Valvular Heart Disease
Medical Management and Timing of Intervention

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Valvular Heart Disease

- Aortic Stenosis
- Aortic Regurgitation
- Mitral Regurgitation
- Mitral Stenosis
- Tricuspid Stenosis
- Tricuspid Regurgitation
Distribution of Valvular Heart Diseases in the Euro Heart Survey

5001 patients

Native Valve Disease 72%
- AS 34%
- AR 10%
- MS 10%
- MR 25%
- Multiple 20%
- Right 1%

Previous Valvular Intervention 28%
- Valve Repair 18%
- Valve Replacement 82%

(lung et al. Eur Heart J 2003;24:1244-53)
Aetiologies of Single Valvular Heart Diseases in the Euro Heart Survey

AS: 43%
AR: 13%
MR: 32%
MS: 12%

- Other
- Ischaemic
- Congenital
- Inflammatory
- Endocarditis
- Rheumatic
- Degenerative

(Iung et al. Eur Heart J 2003;24:1244-53)
Aortic Stenosis
Aortic Stenosis: Natural History

- Long asymptomatic period
- Very low risk of sudden death if asymptomatic (1%/year)
Aortic Stenosis: Timing of Surgery

Operative Mortality
AVR Hemodynamics
Anticoagulation/Hemorrhage
Valve Durability
Thromboembolism

Disease Progression
Risk of Sudden Death
LVH
Diastolic Dysfunction

Early AVR

Watchful Waiting
Indications for AS Intervention

Primary Indications AVR:

- **Severe AS with Symptoms**
  - What is “severe”?
  - What are “symptoms”?
- **Severe AS with reduced EF (<50%)**
- **Severe AS, patient undergoing cardiac surgery (CABG, aorta, or other valves)**
### Severity of AS: ACC/AHA

**Table 4. Classification of the Severity of Valve Disease in Adults**

<table>
<thead>
<tr>
<th>A. Left-sided valve disease</th>
<th>Aortic Stenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Mild</td>
</tr>
<tr>
<td>Jet velocity (m per second)</td>
<td>Less than 3.0</td>
</tr>
<tr>
<td>Mean gradient (mm Hg)*</td>
<td>Less than 25</td>
</tr>
<tr>
<td>Valve area (cm²)</td>
<td>Greater than 1.5</td>
</tr>
<tr>
<td>Valve area index (cm² per m²)</td>
<td></td>
</tr>
</tbody>
</table>
Low Gradient Aortic Stenosis

- Severe AS + Low Cardiac Output = Low gradient AS (Mean Gradient < 30mmHg)
Low Cardiac Output / Low Gradient AS: Two Patient Types

Severe AS with Elevated Afterload

Low Gradient (<30mm Hg)
Decreased Ejection Fraction
Low Stroke Volume
Low Calculated EOA

Likely To Benefit From Surgery

DIFFERENT CAUSES

Mild/Moderate AS with Low Contractile Function

Low Gradient (<30mm Hg)
Decreased Ejection Fraction
Low Stroke Volume
Low Calculated EOA

Unlikely To Benefit From Surgery

SAME RESULTS

How To Distinguish?

Low Gradient Aortic Stenosis

- **Dobutamine Stress Echo**
  - Start 5 mcg/kg/min, max 20mcg/kg/min
  - Severe AS: Valve Area change <0.2cm², gradient increases
  - AS Overestimated: Valve Area increases > 0.2 cm², little change in gradient
  - No Contractile Reserve: SV increase <20%, prognosis poor with or without surgery
Figure 8. Dobutamine stress echocardiography was requested in this 52-year-old man with a history of radiation therapy with heart failure symptoms, left ventricular dysfunction, and a calcified aortic valve. With dobutamine, ejection fraction (EF) and stroke volume (SV) increased, indicating contractile reserve. Outflow tract peak velocity increased from 0.9 to 1.0 cm/s (left ventricular outflow tract [LVOT] diameter 2.2 cm), so calculated aortic valve area was unchanged at 1.0 cm² at rest and at peak dose dobutamine consistent with stiff inflexible leaflets. AS-Jet = aortic jet.

Classic Symptoms in AS

- **Angina**
  Survival 5 years

- **Syncope**
  Survival 3 years

- **Heart Failure**
  Survival 18-24 months
AS Case 1

• 52 yo male with seizure history
  - AS: AVA 0.6 cm², MG 50 mmHg, Peak Vel. 5m/s
  - Passes out driving car, hits lamp post. Reports he smelled a sulfur smell prior to episode.
  - Neurologist writes: “Probable seizure, decision for AVR must rest on other criteria than this episode”

• What to do?
Severe Aortic Stenosis

Vmax greater than 4 m/s
AVA less than 1.0 cm²
Mean gradient > 40 mm Hg

Undergoing CABG or other heart surgery?

