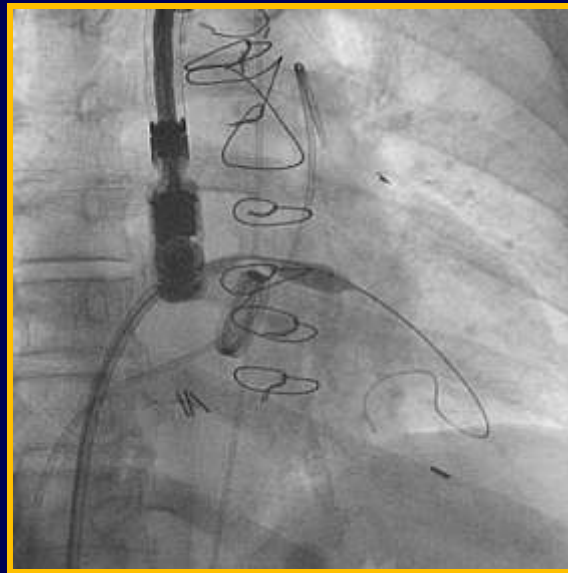
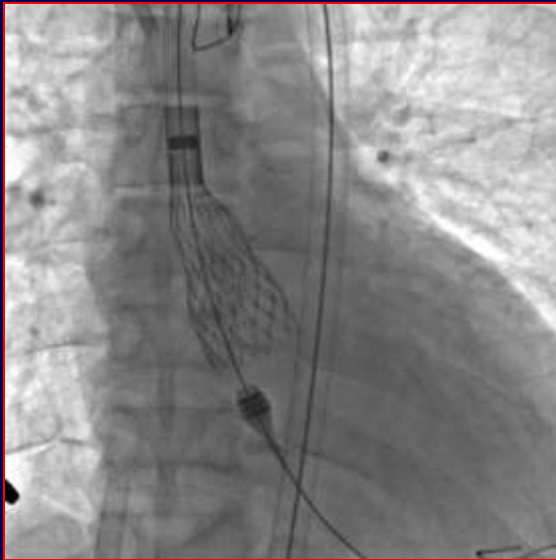


Aortic Stenosis: UPDATE 2010

Anjan Sinha, MD
Krannert Institute of Cardiology



Disclosures

- **None**

67-Year-Old Male

- **Dyspnea and angina**
- **Class III heart failure**
- **No PND or orthopnea**
- **3/6 late peak SEM**
- **Diminished A₂**
- **Parvus et tardus**
- **PCI of LAD in the past**

PHILIPS

DEB A

METHODIST

S5-1

29Hz

18cm

2D

HGen

Gn 50

C 50

3/2/0

75 mm/s



G
P R
1.6 3.2

76
BPM

PHILIPS
DEB A

METHODIST
S5-1
26Hz
21cm

2D
HGen
Gn 50
C 50
3/2/0
75 mm/s



Ⓞ
P R
1.6 3.2



LVEF: 15%
Severe Aortic Stenosis

PHILIPS
DEB A

METHODIST
S5-1
28Hz
18cm

2D
HGen
Gn 50
C 50
3/2/0
75 mm/s



Ⓞ
P R
1.6 3.2



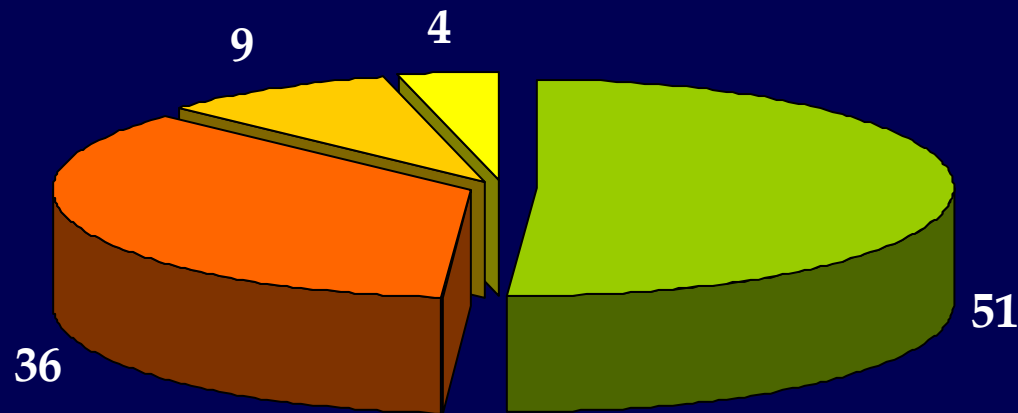
63
BPM

What Next

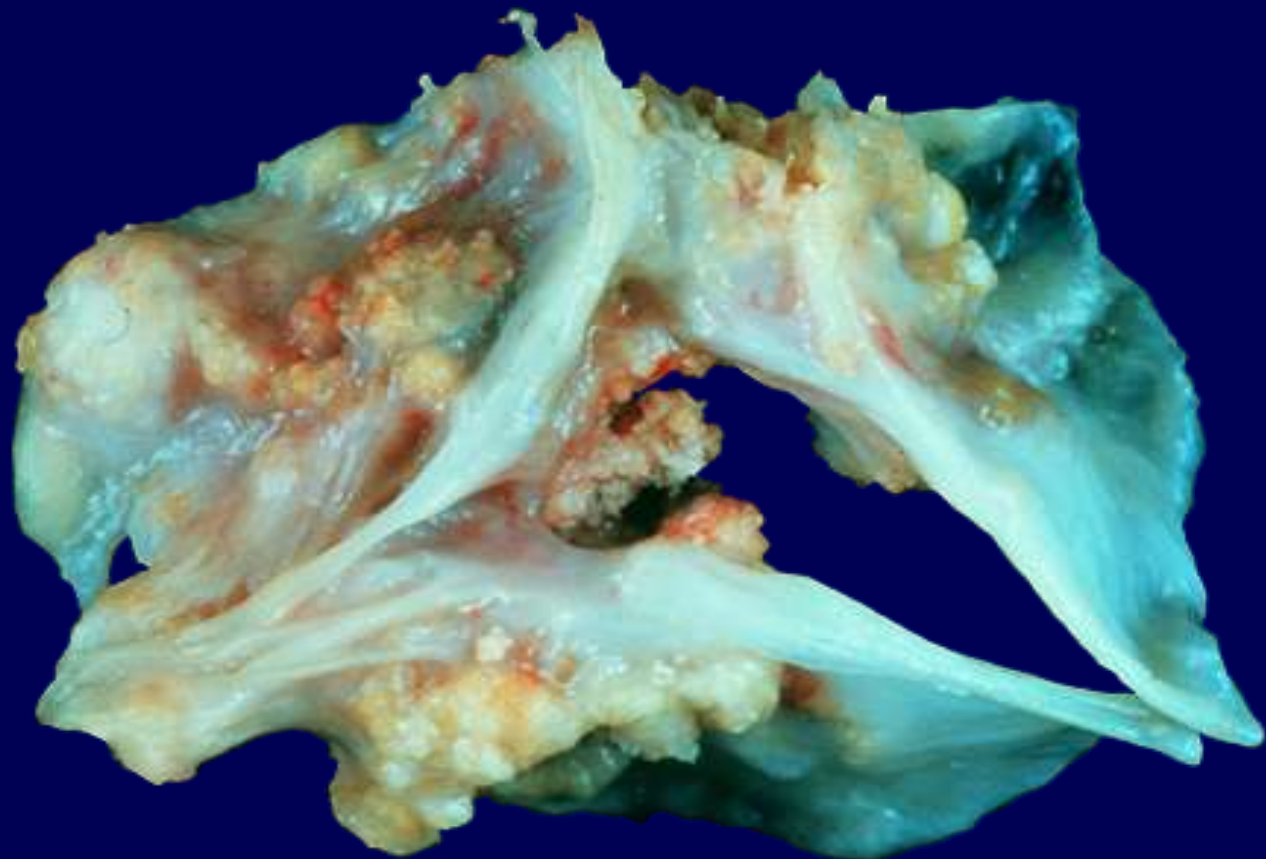
- **Aortic Valve Surgery**
- **Medical Therapy**
- **Balloon Aortic Valvuloplasty**
- **Balloon Aortic Valvuloplasty followed by AVR if improvement**

Etiology of Aortic Stenosis

■ Calcific ■ Bicuspid ■ Rheumatic ■ Misc



Dare et al. Hum Pathol 1993;24:1330-38



Classification of Severity of AS

Indicator	Mild	Moderate	Severe
Jet velocity (m/s)	< 3	3-4	> 4
Mean gradient (mm Hg)	< 25	25-40	> 40
Valve Area (cm ²)	> 1.5	1.0-1.5	< 1.0
Valve area index (cm ² / m ²)			< 0.6

Bonow et al: ACC/AHA Practice guidelines. J Am Coll Cardiol 2006

Rate of hemodynamic progression

- Aortic jet velocity \uparrow by **0.32** m/s per year
- Mean gradient \uparrow by **7** mm Hg per year
- AVA \downarrow by **0.12** cm² per year
- Rate of progression not significantly different for bicuspid and trileaflet valves

Otto et al. Circulation 1997;95:2262-70

Progression of AS

Series	No.	D-gradient/yr (mm Hg)	D-AVA/yr (cm²)
Otto, 1989	42	8	0.10
Fagiano, 1992	45	--	0.10
Brener, 1995	394	6.3	0.14
Bahler, 1999	91	--	0.04
Palta, 2000	170	--	0.10

Pathophysiology

Hypertrophy

Subendocardial ischemia

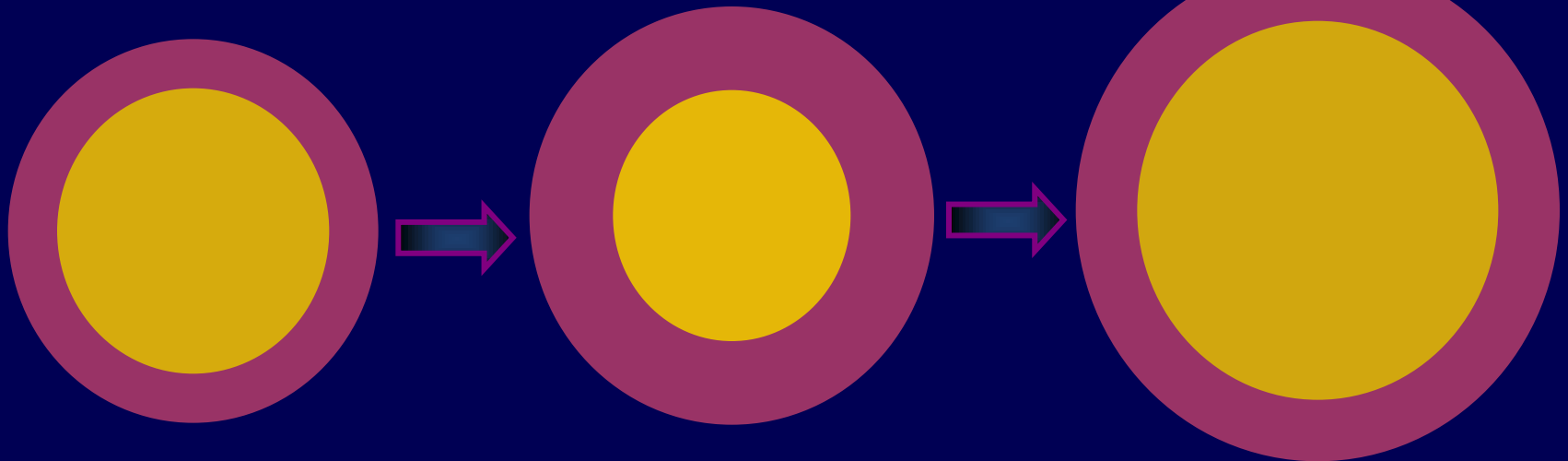
Diastolic dysfunction

Afterload mismatch

Systolic dysfunction

Dilated LV cavity

Low output low gradient AS



“Classic” symptoms

- **Exertional angina**
 - Subendocardial ischemia
- **Exertional syncope**
 - Cerebral hypoperfusion
 - Baroreceptor malfunction
- **Exertional dyspnea progressing to frank heart failure**
 - Pulmonary venous hypertension

Aortic Stenosis

By JOHN ROSS, JR., M.D. AND EUGENE BRAUNWALD, M.D.

