Management of “Small” Aortic Root and Patient-Prosthetic Mismatch

Mr Sanjay Kumar

- Does Aortic valve size make a difference in early and late outcome?

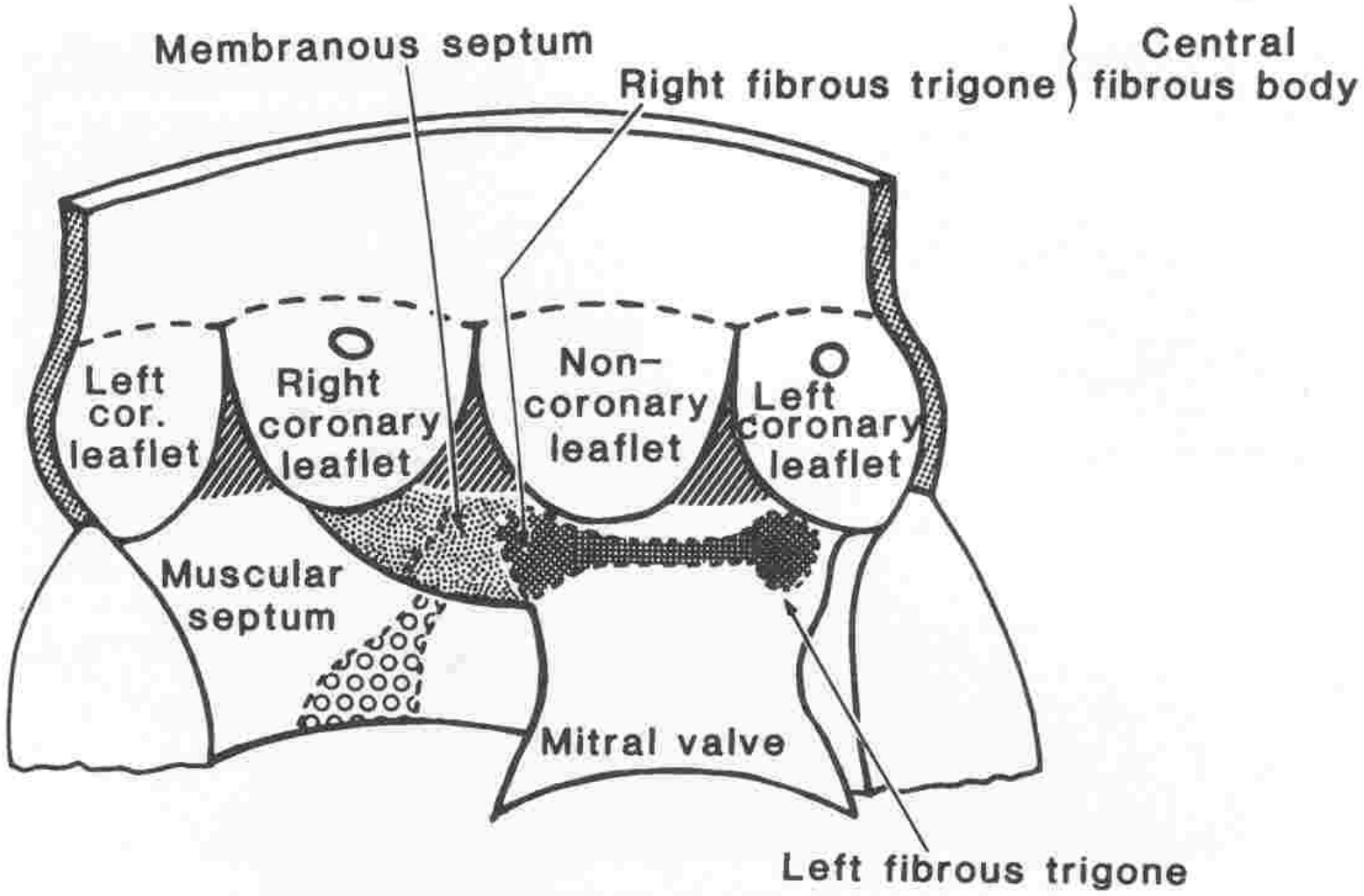
- Size 19 valve in BSA >1.6 in presence of narrow aortic root

- Narrow aortic root-
  - Mechanical valve with aortic root enlargement
  - Homograft
  - Stentless valve
  - Ross procedure

In determining optimal surgical management in small
aortic roots, it is necessary to answer 3 questions:

1) “small” aortic root ?
2) the impact of prosthesis-patient size on outcome after aortic valve replacement ?
3) surgical techniques employed to avoid the clinical syndrome of prosthesis-patient mismatch at aortic valve replacement ?

Aortic Root Anatomy



Small Aortic Root

? Annular diameter < 21 mm or less

- Associated with small body size
- Often with congenital heart disease
- Usually with aortic stenosis














In the world of heart valves
Size matters.

??

Prosthesis-Patient size

Prosthesis size

Geometric

- Manufacturer's labelled size
- Internal orifice size
  - Diameter
  - Area

Functional

- In vitro effective orifice area
  - Static
  - Dynamic
- In vivo effective orifice area

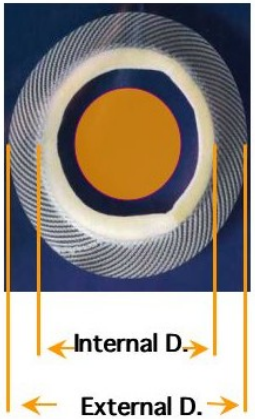
Patient size

- Body Surface Area (BSA)

Internal geometric area vs. effective orifice area

EOA

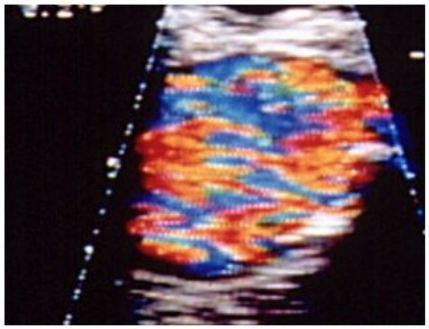
Bioprosthesis



Mechanical Valve



Turbulent Flow Patterns

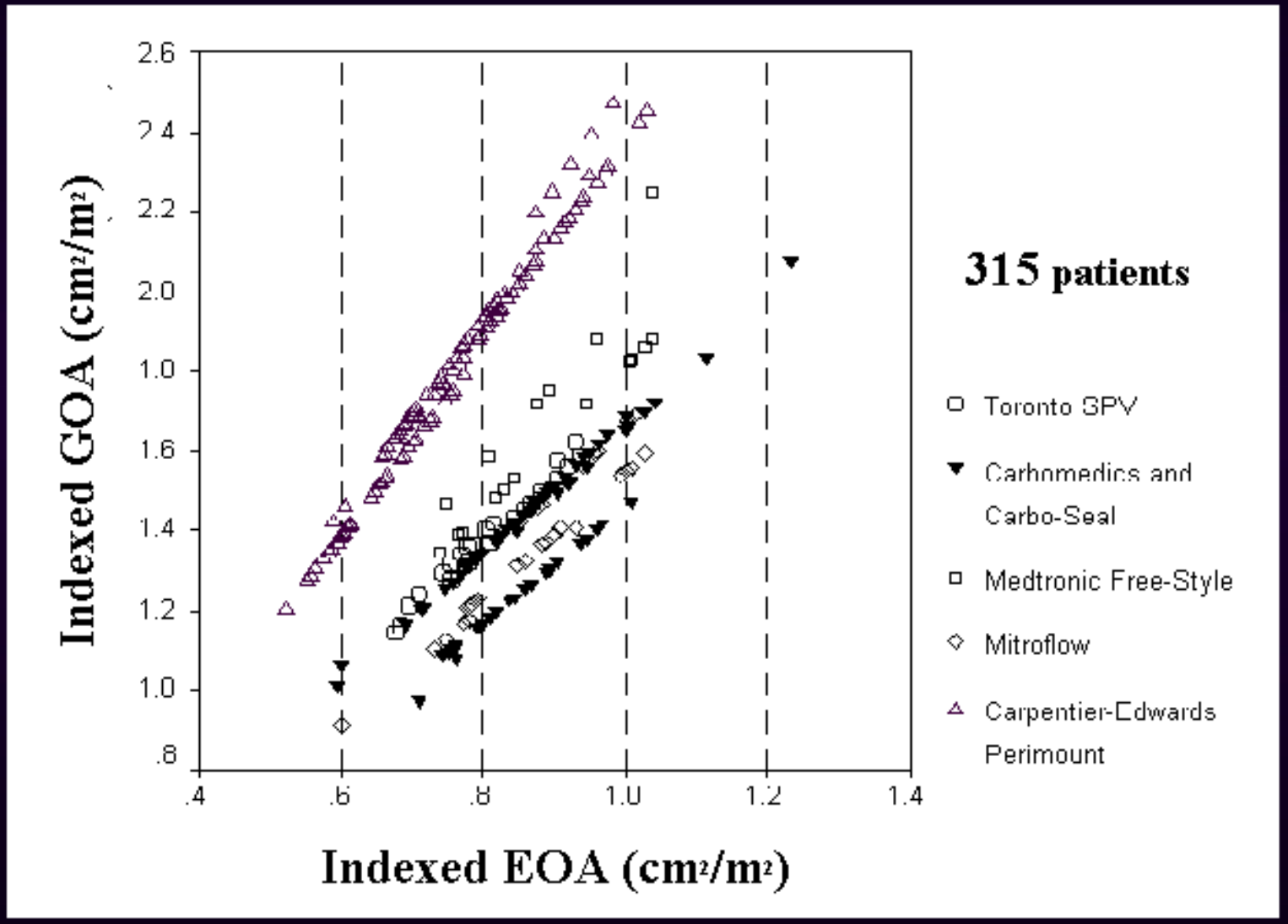


Stented Bioprosthesis



Mechanical Prosthesis

Discrepancies between GOA and EOA



GOA's vs EOA's in Bioprostheses vs Mechanical Valves

Table I: Comparison of geometric orifice area (GOA) and effective orifice area (EOA) values among different sizes of a commonly implanted bioprosthetic and mechanical valve.

Parameter	CE-19	SJM-19	CE-21	SJM-21	CE-23	SJM-23
GOA	1.96	1.63	2.9	2.06	3.9	2.55
EOA	0.9	1.1	1.1	1.5	1.5	2.13

CE: Carpentier-Edwards pericardial valves; SJM: St. Jude Medical Standard mechanical valves.

Muneretto et al., J Heart Valve Dis 13: 59-61, 2004

We are not created equal !

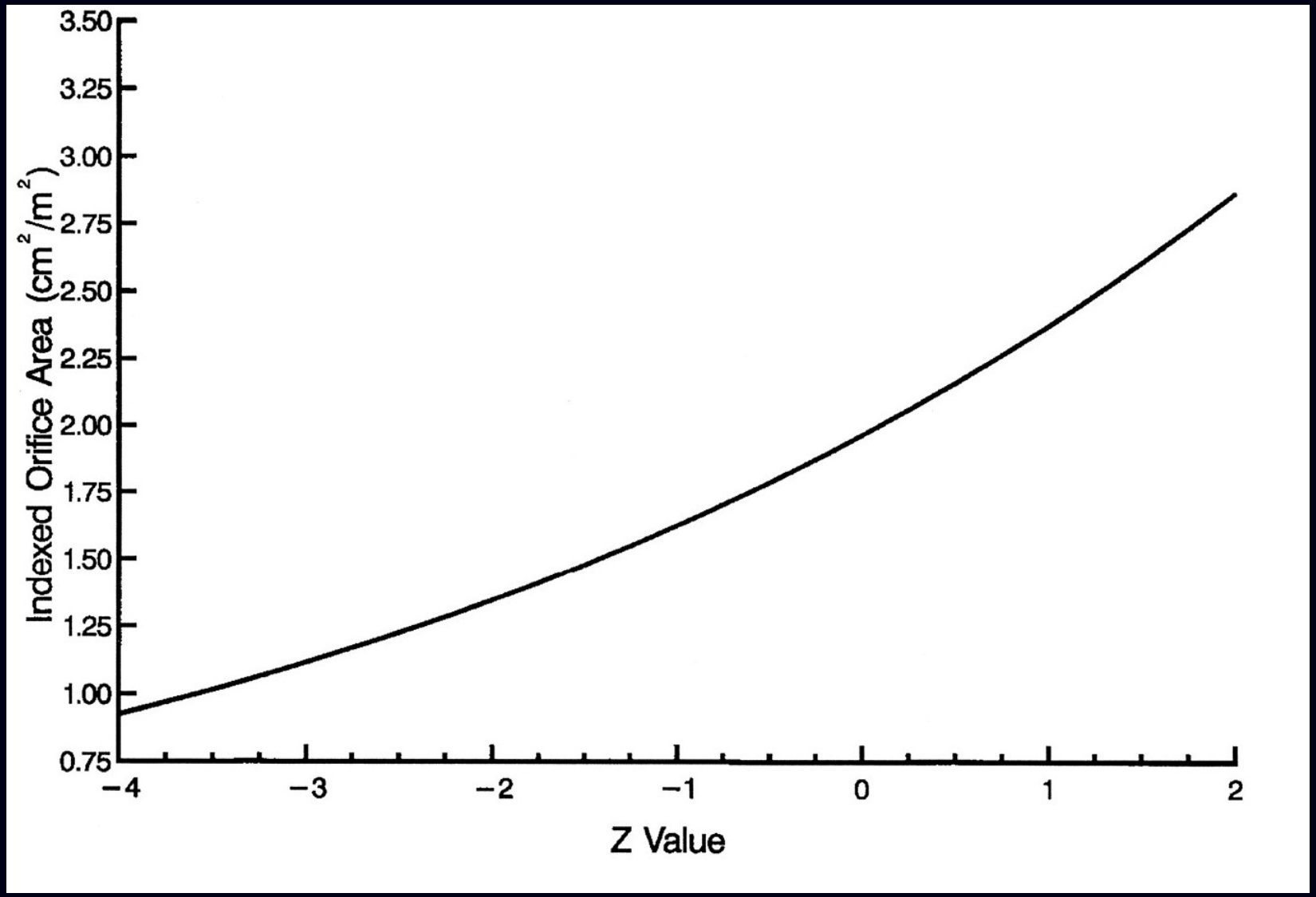
Patient Examples:



Bill (5'8", 180 lbs.) BSA: 2.0



Sally (5'4", 135 lbs.) BSA: 1.7

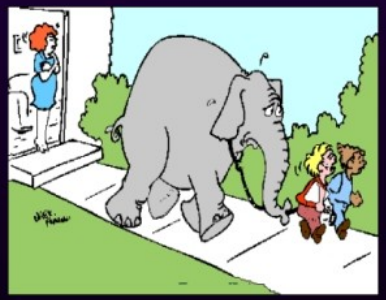


Indexed orifice area versus Z value for the aortic valve. Z value = no of SDs beween pts' pv size and mean normal aortic valve size

The relationship is approximately logarithmic



Mismatch !!!



$$\text{Gradient} = \frac{Q^2}{K \times EOA^2}$$

	Mouse	Elephant	Elephant Mismatch
Cardiac Output (mL/min)	50	50 000	50 000
EOA (cm^2)	0.1	50	0.1
Gradient (mmHg)	1	1	11 000 000 !

Patient – Prosthetic Valve Mismatch

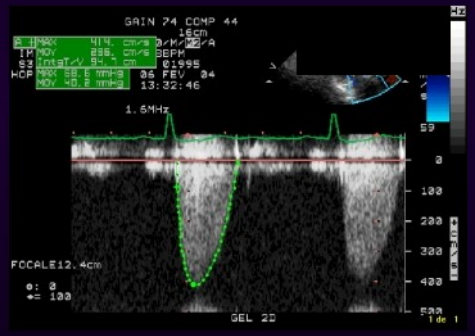
"Mismatch can be considered to be present when the effective prosthetic valve area, after insertion into the patient, is less than that of a normal human valve...occasionally it can be a severe problem because the patient may be hemodynamically and symptomatically worse after valve replacement."

