

PROGNÓSTICO DA ESTENOSE AÓRTICA

PREDITORES DE GRAVIDADE E DE RISCO

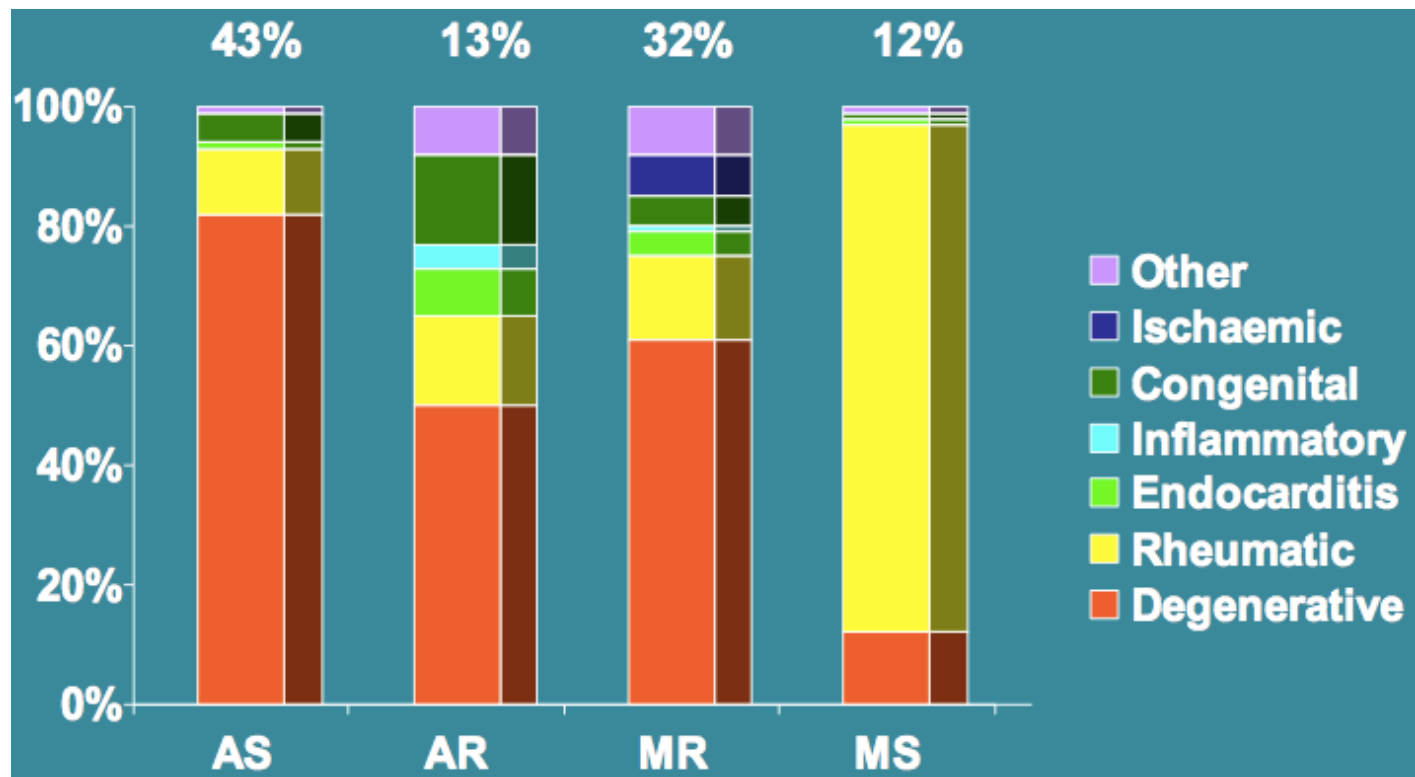
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INTERNO CARDIOLOGIA
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Novas Fronteiras em Cardiologia
11 a 13 de Fevereiro.2011
Hotel Vila Galé Ericeira

Epidemiologia



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Table 3. Clinical Factors Associated With Aortic Stenosis or Sclerosis by Stepwise Multivariate Regression

Variable				
Age				
Male gender				
Lp(a)				
Height (cm)				
History of hypertension				
Present smoking				
LDLc (mg/dl)				
*± 75th vs. 25th percentile				
LDLc = low density lipoprotein cholesterol				
Stepwise regression				
TABLE 1. BASE-LINE CHARACTERISTICS OF THOSE WITH AORTIC STENOSIS OR SCLEROSIS				
CHARACTERISTIC				
Mean ±SD age — yr				
Sex — no. (%)				
Female				
Male				
Current smoking — no. (%)				
History of hypertension — no. (%)				
History of diabetes — no. (%)	446 (11.4)	211 (13.1)	6 (6.5)	0.90
Coronary heart disease — no. (%)	673 (17.2)	383 (23.8)	22 (23.9)	<0.001
Renal insufficiency — no. (%)*	182 (4.8)	123 (8.1)	16 (17.8)	<0.001
Impaired ability to perform activities of daily living — no. (%)†	1039 (26.6)	526 (32.8)	28 (30.8)	<0.001

Table 2. Bivariate Relations of Clinical Variables to Aortic Valve Abnormalities

	Normal (n = 3,709)	Sclerosis/ Stenosis (n = 1,405)	p Value
A. Continuous Variables			
Age (yr)	72.0 ± 5.2	74.7 ± 6.1	<0.0001
Height (cm)	164.8 ± 9.5	165.2 ± 9.7	NS
Weight (kg)	73 ± 14.6	71.7 ± 13.8	NS
Waist circumference (cm)	93.7 ± 13.1	94.0 ± 12.3	NS
Hip circumference (cm)	101.9 ± 10.0	100.7 ± 8.8	0.0002
		324.0 ± 70.3	NS
		123.4 ± 36.6	0.009
		122.9 ± 38.4	NS
		214.3 ± 39.7	NS
		145.9 ± 89.0	NS
		52.3 ± 15.4	<0.0001
		133.9 ± 35.9	NS
		62.3 ± 71.4	<0.001
		112.5 ± 40.7	0.007
		17.8 ± 32.9	NS
		79.6 ± 58.4	0.002
		150.7 ± 62.5	NS
		4.0 ± 0.3	NS
		4.2 ± 0.4	NS
		5.8 ± 1.6	0.0003
		1.1 ± 0.4	<0.0001
		138.0 ± 22.1	<0.0001
		69.7 ± 12.0	NS
B. Categorical Variables			
		608 (44%)	NS
		607 (44%)	
		162 (12%)	
		710 (52%)	0.001
		668 (48%)	
		1,241 (89%)	NS
		148 (11%)	
	No	1,928 (86%)	607 (90%)
	Yes	300 (14%)	67 (10%)
Coronary heart disease‡			NS (0.016)
	No	2,838 (77%)	987 (70%)
	Yes	871 (23%)	418 (30%)
			<0.0001

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TABLE 5. RATES AND RELATIVE RISK OF CARDIOVASCULAR EVENTS AMONG THE 4271 SUBJECTS WITHOUT PREVALENT CARDIOVASCULAR DISEASE AT ENTRY, ACCORDING TO THE PRESENCE OR ABSENCE OF AORTIC SCLEROSIS.*

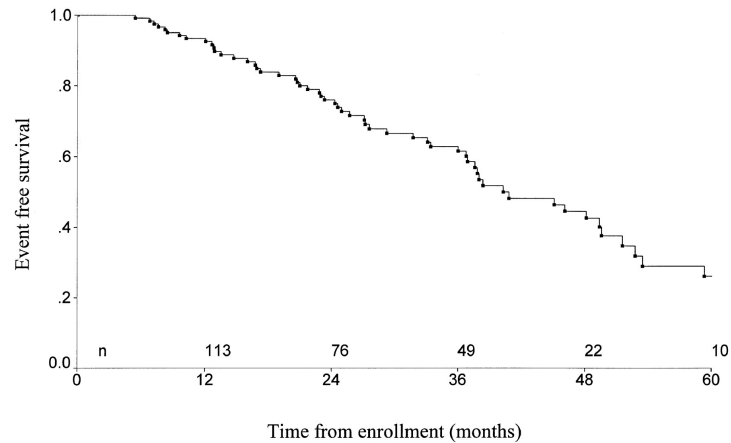
EVENT	TOTAL NO. OF EVENTS	NORMAL VALVES	AORTIC SCLEROSIS	RELATIVE RISK (95% CONFIDENCE INTERVAL)	
				ADJUSTED FOR AGE AND SEX	ADJUSTED FOR AGE, SEX, AND ASSOCI- ATED BASE-LINE FACTORS†
Myocardial infarction	254			1.46 (1.12–1.90)	1.40 (1.07–1.83)
No. of events		166	88		
Event rate/1000 person-yr		9	16		
Angina	478			1.23 (1.00–1.50)	1.17 (0.95–1.43)
No. of events		338	140		
Event rate/1000 person-yr		19	26		
Congestive heart failure	326			1.33 (1.05–1.68)	1.28 (1.01–1.63)
No. of events		215	111		
Event rate/1000 person-yr		12	20		
Stroke	260			1.31 (1.01–1.71)	1.25 (0.96–1.64)
No. of events		173	87		
Event rate/1000 person-yr		10	16		

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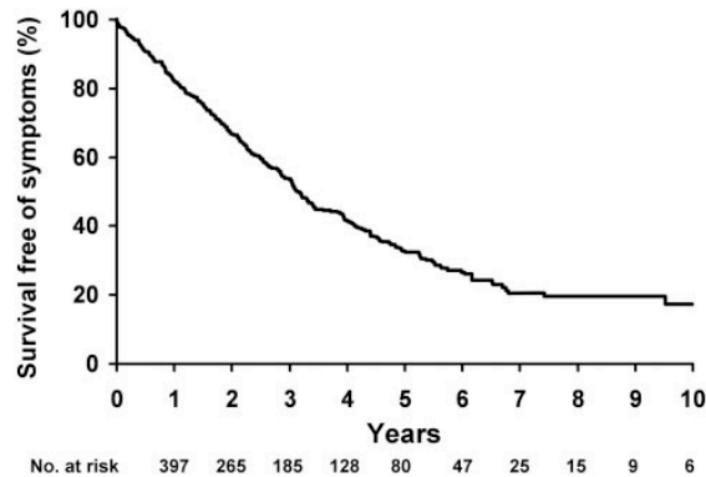
TABLE 3. RATES AND RELATIVE RISKS OF DEATH FROM ANY CAUSE AND OF DEATH FROM CARDIOVASCULAR CAUSES AMONG THE 4073 SUBJECTS WITH NO CORONARY HEART DISEASE AT ENTRY, ACCORDING TO THE PRESENCE OR ABSENCE OF AORTIC SCLEROSIS.*

VARIABLE	TOTAL NO. OF SUBJECTS	RATE/1000 PERSON-YR	RELATIVE RISK (95% CONFIDENCE INTERVAL)	
			ADJUSTED FOR AGE AND SEX	ADJUSTED FOR AGE, SEX, AND ASSOCI- ATED BASE-LINE FACTORS†
Death from any cause				
Normal aortic valves	2958	19	1.42 (1.19–1.70)	1.35 (1.12–1.61)
Aortic sclerosis	1115	37		
Death from cardiovascular causes				
Normal aortic valves	2958	6	1.66 (1.23–2.23)	1.52 (1.12–2.05)
Aortic sclerosis	1115	14		

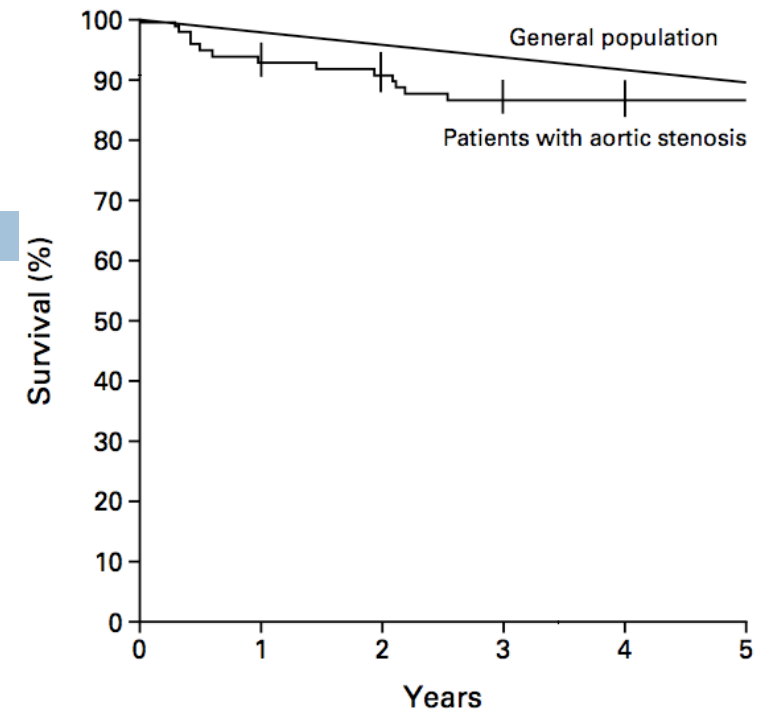
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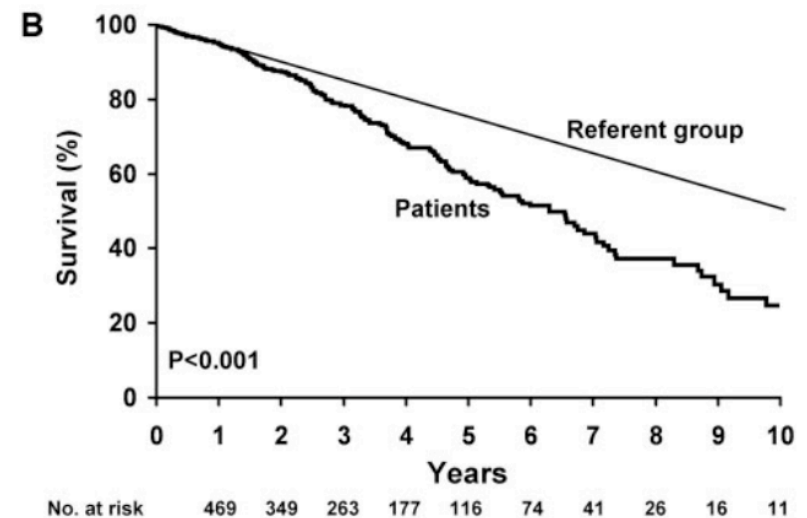
Otto CM et al. *Circulation* 1997;95:2262



Pellikka P et al. *Circulation* 2005;111:3290

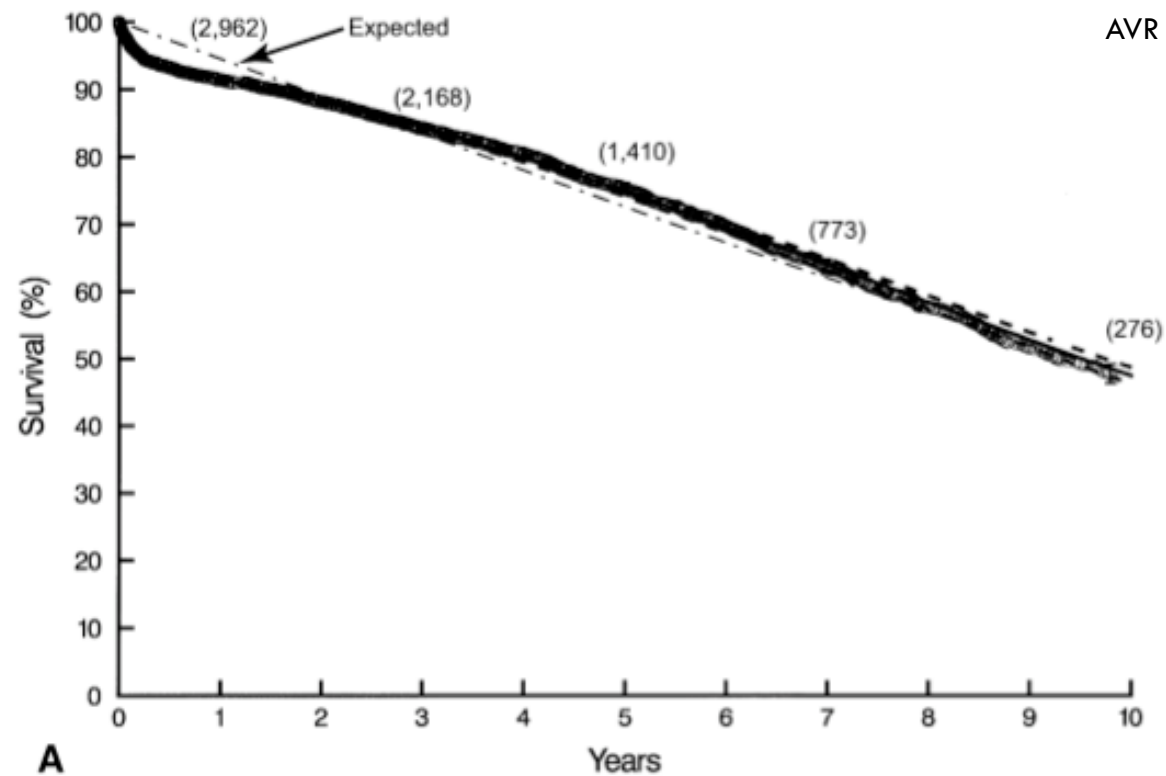


Rosenhek R et al. *N Engl J Med* 2000;343:611



Pellikka P et al. *Circulation* 2005;111:3290

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Table 8 Operative mortality and morbidity of interventions according to the underlying valve disease

	Aortic stenosis n=512	Aortic regurgitation n=119	Mitral stenosis n=112	Mitral regurgitation n=155	Multiple valve disease n=185	Previous conservative intervention n=47	Previous prosthetic replacement n=117
Mortality (%)	3.1	3.4	0.9	3.9	6.5	2.1	6.2
Major Bleeding (%)	7.7	2.5	2.7	7.7	10.8	4.3	12.0
Tamponade (%)	2.9	1.7	0.9	2.6	4.3	0	1.7
Embolism ^a (%)	3.1	2.5	2.7	7.1	2.2	2.1	3.4
Prosthetic thrombosis ^b (%)	0.2	0	0.9	0.6	0	0	0
Myocardial infarction (%)	1.0	0	0	0.6	0.5	0	1.7
Mediastinitis (%)	0.6	0.8	0	1.3	2.2	0	0

The 16 patients operated on for right-sided valve disease are not detailed. Major bleeding is defined by bleeding leading to death, surgery, or transfusion.

^aincluding transient ischaemic attacks.

^bocclusive or non-occlusive thrombosis.

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Table 4 Definitions of risk factors in the EuroSCORE

Risk factor	EuroSCORE definition	Points
Age	<60 years	0
	60–64	1
	65–69	2
	70–74	3
	75–79	4
	80–84	5
	85–89	6
	90–94	7
	≥95	8
Sex	Female	1
Chronic pulmonary disease	Long-term use of bronchodilators or steroids for lung disease	1
Extracardiac arteriopathy	Claudication, carotid occlusion or stenosis >50%, previous or planned intervention on the abdominal aorta, limb arteries or carotids	2
Neurological dysfunction	Severely affecting ambulation or day-to-day functioning	2
Previous cardiac surgery	Requiring opening of the pericardium	3
Serum creatinine	>200 µM/L preoperatively	2
Active endocarditis	Patient still under antibiotic treatment for endocarditis at the time of surgery	3
Critical preoperative state	Ventricular tachycardia, fibrillation or aborted sudden death, preoperative cardiac massage, preoperative ventilation, preoperative inotropic support, intra-aortic balloon counterpulsation, or preoperative acute renal failure (anuria or oliguria <10 mL/h)	3
Unstable angina	Rest angina requiring intravenous nitrates until arrival in the anaesthetic room	2
LV dysfunction	Moderate (LVEF 30–50%)	1
	Poor (LVEF <30%)	3
Recent MI	<90 days	2
Pulmonary hypertension	Systolic pulmonary artery pressure >60 mmHg	2
Emergency	Carried out on referral before the beginning of the next working day	2
Other than isolated CABG	Major cardiac procedure other than or in addition to CABG	2
Surgery on thoracic aorta	For disorder of ascending, arch, or descending aorta	3
Post-infarct septal rupture		4

CABG = coronary artery bypass grafting, LV = left ventricular, EF = ejection fraction, MI = myocardial infarction.

The estimation of the operative mortality for a given patient can be obtained using a calculator accessible at <http://www.euroscore.org/calc.html>.

