

# Early Surgery in Asymptomatic Severe Aortic Stenosis

## *Pros and Cons*

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# Background

**Dilemma of balancing the risks versus benefits of AV replacement in asymptomatic severe AS**

## Risks

- Operative mortality
- Prosthesis-related mortality and morbidity

## Benefits

- Preventing sudden death
- Lowering cardiac mortality related with refusal and delay of surgery

# Background

## Surgery for asymptomatic severe AS

### ESC guidelines

- **LVEF < 50%**
- **Abnormal exercise test**
- **AV calcification with rapid progression**

### ACC/AHA guidelines

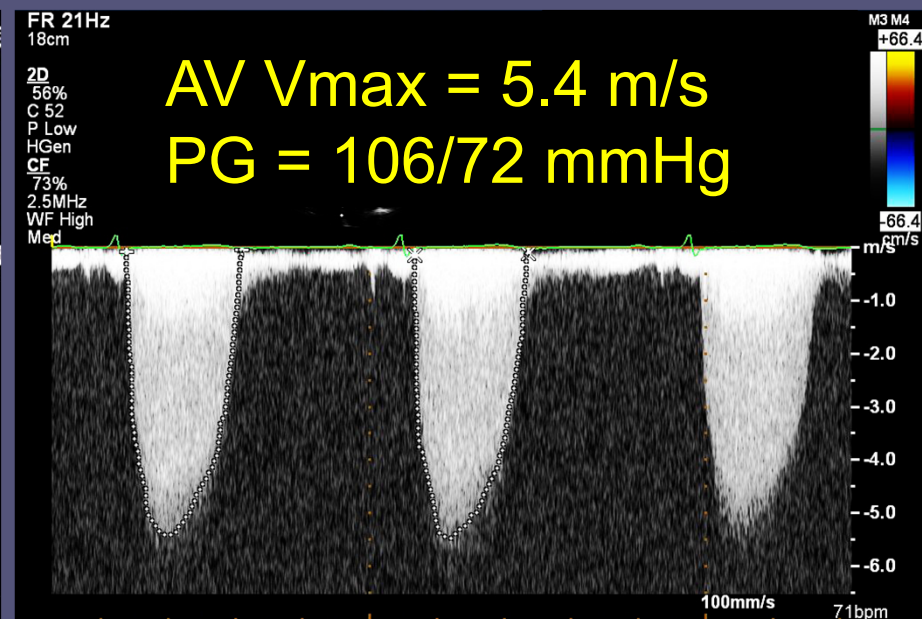
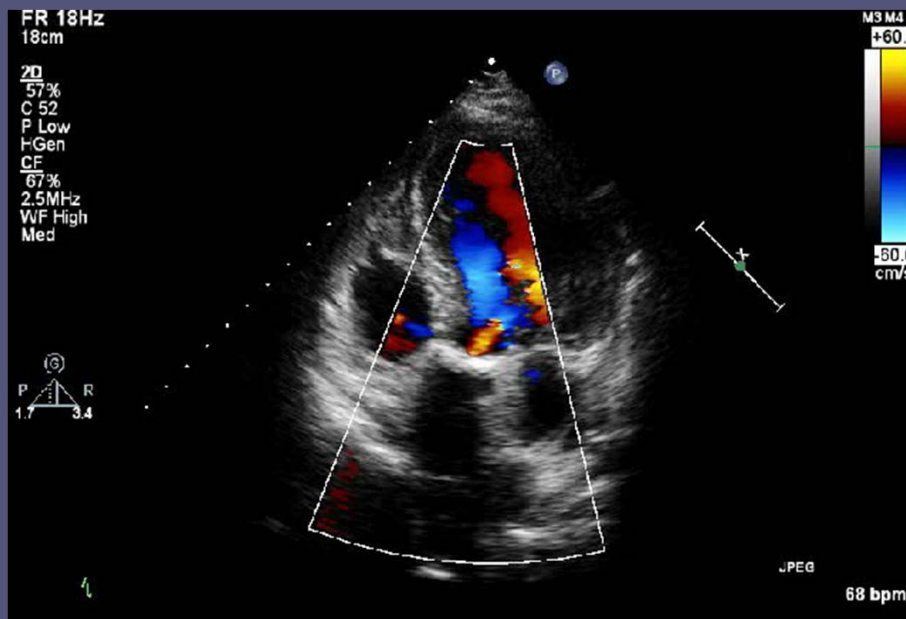
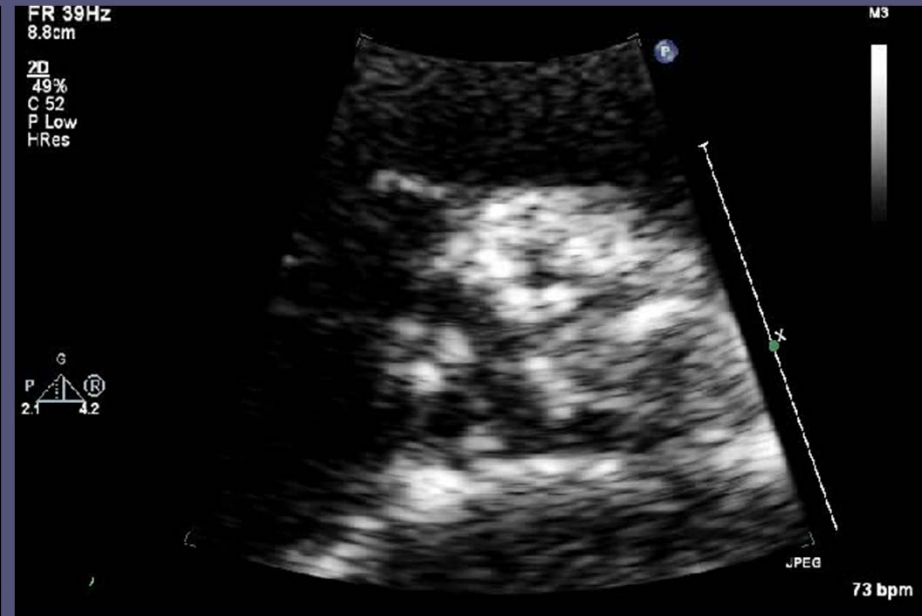
#### **Class I indication**

- LVEF < 50%

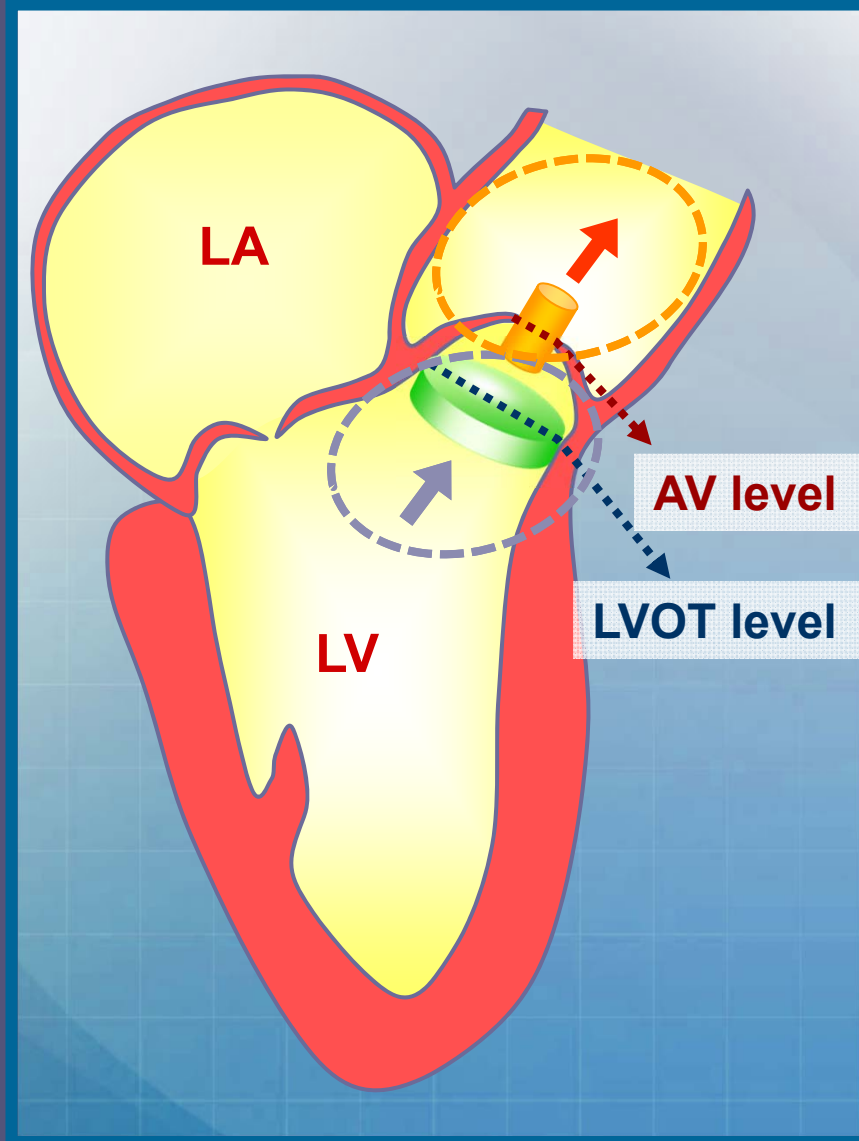
#### **Class IIb indication**

- Abnormal exercise test
- Rapid progression
- Extremely severe AS with operative mortality  $\leq 1\%$

# Case: 72 yr-old female with asymptomatic severe AS



# Continuity Equation for AV Area

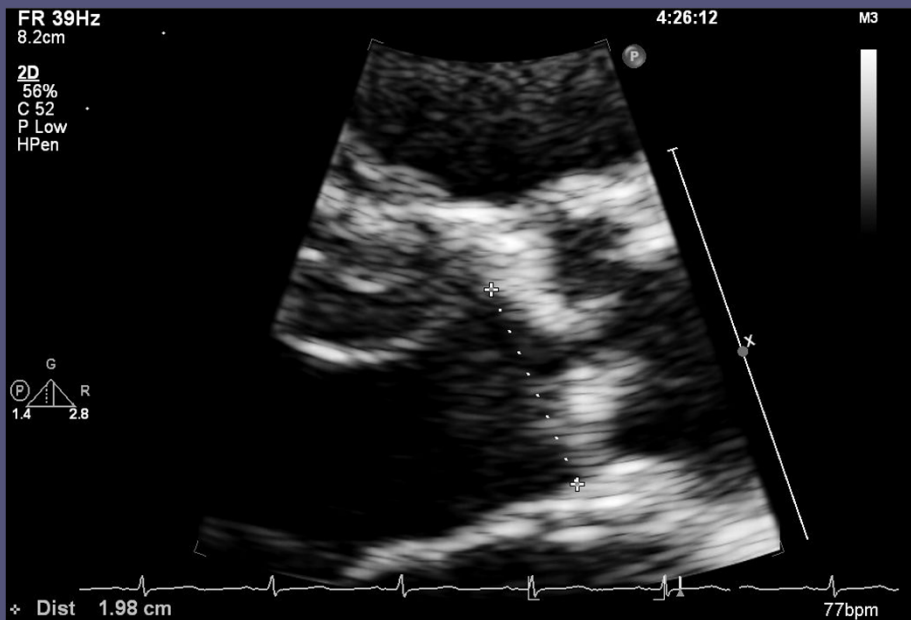


LVOT flow = AV flow

$$A_{LVOT} \times TVI_{LVOT} = A_{AV} \times TVI_{AV}$$

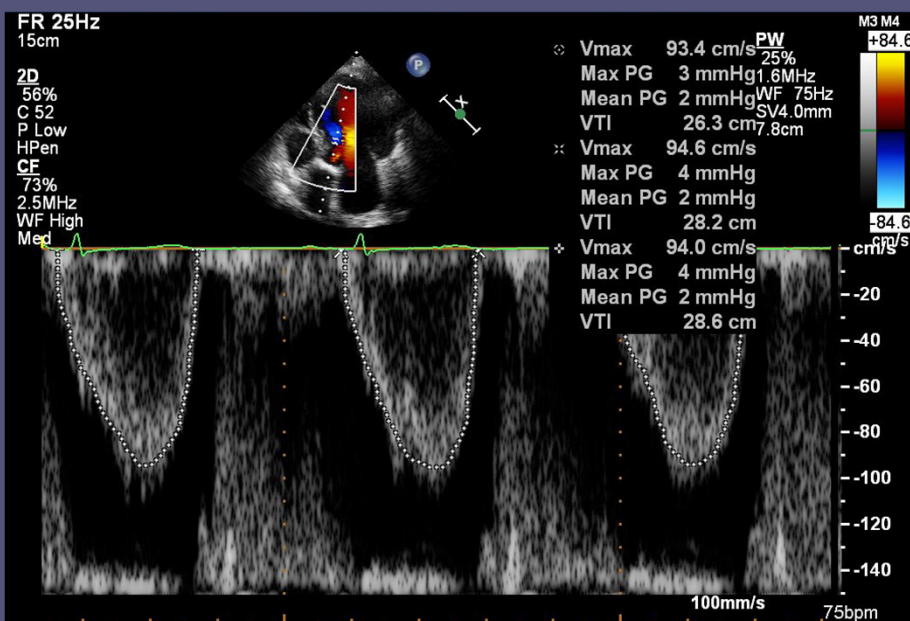
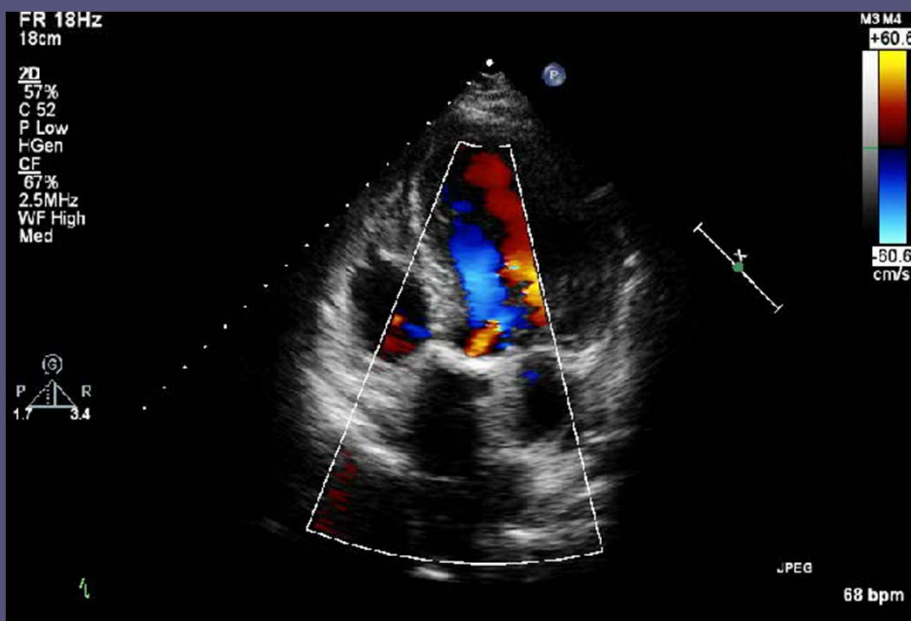
$$A_{AV} = \frac{A_{LVOT} \times TVI_{LVOT}}{TVI_{AV}}$$

**LVOT diameter = 2.01 cm**



$$\begin{aligned}
 \text{AVA} &= \frac{0.785 \times (\text{LVOT})^2 \times \text{LVOT TVI}}{\text{AV TVI}} \\
 &= \frac{0.785 \times (2.01)^2 \times 28}{138} \\
 &= 0.64 \text{ cm}^2
 \end{aligned}$$

**LVOT TVI = 28cm**



**Early Surgery**

**Vs.**

**Watchful Waiting**

# **Comparison of Early Surgery versus Conventional Treatment in Asymptomatic Very Severe Aortic Stenosis**

**Duk-Hyun Kang, Sung-Ji Park\*, Ji Hye Rim,  
Dae-Hee Kim, Jong-Min Song, Kee-Joon Choi,  
Seung Woo Park\*, Jae-Kwan Song,  
Jae-Won Lee, Pyo-Won Park\***

**Division of Cardiology, Cardiac Surgery  
Asan Medical Center, Samsung Medical Center\*  
Seoul, South Korea**



# Background

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- **The more severe AS, the worse the clinical outcomes**
- **Asymptomatic patients with very severe AS are often referred for AV surgery**
- **Recent improvements in surgical techniques and AV prosthesis**