Rahimtoola SH. The problem of valve prosthesis-patient mismatch. *Circulation*. 1978;58:20–24

Case Study : High Doppler Gradient in Aortic Valve Prosthesis

72 y.o. patient with Carbomedic # 19 aortic prosthesis (3 years) :

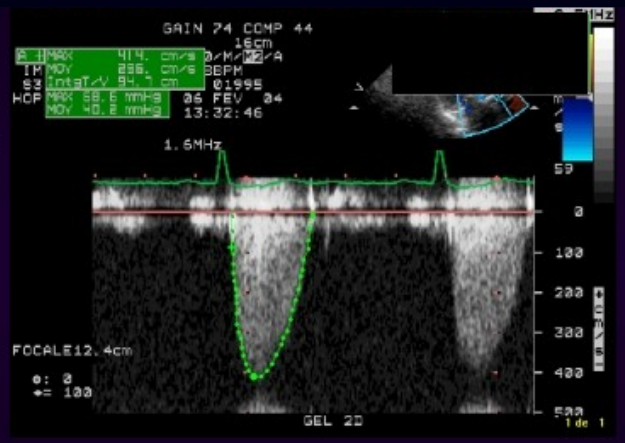
- NYHA class III
- Moderate diastolic dysfunction
- Pulmonary arterial hypertension (systolic PA pressure: 50 mmHg)



Max Gradient = 69 mm Hg
Mean Gradient = 40 mmHg

Courtesy of Drs Denault and Carrier, Montreal Heart Institute

72 y.o. patient with Carbomedic # 19 aortic prosthesis



Normal EOA for Carbomedic # 19: 1.10±0.10 ⟷ **EOA = 1.06 cm^2**

BSA = 1.89 m^2 → **Indexed EOA = 0.56 cm^2/m^2**

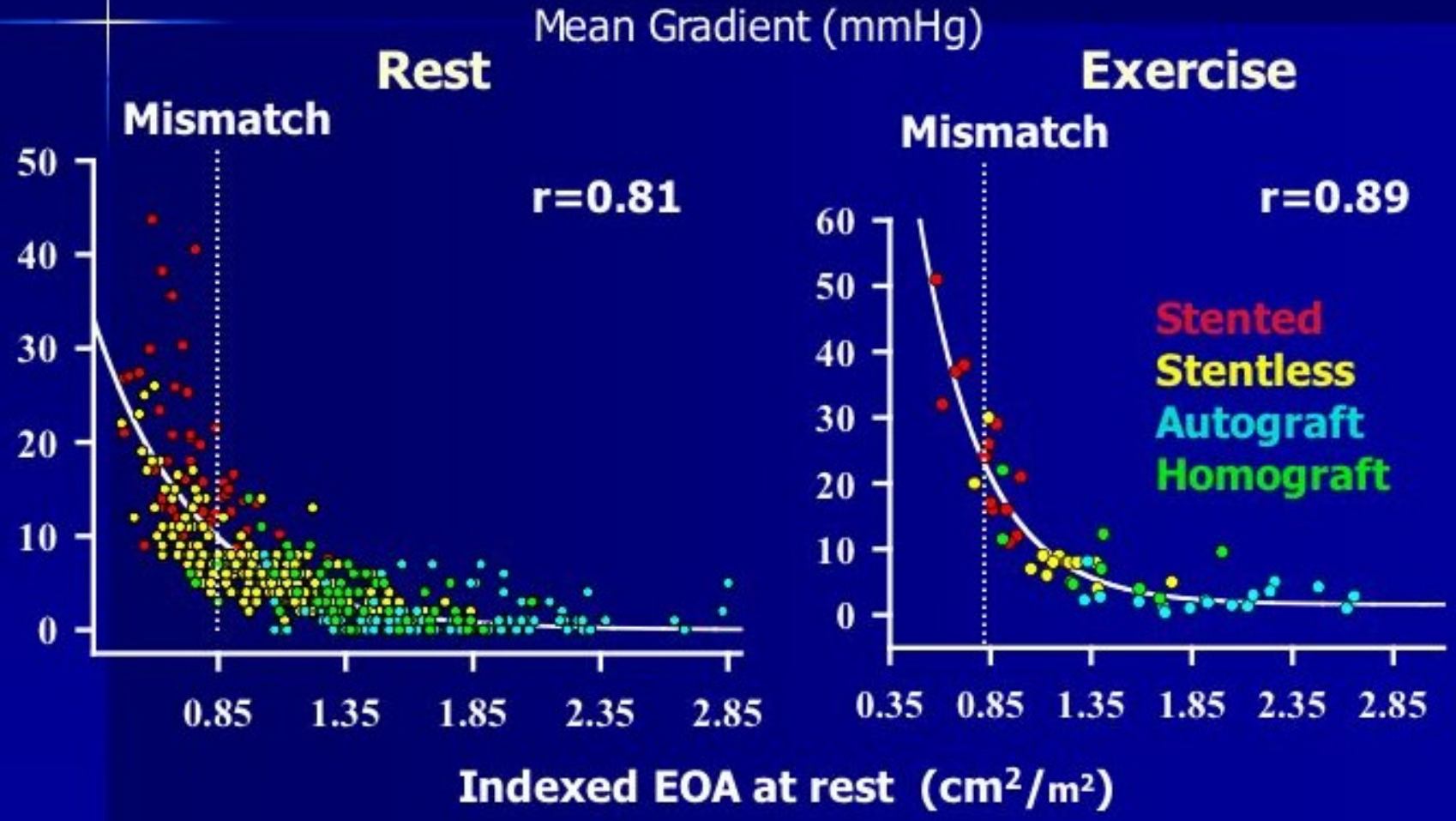
Courtesy of Drs Denault and Carrier, Montreal Heart Institute

Estimating PPM

EOAI = EOA/ BSA

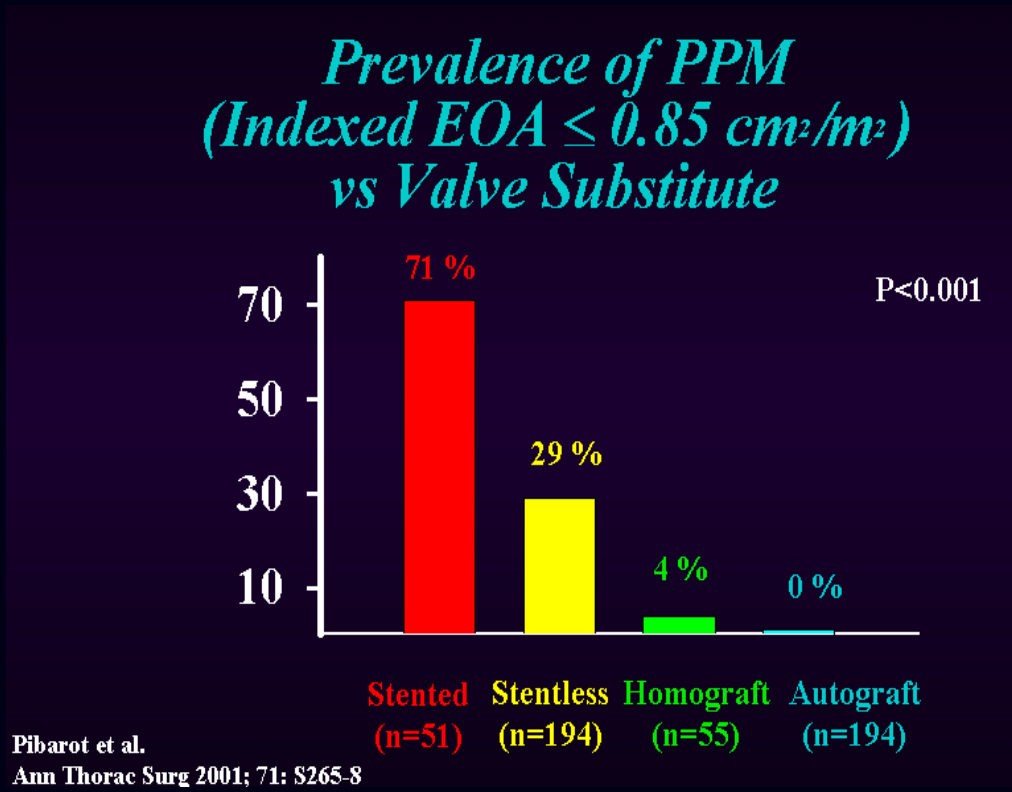
- Patient – Prosthetic Valve Mismatch (PPM) =EOAI< 0.85
  - Moderate PPM : EOAI between 0.65- 0.85
    - Severe PPM : EOAI <0.65

Dependence of gradients on indexed valve EOA



Patient-prosthetic mismatch

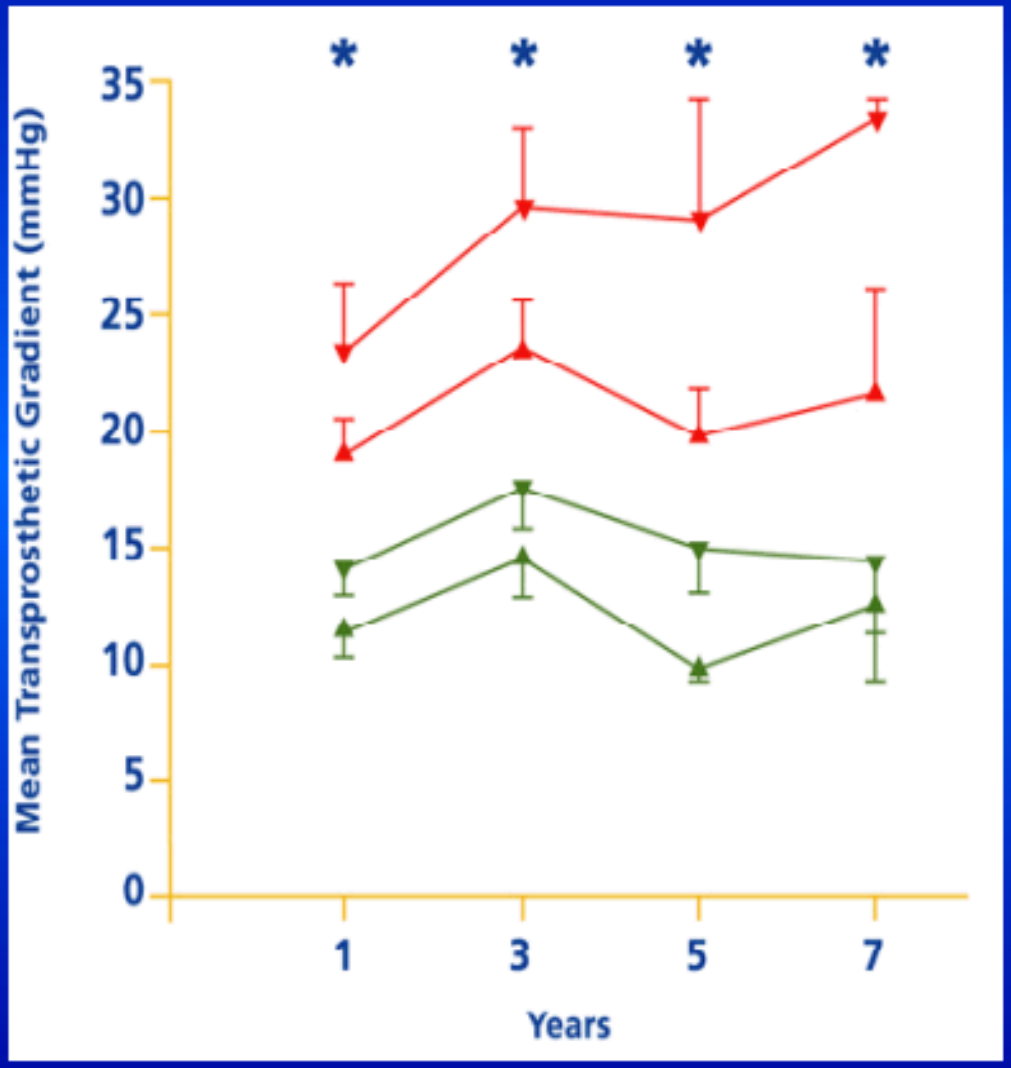
- Shown to have serious clinical consequences
- More frequently than originally believed
  - 52% of patients receiving stented tissue valves have mismatch (Pibarot et al)



Is the Problem Real?
Dimesil et al, JACC 1990

“ 40% of aortic valve replacements have patient-valve mismatch that resulted in elevated systolic gradients.”

Mean Gradient Over Time - Pibarot et al



Significant difference in mean gradient between matched and mismatched groups at each interval

Impact of patient-Prosthesis Mismatch

- Higher gradients
- Persistent left ventricular hypertrophy
- Decreased postoperative cardiac index
- (? Increased bleeding complication)
- Decreased late survival (>8yrs)
- Decreased NYHA class improvement
- Sudden death
- Decreased quality of life
- Higher incidence of late adverse complications

Implications of PPM

- One of the most vexing problems to the cardiac surgeon
- Size of the prothesis inserted has little influence on survival [1,2]
- The patient-prosthesis mismatch is an extremely important variable that predicts morbidity and mortality [3]

1. **Medalion B, Blackstone EH, Lytle BW, White J, Arnold JH, Cosgrove DM. Aortic valve replacement: Is valve size important? J Thorac Cardiovasc Surg 2000;119:963-974.**

2. **Bloomstein LZ, Gielchinsky I, Bernstein AD, et al. Aortic valve replacement in geriatric patients:determinants of in-hospital mortality. Ann Thorac Surg 2001;71:597-600.**

3. **Blais C, Dumesnil JG, Baillot R, Simard S, Doyle D, Pibarot P. Impact of valve prosthesis-patient mismatch on short-term mortality after aortic valve replacement, Circulation 2003;108:983-988.**

Contributors to Meta-Analysis of Aortic Valve Size

Name	Organization
-----	Baxter Healthcare Corporation (Irvine, CA)
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Dr. D. Craig Miller	Sanford University (Stanford, CA)
Dr. W.R. Eric Jamieson	University of British Columbia (Vancouver, BC)
Dr. Eric Butchart	University Hospital (Cardiff, Wales)

Prostheses

Variety	Type(s)	#
Xenografts	Hancock, C-E	3561
Pericardial	Carp.- Edwards	1222
Mechanical	St. Jude, Medtronic Hall	962
Allograft	Cryolife	97
TOTAL		6610

Risk Factors for Early Death

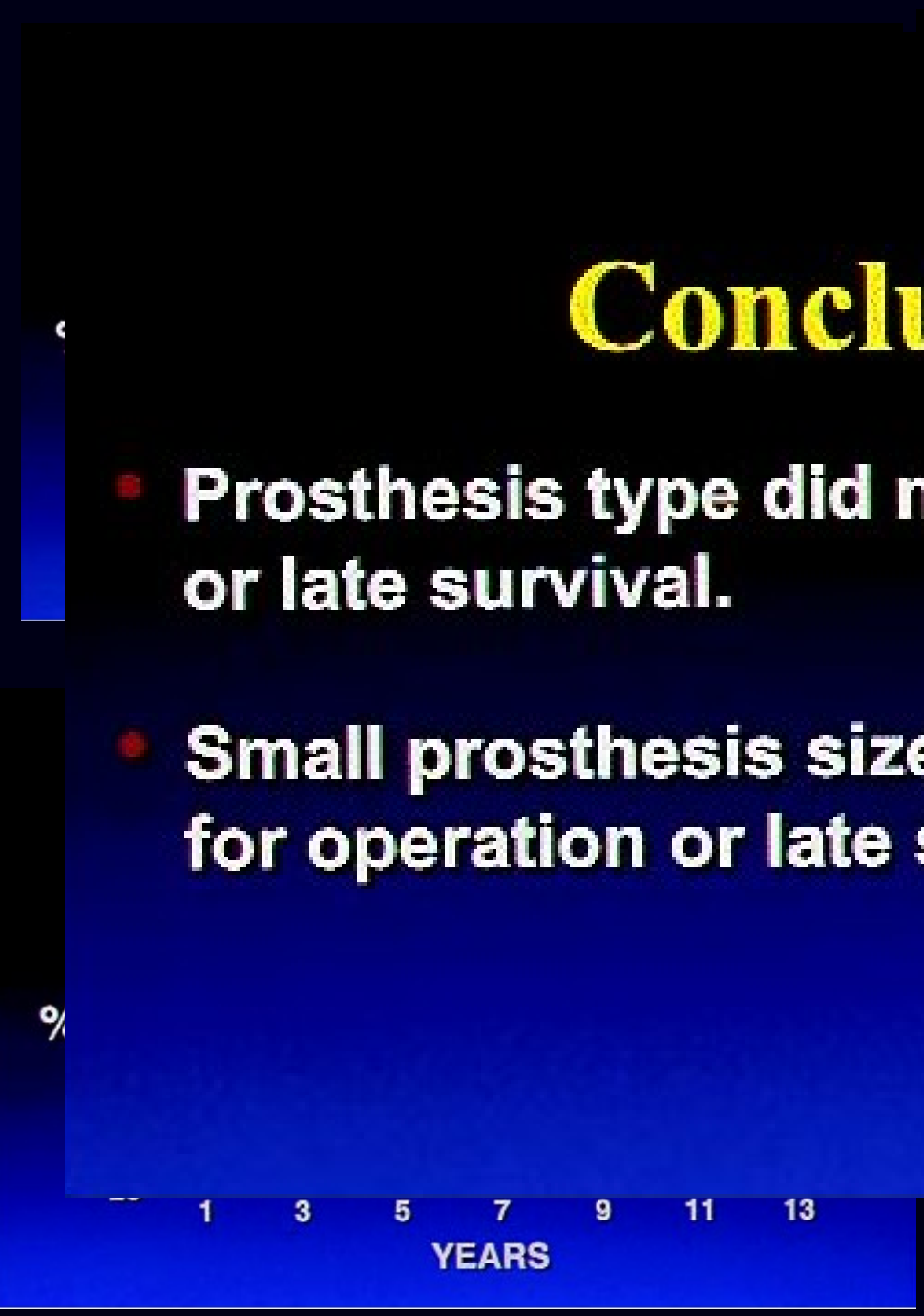
Demographics	p Value
Older Age	<.0001
Younger Age	.0003
Small BSA	.0008
Clinical	
NYHA III-IV	<.0001
Previous AVR	<.0001
Procedure	
CABG	.002
Allograft	.002
Experience	
Early Experience	<.0001

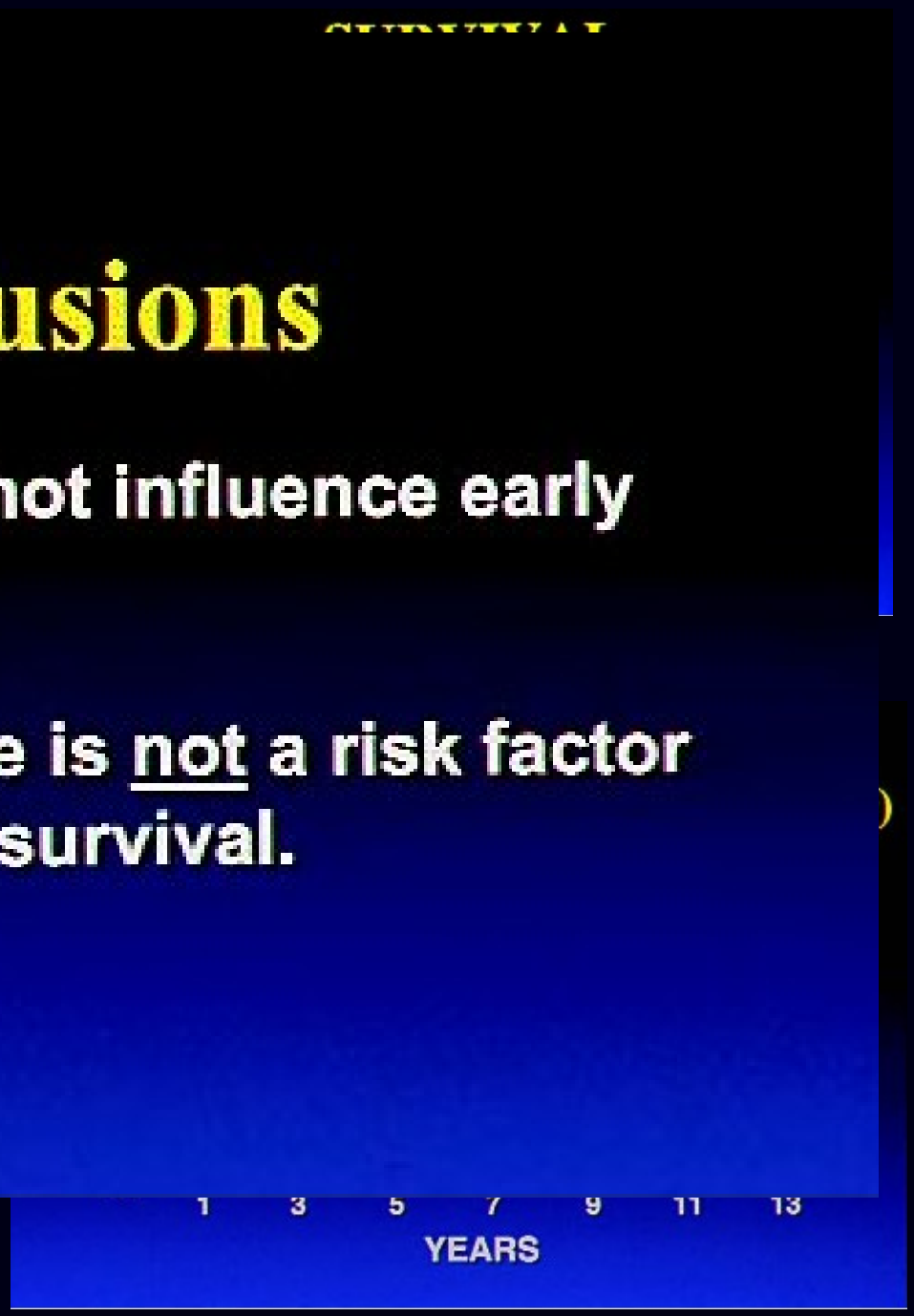
Risk Factors for Late Death

	p Value
Advanced Age	<.0001
Previous AVR	<.0001
CABG	<.0001

Conclusions

- Prosthesis type did not influence early or late survival.
- Small prosthesis size is <u>not</u> a risk factor for operation or late survival.