From Roques *et al.*³⁵

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Table 5
Determinants of operative mortality for adult patients undergoing open heart surgery

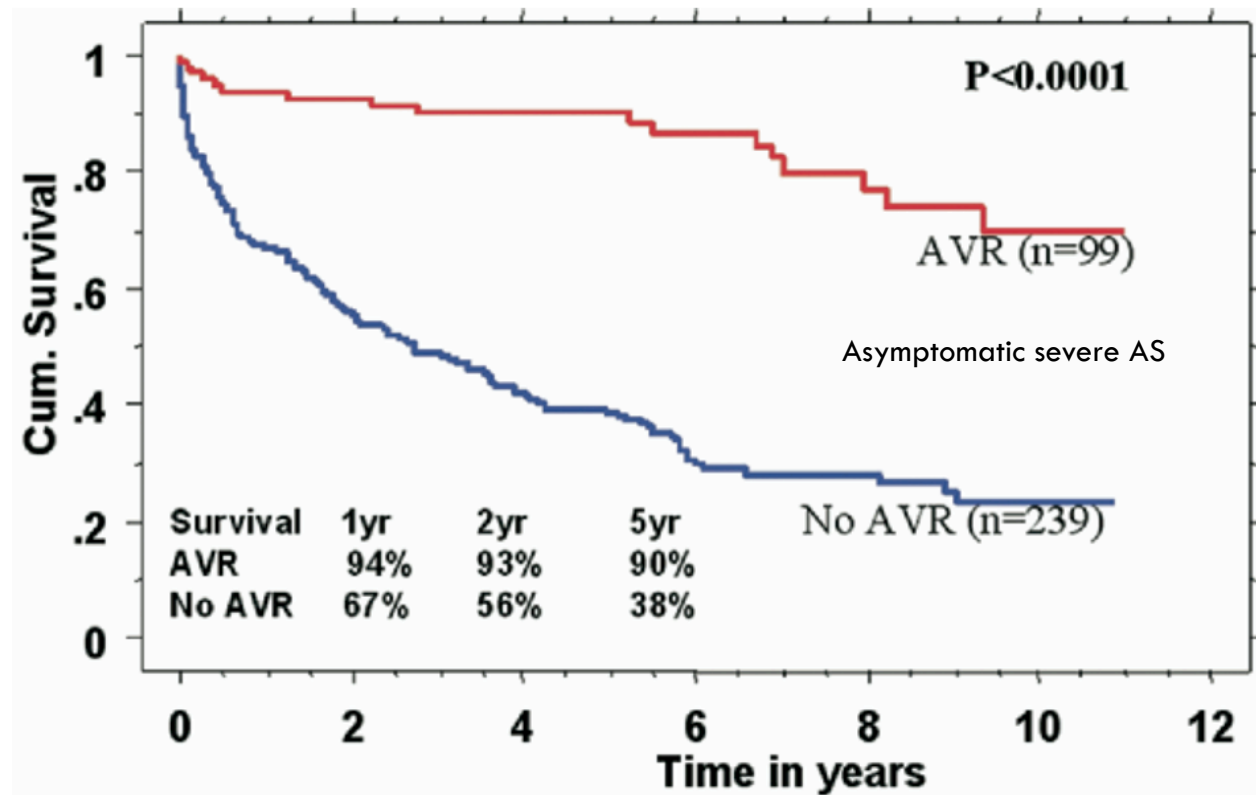
Variable	Odds ratio	Standard error	P value
Age (continuous)	1.1	0.007	0.001
Female	1.4	0.128	0.001
Serum creatinine > 200	1.9	0.256	0.001
Extracardiac arteriopathy	1.9	0.376	0.001
Pulmonary disease	1.6	0.284	0.006
Neurological dysfunction	2.3	0.584	0.001
Previous cardiac surgery	2.6	0.324	0.001
Recent myocardial infarct	1.6	0.208	0.001
LVEF 30–50%	1.5	0.138	0.001
LVEF < 30%	2.5	0.340	0.001
Chronic congestive heart failure	1.5	0.179	0.001
Systolic pulmonary pressure > 60	2	0.423	0.001
Active endocarditis	2.5	0.678	0.001
Unstable angina	1.5	0.202	0.001
Urgent operation	1.6	0.173	0.001
Emergency operation	2.8	0.440	0.001
Critical preoperative state	2.2	0.319	0.001
Ventricular septal rupture	3.8	1.735	0.002
Non-coronary surgery	1.6	0.170	0.001
Thoracic aortic surgery	3.2	0.650	0.001

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Indications for Surgery in Asymptomatic Aortic Stenosis

	Class
Asymptomatic patients with severe AS and systolic LV dysfunction (LV EF < 50%) unless due to other cause	IC
Asymptomatic patients with severe AS and abnormal exercise test showing symptoms on exercise	IC
Asymptomatic patients with severe AS and moderate to severe valve calcification, and a rate of peak velocity progression ≥ 0.3 m/sec. per year	IIaC
Asymptomatic patients with severe AS and abnormal exercise test showing fall in blood pressure below baseline	IIaC
Asymptomatic patients with severe AS and abnormal exercise test showing complex ventricular arrhythmias	IIbC
Asymptomatic patients with severe AS and excessive LV hypertrophy (≥ 15 mm) unless this is due to hypertension	IIbC

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Factores Prognósticos – Clínicos

Table 4. Independent Predictors of Survival of Nonsurgically Managed Patients Without Pulmonary Artery Pressure in the Model

Age (per year)
Hypertension
Congestive heart failure
Chronic renal insufficiency
Ejection fraction

Varada

Table 4. Independent Predictors of Survival of Nonsurgically Managed Patients Without Pulmonary Artery Pressure in the Model

Variable
Age (per 1 year)
LV ejection fraction
Chronic renal insufficiency
Beta blocker use
Statin use

- ☐ Idade
- ☐ Sexo
- ☐ ICC
- ☐ Classe funcional NYHA
- ☐ Síndrome metabólico
- ☐ Diabetes mellitus
- ☐ Insuficiência renal crônica / Hemodiálise
- ☐ Doença coronária significativa

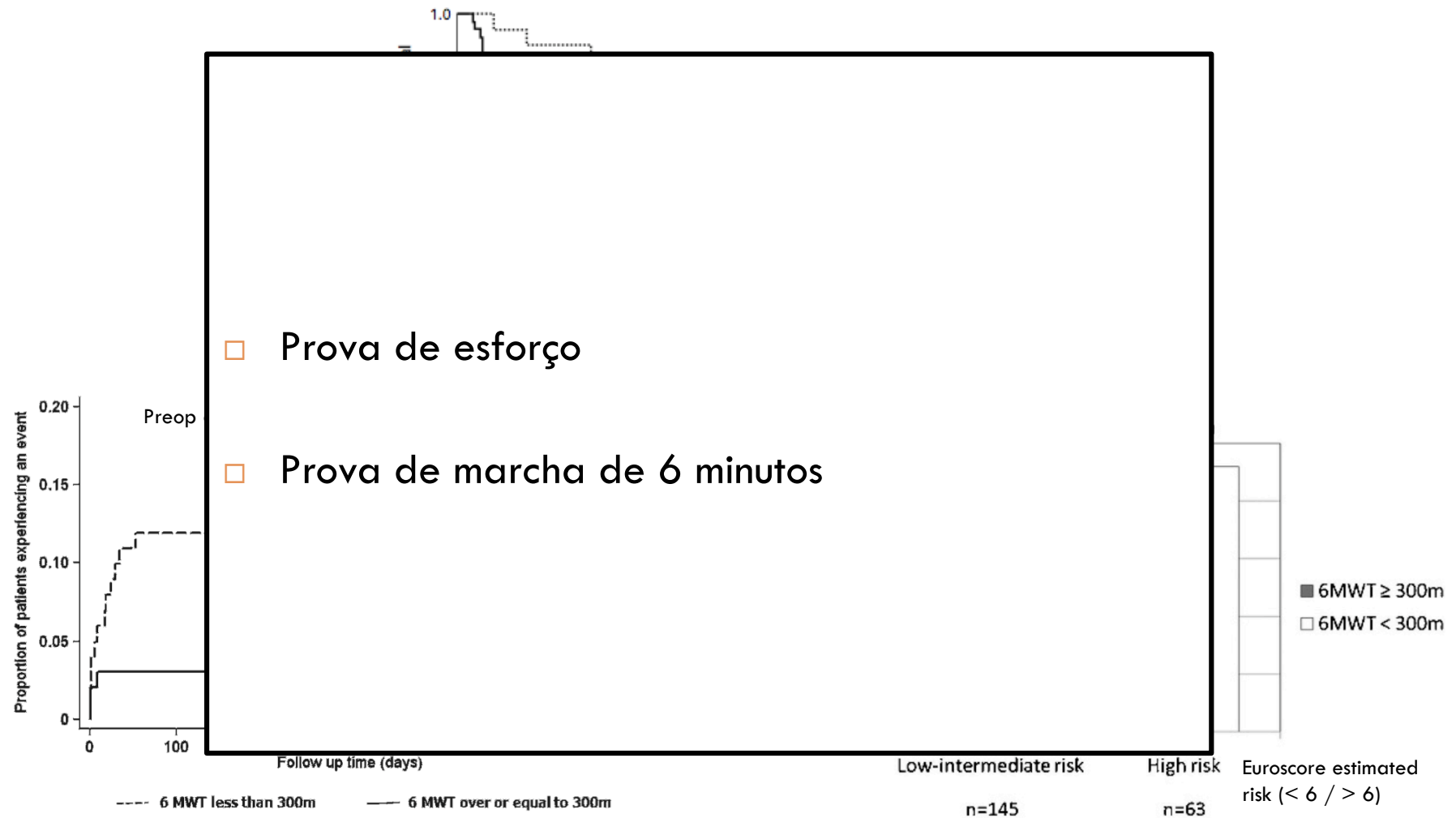
Pai RG et al. Ann Thorac Surg 2006;82:2116

Table 3. Correlates of Cardiac Mortality in the Conventional Treatment group

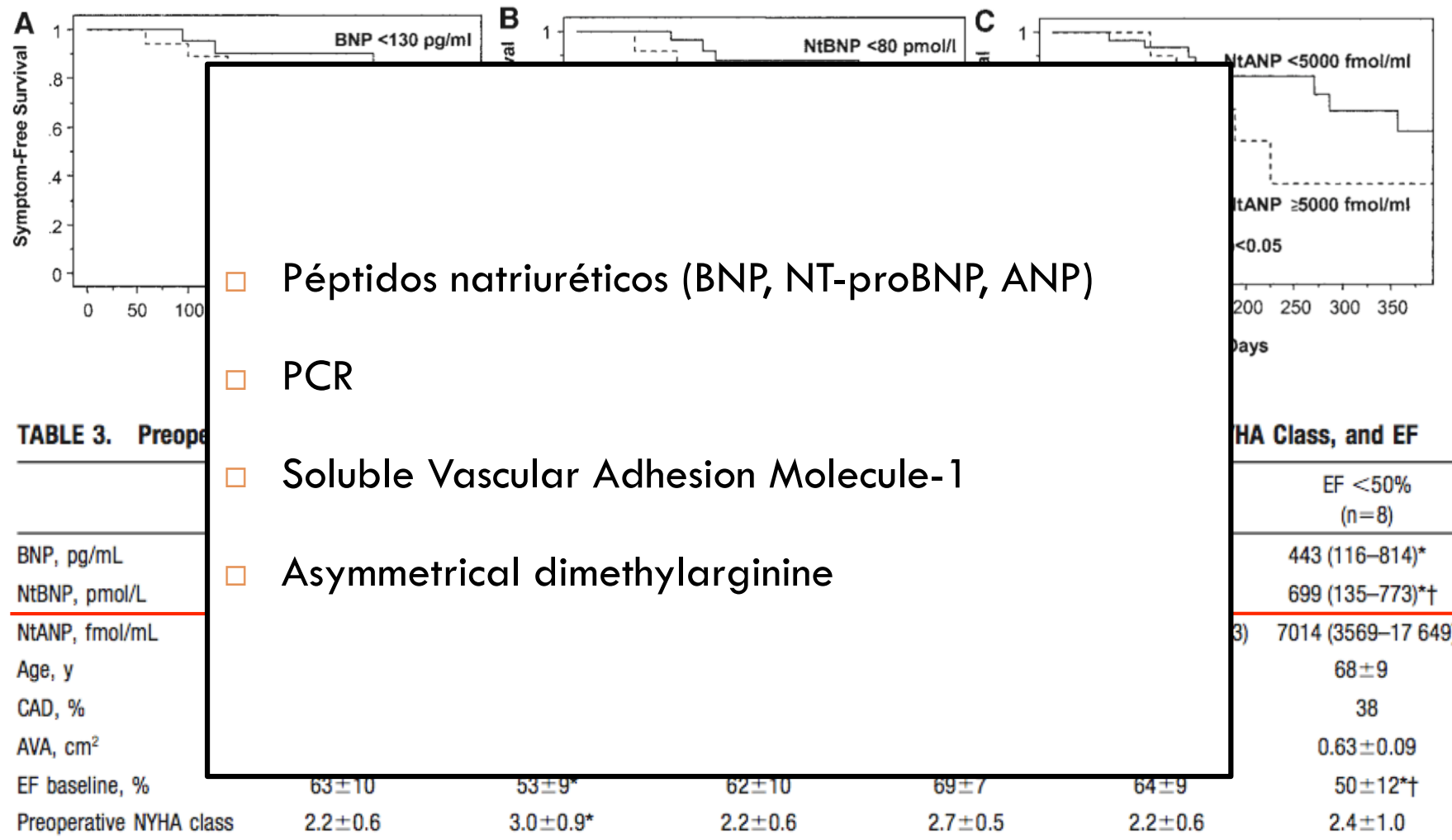
	HR	95% CI
	1.09	1.04–1.14
	7.07	1.99–25.07
	1.37	0.30–6.19
	0.85	0.31–2.34
	2.71	0.94–7.80
	1.36	0.49–3.74
	1.43	1.12–1.81
	1.22	0.27–5.49
	1.00	0.99–1.01
	1.00	0.94–1.07
	0.80	0.30–2.11
	2.15	0.81–5.70
	2.37	1.00–5.62
	2.87	1.07–7.71
	2.36	0.91–6.09
	0.68	0.26–1.79
	0.03	<0.001–58.97
	0.98	0.85–1.12
Adjusted		
AV mean gradient	0.73	
AV velocity ≥5 m/s*	0.002	4.76 1.74–12.94

Kang Dh et al. Circulation 2010;121:1502

Factores Prognósticos – Provas Funcionais

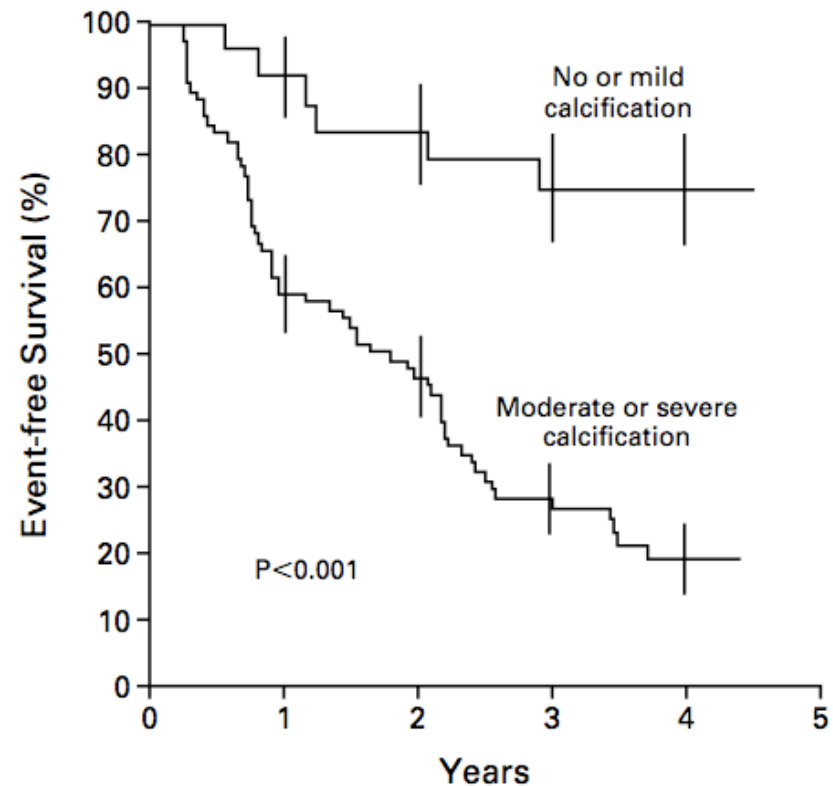


Factores Prognósticos – Laboratoriais



Parâmetros Ecocardiográficos

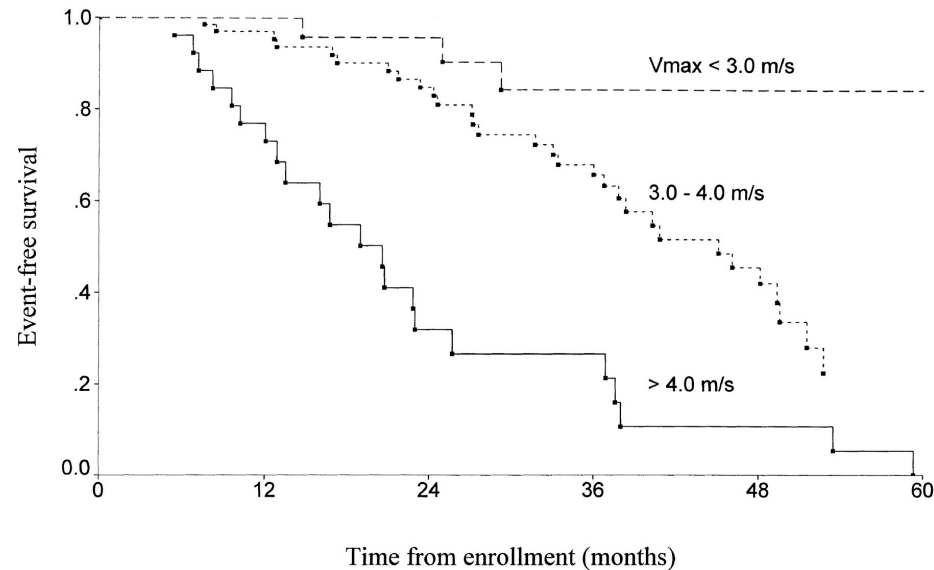
Calcificação Valvular



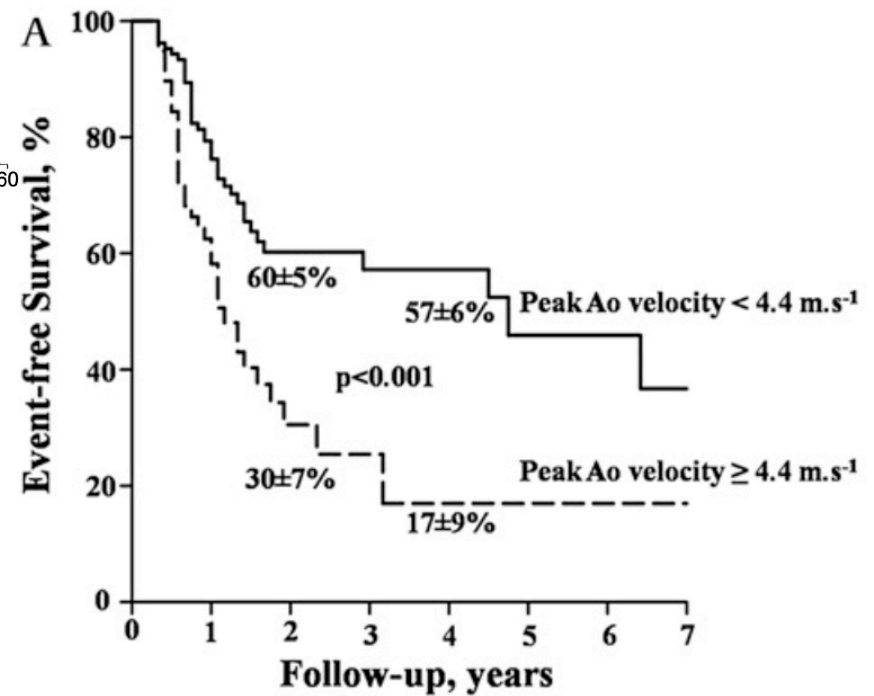
Rosenhek R et al. *N Engl J Med* 2000;343:611

Parâmetros Ecocardiográficos

Velocidade máxima



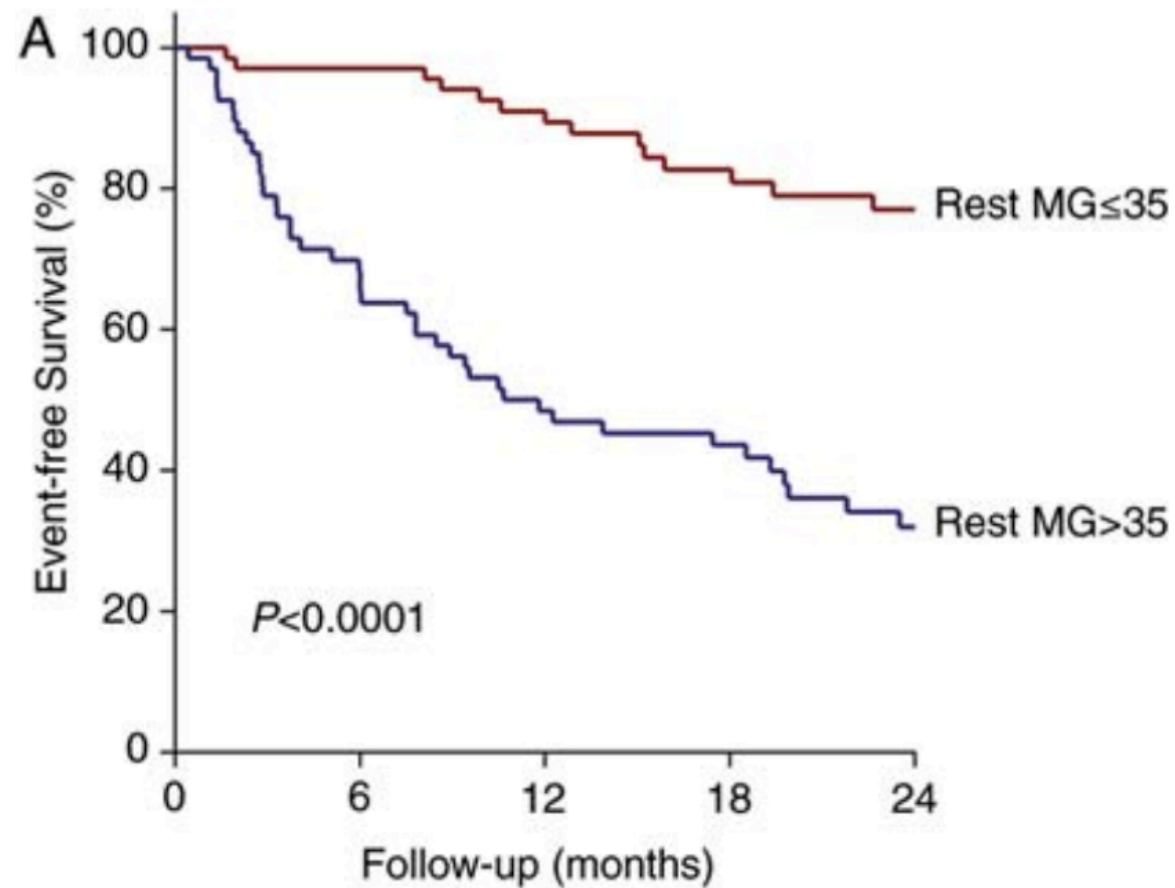
Otto CM et al. *Circulation* 1997;95:2262