Symptoms?

Yes

Equivocal

Exercise test

Symptoms ↓BP

Less than 0.50

Severe valve calcification, rapid progression, and/or expected delays in surgery

Class I Class I Class IIb Class I Class IIb

Aortic Valve Replacement

Preoperative coronary angiography

Clinical follow-up, patient education, risk factor modification, annual echo

Re-evaluation

No

LV ejection fraction

Normal

Normal
Treadmill in AS

- Do only in Asymptomatic patients
- Brings out symptoms in 30% of AS patients
- Abnormal Hemodynamic Response:
  - Increase in BP < 20mmHg
- ST changes with exercise not specific (seen in 80% of AS patients)
- Best use in active patients < 70yo
- A IIb indication for AVR
Management of Asymptomatic Aortic Stenosis
Euro Heart Survey

92 Centers, 25 Countries
Mean age 66yo
There was no Age difference between patients with AS who had a decision to operate and those who did not (65 F 12 and 66 F 16 years, P = .64)

Changes to ACC/AHA 2006 Guidelines

- Deleted IIb indication for asymptomatic AS: Severe LVH
- Deleted IIb indication for asymptomatic AS: Ventricular Tachycardia
- Reason: Lack of Evidence
Use of BNP in AS


Fig. 1 Association between BNP levels (indicated as median and quartiles) and NYHA functional class (trend test, p < 0.01).

Fig. 2 ROC curve analysis of BNP and AVA measurements in patients with symptomatic AS.
Approach to Severe Aortic Stenosis

Additional evaluation of AS severity may include measurement of newer parameters, evaluation of the extent of leaflet calcification, cardiac catheterization, and/or dobutamine stress echocardiography.
AS Evaluation

- Echo to evaluate AS severity, LVEF, LVH
- Repeat Echo every
  - Severe AS: 1 year
  - Moderate AS: Every 1-2 years
  - Mild AS: Every 3-5 years
Med Rx of Aortic Stenosis

- Pulmonary congestion: Can use digitalis, diuretics, and ACE inhibitors.

- Acute pulmonary edema due to AS: Nitroprusside infusion may be used to reduce congestion, improve LV performance. Perform with hemodynamic monitoring.

- Digitalis: Reserve for low EF or atrial fibrillation

- Angina: Cautious use of nitrates and beta blockers

- Syncope: No specific medical therapy for syncope unless it is caused by a bradyarrhythmia or tachyarrhythmia.
Lipid Lowering in AS

- Preliminary data suggested lipid lowering with a statin reduced progression of AS

- SEAS Trial (Simvastatin and Ezetimibe Aortic Stenosis)
  - Double blind, placebo controlled trial
  - Randomized 1873 patients with AS
  - Showed no benefit of lipid lowering with these agents in AS
SEAS Trial Results in AS

- During follow-up of 52.2 months, no statistically significant difference in “primary outcome” (a combination of 9 different events)
  
  Simvastatin/Ezetemibe group (35.3%), placebo group (38.2%) (p 0.59).

- No difference in performance of AVR (p 0.97); however, there were fewer incidents of ischemic CV events in the treated group (p 0.02), mainly because fewer patients underwent coronary artery bypass graft (CABG).
Aortic Regurgitation
### Natural History of Aortic Regurgitation

<table>
<thead>
<tr>
<th>Category</th>
<th>Event</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptomatic patients with normal LV systolic function (268–277)</td>
<td>Progression to symptoms and/or LV dysfunction</td>
<td>Less than 6% per y</td>
</tr>
<tr>
<td></td>
<td>Progression to asymptomatic LV dysfunction</td>
<td>Less than 3.5% per y</td>
</tr>
<tr>
<td></td>
<td>Sudden death</td>
<td>Less than 0.2% per y</td>
</tr>
<tr>
<td>Asymptomatic patients with LV dysfunction (281–283)</td>
<td>Progression to cardiac symptoms</td>
<td>Greater than 25% per y</td>
</tr>
<tr>
<td>Symptomatic patients (284–288)</td>
<td>Mortality rate</td>
<td>Greater than 10% per y</td>
</tr>
</tbody>
</table>
## Definition of Severe Aortic Valve Regurgitation - An Integrative Approach

<table>
<thead>
<tr>
<th>Criteria Aortic Regurgitation</th>
<th>Specific signs of severe regurgitation</th>
<th>Supportive signs</th>
<th>Quantitative parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Central jet, width ≥ 65% of LVOT</td>
<td>• Pressure half-time &lt; 200 ms</td>
<td>Reg. Vol (ml/beat) ≥ 60</td>
</tr>
<tr>
<td></td>
<td>• Vena contracta &gt; 0.6 cm</td>
<td>• Holodiastolic aortic flow reversal in descending aorta</td>
<td>RF (%) ≥ 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Moderate or greater LV enlargement</td>
<td>ERO (cm²) ≥ 0.30</td>
</tr>
</tbody>
</table>

AR Case 2

- Asymptomatic 31 yo male with history of congenital aortic stenosis, s/p balloon valvuloplasty at age 12. Now with severe AR on TTE, EF 65%, dilated LV to 6.6 cm. TEE performed shows bicuspid aortic valve with ascending aorta 5.3 cm diameter. Loss of definition of sinotubular junction.