# Methods

From 1996 to 2006

**197 consecutive patients  
with asymptomatic  
very severe AS**

**Conventional Tx  
CONV (N=95)**

**Early surgery  
OP (N=102)**

Follow-up of  $59 \pm 33$  months

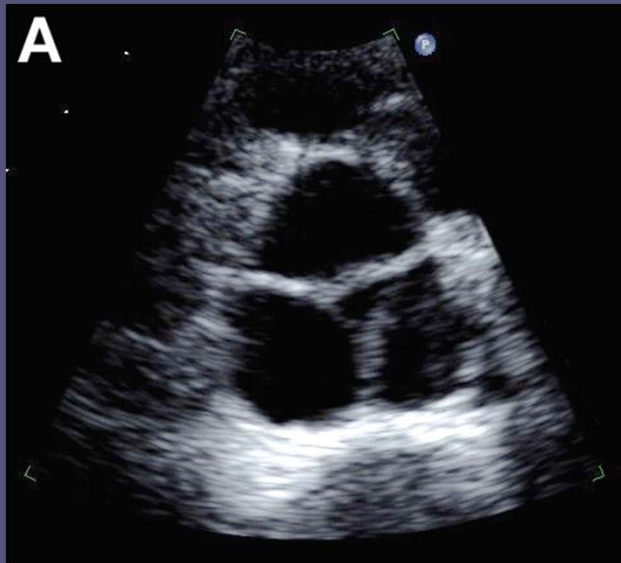
# Echocardiographic Evaluation

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- Etiology of AS and grading of AV calcification on 2D echo
- Maximal aortic jet velocity, mean pressure gradients and aortic valve area on Doppler
- Very severe aortic stenosis

AV area  $\leq 0.75$  cm<sup>2</sup> fulfilling one of criteria;  
peak aortic velocity  $\geq 4.5$  m/sec or mean  
pressure gradient  $\geq 50$  mmHg

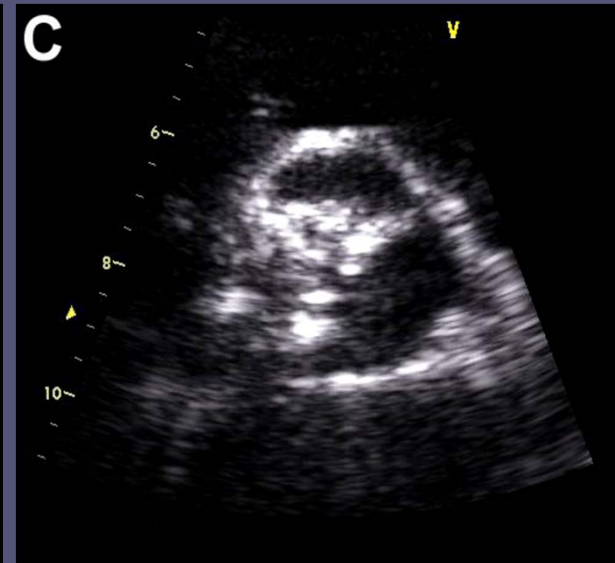
# Echocardiographic Evaluation



**Rheumatic AS**  
**Mild**  
**Calcification**

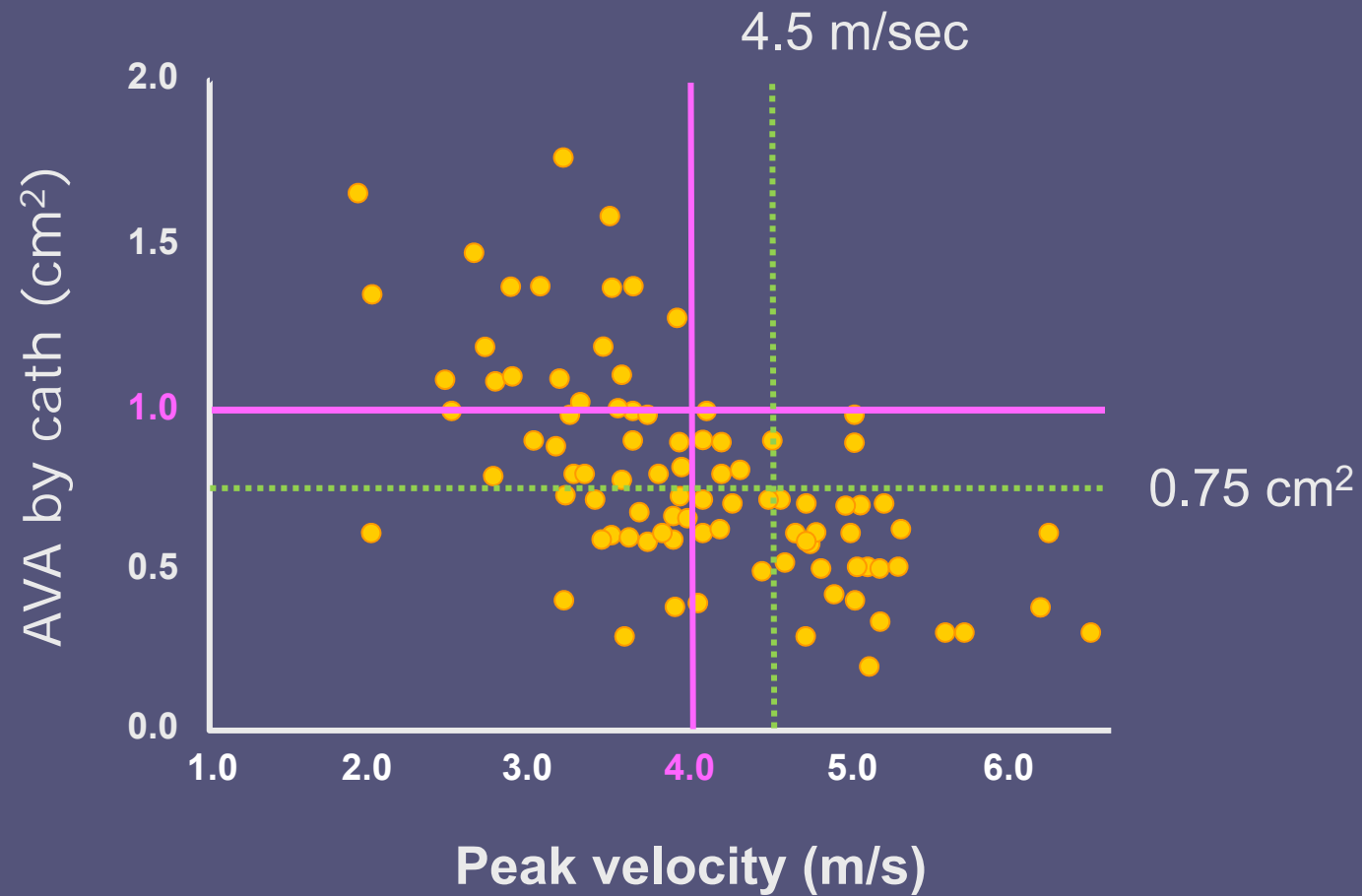


**Bicuspid AV**  
**Moderate**  
**Calcification**



**Degenerative AS**  
**Severe**  
**Calcification**

# AV area and Peak velocity



# Methods

From 1996 to 2006

**197 consecutive patients  
with asymptomatic  
very severe AS**

**Conventional Tx  
CONV (N=95)**

**Early surgery  
OP (N=102)**

Follow-up of  $59 \pm 33$  months

# Baseline Characteristics (I)

Variables	CONV (n=95)	OP (n=102)	P-value
Age, years	63 ± 12	63 ± 11	NS
Gender, male	44 (46%)	55 (54%)	NS
EuroSCORE,	3.6 ± 1.9	3.9 ± 1.7	NS
LV mass index, g/m <sup>2</sup>	159 ± 52	158 ± 43	NS
Ejection fraction, %	63 ± 7	62 ± 7	NS
AV calcification ≥ moderate	85 (90%)	95 (93%)	NS

# Baseline Characteristics (II)

Variables	CONV (n=95)	OP (n=102)	p-value
Etiology of AS			0.08
Degenerative	45 (47%)	33 (32%)	
Bicuspid	39 (41%)	57 (56%)	
Rheumatic	11 (12%)	12 (12%)	
Aortic valve area, cm <sup>2</sup>	0.62 ± 0.09	0.61 ± 0.10	0.46
<b>Aortic jet velocity, m/s</b>	<b>4.9 ± 0.4</b>	<b>5.1 ± 0.5</b>	<b>&lt;0.001</b>
<b>Mean gradient, mmHg</b>	<b>59 ± 12</b>	<b>65 ± 13</b>	<b>0.001</b>

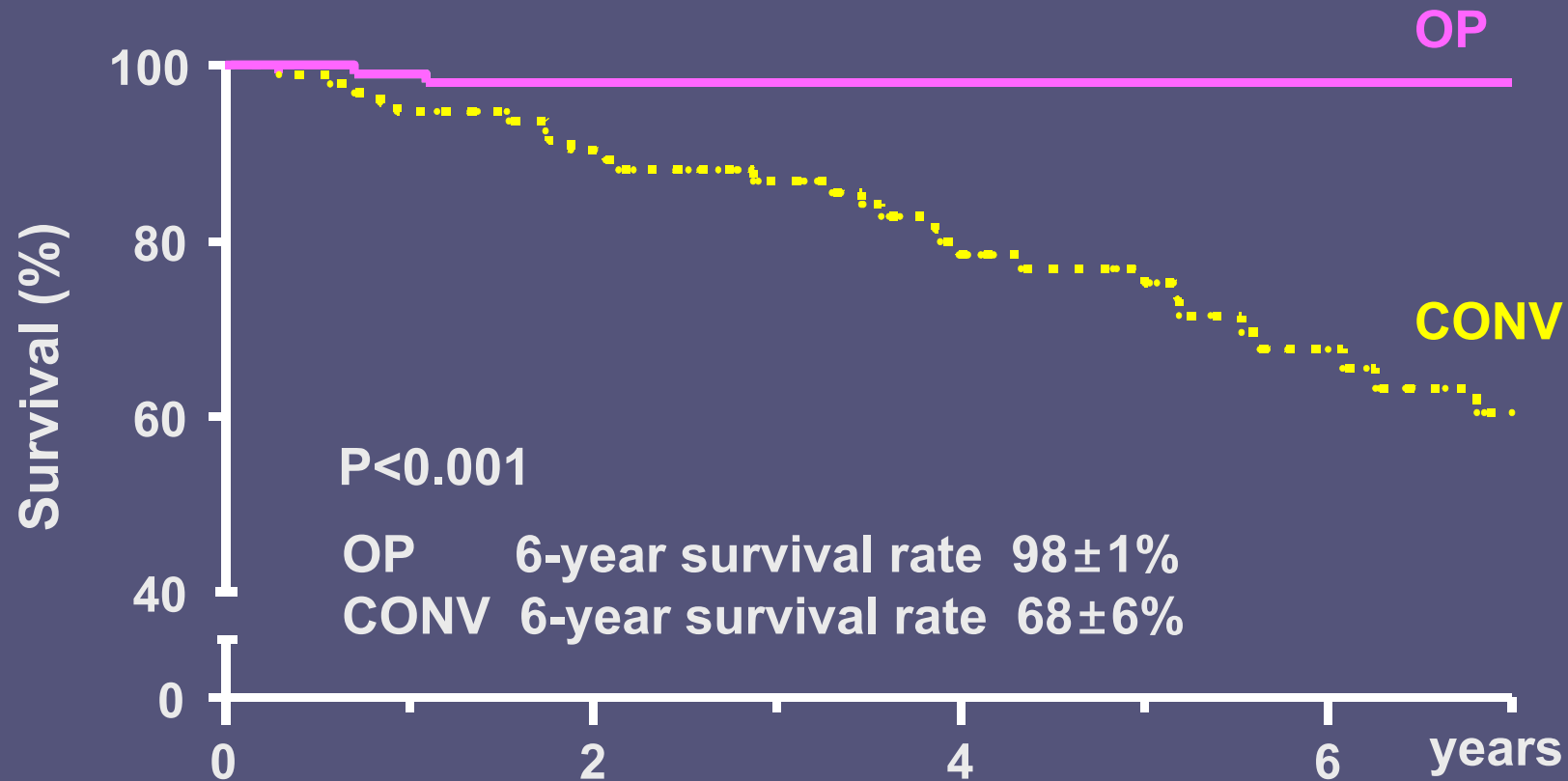


# Results

Variables	CONV (n=95)	OP (n=102)	p-value
All-cause death	28 (29 %)	3 (3 %)	<0.001
6-yr survival rate	68 ± 6 %	98 ± 1 %	<0.001
Cardiac death	18 (19 %)	0 (0 %)	<0.001
6-yr cardiac death rate	24 ± 5 %	0 %	<0.001

