Σύμπλοκες βαλβιδοπάθειες
Στένωση αορτής & ανεπάρκεια μιτροειδούς

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Multivalve disease: prevalence

• According to the Society of Thoracic Surgeons Database, multivalve surgery accounted for 8.6% of all 86,580 valvular surgical procedures performed between 1986 and 1995.


• In the EuroHeart Survey, up to 15% of the patients undergoing valve surgery had multiple valve disease.

Prevalence of MR in pts undergoing AV procedure

Aortic valve replacement

N = 7758
Variable inclusion/exclusion criteria
Mainly non-quantitative MR assessment

Mild 30-80%

Moderate – Severe 15%

TAVI

N = 950
Organic 50-80%
Mainly non-quantitative MR assessment

Mild 70-80%
Moderate – Severe 25-45%

Unger P. ESC Congress 2012
Multivalve disease: aetiology

- Rheumatic heart disease
- Degenerative
- Endocarditis
- End-stage renal disease on haemodialysis
- Connective disorders (Marfan and Ehlerse-Danlos syndromes)
- Thoracic and mediastinal radiation therapy
- Carcinoid disease
- Adverse drug effects (ergot-derived agonists, anorectic agents)
Multivalve disease – evaluation tips

Separate assessment of each valve lesion

Interaction between different valve lesions

Myocardial dysfunction assessment
Multivalve disease – evaluation tips

• **Echocardiography** is the preferred method.

• **Haemodynamic interactions**, including changes in stroke volume and in intracardiac pressure, **may affect the diagnostic accuracy** of several non-invasive echo diagnostic methods (and also invasive methods).

• Doppler-echocardiographic measures that have been validated in single valve disease may not be valid in multivalve disease. **Measurements that are less dependent on loading conditions are preferred**, such as direct planimetry of the stenotic valve.
AS and MVR: pathophysiology

Multivalve disease – diagnostic caveats

<table>
<thead>
<tr>
<th>Impacts on the diagnosis of:</th>
<th>AS</th>
<th>AR</th>
<th>MR</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>NA</td>
<td>Prolonged PHT if left ventricular hypertrophy with impaired relaxation</td>
<td>High intraventricular pressure may result in higher RV whereas ERO is less affected</td>
<td>Low-flow low-gradient MS. Prolonged PHT if impaired left ventricular relaxation</td>
</tr>
<tr>
<td>AR</td>
<td>Gorlin formula using thermodilution technique invalid. Owing to high transaortic volume flow rate, maximum velocity, and pressure gradients may be higher than expected for a given valve area</td>
<td>NA</td>
<td>Not significantly affected</td>
<td>Owing to increased anterograde aortic flow, there is an overestimation of MVA by the continuity equation. Overestimation of MVA with PHT method. This approach is not valid</td>
</tr>
<tr>
<td>The presence of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MR</td>
<td>MR could favour a low-flow, low-gradient state. Aortic valve area calculation remains accurate. High-velocity MR jet may be mistaken for the AS jet (MR is longer in duration)</td>
<td>Not significantly affected</td>
<td>NA</td>
<td>Owing to increased anterograde mitral flow, there is an underestimation of MVA by the continuity equation. MVA may be underestimated with PHT method</td>
</tr>
<tr>
<td>MS</td>
<td>Low-flow low-gradient state. Aortic valve area calculation remains accurate</td>
<td>Blunted hyperdynamic circulation</td>
<td>Not significantly affected</td>
<td>NA</td>
</tr>
<tr>
<td>TR</td>
<td>Gorlin formula invalid</td>
<td>Not affected</td>
<td>Not affected</td>
<td>Gorlin formula invalid</td>
</tr>
</tbody>
</table>

AR, aortic regurgitation; AS, aortic stenosis; ERO, effective regurigitant orifice; MR, mitral regurgitation; MS, mitral stenosis; MVA, mitral valve area; PHT, pressure half-time; RV, regurgitant volume; NA, not applicable.

Aortic gradient should not be used as the sole measure of AS severity, since it may underestimate it.