- Recommendation?
## Indications for Surgery in Aortic Regurgitation

### Severe AR

<table>
<thead>
<tr>
<th>Indication</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic patients (dyspnoea NYHA class II, III, IV or angina)</td>
<td>IB</td>
</tr>
<tr>
<td>Asymptomatic patients with resting LV EF ≤ 50%</td>
<td>IB</td>
</tr>
<tr>
<td>Patients undergoing CABG or surgery of ascending aorta, or on another valve</td>
<td>IC</td>
</tr>
<tr>
<td>Asymptomatic patients with resting LV EF &gt; 50% with severe LV dilatation:</td>
<td></td>
</tr>
<tr>
<td>- End diastolic dimension &gt; 70 mm</td>
<td>IIaC</td>
</tr>
<tr>
<td>- <em>or</em></td>
<td></td>
</tr>
<tr>
<td>- End systolic dimension &gt; 50 mm (or &gt; 25 mm/m² BSA)*</td>
<td>IIaC</td>
</tr>
</tbody>
</table>

*Changes in sequential measurements should be taken into account.*
**Indications for Surgery in Aortic Regurgitation**

**Whatever the Severity of AR**

<table>
<thead>
<tr>
<th>Patients who have aortic root disease with maximal aortic diameter*:</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 45 mm for patients with Marfan’s syndrome</td>
<td>IC</td>
</tr>
<tr>
<td>≥ 50 mm for patients with bicuspid valves</td>
<td>IIaC</td>
</tr>
<tr>
<td>≥ 55 mm for other patients</td>
<td>IIaC</td>
</tr>
</tbody>
</table>

* Decision should also take into account the shape and thickness of ascending aorta as well as the shape of the other parts of aorta.

For patients who have an indication for surgery on the aortic valve, lower thresholds can be used for combining surgery on the ascending aorta.
Management of Aortic Regurgitation

Significant enlargement of ascending aorta

- No
  - AR severe
    - No
    - Follow-up
    - Yes
      - Symptoms
        - No
          - Follow-up
        - Yes
          - LV EF ≤ 50% or EDD > 70 mm or ESD > 50 mm (or > 25 mm/m² BSA)
            - No
              - Follow-up
            - Yes
              - Surgery *

* surgery must also be considered if significant changes occur during follow-up
# AR Management

<table>
<thead>
<tr>
<th>AR</th>
<th>Symptoms</th>
<th>LV Function</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild-Moderate</td>
<td>No</td>
<td>Normal</td>
<td>No therapy</td>
</tr>
<tr>
<td>Severe</td>
<td>No</td>
<td>Normal</td>
<td>Medical</td>
</tr>
<tr>
<td>Severe</td>
<td>No</td>
<td>Depressed</td>
<td>AVR</td>
</tr>
<tr>
<td>Severe</td>
<td>Yes</td>
<td>Normal/Depressed</td>
<td>AVR</td>
</tr>
<tr>
<td>Severe</td>
<td>Severe</td>
<td>Severely Depressed</td>
<td>Medical leading to possible AVR</td>
</tr>
</tbody>
</table>
Data is mixed. Individual studies have shown:

- Nifedipine: Shown to delay time to surgery, reduce LV size (EDD, ESD), LV mass
- Hydralazine: Reduce LV size, LV mass
- ACE Inhibitors: Reduce LV size, LV mass
- ACEI, Nifedipine: No benefit
ACE Inhibitors in Aortic Regurgitation

- 76 patients with AI
  Randomized, double blind trial of Hydralazine vs Enalapril

- Results (1 year)
  - Enalapril patients had significant reduction in EDV and ESV and LV Mass
  - Hydralazine patients had no significant changes in ESV/LVM
  - Both Enalapril and Hydralazine reduced wall stress and improved exercise duration

Lin et al. JACC 1994;24:1046-53
Nifedipine for Aortic Regurgitation

- 143 asymptomatic patients with AI
- Nifedipine 20mg BID vs Digoxin 0.25 mg qd
- Valve Replacement by 6 years:
  - 34% of Digoxin patients
  - 15% of Nifedipine patients (P<0.001)
  - Valve replacement done for LV dysfunction ± symptoms