Lancellotti P et al. *Heart* 2010;96:1364

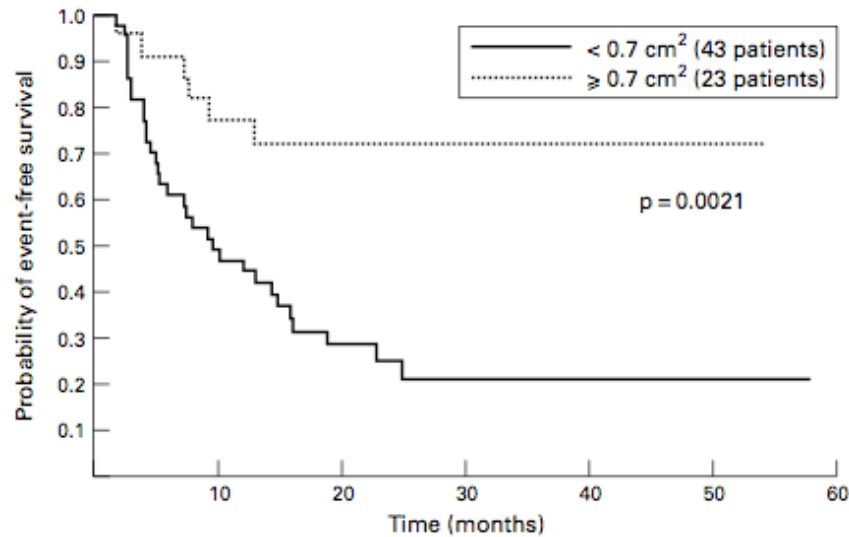
Parâmetros Ecocardiográficos

Gradiente Médio

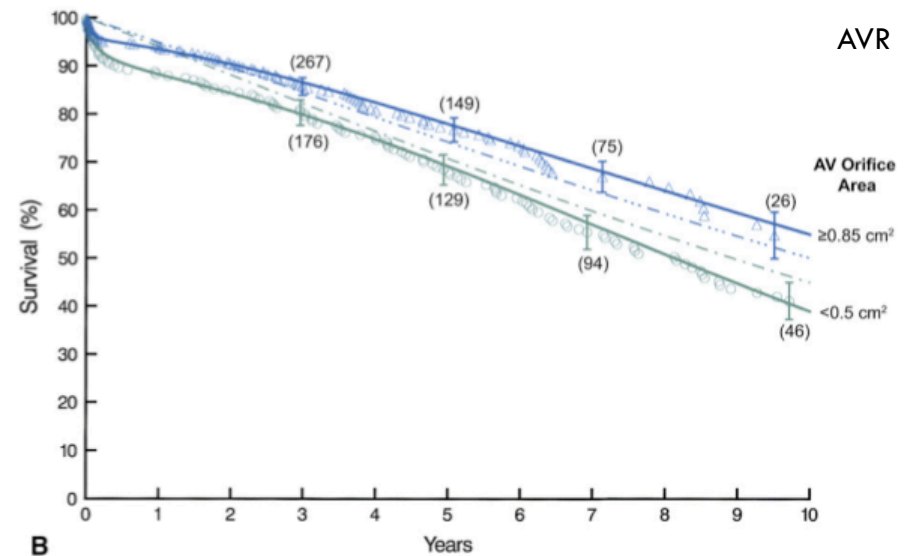


Parâmetros Ecocardiográficos

Área Valvular



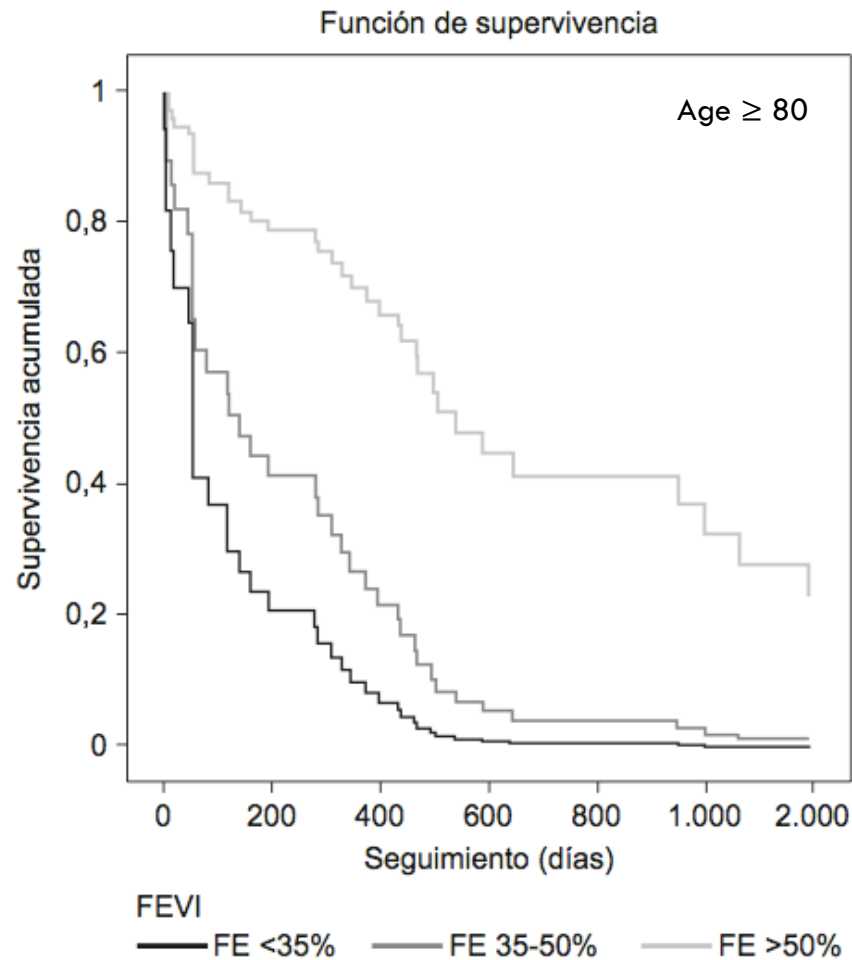
Amato MCM et al. *Heart* 2001;86:381



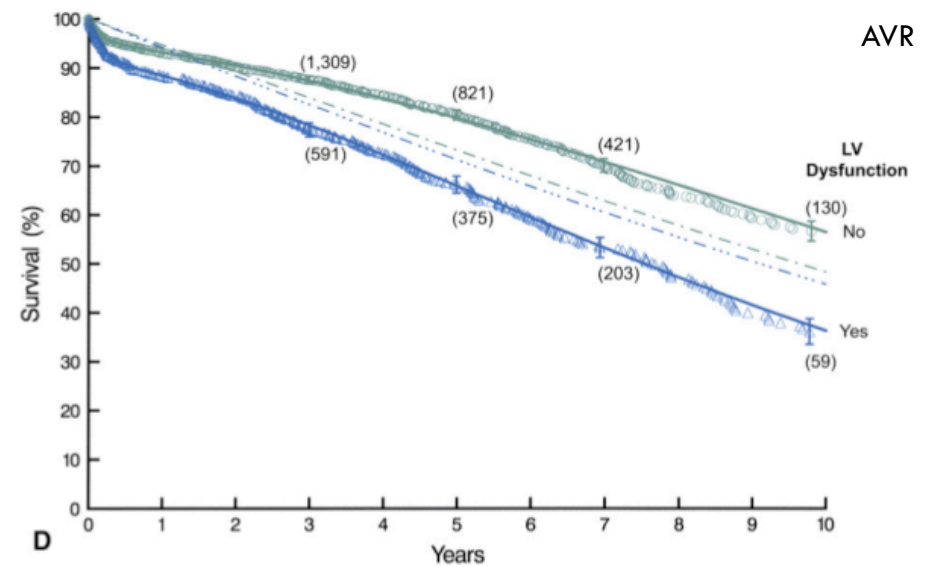
Mihaljevic T et al. *J Thorac Cardiovasc Surg* 2008;135:1270

Parâmetros Ecocardiográficos

Função Sistólica VE



Quesada GRG et al. *Rev Esp Geriatr Gerontol* 2010;45:1335



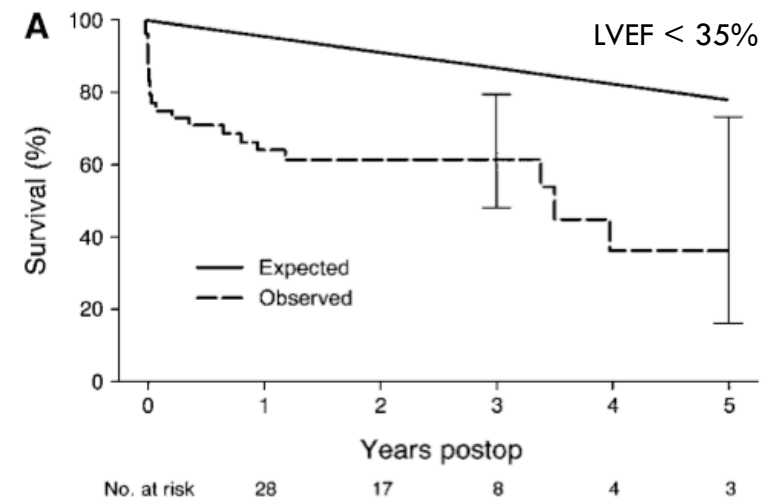
Mihaljevic T et al. *J Thorac Cardiovasc Surg* 2008;135:1270

Parâmetros Ecocardiográficos

Função Sistólica VE

Table 2 Predictors of mortality following AVR

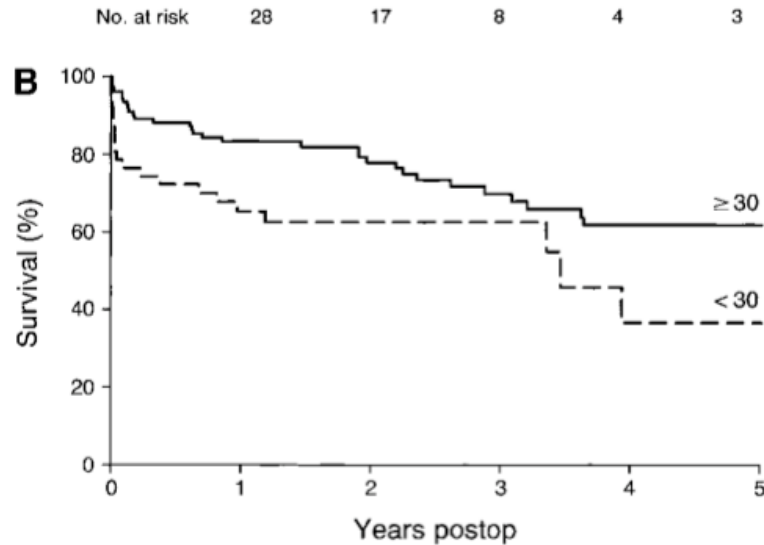
Variable	Hazard ratio (95% CI)	P-value
Univariate predictors		
LVEF <40%	0.68 (0.60–0.78)	<0.001
PSPAP >45 mmHg	1.07 (1.05–1.09)	<0.001
Restrictive LV filling	3.52 (2.06–6.01)	<0.001
Creatinine (mmol/L)	1.01 (1.00–1.01)	<0.001
Concomitant CABG	4.93 (1.10–22.1)	0.037
Atrial fibrillation	2.01 (1.01–10.5)	0.039
CPB time (min)	1.01 (1.00–1.02)	0.041
Emergency surgery	3.10 (1.04–9.25)	0.043
NYHA class III/IV	6.52 (0.85–49.9)	0.071
Age (years)	1.00 (0.95–1.05)	0.919
Gender	3.37 (0.44–25.7)	0.242
QRS duration (ms)	1.00 (0.98–1.02)	0.567
Hypertension, n (%)	1.35 (0.47–3.83)	0.578
Prosthesis diameter (mm)	1.02 (0.80–1.29)	0.895
AVMG (mmHg)	0.97 (0.94–1.02)	0.205
SV/BSA (mL/m ²)	1.01 (0.77–1.34)	0.612
EDD (mm)	1.19 (0.85–2.91)	0.770
ESD (mm)	1.21 (0.90–2.61)	0.270
LVMI (gm/m ²)	1.00 (0.99–1.00)	0.675
Deceleration time (ms)	1.26 (0.81–2.57)	0.128
Multivariate predictors		
PSPAP >45 mmHg	2.71 (1.49–3.99)	0.010
LVEF <40%	0.74 (0.63–0.89)	0.030
Restrictive LV filling	1.77 (1.04–2.98)	0.033



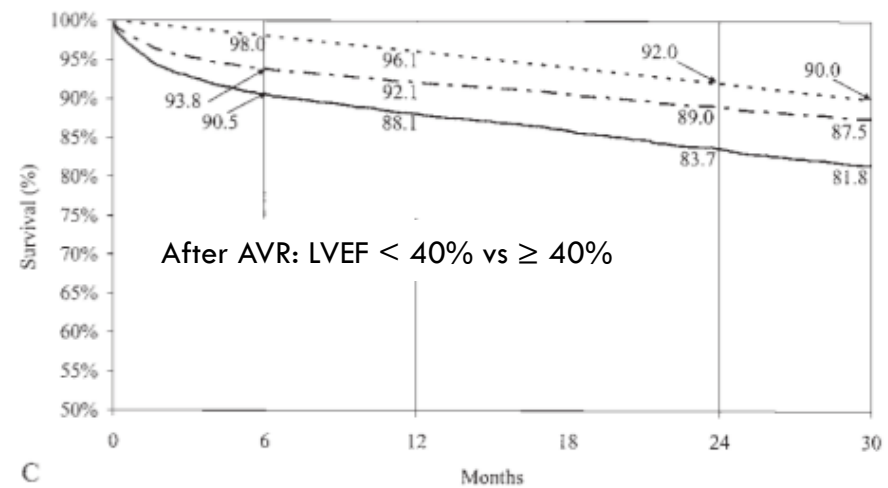
Connolly HM et al. *Circulation* 2000;101:1940

Parâmetros Ecocardiográficos

Função Sistólica VE



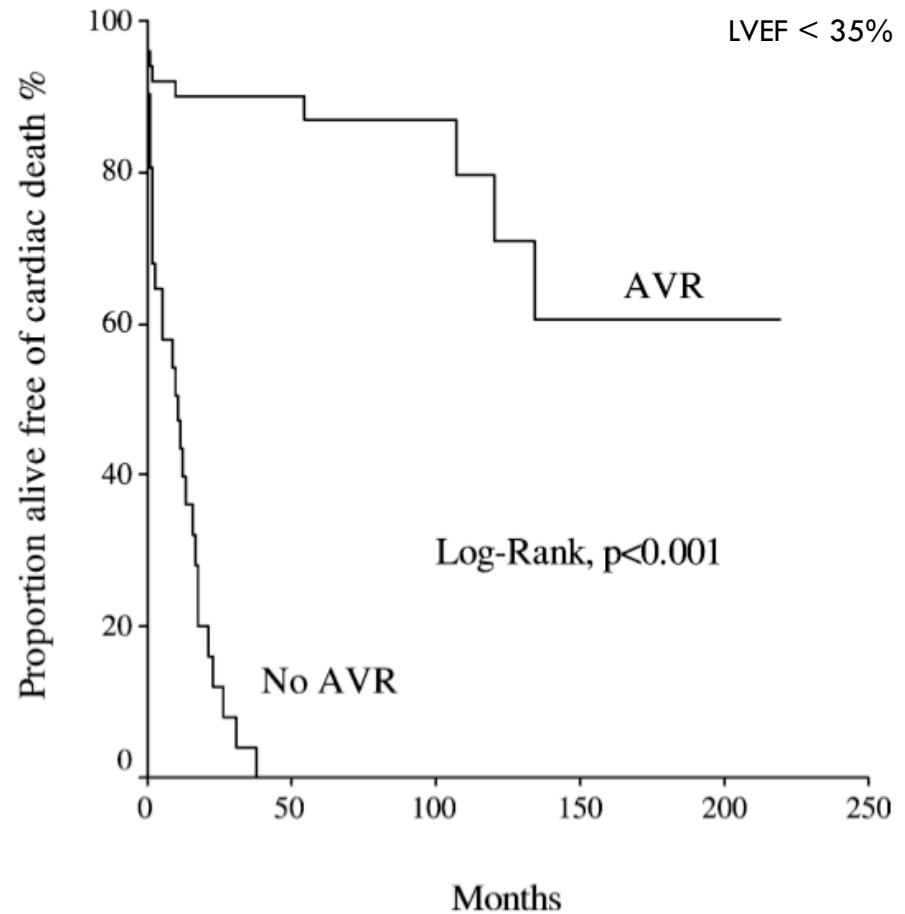
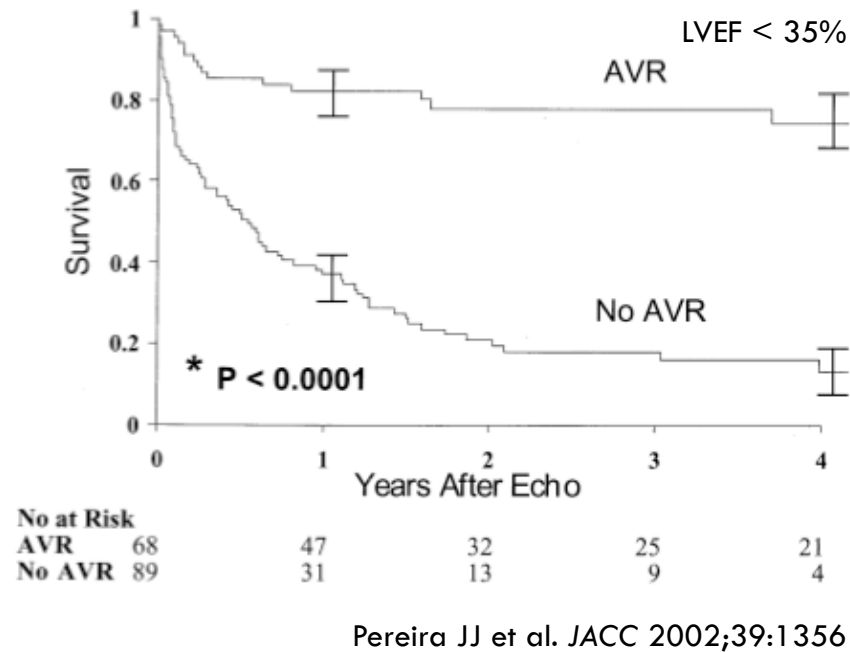
Connolly HM et al. *Circulation* 2000;101:1940



Hannan EL et al. *Ann Thorac Surg* 2009;87:1741

Parâmetros Ecocardiográficos

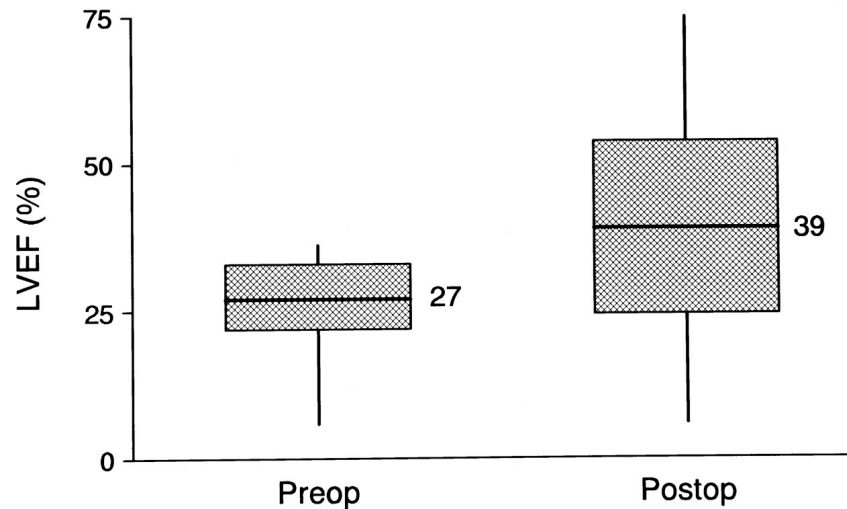
Função Sistólica VE



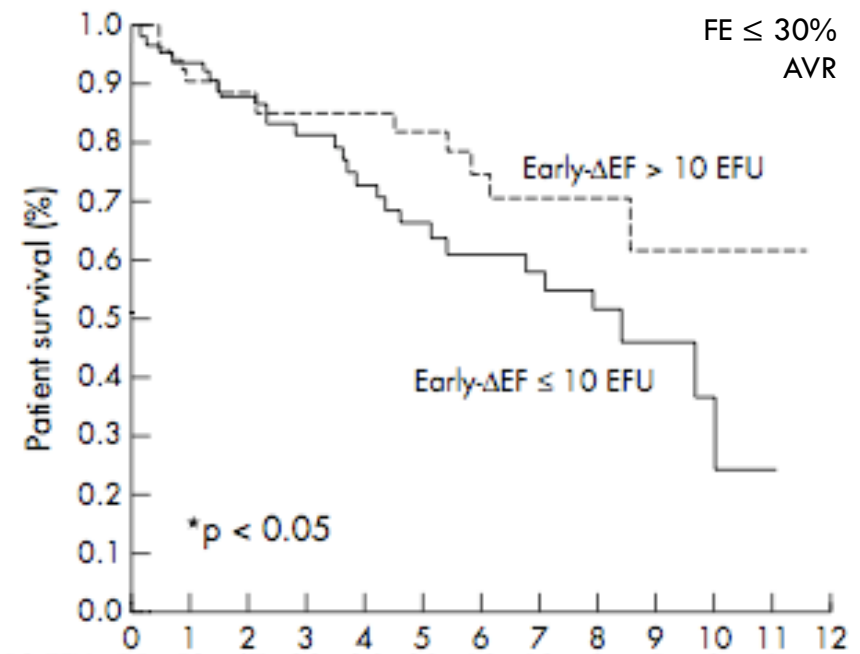
Tarantini G et al. Eur J Cardiothorac Surg 2003;24:879

Parâmetros Ecocardiográficos

Função Sistólica VE



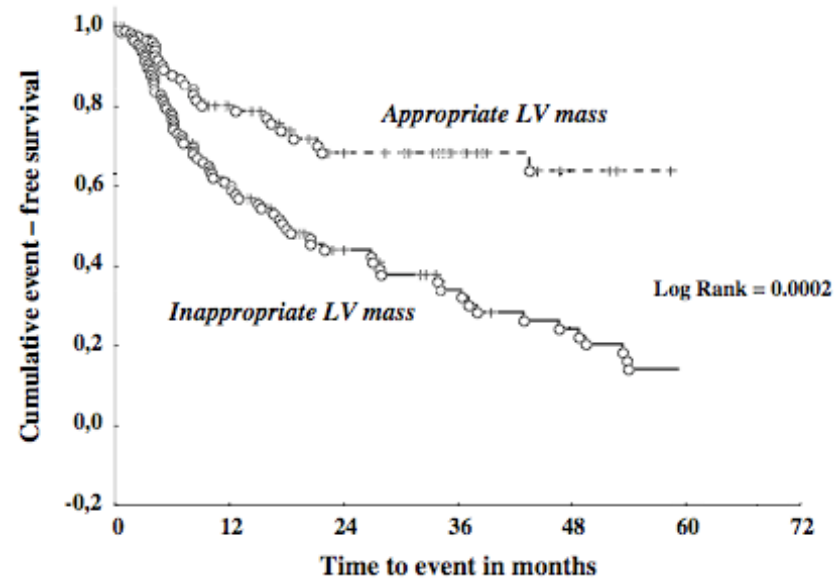
Connolly HM et al. *Circulation* 1997;95:2395



