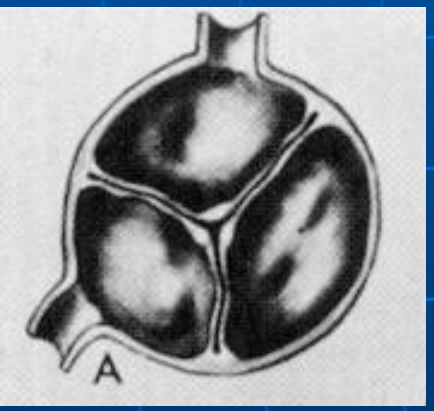
# Aortic Stenosis

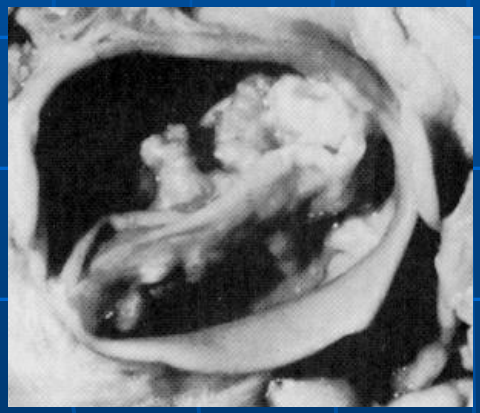
# Aortic Stenosis

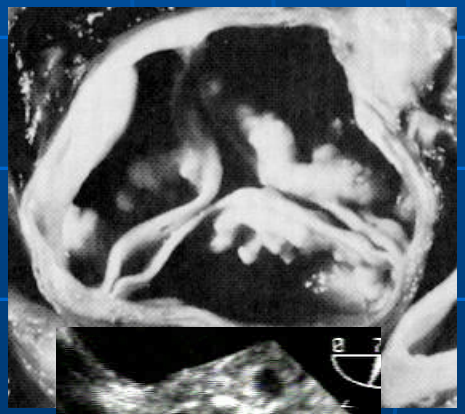
- Etiology
- Physical Examination
- Assessing Severity
- Natural History
- Prognosis
- Timing of Surgery

# Aortic Stenosis: Etiology

- Congenital bicuspid valve is the most common abnormality
- Rheumatic heart disease and degeneration with calcification are found as well