# Survival Rate

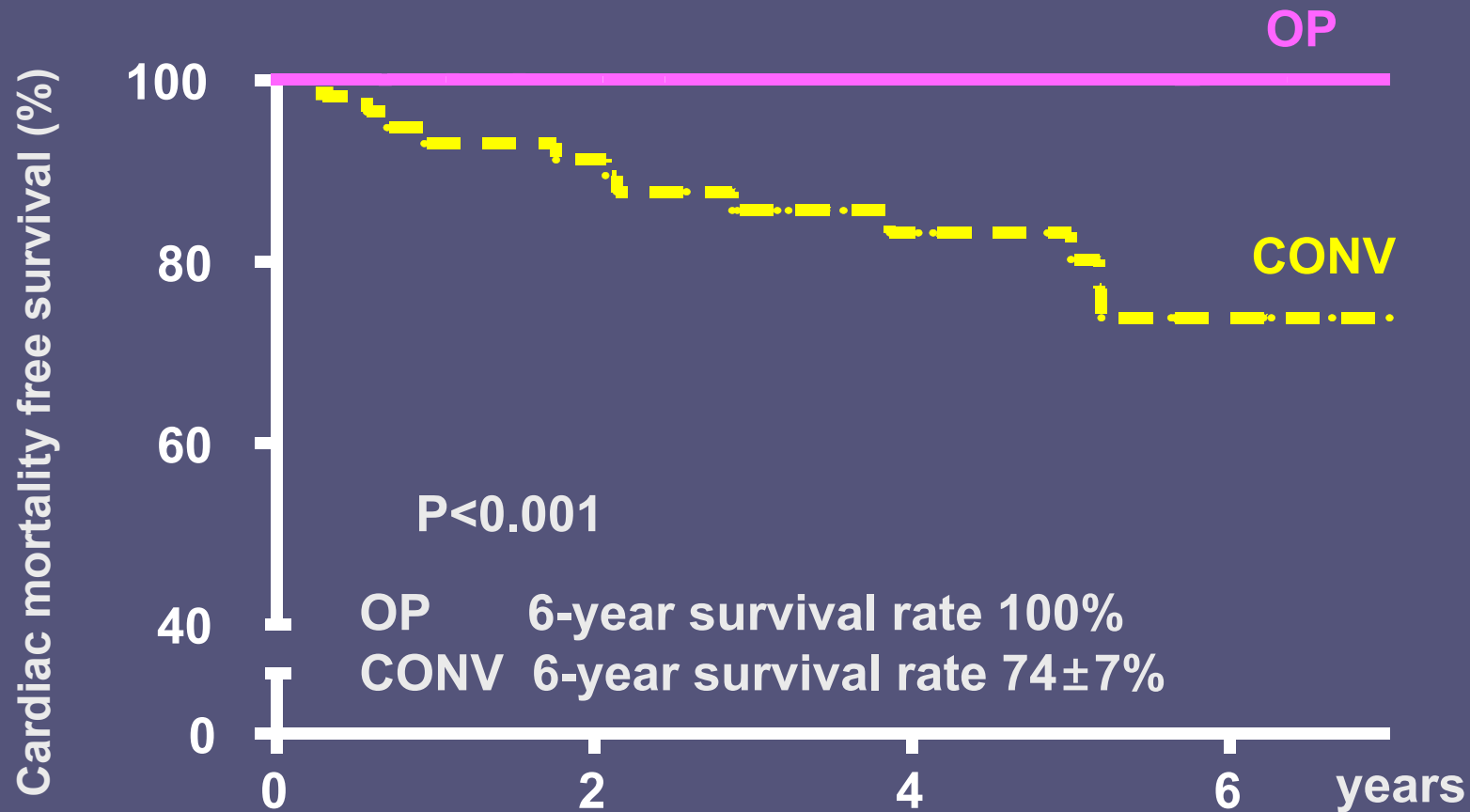
## OP versus CONV group



No at Risk

OP	102	96	48	29
CONV	95	82	54	32

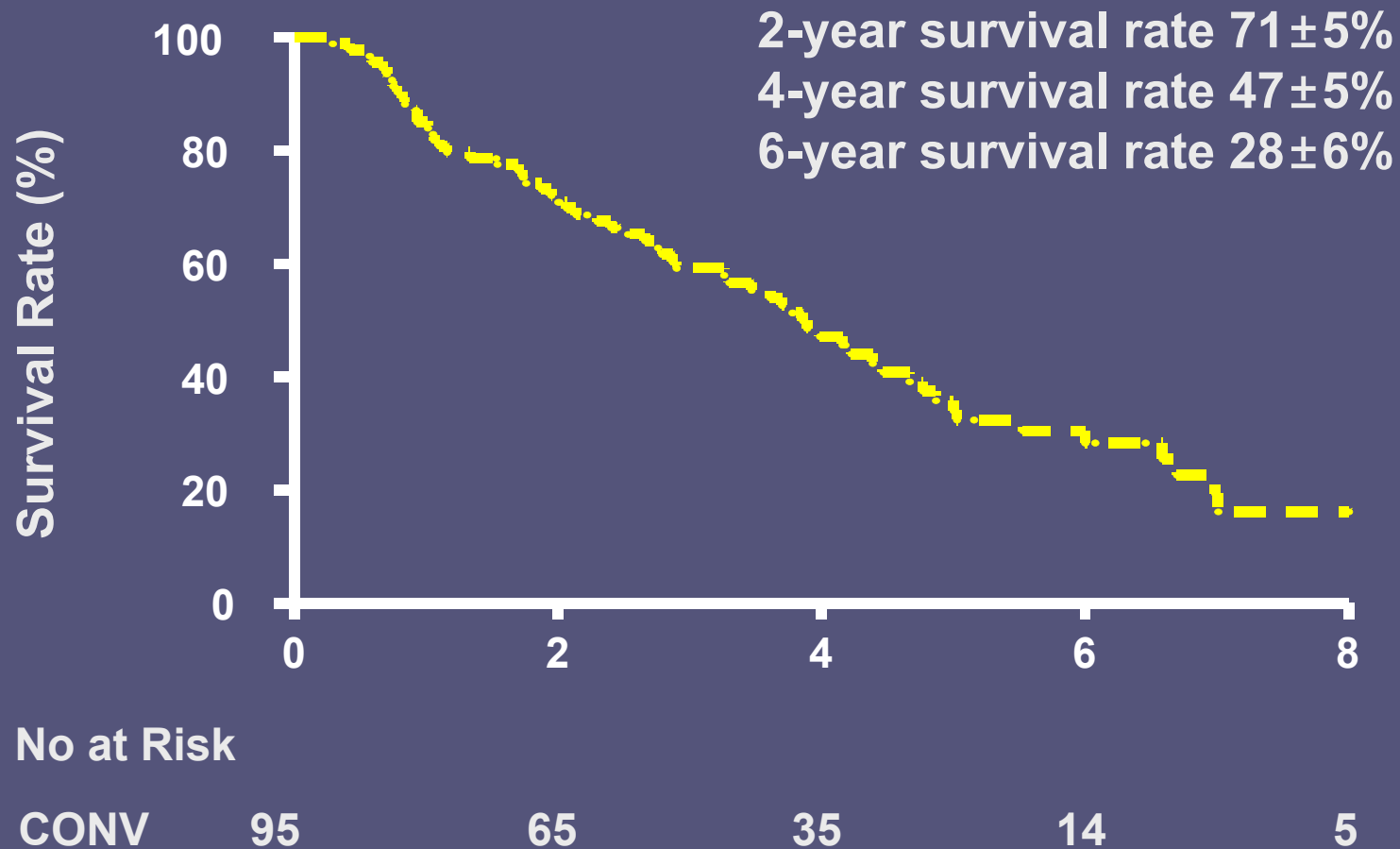
# Survival Free of Cardiac Death in the Propensity-matched Pairs



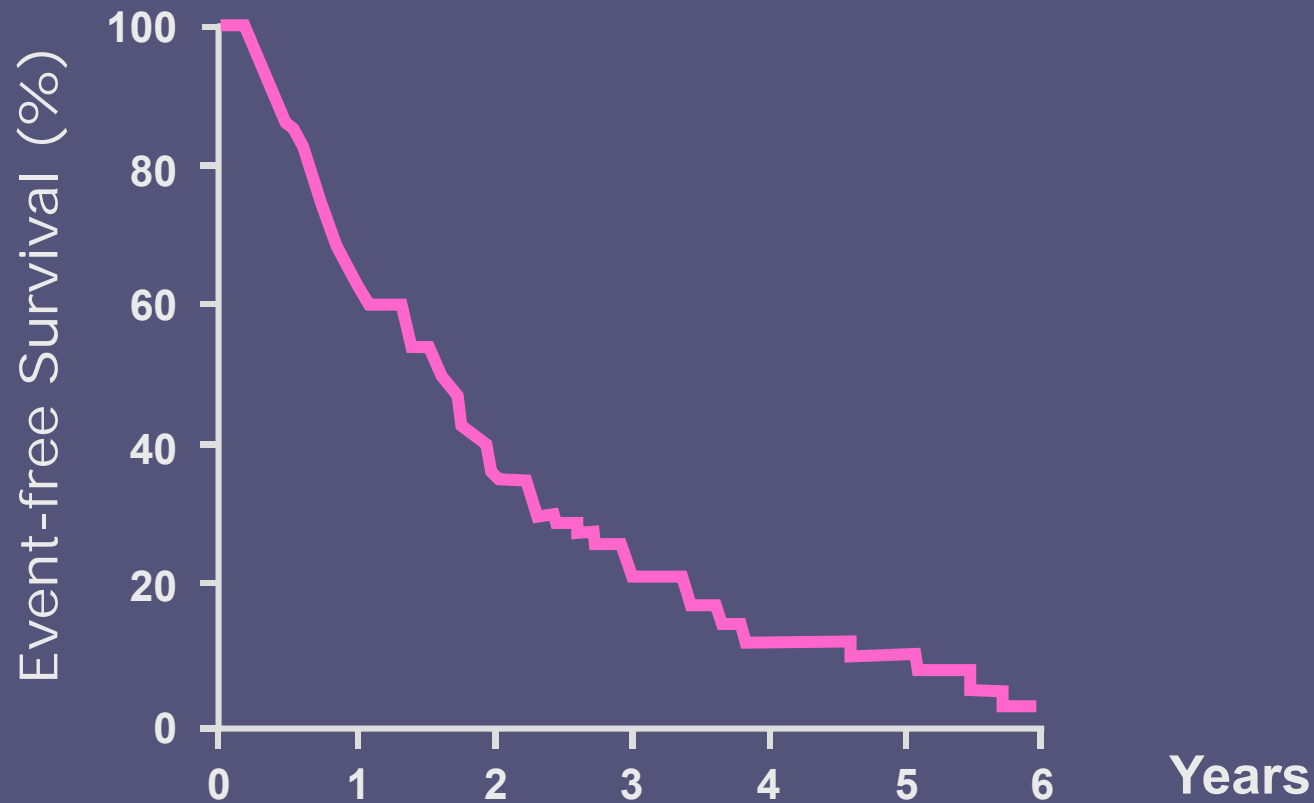
No at Risk

OP	57	54	23	13
CONV	57	53	34	17

# Survival Rate Free of Cardiac Death or Surgery in the CONV group



# Event-free Survival in Very Severe AS With Aortic Jet Velocity > 5 m/s

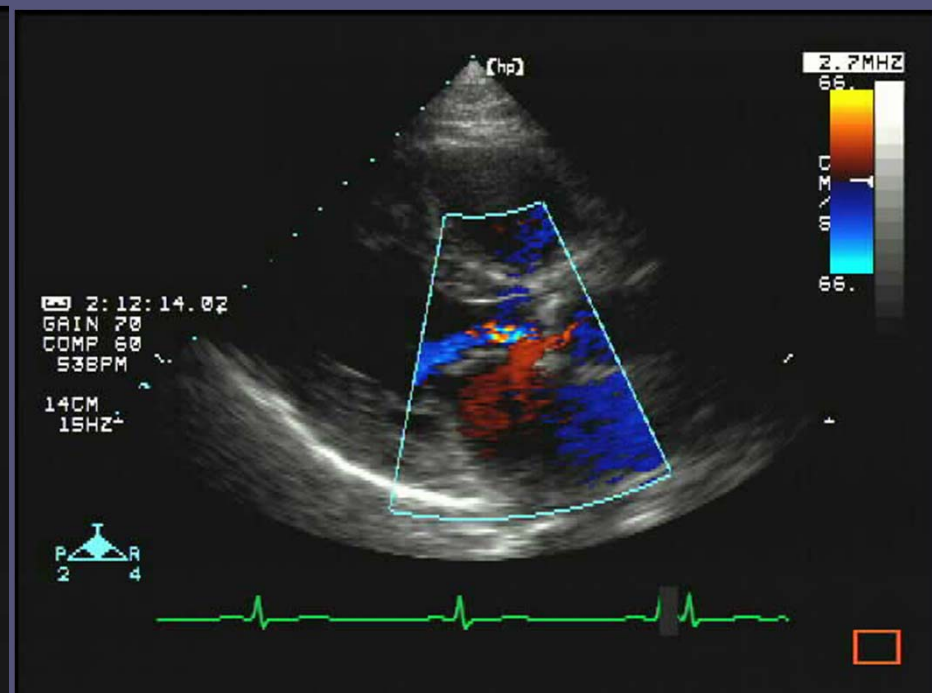
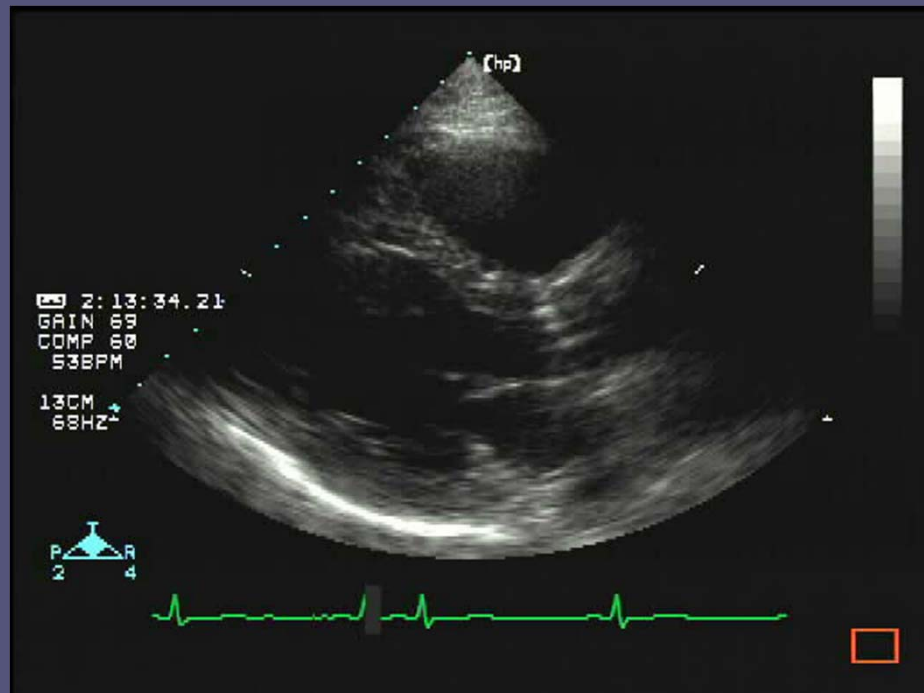


Pts at risk 116 73 40 23 9 6 2

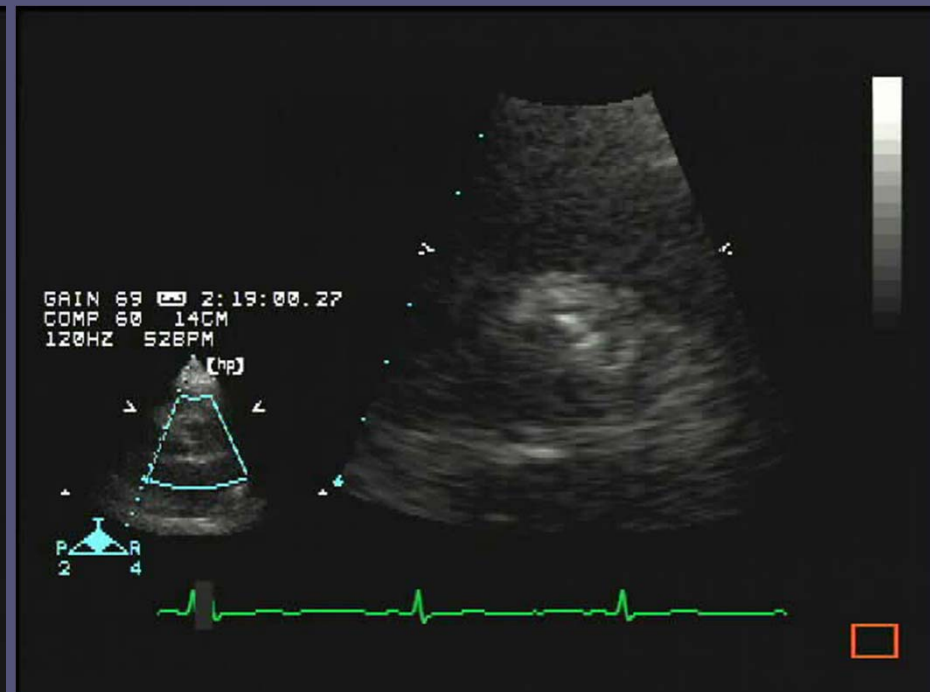
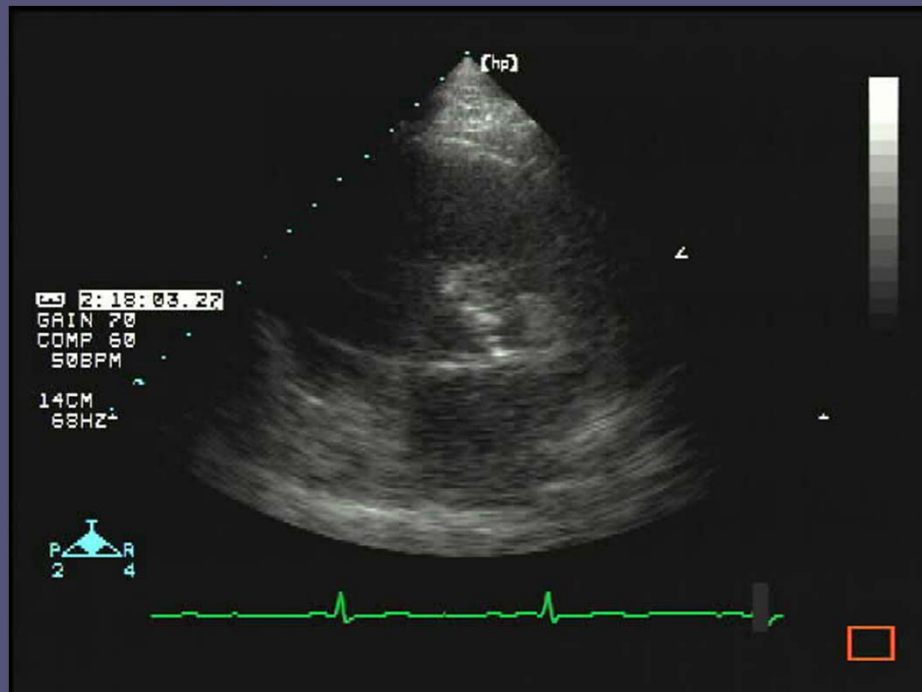
# Conclusions

- Early surgery is associated with improved long-term survival by decreasing cardiac mortality and sudden cardiac death in very severe AS
- Early surgery is a therapeutic option to further improve clinical outcomes in asymptomatic patients with very severe AS and low operative risk