Scognamiglio et al, NEJM 1994;331:689-94
Vasodilator Therapy in AR

- 95 patients with severe AR
- Placebo vs Nifedipine vs. Enalapril
- 7 year followup
- No difference in need for AVR, development of symptoms, onset LV dysfunction, LV size, EF, LV mass

Vasodilator Therapy in AR

- **Class I:** Severe AR symptoms or LV dysfunction AND surgery not recommended
- **Class IIa:** Short term Rx to improve hemodynamics before AVR
- **Class IIb:** Long term in asymptomatic patients with normal LV function but enlarged LV
Medical Therapy of AR

- Goal is slowing of myocardial deterioration in AR
  - Should involve modulation of the JNK and related pathways
  - Should not block collagen synthesis
    - ACEI, ARB may be deleterious despite unloading effects
  - Should not be based on non-specific unloading
Mitral Regurgitation
# Definition of Severe Mitral Valve Regurgitation - An Integrative Approach

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<tr>
<th>Criteria Mitral Regurgitation</th>
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<td><strong>Specific signs of severe regurgitation</strong></td>
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<tr>
<td><strong>Supportive signs</strong></td>
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<tr>
<td><strong>Quantitative parameters</strong></td>
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</table>

Figure 3: Intraoperative view of a reconstructed mitral valve (indication: mitral regurgitation). Preoperatively, the posterior leaflet was prolapsed because of a chordal tear. The corresponding segment of the posterior leaflet was removed by quadrantectomy (a), the leaflet was reconstructed, and a flexible annuloplasty ring was implanted (b).
Treatment of Mitral Regurgitation

• Are current guidelines for patients with mitral regurgitation being followed?

• Are the current guidelines for treatment of mitral regurgitation adequate or should they be refined or expanded?
Characteristics of Patients with Severe Symptomatic MR Denied Surgery

EuroHeart Survey

92 Centers, 25 Countries

- Isolated MR (n=877)
  - No severe MR (n=331)
    - Symptoms missing, n=6
  - Severe MR (n=546)
    - No symptoms, n=144
    - Symptoms, n=396
      - No intervention, n=193 (49%)
      - Intervention, n=203 (51%)

Factors associated with a decision not to operate.
- LVEF (per 10% decrease) 0.0002 1.39 (1.17–1.66)
- Etiology P= 0.0006
  Ischemic 1  Non-ischemic 4.44 (1.96–10.76)
- Age (per 10-year increase) 0.001 1.40 (1.15–1.72)
- Charlson comorbidity index 0.004 1.38 (1.12–1.72)
- Degree of MR 0.005
In this contemporary pan-European survey including a wide range of centres, 49% of symptomatic patients with severe MR were denied surgery, although surgery is strongly recommended in symptomatic MR according to current guidelines. The characteristics independently associated with a decision not to operate were lower LVEF, nonischaemic aetiology, older age, higher Charlson comorbidity index, and grade 3 MR.
MV Repair in Severely Depressed EF ACORN Trial

- 193 patients
- Mean EF 23.9%
- Mean LVEDD 7.0cm
- 30 day/operative mortality only 1.6%


Figure 1. Kaplan-Meier survival curve for the entire group of 193 patients in the MV surgery stratum. See text for discussion.
MV Repair in ACORN Trial

Change in LV Ejection Fraction - MV Surgery Stratum

Change from baseline (units)

<table>
<thead>
<tr>
<th>Months since randomization</th>
<th>p-value</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.32</td>
<td>144</td>
</tr>
<tr>
<td>6</td>
<td>0.70</td>
<td>127</td>
</tr>
<tr>
<td>12</td>
<td>0.09</td>
<td>124</td>
</tr>
<tr>
<td>18</td>
<td>0.003</td>
<td>81</td>
</tr>
<tr>
<td>24</td>
<td>0.033</td>
<td>46</td>
</tr>
</tbody>
</table>

Do Elderly get Same Benefit from MVR?

- 1344 Patients undergoing MVR
- 284 patients >75yo
- Similar benefit in elderly from MVR
- Survival of degenerative disease MR patients was nearly identical to age matched population
Survival after MVR

Panel B shows survival of degenerative MR patients after repair vs. age matched general population.

Elderly get same benefit from MVR as younger patients.
Severe MR Alone is Associated with Worse Prognosis

Figure 1. Kaplan–Meier Estimates of the Mean (±SE) Rates of Overall Survival among Patients with Asymptomatic Mitral Regurgitation under Medical Management, According to the Effective Regurgitant Orifice (ERO). Values in parentheses are survival rates at five years.