Measurement of the MR EROA as routine
Multivalve disease: no evidence-based recommendations in current guidelines

Significant stenosis and regurgitation can be found on the same valve. Disease of multiple valves may be encountered in several conditions, particularly in rheumatic and congenital heart disease, but also less frequently in degenerative valve disease. There is a lack of data on combined or multiple-valve diseases. This does not allow for evidence-based recommendations.

2017 ESC/EACTS Guidelines for the management of valvular heart disease
Surgical decision-making process

- Risks associated with multivalve surgery

- Perioperative risk of non-correcting all significant lesions

- Likelihood of the necessity and risk of a future reoperation
Multivalve disease – management

- Combined valve replacement tends to be associated with greater perioperative risk and poorer survival:
  - **Operative risk**: 0.9 - 3.9% for single valve interventions rose to 6.5% in cases of multiple valve disease (EuroHeart Survey-2003)
  - **Mortality** increased from 4.3% and 6.4% for isolated aortic and mitral valve replacement, respectively, to 9.6% for combined valve replacement.

Society of Thoracic Surgeons National Database report-2005
Mitral valve repair should be preferred to replacement as it improves late survival.

AV replacement indications if surgery is indicated for severe MR:

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>d) Concomitant aortic valve surgery at the time of other cardiac/ascending aorta surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAVR is indicated in patients with severe aortic stenosis undergoing CABG, or surgery of the ascending aorta or of another valve.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>SAVR should be considered in patients with moderate aortic stenosis* undergoing CABG, or surgery of the ascending aorta or of another valve after Heart Team decision.</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</table>

* Moderate aortic stenosis is defined by a valve area of 1.0–1.5 cm² or a mean gradient of 25–40 mmHg in the presence of normal flow conditions. However, clinical judgement is required.
Severe organic MR undergoing surgery with low flow-low grad AOS

LVOT diam 2.2cm

Mean grad 20mmHg
AVA 0.75cm²
Svi 35ml

LVOT VTI 9.5cm

Severe MVR

Philippe Unger et al. Heart 2011;97:272e277
Does SAVR/TAVI affect the MVR severity?
Multivalve disease – management