# CASE; Degenerative AS

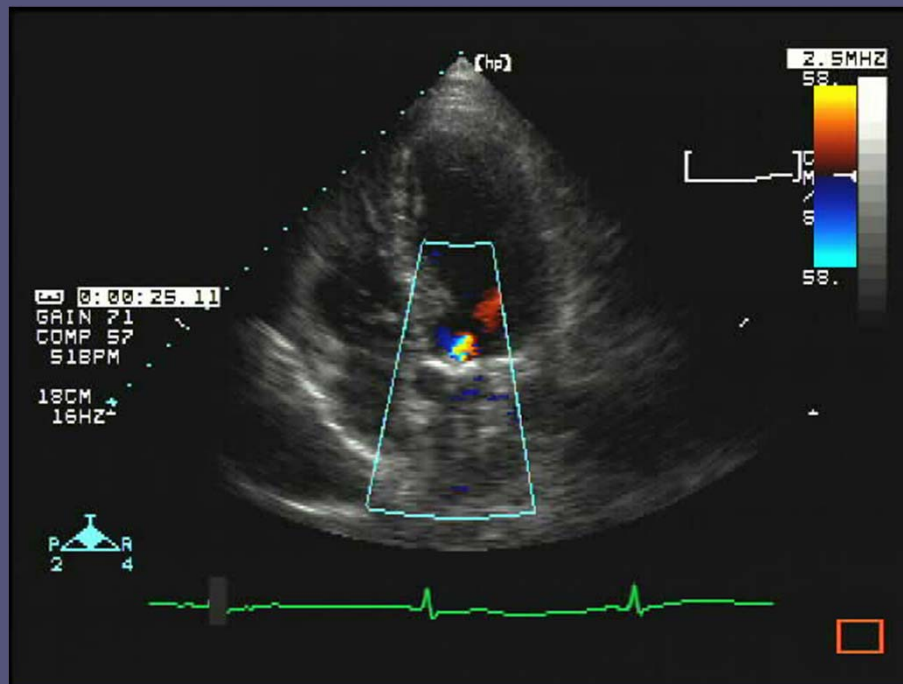


# CASE; Degenerative AS

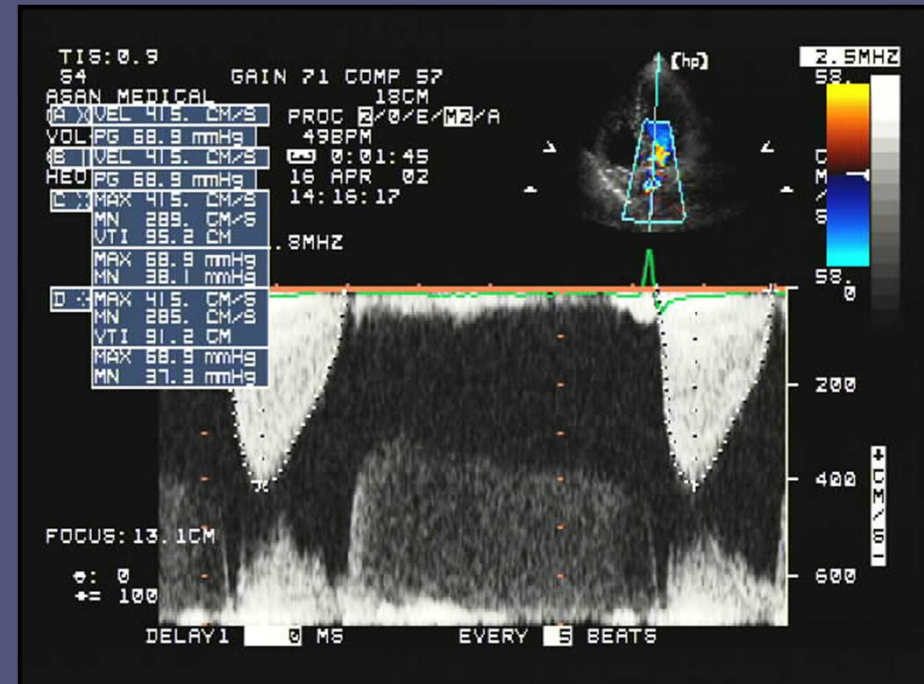




# CASE; Degenerative AS

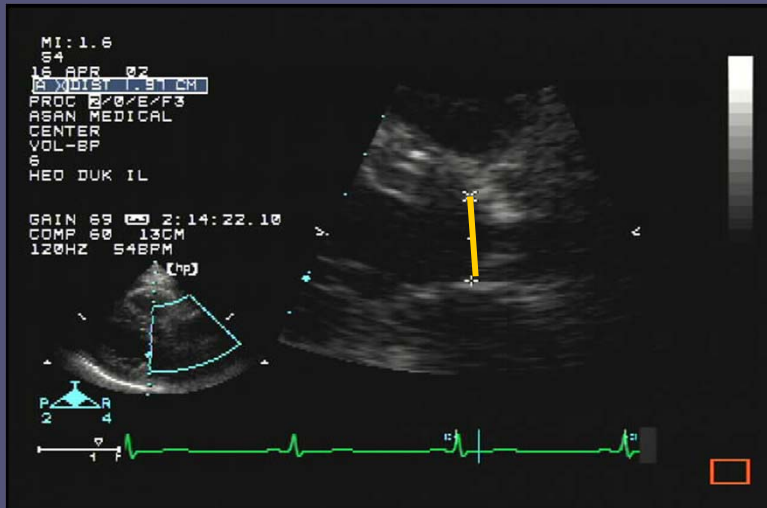


AV Vmax = 4.2m/sec

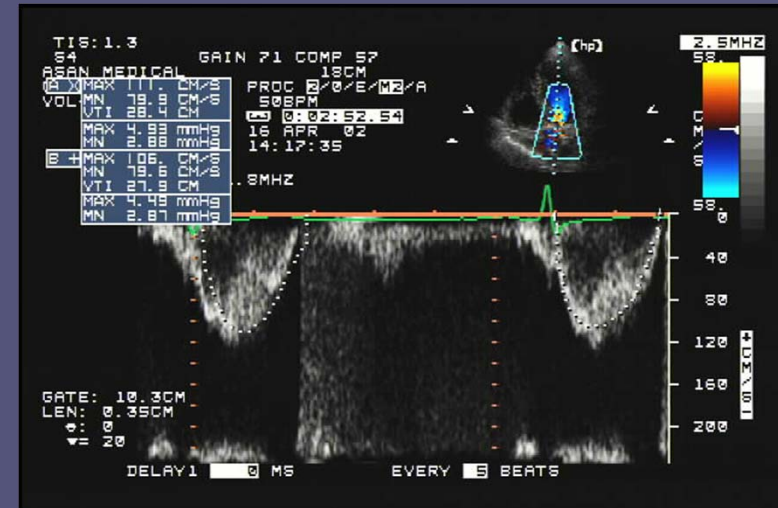


Mean PG = 38mmHg

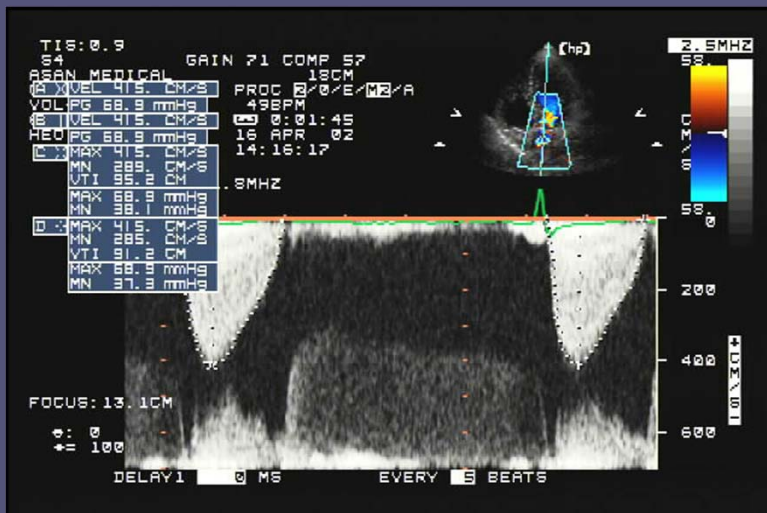
# Continuity Equation; Measurement of AVA



LVOT diameter 2.0cm



LVOT TVI 28cm



AoV TVI 91cm

$$\begin{aligned}
 \text{AVA} &= D^2 \times 0.785 \times \frac{\text{TVI}_{\text{LVOT}}}{\text{TVI}_{\text{AoV}}} \\
 &= (2.0)^2 \times 0.785 \times \frac{28}{91} \\
 &= 0.97
 \end{aligned}$$

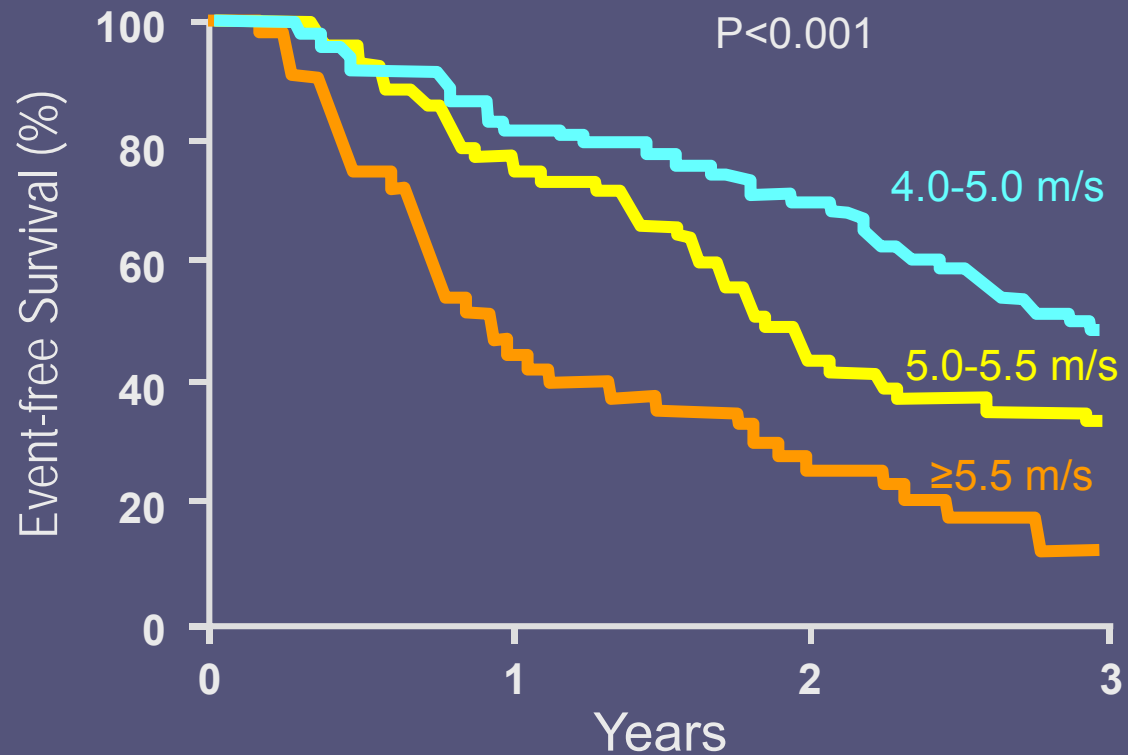
**AVA = 0.97cm<sup>2</sup>**

**Early Surgery**

**Vs.**

**Watchful Waiting**

# Event-Free Survival Rate



## Pts. at risk

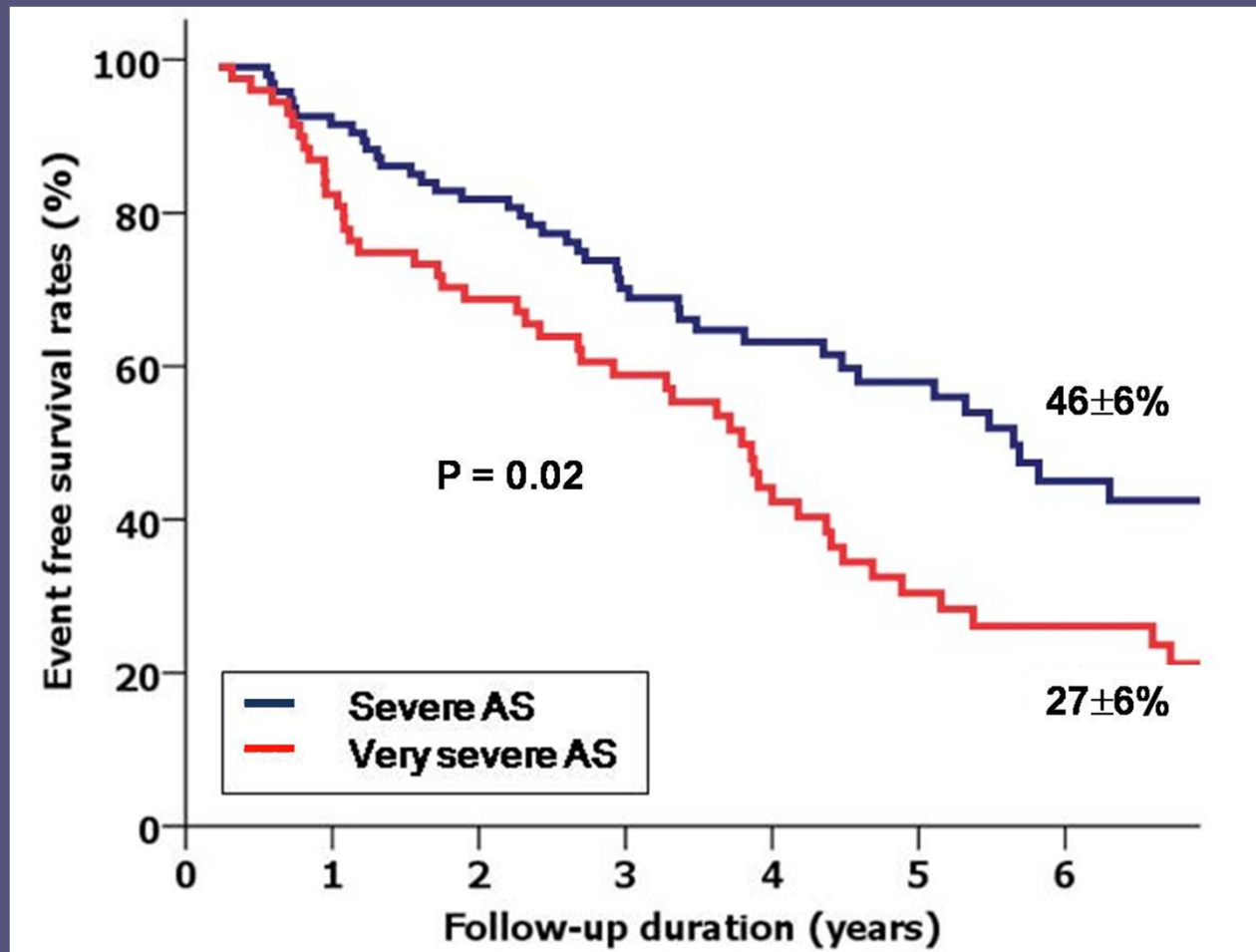
AV-Vel 4.0-5.0m/s	82	69	59	38
AV-Vel 5.0-5.5m/s	72	53	29	18
AV-Vel ≥ 5.5m/s	44	20	11	5

# **Comparison of Early Surgery Versus Conventional Treatment in Asymptomatic Severe Aortic Stenosis**

**Duk-Hyun Kang, Ji Hye Rim, Jong-Min Song,  
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Asan Medical Center, University of Ulsan  
Seoul, South Korea**