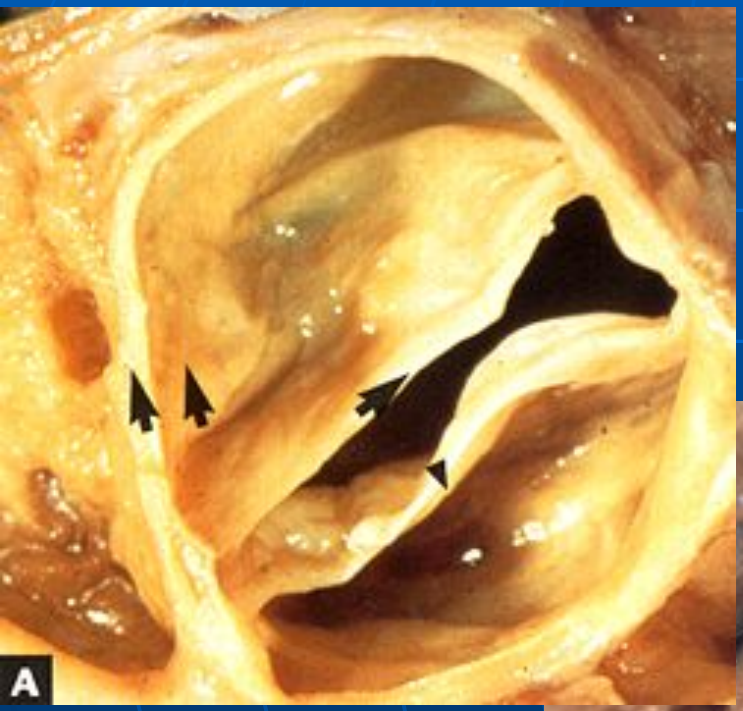
Normal

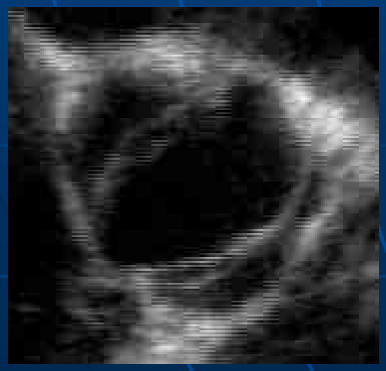
Bicuspid Ao V calcific valve

"Normal" geriatric

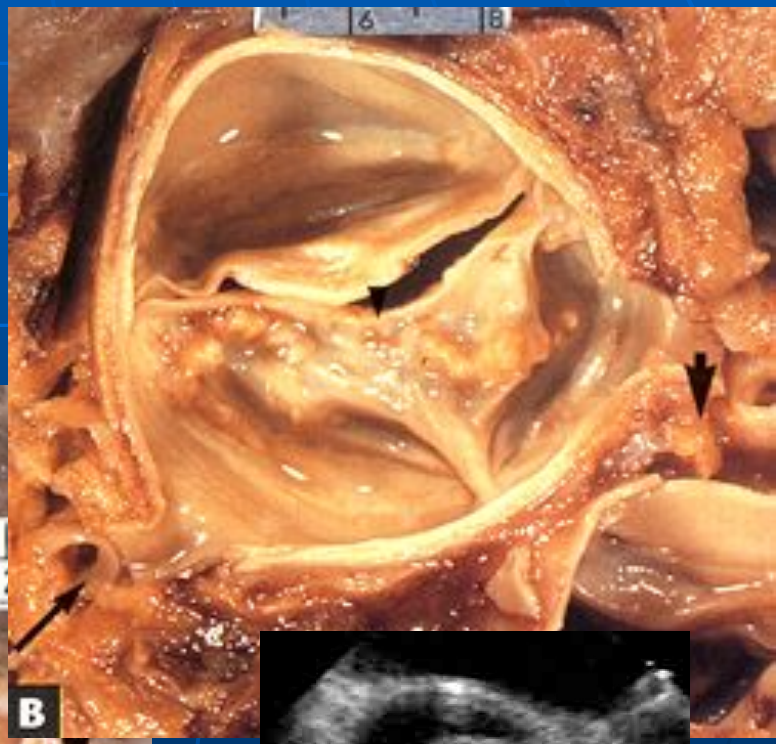
Rheumatic

# Bicuspid Aortic Valve








# Aortic Stenosis - Etiology

- Young or middle-aged patient (4 & 5th decades) think congenital or rheumatic
  - Bicuspid
    - 2% population
    - 3:1 male:female distribution
    - Co-existing coarctation 6% of patients
- Rarely
  - Unicuspid valve
  - Sub-aortic stenosis
    - Discrete
    - Diffuse (Tunnel)
- Old patient think degenerative (6,7,8th decades)

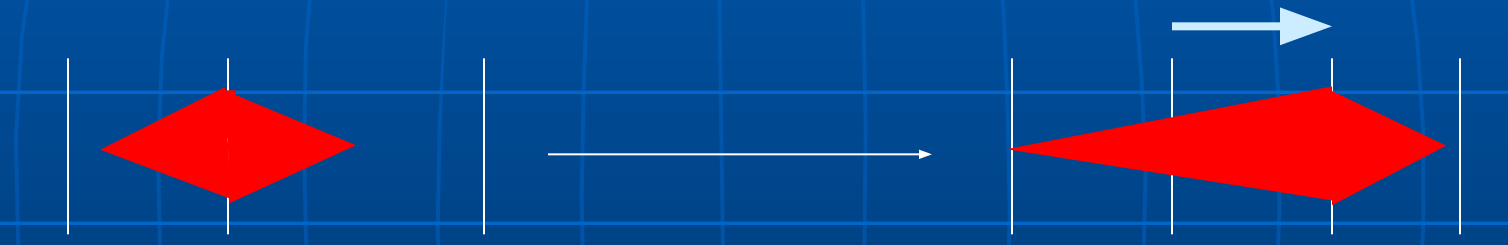
# Aortic Stenosis: Symptoms

- Cardinal Symptoms
  - Chest pain (angina)
    - Reduced coronary flow reserve
    - Increased demand-high afterload
  - Syncope/Dizziness (exertional pre-syncope)
    - Fixed cardiac output
    - Vasodepressor response
  - Dyspnea on exertion & rest
  - Impaired exercise tolerance
- Other signs of LV failure
  - Diastolic & systolic dysfunction

