Assessment of Multivalvular Heart Disease - CMR

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ASE GUIDELINES AND STANDARDS

Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation
A Report from the American Society of Echocardiography Developed in Collaboration with the Society for Cardiovascular Magnetic Resonance

Author Notes

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2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease
A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

2017 ESC/EACTS Guidelines for the management of valvular heart disease

Helmut Baumgartner, Volker Falk, Jeroen J Bax, Michele De Bonis, Christian Hamm, Per Johan Holm, Bernard Jung, Patrizio Lancellotti, Emmanuel Lansac, Daniel Rodriguez Muñoz...
Echocardiography is the primary modality for valvular assessment.

- AS and AR
- AS and MR
- MS and MR
- MR and TR

Interobserver and intraobserver variability of echocardiography

- Low flow low gradient AS
- AS with MR (lost flow)
- Mixed valvular disease and RV failure
THERAPEUTIC PROBLEM

Surgery or percutaneous intervention?

- TAVI first then clip?
- Clip first then TAVI?
MULTIVALVULAR HEART DISEASE

- What is the dominant lesion?
- Are the symptoms related to the valvular disease?
- Is there cardiac remodeling?

CMR can assess lesion severity and the hemodynamic consequences.
Function assessment

Diastole

Systole

Left Ventricle

Right Ventricle
Multivalvular Disease

- 61 year old, History of MV repair, Heart Failure
- Presented with SOB
CMR for flow assessment

Assess flow in multiple locations
CMR for flow assessment

A. No valvular disease
   No cardiac shunt
   \[ \text{LVSV} = \text{Ao flow} = \text{RVSV} = \text{PA flow} \]

B. MR
   \[ \text{LVSV} \neq \text{Ao flow} = \text{RVSV} = \text{PA flow} \]
   \[ \text{MR} = \text{LVSV – Forward Stroke Volume} \]

C. MR & AR
   \[ \text{LVSV} \neq \text{Ao flow} = \text{RVSV} = \text{PA flow} \]
   \[ \text{AR} = \text{Ao forward flow} \]
   \[ \text{MR} = \text{LVSV – (AR + Forward Stroke Volume)} \]

D. MR & ASD
   \[ \text{LVSV} \neq \text{Ao flow} \neq \text{RVSV} = \text{PA flow} \]
   \[ \text{MR} = \text{LVSV – Ao flow} \]
   \[ \text{Qp-Qs} = \text{Ao flow} \]

E. MR & TR
   \[ \text{LVSV} \neq \text{RVSV} \neq \text{Ao flow} = \text{PA flow} \]
   \[ \text{MR} = \text{LVSV – Forward Stroke Volume} \]
   \[ \text{TR} = \text{RVSV – Forward Stroke Volume} \]

AORTIC REGURGITATION

Direct measurement of regurgitant flow

Reg Vol=19ml
LVOT STROKE VOLUME

Direct measurement LVOTSV

LVOTSV = 74ml
PA STROKE VOLUME

Direct measurement
PASV

PASV = 55ml
MV STROKE VOLUME
AORTIC REGURGITATION

Direct measurement of regurgitant flow

Indirect measurement of Regurgitant Flow

AR Regurgitant Volume = LVOT stroke volume - Pulmonic net flow
Clinical Case-AR Severity

AR Regurgitant Fraction = \( \frac{\text{Regurgitant Volume}}{\text{AVFlow}} \)

AR Regurgitant Volume = 19 ml

AR Regurgitant Fraction = \( \frac{19}{74} = 26\% \)
AORTIC STENOSIS SEVERITY

Direct measurement of peak velocity

Peak Vel=3.22 m/s
AORTIC STENOSIS SEVERITY

AVA = 1.2 cm²

AVA Planimetry
MR MECHANISM
MR AROA
Indirect measurement of regurgitant flow

Regurgitant Volume = LV stroke volume - LVOT stroke volume

Regurgitant Fraction = \( \frac{MR \text{ Regurgitant Volume}}{LVOT SV - AR \text{ regurgitant volume}} \)
Clinical Case - MR Severity

MR Regurgitant Volume = LV stroke volume - LVOT stroke volume

MR Regurgitant Fraction = \( \frac{MR \text{ Regurgitant Volume}}{LVSV - AR \text{ volume}} \)

<table>
<thead>
<tr>
<th>LVEF</th>
<th>LVEDV</th>
<th>LVSV</th>
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<tr>
<td>75%</td>
<td>151ml</td>
<td>113ml</td>
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MR Regurgitant Volume = 113 - 74 = 39ml

MR Regurgitant Fraction = \( \frac{39}{113-19} = 41\% \)
CMR LIMITATIONS

- Availability
- Arrhythmias
- Difficult to perform in very sick patients
- Segmentation errors
- Corrupted phase contrast data
- Pacemakers, ICD
• Assess flow in multiple locations
• Solve multiple equations using your best data
• Report total regurgitant stroke volume in challenging cases
• Refer patients to CMR centers with experience in valvular disease
• Individualize care
• Valve clinic and multimodality imaging for diagnostic assessment
• Heart team for therapeutic decisions