Assessing function by echocardiography in valvular heart disease

Multivalvular disease

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DECLARATION OF CONFLICT OF INTEREST

☑ None
Multivalvular disease

- Multivalvular heart disease is not uncommon, EHS > 15% of valve surgery.

- Data on multivalve disease is scarce because of a large number of possible combinations. Many areas are not covered by the Guidelines.

- Difficulties:
  Exact quantification of different valve lesions.
  Overlap in surgical indications.
Multivavular Disease
Quantification of Severity

- Doppler-echocardiographic methods have been validated in single valve disease but not in multivalve disease.

- Interactions between different valve lesions.

- Methods that depend less on loading conditions are preferred, such as direct planimetry of the stenotic valves.
Causes of multivalve heart disease

- Rheumatic heart disease
- Infective endocarditis
- Degenerative valve calcification
- Cardiac remodelling/dilatation (functional)

- Adverse effects of treatment thoracic/mediastinal radiation therapy
- Adverse drug effects (ergot-derived agonists, anorectic agents)
- End-stage renal disease on haemodialysis

- Carcinoid heart disease
- Connective tissue disorders (Marfan syndrome, etc)
I- Aortic Stenosis and Mitral Regurgitation
Pathophysiology of interaction between AS and MR
Aortic Stenosis and Mitral Regurgitation

- With severe MR, transaortic flow rate may be low resulting in a low gradient even when severe AS is present; valve area calculations remain accurate.

- Attention: Valve calcification, LV size, LV hypertrophy, LA size, PAP.

- Careful evaluation of MR mechanism is crucial for the decision of whether also to operate on the mitral valve.
Severe Mitral Regurgitation and Aortic Stenosis
Mitral Regurgitation in Aortic Stenosis

- MR often coexist with severe AS.

- Careful echo examination is needed to obtain an etiologic diagnosis of the mitral disease and grading the severity of the MR.

- When both valve lesions are severe surgery is recommended for both lesions. If mitral lesion is feasible mitral valve repair + AVR is recommended.

- When MR is moderate or functional a conservative approach to concomitant aortic surgery should be considered.
Management of Mitral Regurgitation in severe Aortic Stenosis.
II- Mitral Stenosis and Aortic Stenosis

- The main aetiology is rheumatic heart disease.

- Difficulty in quantification: a low-flow, low-gradient situation may occur in both valves.

- Emphasize “area assessment” in both stenosis.

- Risk. Failure to recognise significant AS in PMV: sudden haemodynamic changes in a previously protected LV may lead to pulmonary oedema.
Mitral Stenosis and Aortic Stenosis

- In severe MS and non-severe AS, PMV should be considered.

- Main difficulty is to assess AS severity: low flow-low gradient and atrial fibrillation.
The association MS and AR is common. Approximately 10% of patients with MS also have significant rheumatic AR.

The pressure half-time across the mitral valve may be shortened, leading to underestimated MS severity.

MS and AR generate opposite loading conditions. Hyperdynamic contractility and LV enlargement may be less evident.
Mitral Stenosis with Aortic Regurgitation
The association of MR and AR may be caused by rheumatic heart disease, prolapse of AO - MI valves, (Marfan, aortic ectasia). About 17% of patients who undergo surgery for myxomatous aortic valve require surgical correction of mitral regurgitation.

The combination of mitral and aortic valve regurgitation produces severe volume overload of the left ventricle.

The reduction of ejection impedance allows the ventricle to empty further, reducing ventricular wall tension with a resultant increase of EF and in the velocity of LV shortening. Therefore, EF may be a misleading parameter for evaluating LV contractility.
Aortic Regurgitation and Mitral Regurgitation
Large and Hyperdynamic LV
V- Tricuspid Regurgitation

- Secondary TR is by far more common than primary causes, occurring mainly from pressure overload (PAH) provoking annular dilatation and RV enlargement.

- TR is associated with poor outcome and predicts poor survival, heart failure and reduced functional capacity.
Mild MS postcomisurotomy 22 y ago, mild AR, severe TR
ESC favours tricuspid surgery as a class IIa indication in patients with moderate secondary TR with a dilated annulus > 40 mm or 21 mm/m².
Severe MS + Moderate AR + Severe TR + PAH

40 mm

120 mm Hg
9 months after PMV

1.6 cm²

1.3 cm²

47 mm Hg
## Diagnostic caveats in multivalve lesions

<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>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>
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</tbody>
</table>
### Indications for concomitant valve surgery in patients undergoing surgery on another valve

<table>
<thead>
<tr>
<th>Condition</th>
<th>Class</th>
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<tbody>
<tr>
<td>Severe AS</td>
<td>Class I</td>
</tr>
<tr>
<td>Moderate AS</td>
<td>Class IIa</td>
</tr>
<tr>
<td>Severe AR</td>
<td>Class I</td>
</tr>
<tr>
<td>Severe TR</td>
<td>Class I</td>
</tr>
<tr>
<td>Moderate organic TR or secondary TR with annulus $&gt; 40$ mm</td>
<td>Class IIa</td>
</tr>
</tbody>
</table>
Indications for concomitant valve surgery in patients undergoing surgery on another valve

• Severe MS and moderate aortic valve disease, If score < 10, PMV can be performed.

• Severe MS combined with severe aortic valve disease, surgery is preferable.

• MR with severe aortic valve disease: Severity and valve morphology

  Moderate-severe MR with abnormal morphology: AVR+ MVR/ repair

  Non-severe MR and normal valvular morphology: MR may improve greatly after isolated AVR. (Intraoperative TEE and visual inspection).
Mitral prosthesis 5 y ago, severe TR, severe AS.

Mean Gr: 46 mm Hg; AVA: 0.8 cm²
To distinguish the ripe from the non deteriorated.

The challenge:
To define which will deteriorate soon and to manage this information correctly.
Conclusions

• Multivalvular disease is not infrequent. Various combinations of valve lesions may be present and data poverty does not allow the proposal of a clear standardization.

• A careful quantification considering possible pitfalls and a comprehensive assessment of the consequences of the valve lesions is advisable.

• Surgical indication should take into account the interaction between different valve lesions, their natural history, the risk of combined valve surgery and the likelihood of future reoperation.