# Aortic Stenosis: Physical Findings

- Intensity DOES NOT predict severity
- Presence of thrill DOES NOT predict severity
- "Diamond" shaped, harsh, systolic crescendo-decrescendo
- Decreased, delay & prolongation of pulse amplitude
- Decreasing intensity of S2
- S4 (with left ventricular hypertrophy)
- S3 (with left ventricular failure)

# Aortic Stenosis: Physical Findings




Mild-Moderate

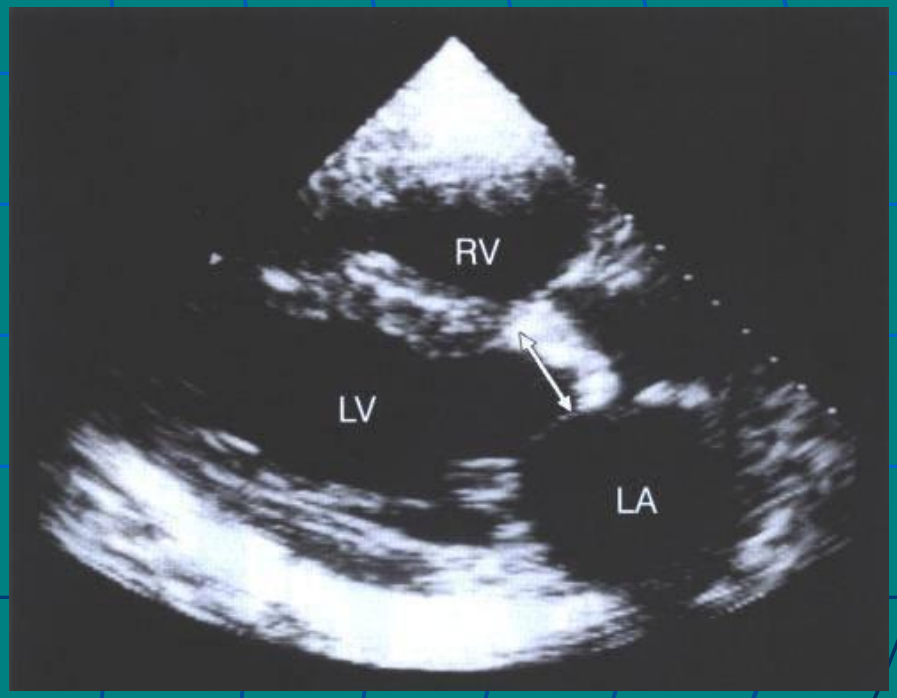
Severe

# Severity of Stenosis

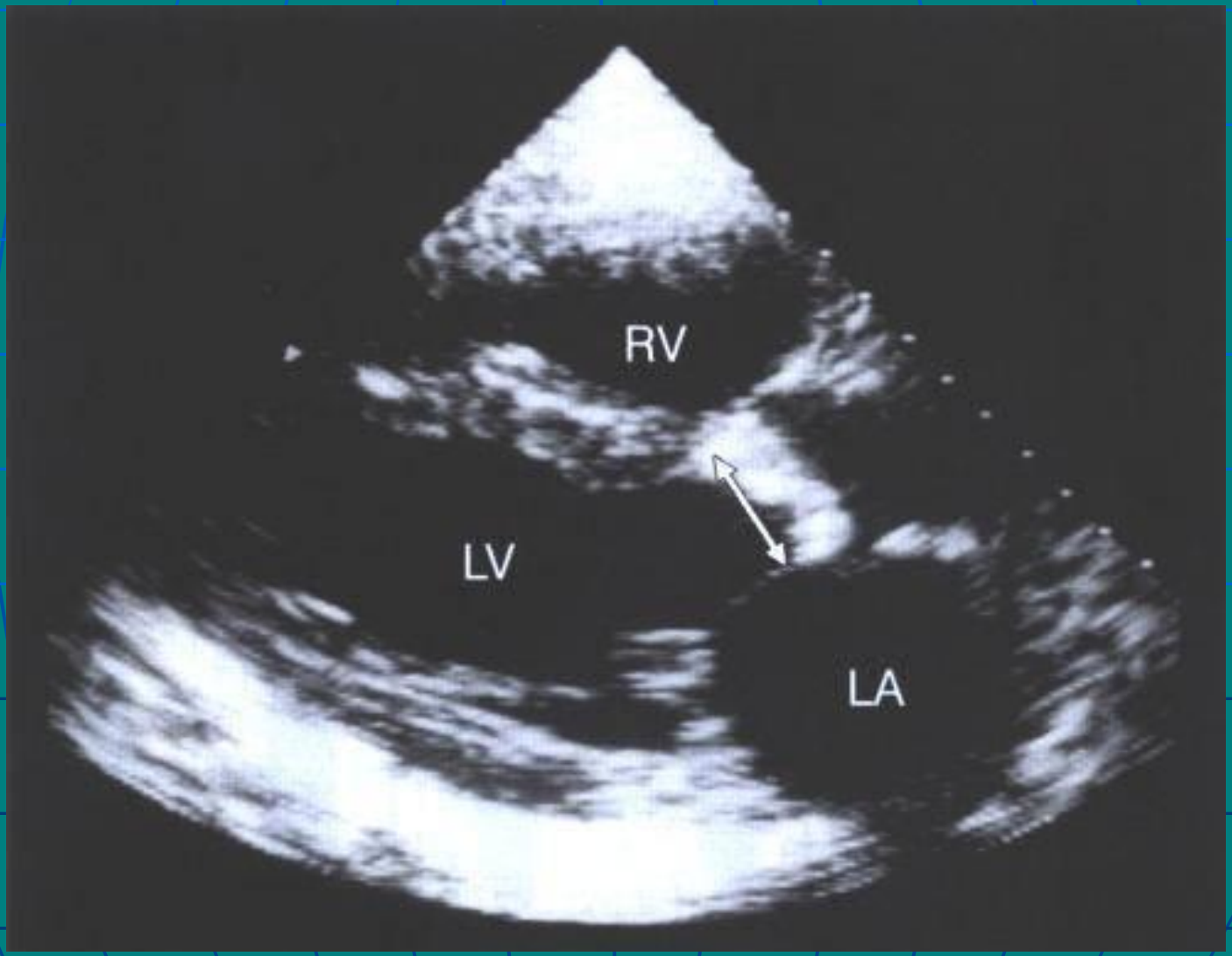