Figure 2. Kaplan–Meier Estimates of the Mean (±SE) Rates of Death from Cardiac Causes among Patients with Asymptomatic Mitral Regurgitation under Medical Management, According to the Effective Regurgitant Orifice (ERO). Values in parentheses are survival rates at five years.
BNP and Prognosis in MR

Circulation. 2005;111:2391-2397
BNP and MR Severity

- In MR patients, BNP does not seem to correlate well with severity of MR

*Circulation. 2005;111:2391-2397*
BNP in MR

- BNP Levels correlate with increasing ESVI
- May be a marker for LV remodeling
- High predictive accuracy for increased ESVI
- Could BNP further stratify asymptomatic patients?

Am J Cardiol 2006;97:1029–1034
Exercise Testing in MR

- Cleveland Clinic: 139 patients with “pure” nonrheumatic MR going for MVR, NYHA I or II
  Excluded CAD, RHD, aortic valve disease, MS, prior surgery
- Average preop EF 64%
- Average postop EF 55% (range 28%-77%)
- 18 patients (24%) dropped EF<50%

Leung, Griffin, Thomas, Stewart, Cosgrove et al. J Am Coil Cardiol 1996;28:1198-205
Exercise Echo and MR
Predictors of Postop LV Dysfunction
Threshold for MV Repair

- Risk vs. Benefit
- Advances that reduce risk of MV repair would lower threshold for performing repair
- 30 New Percutaneous Valve devices from 26 different companies
- Could prompt wider use of MV Repair in patients with significant LV Dysfunction
MR Case 3

- 42 yo male with ESRD, CABG 1 year previously now with class IIIb (VO2 6.6) CHF, EF 25%, dilated LV (6.6) and severe MR. 4 admissions in last year for CHF, referred for transplant.
- ACEI, beta blocker, limited by hypotension. Dialysis shunt flow: 4l/m
- Increased frequency of dialysis to 4x/wk, restricted shunt to decrease volume load
- 6 months later: class II, MR mild-mod, LV size reduced to 5.9, EF 40% (MUGA). 3 years later, no further CHF admissions
- May be a candidate for nocturnal dialysis (10-12 hours)
MR Case 4

- Patient GS: 67 yo male with history of ischemic cardiomyopathy, LVEF 15%, severe MR on Echo with annular dilation. PA pressures 70 mmHg. He has had 7 admissions in the last 6 months for CHF. SBP is 80-85 on very low dose ACEI/beta blocker.
- Patient referred for transplant evaluation.
MR Case 4

- Patient referred to Cedars-Sinai for eValve Mitral clip procedure (Dr. Kar)
- Admitted on a Thursday AM, discharged the next day on Friday after successful repair (authorized an overnight stay)
- Patient alive and well with no further admissions in the last 2 years.
- However, EF is unchanged (20%)
End
**Indications for Surgery in Severe Chronic Organic Mitral Regurgitation**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic patients with LV EF &gt;30% and ESD &lt; 55 mm*</td>
<td>IB</td>
</tr>
<tr>
<td>Asymptomatic patients with LV dysfunction (ESD &gt; 45 mm* and/or LV EF ≤ 60%)</td>
<td>IC</td>
</tr>
<tr>
<td>Asymptomatic patients with preserved LV function and AF or pulmonary hypertension (sPAP &gt;50 mmHg at rest)</td>
<td>IIaC</td>
</tr>
<tr>
<td>Patients with severe LV dysfunction (LV EF &lt; 30% and/or ESD &gt; 55 mm*) refractory to medical therapy with high likelihood of durable repair and low comorbidity</td>
<td>IIaC</td>
</tr>
<tr>
<td>Asymptomatic patients with preserved LV function, high likelihood of durable repair, and low risk for surgery</td>
<td>IIbB</td>
</tr>
<tr>
<td>Patients with severe LV dysfunction (LV EF &lt; 30% and/or ESD &gt; 55 mm*) refractory to medical therapy with low likelihood of repair and low comorbidity</td>
<td>IIbC</td>
</tr>
</tbody>
</table>

* Lower values can be considered for patients of small stature.
# Indications for Surgery in Chronic Ischaemic Mitral Regurgitation

<table>
<thead>
<tr>
<th>Indication</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with severe MR, LV EF &gt; 30% undergoing CABG</td>
<td>IC</td>
</tr>
<tr>
<td>Patients with moderate MR undergoing CABG if repair is feasible</td>
<td>IIaC</td>
</tr>
<tr>
<td>Symptomatic patients with severe MR, LV EF &lt;30% and option for revascularization</td>
<td>IIaC</td>
</tr>
<tr>
<td>Patients with severe MR, LVEF &gt; 30%, no option for revascularization, refractory to medical therapy, and low comorbidity</td>
<td>IIbC</td>
</tr>
</tbody>
</table>
Management of Asymptomatic Severe Chronic Organic Mitral Regurgitation