Impact of isolated aortic valve replacement on mitral regurgitation

<table>
<thead>
<tr>
<th>First author, Year</th>
<th>Aetiology of MR</th>
<th>Number of patients</th>
<th>Timing of the postop echo</th>
<th>Method of MR assessment</th>
<th>% of patients with improvement in MR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tunick 1990</td>
<td>Functional + Organic</td>
<td>N = 27 ≥ mild MR</td>
<td>58 days</td>
<td>CFM</td>
<td>67%</td>
</tr>
<tr>
<td>Adams 1990</td>
<td>Organic + Functional</td>
<td>N = 46 ≥ mild MR</td>
<td>6 months</td>
<td>PW mapping</td>
<td>27%</td>
</tr>
<tr>
<td>Harris 1997</td>
<td>Functional</td>
<td>N = 28 ≥ mild MR</td>
<td>2 months</td>
<td>PW mapping</td>
<td>82%</td>
</tr>
<tr>
<td>Brasch 2000</td>
<td>Organic + Functional</td>
<td>N = 16 ≥ moderate MR</td>
<td>1 week/3 months</td>
<td>PW mapping</td>
<td>44%</td>
</tr>
<tr>
<td>Christenson 2000</td>
<td>Functional</td>
<td>N = 58 ≥ mild MR</td>
<td>1 week/3 months</td>
<td>PW mapping</td>
<td>44%</td>
</tr>
<tr>
<td>Tassan-Mangina 2003</td>
<td>Functional</td>
<td>N = 23 ≥ mild MR</td>
<td>5 months</td>
<td>PW mapping</td>
<td>82%</td>
</tr>
<tr>
<td>Mozazami 2004</td>
<td>Functional</td>
<td>N = 80 ≥ mild MR</td>
<td>&gt; 60 days</td>
<td>PW mapping</td>
<td>67%</td>
</tr>
<tr>
<td>Barreiro 2005</td>
<td>Organic + Functional</td>
<td>N = 70 ≥ moderate MR</td>
<td>1 year</td>
<td>PW, Doppler mapping</td>
<td>55%</td>
</tr>
<tr>
<td>Ruel 2006</td>
<td>Functional</td>
<td>N = 107 ≥ 2+ MR</td>
<td>before discharge</td>
<td>PW, Doppler mapping</td>
<td>72%</td>
</tr>
<tr>
<td>Vanden Eynden 2007</td>
<td>Organic + Functional</td>
<td>N = 80 ≥ moderate MR</td>
<td>1 year</td>
<td>PW, Doppler mapping</td>
<td>86%</td>
</tr>
<tr>
<td>Caballero-Borrego 2008</td>
<td>Functional</td>
<td>N = 153 non-severe MR</td>
<td>before discharge</td>
<td>PW, Doppler mapping</td>
<td>72%</td>
</tr>
<tr>
<td>Wachtbren 2008</td>
<td>Functional (No CABG)</td>
<td>N = 157 ≥ moderate MR</td>
<td>1 year</td>
<td>PW Doppler mapping</td>
<td>86%</td>
</tr>
<tr>
<td>Wan 2009</td>
<td>Functional</td>
<td>N = 159 ≥ moderate MR</td>
<td>1 year</td>
<td>PW Doppler mapping</td>
<td>76%</td>
</tr>
<tr>
<td>Unger 2008</td>
<td>Organic + Functional</td>
<td>N = 52 ≥ mild MR</td>
<td>Early postoperative</td>
<td>PISA</td>
<td>69%</td>
</tr>
<tr>
<td>Matsumura 2010</td>
<td>Functional</td>
<td>N = 110 ≥ moderate MR</td>
<td>Early postoperative</td>
<td>PISA</td>
<td>64%</td>
</tr>
<tr>
<td>Joo 2011</td>
<td>Functional</td>
<td>N = 118 &gt; mild MR</td>
<td>57 months</td>
<td>PISA</td>
<td>72%</td>
</tr>
</tbody>
</table>

16 studies
1294 patients with MR

Mostly retrospective
Mainly qualitative or half quantitative MR assessment

From OR up to 18 months

Functional only (10) or Functional + organic (6)

Improvement 55-65% (27-82%)
Deterioration 5-10%
Most patients present some decrease in MR severity after isolated AVR.

Which are the **predictive factors** of this beneficial effect?
Predictive factors of MR severity after AV intervention (SAVR/TAVI)

Factors related to **decrease** in MR severity

<table>
<thead>
<tr>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced LV systolic pressure (haemodynamic success of SAVR/TAVR)</td>
</tr>
<tr>
<td>Reversal of LV remodelling</td>
</tr>
<tr>
<td>Absence of mitral annular calcification</td>
</tr>
<tr>
<td>Secondary mitral regurgitation</td>
</tr>
<tr>
<td>LVEDD ≥ 50 mm</td>
</tr>
<tr>
<td>LVESD ≥ 36 mm</td>
</tr>
<tr>
<td>Absence of atrial fibrillation</td>
</tr>
<tr>
<td>Absence of pulmonary hypertension</td>
</tr>
<tr>
<td>Mean gradient ≥ 40 mm Hg</td>
</tr>
<tr>
<td>Valve type (balloon-expandable)</td>
</tr>
<tr>
<td>Previous coronary artery disease or myocardial infarction</td>
</tr>
</tbody>
</table>

Factors related to **increase** in MR severity

<table>
<thead>
<tr>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient-prosthesis mismatch (persistently high LV pressure)</td>
</tr>
<tr>
<td>Continued LV remodelling</td>
</tr>
<tr>
<td>Dilated mitral annulus</td>
</tr>
<tr>
<td><strong>Primary mitral regurgitation</strong></td>
</tr>
<tr>
<td>Dilated left atrium</td>
</tr>
<tr>
<td>Dilated mitral annulus</td>
</tr>
<tr>
<td>Self-expanding valve with deep implant</td>
</tr>
<tr>
<td>Moderate or greater aortic regurgitation</td>
</tr>
</tbody>
</table>

Sannino A, Grayburn PA. Heart 2018 (modified)
MV surgery indications
if surgery is indicated for severe AS:

• **Severe** MR associated with AS should be corrected at the time of AVR, particularly if the aetiology is **organic**.