- Normal aortic valve area 2.5-3.5 $cm^2$
- Mild stenosis 1.5-2.5 $cm^2$
- Moderate stenosis 1.0-1.5 $cm^2$
- Severe stenosis < 1.0 $cm^2$
- Critical stenosis < 0.7 $cm^2$
- Onset of symptoms
  ~ 0.9 $cm^2$ with CAD
  ~ 0.7 $cm^2$ without CAD

# Diagnosis: Echocardiogram

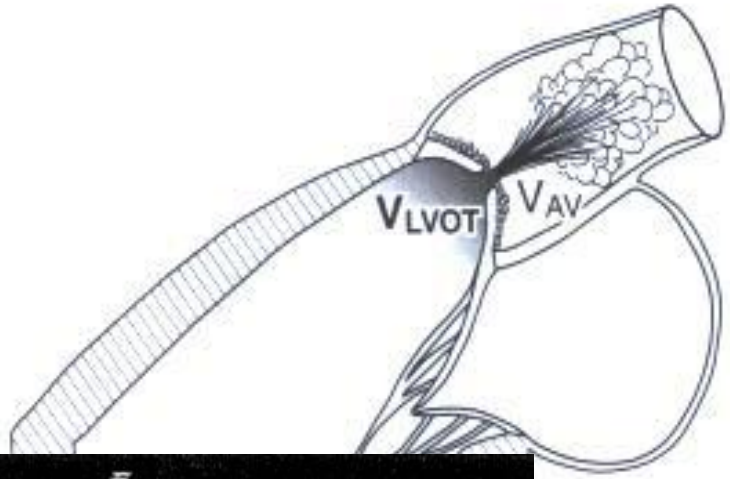
- Etiology
- Valve gradient and area
- LVH
- Systolic LV function
- Diastolic LV function
- LA size
- Concomitant regional wall motion abnormalities
- Coarctation associated with bicuspid AV