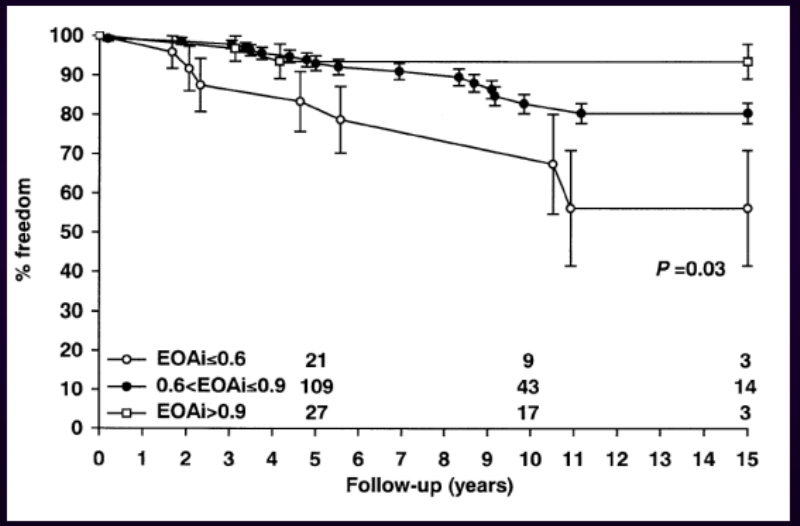
PPM is Predictive of Congestive Heart Failure after AVR

1681 patients, mean follow-up 4.4 years

- **Independent predictors of CHF (NYHA 3-4 or CHF death):**
- **Age**
- **Preop. NYHA class**
- **Elevated diastolic pulmonary arterial pressures**
- **Atrial fibrillation**
- **Coronary artery disease**
- **Smoking**
- **Redo status**
- **PPM (EOAI ≤ 0.80 cm^2/m^2): 60% increase in the risk of CHF**

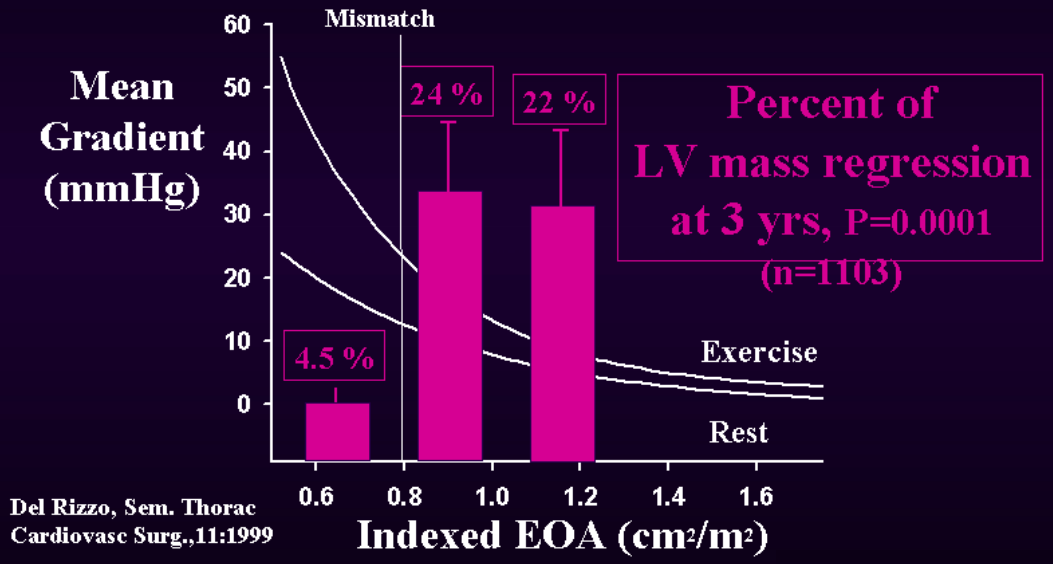
Ruel et al, JTCVS; 127:149-159, 2003

Freedom of Late Cardiac Events vs. Severity of PPM



Milano et al., Ann Thorac Surg, 73, 2002.

Impact of PPM on LV Mass Regression

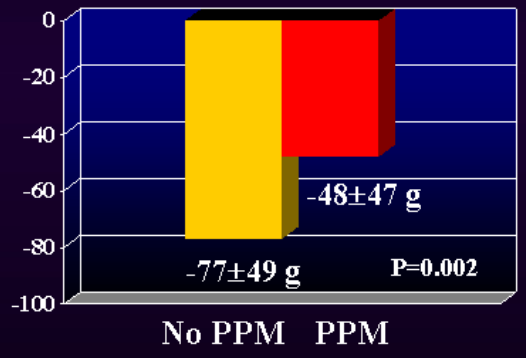


Percent of LV mass regression at 3 yrs, P=0.0001 (n=1103)

Del Rizzo, Sem. Thorac Cardiovasc Surg.,11:1999

Impact of PPM on LV mass regression

109 patients with a CEP bioprosthesis
53% had PPM based on an indexed EOA ≤ 0.9 cm²/m²

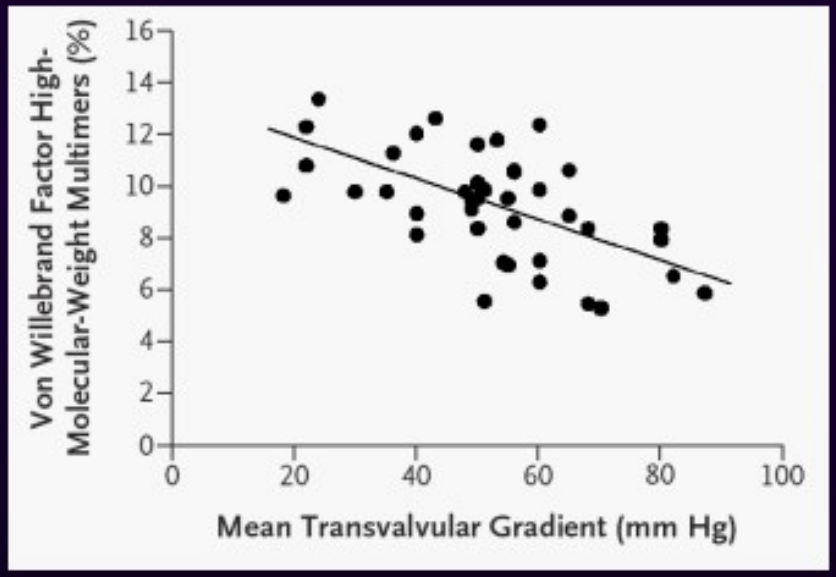


Independent predictors of greater LV mass regression:
- Female Gender
- Higher Preoperative LV mass
- Larger Indexed EOA

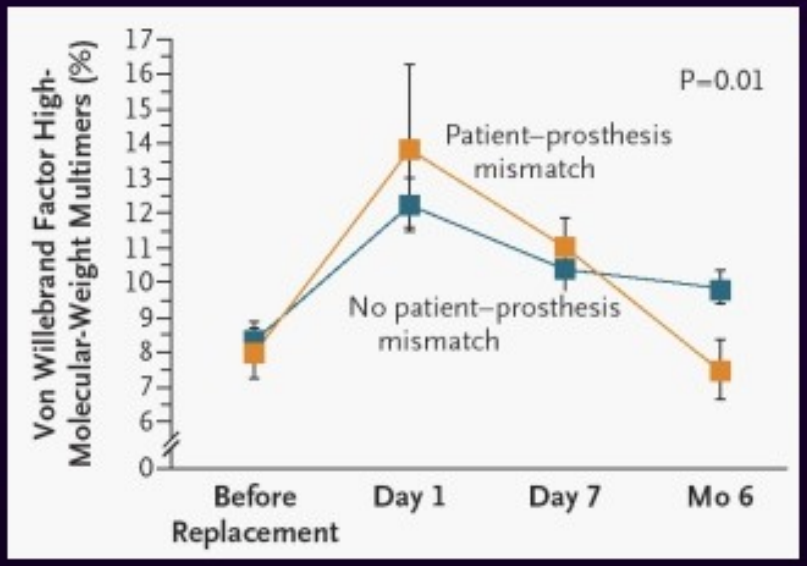
Tasca et al., Ann Thorac Surg, 79:505-510, 2005

Impact of PPM on Bleeding Complications ?

Before AVR



After AVR



PPM: IEOA ≤ 0.8 cm²/m²

Vincentelli et al., NEJM; 349:343-9; 2003.

Conventional Prostheses





60% - 70% 10 Year Survival

Impact of PPM on survival – Confounding variables

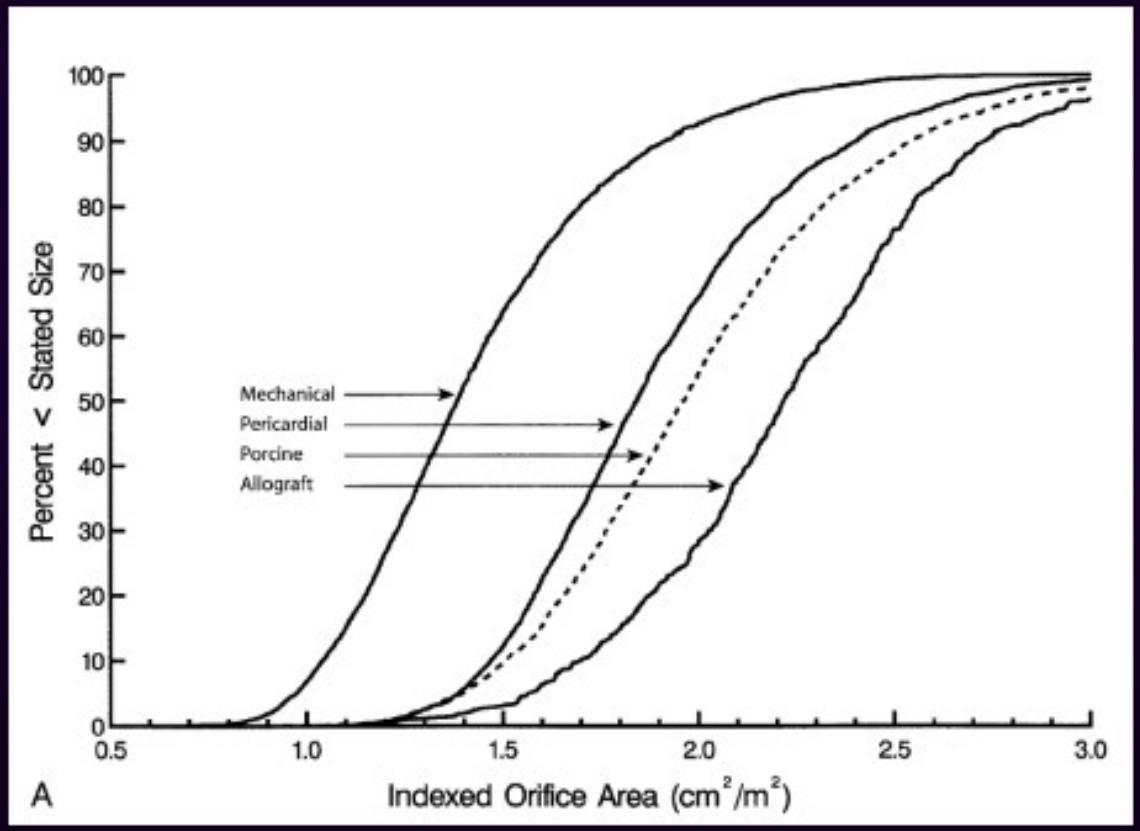
- Parameters used to identify mismatch
  - ✓ Indexed EOA vs Indexed GOA
- Severity of mismatch –mild-moderate-severe
- Status of LV Function
- Short vs Mid vs Long term mortality

Impact of Mismatch on Mortality

Study	Nb. of pts.	Definition of PPM	Short-term Mortality	Mid/Long-term Mortality
Fernandez et al. 1996	607	IGOA	-	No (8 yr)
Pibarot et al. 1998	392	IEOA	-	No (7 yr)
Rao et al. 2000	2,154	IEOA	Yes	Yes (12 yr)
Medalion et al. 2000	892	IGOA	No	No (10 yr)
Hanayama et al. 2002	1,129	IEOA	Yes	No (7 yr)
Blais et al. 2003	1,266	IEOA	Yes	-
Blackstone et al. 2003	13,258	IGOA	Yes	No (15 yr)
Mohty et al. In press	518	IEOA	-	Yes (10 yr)

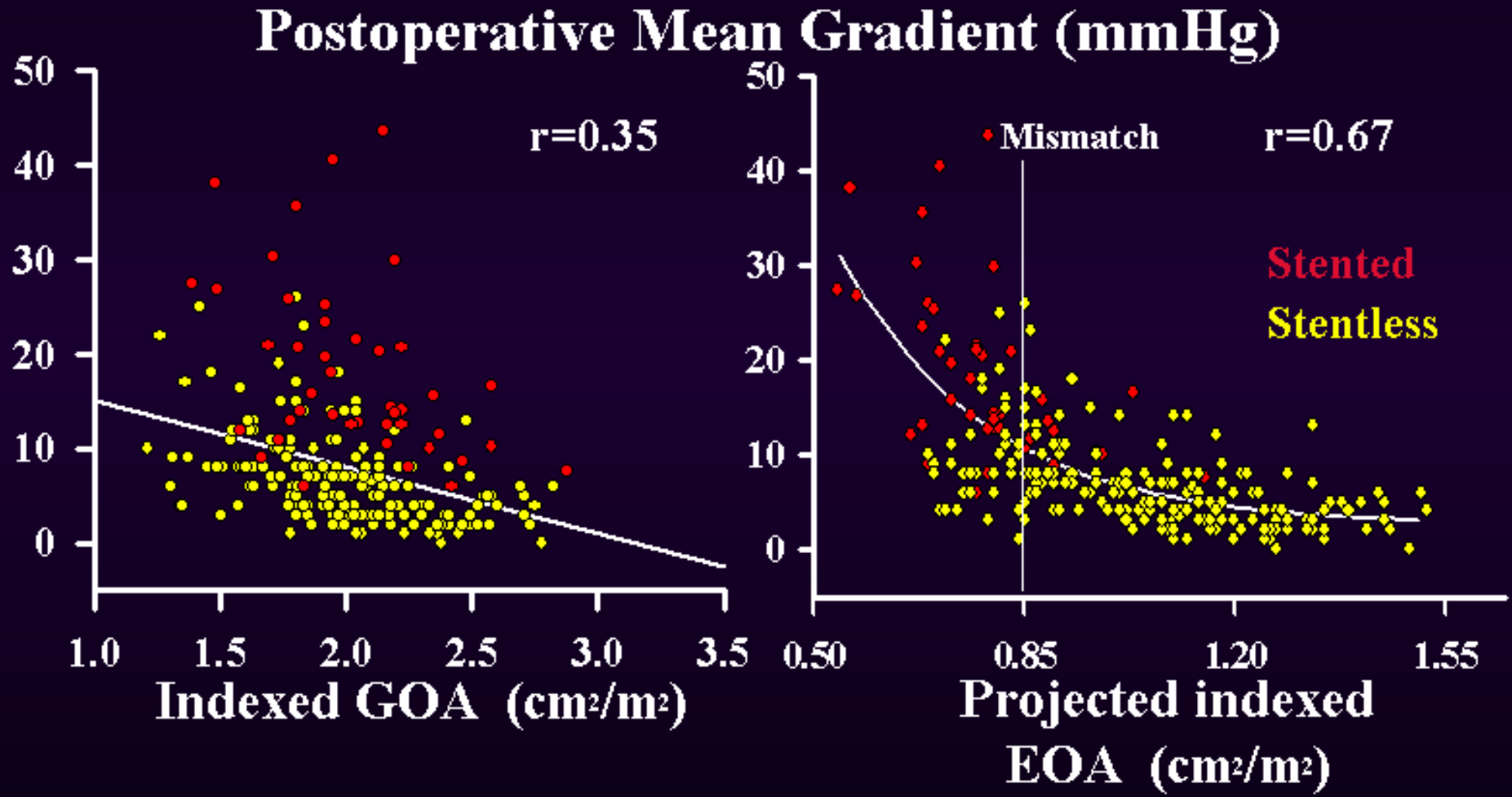
Prosthesis size and long-term survival after aortic valve replacement

Indexed GOA (cm^2/m^2)

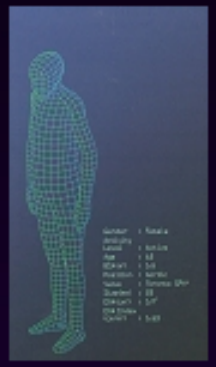


Blackstone et al., J Thorac Cardiovasc Surg , 126, 2003

Indexed GOA vs. Projected Indexed EOA as a Predictor of Postoperative Gradient



Pibarot et al., Ann Thorac Surg, 71: S265-8, 2001.

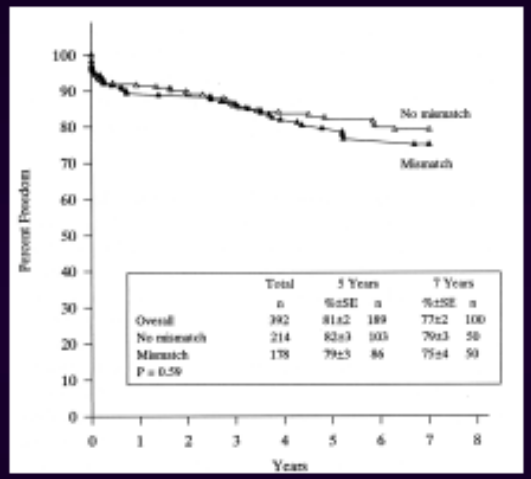




It is not the size (external or internal) of the prosthesis that matters, but rather its EOA and in whom you implant it.