• The management of **less-than-severe** and particularly **secondary** MR remains debated.
Different MR aetiologies in pts with severe AS

A. Flail P2 scallop

B. Calcification

C. Prolapse

D. Secondary ischemic MR
Threshold of MR severity when exist severe AS?

- Ischaemic (functional) MR
  - ERO > 20mm²

- Organic MR
  - ERO > 40mm²

- Rarely downgrading after AVR
- Risk of future reoperation

ERO ≈ 30 cm² ????

Proposed algorithm for the evaluation and management of patients with severe aortic stenosis (AS) and concomitant mitral regurgitation (MR).

1. Comprehensive Evaluation of the Mechanism and Severity of MR per ASE Guidelines
   - If TTE findings uncertain or discordant, consider TEE, CMR or RLHC

   **Mild or Moderate MR**

   SAVR vs TAVR per guideline indications
   - no current indication for surgical or transcatheter therapy for mild/moderate (Stage B) MR

   **EROA 0.2-0.29cm²**
   **Rvol 30-44ml**
   **RF<30-39%**

2. **Severe MR**
   - Is there classic secondary MR due to LV dysfunction/leaflet tethering?
     - yes
     - Optimize guideline-directed medical therapy, CRT, and revascularization, if indicated, then reassess MR severity
     - no

   **Primary MR**

   - No major anatomic lesion; MR could potentially improve with resolution of AS
   - Major anatomic lesion unlikely to improve with resolution of AS (i.e. flail leaflet, absent coaptation)

3. 1) Guideline-directed SAVR vs TAVR; reassess MR severity at one month; if still severe MR, minimally invasive surgical or transcatheter MVR/repair vs medical therapy/hospice (Cohort C)

4. 1) Combined SAVR + MVR or repair (low/intermediate risk) vs TAVR or SAVR followed by minimally invasive surgical or transcatheter MVR/repair (intermediate or high risk) vs medical therapy/hospice (Cohort C)
CASE 1

Severe AS undergoing surgery with concomitant moderate primary MR/MS
Severe AS and moderate MR/MS
Severe AS and moderate to severe MR/TVR
Severe AS
Moderate MR / Moderate MS
SEVERE SECONDARY TVR ELEVATED RV PRESSURES
Severe AS undergoing surgery with concomitant moderate MR/MS (rheumatic heart disease)

Clinical decision

AO & MV VALVE REPLACEMENT
TR VALVE REPAIR
CASE 2

Severe AS undergoing surgery
with concomitant secondary moderate MR
Severe AS / Low LVEF
Low LVEF – Moderate MR
Low LVEF – Moderate MR
Low flow-low gradient AS – moderate secondary MR

Severe low flow-low gradient AS

Moderate MR stage C
Severe AS undergoing surgery with concomitant secondary-ischemic MR high operative risk / comorbidities

Clinical decision

PCI to LAD + TAVI

Optimized medical therapy

Close f-up of MR, considering future Mitraclip
Key points - Combined AOS/MR

✓ Combined AOS/MR is a highly prevalent condition

✓ Haemodynamic interactions between valve lesions can promote, exacerbate, or, in contrast, blunt the clinical expression of each singular lesion

✓ Several diagnostic echocardiography tools used for single valve disease assessment, might not be so accurate for a multivalvulopathy evaluation and need much caution and deep pathophysiology knowledge

✓ Therapeutic decisions should be made by a heart valve team, considering the severity of MVD, the patient’s life expectancy and comorbidities, and the risks of multiple prostheses and eventual reoperation

✓ The introduction of transcatheter valve therapies is changing the therapeutic paradigm, but further studies are needed to guide therapeutic decision-making
Σας ευχαριστώ