Severe asymptomatic organic MR

LVEF > 60% and LVESD < 45 mm

Yes

Atrial fibrillation or sPAP > 50 mmHg at rest

No

Follow-up*

Yes

Surgery (repair whenever possible)

No

* valve repair can be considered when there is a high likelihood of durable valve repair at a low risk
Management of Symptomatic Severe Chronic Organic Mitral Regurgitation

Severe symptomatic organic MR

LVEF > 30%

Yes

Surgery (repair whenever possible)

No

Refractory to medical therapy

Yes

Valve repair is likely and low comorbidity

No

Medical therapy

Medical therapy

* Valve replacement can be considered in selected patients
Medical Therapy of MR

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Drug</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heck, 1985</td>
<td>10</td>
<td>Captopril</td>
<td>Negative</td>
</tr>
<tr>
<td>Wisenbaugh 1994</td>
<td>12</td>
<td>Captopril</td>
<td>Negative</td>
</tr>
<tr>
<td>Schon 1994</td>
<td>12</td>
<td>Quinapril</td>
<td>Negative</td>
</tr>
<tr>
<td>Sampaio 2005</td>
<td>47</td>
<td>Enalapril</td>
<td>Negative</td>
</tr>
</tbody>
</table>

Benefits of ACEI in chronic MR not established
Mitral Stenosis
Severity of MS

<table>
<thead>
<tr>
<th>Mitral Stenosis</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean gradient (mm Hg)*</td>
<td>Less than 5</td>
<td>5–10</td>
<td>Greater than 10</td>
</tr>
<tr>
<td>Pulmonary artery systolic pressure (mm Hg)</td>
<td>Less than 30</td>
<td>30–50</td>
<td>Greater than 50</td>
</tr>
<tr>
<td>Valve area (cm²)</td>
<td>Greater than 1.5</td>
<td>1.0–1.5</td>
<td>Less than 1.0</td>
</tr>
</tbody>
</table>
Mitral Stenosis: Medical Therapy

- Prevention of thromboembolism: Coumadin
  - Class I: Afib, Prior TE, or LA clot
  - Class Iib: LA>55mm or SEC in enlarged LA

- Heart rate control
  - Avoid strenuous activity
  - Beta blockers
  - Calcium Channel blockers

- Prevention/Treatment of atrial fibrillation
## Mitral Stenosis

**Wilkins Score**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mobility</th>
<th>Subvalvular Thickening</th>
<th>Thickening</th>
<th>Calcification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Highly mobile valve with only leaflet tips restricted</td>
<td>Minimal thickening just below the mitral leaflets</td>
<td>Leaflets near normal in thickness (4 to 5 mm)</td>
<td>A single area of increased echo brightness</td>
</tr>
<tr>
<td>2</td>
<td>Leaflet mid and base portions have normal mobility</td>
<td>Thickening of chordal structures extending up to one third of the chordal length</td>
<td>Midleaflets normal, considerable thickening of margins (5 to 8 mm)</td>
<td>Scattered areas of brightness confined to leaflet margins</td>
</tr>
<tr>
<td>3</td>
<td>Valve continues to move forward in diastole, mainly from the base</td>
<td>Thickening extending to the distal third of the chords</td>
<td>Thickening extending through the entire leaflet (5 to 8 mm)</td>
<td>Brightness extending into the midportion of the leaflets</td>
</tr>
<tr>
<td>4</td>
<td>No or minimal forward movement of the leaflets in diastole</td>
<td>Extensive thickening and shortening of all chordal structures extending down to the papillary muscles</td>
<td>Considerable thickening of all leaflet tissue (greater than 8 to 10 mm)</td>
<td>Extensive brightness throughout much of the leaflet tissue</td>
</tr>
</tbody>
</table>

**Optimal for PMC**: Wilkins score $< 8$
### Indications for Percutaneous Mitral Commissurotomy in Symptomatic Mitral Stenosis with Valve Area < 1.5 Cm²

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB</td>
<td>Symptomatic patients with favourable characteristics for percutaneous mitral commissurotomy</td>
</tr>
<tr>
<td>IC</td>
<td>Symptomatic patients with contra-indication or high risk for surgery</td>
</tr>
<tr>
<td>IIaC</td>
<td>As initial treatment in symptomatic patients with unfavourable anatomy but otherwise favourable clinical characteristics</td>
</tr>
</tbody>
</table>
Management of Severe Symptomatic Mitral Stenosis

Contraindications To Percutaneous Mitral Commiss
Management of Severe Asymptomatic Mitral Stenosis