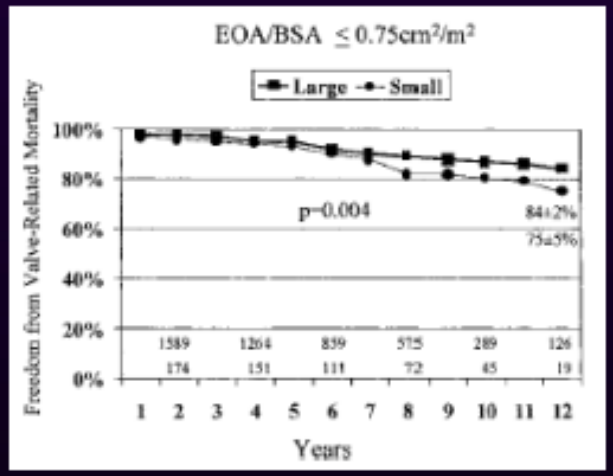
Impact of PPM on Mid- and Long-term Mortality - Summary

Mismatch: IEOA≤ 0.85
Follow-up: 7 years



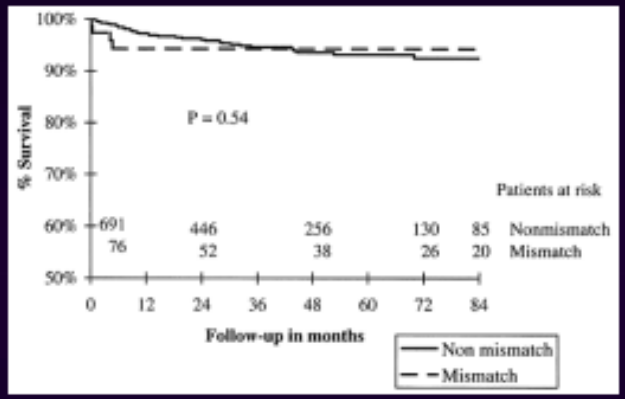
Pibarot et al.,
J Heart valve Dis, 7, 1998.

Mismatch: IEOA≤ 0.75
Follow-up: 12 years



Rao et al., Circulation 101, 2000.

Mismatch: IEOA≤ 0.60
Follow-up: 7 years

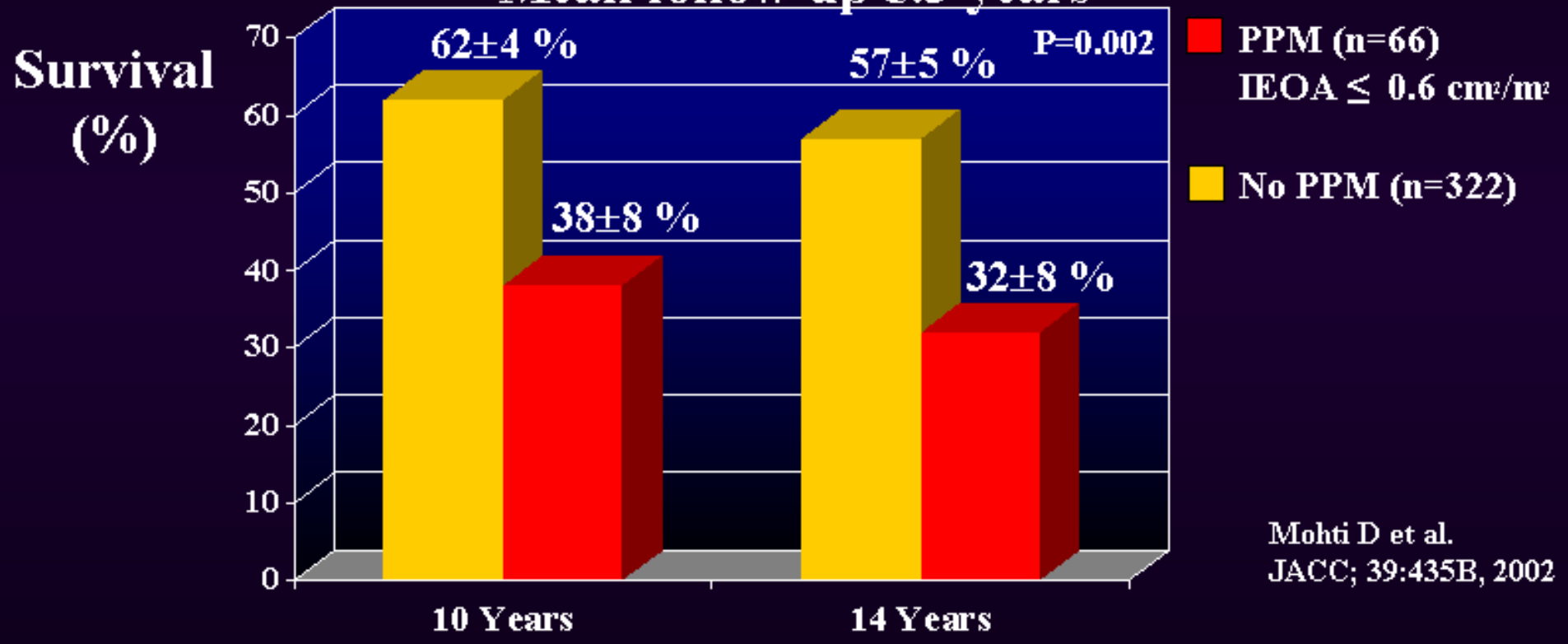


Hanayama N et al.,
Ann Thorac Surg;73,2002.

Impact of severe PPM on Long-term Survival

518 patients with 19 or 21 mm St-Jude Standard

Mean follow-up 5.3 years



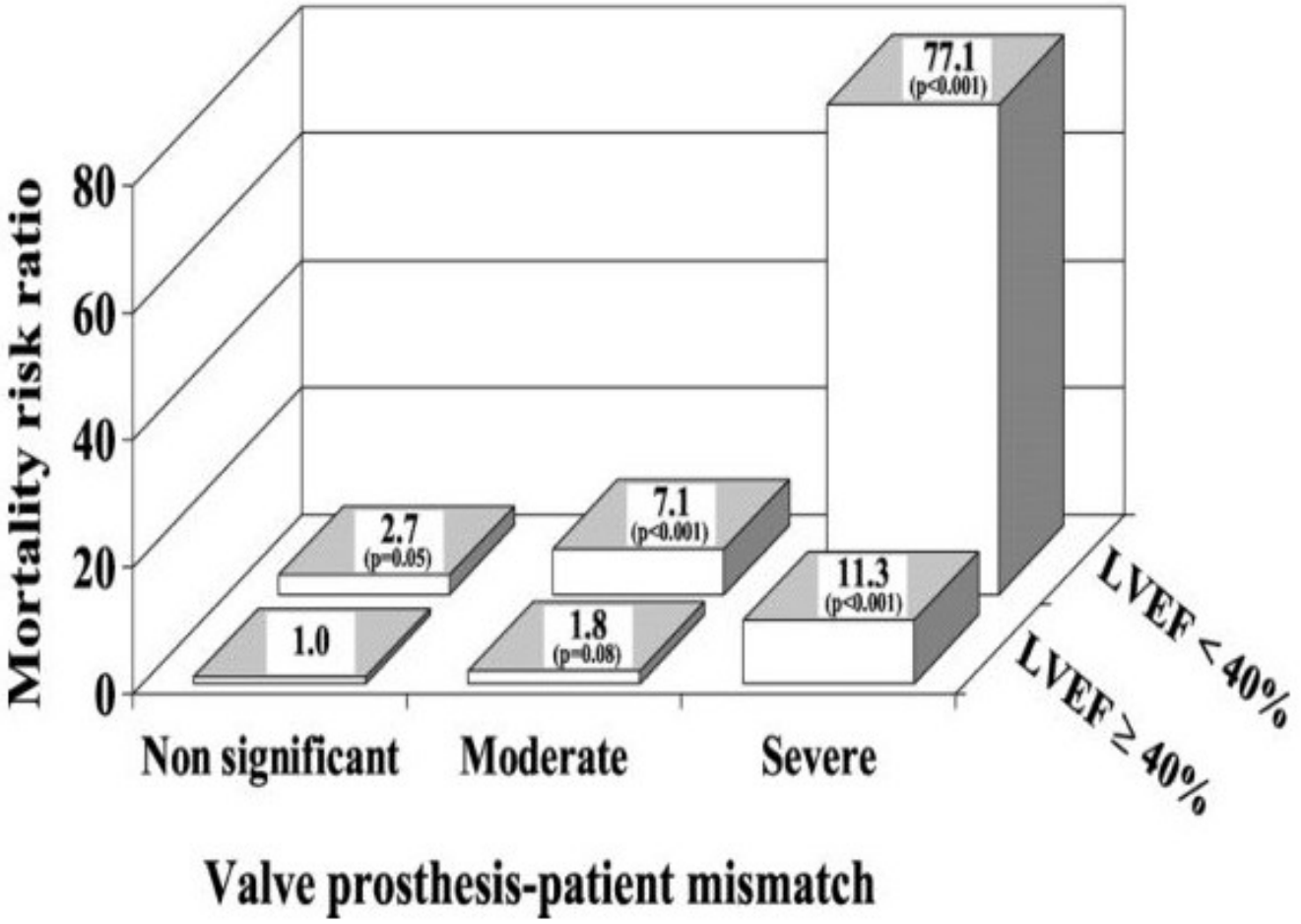
Mohti D et al.
JACC; 39:435B, 2002

« Significantly higher mortality in patients with PPM even after adjusting for all other predictors of survival: hazard ratio 1.73 [1.08-2.7] »

Impact of Valve Prosthesis-Patient Mismatch on Short-Term Mortality After Aortic Valve Replacement

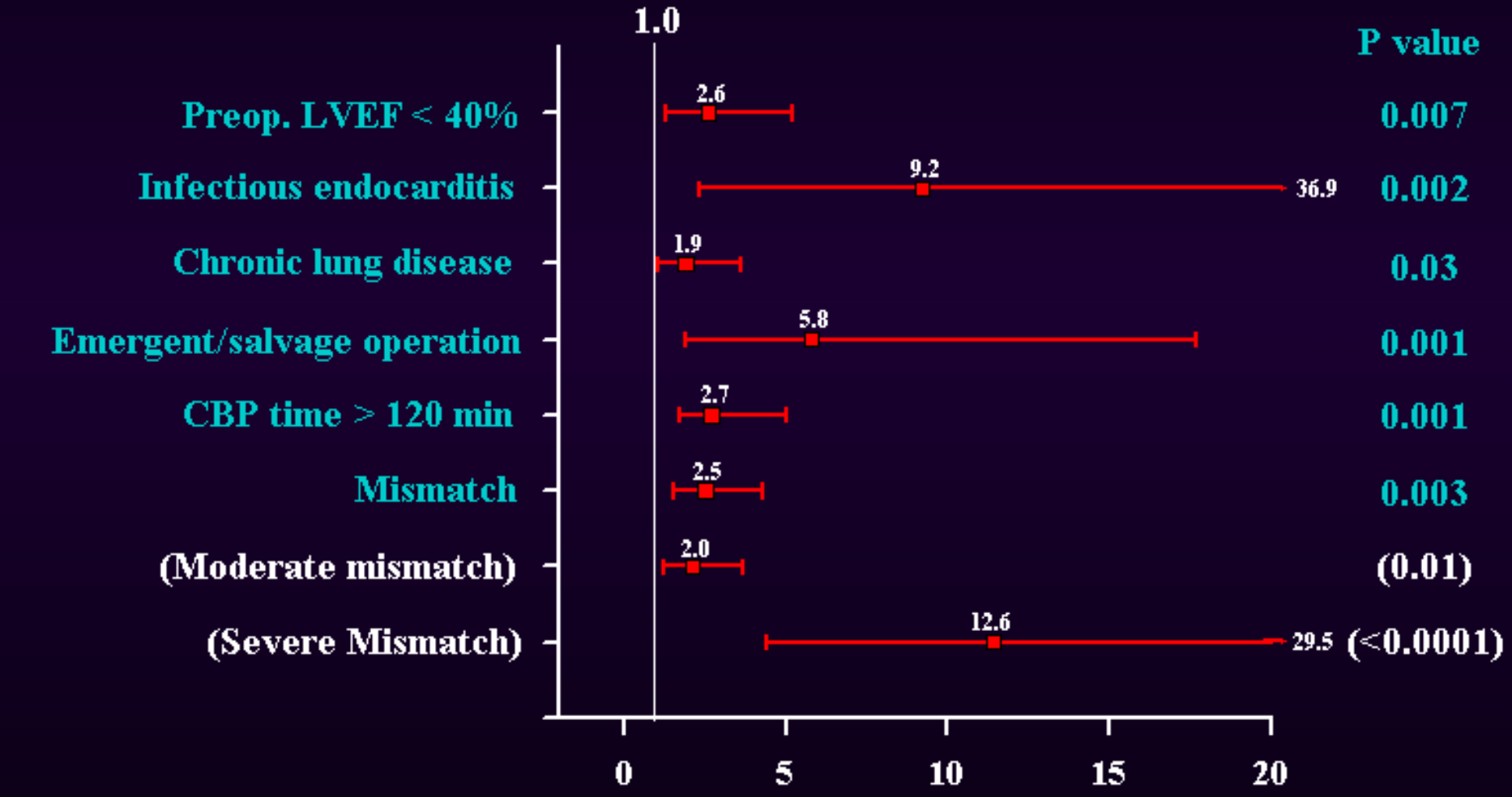
Claudia Blais, BSc; Jean G. Dumesnil, MD; Richard Baillot, MD; Serge Simard, MS; Daniel Doyle, MD; Philippe Pibarot, DVM, PhD

(*Circulation*. 2003;108:983-988.)



Multivariate Analysis

Relative risk ratio for operative mortality



Blais et al, Circulation,108:983-988, 2003

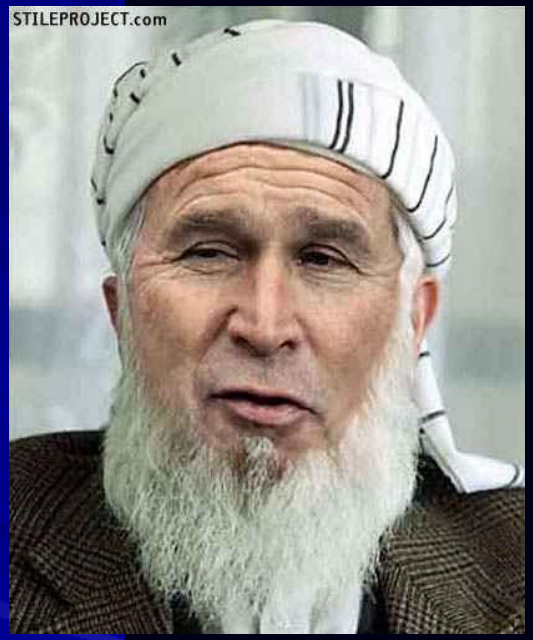
I have opinions of my own -

strong opinions -

but

I don't always agree

with them.



Source: George Bush

Surgical solutions for patients with small Aortic Valve Annulus

- Enlarge the annulus
- Suture technique
- Valve orientation
- Septal hypertrophy
- Stentless biological valve
- More efficient mechanical valve

I AM EASILY SATISFIED WITH THE VERY BEST

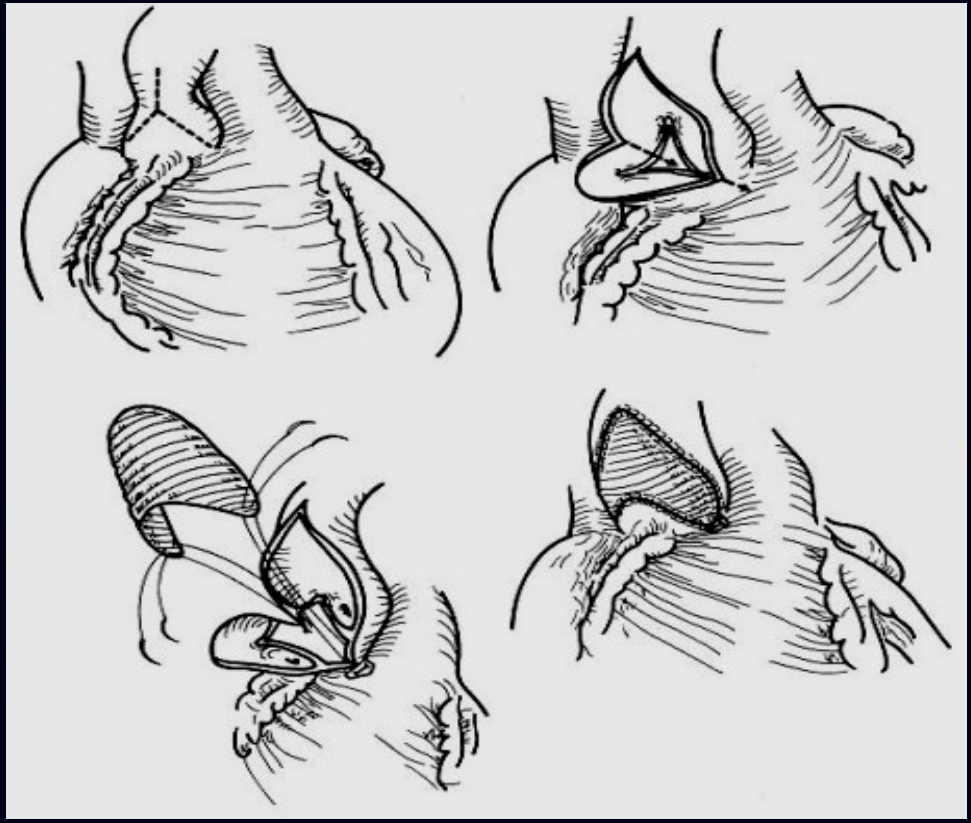
Winston Churchill



Enlarge Annulus

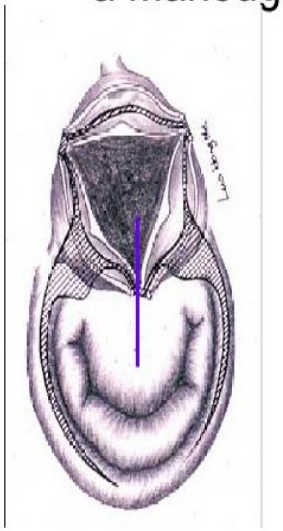
- Manougian or Nicks procedure
  - Extend aortic incision through noncoronary cusp onto anterior leaflet of mitral valve
- Konno procedure
  - Aortic incision carried into right coronary sinus into rt ventricle, across septum. Patch repair of septum and annulus
- Left ventricular arterial conduit