# Echocardiogram



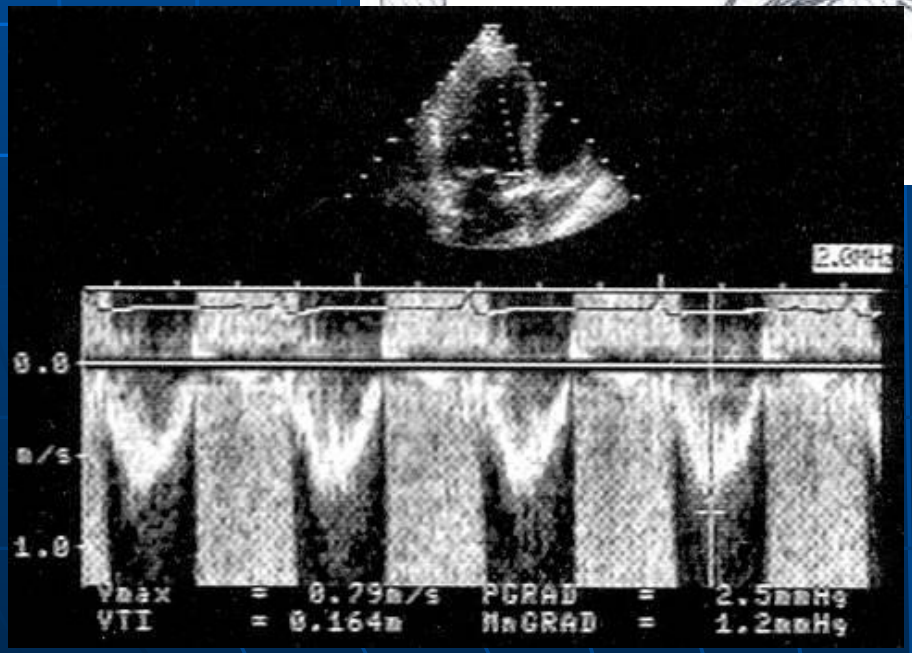
# Doppler estimation of AVA




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

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

$$AVA = A_{LVOT} \times \frac{V_{LVOT}}{V_{AV}}$$

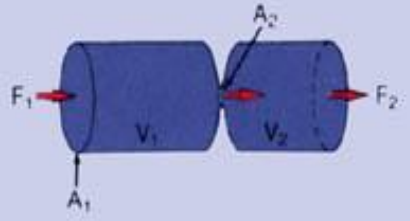