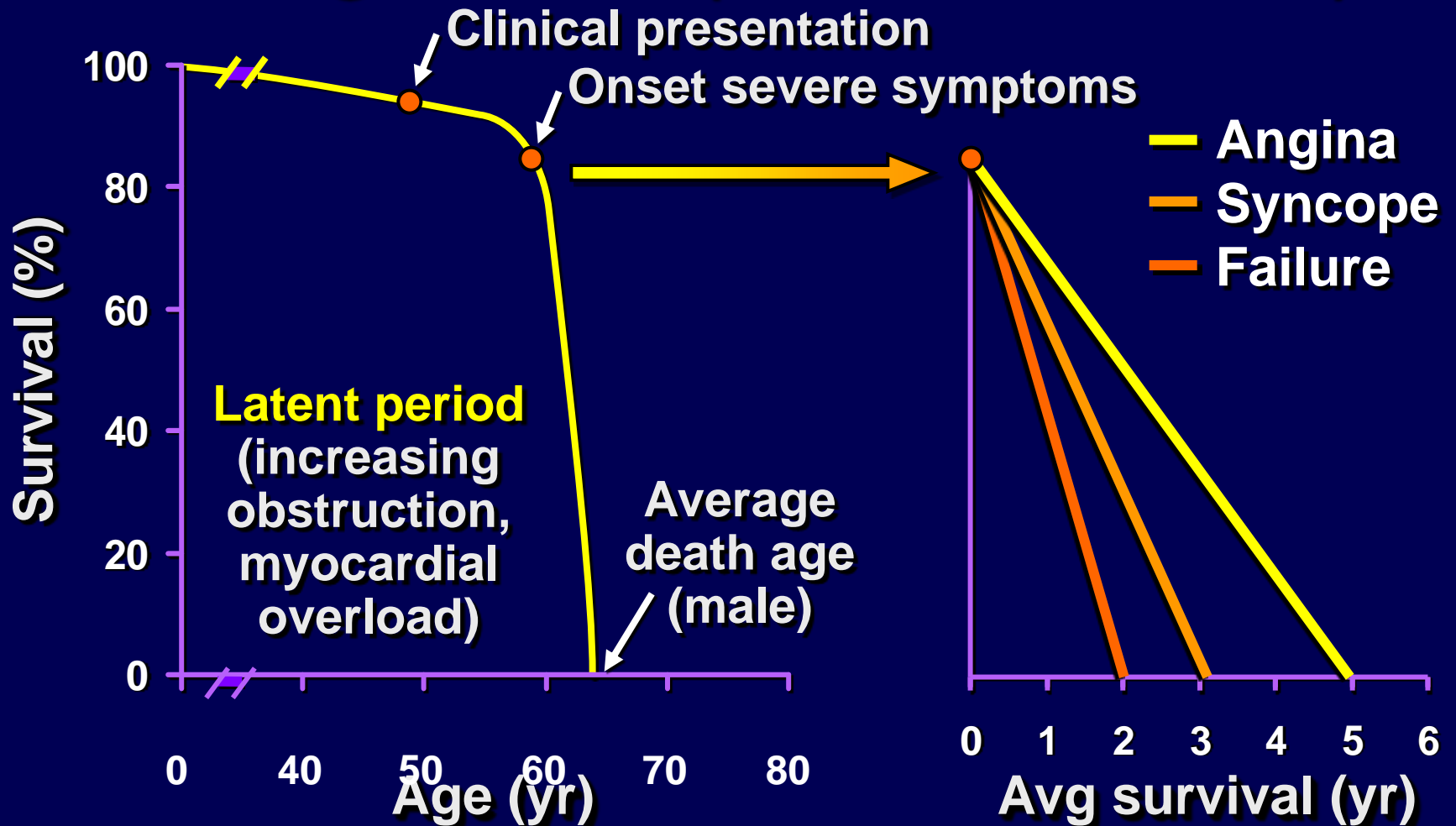
However, evaluation of the natural history of aortic stenosis has been difficult, because the development of objective means for assessment of its severity by left heart catheterization, and the initial attempts at operative treatment, occurred almost simultaneously.

The interruption of the course of aortic stenosis by operation, and the lack of prospective information concerning the outlook of patients with obstruction of known hemodynamic severity, necessitate a largely retrospective view of the natural history. Therefore, in the present report, the natural course of the discrete forms of acquired and congenital aortic stenosis was assembled from clinical and post-mortem studies largely from before 1955, and

dead after 4 to 15 years.¹² Recently, we have obtained follow-up information on patients with isolated aortic valve stenosis who were studied hemodynamically at the National Heart Institute and in whom operation was refused or not carried out for a variety of reasons. Ten of 12 patients with severe aortic stenosis (transvalvar pressure gradients ≥ 50 mm Hg, or effective aortic valve orifices ≤ 0.70 cm²/m² BSA) who were followed for at least five years after catheterization are now dead.¹⁴

Valvular Aortic Stenosis in Adults

Average Course (Post Mortem Data)



Ross, Bruanwald: Circulation 1968: 38 (Supp V):61

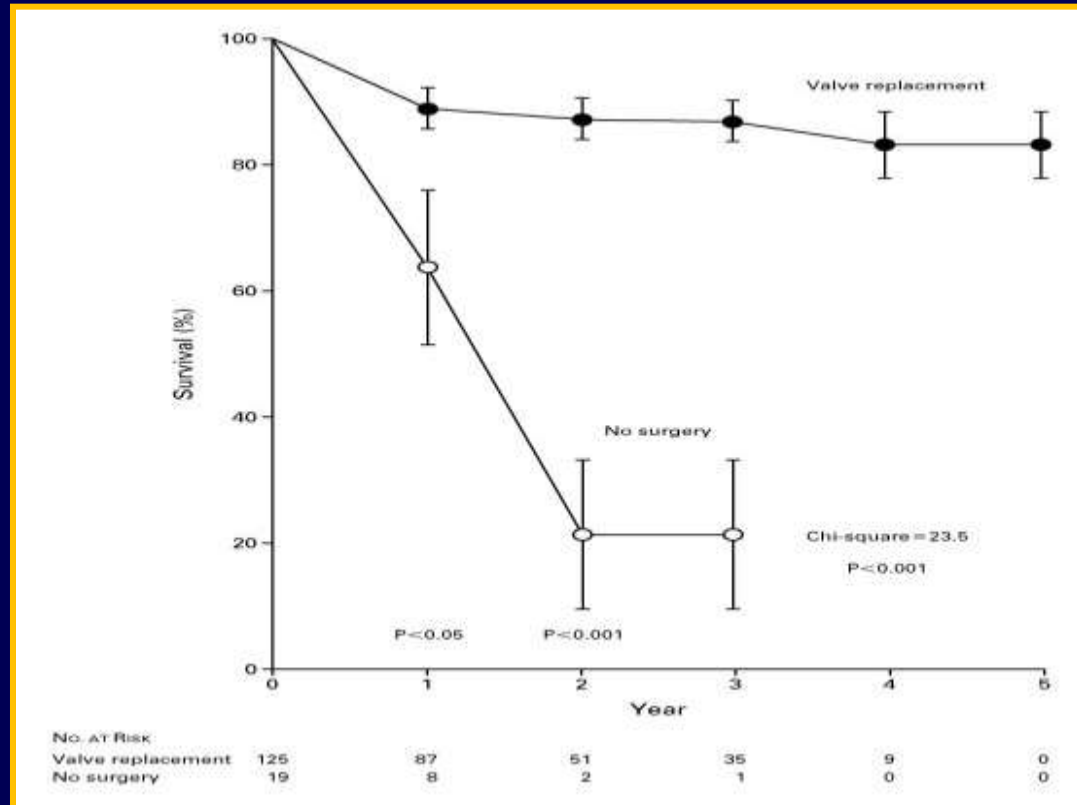
Natural History of Valvular AS

Symptomatic Patients

Study	Criteria	n	F/U	Survival
O'Keefe, 1987	Vmax >4.5	50	1.7y	37% at 2 y
Turina, 1987	MG >60	125	6.6y	12% at 5 y
Horstkotte, 1988	AVA <0.8	35	5 y	18% at 5 y

Aortic Stenosis

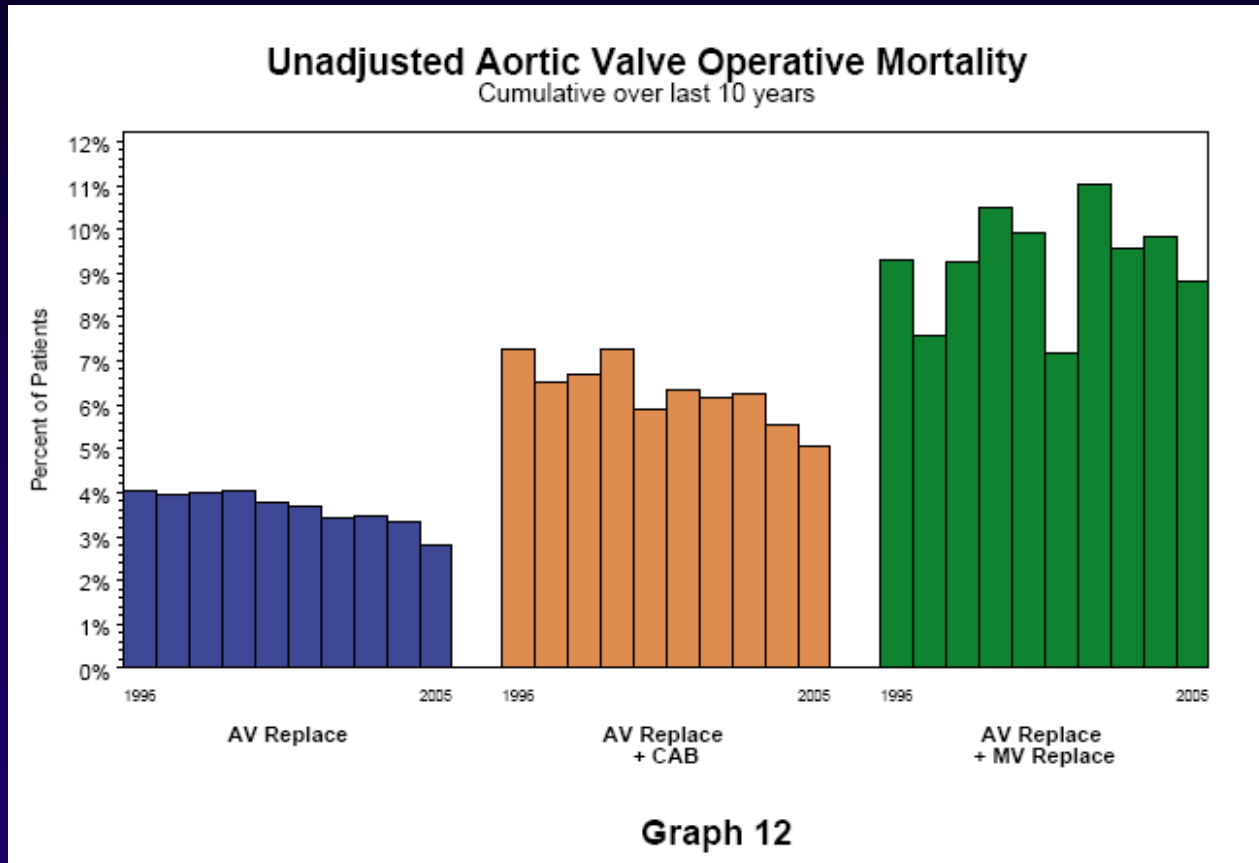
The Truth-For Now



Carabello NEJM 2002

“ In the vast majority of adults , AVR(aortic valve replacement) is the only effective treatment for severe aortic stenosis...” *ACC/AHA guidelines Bonow RO,1998*