# Event-free Survival Severe vs Very Severe AS



# Methods

From 1997 to 2005

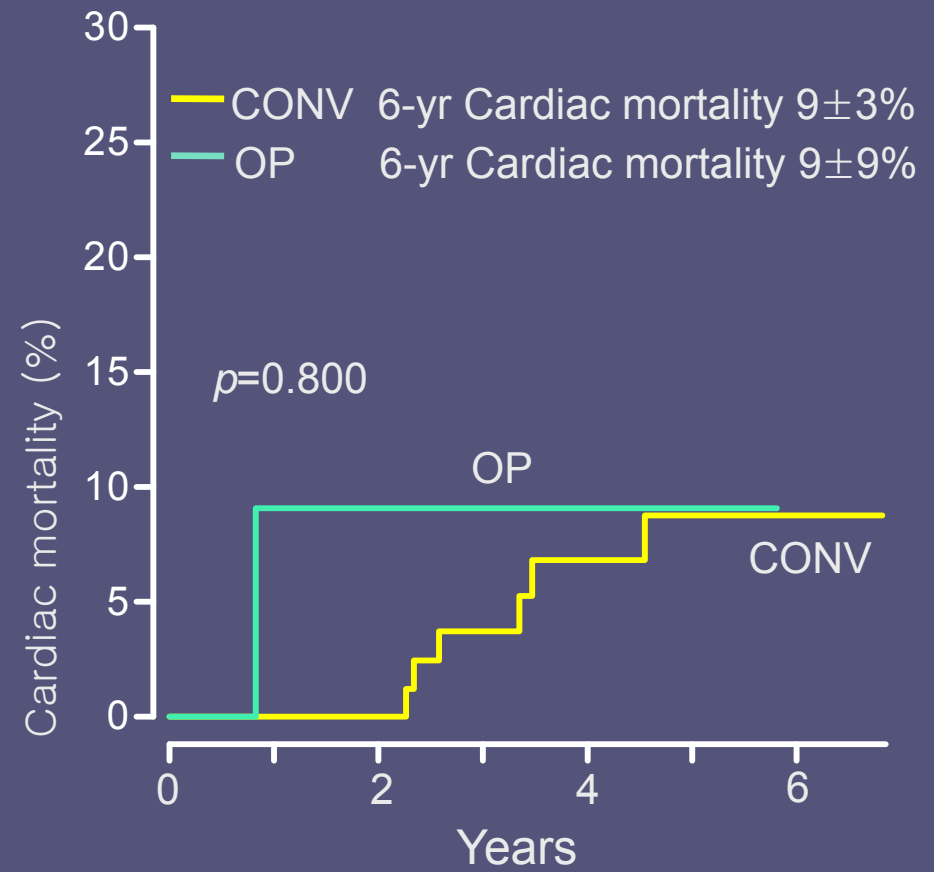
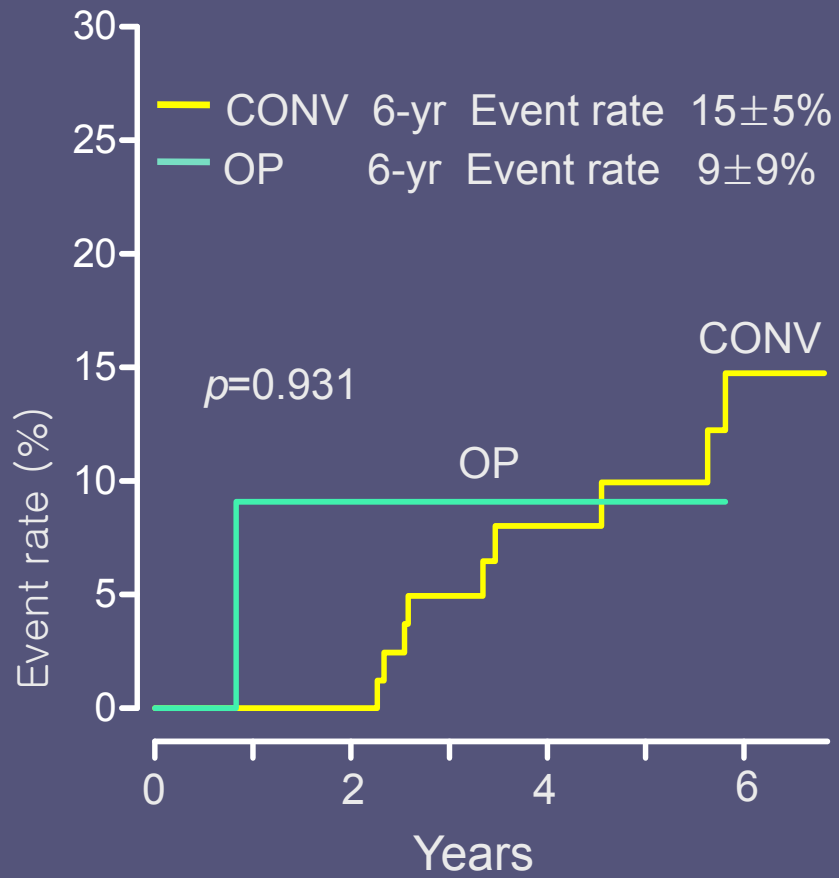
**224 consecutive patients with asymptomatic severe AS**