Vaquette G et al. *Heart* 2005;91:1324

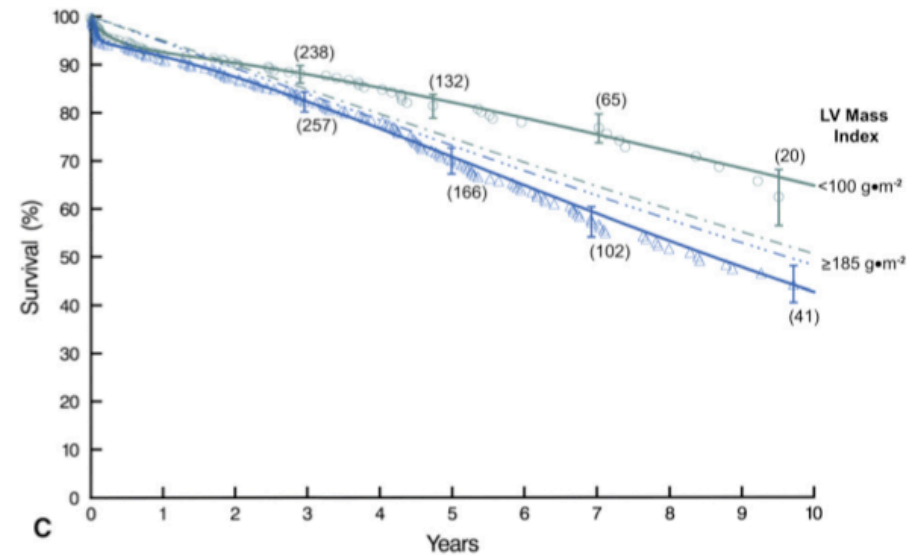
Parâmetros Ecocardiográficos

Massa VE



Cioffi G et al. *Heart* 2011;97:301

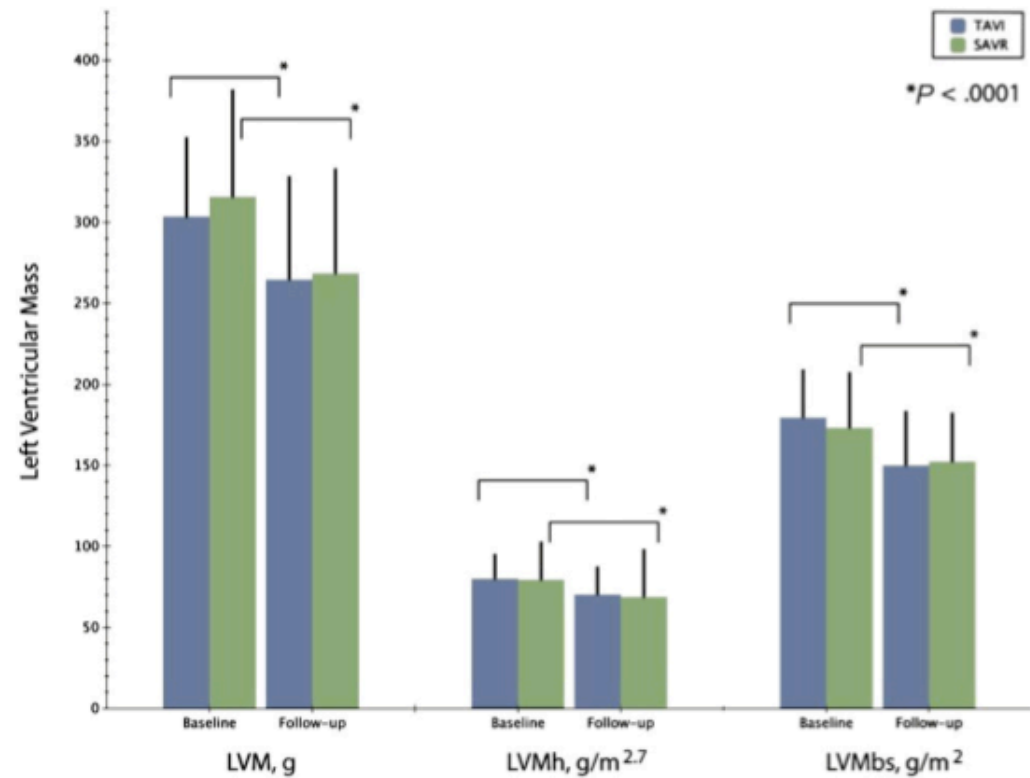
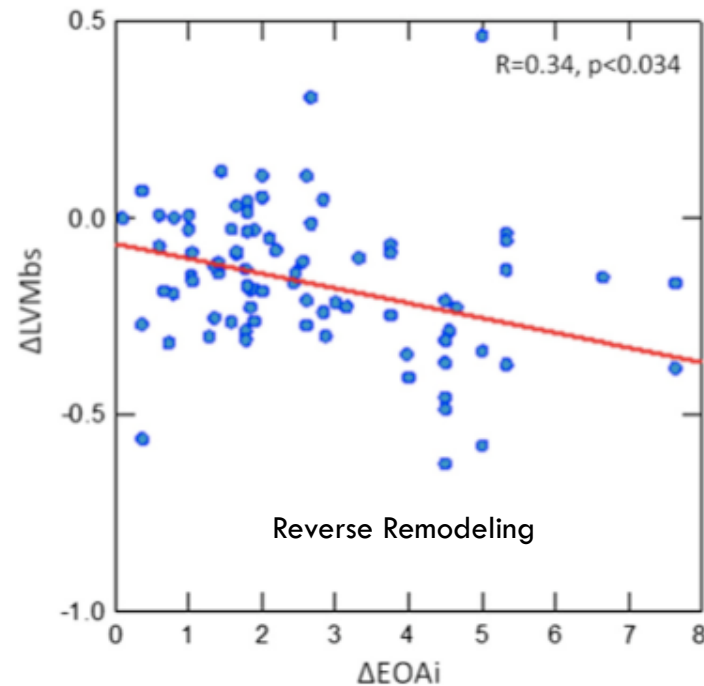
Inappropriate LVM: ratio between the observed and predicted value $> 110\%$



Mihaljevic T et al. *J Thorac Cardiovasc Surg* 2008;135:1270

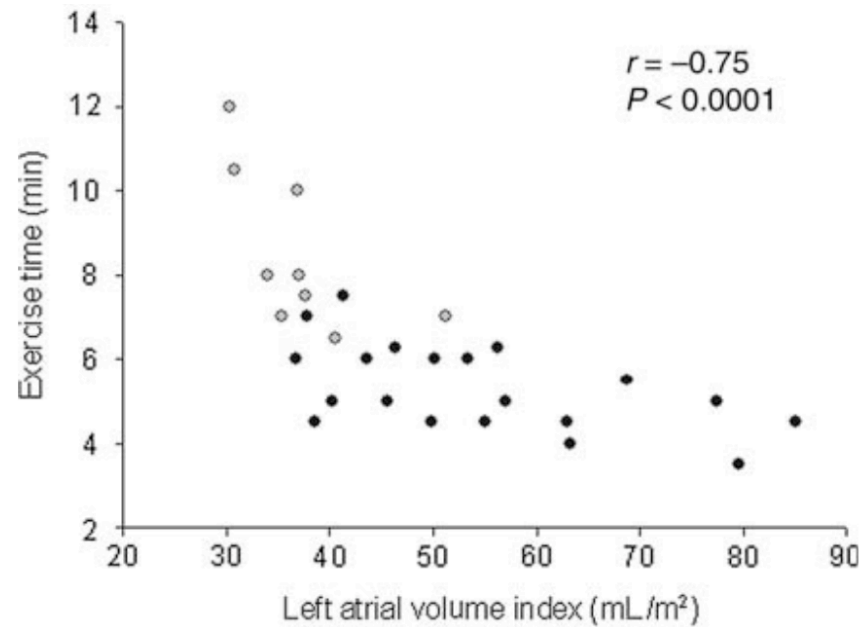
Parâmetros Ecocardiográficos

Massa VE

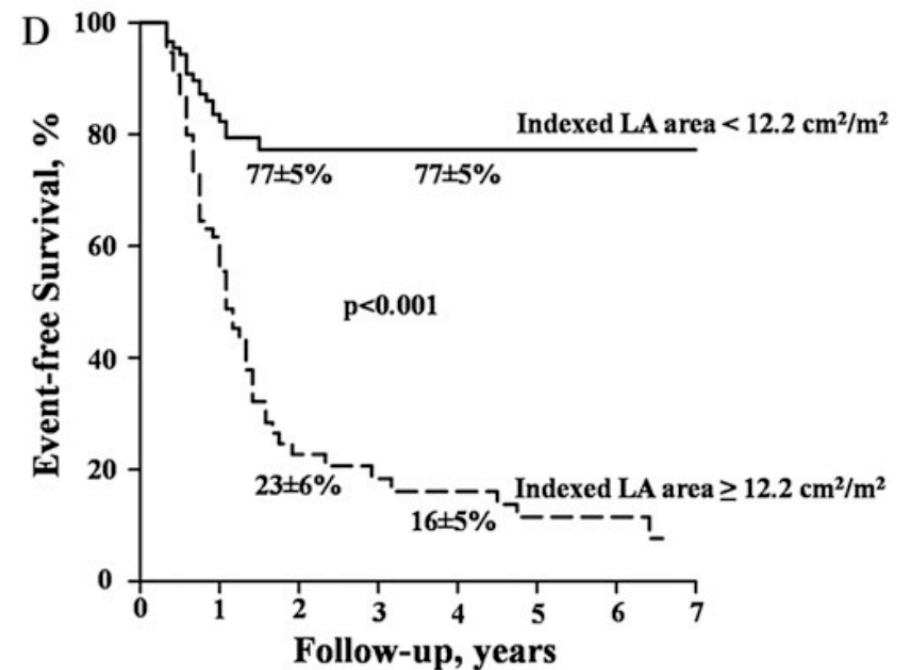


Parâmetros Ecocardiográficos

Dimensões AE



Dalsgaard M et al. *Eur J Echocardiogr* 2010;11:482



Lancellotti P et al. *Heart* 2010;96:1364

Parâmetros Ecocardiográficos

Insuficiência Mitral

- 61-90% with $\geq$ mild MR; 17-74% with moderate MR¹
- 27-82% with improvement¹

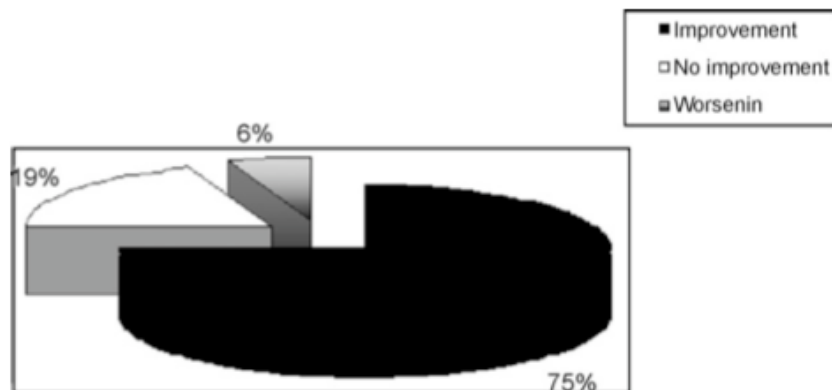


Table 3

Univariate analysis of complications according to the presence or absence of mitral regurgitation prior to surgery

	MR	No MR	p-Value
Low output	43 (28.1%)	71 (23.3%)	0.048*
Kidney failure	17 (11.1%)	19 (6.2%)	0.028*
Perioperative MI	3 (2%)	6 (2%)	0.2
Neurological complications	10 (6.5%)	11 (3.6%)	0.069
Respiratory complications	17 (11.1%)	28 (9.2%)	0.1
Infectious endocarditis	2 (1.3%)	5 (1.6%)	0.3
Superficial infection	5 (3.3%)	8 (2.6%)	0.2
Postoperative block	5 (3.3%)	11 (3.6%)	0.2
Reoperation due to bleeding	3 (2%)	3 (1%)	0.2
Suture dehiscence	0 (0%)	6 (2%)	0.086
Death	16 (10.5%)	17 (5.6%)	0.025*

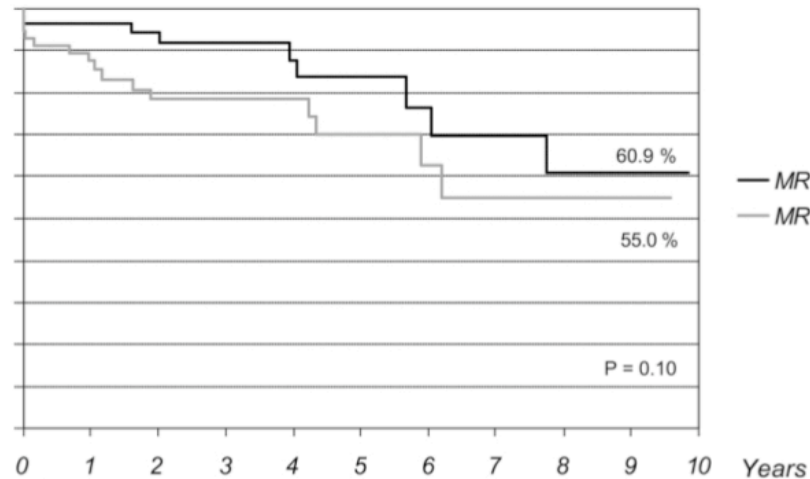
* $p < 0.05$.

¹Unger P et al. *Heart* 2010;96:9

²Caballero-Borrego J et al. *Eur J Cardiothorac Surg* 2008;34:62

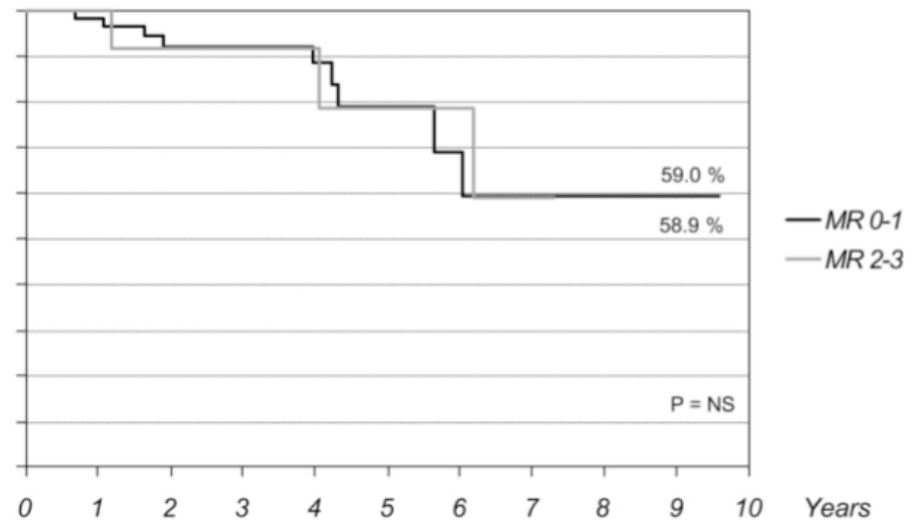
Parâmetros Ecocardiográficos

Insuficiência Mitral



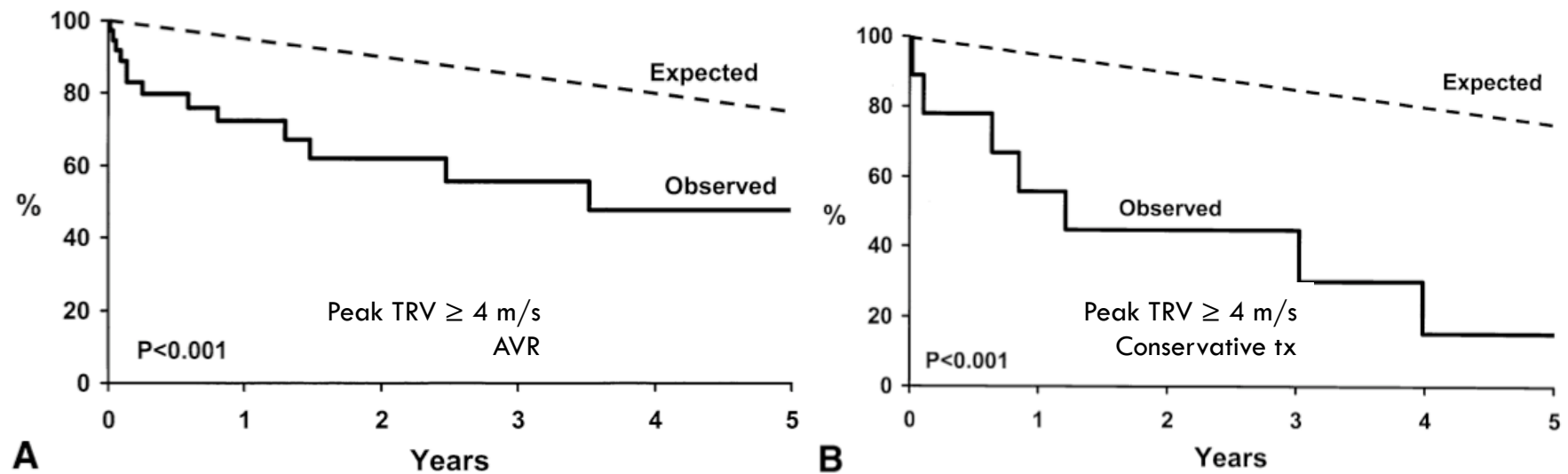
Mortality with preoperative MR

Mortality with postoperative MR



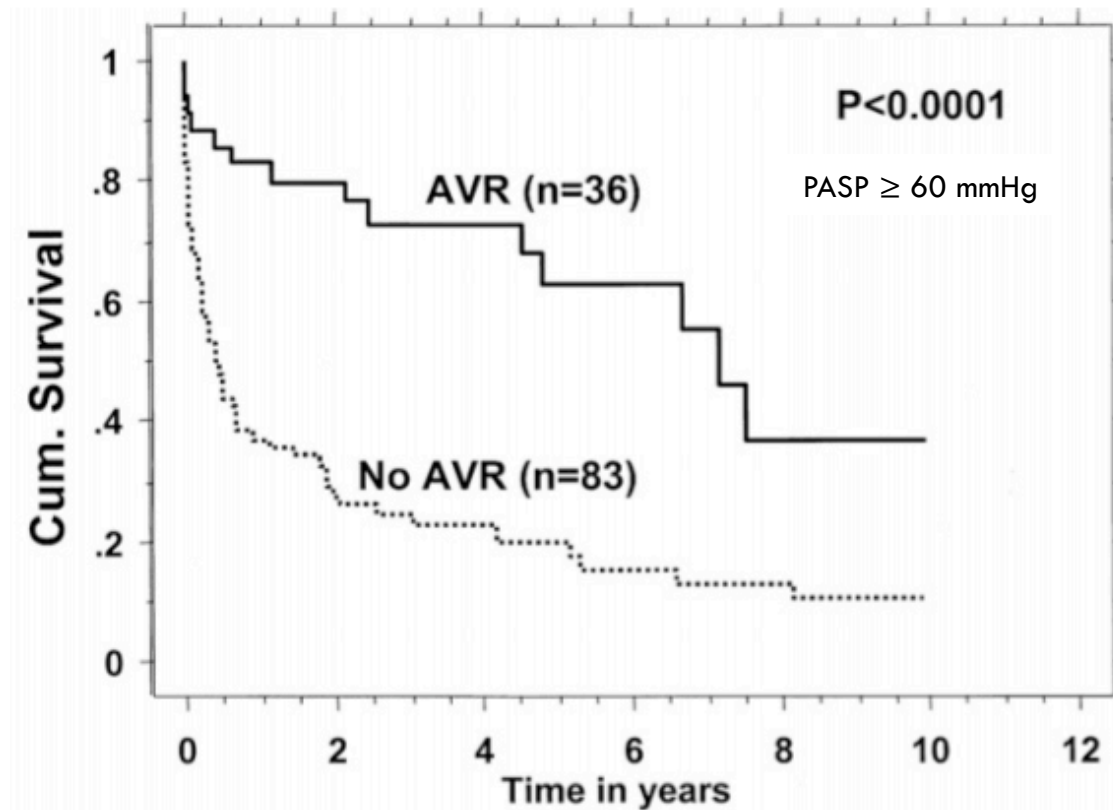
Parâmetros Ecocardiográficos

Hipertensão Pulmonar



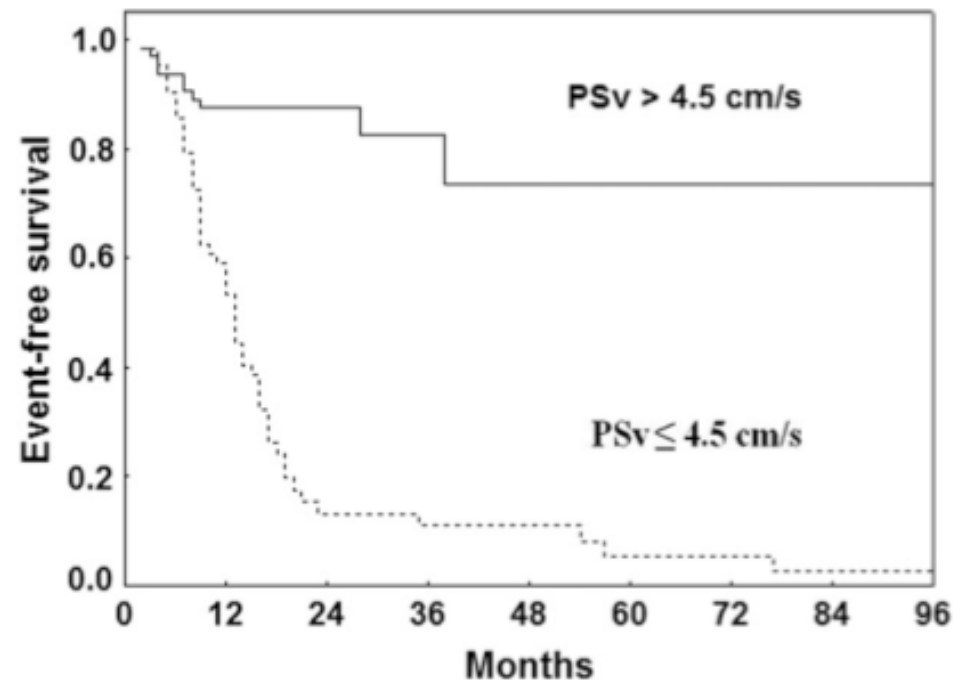
Parâmetros Ecocardiográficos

Hipertensão Pulmonar



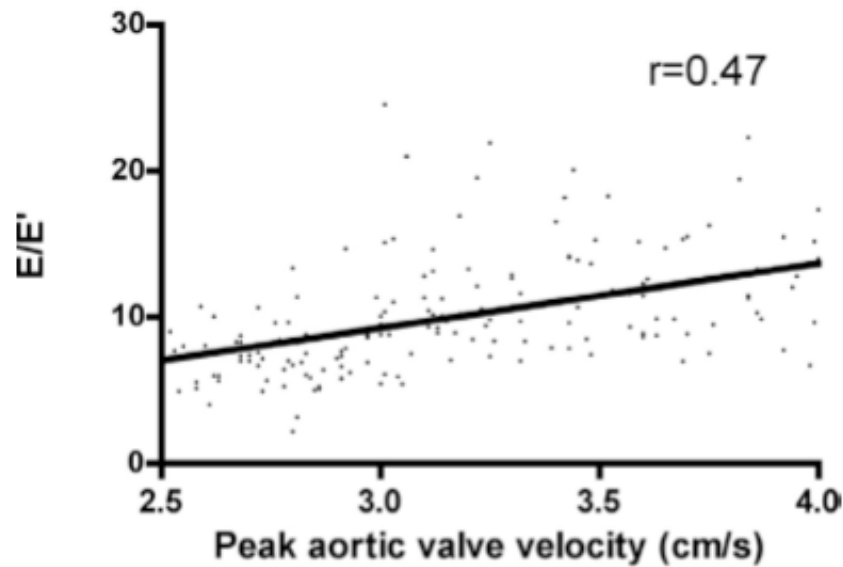
Parâmetros Ecocardiográficos

Peak Systolic Velocity

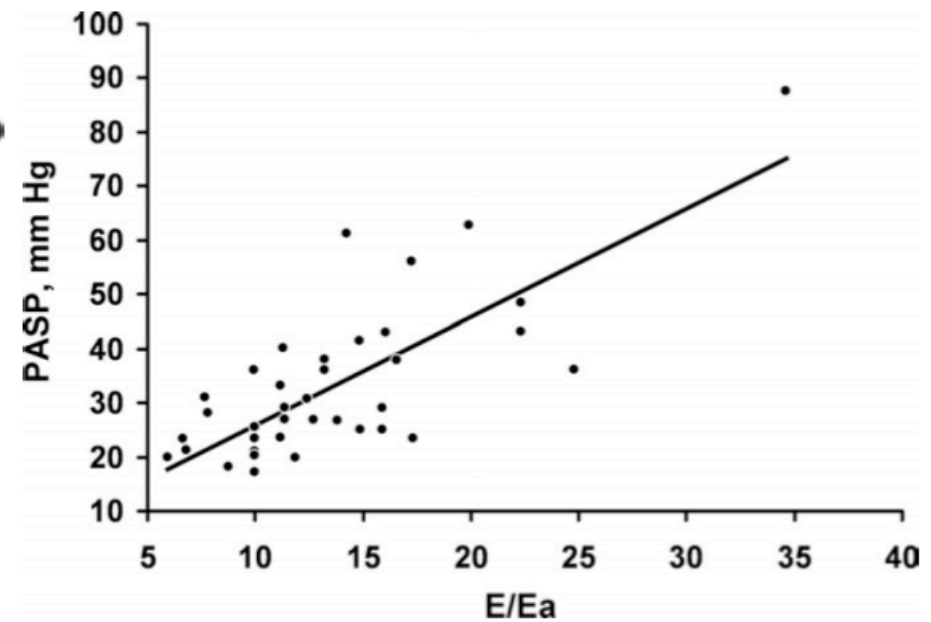


Parâmetros Ecocardiográficos

Razão E/E'



