MANAGEMENT OF VALVULAR AORTIC STENOSIS

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AORTIC STENOSIS

- Third most common cardiovascular disease
- Most prevalent valvular heart disease in the world
- Commonest acquired valvular lesion with a prevalence of 2-4% in the above 65 age
- Most important because of its potential for sudden death—15-20% in symptomatic, 1-5% in asymptomatic

AORTIC STENOSIS

- Calcific AS commonest cause
- Predisposing factors of CAD
- Rheumatic AS
- Congenital
  - Bicuspid AV in 2% of population

Natural history of AS

Role of echo in clinical decision making in AS

Basic examination includes
- Maximum jet velocity and gradient
- Valve area
- Assessment of degree of coexisting AR, MR
- LV size, hypertrophy, systolic function
- Estimation of pulmonary artery pressure

SEVERITY OF AS

<table>
<thead>
<tr>
<th>Severity</th>
<th>Aortic area (sq cm)</th>
<th>Jet velocity (m/sec)</th>
<th>Mean grad (mmHg)</th>
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</thead>
<tbody>
<tr>
<td>Normal</td>
<td>2-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>&gt; 1.5</td>
<td>&lt;3</td>
<td>&lt;25</td>
</tr>
<tr>
<td>Moderate</td>
<td>1-1.5</td>
<td>3-4</td>
<td>25-40</td>
</tr>
<tr>
<td>Severe</td>
<td>&lt;1</td>
<td>&gt;4</td>
<td>&gt;40</td>
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Cardiac catheterisation in AS

- Coronary angiogram before AVR at risk for CAD
- Assessment of severity if noninvasive tests are inconclusive or any discrepancy
- Ross procedure (pulmonary autograft) contemplated and if coronary origin is not visualised in noninvasive tests

Medical Management

- Most important principle is patient education regarding disease course and typical symptoms
- Avoid vigorous athletic and physical activity in severe aortic stenosis
- Infective endocarditis prophylaxis—Not recommended as per latest guidelines
- Rheumatic prophylaxis

Medical Management

- No medical treatment has been proven to delay the progression of aortic valve disease or to improve survival

Medical Management

- Coronary risk reduction
  - Cessation of smoking
  - Treating hypercholesterolemia
  - Treating hypertension
  - Aspirin prophylaxis in adults with 10-year risk of cardiovascular disease ≥ 6%

Role of Statins

Can statins slow the progression of AS?

Initial observational studies (retrospective or case-control) suggested a significantly lower rate of progression.

Randomized prospective study (SALTIRE) showed no statistical difference (Atorvastatin 80mg, 134 patients).

RAAVE suggested slowing of the progression of stenosis (Rosuvastatin 20mg, 121 patients).

SEAS

- Randomized, double-blind, placebo controlled, N=1873
- 45-85y, asymptomatic, mild-to-moderate (2.5-4 m/s)
- Simvastatin 40mg + Ezetimibe 10mg, 4-yr follow up
- Excluded for CAD or equivalent
- Aggressive lipid lowering does not affect hemodynamic progression
Role of Statins

- **ASTRONOMER TRIAL**
  - 272 patients, Rosuvastatin 40mg
  - Younger patients, less jet velocity
- **ACEIs** - Antiinflammatory effect
  - Do not appear to slow progression of the disease

Medical Management

- Diuretics in the presence of heart failure
  - Caution as it decreases CO and hypotension
- **ACEIs** in symptomatic LV systolic dysfunction
- Nitrates with caution
- Avoid betablockers and CCBs – negative inotropic effect
- Digoxin for supraventricular arrhythmias and HF
- Cardiogenic shock – Dobutamine, IABP

Treatment

- **Aortic valve replacement is the only effective treatment for hemodynamically significant AS**
- No prospective randomized trials comparing medical versus surgical treatment
  - The effect of aortic valve replacement on survival, Circulation 1992