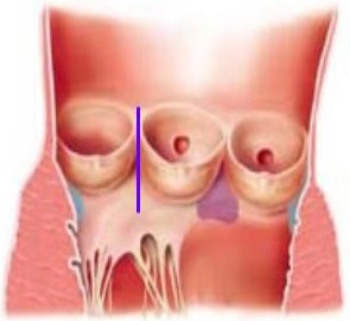
Nicks procedure



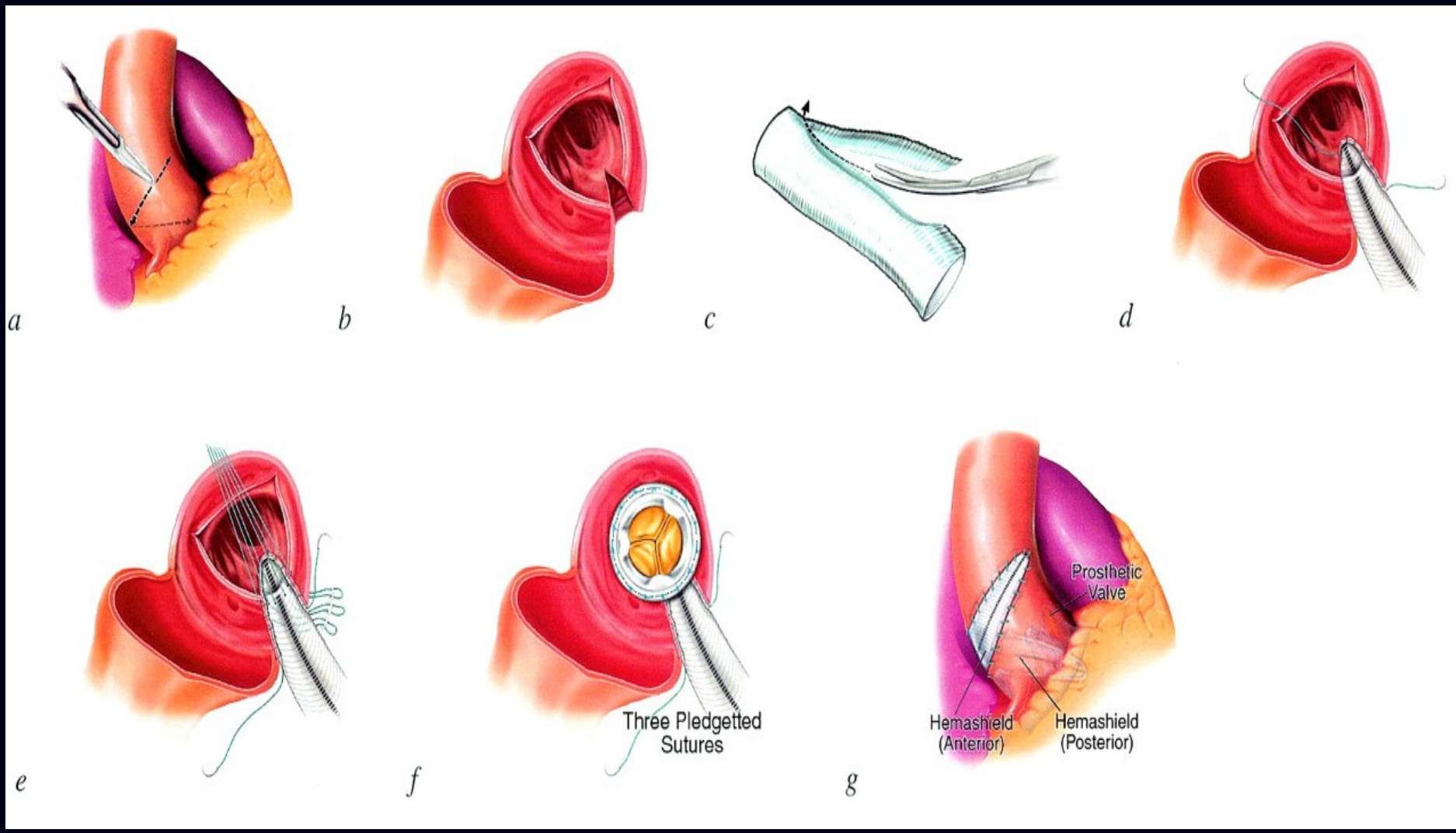
Manougian's Procedure

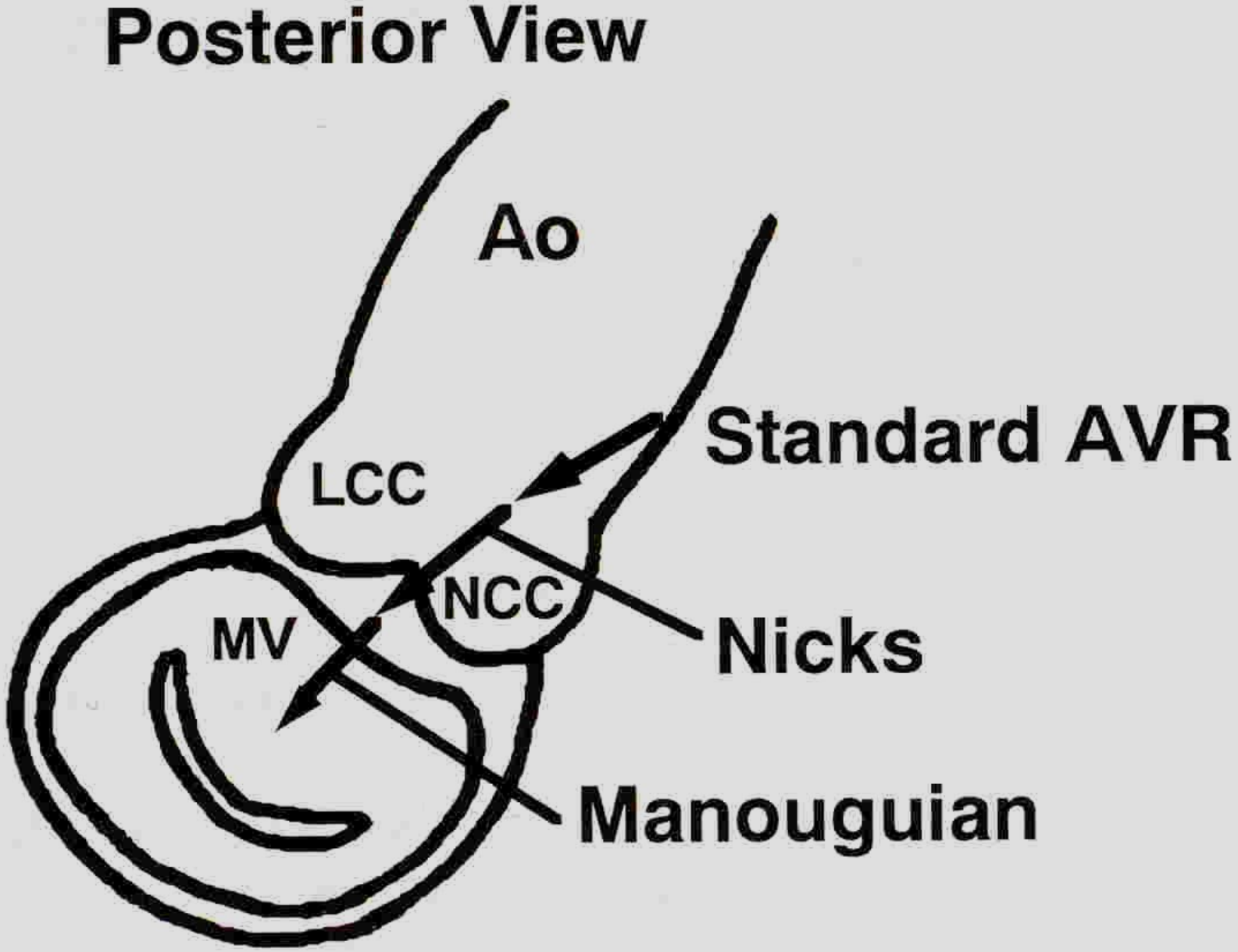
Line demonstrates region of incision to enlarge aortic annulus when performing a Manougian proceedure





1. Manouguian S and Seybold-Epting W. Patch enlargement of the aortic valve ring by extending the aortic incision into the anterior mitral leaflet. New operative technique. J Thorac Cardiovasc Surg 1979;78:402-412.

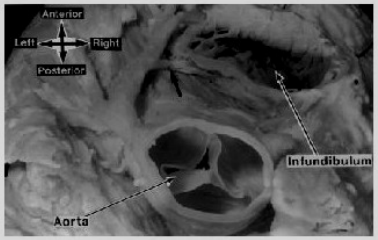

a
b
c
d
e
f
Three Pledgetted Sutures
g
Prosthetic Valve
Hemashield (Anterior)
Hemashield (Posterior)


Posterior View
Ao
Standard AVR
LCC
NCC
MV
Nicks
Manouguian

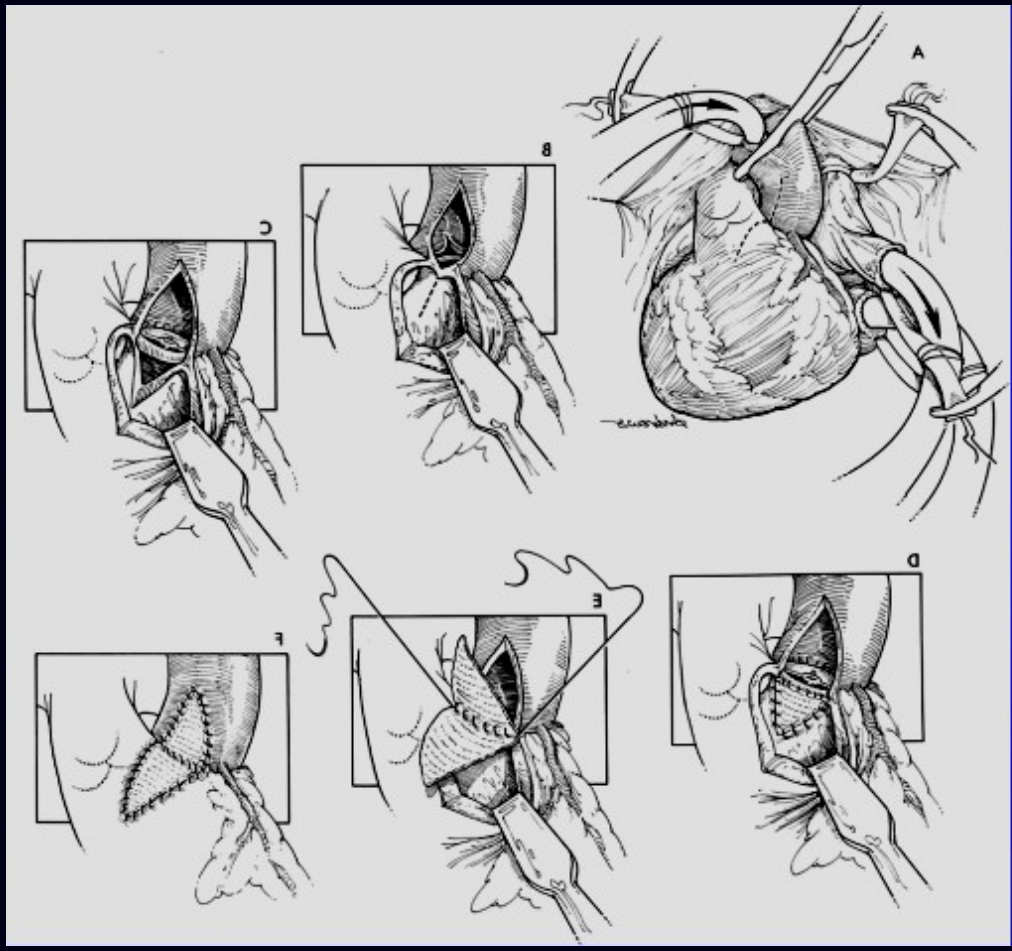
Aortic incision carried into right coronary sinus into right ventricle, across septum.Patch repair of septum and annulus