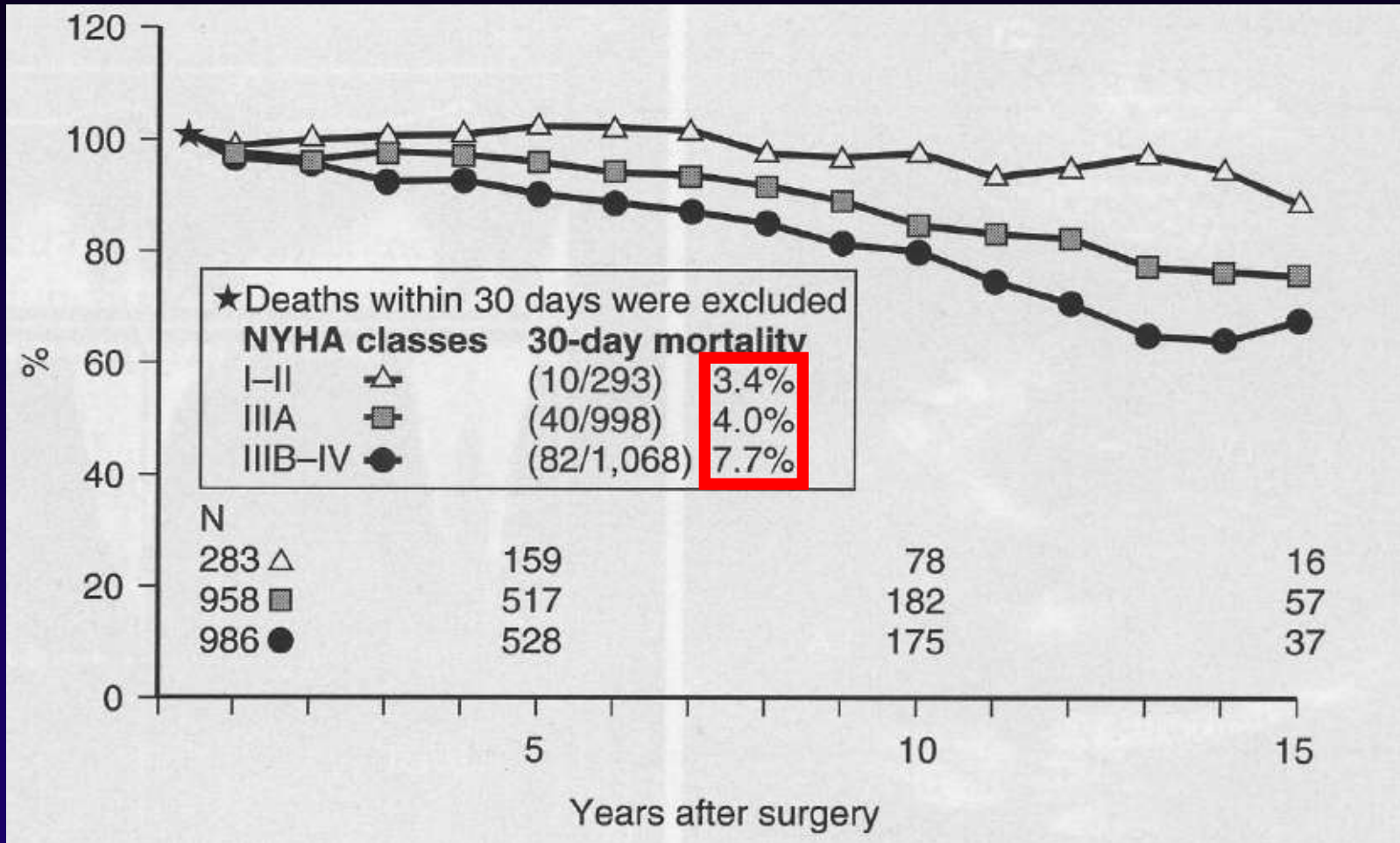
Operative mortality with AVR



Predictors of outcome after AVR

- Age
- Concomitant CAD
- LV dysfunction / HF
- Atrial fibrillation
- Concurrent MVR
- Renal failure

Survival after AVR by preop NYHA class



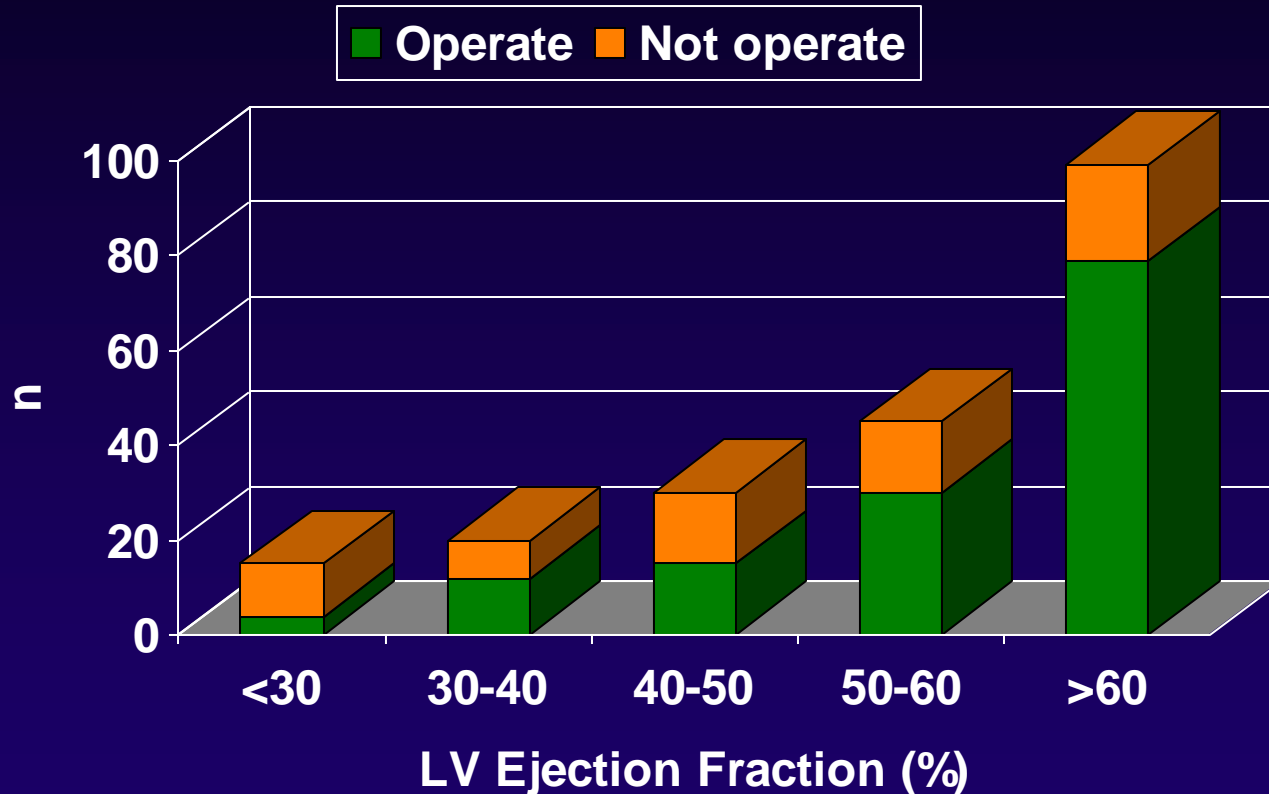
Kvidal et al. J Am Coll Cardiol 2000;35:747-56

Severe AS with LV dysfunction

- Patients with LVEF < 30% have three-fold higher mortality (15% vs. 6%)¹
- Outcome is even worse without surgical interventions (Survival 20-50% at 12 m)²

Fremes et al. Circulation 1989;80:177-90
Otto et al. Circulation 1994;89:642-50

Decision to operate according to LV systolic function



Lung B et al. Eur Heart J 2005;26:2714-20

Aortic Stenosis with Ventricular systolic dysfunction

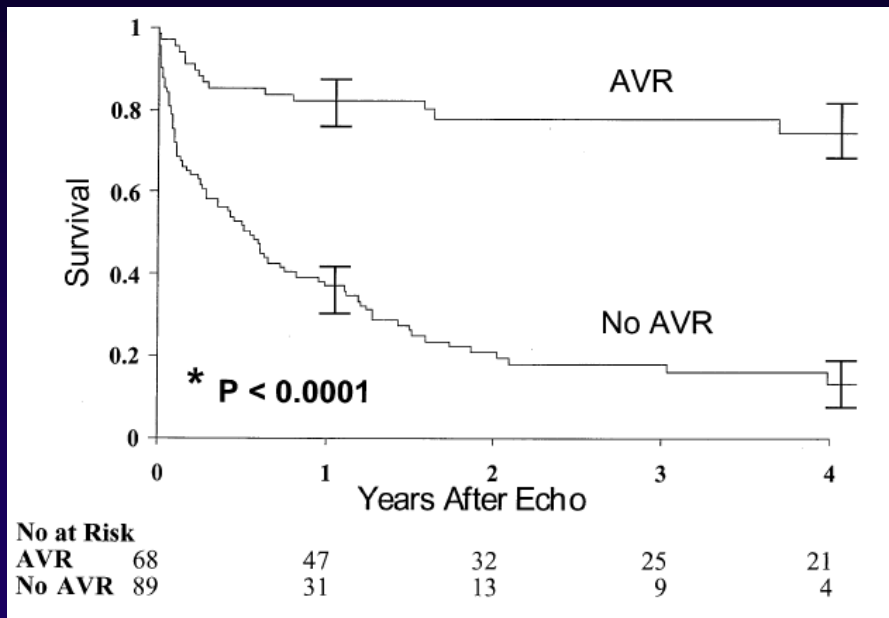
Survival After Aortic Valve Replacement for Severe Aortic Stenosis With Low Transvalvular Gradients and Severe Left Ventricular Dysfunction

Jeremy J. Pereira, MB, BS,* Michael S. Lauer, MD, FACC,* Mohammad Bashir, MB, BS,* Imran Afridi, MD, FACC,* Eugene H. Blackstone, MD, FACC,† William J. Stewart, MD, FACC,* Patrick M. McCarthy, MD,†† James D. Thomas, MD, FACC,* Craig R. Asher, MD, FACC*
Cleveland, Ohio

- **157 patients, mean age 70 years**
- **Mean AVA 0.62 cm²**
- **Mean gradient 25mm Hg**
- **Mean LVEF 22%**
- **68 pts had AVR, 89 treated medically**
- **Mean follow-up 2.7 ± 1.3 years**

J Am Coll Cardiol 2002;39:1356-63

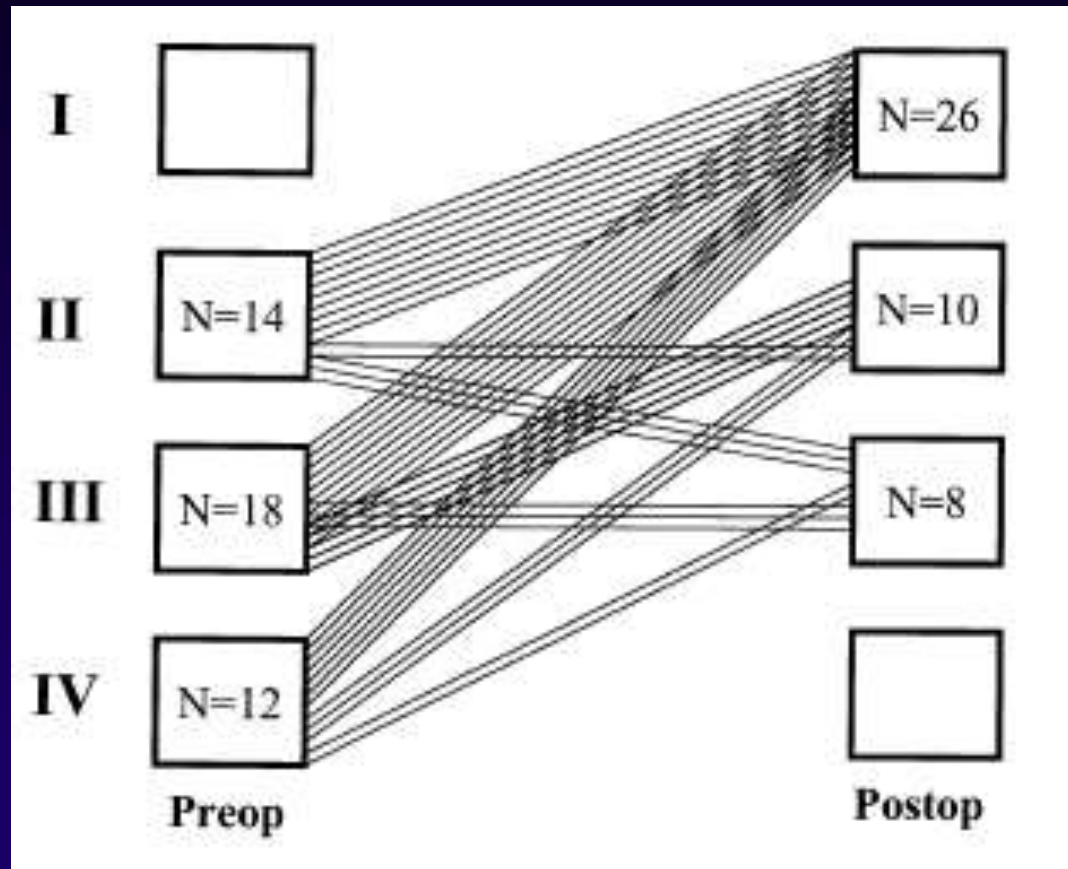
Improved survival



- **Surgically treated**
 - 82% at 1 year
 - 78% at 4 years
- **Medically treated**
 - 41% at 1 year
 - 15% at 4 years