Treatment-Symptomatic

- Well-accepted recommendation that aortic valve replacement should be performed promptly in symptomatic patients
- Surgery has an average perioperative mortality rate of 3-4%
- Risk of prosthetic valve failure of 1% per year
  - Mechanical valve
    - Durability versus Anticoagulation (INR 2-3)
  - Biological valve
  - Xenograft

AORTIC VALVE REPLACEMENT

- Overall 10 yr survival rate in patients with AVR is ~ 50%
- Need to replace bioprosthetic valve = 30% by 10 yrs
- 30% pts with mechanical prosthetic valve develop significant hemorrhagic complications
- Thromboembolic complications even with best prosthesis:
  - 0.2 fatal
  - 1-2 nonfatal complications per 100 pts yr.
**Should We Treat Asymptomatic Aortic Stenosis??**

**Asymptomatic AS**
- Excellent prognosis despite severe LVOT obstruction.
- Risk of sudden death 1-5%.
- Symptom-free survival is less than 50% without surgery.
- Irreversible myocardial depression might develop and preclude an optimal outcome.
- Risk of sudden death/Operative risk/risk of living with prosthesis.
  - Surgical risk (4%) outweighs the approximately 1-2% annual risk of sudden death in asymptomatic patients.
- Survival in patients with watchful waiting is comparable.

**Asymptomatic AS - Disease Progression**
- Jet velocity increases by 0.3 m/sec/yr (0.2-0.4).
- Mean pressure gradient increases by about 7 mm Hg/yr.
- Valve area decreases by about 0.1 cm²/yr (0.1-0.3).
- Rate of progression not predictable in an individual patient.
- Extreme heterogeneity of valve areas at which symptomatic.

**Asymptomatic AS - Prognosis**

<table>
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<tr>
<th>Initial Jet Velocity</th>
<th>Progression to Symptoms Requiring AVR</th>
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<tbody>
<tr>
<td>&lt; 3 m/sec</td>
<td>8% per year</td>
</tr>
<tr>
<td>3-4 m/sec</td>
<td>17% per year</td>
</tr>
<tr>
<td>&gt; 4 m/sec</td>
<td>40% per year</td>
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Ott and colleagues:
Transaortic flow velocity as a predictor:
- <3 m/sec: need for surgery <15% in next 5 yrs.
- >4 m/sec: need for surgery 70% in next 2 yrs.

**Abnormal stress test in asymptomatic AS - ACC/AHA guidelines recommend exercise stress test**
- Symptoms during exercise: dyspnea, angina, syncope or near syncope.
- Fall in BP or <20 mmHg rise in SBP during exercise.
- <50% of normal level of exercise tolerance.
- >2 mm ST segment depression during exercise (horizontal or downsloping, in comparison to baseline, not attributable to other causes).
- Ventricular arrhythmias.

**Asymptomatic - Other Considerations**
- High risk of developing symptoms.
  - Very severe AS (<0.6 cm² or 5 m/sec).
  - More rapid increase in aortic jet velocity over time (0.3 m/sec or more per year).
  - Severe valve calcification.
- Patients who do not live near a medical care facility.
- Predicted operative mortality rate ≤1% (70 years or younger without comorbidities).
- High or serially rising BNP predicts need for surgery.
**Class I indications for AVR**

- **Symptomatic patients with severe AS**
- **Patients with severe AS undergoing CABG**
- **Pts with severe AS undergoing surgery on the aorta or other heart valves**
- **Patients with severe AS and LV systolic dysfunction**

**Class IIa indication for AVR**

- **Pts with moderate AS undergoing CABG or surgery on aorta or other heart valves**

**Class II b indications**

- **Asymptomatic pt with severe AS and abnormal response to exercise**
- **Asymptomatic pt with severe AS if high likelihood of rapid progression**
- **Patients undergoing CABG who have mild AS with moderate to severe calcification**
- **Asymptomatic pt with severe AS valve area < 0.6 cm², mean grd >60mmHg and jet velocity > 5m/sec.**