Line demonstrates region of aortic annulus cut to initiate Konno proceedure

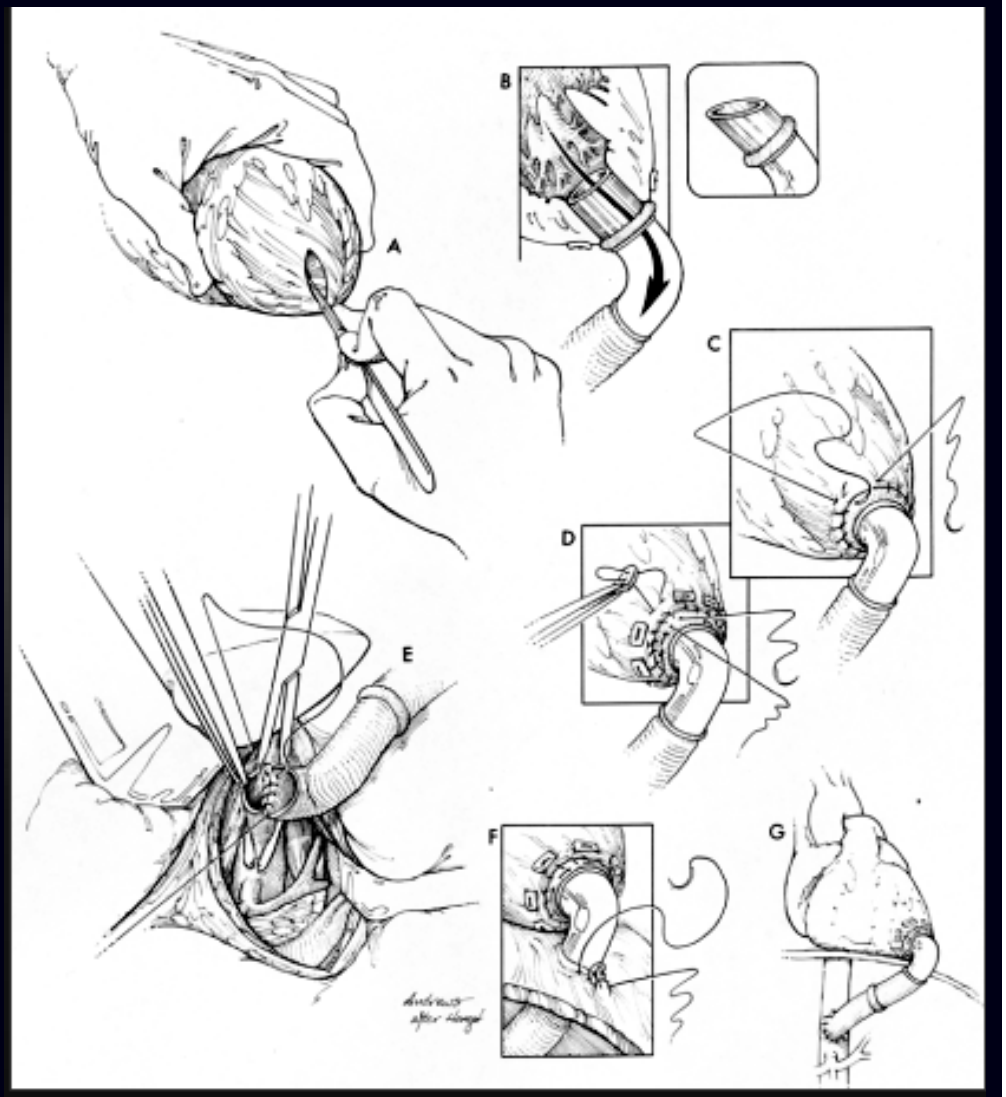


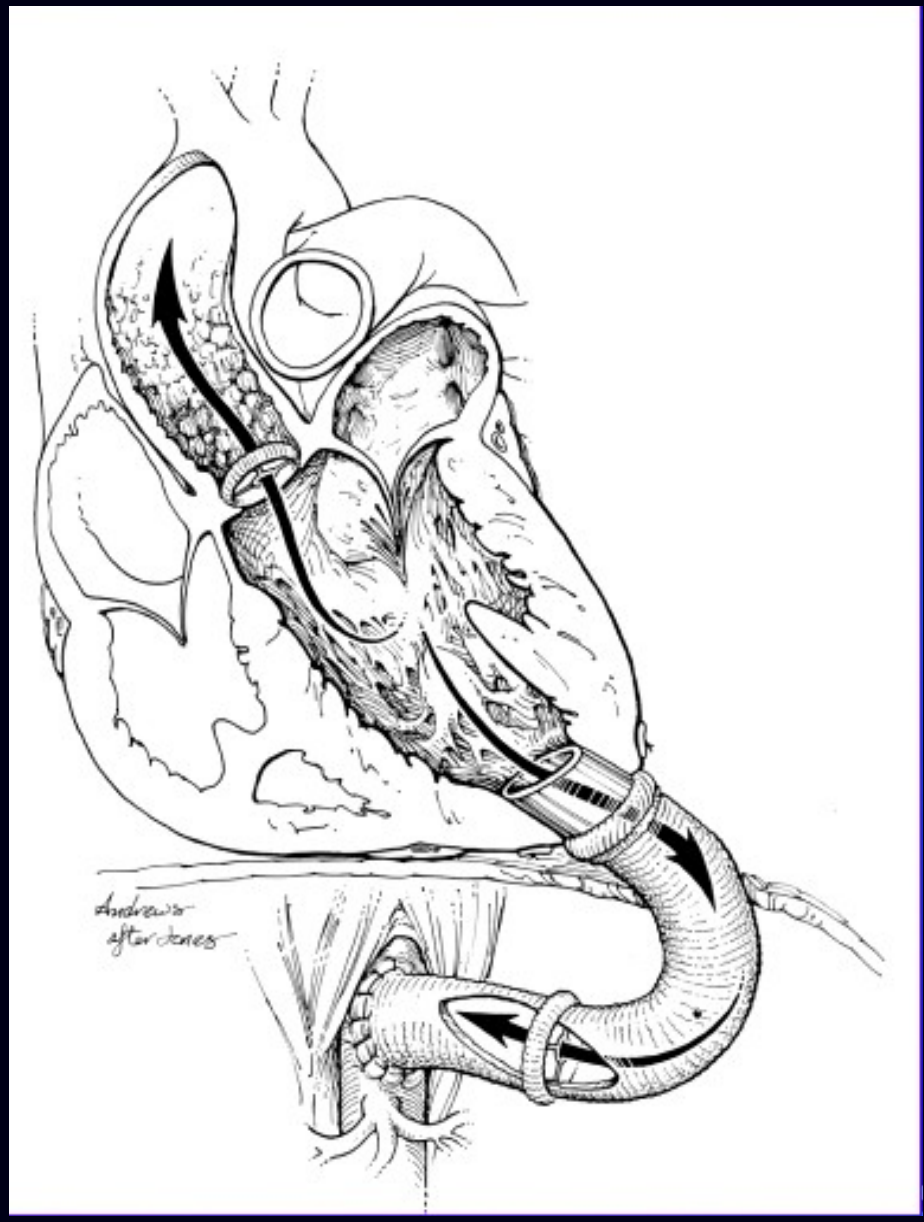


Note: location of first septal perforator



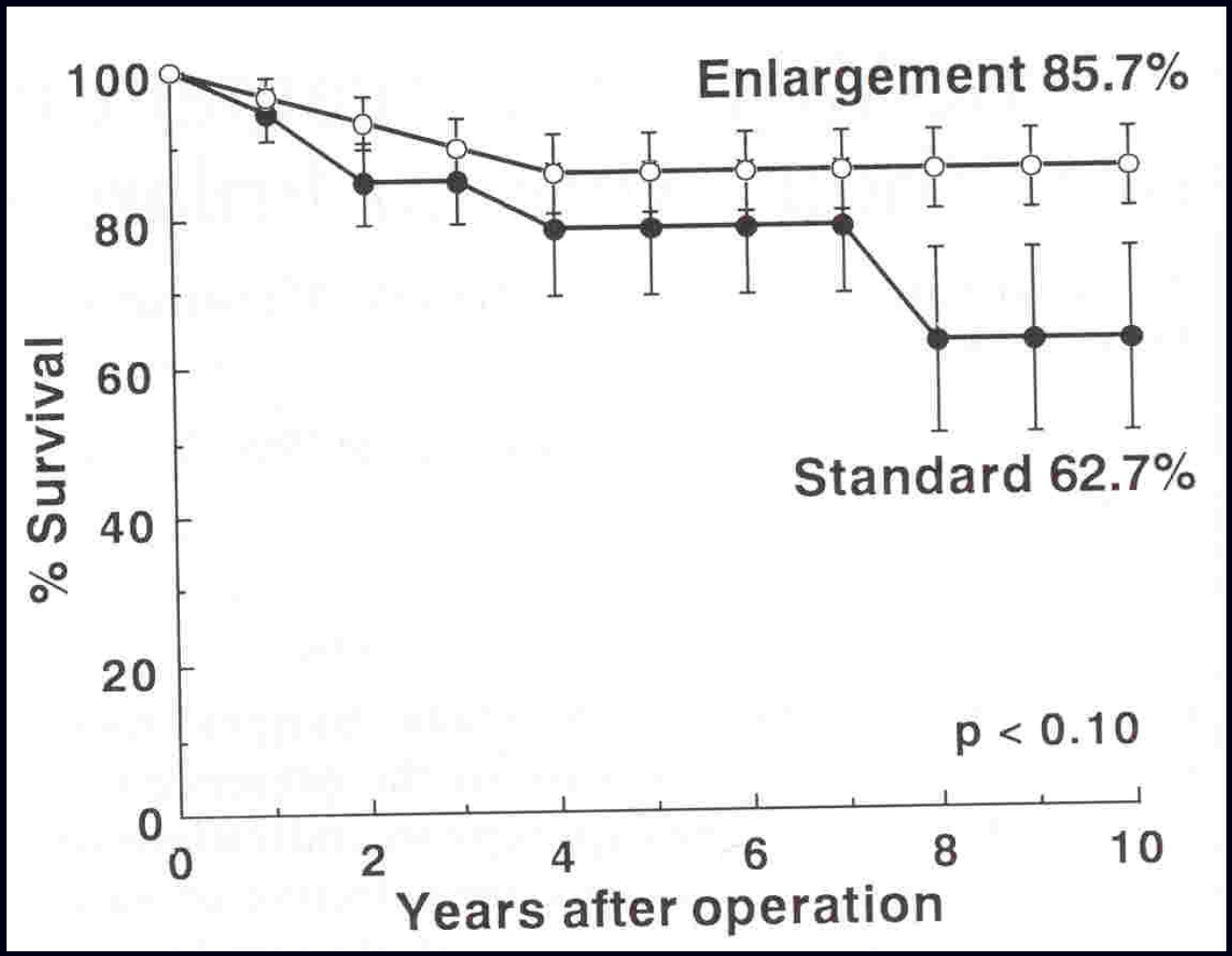
1. Konno K, Imai Y, Iida Y, Nakajima M,Tatsuno K. A new method for prosthetic valve replacement in congenital aortic stenosis associated with hypoplasia of the aortic valve ring. J Thorac Cardiovasc Surg 1975;70:909-917.


A
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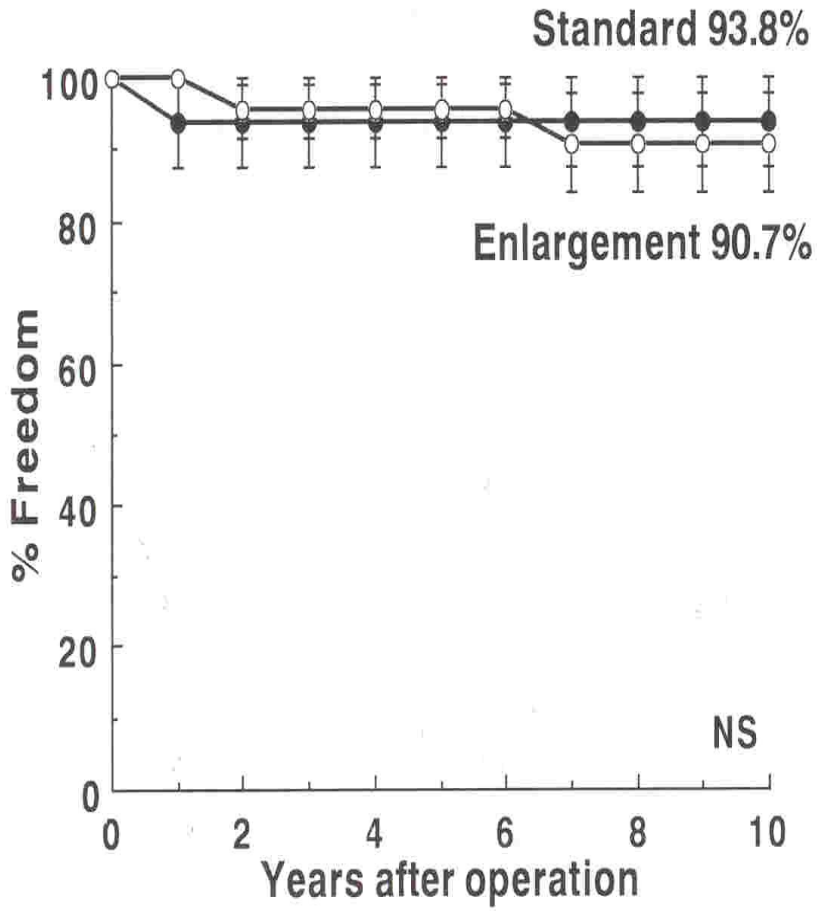
Masaya et al JHVD 1996, AVR in Small Aortic Annulus with and without Annular Enlargement

Acturial survival including all death

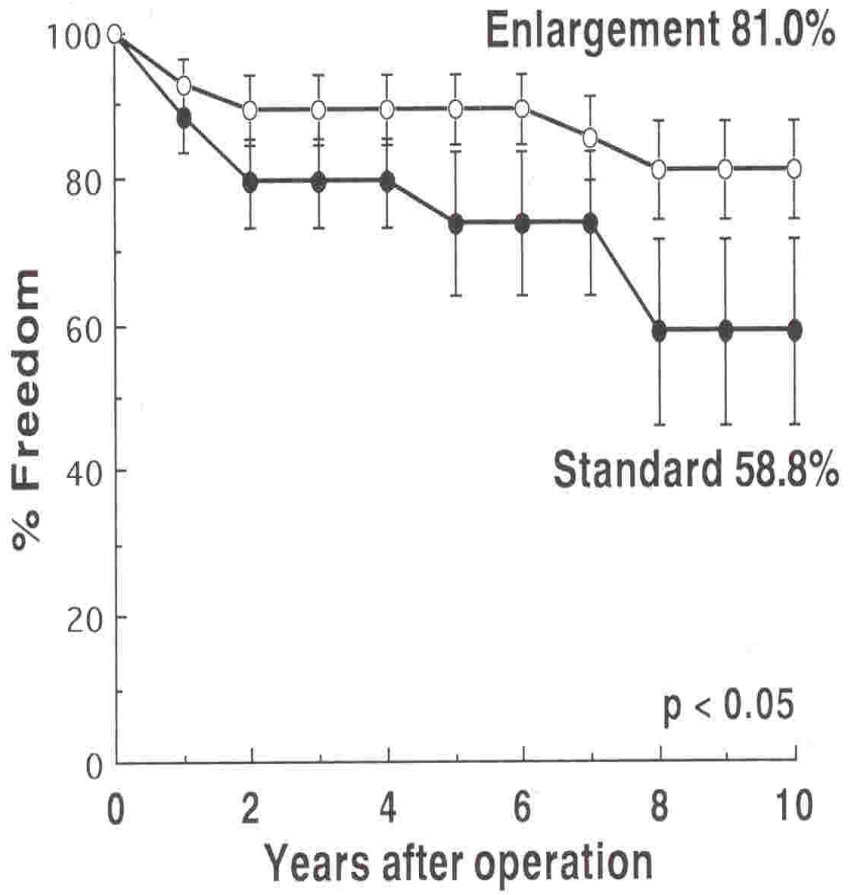


Masaya et al JHVD 1996, AVR in Small Aortic Annulus with and without Annular Enlargement

Freedom from reoperation



Freedom from all valve - related events including early death



L. J. Castro, J. M. Arcidi Jr, A. L. Fisher, and V. A. Gaudiani
Routine enlargement of the small aortic root: a preventive strategy to minimize mismatch
Ann. Thorac. Surg., July 1, 2002; 74(1): 31 - 36.

Table 4. Perioperative Outcomes

Variable	All ARE (n = 114)	All AVR (n = 543)	p Value	Iso ARE (n = 40)	Iso AVR (n = 231)	p Value
Aortic clamp time (min)	87.0 ± 26.5	65.0 ± 24.4	<0.001	67.0 ± 15.8	48.2 ± 12.0	<0.001
CPB time (min)	106.8 ± 31.1	82.2 ± 31.4	<0.001	84.5 ± 18.5	63.6 ± 22.8	<0.001
Stroke	4 (3.5%)	30 (5.5%)	0.378	0 (0%)	8 (3.5%)	0.234
Reoperation for bleeding	5 (4.4%)	25 (4.6%)	0.919	0 (0%)	5 (2.2%)	0.349
Myocardial infarction	2 (1.8%)	1 (0.2%)	0.211	0 (0%)	1 (0.4%)	0.678
30-Day mortality	1 (0.9%)	22 (4.1%)	0.010	1 (2.5%)	10 (4.3%)	0.590

All ARE = all aortic root enlargements; All AVR = all aortic valve replacements without root enlargement; Iso ARE = isolated aortic root enlargements; Iso AVR = isolated aortic valve replacements without root enlargement; CPB = cardiopulmonary bypass.

THE ANNALS OF THORACIC SURGERY

Aortic Valve Replacement with Patch Enlargement of the Aortic Annulus

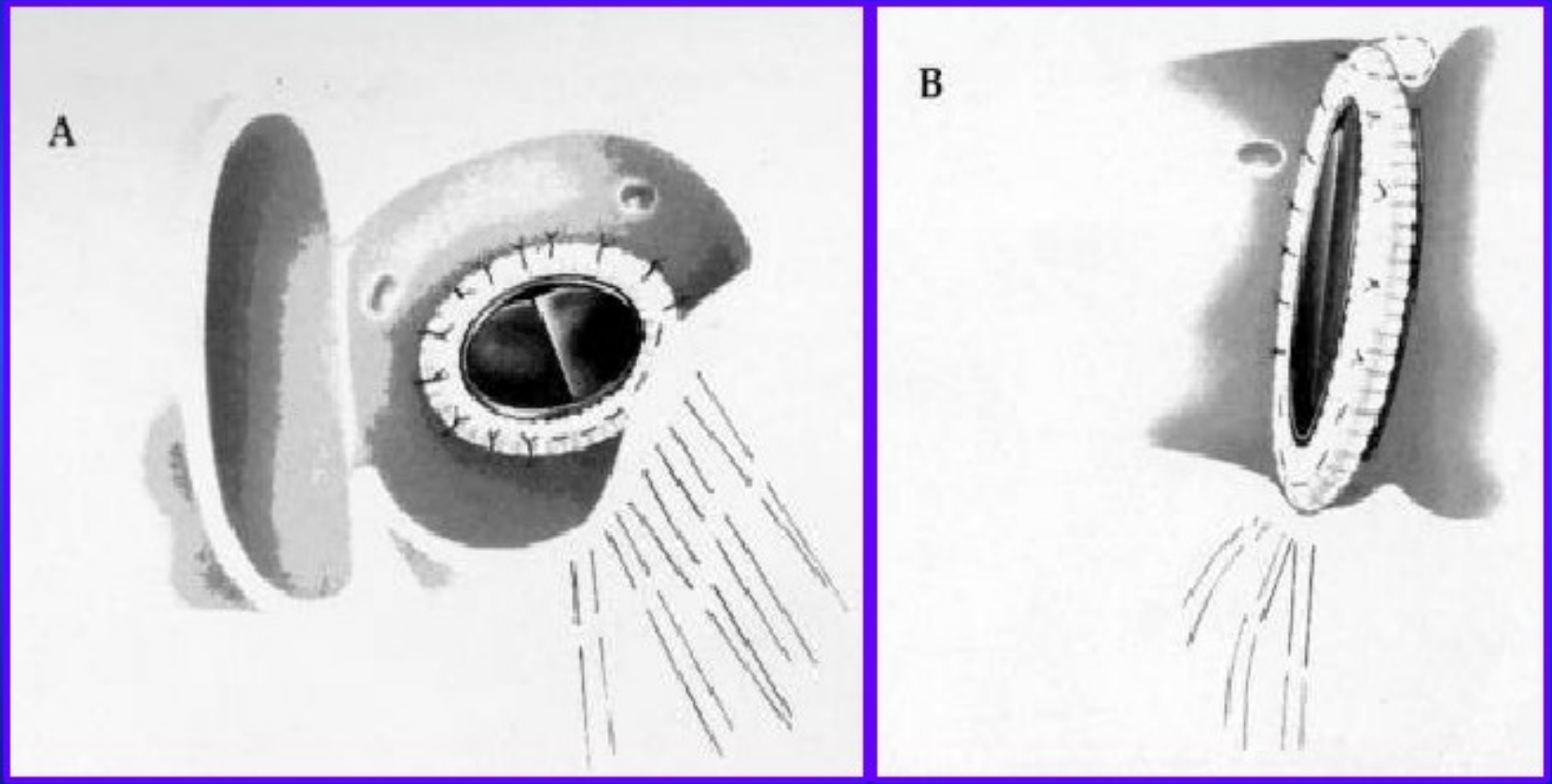
K. Eric Sommers, MD, and Tirone E. David, MD

"*Results.* Enlargement of the aortic annulus during aortic valve replacement increased the operative mortality rate from 3.5% to 7.1%"

"*Conclusion.* Aortic annulus enlargement increased the operative mortality of aortic valve replacement"

1997;63:1608

Increasing Valve Size by Inserting the Valve Supra-Annularly Into the Non-Coronary Cusp



J Heart Valve Dis 2002;11[Suppl 1]:S66

Suture Technique

- Newer mechanical valves have smaller, less bulky sewing ring
- Everting pledgetted mattress sutures- decrease annulus size, promote pannus formation
- Interrupted simple sutures may avoid this problem- need more sutures
- Non- pledgetted mattress sutures on the ventricular side for supra annular valve placement

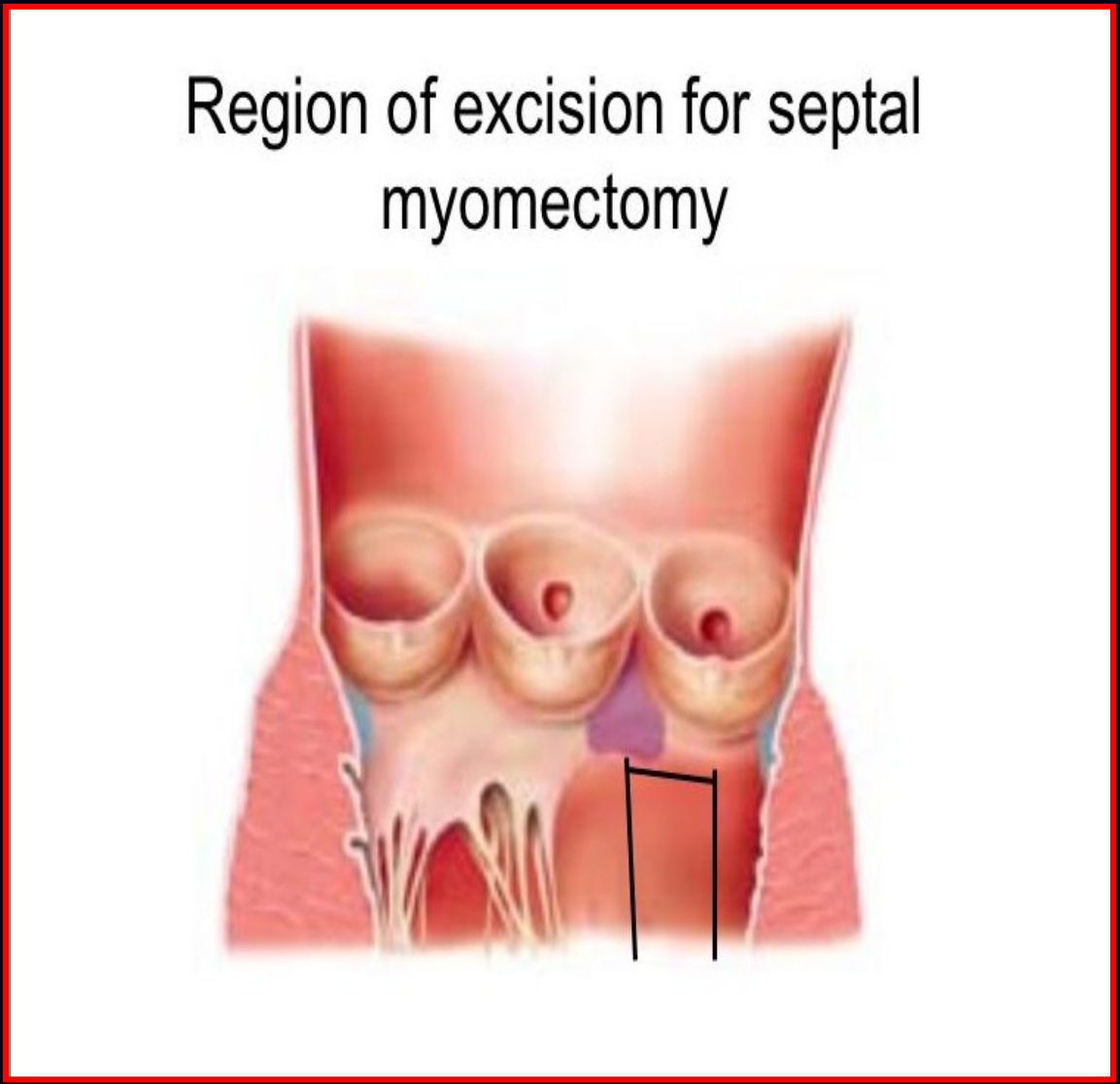
Valve Orientation

- Orienting parallel to septum may cause obstruction when open
- Place valve perpendicular to the septum
- Evaluate after placement and rotate to obtain optimum function