**Continuity Equation**

$$Flow_2 = Flow_1$$

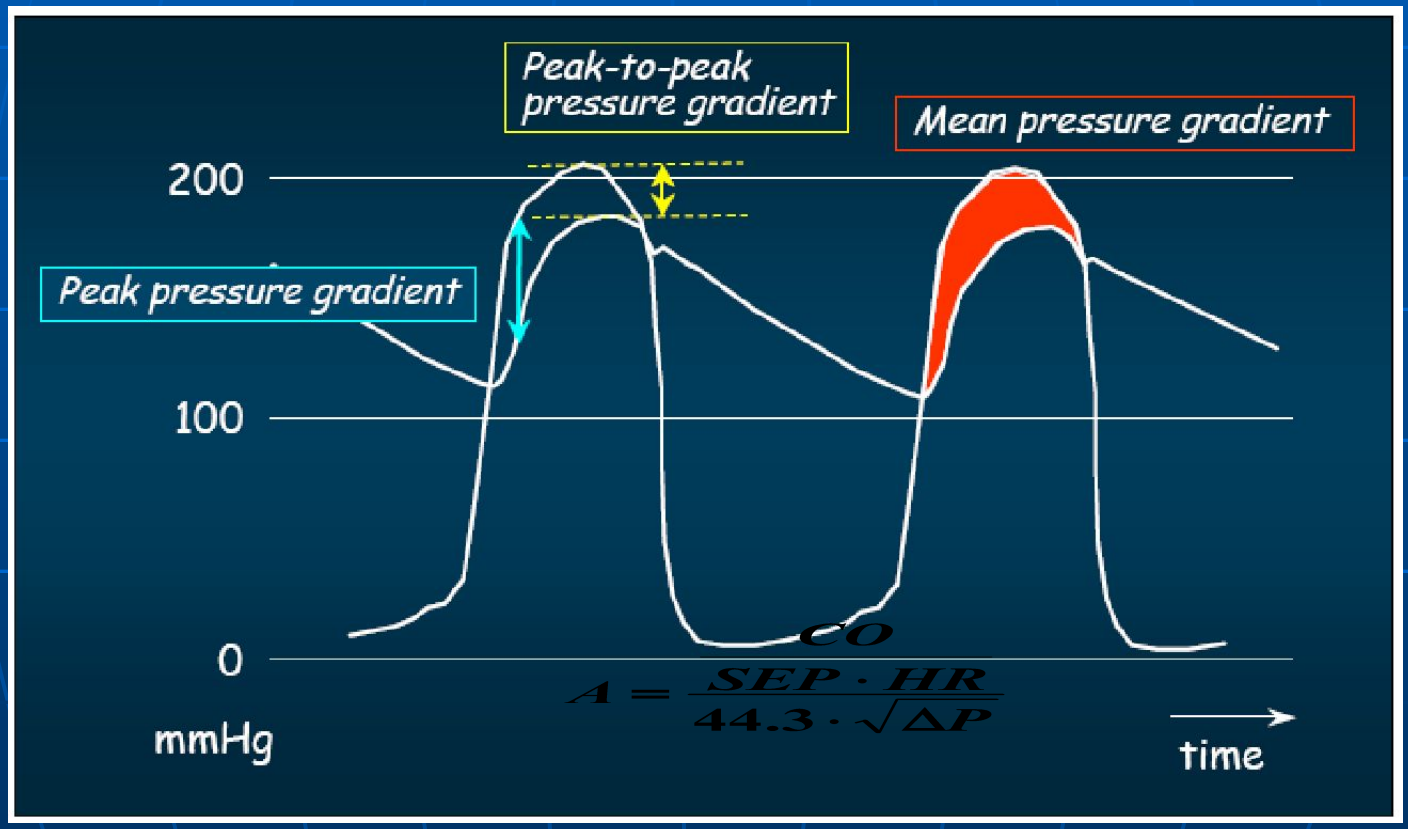
$$Area_2 \times V_2 = Area_1 \times V_1$$

$$Area_2 = \frac{Area_1 \times V_1}{V_2}$$



# Cardiac catheteriztion

Gorlin Method




Simplified: Hakke's formula AVA=CO/√(p-p gradient)