**Class III indications**

- **AVR not useful for prevention of sudden death in asymptomatic patients who have none of the findings listed under class IIa/IIb**

**Low flow, low-gradient Aortic stenosis with LV dysfunction**

- Constitutes 5% of the patients with significant AS
- **True stenosis** (Severe AS with low cardiac output)
  - AV area <1.0 cm²
  - Mean gradient <45mmHg
  - LVEF <40%
- **Aortic pseudostenosis**
  - Patients with primary contractile dysfunction and mild to moderate AS

- Differentiating "true fixed" aortic stenosis from aortic pseudostenosis is challenging

**Low flow, low-gradient Aortic stenosis with LV dysfunction**

  - Differentiating low gradient, severe AS from pseudostenosis
  - Increasing the Cardiac output - dobutamine infusion
  - Decreasing the total peripheral resistance - nitroprusside infusion
Dobutamine Stress Echo

- **True severe AS**
  - Parallel increase in cardiac output and transvalvular gradient (by at least 10mmHg)
  - Calculated valve area therefore does not increase.
  - May benefit from valve replacement as reduced EF is secondary to afterload mismatch in majority of cases
  - Huber et al - mismatch in 1% of patients
  - Greater the role of mismatch, better the response to surgery
  - Mean gradient forms a reasonable surrogate for afterload mismatch

- **Patients with pseudostenosis**
  - Increase in cardiac output without a significant increase in gradient
  - So valve area increases significantly (>3.2cm²)

Mild to moderate AS in patients undergoing CABG

 Operative mortality
- AVR (Isolated) → 4.8%
- AVR + CABG → 8.0%

- In general average ↓ in valve area ~ 0.1 cm²/yr
  - A typical pt with valve area of 1.2 cm² → expected to require AVR in 4-5 yrs

- AVR advocated for moderate stenosis
- No data to support AVR for mild AS except in the presence of moderate to severe calcification

Pt with AS undergoing **non cardiac** elective surgery

- The biggest risk among valvular lesions is AS
  - Hemodynamic derangement during surgery that lead to ↓ BP or fluid loss can lead to cardiac arrest and
  - Significant AS makes resuscitation extremely difficult

- This pt with severe AS should avoid noncardiac surgery
  - Other lesions should be addressed before noncardiac surgery if possible.
  - Most asymptomatic patients tolerate non cardiac surgery without complications

Special considerations in elderly

- Associated co-morbidities
- Narrow LVOT
- Small aortic annulus
- Heavy calcification
- Inappropriate LVH

- Most studies suggest that AVR must be considered in all elderly symptomatic patients in the absence of co-morbidity

Valvular AS (infants and older children)

- Left ventricular dysfunction: Immediate intervention by balloon dilatation, irrespective of gradients (Class I)

- Normal left ventricular function: Balloon dilatation if any of these present
  - Gradient >80 mm Hg peak and 50 mm Hg mean by Doppler (Class I)
  - ST-T changes in ECG with peak gradient of 50 mmHg (Class I)
Valvular AS (neonates)

- If symptomatic or there is evidence of left ventricular dysfunction/mild left ventricular hypoplasia (Class I)
- If Doppler gradient (peak) > 75 mmHg (Class IIa)

Balloon Aortic Valvotomy

- NOT AS SUCCESSFUL AS PTMC/PBV
- FAILED TO PROVIDE A SIGNIFICANT SOLUTION FOR THE PROBLEM OF CALCIFIC STENOSIS

MECHANISM

- INCREASES THE MOBILITY OF LEAFLETS, THUS ENLARGING THE AORTIC VALVE ORIFICE
- FRACTURING OF THE CALCIFIC NODULES
- SEPARATION OF THE FUSED COMMISSURES