Septal hypertrophy

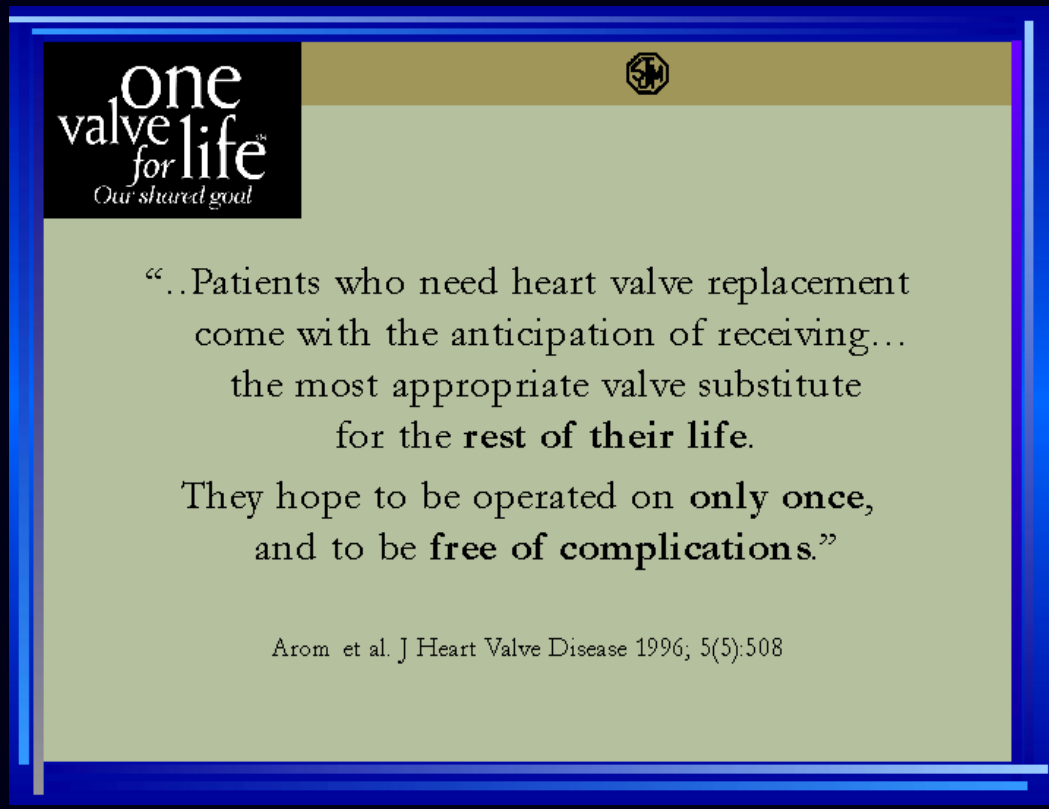
- Often overlooked
- Septal myomectomy will often decrease gradient
- Easy to perform – low risk

Asymmetrical septal hypertrophy



Valve selection for the small aortic root must take into consideration several factors:

- Annular size
- Body surface area (BSA) of the patient
- Effective orifice area (EOA) of the valve to be implanted



Effective Orifice Area Index Calculator

Pocket Guide



Evaluation of Commonly Used Aortic Prostheses

Patient-prosthesis mismatch is a significant issue in valve replacement today.

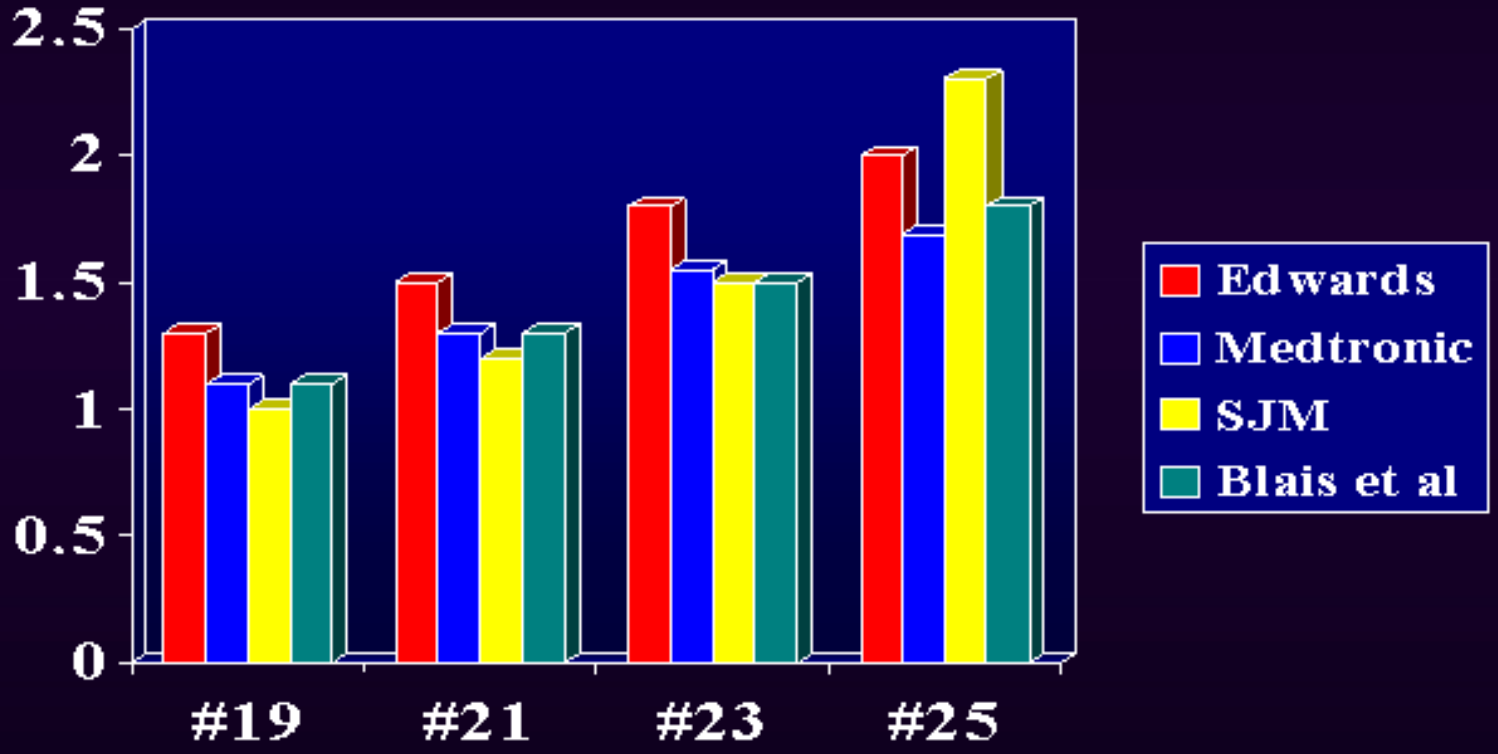
SJM Regent®

The first choice in heart valves.™

SJM Regent® Valve

Carpentier-Edwards® Perimount® Valve (Model 2700)

•*Variability in Reference Values*



CEP Bioprosthesis

EOAI < .80 cm²/mm²(2) – PPM

Bioprosthetic valves in small aortic root

In-Vivo Effective Orifice Area (EOA) for Commonly Used Stented Biologic Valves

Valve Size (mm)	EOA (cm^2) Carpentier-Edwards Standard	Medtronic Hancock II	Edwards Perimount
19	0.77	NR	1.08
21	0.89	1.2	1.3
23	1.14	1.35	1.4
25	1.37	1.43	1.5

NR: Not recorded

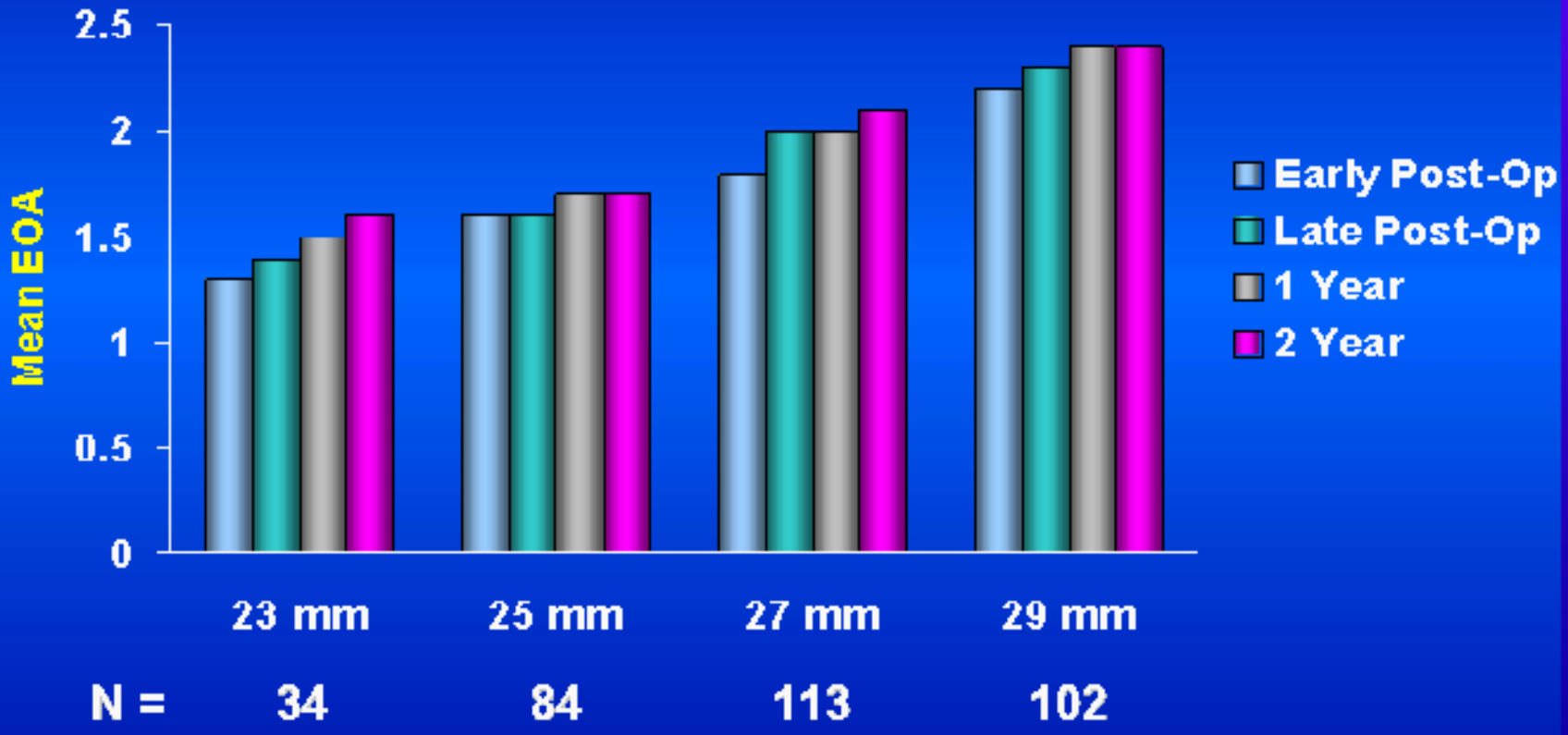
J Heart Valve Dis 2002;11[Suppl 1]:S50

In-Vivo Mean Gradients of the Carpentier-Edwards Perimount Pericardial Valve

	Valve size (mm)			
	19	21	23	25
Mean gradient (mm Hg)	23.0	19.7	15.2	13.2

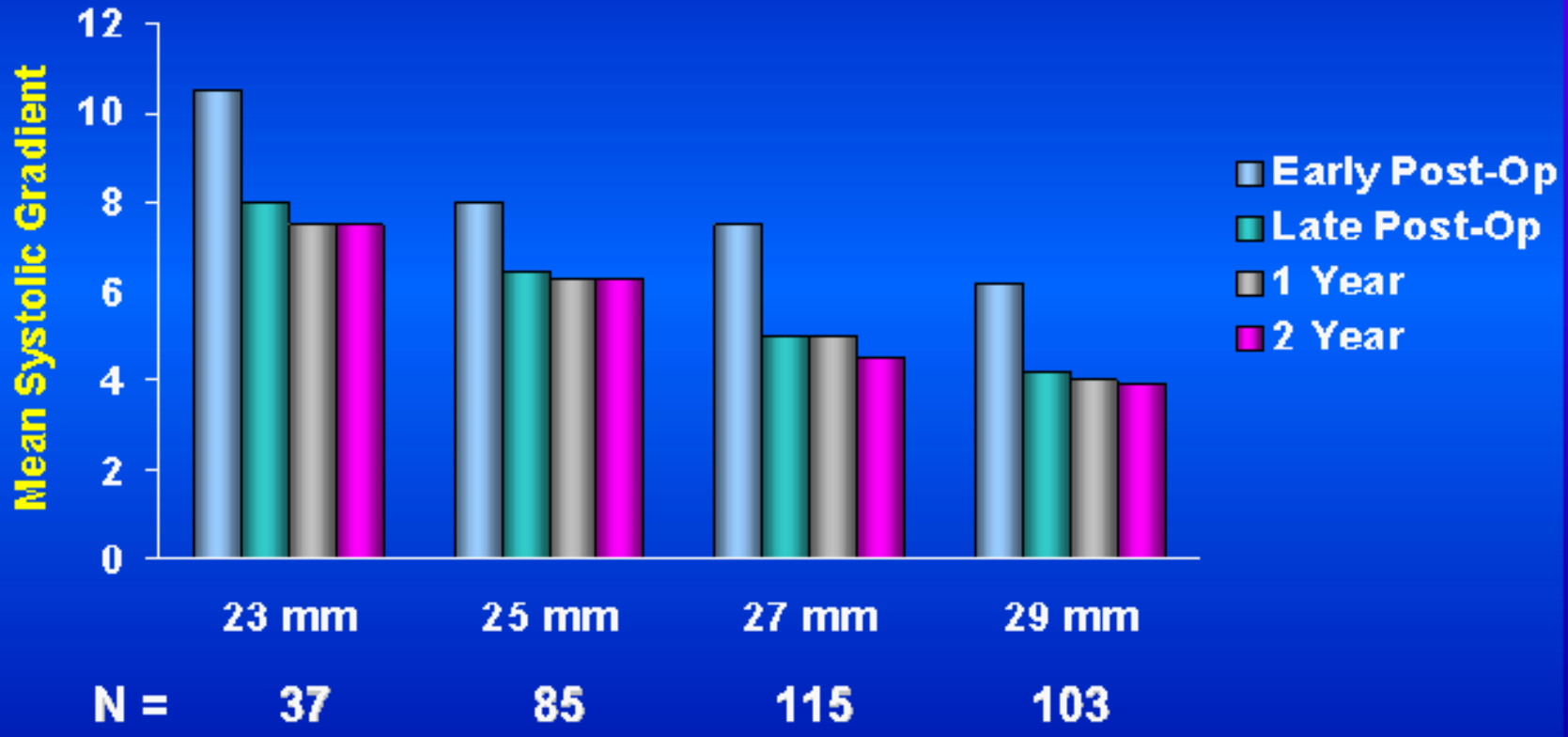
J Heart Valve Dis 2002;11(Suppl 1):S50

Effective Orifice Area (EOA) in Relation to Valve Size: Porcine Stentless Valve



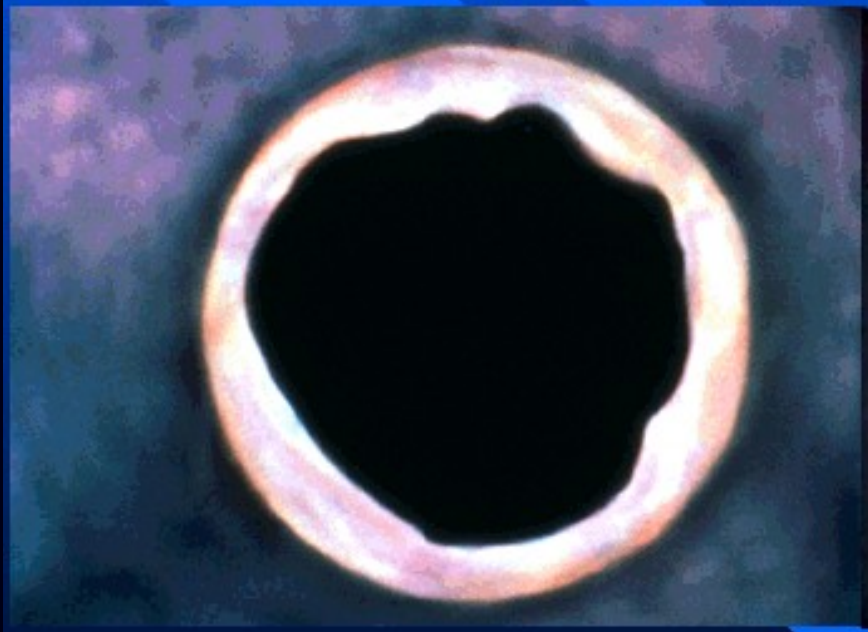
J Heart Valve Dis 2002;11[Suppl 1]:S50

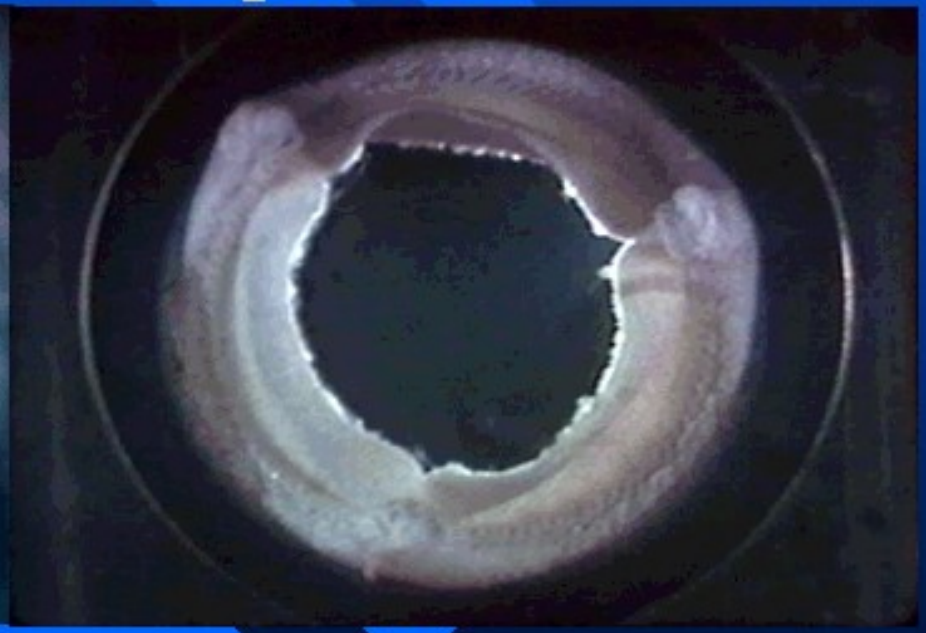
Mean Systolic Gradient in Relation to Valve Size: Porcine Stentless Valve