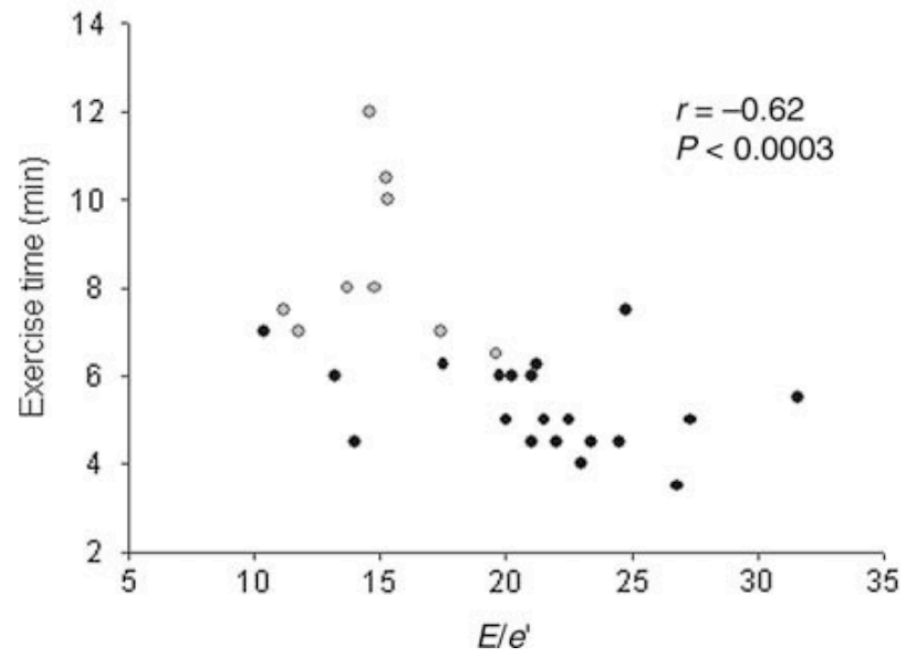
Jassal D et al. *JASE* 2008;21:1023



Casaclang-Verzosa G et al. *JASE* 2008;21:824

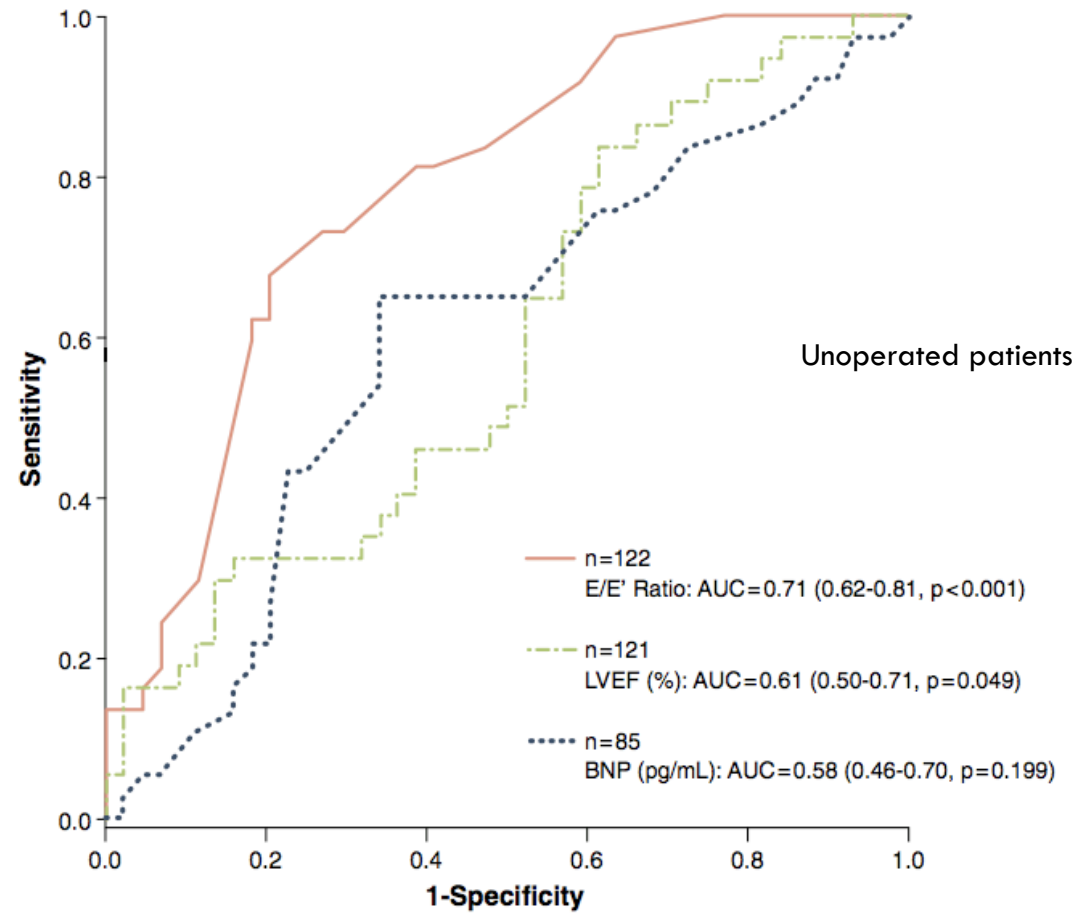
Parâmetros Ecocardiográficos

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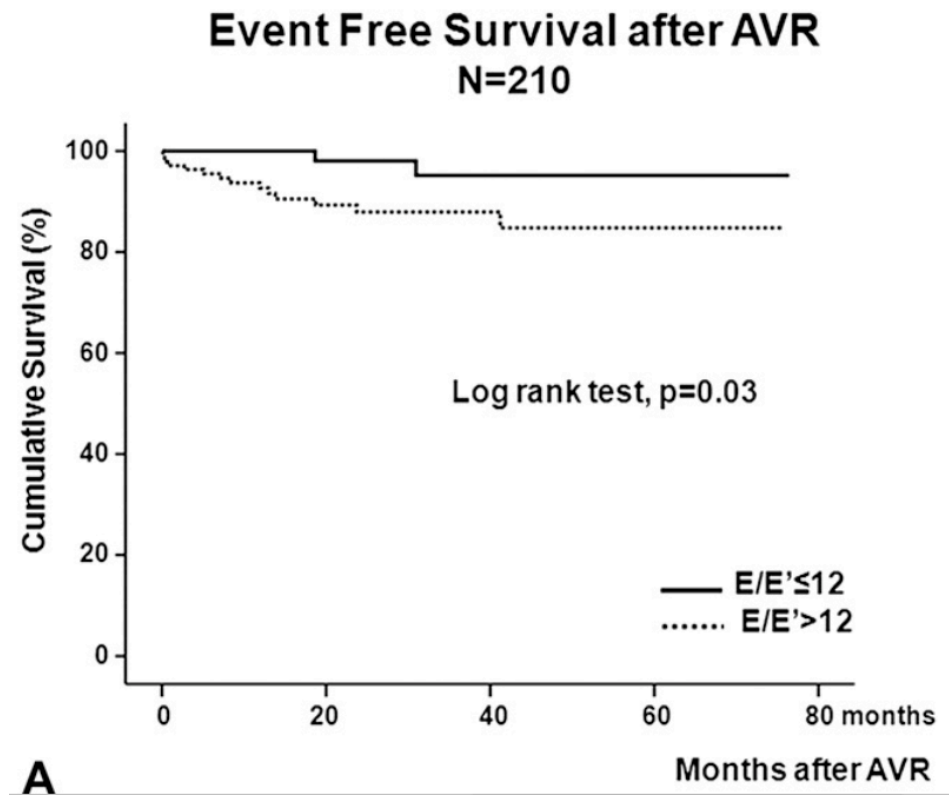
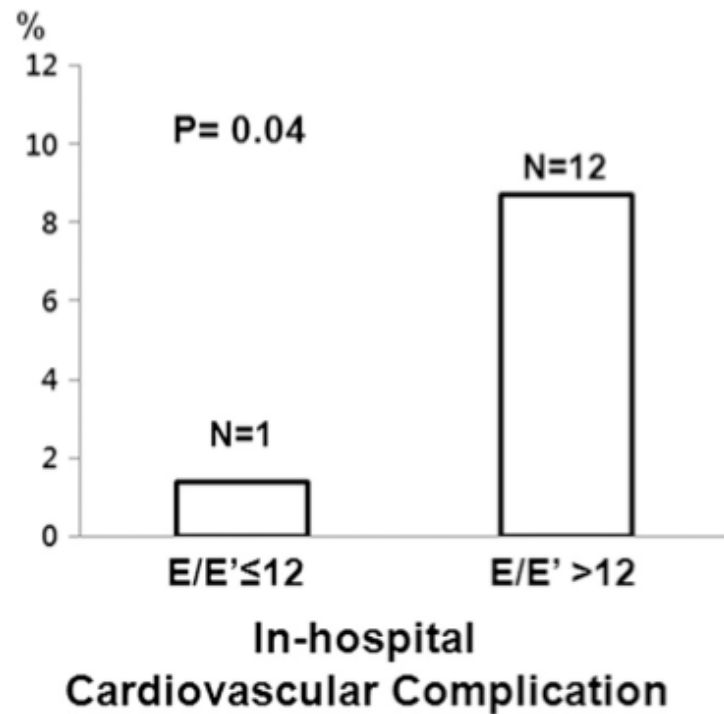
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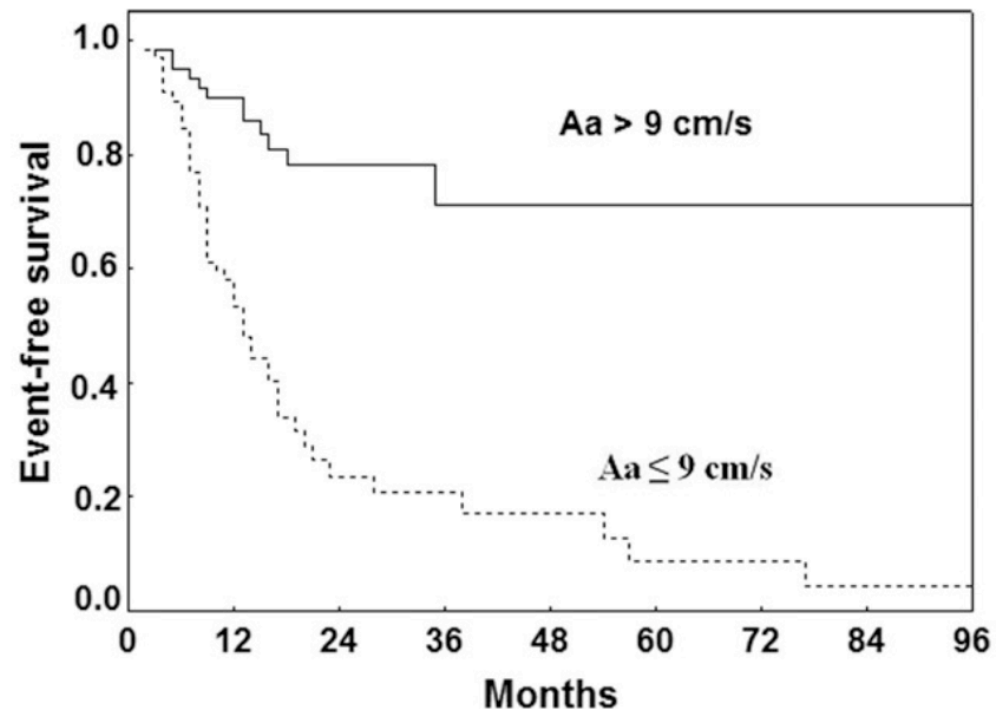
Parâmetros Ecocardiográficos

Razão E/E'



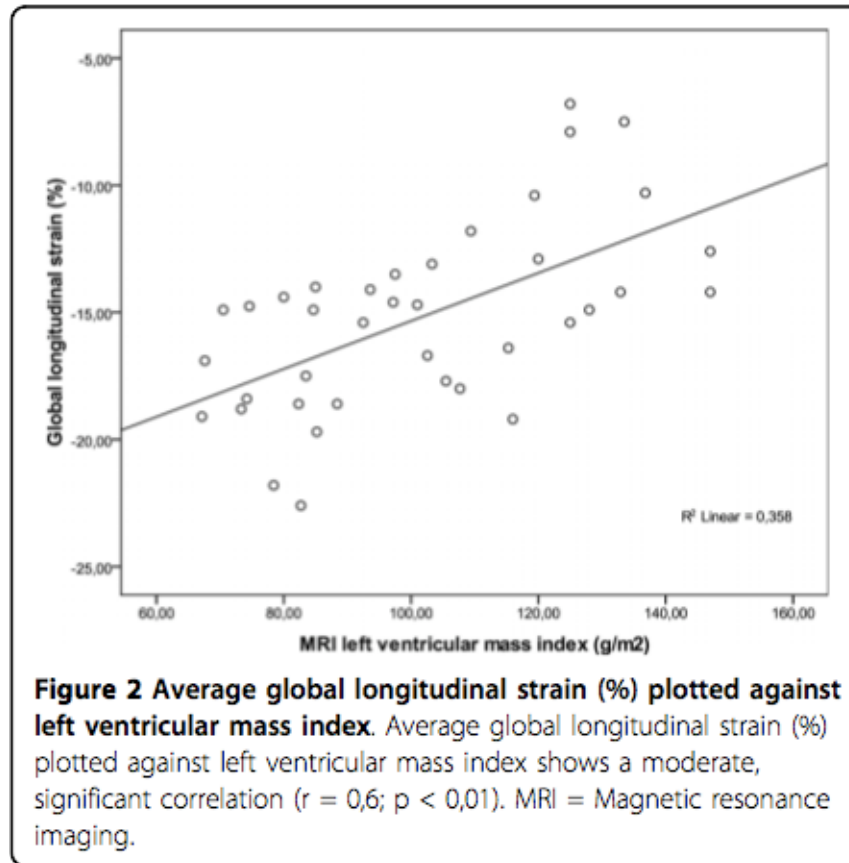
Parâmetros Ecocardiográficos

Velocidade A'

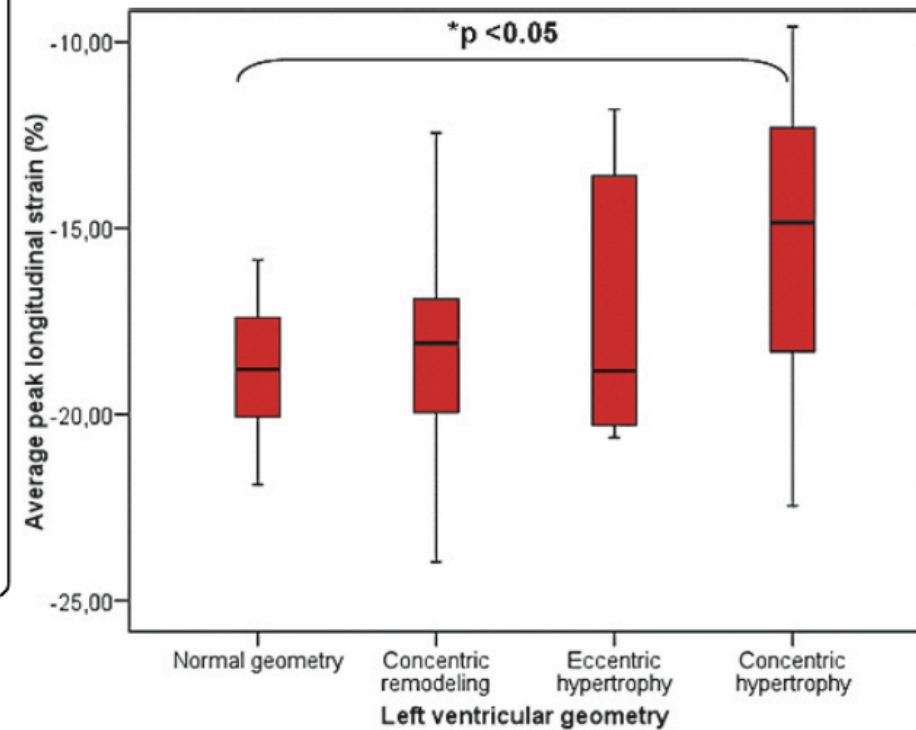


Parâmetros Ecocardiográficos

Strain Longitudinal



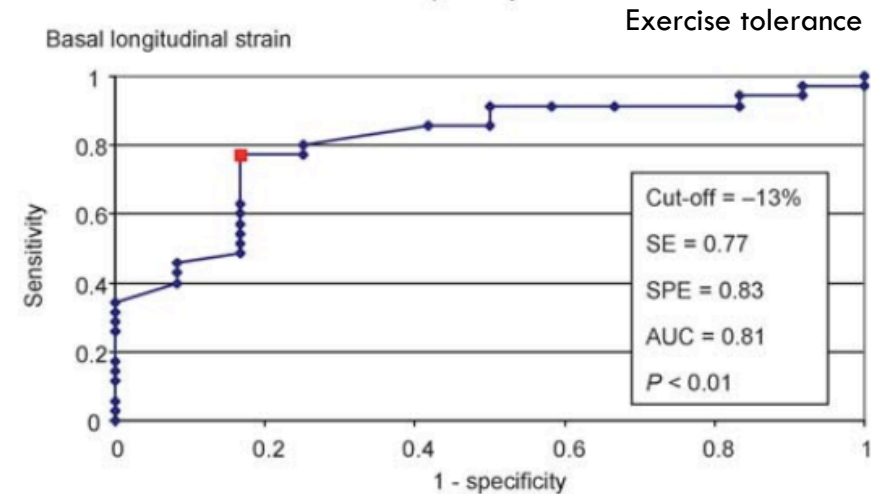
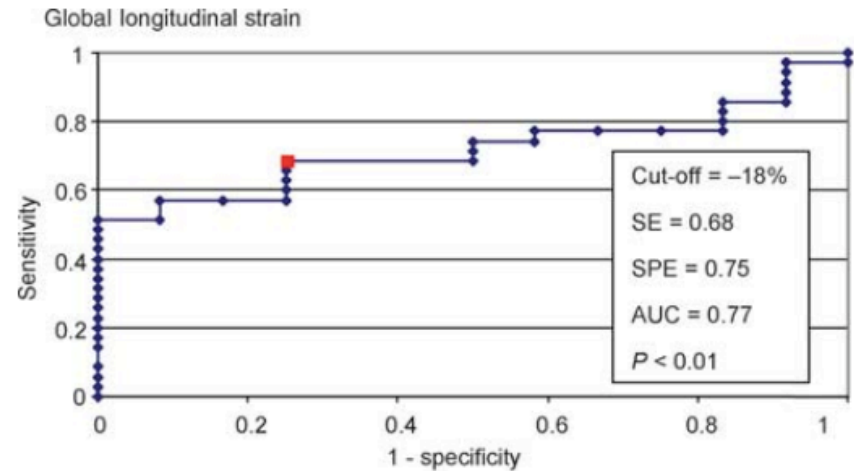
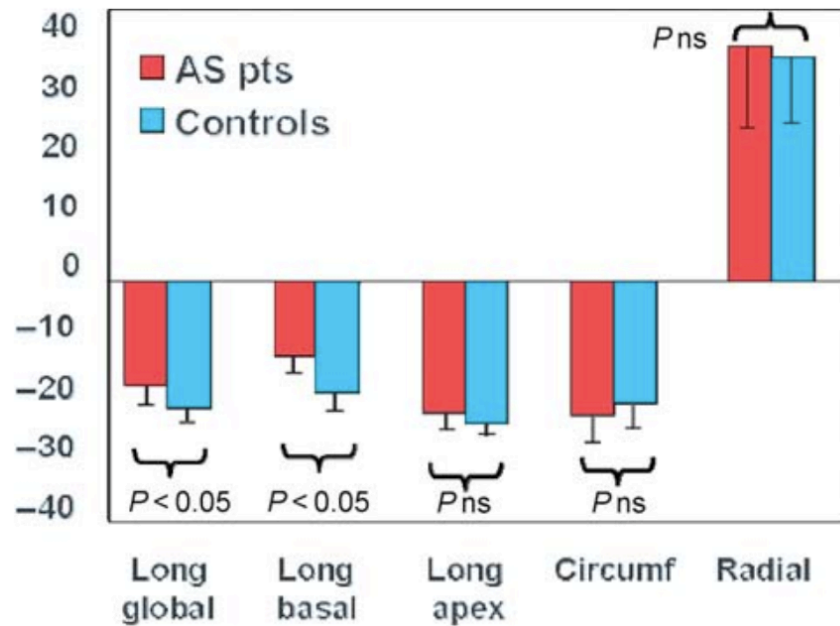
Dinh W et al. *Cardiovasc Ultrasound* 2010;8:29



