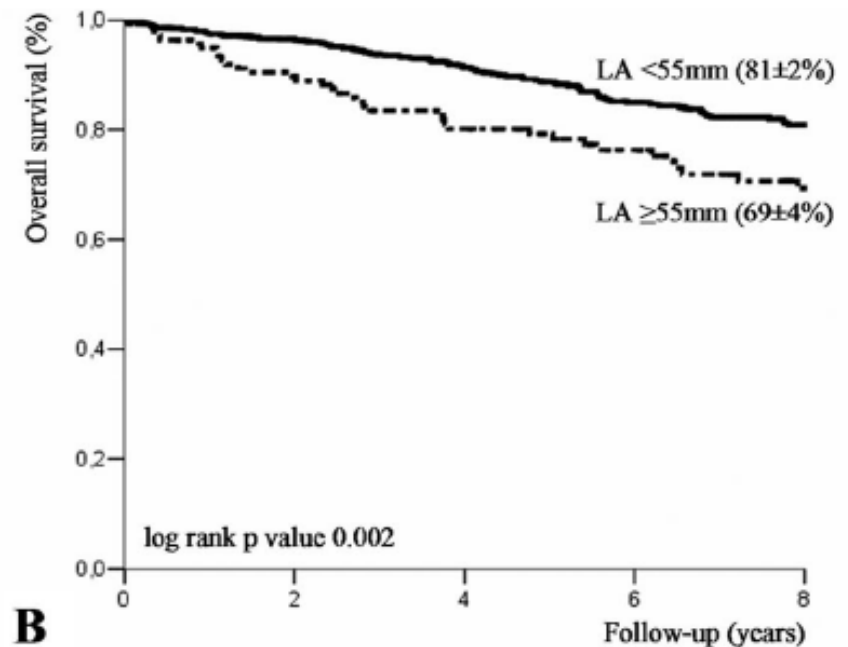
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Medical Treatment



Medical + Surgical Treatment

Cardiac Remodeling and Therapeutical Decisions in VHD