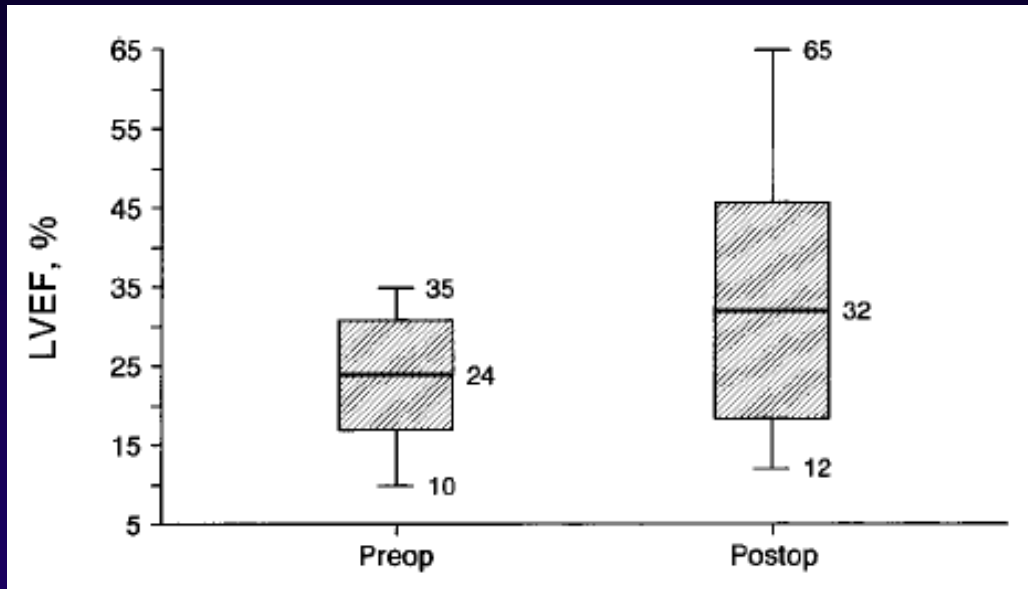
Pereira et al. J Am Coll Cardiol 2002;39:1356-63

Improvement in symptoms



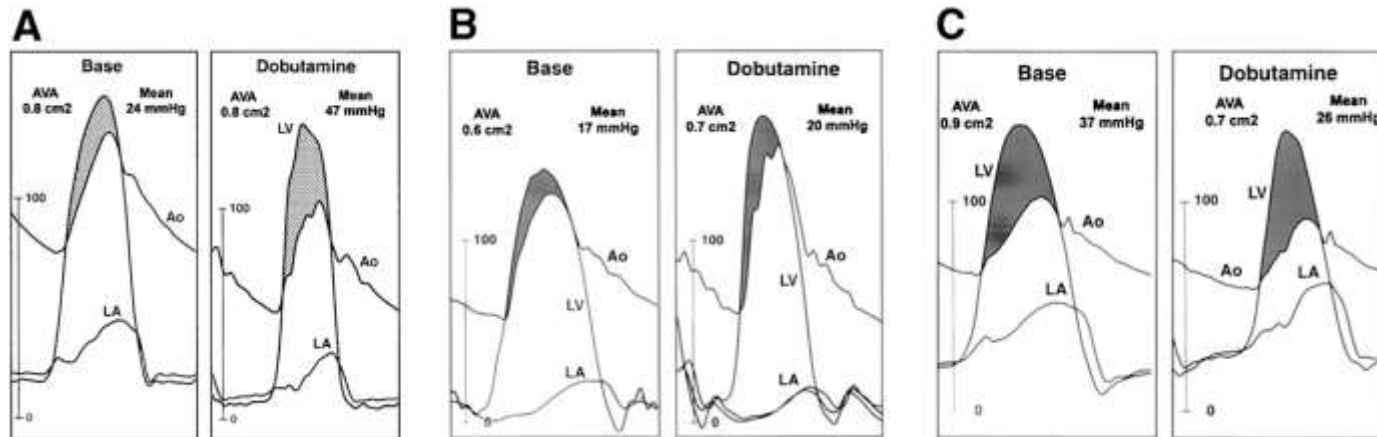
Pereira et al. J Am Coll Cardiol 2002;39:1356-63

Improvement in LV systolic function



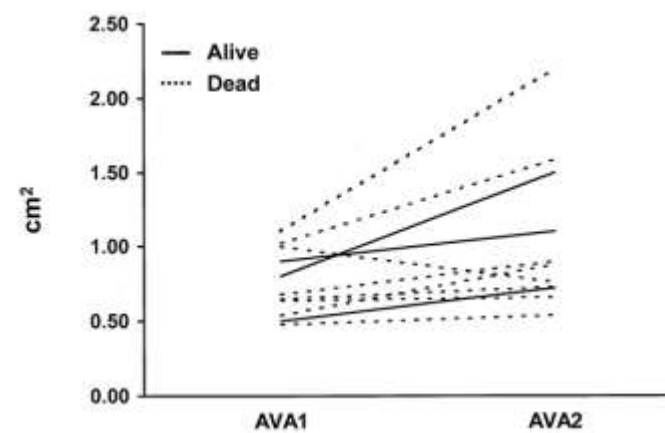
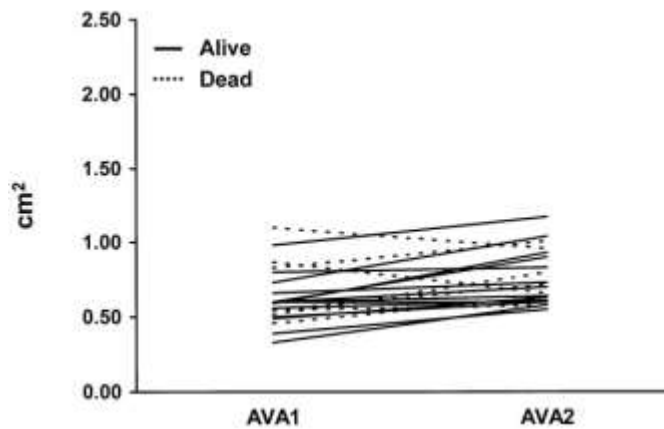
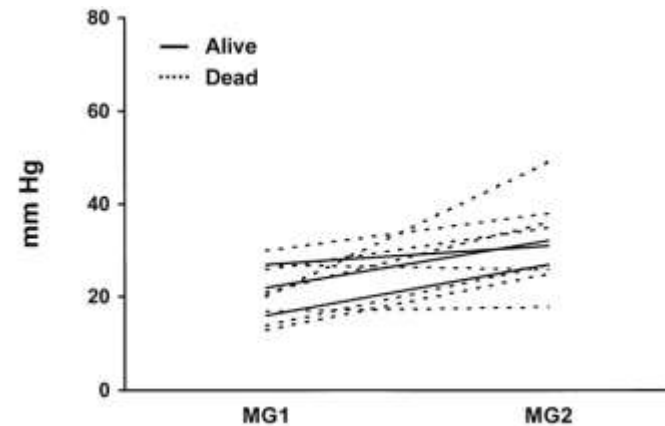
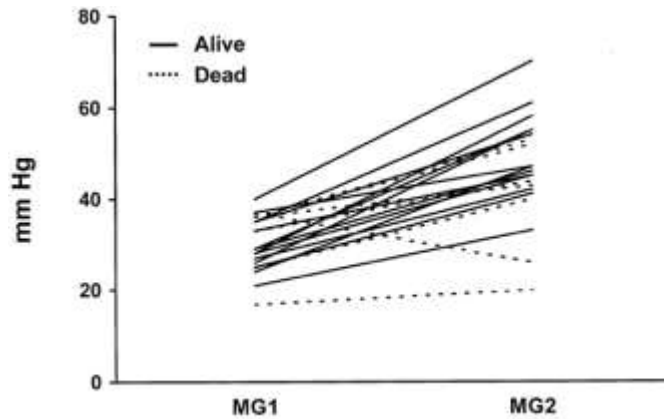
Connolly et al. Circulation 2000;101:1940-46

Representative hemodynamic tracings from 3 patients representing 3 different responses to dobutamine



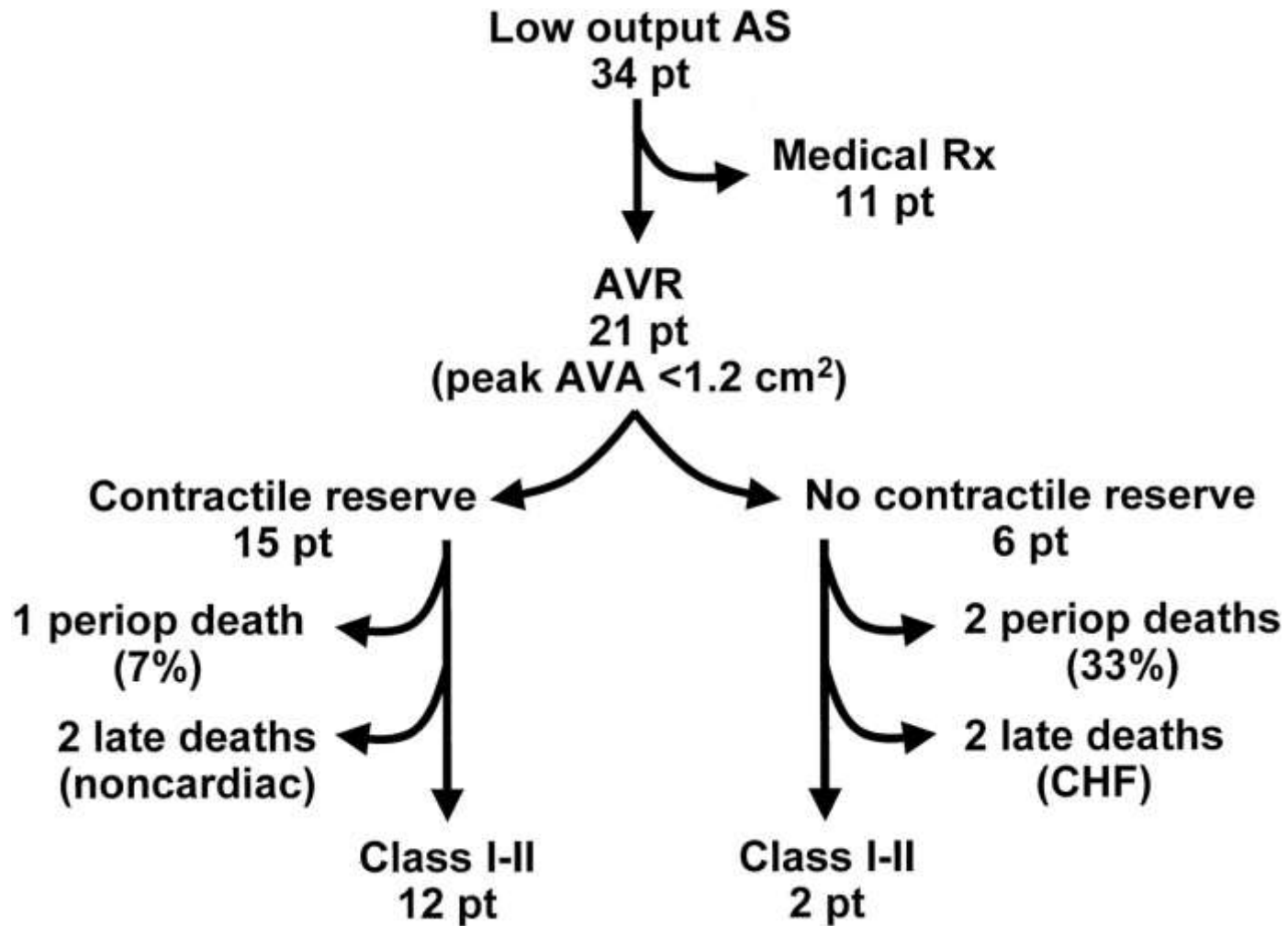
Nishimura, R. A. et al. *Circulation* 2002;106:809-813