**Conventional Treatment  
CONV (N=157)**

**Early surgery  
OP (N=67)**

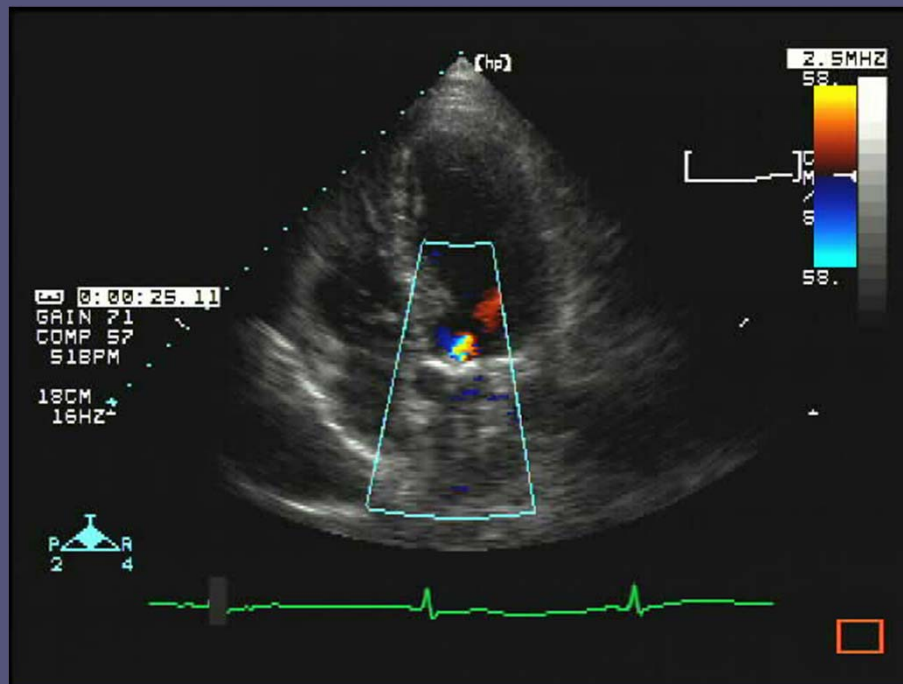
Median Follow-up of 62 months

# Cardiac Event and Mortality Rates in Severe AS

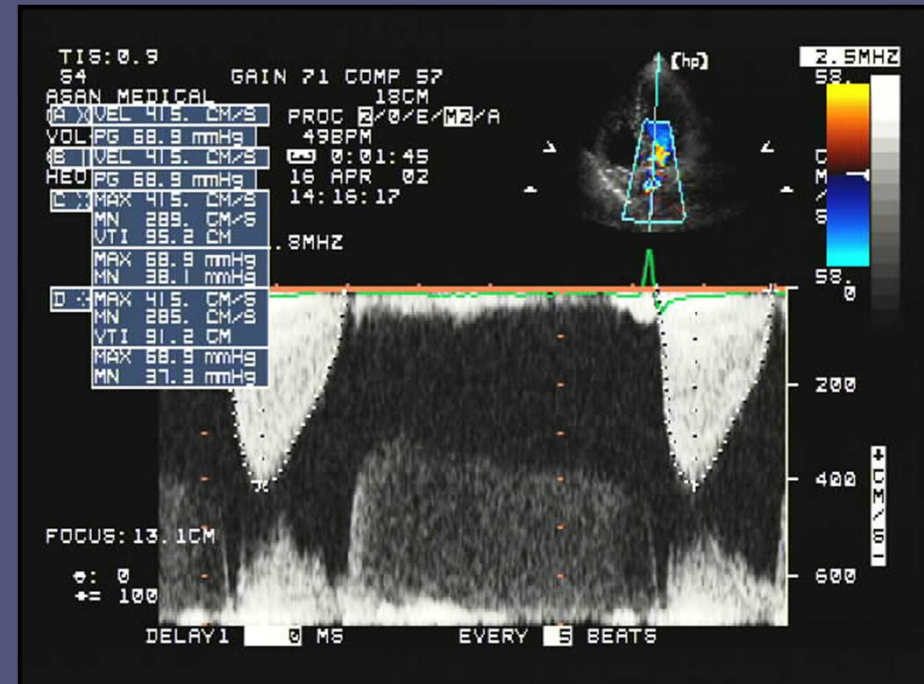




# CASE; Degenerative AS

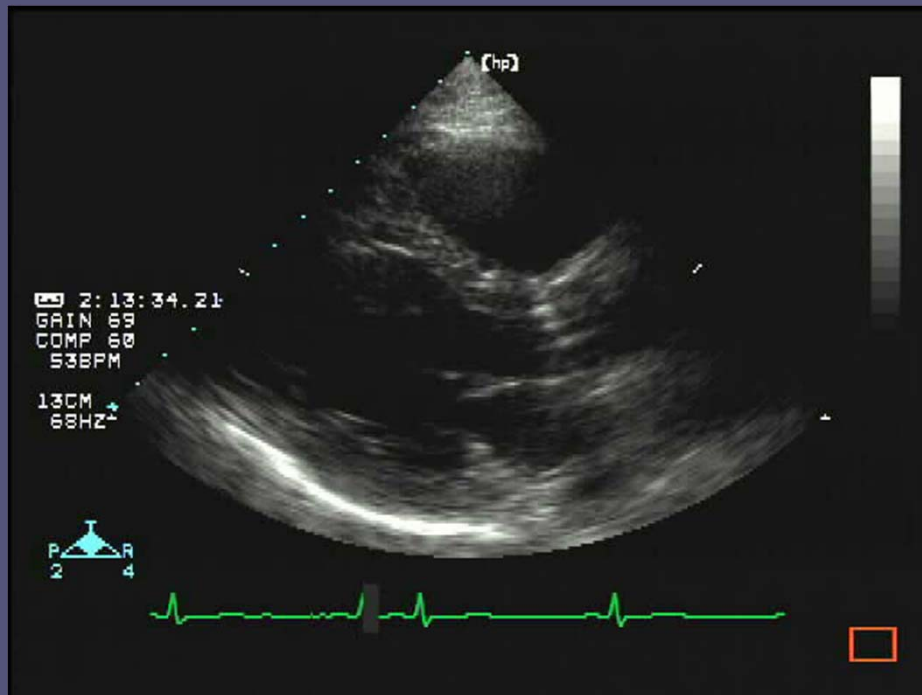


AV Vmax = 4.2m/sec

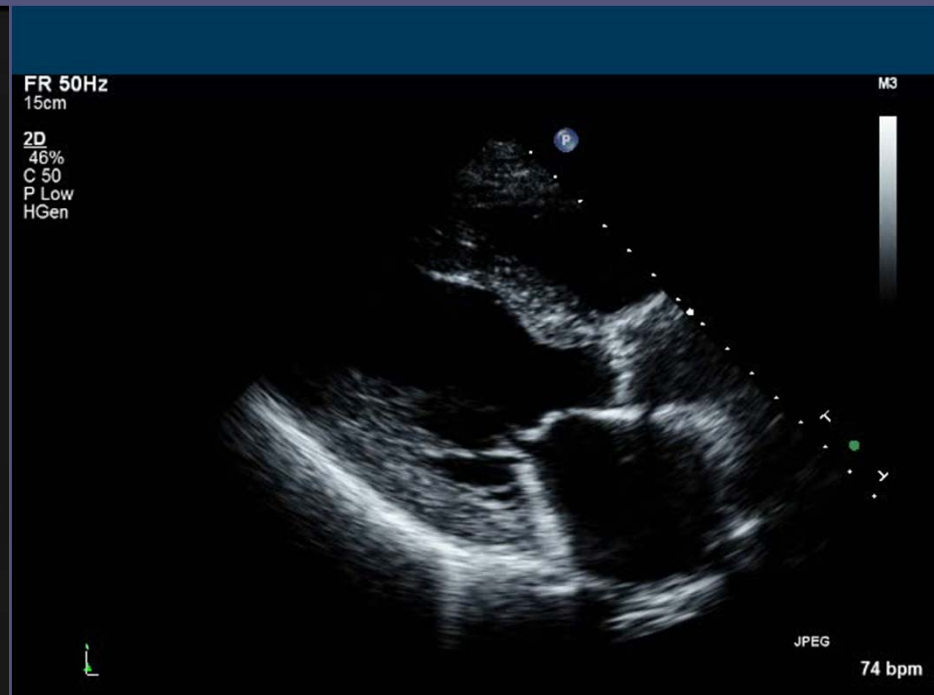


Mean PG = 38mmHg

# Progression of Calcification

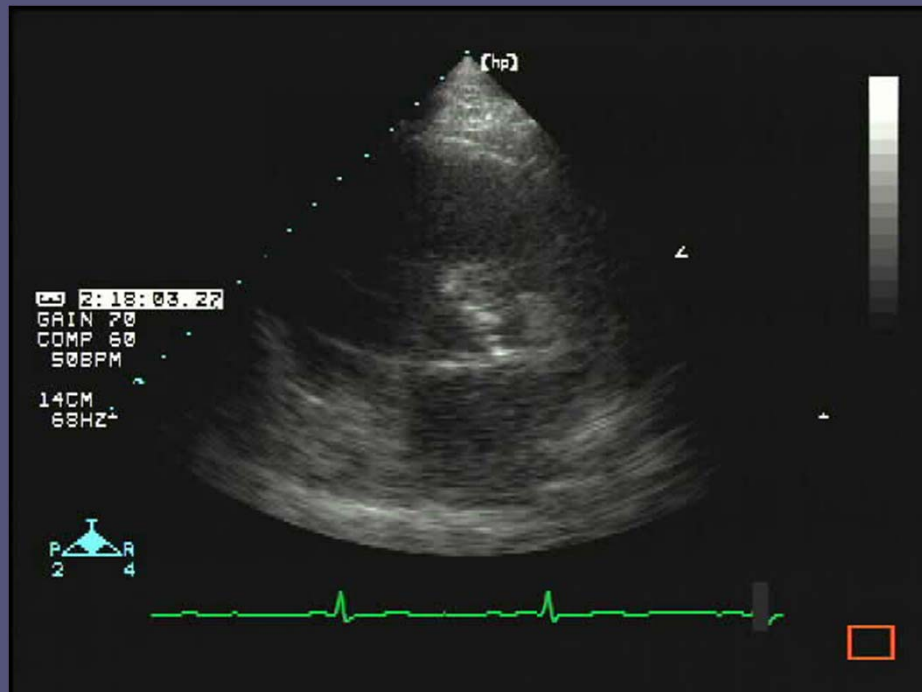


**Baseline**

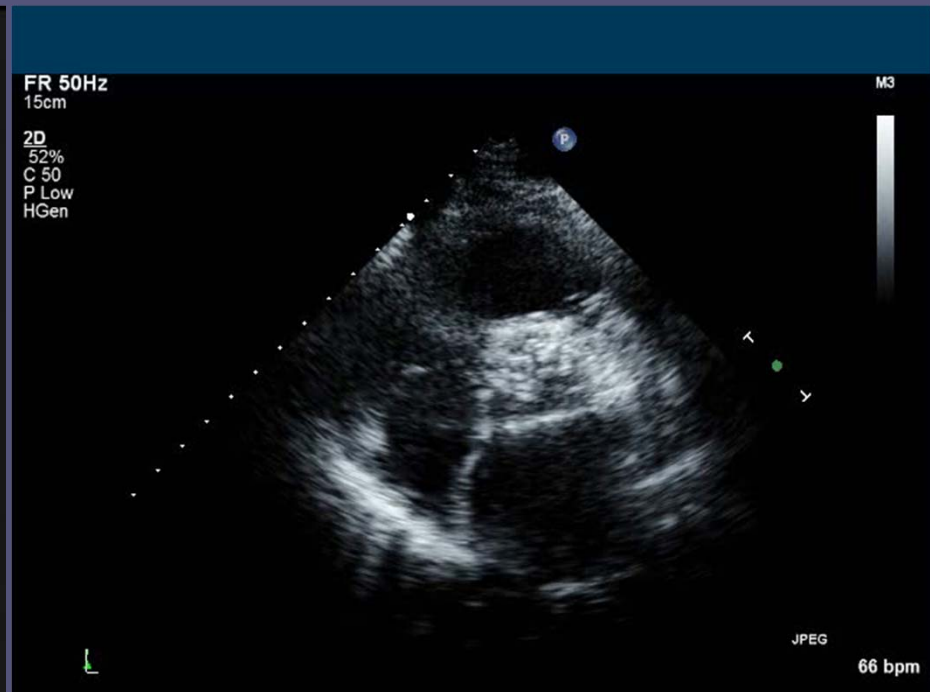


**3 Year**

# Progression of Calcification

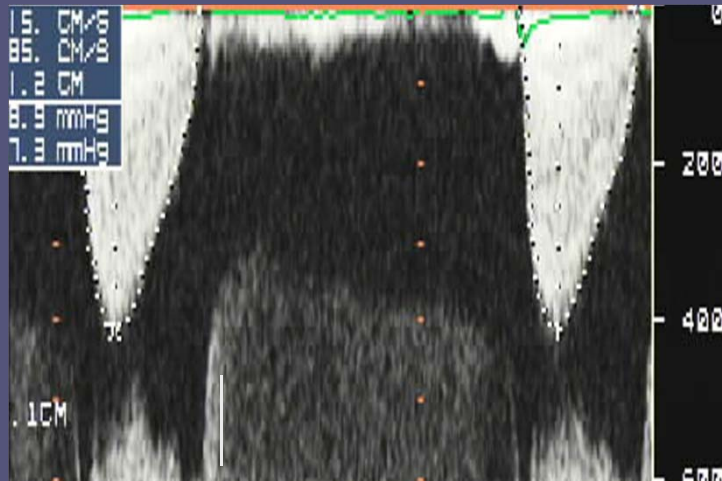


Baseline



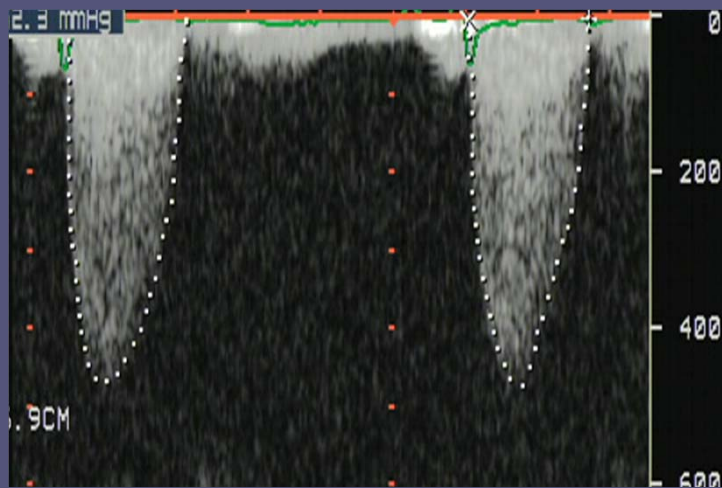
3 Year

## Baseline



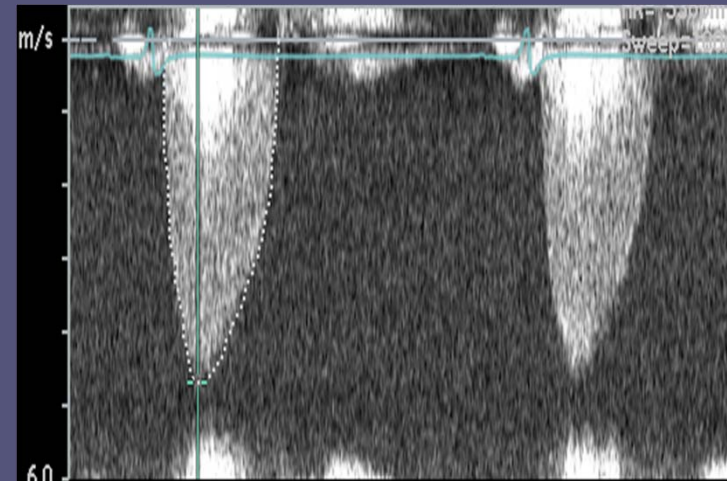
AV Vmax = 4.2m/sec  
Mean PG = 38mmHg

## 2yr



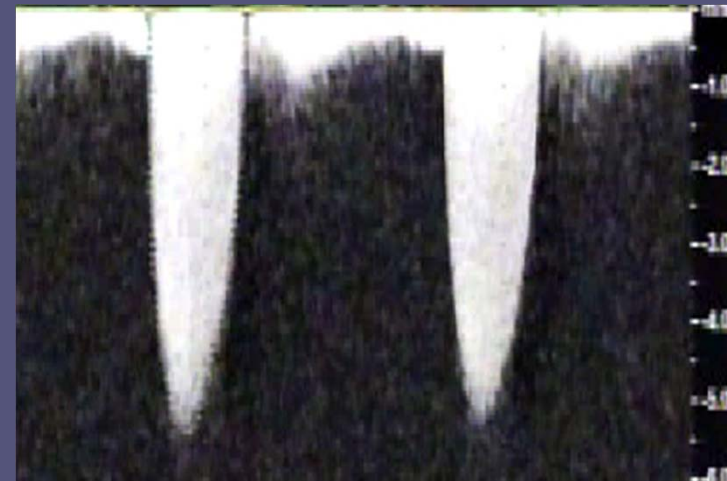
AV Vmax = 4.7m/sec  
Mean PG = 58mmHg

## 1yr



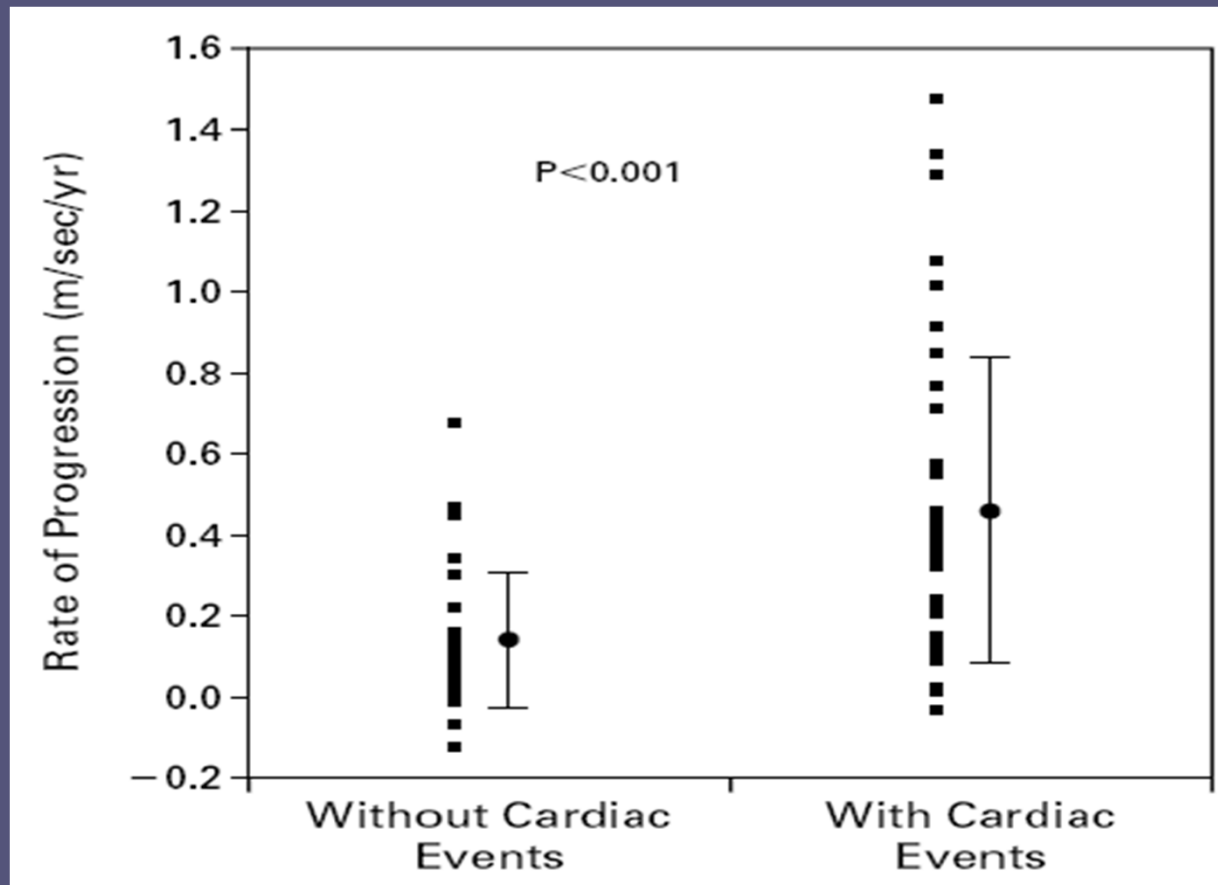
AV Vmax = 4.7m/sec  
Mean PG = 53mmHg

## 3yr

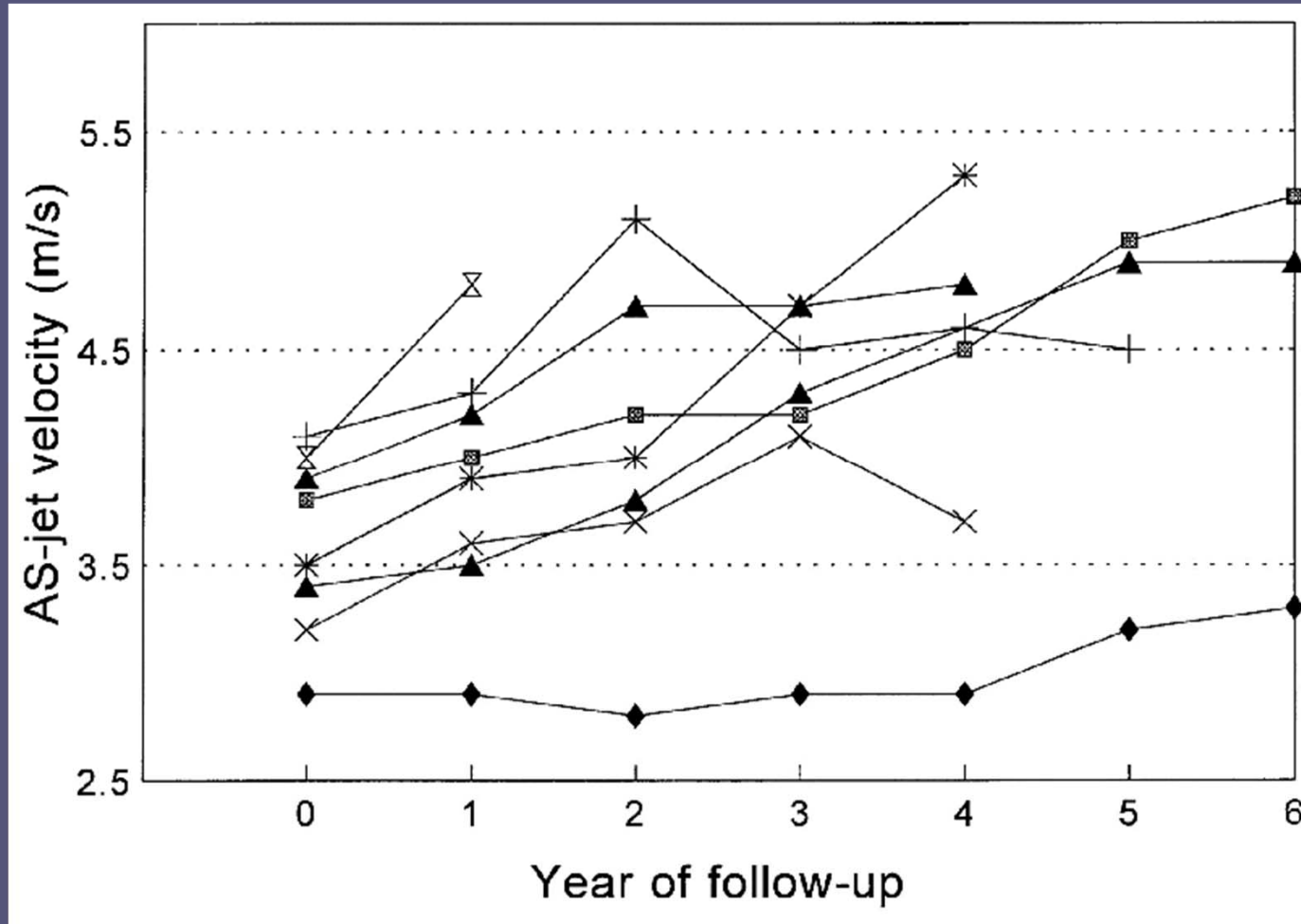


AV Vmax = 5.3m/sec  
Mean PG = 69mmHg

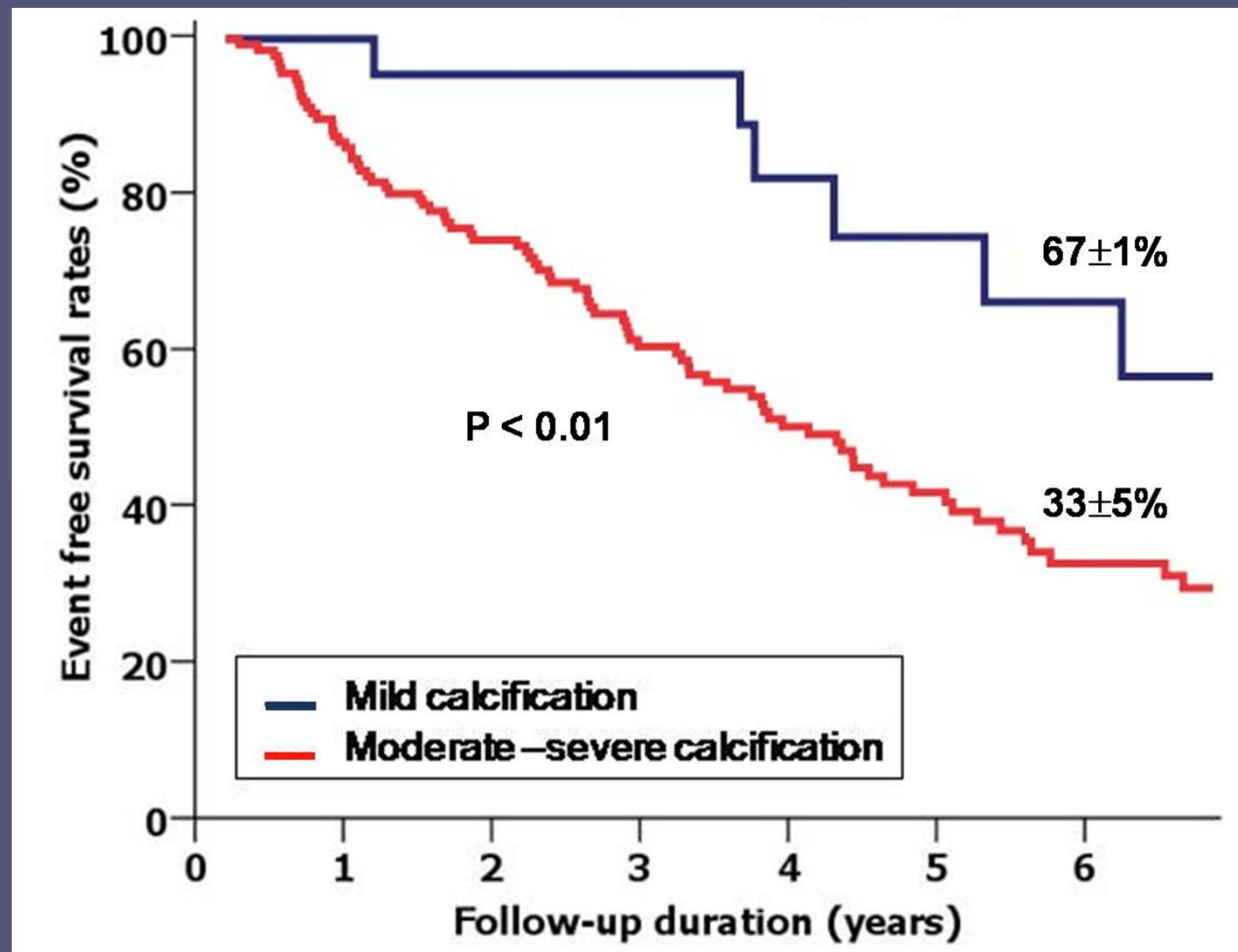
# Predictors of Outcome in Severe AS



# Marked Individual Variability in the Rate of Progression



# Event-free Survival According to Calcification



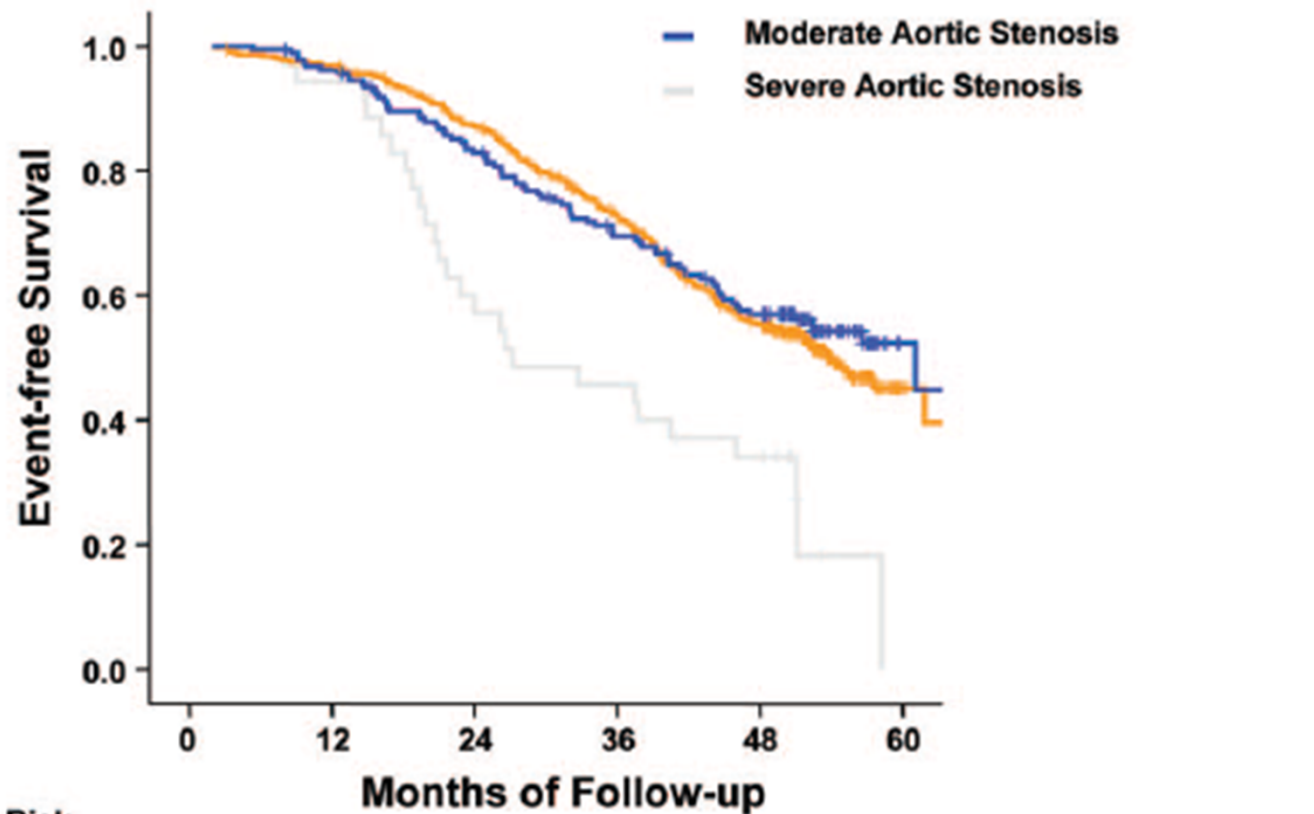
## **Outcome of Patients With Low-Gradient “Severe” Aortic Stenosis and Preserved Ejection Fraction**

- **Outcome of low-gradient “severe” AS (AVA < 1.0 cm<sup>2</sup> and mean gradient ≤ 40 mmHg compared with moderate AS (AVA: 1.0-1.5 cm<sup>2</sup>)**
- **AV events included cardiovascular death, AV replacement and CHF**
- **In 619 asymptomatic patients (SEAS study), AV events occurred in 48.5% versus 44.6%, respectively, during 46 months of follow-up (P= 0.37)**