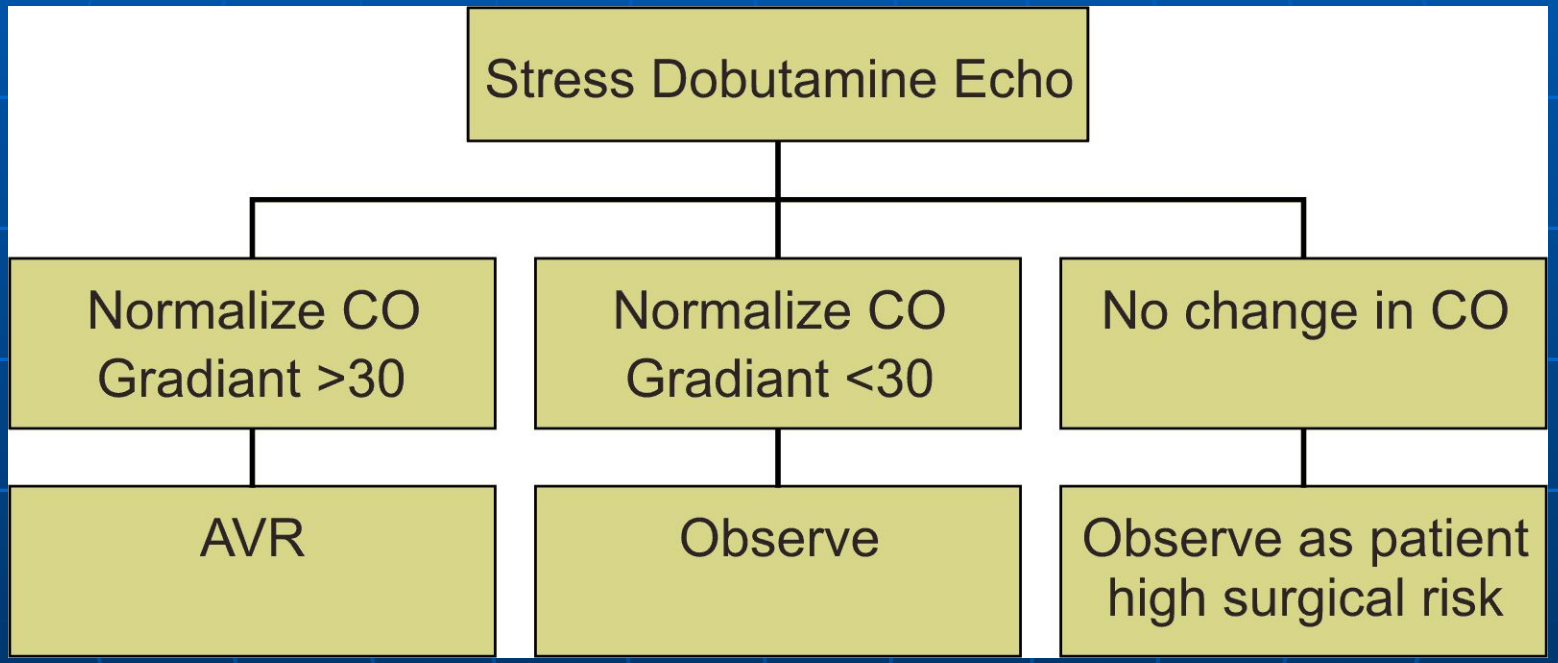
# Low gradient AS

Calculated AVA is < 1.0 $cm^2$ , But…

AV gradient is <30mmHg.

Stenotic or not Stenotic?

# Low gradient AS



# Aortic Stenosis: Prognosis

| Symptom/Sign | Live expectancy |
|---|---|
| Angina | 5 years |
| Syncope | 2-3 years |
| Congestive Heart Failure | 1-2 years |

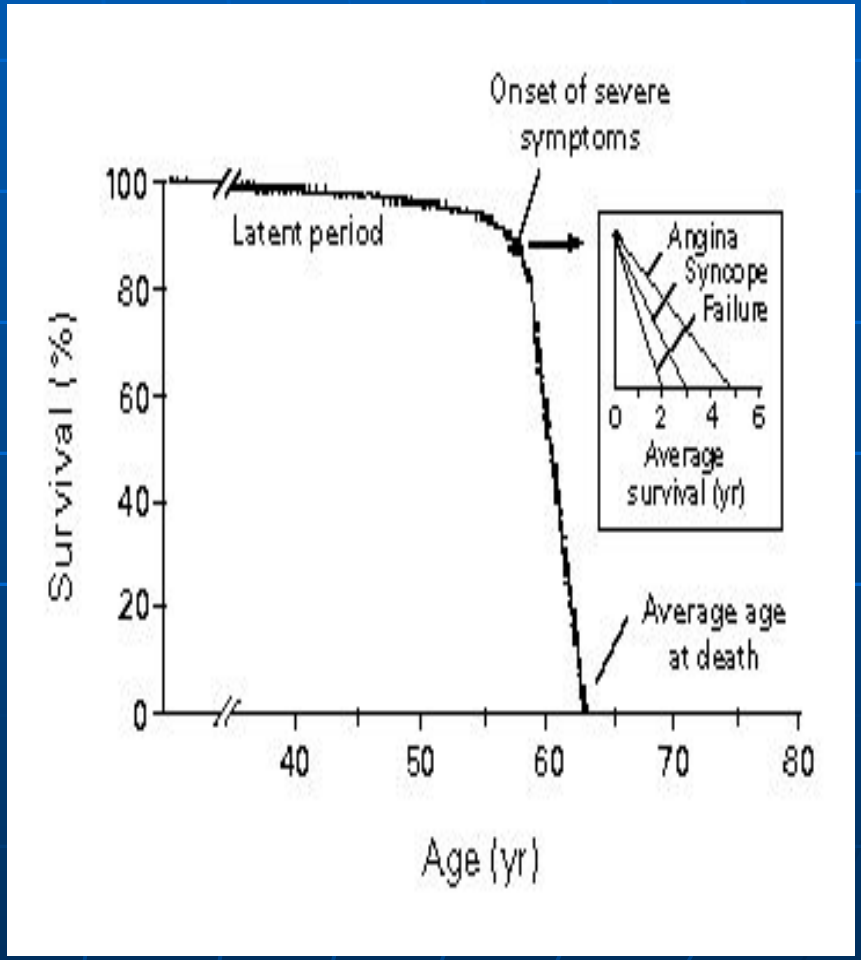
Therapy: Valve replacement for severe aortic stenosis