Response of mean aortic valve gradient (MG; top) and aortic valve area (AVA; bottom) at baseline (1) and during peak dobutamine infusion (2)



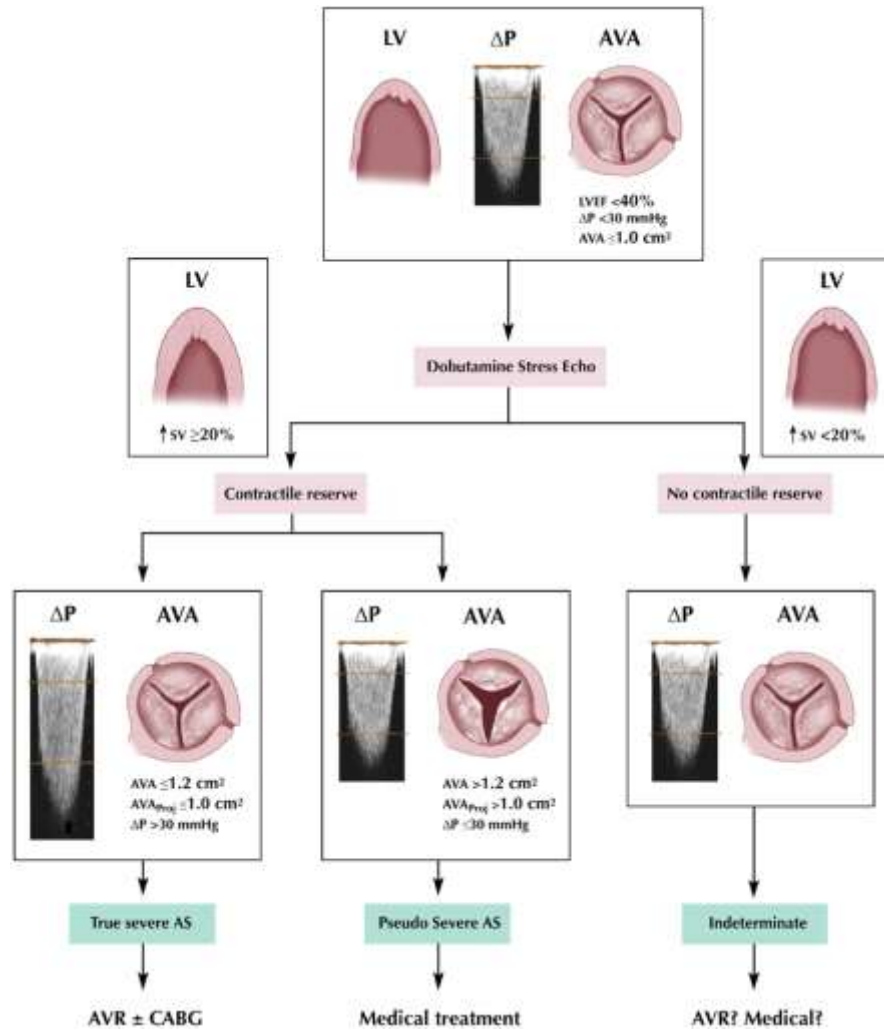
Nishimura, R. A. et al. *Circulation* 2002;106:809-813

Clinical outcome of the patients (pt) with low-output aortic stenosis (AS) who underwent AVR



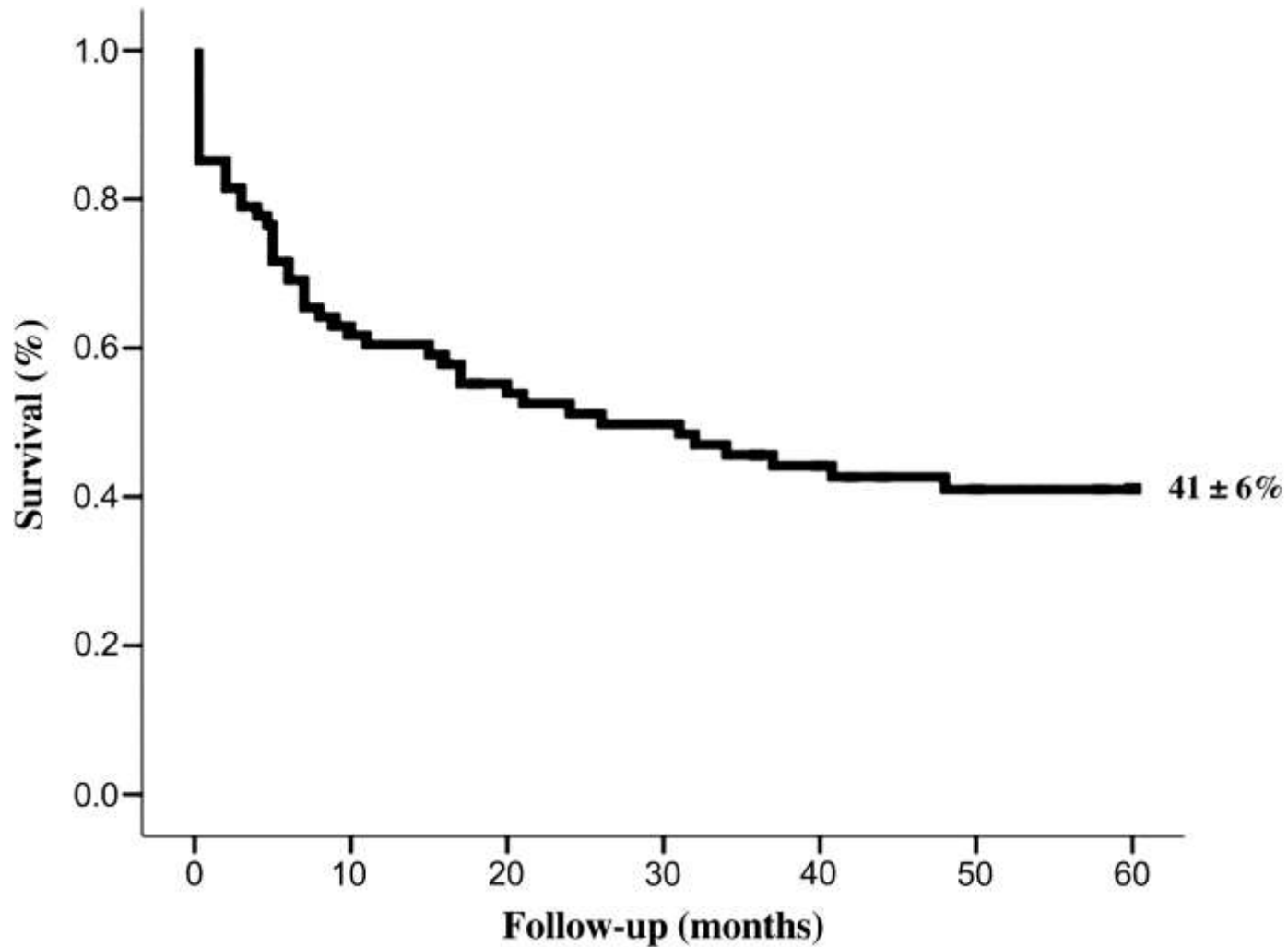
Nishimura, R. A. et al. *Circulation* 2002;106:809-813

Decision Making in Low-Flow, Low-Gradient AS



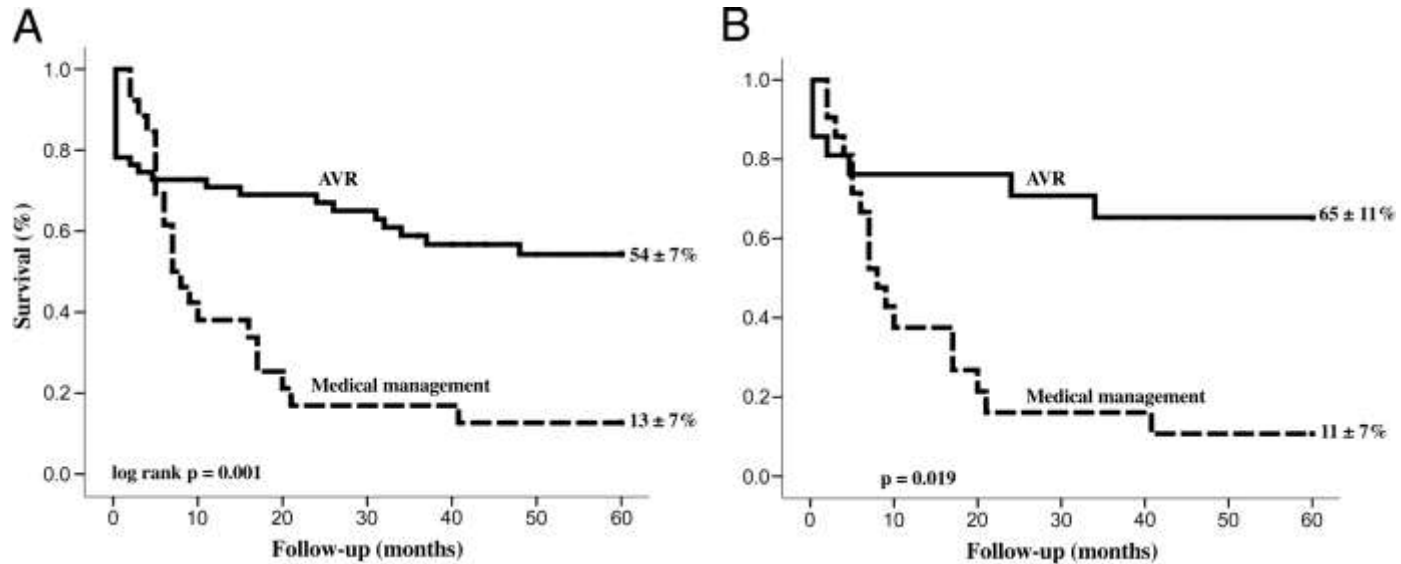
Picano, E. et al. J Am Coll Cardiol 2009;54:2251-2260

Probability of Survival in LF/LGAS Patients Without CR on DSE



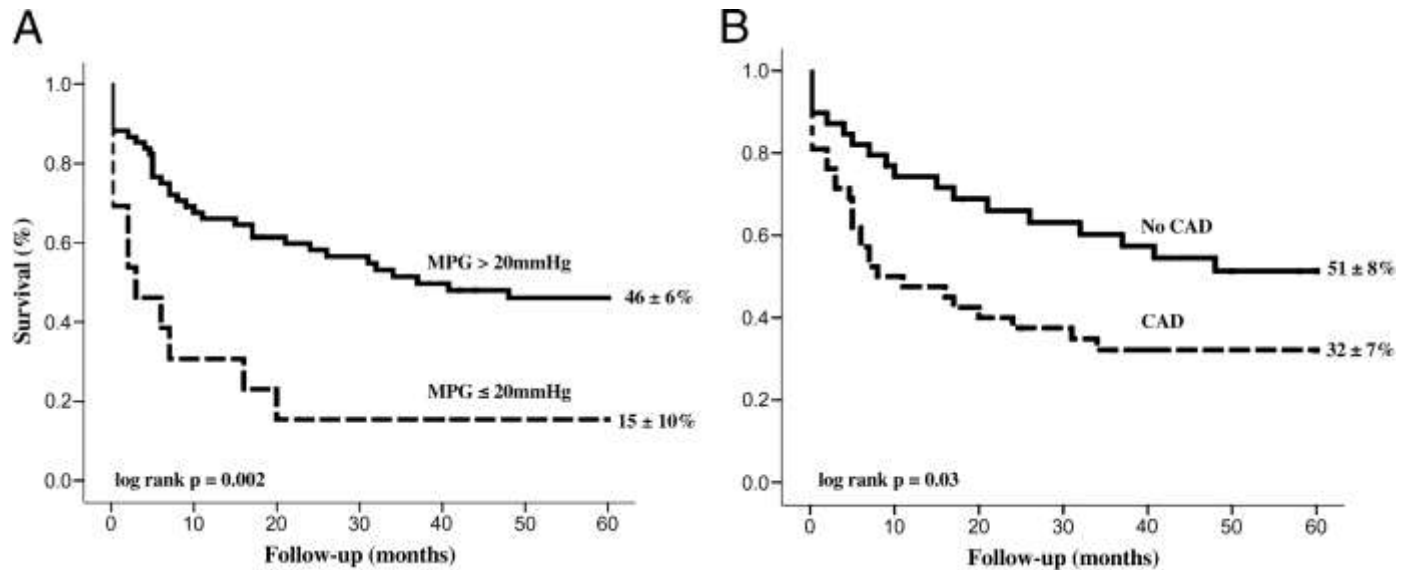
Tribouilloy, C. et al. J Am Coll Cardiol 2009;53:1865-1873