J Heart Valve Dis 2002;11[Suppl 1]:S50

Stentless vs. Stented Bioprosthesis
Size 23 mm Comparison



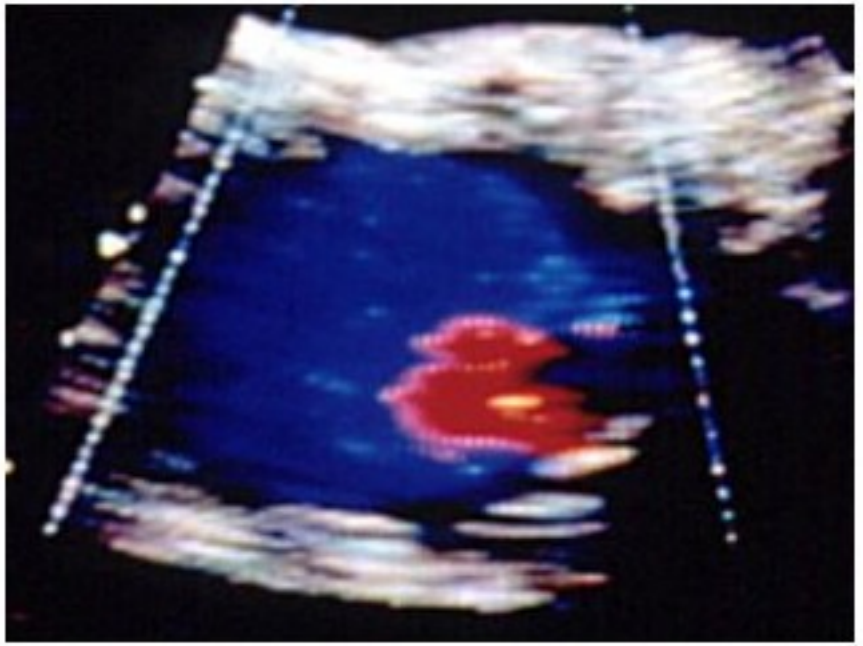


Freestyle® Bioprosthesis

Stented Pericardial Bioprosthesis

Non Turbulent flow patterns with stentless porcine bioprosthesis inserted as total root replacement





Advantages of Stentless Valves

- Similar EOA in similar sizes
- Implant larger sizes(often two sizes larger)
- Increase in EOA
- May wear better
- Different modes of failure
  - Commissures vs sinotubular ridge dilatation and cusp tear
- Difficult Implant

Stentless vs Homografts
Jin et al. Ann Thorac Surg 1996

- Stentless valves:
  - Improved LV systolic and diastolic function
  - Better LV mass reduction
  - Lower gradient
  - Off the shelf

Hemodynamic Parameters of Homograft, Stentless and Stented Valves

Parameter	Homograft	Stentless	Stented
LV Mass index ($g.m^{-2}$)	210 → 147	225 → 144	215 → 178
Peak dimensional shortening velocity (S^{-1})	1.6 → 1.9	1.5 → 1.8	1.5 → 1.5
Peak dimensional lengthening velocity (S^{-1})	2.1 → 3.1	1.8 → 2.8	1.7 → 2.3
Peak AV gradient (mm Hg)	8	6	20

AV: Atrioventricular; LV: Left ventricular

J Heart Valve Dis 2002;11[Suppl 1]:S50

Mechanical valves in small aortic root

"[If you] put a small valve in a small patient [who is young], with a small heart with a small aorta, they do not grow to be an older person. They die prematurely."

Tirone David, M.D.

Mayo Clinic: The impact of Severe Prosthesis-Patient Mismatch on Long-term Survival In patients with Small St. Jude Mechanical Prostheses in the Aortic Position. WCC 2002

- 518 patients received 19 or 21mm valves, mean follow up of 5.3 years, max 16 yrs.
- PPM = EOAI <0.85 cm^2/m^2
- PPM resulted in higher gradient, lower stroke volume

In-Vivo Effective Orifice Areas (EOA) of Commonly Used Mechanical Valves

EOA (cm^2)

Valve area (mm)	ATS	CarboMedics Top Hat	St. Jude Medical Hemodynamic Plus	St. Jude Medical Regent
19	1.1	NR	NR	1.5
21	1.5	1.08	1.57	2.0
23	1.7	1.13	1.69	2.4

NR: Not recorded

J Heart Valve Dis 2002;11[Suppl 1];S50

EOAI Comparison

	SJM Regent™	Carbomedics™ Standard	ATS Medical™	Edwards Perimount®
FEMALE				
19mm	1.13	0.56	0.75	0.69
21 mm	1.25	0.81	0.94	0.81
23mm	1.50	0.88	1.06	0.94
MALE				
19mm	0.96	0.48	0.64	0.59
21mm	1.07	0.69	0.80	0.69
23mm	1.29	0.75	0.91	0.80

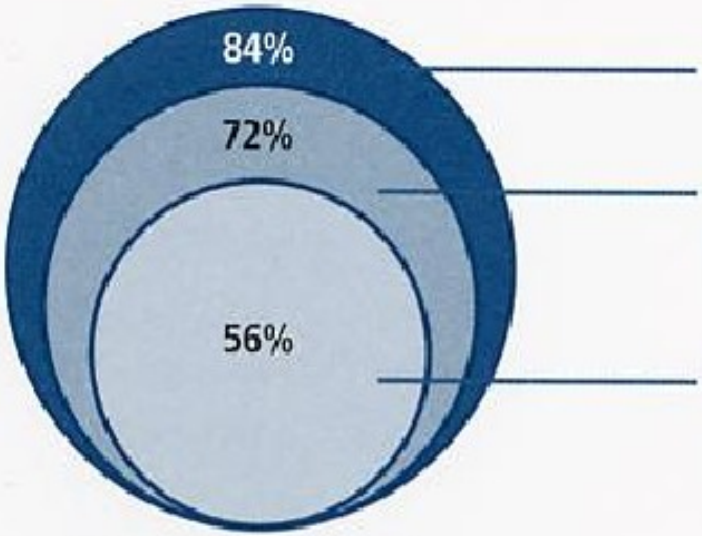
Red numbers indicate patient-prosthesis mismatch (EOAI <0.85cm²/m²)

The SJM Regent valve

- Increased geometric orifice area within the same tissue annulus dimension
- A more supra-annular design
- New rotational mechanism
- Cuff options to suit individual implant preferences

Exceptional Hemodynamic Performance
Orifice to Annulus Ratio

Orifice to annulus ratio—19 mm valve[2]



SJM Regent™ valve

SJM® Masters Series Hemodynamic Plus valve

SJM® Masters Series mechanical heart valve

The SJM Regent™ valve offers up to an 84% orifice to annulus ratio—the largest in a mechanical heart valve.

Summary

- PPM is associated with worse hemodynamics, lesser regression of LVH, more cardiac events and lower survival esp if LV Dysfunction is present.
- PPM is frequent and modifiable
- PPM can largely be avoided with the use of prospective strategy at the time of operation

1: Ann Thorac Surg. 2006 Feb;81(2):481-8; discussion 489.

Prosthesis-patient mismatch after aortic valve replacement: impact of age and body size on late survival.

Moon MR, **Pasque MK**, **Munfakh NA**, **Melby SJ**, **Lawton JS**, **Moazami N**, **Codd JE**, **Crabtree TD**, **Barner HB**, **Damiano RJ Jr**.

Division of Cardiothoracic Surgery, Washington University School of Medicine, St. Louis, Missouri, USA. moonm@msnotes.wustl.edu

BACKGROUND: The purpose of this study was to identify patient subgroups in which prosthesis-patient mismatch most influenced late survival. METHODS: Over a 12-year period, 1,400 consecutive patients underwent bioprosthetic (933 patients) or mechanical (467) aortic valve replacement. Prosthesis-patient mismatch was defined as prosthetic effective orifice area/body surface area less than 0.75 cm2/m2 and was present with 11% mechanical and 51% bioprosthetic valves. RESULTS: With bioprosthetic valves, prosthesis-patient mismatch was associated with impaired survival for patients less than 60 years old (10-year: 68% +/- 7% mismatch versus 75% +/- 7% no mismatch, $p < 0.02$) but not older patients ($p = 0.47$). Similarly, with mechanical valves, prosthesis-patient mismatch was associated with impaired survival for patients less than 60 years old (10-year: 62% +/- 11% versus 79% +/- 4%, $p < 0.005$) but not older patients ($p = 0.26$). For small patients (body surface area less than 1.7 m2), prosthesis-patient mismatch did not impact survival with bioprosthetic ($p = 0.32$) or mechanical ($p = 0.71$) valves. For average-size patients (body surface area 1.7 to 2.1 m2), prosthesis-patient mismatch was associated with impaired survival with both bioprosthetic ($p < 0.05$) and mechanical ($p < 0.005$) valves. For large patients (body surface area greater than 2.1 m2), prosthesis-patient mismatch was associated with impaired survival with mechanical ($p < 0.04$) but not bioprosthetic ($p = 0.40$) valves. CONCLUSIONS: Prosthesis-patient mismatch had a negative impact on survival for young patients, but its impact on older patients was minimal. In addition, although prosthesis-patient mismatch was not important in small patients, prosthesis-patient mismatch negatively impacted survival for average-size patients and for large patients with mechanical valves.

Case study

Open Access

Evaluation of 17-mm St. Jude Medical Regent prosthetic aortic heart valves by rest and dobutamine stress echocardiography

Giovanni Minardi, **Carla Manzara**, **Vittorio Creazzo**, **Daniele Maselli**, **Giovanni Casali**, **Giovanni Pulignano** and **Francesco Musumeci**
Department of Cardiology and Cardiovascular Surgery, Azienda Ospedaliera, S.Camillo-Forlanini, Rome, Italy

author email corresponding author email

Journal of Cardiothoracic Surgery 2006, **1**:27 doi:10.1186/1749-8090-1-27

The electronic version of this article is the complete one and can be found online at:
http://www.cardiothoracicsurgery.org/content/1/1/27

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Published: 19 September 2006

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Journal of Cardiothoracic Surgery
Volume 1

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Abstract

Background

The prosthesis used for aortic valve replacement in patients with small aortic root can be too small in relation to body size, thus showing high transvalvular gradients at rest and/or under stress conditions. This study was carried out to evaluate rest and Dobutamine stress echocardiography (DSE) hemodynamic response of 17-mm St. Jude Medical Regent (SJMR-17 mm) in relatively aged patients at mean 24 months follow-up.

Methods and results

The study population consisted of 19 patients (2 men, 17 women, mean age 69.2 ± 7.3 years). All patients underwent rest Doppler echocardiography before and after surgery and basal and DSE at follow up (infused at rate of 5 micrg/Kg/min and increased by 5 microg/Kg/min at 5 min intervals up to 40 microg/Kg/min). The following parameters were evaluated at rest and/or under DSE: heart rate (HR), ejection fraction (EF), cardiac output (CO), peak and mean velocity and pressure gradients (MxV, MnV, MxPG, MnPG), effective orifice area (EOA), indexed EOA (EOAi), left ventricular mass (LVM), indexed LVM (LVMi), Velocity Time Integral at left ventricular outflow tract (VTI LVOT) and transvalvular (Aortic VTI), Doppler velocity index (DVI). At rest MxPG and MnPG were 29.2 ± 7.1 and 16.6 ± 5.8mmHg, respectively; EOA and EOAi resulted 1.14 ± 0.3 cm^2 and 0.76 ± 0.2 cm^2/m^2; DVI was normal (0.50 ± 0.1). At follow-up LVM and LVMi decreased significantly from pre-operative value of 258 ± 43g and 157.4 ± 27.7g/m^2 to 191 ± 23.8g and 114.5 ± 10.6g/m^2, respectively. DSE increased significantly HR, CO, EF, MxGP (up to 83.4 ± 2 1.9mmHg), MnPG (up to 43.2 ± 12.7mmHg). EOA, EOAi, DVI increased insignificantly (from baseline up to 1.2 ± 0.4 cm^2, 0.75 ± 0.3cm^2/m^2 and 0.48 ± 0.1 respectively). Two patients developed significant intraventricular gradients.

Conclusion

These data show that SJMR 17-mm prostheses can be safely implanted in aortic position in relatively aged patients, offering a satisfactory hemodynamic performance at rest and under DSE, with full utilization of its available orifice, suggesting that a possible mild prosthesis-patient mismatch is not an issue of clinical relevance when this small prosthesis is used. Rest and Dobutamine stress echocardiography is a useful and effective means for evaluating prosthesis hemodynamics and for monitoring the expected LVH regression.

1: Eur J Cardiothorac Surg. 2006 Feb;29(2):139-43. Epub 2006 Jan 11.

Indexed effective orifice area after mechanical aortic valve replacement does not affect left ventricular mass regression in elderly.

Roscitano A, Benedetto U, Sciangula A, Merico E, Barberi F, Bianchini R, Tonelli E, Sinatra R.

Division of Cardiac Surgery, St. Andrea Hospital, University of Rome La Sapienza, Via di Grottarossa 1035, Rome 00181, Italy.

OBJECTIVE: After aortic valve replacement, the effects of a small functional prosthesis on the extent and pattern of regression of left ventricular hypertrophy and on clinical outcomes may be less significant in older patients with low cardiac output requirements. The objective of this study was therefore to determine whether patient-prosthesis mismatch affects left ventricular mass regression in the elderly. METHODS: The population studied was made up of 88 patients over 65 years of age with pure aortic stenosis who underwent mechanical aortic valve replacement. The effective orifice area index was calculated for each patient on the basis of the projected prosthesis in vivo effective orifice area. It was considered a continuous variable and influence of its entire range of values on the extent of left ventricular mass regression was analyzed in a multivariate prediction model. RESULTS: Even though, in the group with prosthesis-patient mismatch there was a trend for lower postoperative left ventricular mass index (115+/-24 g/m(2) vs 102+/-27 g/m(2), p=0.24) and postoperative peak trans-prosthetic gradients (32+/-9.8 mmHg vs 28.9+/-7.79 mmHg, p=0.35) these differences were not statistically significant. The prevalence of residual left ventricular hypertrophy at follow-up was 50% in the group with patient-prosthesis mismatch and 50% in the group without patient-prosthesis mismatch (p=0.83). In multivariate analysis the only factors associated with indexed left ventricular mass were the follow-up time (p=0.015, r(2) =0.22) and preoperative indexed left ventricular mass (p=0.0012, r(2)=0.11). CONCLUSIONS: The major finding of our study is that patient-prosthesis mismatch does not affect left ventricular mass regression in patients older than 65 with pure aortic stenosis who underwent mechanical aortic valve replacement. In older patients with low cardiac output requirements, even a small change in the valve effective orifice area after aortic valve replacement with modern efficient mechanical prosthesis, will result in a marked reduction of pressure gradient and this will be associated with a significant regression of left ventricular mass.

“ …… there are a variety of excellent durable prosthetic and bioprosthetic valves……. In most situations satisfactory valve – patient match is obtainable.”

L.H. Cohn 1999

“ …….Outcomes with "new" good valves are similar to that with "older" good valves.”

Rahimtoola SH, J Am Coll Cardiol. 2003 Mar

Conclusions

- Prosthesis-patient mismatch is
  - ✓ a real clinical syndrome;
  - ✓ uncommon with modern prostheses and surgical techniques.

- Identification of patients at risk for prosthesis-patient mismatch before valve implantation:
  - ✓ Preoperative measurement of patient size and
  - ✓ Intraoperative sizing of the aortic root

Conclusions

- Ross procedure – by only a few well-trained surgeons
- Aortic homograft – use has plateaued
- Natural valve substitute: (stentless heterograft, cryopreserved aortic allograft, pulmonary autograft) – makes ARE an antiquated procedure
- In the unusual circumstance -
  - ✓ additional surgical techniques may be employed to optimize outcome.

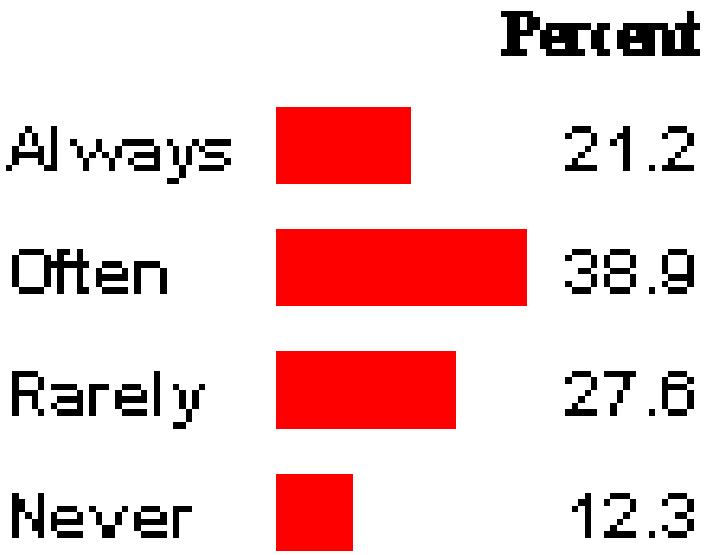
We must tailor the operation to the patient and not the patient to the operation.

Source: D. A. Cooly



POLL RESULTS

Does aortic valve size make a difference in early and late outcome?



Total # of votes = 820 as of January 12, 2005. This is not a scientific survey.

Thank you !





Do you have any questions?