Asx MS MVA < 1.5

High risk of embolism or haemodynamic decompensation

Yes

CI to or unfavourable characteristics for PMC

No

PMC

Yes

Exercise testing

Symptoms

No symptoms

Follow-up
Contraindications to Percutaneous Mitral Commissurotomy

- Mitral valve area > 1.5 cm²
- Left atrial thrombus
- More than mild mitral regurgitation
- Severe- or bicommissural calcification
- Absence of commissural fusion
- Severe concomitant aortic valve disease, or severe combined tricuspid stenosis and regurgitation
- Concomitant coronary artery disease requiring bypass surgery
Suitability for Percutaneous Mitral Commissurotomy

Favourable characteristics can be defined by the absence of several of the following unfavourable characteristics:

- *Clinical characteristics*: old age, history of commissurotomy, NYHA class IV, atrial fibrillation, severe pulmonary hypertension,

- *Anatomic characteristics*: echo score >8, Cormier score 3 (Calcification of mitral valve of any extent, as assessed by fluoroscopy), very small mitral valve area, severe tricuspid regurgitation.
# Tricuspid Valve Disease

## Indications for Intervention in Tricuspid Valve Diseases

<table>
<thead>
<tr>
<th>Indication</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe TR in a patient undergoing left sided valve surgery</td>
<td>IC</td>
</tr>
<tr>
<td>Severe primary TR and symptoms despite medical therapy without severe right ventricular dysfunction</td>
<td>IC</td>
</tr>
<tr>
<td>Severe TS ($\pm$ TR), with symptoms despite medical therapy</td>
<td>IC</td>
</tr>
<tr>
<td>Severe TS ($\pm$ TR) in a patient undergoing left sided valve intervention</td>
<td>IC</td>
</tr>
<tr>
<td>Moderate organic TR in a patient undergoing left-sided valve surgery</td>
<td>IIaC</td>
</tr>
<tr>
<td>Moderate secondary TR with dilated annulus (&gt; 40 mm) in a patient undergoing left sided valve surgery</td>
<td>IIaC</td>
</tr>
<tr>
<td>Severe TR and symptoms, after left-sided valve surgery, in the absence of left sided myocardial, valve, or right ventricular dysfunction and without severe pulmonary hypertension ($sPAP &gt; 60 \text{ mmHg}$)</td>
<td>IIaC</td>
</tr>
<tr>
<td>Severe isolated TR with mild or no symptoms and progressive dilation or deterioration of right ventricular function</td>
<td>IIbC</td>
</tr>
</tbody>
</table>

* Percutaneous technique can be attempted as a first approach if TS is isolated.
Surgical Considerations
Operative Mortality after surgery for valvular heart disease

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic valve replacement, no CABG (%)</td>
<td>3.7</td>
<td>3.1</td>
<td>2.7</td>
</tr>
<tr>
<td>Aortic valve replacement + CABG (%)</td>
<td>6.3</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>Mitral valve repair, no CABG (%)</td>
<td>2.2</td>
<td>2.8</td>
<td>0</td>
</tr>
<tr>
<td>Mitral valve replacement, no CABG (%)</td>
<td>5.8</td>
<td>6.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Mitral valve repair or replacement + CABG (%)</td>
<td>10.1</td>
<td>8.6</td>
<td>8.2</td>
</tr>
</tbody>
</table>

CABG = coronary artery bypass grafting.
STS = Society of Thoracic Surgeons (USA). Mortality for STS includes first and redo interventions. UKCSR = United Kingdom Cardiac Surgical Register. Mortality for UKCSR corresponds to first interventions only. EHS = Euro Heart Survey. CABG = coronary artery bypass grafting.
# Risk Assessment for Valve Surgery

## EuroSCORE

<table>
<thead>
<tr>
<th>Patient-related factors</th>
<th>Cardiac-related factors</th>
<th>Operation-related factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Unstable angina³</td>
<td>Emergency²</td>
</tr>
<tr>
<td>Gender</td>
<td>LV function</td>
<td>Other than isolated CABG</td>
</tr>
<tr>
<td>Chronic pulmonary disease¹</td>
<td>Recent MI'</td>
<td>Surgery on thoracic aorta</td>
</tr>
<tr>
<td>Extracardiac arteriopathy²</td>
<td>Pulmonary hypertension⁵</td>
<td>Post infarct septal rupture</td>
</tr>
<tr>
<td>Neurological dysfunction³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous Cardiac Surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creatinine &gt; 200 μmol/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active endocarditis⁴</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical preoperative state⁵</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Standard EuroSCORE**

[http://www.euroscore.org/calc.html](http://www.euroscore.org/calc.html)