Prognostic Impact of AVR in LF/LGAS Patients Without CR on DSE

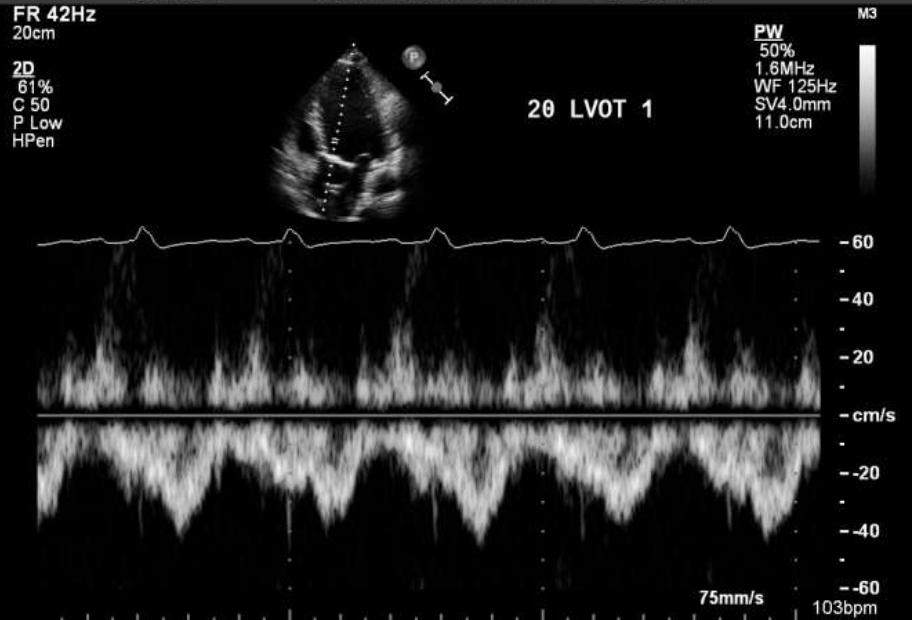
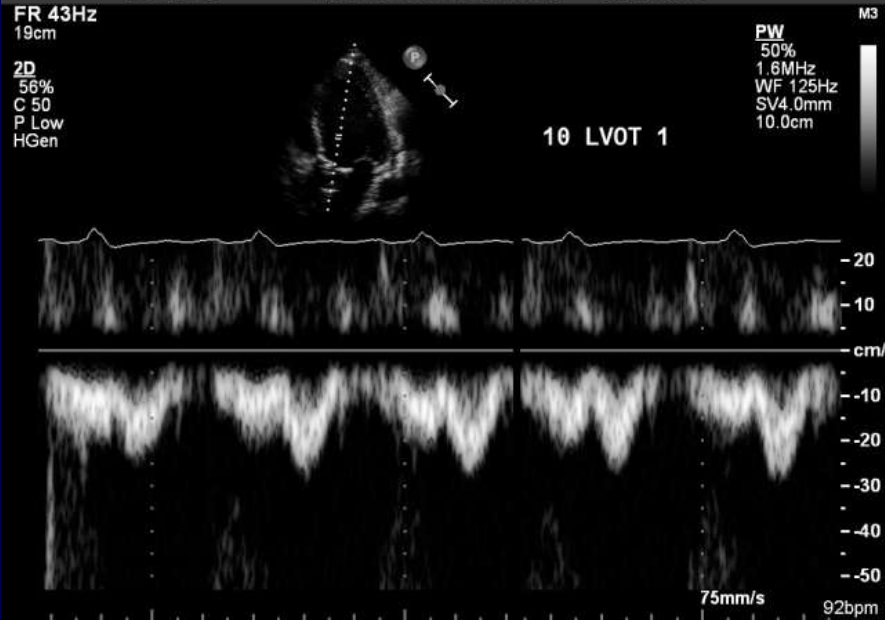
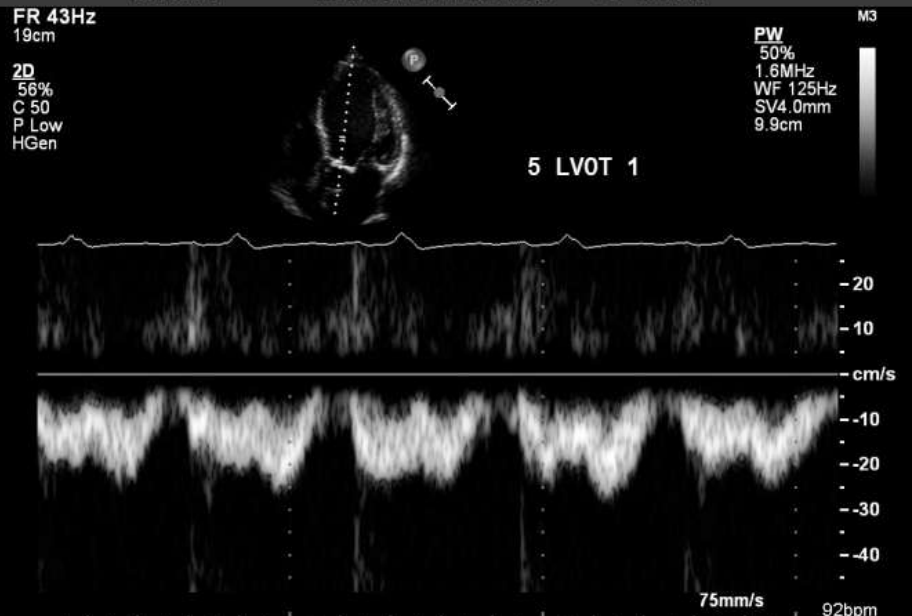
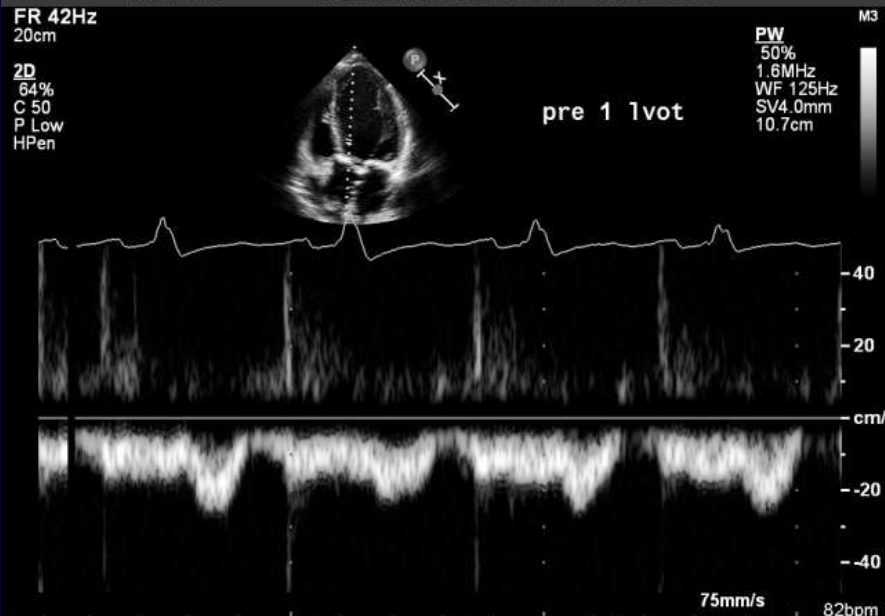