INDICATIONS

- CLASS I
  SYMPTOMATIC AS IN THE ADOLESCENT OR YOUNG ADULT WITH LV - AO PEAK GRAD >50mmHg WITHOUT A CALCIFIED VALVE
  ASYMPTOMATIC AS IN THE ADOLESCENT OR YOUNG AGE WITH PEAK GRAD >60mmHg

- CLASS IIb
  REASONABLE AS BRIDGE TO SURGERY IN HEMODYNAMICALLY UNSTABLE ADULT PATIENTS WHO ARE AT HIGH RISK FOR AVR
  REASONABLE FOR PALLIATION IN ADULT PATIENTS WITH AS IN WHOM AVR CANNOT BE PERFORMED BECAUSE OF SERIOUS COMBINED CONDITIONS

TECHNIQUE

RETROGRADE AORTIC TECHNIQUE MOST COMMONLY USED.
**COMPLICATIONS**

- PROCEDURAL DEATH (2%)
- CARDIAC ARREST (5%)
- EMERGENCY AVR (1%)
- LV PERFORATION (2%)
- EMBOLIC EVENT (1%)

VENTRICULAR ARRHYTHMIAS AND LBBB VERY COMMONLY INDUCED, TRANSIENT

**RESULTS**

- NONCALCIFIED CONGENITAL AS IN CHILDREN AND ADOLESCENTS
  
  **SUCCESS RATE** 80-90%
  
  **MORTALITY** 0.7%

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**Special Report**

**Percutaneous Transcatheter Implantation of an Aortic Valve Prosthesis for Calcific Aortic Stenosis**

- PV composed of 3 bovine pericardial leaflets mounted within a balloon-expandable stent
- 57-yr-M with calcific AS, cardiogenic shock, leg ischemia, and other associated noncardiac diseases.
- AVR declined
  
  Cribier et al., Circulation 2002

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**Indications for percutaneous AV replacement**

- Patients requiring AVR but at highest risk of potential complications of mechanical valves
- High operative risk
- Contraindications for anticoagulation
- Pregnancy

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**Percutaneous AV Replacement**

- The balloon-expandable Edwards SAPIEN valve incorporates a stainless steel stent, bovine pericardial leaflets, and a fabric sealing cuff.
- The self-expanding CoreValve device incorporates a nitinol (nickel-titanium) alloy stent with leaflets and a sealing cuff constructed of porcine pericardial tissue.
Technical difficulties

Precise placement very important

- Implantation above the valve near coronary orifice compromises the coronary flow.
- Implantation below the coronary orifice encroaching upon the LV – impair mitral valve function and risk of paraprosthetic insufficiency.
- High pressure in the left system risk of embolisation into ascending aorta / LV.

Technical difficulties

- Patients with AR – dilated aortic root is a limitation.
- Patients with AS – risk of calcium emboli during dilatation.
- Contraindications – Severe iliofemoral disease, Very small or large aortic annulus.

Complications

- Device migration
- MV laceration
- Paravalvular leak
- Arterial dissections and perforation
- Myocardial ischemia
- Stroke

Valve areas are reported to be larger than surgical prostheses with effective orifice areas of over 1.5sqcm.

Current prostheses are suitable for an echocardiographic annulus diameter between 16 and 26 mm.

With balloon expandable valves, success rates between 70-98% and mortality rates < 10% reported.

Multicenter analysis from the REVIVE-I and REVIVE-II trials confirm similar outcomes.
• Percutaneous aortic valve replacement offers the potential for significant benefit but is not without risk.
• Optimal outcomes will require cautious application, technological and procedural improvements, formal training, centers of expertise, further trials and ongoing surveillance.
• Currently this procedure can be considered for symptomatic patients who are poor candidates for conventional surgery.

CONCLUSIONS
• Medical therapy has limited role in the management of aortic stenosis
• AVR in symptomatic severe stenosis improves symptoms and survival
• AVR is offered for only high risk patients in asymptomatic aortic stenosis
• BAV is limited to children and young adults
• Percutaneous valve replacement offers an exciting therapy for high risk surgical candidates

Thank You