# EuroScore Definitions

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>EuroSCORE definition</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&lt;60 years</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>60–64</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>65–69</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>70–74</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>75–79</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>80–84</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>85–89</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>90–94</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>≥95</td>
<td>8</td>
</tr>
<tr>
<td>Sex</td>
<td>Female</td>
<td>1</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>Long-term use of bronchodilators or steroids for lung disease</td>
<td>1</td>
</tr>
<tr>
<td>Extracardiac arteriopathy</td>
<td>Claudication, carotid occlusion or stenosis &gt;50%, previous or planned intervention on the abdominal aorta, limb arteries or carotids</td>
<td>2</td>
</tr>
<tr>
<td>Neurological dysfunction</td>
<td>Severely affecting ambulation or day-to-day functioning</td>
<td>2</td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>Requiring opening of the pericardium</td>
<td>3</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>&gt;200 μM/L preoperatively</td>
<td>2</td>
</tr>
<tr>
<td>Active endocarditis</td>
<td>Patient still under antibiotic treatment for endocarditis at the time of surgery</td>
<td>3</td>
</tr>
<tr>
<td>Critical preoperative state</td>
<td>Ventricular tachycardia, fibrillation or aborted sudden death, preoperative cardiac massage, preoperative ventilation, preoperative inotropic support, intra-aortic balloon counterpulsation, or preoperative acute renal failure (anuria or oliguria &lt;10 mL/h)</td>
<td>3</td>
</tr>
<tr>
<td>Unstable angina</td>
<td>Rest angina requiring intravenous nitrates until arrival in the anaesthetic room</td>
<td>2</td>
</tr>
<tr>
<td>LV dysfunction</td>
<td>Moderate (LVEF 30–50%)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Poor (LVEF &lt;30%)</td>
<td>3</td>
</tr>
<tr>
<td>Recent MI</td>
<td>&lt;90 days</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td>Systolic pulmonary artery pressure &gt;60 mmHg</td>
<td>2</td>
</tr>
<tr>
<td>Emergency</td>
<td>Carried out on referral before the beginning of the next working day</td>
<td>2</td>
</tr>
<tr>
<td>Other than isolated CABG</td>
<td>Major cardiac procedure other than or in addition to CABG</td>
<td>2</td>
</tr>
<tr>
<td>Surgery on thoracic aorta</td>
<td>For disorder of ascending, arch, or descending aorta</td>
<td>3</td>
</tr>
<tr>
<td>Post-infarct septal rupture</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

CABG = coronary artery bypass grafting, LV = left ventricular, EF = ejection fraction, MI = myocardial infarction.

The estimation of the operative mortality for a given patient can be obtained using a calculator accessible at [http://www.euroscore.org/calc.html](http://www.euroscore.org/calc.html). From Roques et al. 19
Factors Favoring Mechanical Valve

Desire of the informed patient and absence of contraindication for long-term anticoagulation
Patients at risk of accelerated SVD
Patient already on anticoagulation because of other mechanical prosthesis
Patients already on anticoagulation because at high risk for thrombo-embolism
Age <65–70 and long life expectancy
Patients for whom future redo valve surgery would be at high risk (due to LV dysfunction, previous CABG, multiple valve prosthesis)

CABG = coronary artery bypass grafting, LV = left ventricular, SVD = structural valve deterioration.

a The decision is based on the integration of several of the factors given in the table.
b Young age, hyperparathyroidism.
c Risk factors for thrombo-embolism: severe LV dysfunction, atrial fibrillation, previous thrombo-embolism, hypercoagulable state.
d According to age, gender, the presence of comorbidity, and country-specific life expectancy.
Factors Favoring Tissue Valve

<table>
<thead>
<tr>
<th>Factor</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desire of the informed patient</td>
<td>IC</td>
</tr>
<tr>
<td>Unavailability of good-quality anticoagulation</td>
<td>IC</td>
</tr>
<tr>
<td>(contraindication or high risk, unwillingness, compliance problems, lifestyle, occupation)</td>
<td>IC</td>
</tr>
<tr>
<td>Re-operation for mechanical valve thrombosis in a patient with proven poor anticoagulant control</td>
<td>IC</td>
</tr>
<tr>
<td>Patient for whom future redo valve surgery would be at low risk</td>
<td>IIaC</td>
</tr>
<tr>
<td>Limited life expectancy, severe comorbidity, or age &gt; 65 - 70</td>
<td>IIaC</td>
</tr>
<tr>
<td>Young woman contemplating pregnancy</td>
<td>IIbC</td>
</tr>
</tbody>
</table>

*a The decision is based on the integration of several of the factors given in the table.

*b According to age, gender, the presence of comorbidity, and country-specific life expectancy.