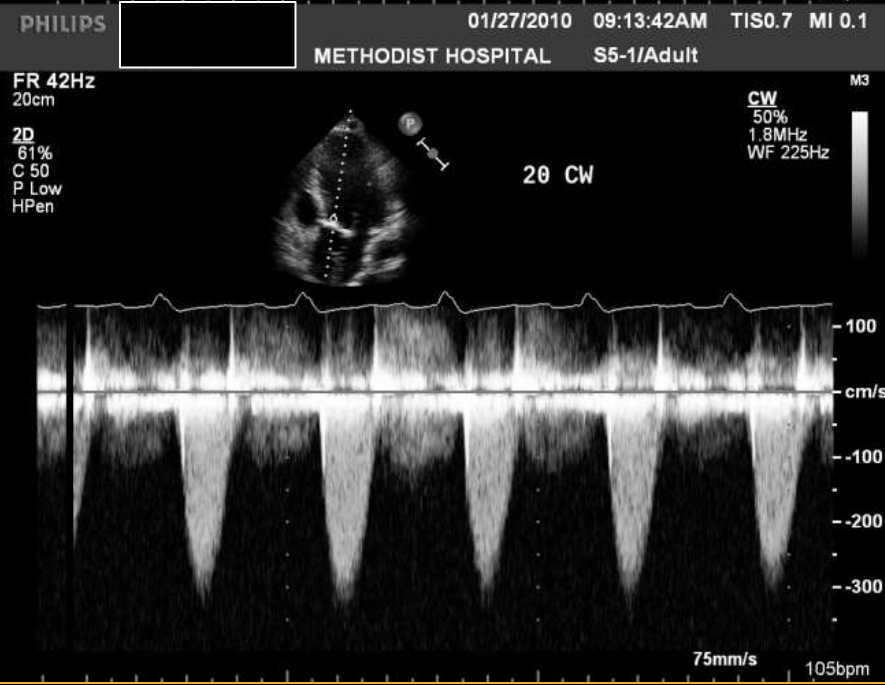
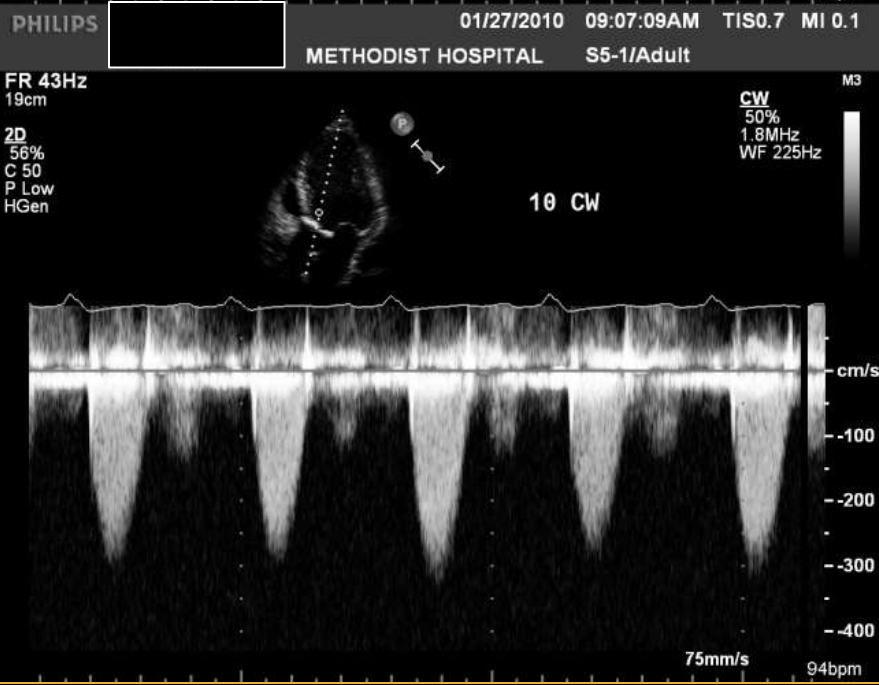
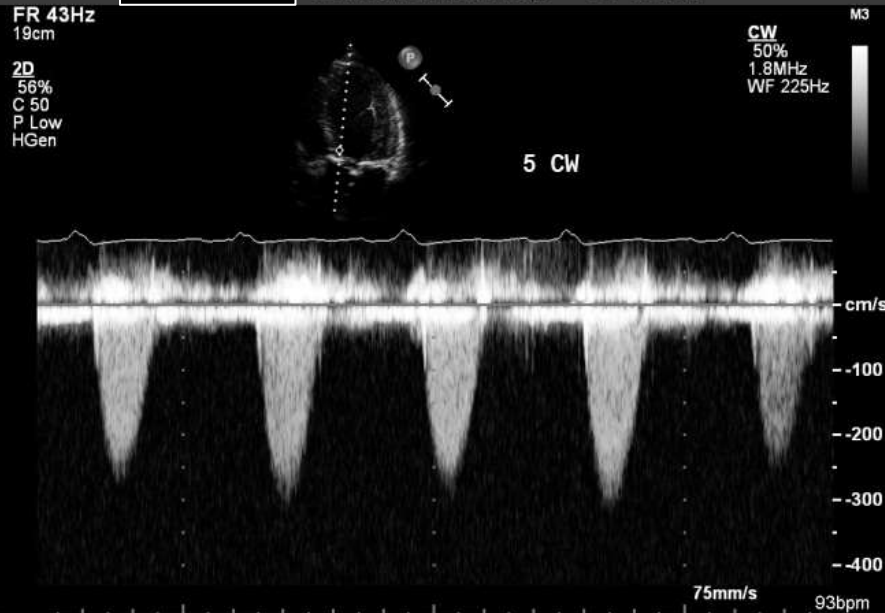
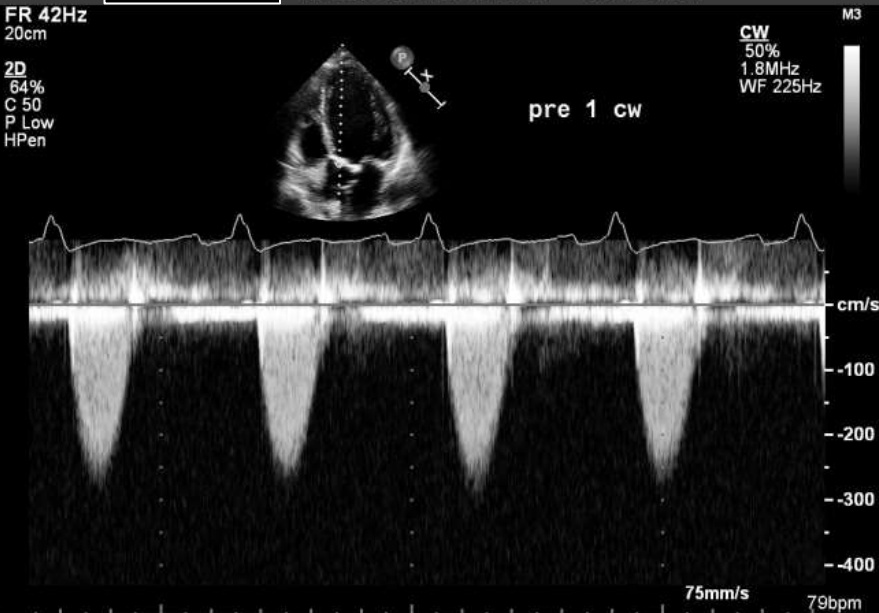
Tribouilloy, C. et al. J Am Coll Cardiol 2009;53:1865-1873

Influence of MPG and CAD on Survival in LF/LGAS Patients Without CR on DSE



Tribouilloy, C. et al. J Am Coll Cardiol 2009;53:1865-1873





- **Viability assessment:**

There is limited area of improved contractility (mainly in the lateral and anterior segments) at 20mcg/Kg/min dobutamine infusion.

- **Aortic valve assessment with Dobutamine:**

At 20 mcg/ kg/min Dobutamine infusion there is a 23% relative increase in LVOT TVI compared to rest.

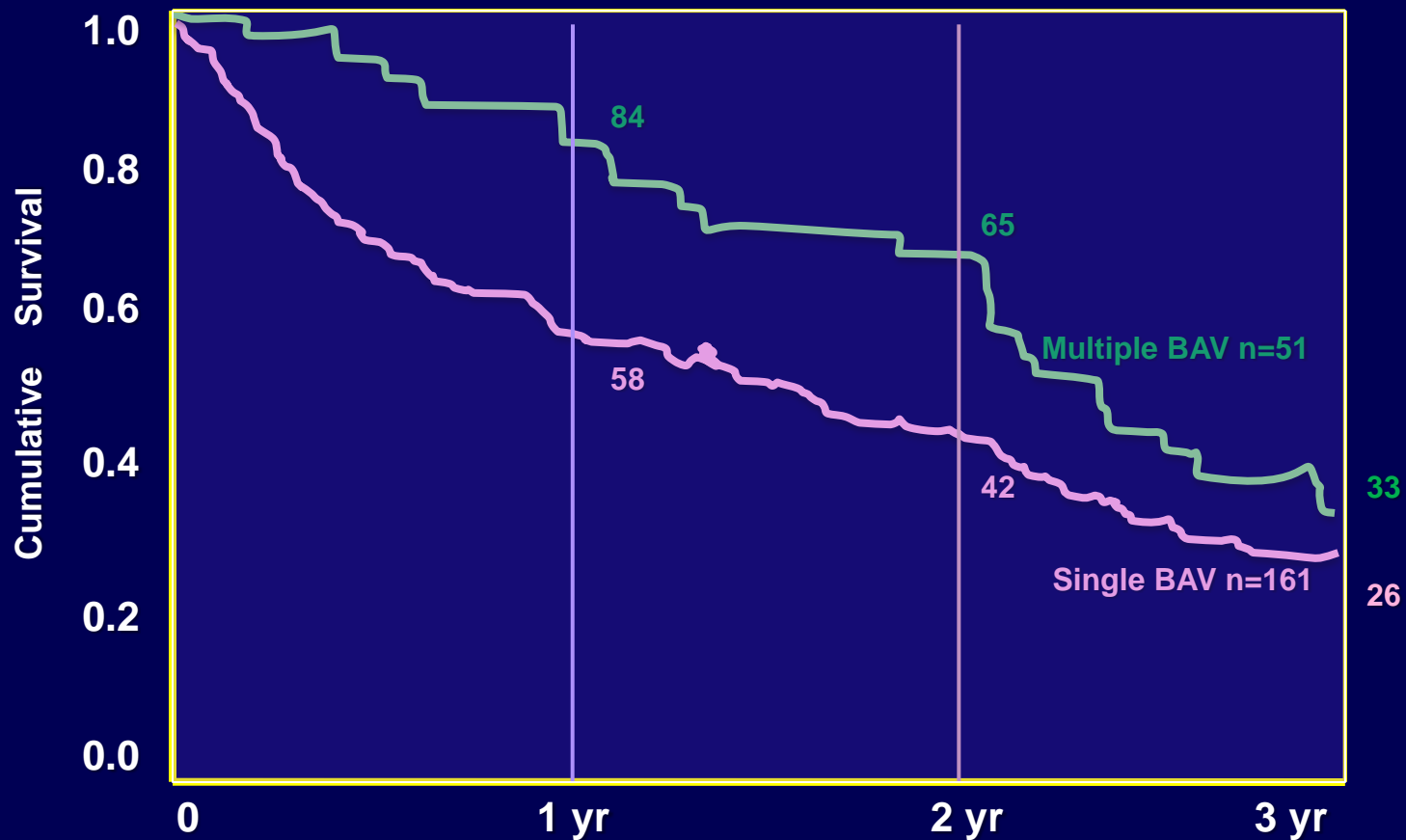
Rest: LVOT/AV = 0.13, peak AV velocity 2.8m/sec, mean AV gradient 14mmHg, valve area 0.8cm²

Peak (20mcg/Kg/min dob): LVOT/AV = 0.16, peak AV 3.27m/sec, mean AV gradient 22mmHg, valve area 0.89cm².

What Next

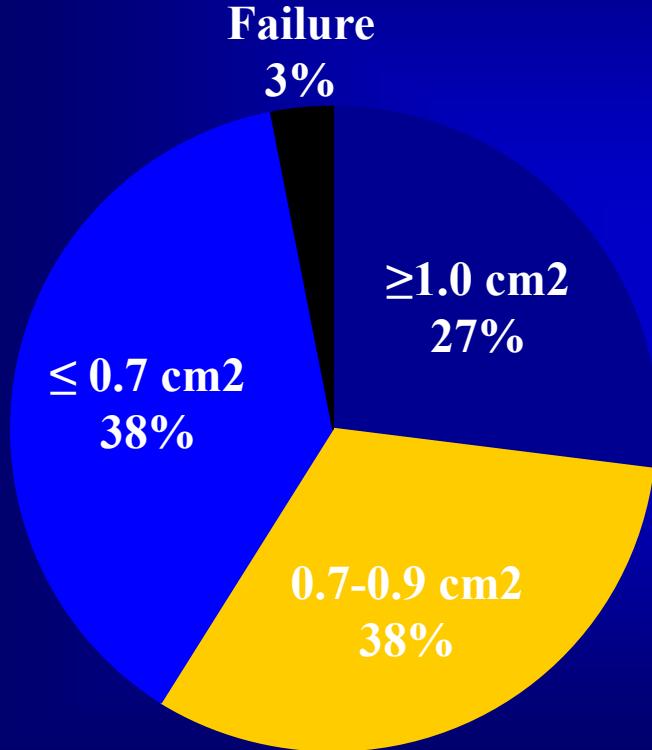
- **Aortic Valve Surgery**
- **Medical Therapy**
- **Balloon Aortic Valvuloplasty**
- **Balloon Aortic Valvuloplasty followed by AVR if improvement**

Repeat Valvuloplasty for Aortic Stenosis (59 to 104 yr)



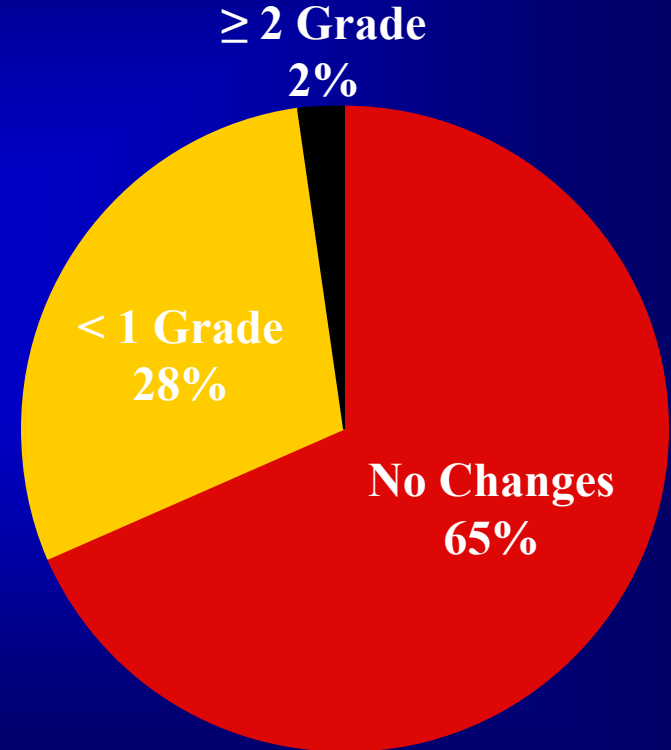
Aortic Balloon Valvuloplasty

Post-PAV AVA



Palacios et al

Post-PAV AI



Cribier et al

Balloon Aortic Valvuloplasty

Hemodynamic Follow-up

	Pre BAV	Post BAV	6m f/u
AVA cm ²	0.56	0.87	0.63
m AVG mmHg	72	35	55
P-P AVG mmHg	59	32	51
LV EF %	49		53
LVeDP mmHg	19	16	19