Operative mortality (elderly) ~ 4%/Morbidity ~ 3-11%

Event rate in asymptomatic severe AS ~ 1%/year

# Natural History of Aortic Stenosis

- Heart failure reduces life expectancy to less than 2 years
- Angina and syncope reduce life expectancy between 2 and 5 years
- Rate of progression ↓ @ 0.1 cm2/year



# Operative mortality of AVR in the elderly

- ~ 4-24%/year
- Risk factors for operative mortality
  - Functional class
  - Lack of sinus rhythm
  - HTN
  - Pre-existing LV dysfunction
  - Aortic regurgitation
  - Concomitant surgical procedures:CABG/MV surgery
  - Previous bypass
  - Emergency surgery
  - CAD
  - Female gender

# AVR is recommended in symptomatic patients with severe AS (stage D1) with :

Decreased systolic opening of a calcified or congenitally stenotic aortic valve; and

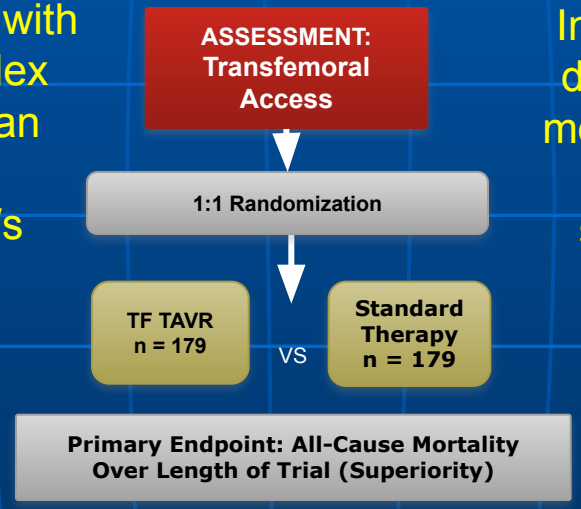
- An aortic velocity 4.0 m per second or greater or mean pressure gradient 40 mm Hg or higher; and
- Symptoms of HF, syncope, exertional dyspnea, angina, or (pre)syncope by history or on exercise testing.

# PARTNER Study Design

## Symptomatic Severe Aortic Stenosis

**Inoperable** N = 358

Severe Symptomatic AS with AVA< 0.8 $cm^2$ (EOA index < 0.5 $cm^2/m^2$), and mean gradient > 40 mmHg or jet velocity > 4.0 m/s




Inoperable defined as risk of death or serious irreversible morbidity of AVR as assessed by cardiologist and two surgeons exceeding 50%.

- *Primary endpoint evaluated when all patients reached one year follow-up.*
- *After primary endpoint analysis reached, patients were allowed to cross-over to TAVR.*

# All-Cause Mortality Landmark Analysis

# Prosthetic Heart Valves

# Caged-Ball Valve

# Disc Valve

# Bio-prosthetic Valve

# Prosthetic Valves

- MECHANICAL
  - Durable
  - Large orifice
  - High thromboembolic potential
  - Best in Left Side
  - Chronic warfarin therapy
- BIO-PROSTHETIC
  - Not durable
  - Smaller orifice/functional stenosis
  - Low thromboembolic potential
  - Consider in elderly
  - Best in tricuspid position