- **In conclusion, outcome of low-gradient “severe” AS and normal ejection fraction similar to that of moderate AS**



# Outcome in Low-Gradient “Severe” AS

**Aortic Valve Events**

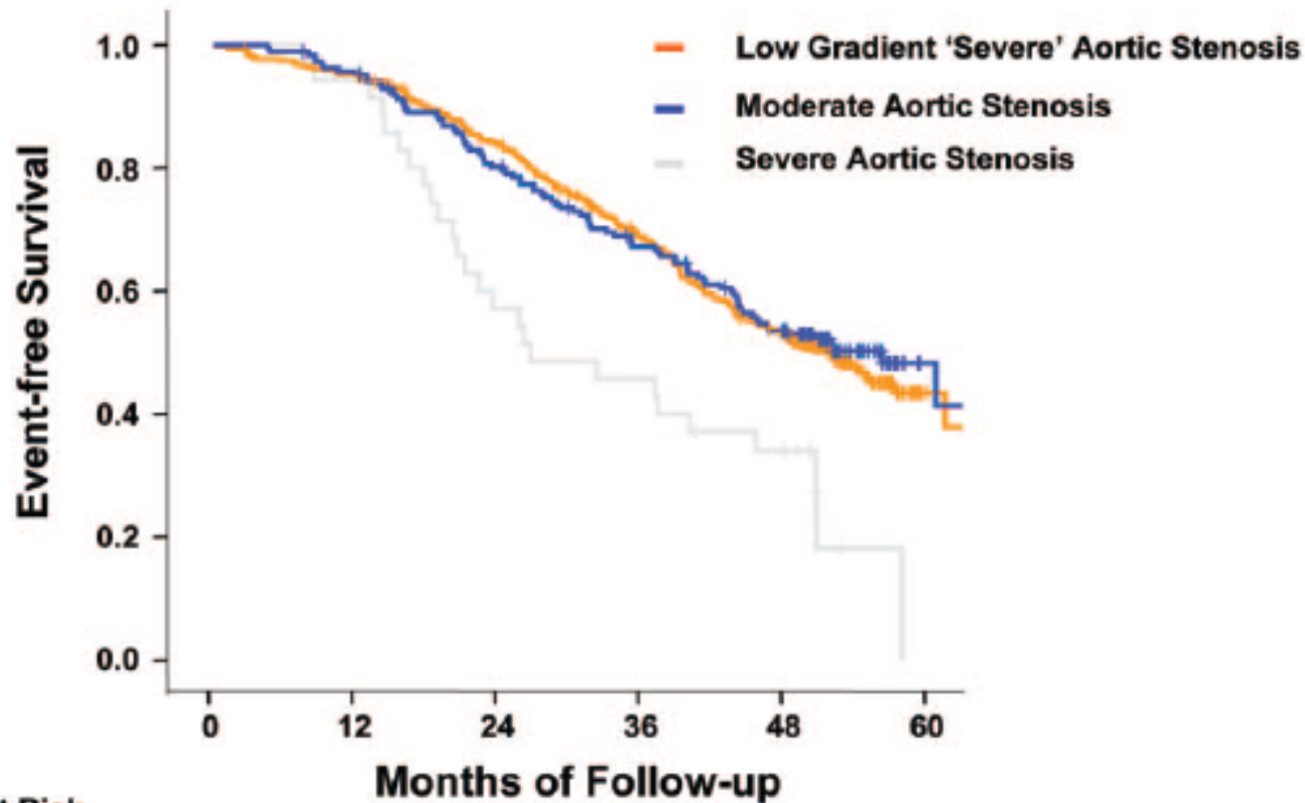


**No. at Risk**

<b>LGSAS</b>	<b>435</b>	<b>420</b>	<b>376</b>	<b>310</b>	<b>232</b>	<b>17</b>
<b>Moderate AS</b>	<b>184</b>	<b>176</b>	<b>151</b>	<b>126</b>	<b>99</b>	<b>10</b>
<b>Severe AS</b>	<b>35</b>	<b>33</b>	<b>21</b>	<b>16</b>	<b>11</b>	<b>0</b>

# Outcome in Low-Gradient “Severe” AS

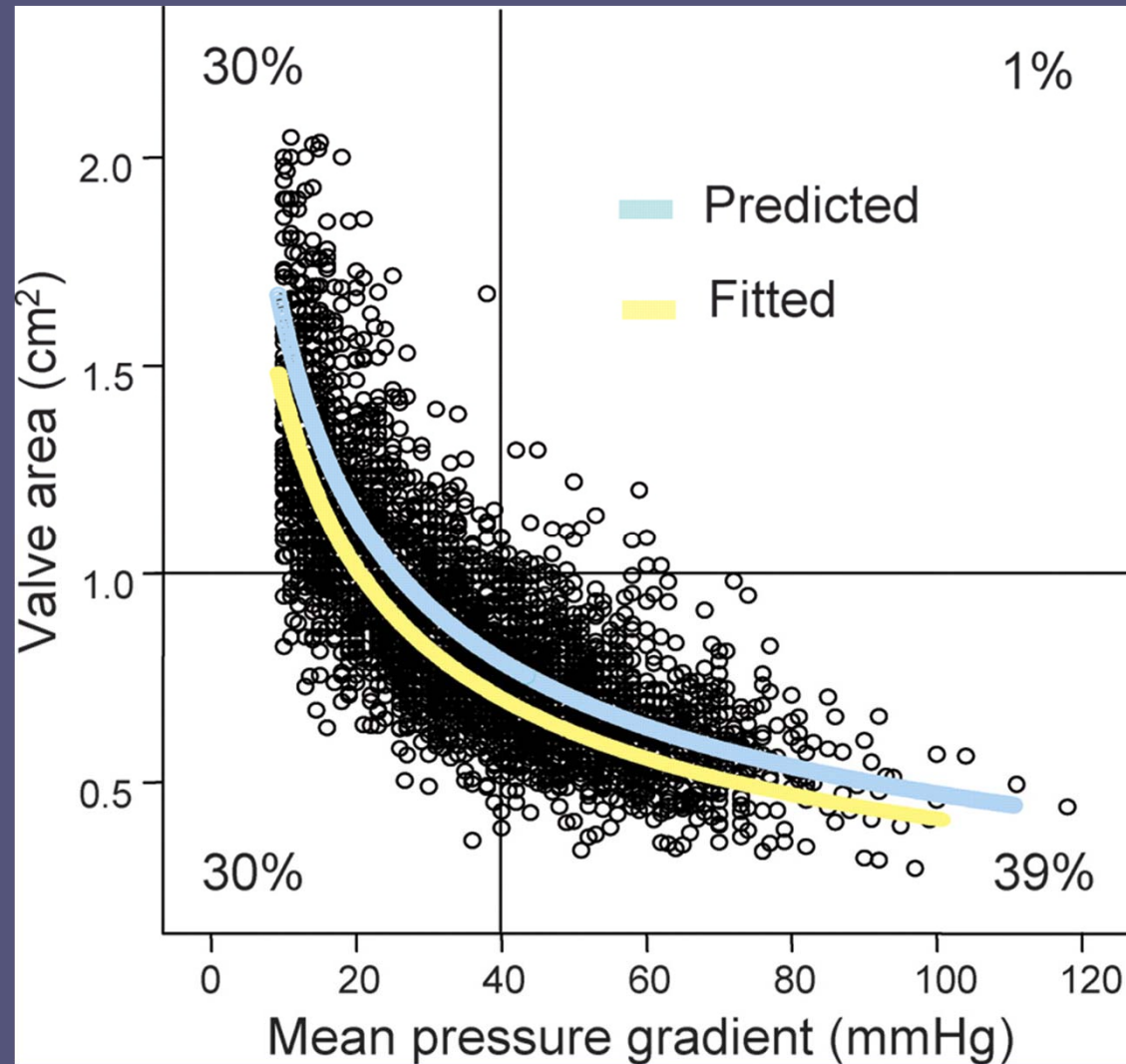
## Major Cardiovascular Events



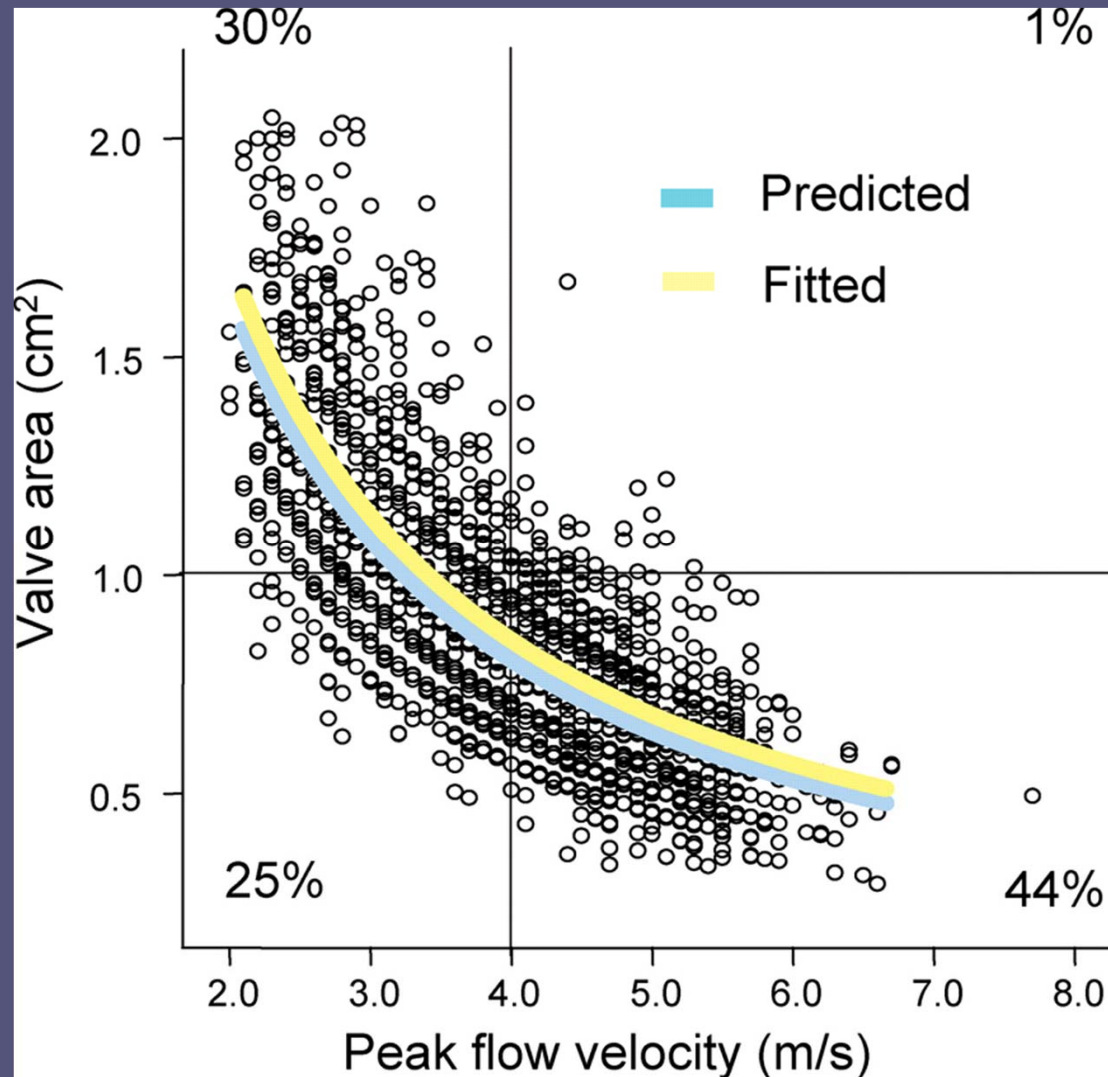
No. at Risk

LGSAS	435	413	364	296	225	17
Moderate AS	184	175	146	122	93	10
Severe AS	35	33	21	16	11	0

# AV Area vs. Mean Pressure Gradient



# AV Area vs. Peak Flow Velocity



# Conclusions

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- The clinical outcomes were different according to severity and etiology of AS, and degree of calcification
- **Early surgery** can be a **therapeutic option** to further improve clinical outcomes for asymptomatic patients with **very severe AS** and **low operative risks**

**Randomized Comparison of Early Surgery  
versus CONventional Treatment in  
Asymptomatic VERY Severe Aortic Stenosis  
(RECOVERY)**

**Duk-Hyun Kang, Sung-Ji Park\*, Yong-Jin Kim<sup>+</sup>,  
Dae-Hee Kim, Jong-Min Song, Seung Woo Park\*,  
Jae-Kwan Song, Jae-Won Lee, Pyo-Won Park\***

**Division of Cardiology, Cardiac Surgery  
AMC, SMC\*, SNUH<sup>+</sup>  
Seoul, South Korea**

# RECOVERY (http://recovery.e-crf.co.kr)

RECOVERY [Home](#) [New Case](#) [Subject List](#) [Registry Group](#) 강덕현@R01 as master  
로그아웃 관리자 문의하기

## New Case

**General Information**

Enrollment Date:

Subject Initial:

Date of Birth:  (yyyy-mm-dd)

Hospital ID:

Gender:  Male  Female

Age:

Inclusion Criteria		All Yes	
		Yes	No
1.	Age $\geq$ 16 years and $\leq$ 80 years	<input type="radio"/>	<input type="radio"/>
2.	Aortic valve area (by continuity equation) $\leq$ 0.75cm <sup>2</sup>	<input type="radio"/>	<input type="radio"/>
3.	Peak aortic-jet velocity $\geq$ 4.5m/s or mean pressure gradient $\geq$ 50mmHg	<input type="radio"/>	<input type="radio"/>

Exclusion Criteria		All NO	
		Yes	No
1.	Symptomatic aortic stenosis: exertional dyspnea, angina, syncope	<input type="radio"/>	<input type="radio"/>
2.	LV ejection fraction < 50%	<input type="radio"/>	<input type="radio"/>
3.	Combined significant valvular disease: moderate AR, MS, MR	<input type="radio"/>	<input type="radio"/>
4.	History of ischemic heart disease or regional wall motion abnormality on echocardiography	<input type="radio"/>	<input type="radio"/>
5.	Coexisting malignancies	<input type="radio"/>	<input type="radio"/>
6.	Patients who did not consent to participate	<input type="radio"/>	<input type="radio"/>

**This patient can be randomized** Do you want to randomize this case?  Yes(Random Group)  No(Registry Group)

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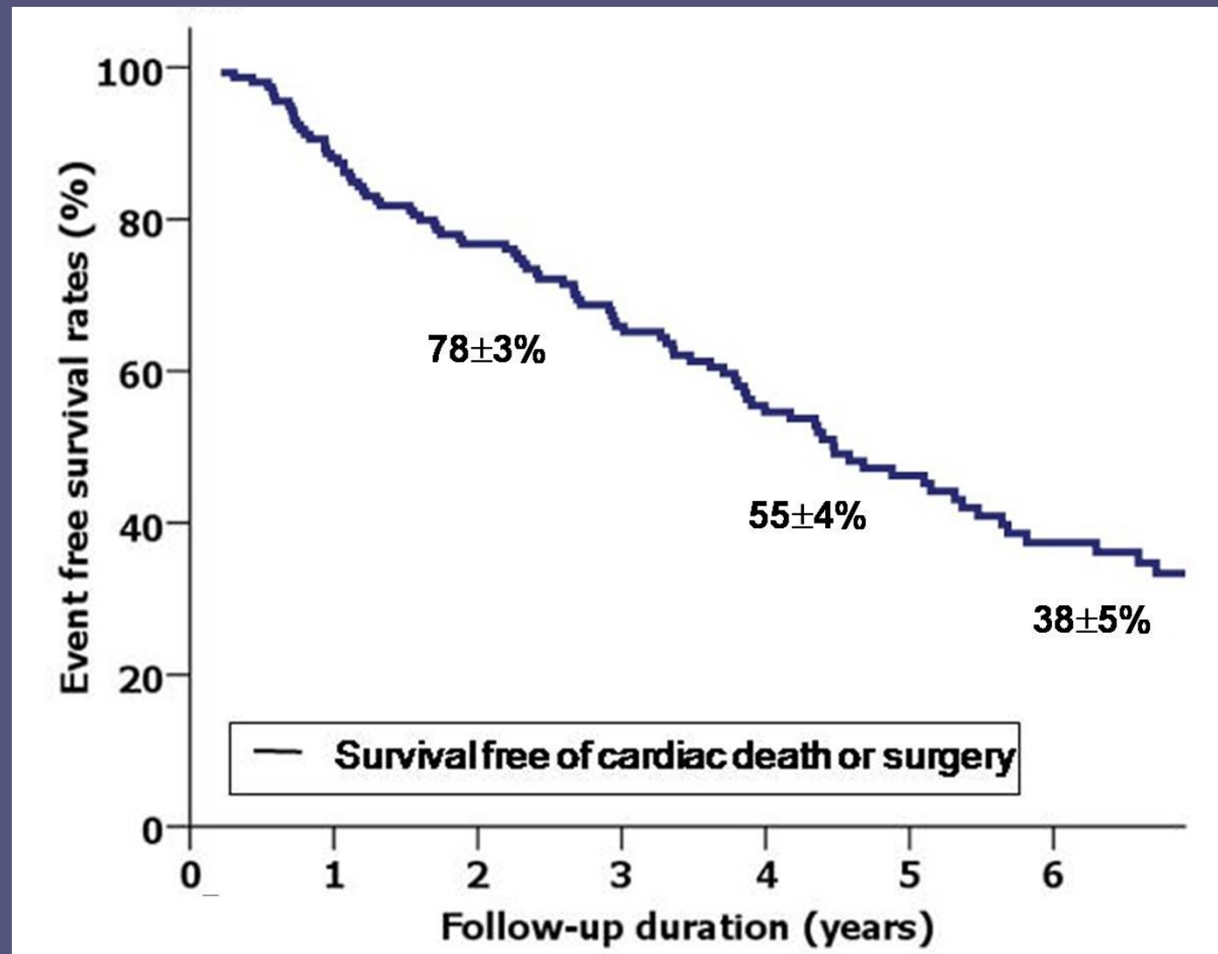
**Randomized Comparison of Early Surgery  
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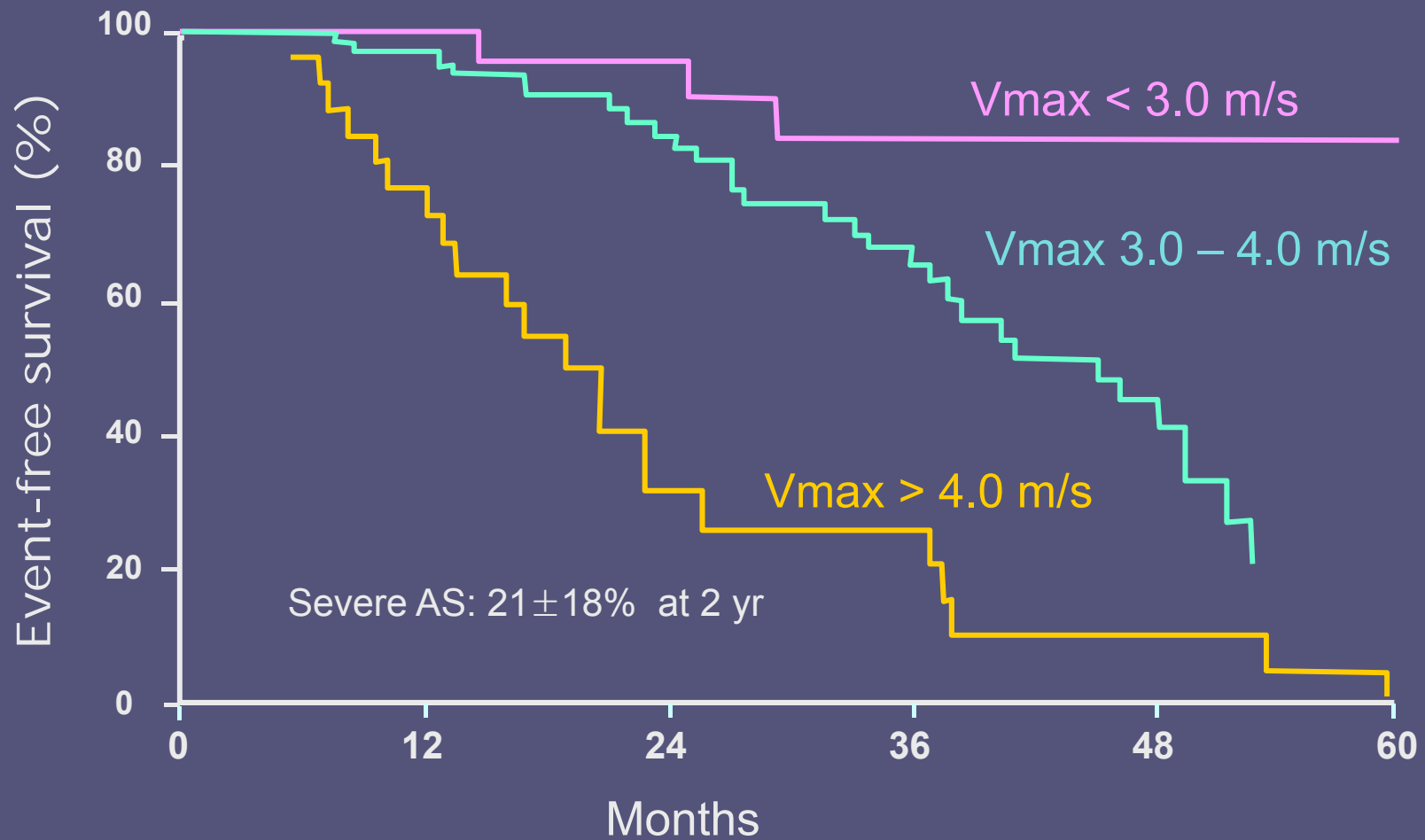
**Division of Cardiology, Cardiac Surgery  
AMC, SMC\*, SNUH<sup>+</sup>  
Seoul, South Korea**



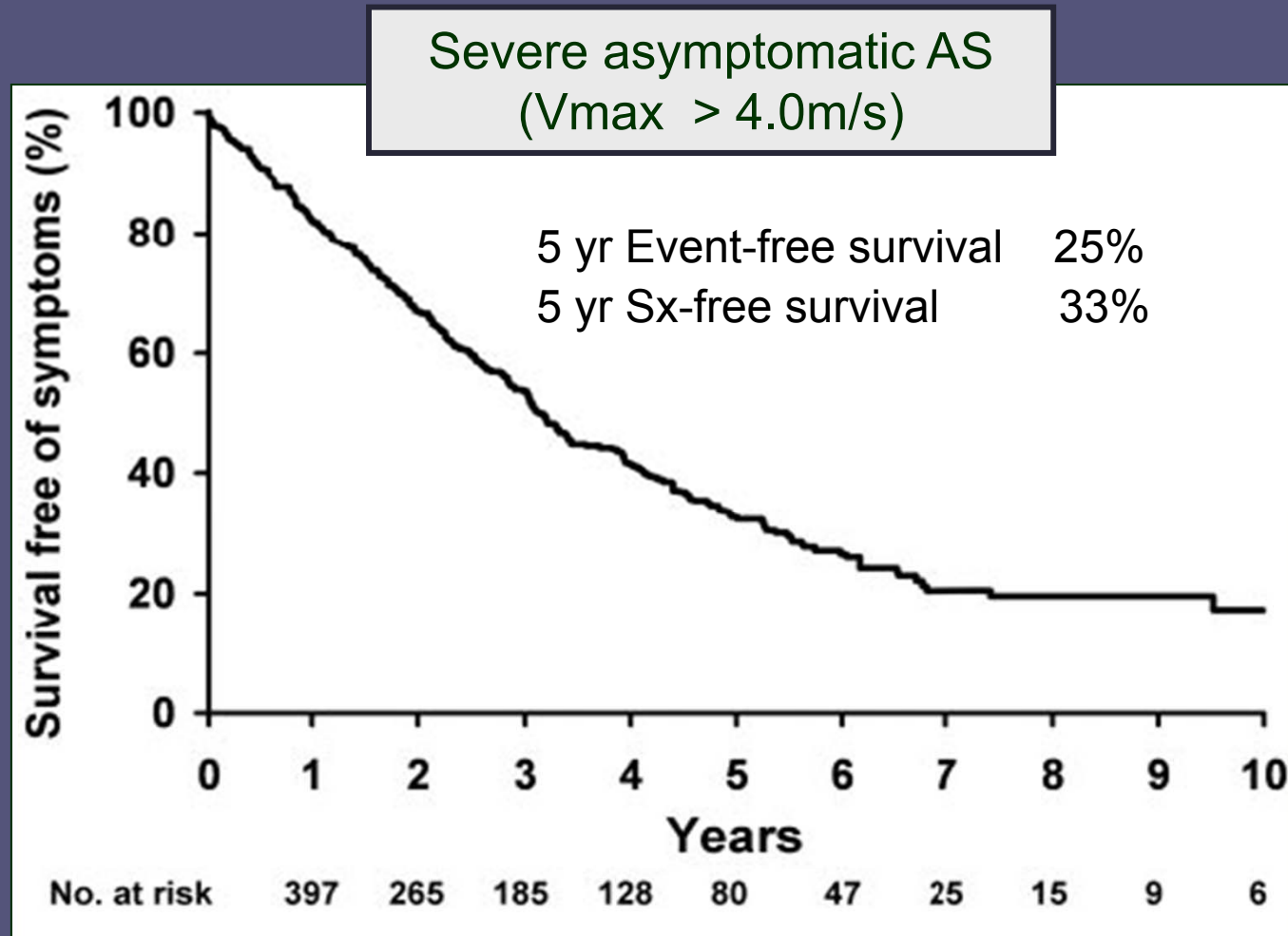
# Event-free Survival Rate in the CONV group



# Event-Free Survival Rate

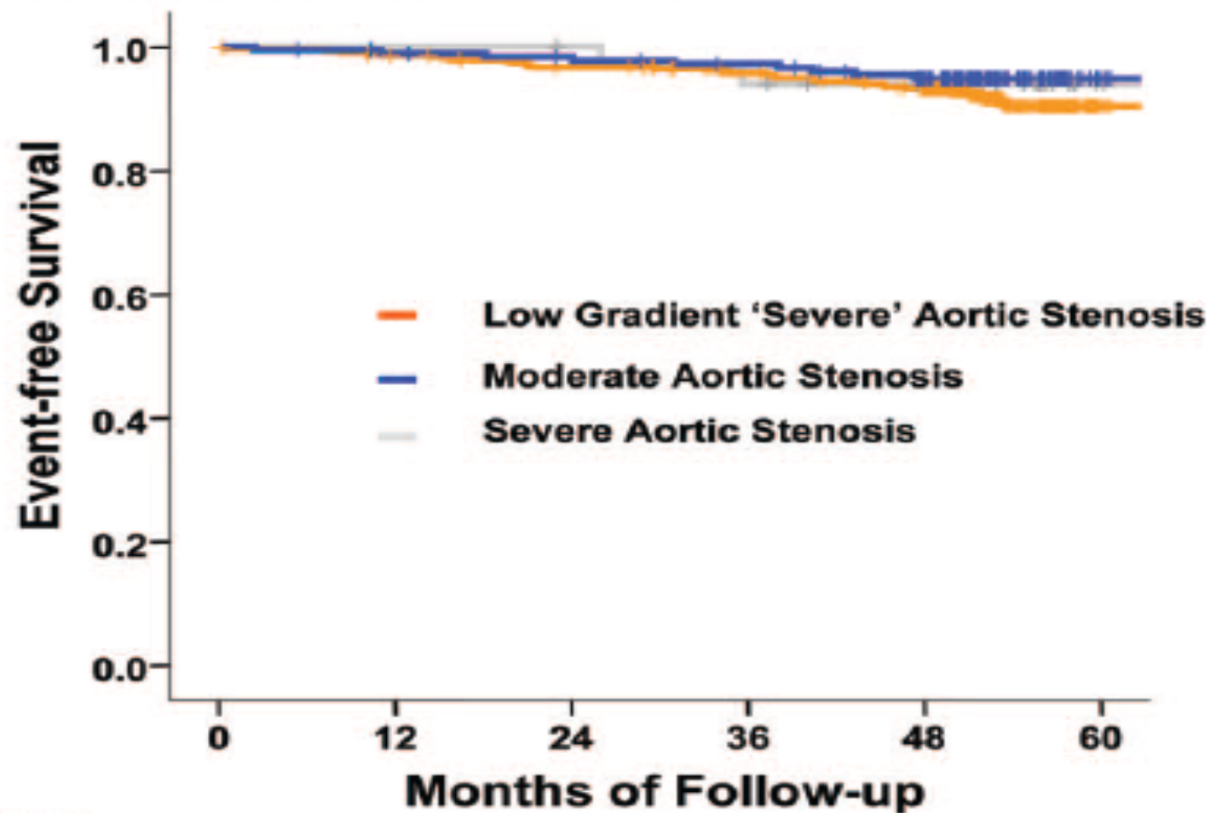


# Outcome of 622 Patients with Severe Asymptomatic AS



# Outcome in Low-Gradient “Severe” AS

## Cardiovascular Death



### No. at Risk

LGSAS	435	430	415	405	389	37
Moderate AS	184	182	178	173	167	22
Severe AS	35	35	35	33	30	5