6.2 ±3.3 months n = 95

Mansfield Registry

Bashore JACC 1991:1188

What Next

- **Aortic Valve Surgery**
- **Medical Therapy**
- **Balloon Aortic Valvuloplasty**
- **Balloon Aortic Valvuloplasty followed by AVR if improvement**

PHILIPS

01/23/2009 11:16:09AM TIS0.6 MI 1.4

S5-1/METH ECHO

FR 39Hz
12cm

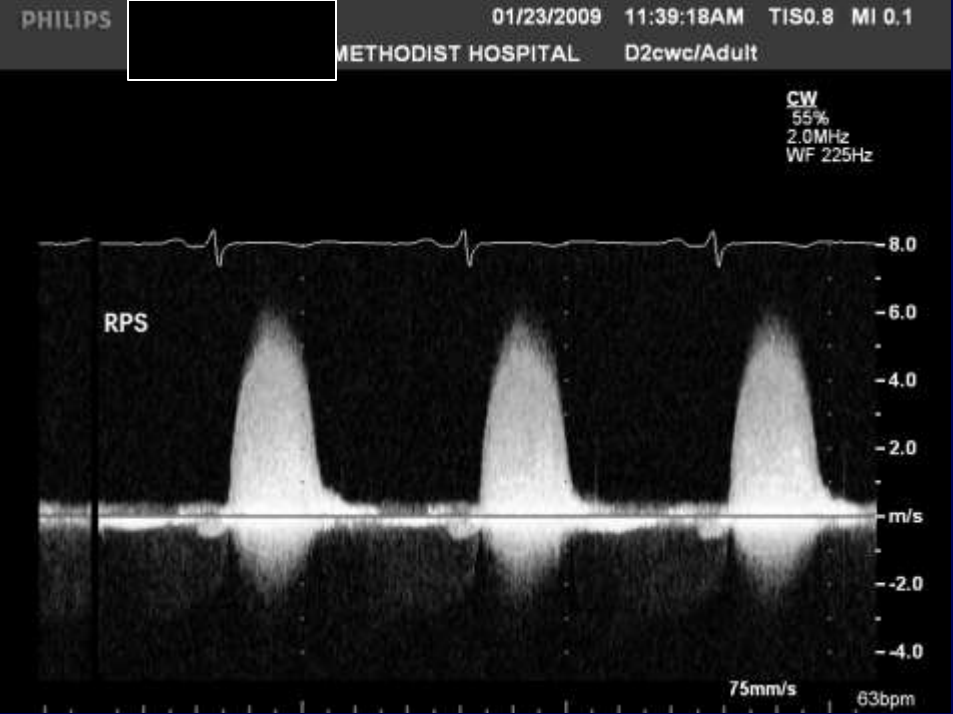
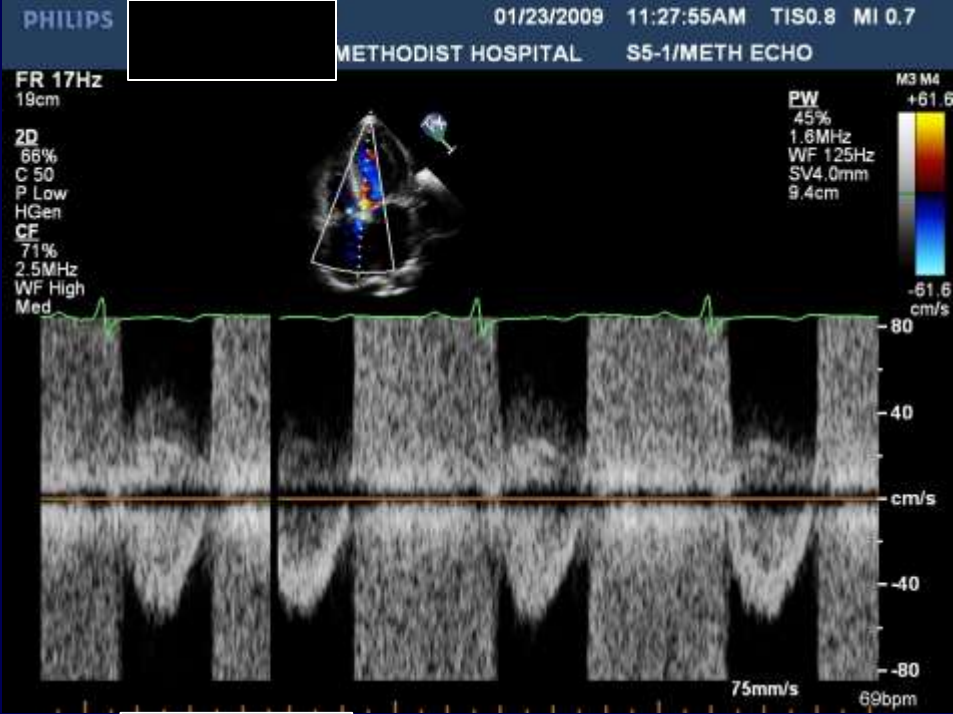
M3

2D
63%
C 50
P Low
HGen



JPEG

60 bpm



LVEF: 29%

AVA: 0.17 cm² by VTI, 0.22 by PV

RVSP: 70-80 mmHg

PHILIPS

02/02/2009 15:27:57 TIS0.6 MI 1.4
S5-1/METH ECHO

FR 39Hz
13cm

2D
49%
C 50
P Low
HGen

Ⓢ
P R
1.7 3.4



PHILIPS

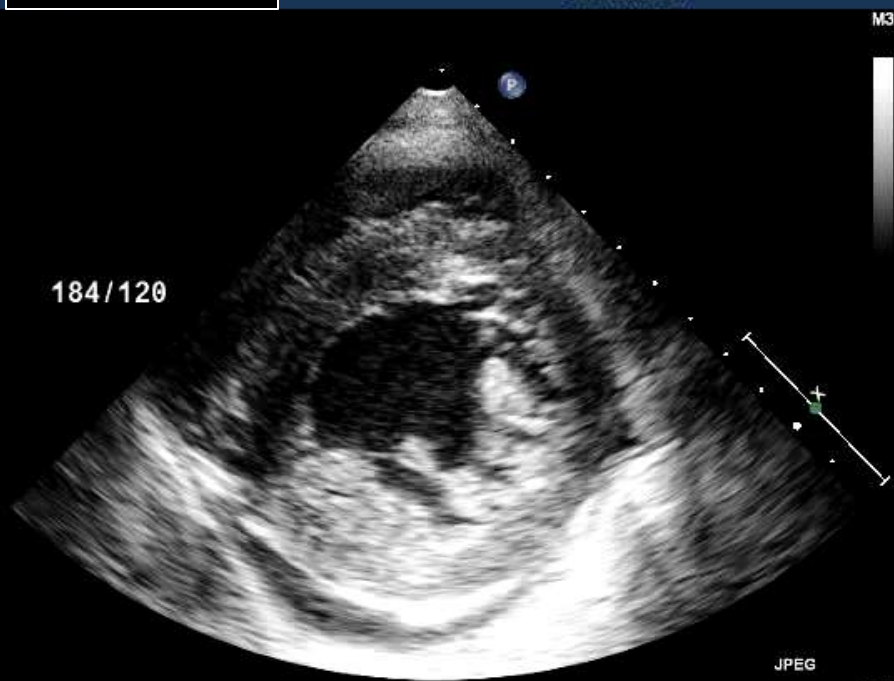
08/24/2009 09:36:45AM TIS0.6 MI 1.4
S5-1/KIC2

FR 39Hz
12cm

2D
66%
C 50
P Low
HGen

Ⓢ
P R
1.7 3.4

184/120



JPEG

86 bpm

PHILIPS

02/02/2009 15:37:15 TIS0.7 MI 0.1

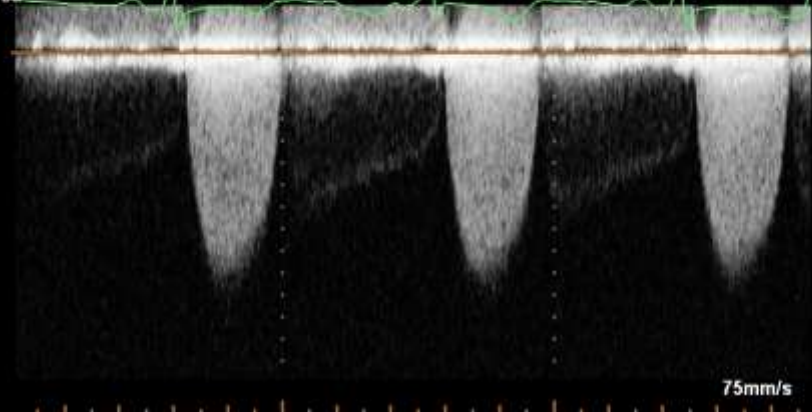
METHODIST

S5-1/METH ECHO

FR 18Hz
17cm

2D
65%
C 50
P Low
HGen
CE
66%
2.5MHz
WF High
Med

CW
50%
1.8MHz
WF 225Hz



64bpm

PHILIPS

02/02/2009 15:37:07 TIS0.8 MI 0.7

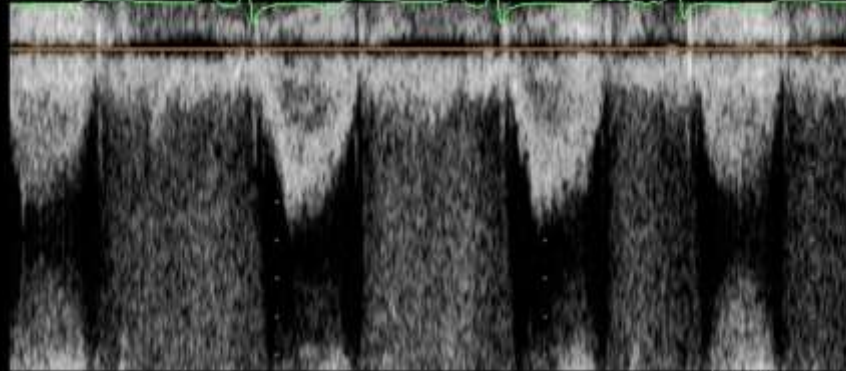
METHODIST

S5-1/METH ECHO

FR 18Hz
17cm

2D
65%
C 50
P Low
HGen
CE
66%
2.5MHz
WF High
Med

PW
50%
1.6MHz
WF 125Hz
SV4.0mm
9.3cm



65bpm



Balloon Aortic Valvuloplasty

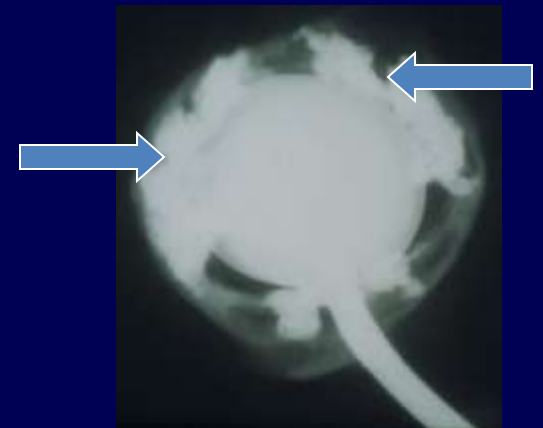
Why such poor outcomes ?

Patient characteristics

- Medical Co-morbidities
 - Coronary Artery Disease
 - $\geq 50\%$ of patients
 - Inadequate residual valve area
 - $< 1 \text{ cm}^2$ in most patients post procedure
- Start with AS end with AS*

The procedure

- Fracture of calcific nodules
- Commissural splitting
- Annular stretching



- **Underwent Aortic Valve Replacement**
- **Last seen by cardiologist on Oct 26th 2010**

History of Present Illness: pt. feels good and remains active , played some golf , walking 1 mile qod , mild dry nonproductive cough slowly getting better , mild dizziness /orhtostasis occ
- **Currently Functional Class I.**

Conclusion

- **Decision regarding whether to operate or not still has to be made on a case-by- case basis.**
- **Despite significantly higher peri-operative mortality, AVR markedly improves the long-term outcome of patients with LV systolic dysfunction**