Cramariuc D et al. *Heart* 2010;96:106

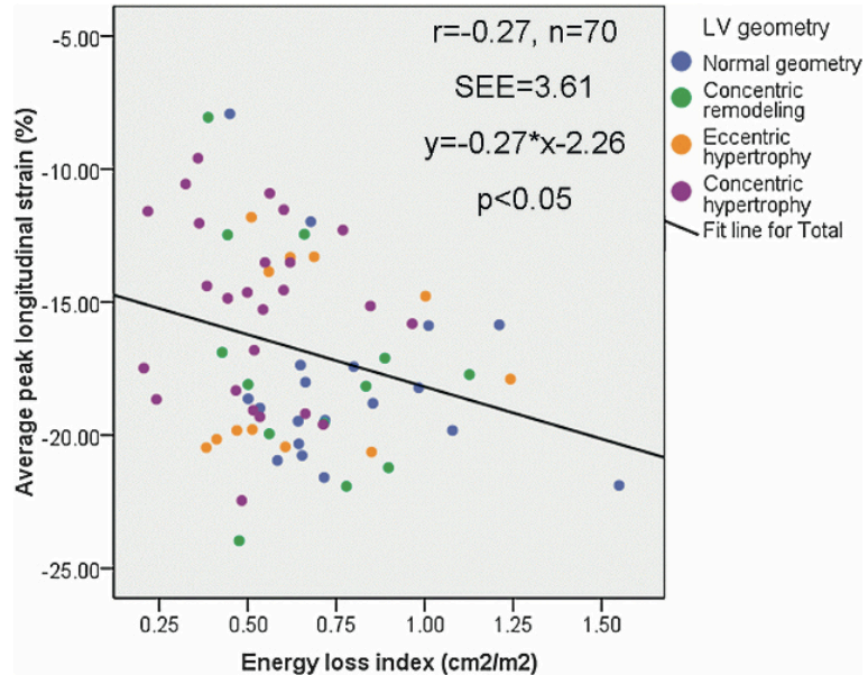
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Strain Longitudinal

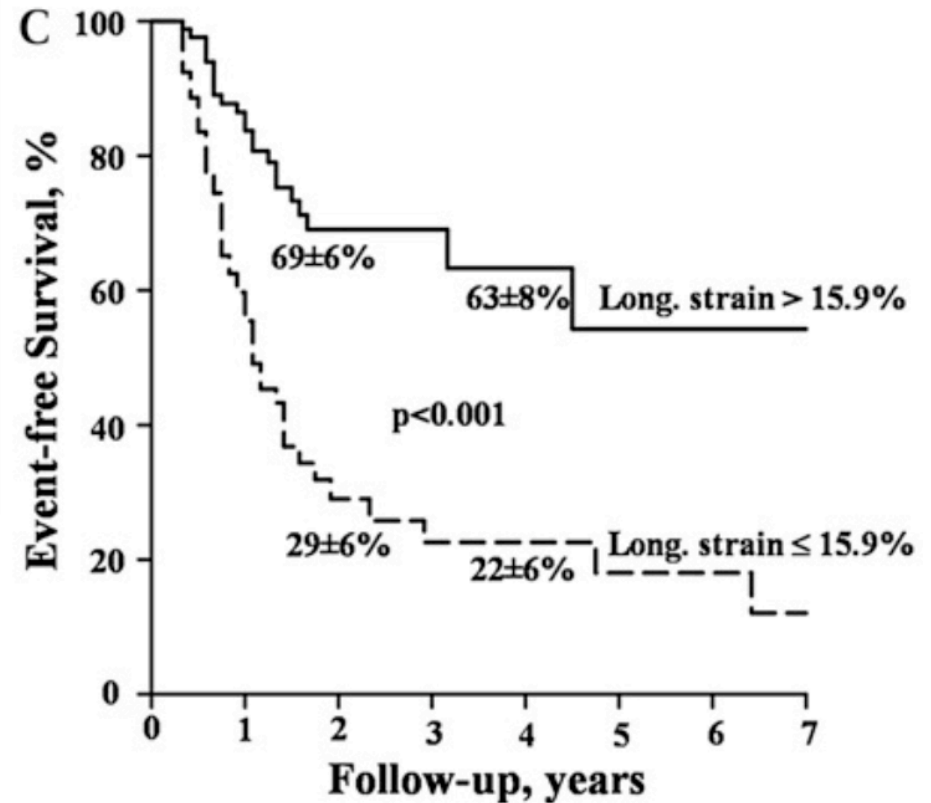


Parâmetros Ecocardiográficos

Strain Longitudinal



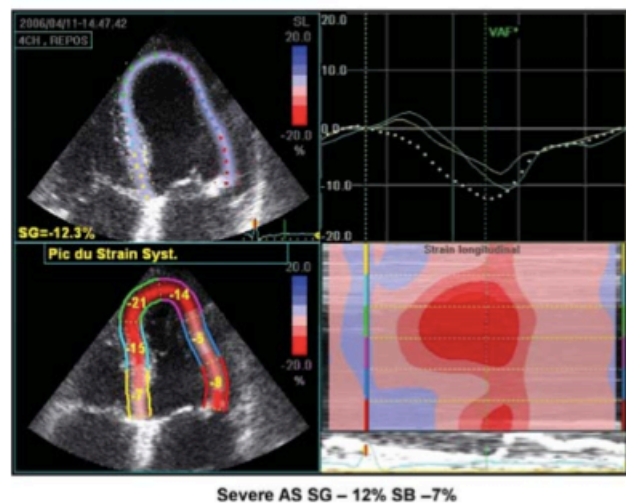
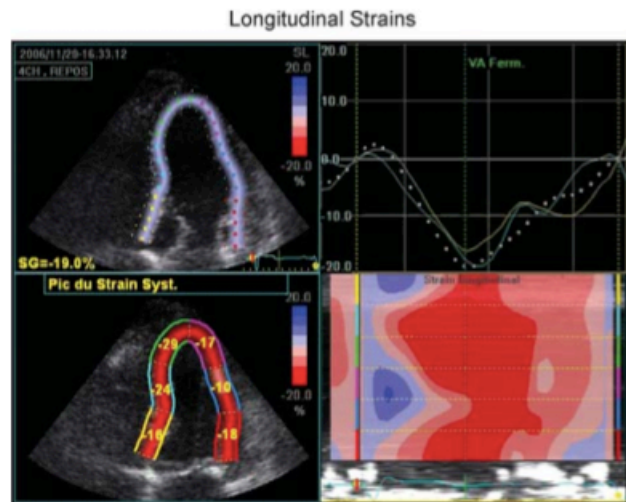
Cramariuc D et al. *Heart* 2010;96:106



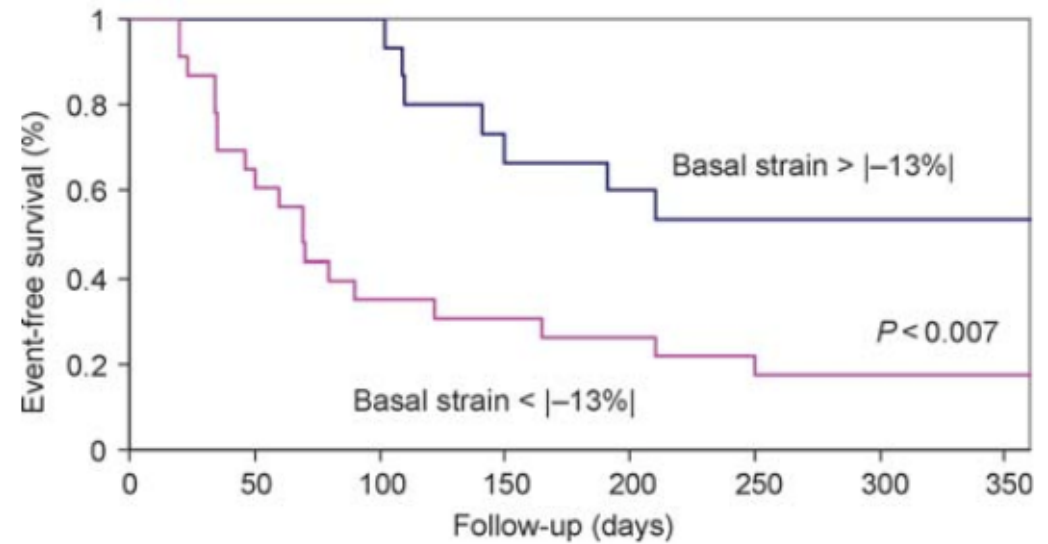
Lancellotti et al. *Heart* 2010;96:1364

Parâmetros Ecocardiográficos

Strain Longitudinal



Kaplan-Meier curve



Parâmetros Ecocardiográficos

Strain Longitudinal e Radial

Table 1. Baseline Characteristics of Study Participants According to Myocardial Fibrosis (Histology)

	No Fibrosis (n=22)	Mild Fibrosis (n=15)	Severe Fibrosis (n=21)	P
Radial strain, %	31 (11)	29 (9)	26 (10)	0.119
Radial strain rate, s ⁻¹	1.7 (0.4)	1.7 (0.4)	1.6 (0.3)	0.247
Septal longitudinal strain, %	-19 (5)	-15 (6)	-10 (5)	<0.001
Septal longitudinal strain rate, s ⁻¹	-1.2 (0.2)	-0.9 (0.3)	-0.6 (0.2)	<0.001

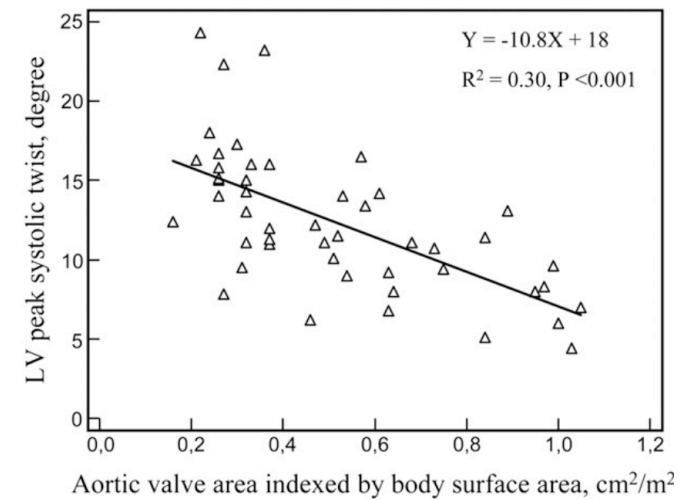
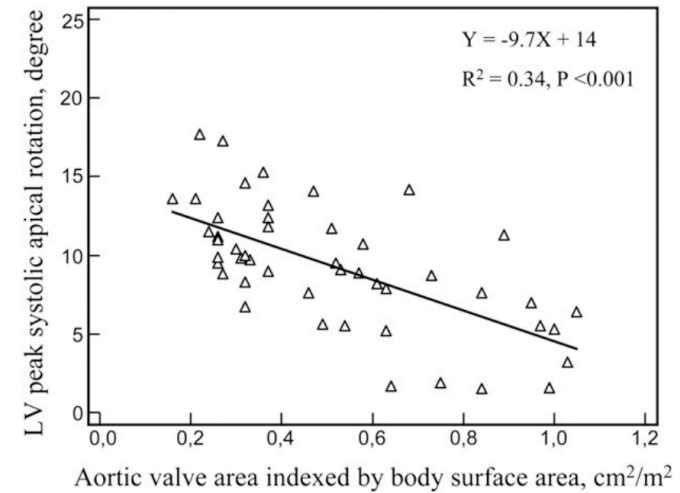
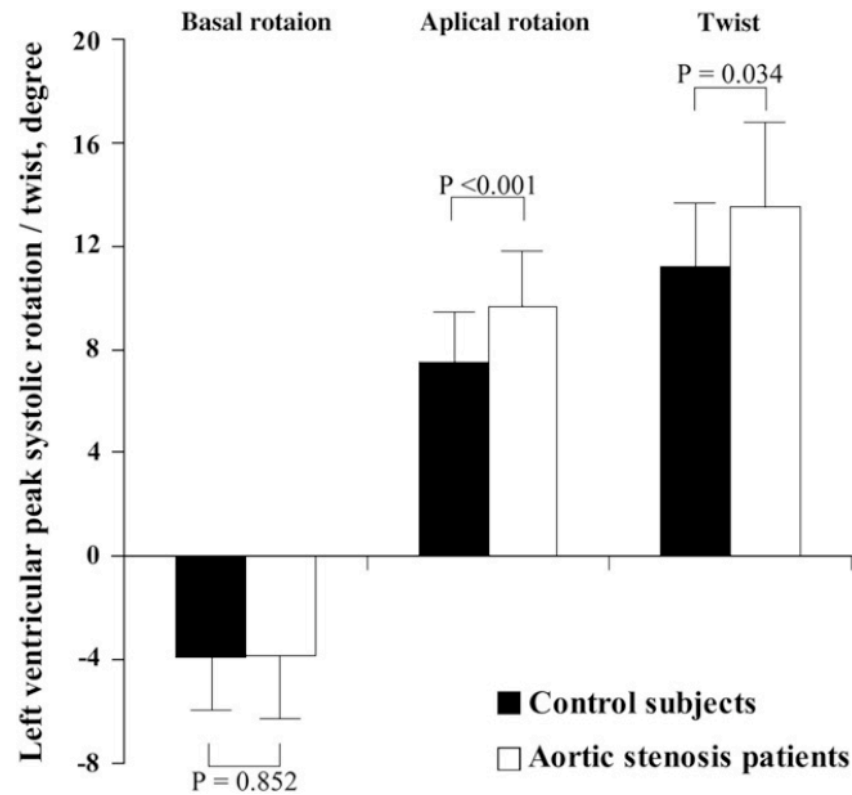
Table 2. Change in Radial and Longitudinal LV Function After AVR

	Baseline	10 Days	9 Months	P*	P†
No fibrosis					
Radial strain, %	31 (11)	44 (16)	55 (16)	0.001	<0.001
Radial strain rate, s ⁻¹	1.7 (0.4)	2.3 (0.6)	2.5 (0.5)	<0.001	<0.001
Longitudinal strain, %	-19 (5)	-19 (5)	-22 (5)	0.836	<0.001
Longitudinal strain rate, s ⁻¹	-1.2 (0.2)	-1.3 (0.4)	-1.5 (0.2)	0.142	0.008
Mild fibrosis					
Radial strain, %	29 (9)	41 (15)	40 (15)	0.004	0.003
Radial strain rate, s ⁻¹	1.7 (0.4)	2.3 (0.6)	2.3 (0.5)	0.004	0.006
Longitudinal strain, %	-15 (6)	-15 (4)	-18 (5)	0.852	0.021
Longitudinal strain rate, s ⁻¹	-0.9 (0.3)	-1.1 (0.3)	-1.3 (0.4)	0.157	0.009
Severe fibrosis					
Radial strain, %	26 (11)	31 (14)	34 (11)	0.492	0.021
Radial strain rate, s ⁻¹	1.6 (0.3)	1.6 (0.5)	1.7 (0.4)	0.843	0.245
Longitudinal strain, %	-10 (5)	-11 (6)	-14 (5)	0.853	0.079
Longitudinal strain rate, s ⁻¹	-0.6 (0.2)	-0.8 (0.3)	-0.8 (0.2)	0.044	0.040

Weidemann F et al. *Circulation* 2009;120:577

Parâmetros Ecocardiográficos

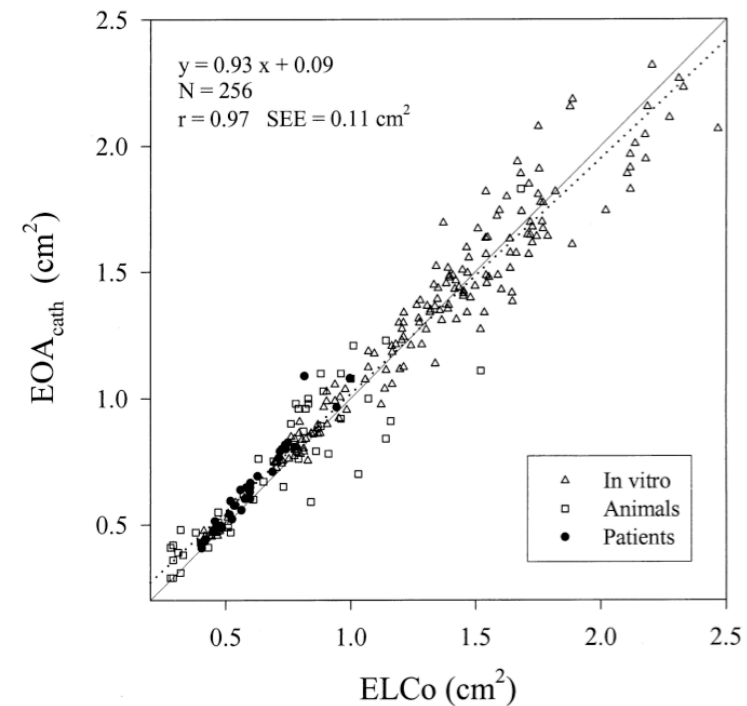
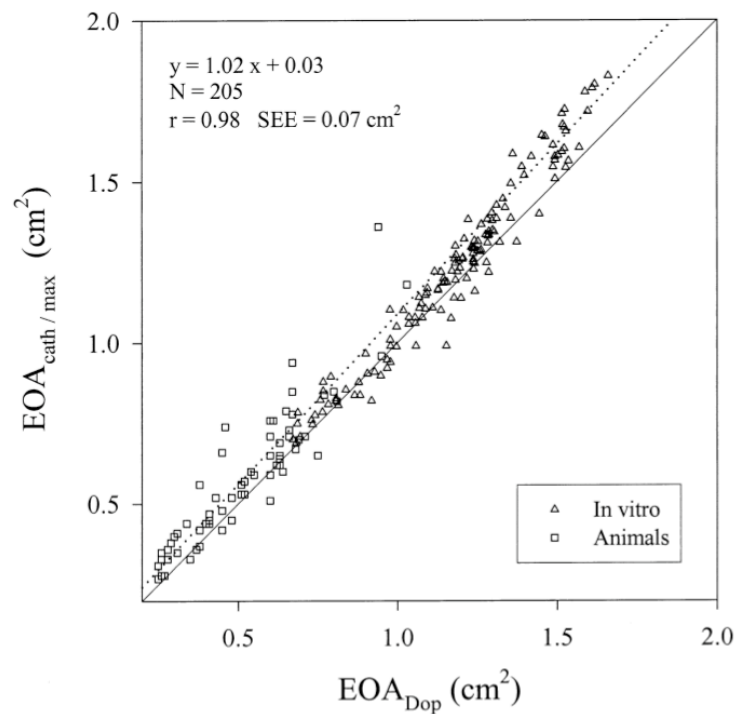
Torção Miocárdica



Parâmetros Ecocardiográficos

Energy Loss Coefficient / Index

$$\square \text{ ELCo} = \text{AVA}_{\text{Dop}} \times \frac{\dot{\text{Área}}_{\text{Aorta}}}{\dot{\text{Área}}_{\text{aorta}} - \text{AVA}_{\text{Dop}}}$$

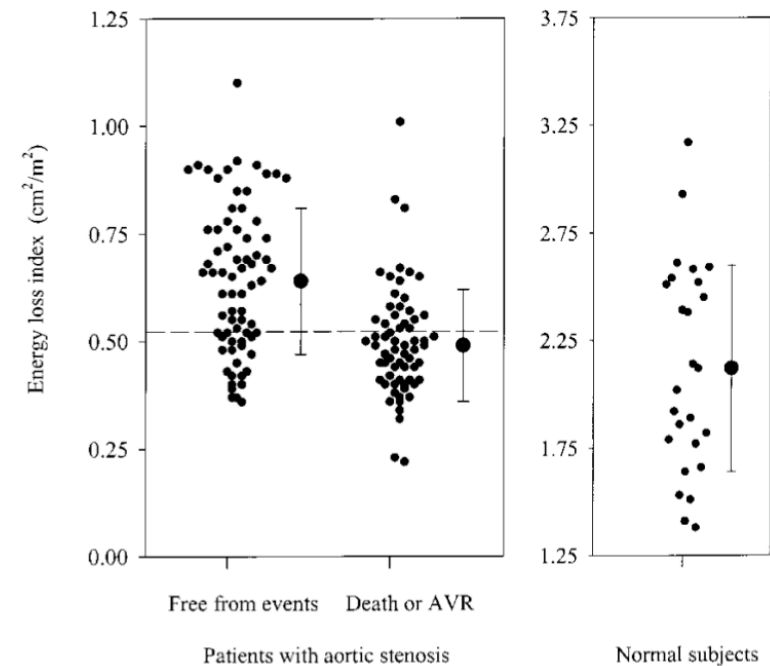


Parâmetros Ecocardiográficos

Energy Loss Coefficient / Index

Association Between the Doppler Echocardiographic Parameters and the Outcome in Patients With Aortic Stenosis

Parameter	Univariate Analysis		Multivariate Analysis	
	Odds Ratio	P	Odds Ratio	P
Age	0.96	0.004	0.96	0.006
Sex	...	NS	...	NS
LV mass (g)	...	NS	...	NS
LV mass index (g/m ²)	...	NS	...	NS
Ejection fraction (%)	...	NS	...	NS
Peak gradient (mm Hg)	1.04	0.001	...	NS
Mean gradient (mm Hg)	1.06	<0.001	...	NS
Valve EOA (cm ²)	0.015	<0.001	...	NS
Indexed valve EOA (cm ² /m ²)	0.0003	<0.001	...	NS
Energy loss coefficient (cm ²)	0.032	<0.001	...	NS
Energy loss index (cm ² /m ²)	0.002	<0.001	0.001	<0.0001



Garcia D et al. *Circulation* 2000;101:765

Parâmetros Ecocardiográficos

Impedância Valvuloarterial

$$\square Z_{VA} = (\text{systolic AP} + \text{MTG}) / \text{Stroke volume index}$$

Table 1

Baseline Clinical Characteristics of the Patients According to the Level of Z_{va}

Group	Low Z_{va} (n = 172)	Medium Z_{va} (n = 192)	High Z_{va} (n = 180)	p Value
Age, yrs	66 ± 15	70 ± 12*	73 ± 13*†	<0.001
Female sex	69 (40)	73 (38)	82 (46)	NS
Body surface area, m ²	1.8 ± 0.2	1.8 ± 0.2	1.8 ± 0.2	NS
Body mass index, kg/m ²	27 ± 6	27 ± 5	28 ± 5	NS
Obesity	39 (23)	53 (27)	55 (31)	NS
Hypertension	96 (56)	138 (72)*	128 (71)*	0.02
Hypercholesterolemia	93 (54)	109 (57)	76 (42)	NS
Diabetes	39 (23)	40 (21)	34 (19)	NS
Coronary artery disease	96 (56)	128 (67)	106 (59)	NS

Table 2

Doppler Echocardiographic and Systemic Arterial Indexes of Valvular Load, Arterial Load, and Global LV Hemodynamic Load According to the Level of Z_{va}

Group	Low Z_{va} (n = 172)	Medium Z_{va} (n = 192)	High Z_{va} (n = 180)	p Value
Valvular load				
Aortic valve area, cm ²	1.2 ± 0.2	1.0 ± 0.3*	0.8 ± 0.2*†	<0.0001
Aortic valve area index, cm ² ·m ⁻²	0.66 ± 0.13	0.56 ± 0.15*	0.45 ± 0.12*†	<0.0001
Energy loss index, cm ² ·m ⁻²	0.78 ± 0.18	0.65 ± 0.23*	0.51 ± 0.15*†	<0.0001
Peak gradient, mm Hg	44 ± 16	46 ± 20	56 ± 26*†	<0.0001
Mean gradient, mm Hg	25 ± 10	27 ± 12	34 ± 17*†	<0.0001
Vascular load				
Systolic arterial pressure, mm Hg	122 ± 16	135 ± 19*	145 ± 23*†	<0.001
Diastolic arterial pressure, mm Hg	68 ± 9	73 ± 10*	78 ± 10*†	<0.0001
Systemic arterial compliance, ml·m ⁻² ·mm Hg ⁻¹	0.94 ± 0.24	0.69 ± 0.18*	0.57 ± 0.18*†	<0.0001
Systemic vascular resistance, dyne·s·cm ⁻⁵	1,303 ± 287	1,605 ± 361*	1,824 ± 398*†	<0.001
Global LV hemodynamic load				
Valvuloarterial impedance, mm Hg·ml ⁻¹ ·m ²	3.1 ± 0.4	4.0 ± 0.3*	5.2 ± 0.9*†	<0.0001

Low Z_{VA} : ≤ 3.5
 Medium Z_{VA} : > 3.5 e < 4.5
 High Z_{VA} : ≥ 4.5

Parâmetros Ecocardiográficos

Impedância Valvuloarterial

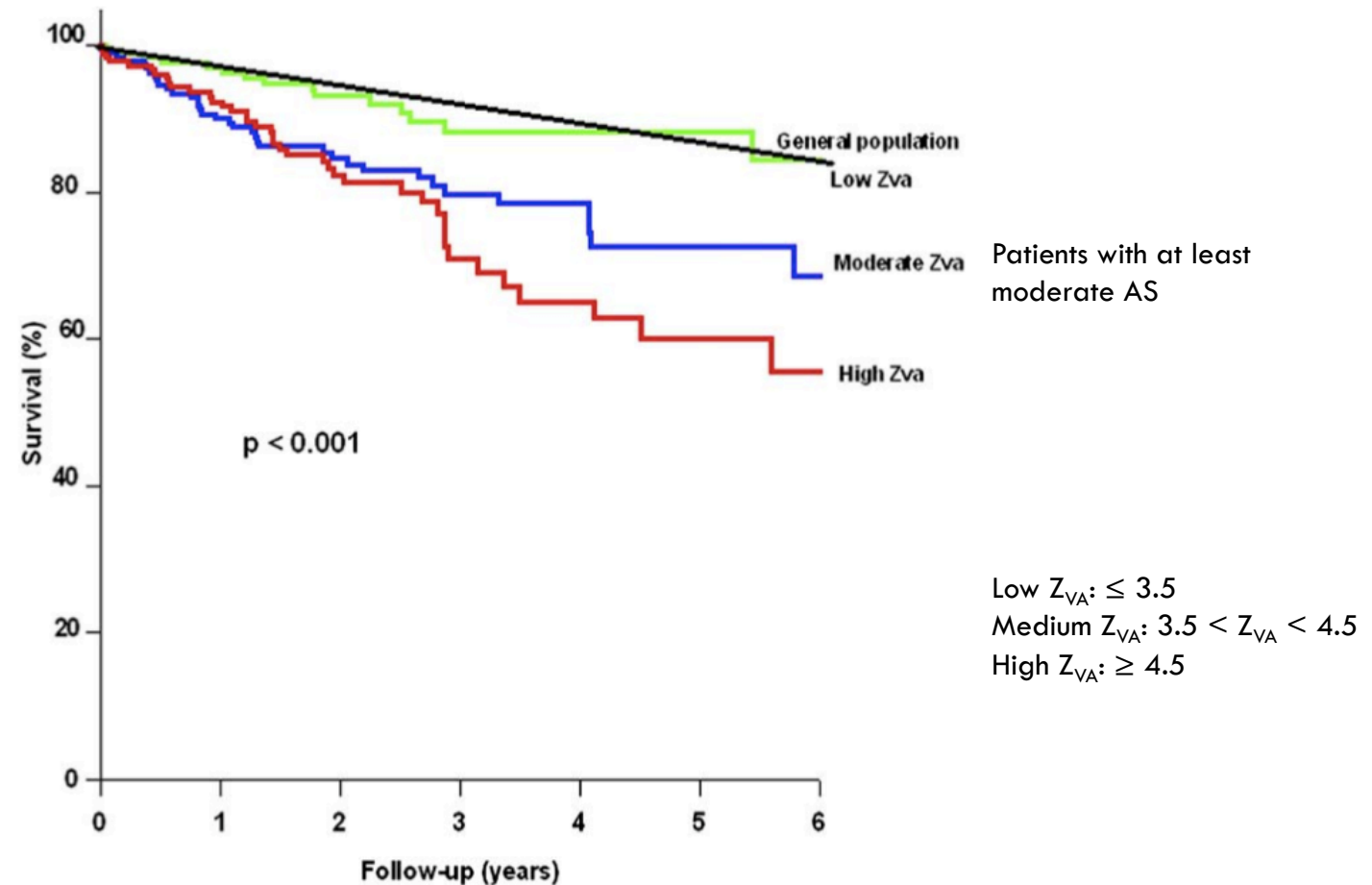
Table 3

Doppler Echocardiographic Data of LV Geometry and Function According to the Level of Z_{va}

Group	Low Z_{va} (n = 172)	Medium Z_{va} (n = 192)	High Z_{va} (n = 180)	p Value
LV geometry				
IVSTd, mm	12 ± 3	12 ± 2	13 ± 3*†	<0.001
PWTd, mm	10 ± 2	11 ± 2	11 ± 2*	0.02
LVIDd, mm	48 ± 5	47 ± 5	45 ± 5*†	<0.001
LVEDV, ml	111 ± 27	106 ± 27	96 ± 25*†	<0.001
LVEDV index, ml·m ⁻²	61 ± 13	58 ± 13*	52 ± 12*†	<0.001
Relative wall thickness, %	44 ± 10	46 ± 10*	49 ± 10*†	<0.001
LV mass, g	210 ± 73	209 ± 56	210 ± 64	NS
LV mass index, g/m ²	116 ± 34	114 ± 27	115 ± 32	NS
LV systolic function				
LV ejection fraction, %	67 ± 7	66 ± 7	65 ± 7*	0.025
Stroke volume, ml	87 ± 16	75 ± 12*	65 ± 15*†	<0.001
Stroke volume index, ml·m ⁻²	48 ± 8	41 ± 5*	35 ± 7*†	<0.001
Cardiac output, l·min ⁻¹	5.5 ± 1.2	4.8 ± 1.0*	4.6 ± 1.1*†	<0.001
Cardiac index, l·min ⁻¹ ·m ⁻²	3.1 ± 0.7	2.6 ± 0.5*	2.5 ± 0.5*†	<0.001
Mean transvalvular flow rate, ml·s ⁻¹	268 ± 61	232 ± 49*	210 ± 55*†	<0.001
LV diastolic function, %				
Normal	20	13	11	NS
Abnormal	80	87	89	<0.001

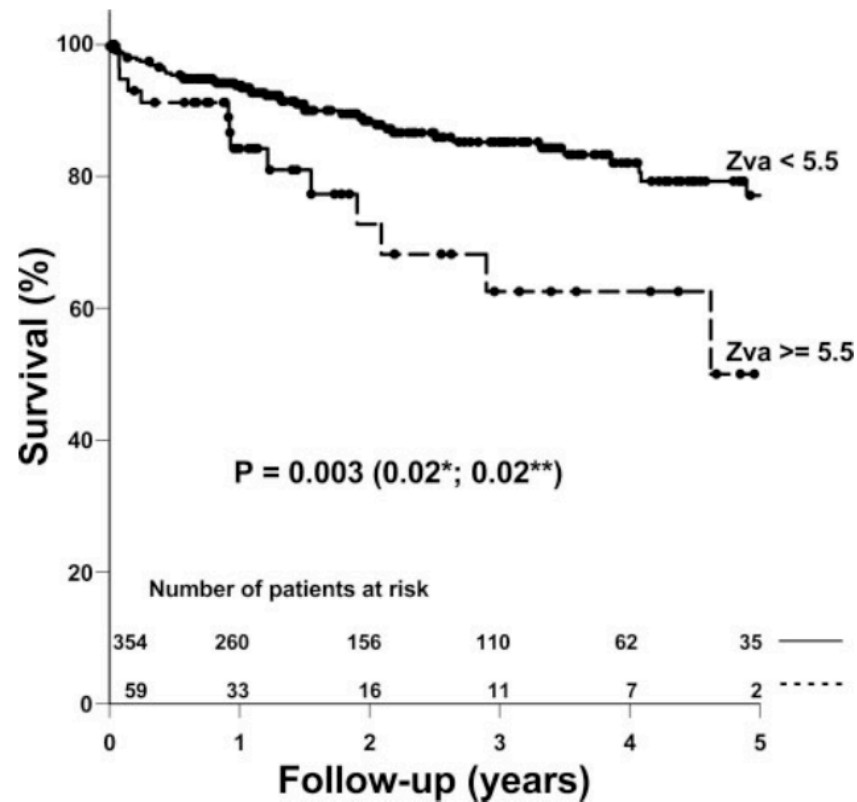
Parâmetros Ecocardiográficos

Impedância Valvuloarterial

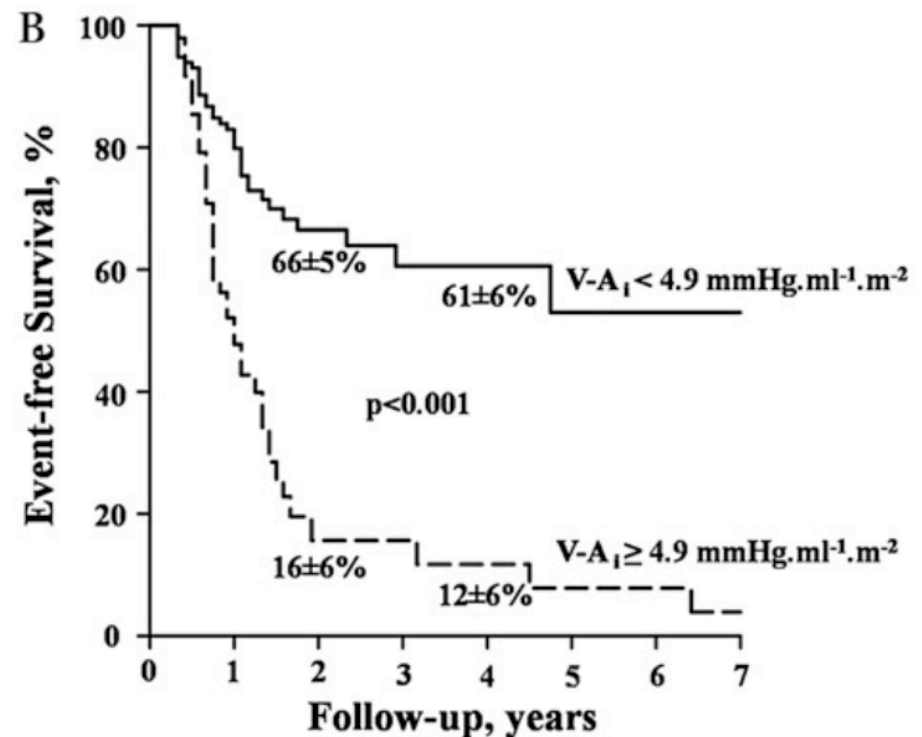


Parâmetros Ecocardiográficos

Impedância Valvuloarterial



Hachicha Z et al. *Circulation* 2007;115:2856



Lancellotti P et al. *Heart* 2010;96:1364

Ecocardiograma 3D

TABLE 2. Degree of Inter- and Intraobserver Agreement in the Calculation of the Left Ventricular Outflow Tract Area^a

	ICC	95% CI	P
Intraobserver			
2D-echo LVOT area	0.27	0.025-0.537	.037
3D-echo LVOT area	0.99	0.983-0.995	<.001
Interobserver			
2D-echo LVOT area	0.43	0.143-0.656	.001
3D-echo LVOT area	0.97	0.951-0.986	<.001

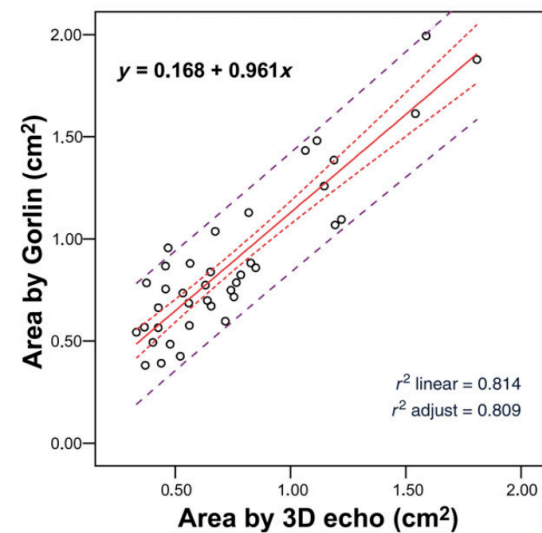
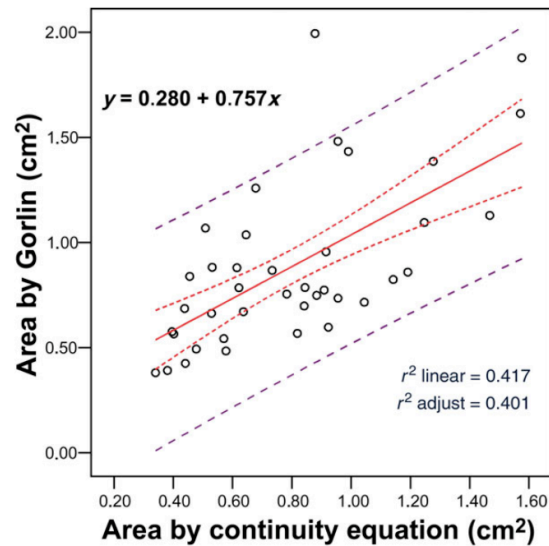
Pérez de Isla L et al. *Rev Esp Cardiol* 2008;61:494

Table 2 Correlation and absolute agreement (expressed as ICCa and Lin's coefficient) between the different invasive and echocardiographic methods studied for aortic valve calculation

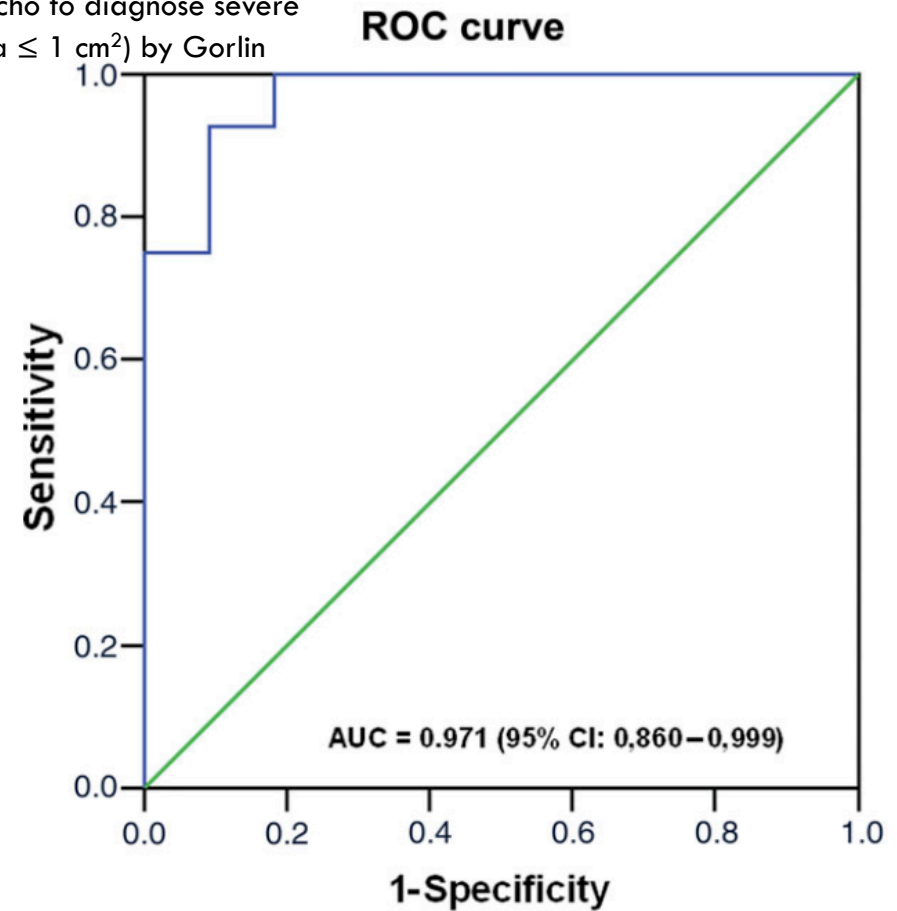
Correlation and absolute agreement		Area by continuity equation (cm ²)	Area by Simpson's two dimensional method (cm ²)	Area by three-dimensional echo (cm ²)	Area by Hakki's formula (cm ²)
Area by Simpson's two dimensional method (cm ²)	Pearson's correlation	0.731 (0.540–0.850)			
	ICCa	0.520 (0.027–0.764)			
	Lin's coefficient	0.518			
Area by three-dimensional echo (cm ²)	Pearson's correlation	0.659 (0.434–0.807)	0.742 (0.557–0.857)		
	ICCa	0.654 (0.436–0.800)	0.583 (0.163–0.793)		
	Lin's coefficient	0.648	0.579		
Area by Hakki's formula (cm ²)	Pearson's correlation	0.636 (0.401–0.792)	0.598 (0.348–0.769)	0.870 (0.764–0.930)	
	ICCa	0.610 (0.363–0.775)	0.333 (0.101–0.617)	0.779 (0.327–0.910)	
	Lin's coefficient	0.604	0.332	0.777	
Area by Gorlin (cm ²)	Pearson's correlation	0.646 (0.415–0.799)	0.627 (0.540–0.850)	0.902 (0.820–0.948)	0.901 (0.818–0.947)
	ICCa	0.626 (0.394–0.784)	0.378 (0.066–0.654)	0.846 (0.473–0.939)	0.857 (0.745–0.922)
	Lin's coefficient	0.621	0.375	0.844	0.852

Gutiérrez-Chico JL et al. *Eur Heart J* 2008;29:1296

Ecocardiograma 3D



ROC curve of the AVA calculated by 3D echo to diagnose severe AS (area $\leq 1 \text{ cm}^2$) by Gorlin



TC Cardíaca

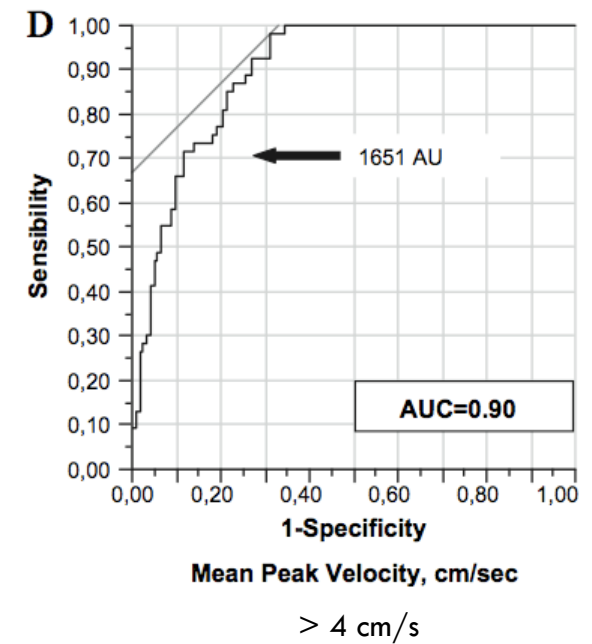
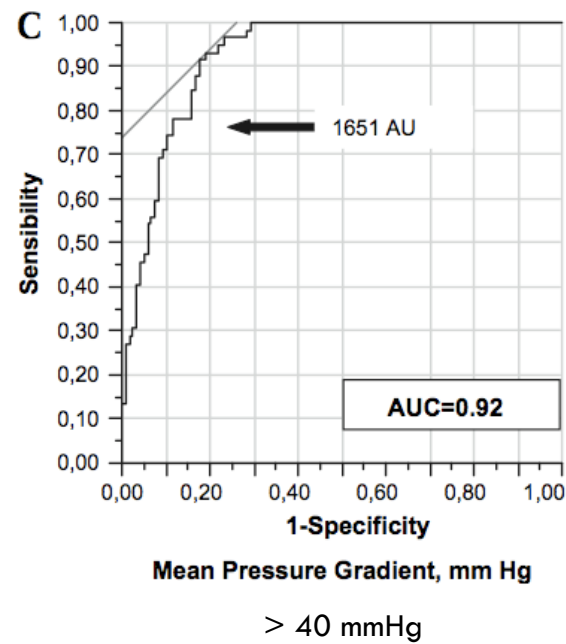
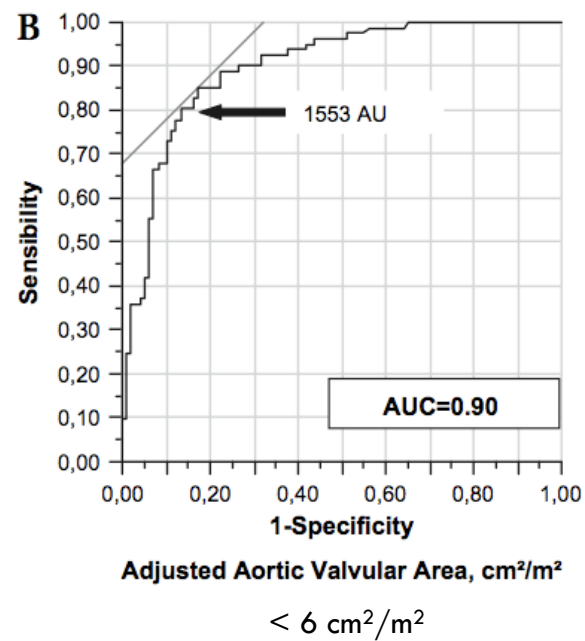
Calcificação Valvular

TABLE 1. Baseline Characteristics of 100 Patients Overall and According to AVC Score Quartiles*

Variable	Overall	First Quartile (<9 AU)	Second Quartile (9–557 AU)	Third Quartile (558–1934 AU)	Fourth Quartile (>1934 AU)	P
Age, y	70±10	66±9	68±11	72±7	73±12	0.06
Male gender, %	58	48	68	36	80	0.008
NYHA class I/II	93	100	92	96	84	0.21
LV EF, %	64±8	66±8	64±6	66±6	61±10	0.19
LV mass, g	202±64	172±13	200±14	217±13	222±14	0.04
AVA, cm ²	1.8±0.9	2.7±0.6	2.5±0.6	1.1±0.3	0.9±0.3	<0.0001
Dimensionless index	0.46±0.24	0.74±0.15	0.65±0.14	0.31±0.08	0.23±0.07	<0.0001
Peak aortic valve velocity, m/s	2.8±1.4	1.5±0.5	1.8±0.7	3.6±0.7	4.4±0.9	<0.0001
Severe AS, %	29	0	0	48	68	<0.0001
AVC score, AU	1316±1749	1±2	129±166	1217±376	3916±1460	...

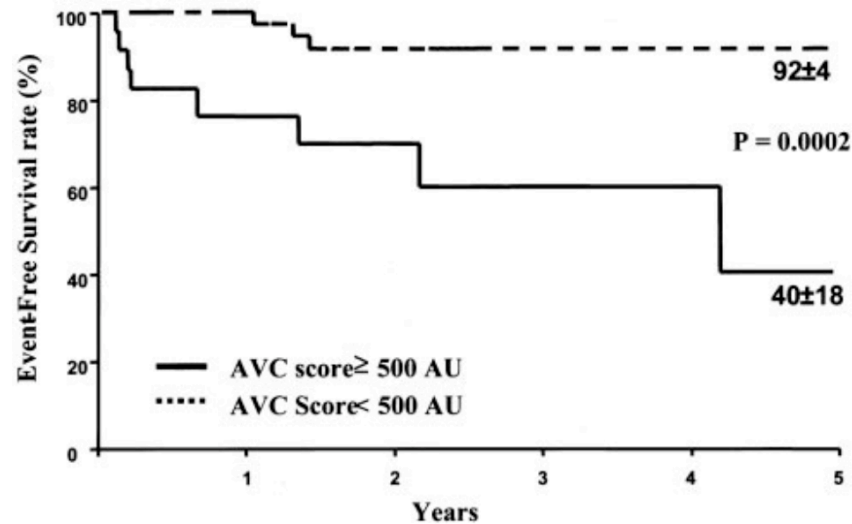
TC Cardíaca

Calcificação Valvular

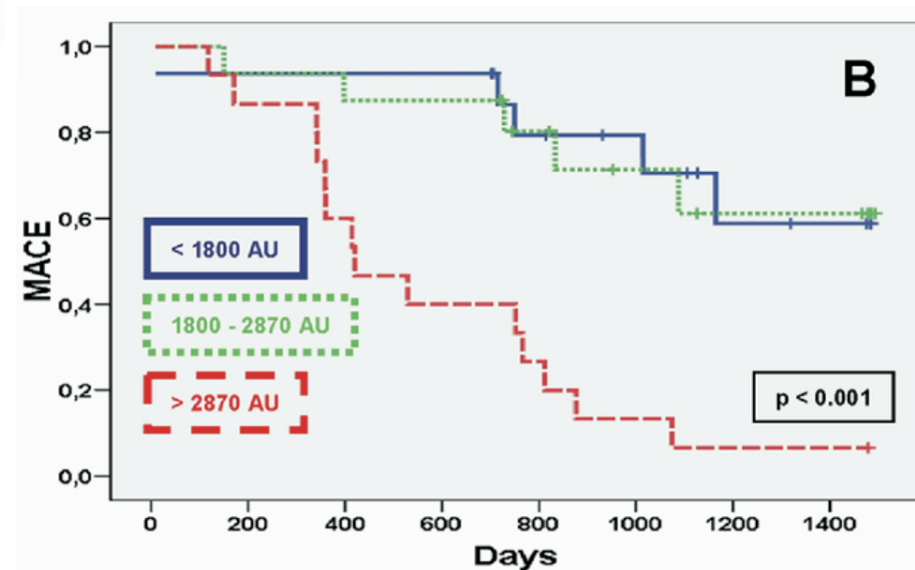


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Calcificação Valvular



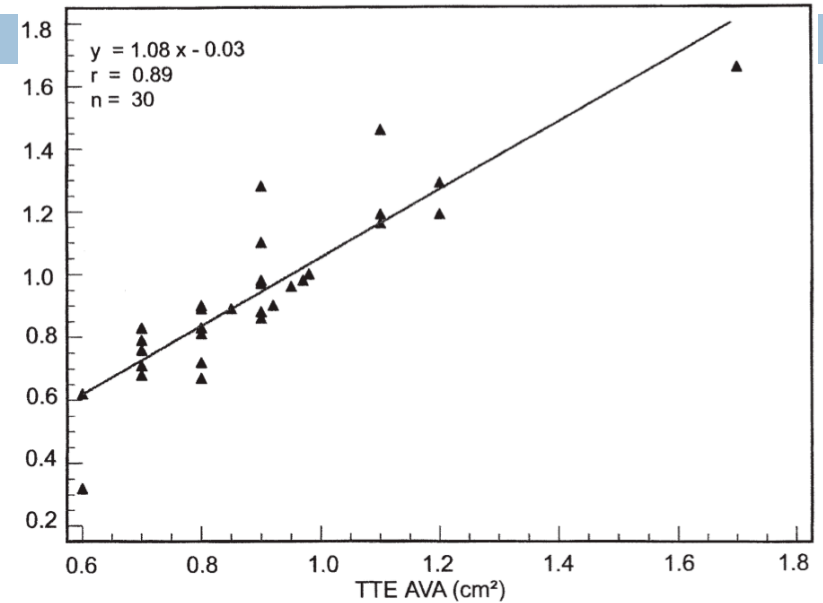
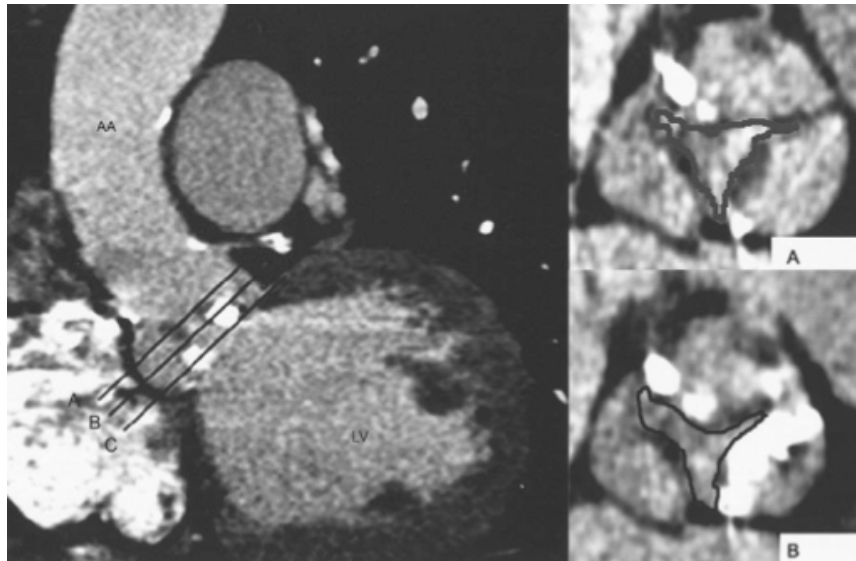
Messika-Zeitoun D et al. *Circulation* 2004;110:356



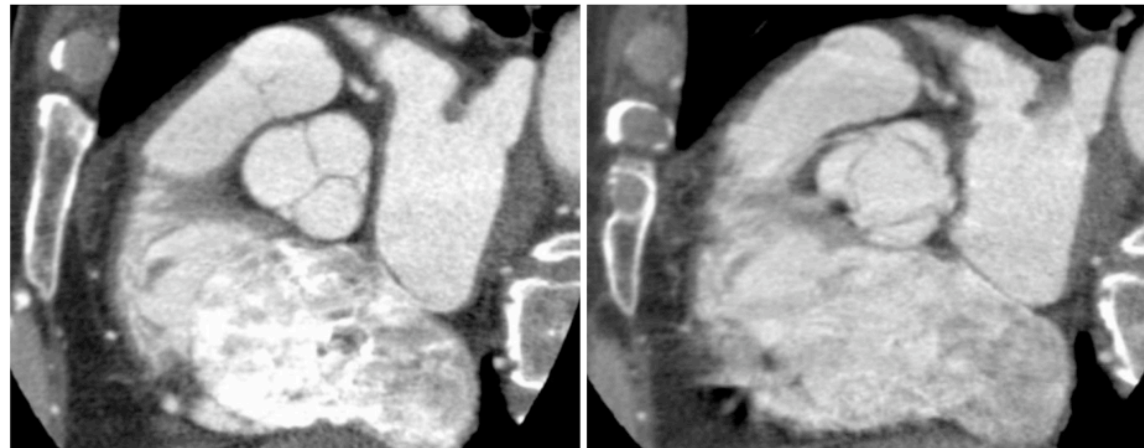
Dichtl W et al. *Am J Cardiol* 2008;102:743

TC Cardíaca

Área Valvular



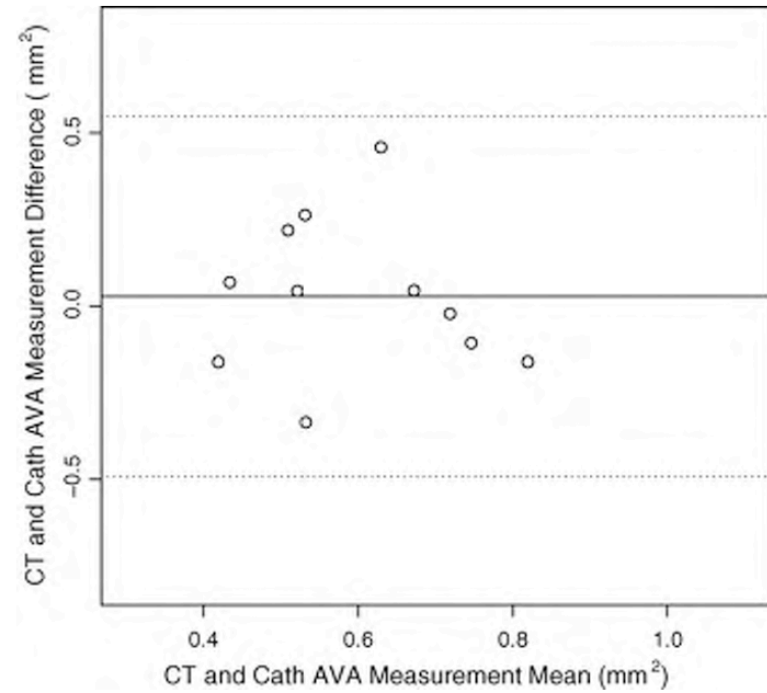
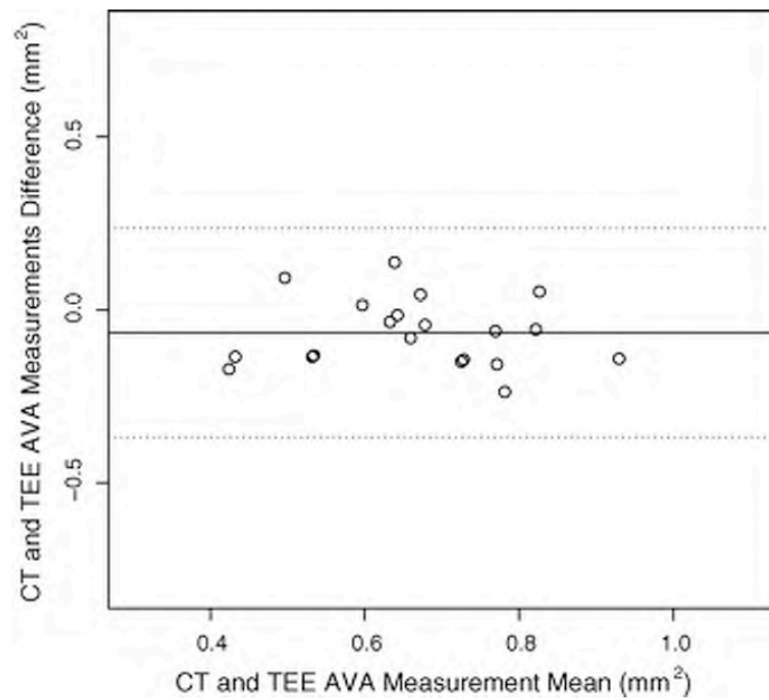
Feuchtnner GM et al. JACC 2006;47:1410



Chun EJ et al. Korean J Radiol 2008;9:439

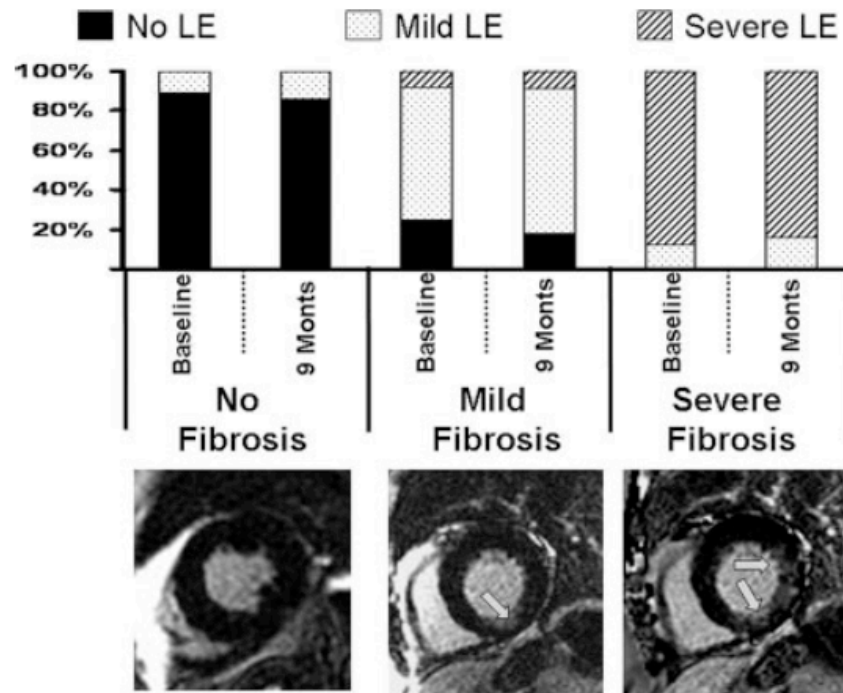
TC Cardíaca

Área Valvular

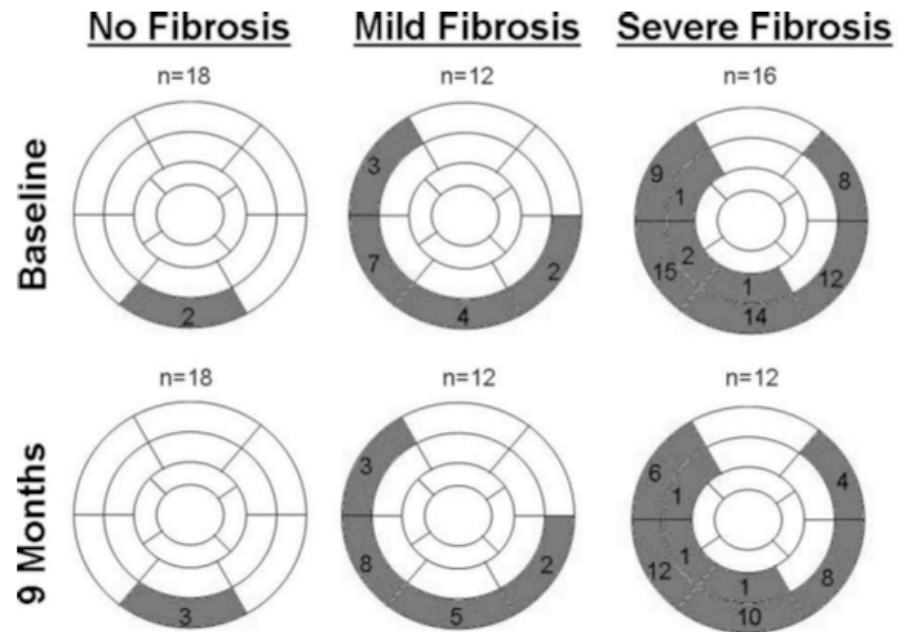


RM Cardíaca

Fibrose Miocárdica

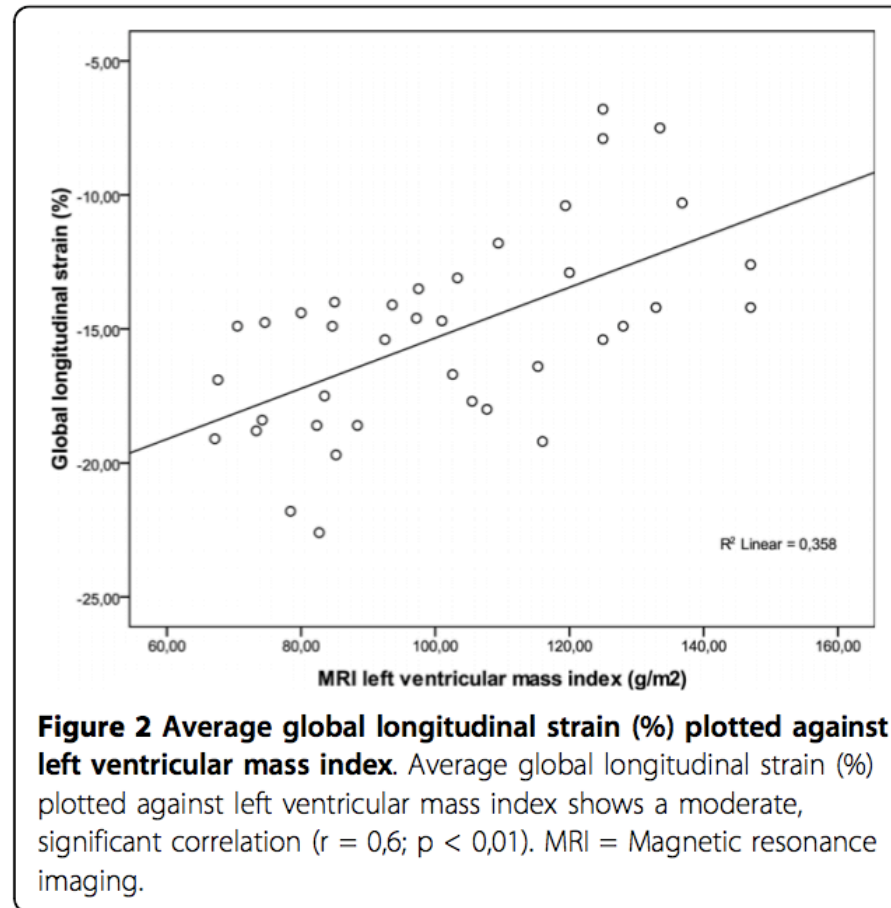


Myocardial fibrosis determined histologically and by CMR



RM Cardíaca

Massa VE



RM Cardíaca

Área Valvular e Gradientes

Table 2. MRI Value of Assessment of AVA

First Author	MRI AVA	TTE (<i>r</i> -value)	TEE AVA (<i>r</i> -value)	Interobserver Variability
Schlosser (21)	0.80 cm ² + 0.25	0.74 cm ² + 0.30 (NA*)	0.80 cm ² + 0.28 (NA)	0.03 + 0.05 cm ²
Johs (22)	0.91 cm ² + 0.25	NA	0.89 cm ² + 0.28 (0.96)	0.07 + 0.06 cm ²
Pouleur (6)	2.4 cm ² + 1.8	2.0 cm ² + 1.5 (0.96)	2.5 cm ² + 1.7 (0.99)	0.1 + 0.3 cm ²

Table 3. Correlations between MRI and Other Tests for Quantification of Flow and Pressure Gradient in Aortic Stenosis

First Author	TTE (<i>r</i> -value)	Cath (<i>r</i> -value)	Reproducibility (<i>r</i> -value)
Cauthers 23	0.97	NA*	0.87
Eichenberger 24	0.94	0.97	NA

Conclusões



- A estenose aórtica é uma doença muito frequente que nos seus estadios mais avançados acarreta elevadas taxas de morbilidade e mortalidade
- A substituição valvular precoce em doentes com estenose aórtica grave assintomática melhora o prognóstico a longo prazo
- Nem todos os doentes retiram igual benefício desta estratégia cirúrgica precoce

Conclusões



- Múltiplos estudos demonstraram que vários marcadores (parâmetros clínicos, funcionais, laboratoriais, ecocardiográficos ou imagiológicos) permitem identificar grupos de doentes com melhor prognóstico ou que beneficiam mais de uma estratégia cirúrgica precoce
- Novos parâmetros ecocardiográficos (Doppler tecidual, *strain* miocárdico, *energy loss coefficient*, impedância valvuloarterial, ecocardiografia 3D), de TC e RM podem vir a ter um papel na estratificação desta patologia e na decisão da abordagem terapêutica

PROGNÓSTICO DA ESTENOSE AÓRTICA

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