ECHOCARDIOGRAPHIC EVALUATION OF VALVULAR STENOSIS

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AORTIC STENOSIS
AORTIC STENOSIS

- Obstruction to LV outflow
- Decrease in aortic valve area
  - Normal: 3.0 – 4.0 cm$^2$
  - Mild: 1.5-2.0 cm$^2$
  - Moderate: 1.0 – 1.5 cm$^2$
  - Severe: < 1.0 cm$^2$
AORTIC STENOSIS

Causes:
• Congenital (unicuspal, bicuspal, quadricuspal)
• Rheumatic
• Calcific/ Degenerative

A. Evaluate the anatomy of the AV

ECHO EVALUATION OF AORTIC STENOSIS

EAE/ASE recommendations for Echocardiographic assessment of valve stenosis,
European Journal of Echocardiography 2009
ECHO EVALUATION OF AORTIC STENOSIS

fusion of RCC and NCC

fusion of RCC and LCC
ECHO EVALUATION OF AORTIC STENOSIS

BICUSPID AORTIC VALVE

Diastole

Systole

Aortic Valve

AoV Vmax 2.28 m/sec
AoV VTI 0.352 m
AoV AT 113 m/sec
AoV ET 237 m/sec

Aortic Doppler

AoV Pk Grad 20.7 mmHg
AoV Min Grad 10.0 mmHg
AoV AT/ET 0.49

AoV Continuity Equation

AoV Area, VTI 2.62 cm²
AoV Area, Vmax 2.55 cm²
AoV Area, Vmean 2.21 cm²

LWOT Dia 2.27 cm
LWOT Area 4.05 cm²
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B. Determine the aortic valve area by Continuity Equation

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C. Determine the transaortic jet velocity
   • measured using continuous-wave (CW) Doppler
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D. Determine the transaortic gradient

**ECHO EVALUATION OF AORTIC STENOSIS**

Table 3  Recommendations for classification of AS severity

<table>
<thead>
<tr>
<th></th>
<th>Aortic sclerosis</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic jet velocity (m/s)</td>
<td>&lt;2.5 m/s</td>
<td>2.6–2.9</td>
<td>3.0–4.0</td>
<td>&gt;4.0</td>
</tr>
<tr>
<td>Mean gradient (mmHg)</td>
<td>–</td>
<td>&lt;20 (&lt;30&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>20–40&lt;sup&gt;b&lt;/sup&gt; (30–50&lt;sup&gt;a&lt;/sup&gt;)</td>
<td>&gt;40&lt;sup&gt;b&lt;/sup&gt; (&gt;50&lt;sup&gt;a&lt;/sup&gt;)</td>
</tr>
<tr>
<td>AVA (cm&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>–</td>
<td>&gt;1.5</td>
<td>1.0–1.5</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Indexed AVA (cm&lt;sup&gt;2&lt;/sup&gt;/m&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>&gt;0.85</td>
<td>0.60–0.85</td>
<td>0.25–0.50</td>
<td>&lt;0.6</td>
</tr>
<tr>
<td>Velocity ratio</td>
<td>&gt;0.50</td>
<td>0.25–0.50</td>
<td></td>
<td>&lt;0.25</td>
</tr>
</tbody>
</table>

• LOW FLOW LOW GRADIENT AORTIC STENOSIS

• PARADOXICAL LOW FLOW LOW GRADIENT AORTIC STENOSIS
Baseline echo
AVA: 0.96 cm²
PIG: 57 mmHg
MG: 38 mmHg
EF 31%
PSEUDOSEVERE AORTIC STENOSIS

- will exhibit an increase in the AVA
- little change in transvalvular gradient in response to the increase in transvalvular flow rate
TRUE SEVERE AORTIC STENOSIS

- will have no or minimal increase in AVA
- marked increase in gradient when flow is increased
REST
- AVA: 0.96cm²
- MG: 38
- PIG: 57
- EF: 31%

TRUE SEVERE AORTIC STENOSIS

LOW DOSE DOBU
- AVA: 0.99cm²
- MG: 51
- PIG: 76
- EF: 41% (32% inc)
Paradoxical Low flow Low gradient AS

- Elderly female
- Associated with HTN, DM

Echo Characteristics
- Severely thickened and calcified AV
- $\text{AVA < 1.0; MVG <40mmHg}$
- $\text{EF \geq 50\%}$
- Small LV cavity size ($\text{LVEDD <47mm, LVEDV <55mL}$
- $\text{RWT of >0.5}$
- Impaired global longitudinal strain $<15\%$
- $\text{SV index of <35mL/m2}$

ASE’s Comprehensive Echocardiography 2nd ed, 2016
ECHO EVALUATION OF AORTIC STENOSIS

Hemodynamic Progression

• annual decrease in valve area: 0.12 cm$^2$/year
• annual increase in jet velocity of 0.32 m/sec/year

Follow-up Echo

• every year: severe AS
• every 1 to 2 years for moderate AS
• every 3 to 5 years for mild AS.
MITRAL STENOSIS
MITRAL STENOSIS

• most frequent valvular complication of rheumatic fever

Other causes:
• Congenital
• Obstruction of LV inflow by LA tumor/mass (myxoma, thrombus, vegetation)
• extensive mitral annular calcification
A. Appearance of the MV and the mobility of its leaflets

ECHO EVALUATION OF MITRAL STENOSIS

B. Determine the valve area
1. Planimetry
2. Pressure Half Time
   \[ MVA = \frac{220}{PHT} \]
3. Continuity Equation
4. PISA

B. Determine the valve area

1. Planimetry

2. Pressure Half Time
   \[ MVA = \frac{220}{PHT} \]

3. Continuity Equation

4. PISA

PHT = 211
MVA = 1.04cm²

PHT = 159
MVA = 1.38cm²
ECHO EVALUATION OF MITRAL STENOSIS

C. Determine the Mean Valve gradient
## ECHO EVALUATION OF MITRAL STENOSIS

<table>
<thead>
<tr>
<th>Table 9</th>
<th>Recommendations for classification of mitral stenosis severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild</td>
</tr>
<tr>
<td>Specific findings</td>
<td></td>
</tr>
<tr>
<td>Valve area (cm²)</td>
<td>&gt;1.5</td>
</tr>
<tr>
<td>Supportive findings</td>
<td></td>
</tr>
<tr>
<td>Mean gradient (mmHg)</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Pulmonary artery pressure (mmHg)</td>
<td>&lt;30</td>
</tr>
</tbody>
</table>
ECHO EVALUATION OF MITRAL STENOSIS

ASSOCIATED FINDINGS:

• Left atrial enlargement
• LA/ LAA thrombus
• RV dilatation and dysfunction
• Pulmonary hypertension
TRICUSPID STENOSIS
TRICUSPID STENOSIS

- Uncommon
- Almost always due to RHD
- Other causes:
  - Congenital tricuspid atresia
  - RA tumor/mass (myxoma, thrombus, vegetation)
  - Carcinoid Syndrome
A. Determine valve morphology and mobility of the leaflets
ECHO EVALUATION OF TRICUSPID STENOSIS

B. Measure the valve area
   \[ TVA = \frac{190}{PHT} \]

C. Measure the mean gradient

TVI = 60 cm; mean grad = 9 mmHg
\[ P_1/2t = 173 \text{ ms} \]
# ECHO EVALUATION OF TRICUSPID STENOSIS

## Table 10  Findings indicative of haemodynamically significant tricuspid stenosis

<table>
<thead>
<tr>
<th>Specific findings</th>
<th>Supportive findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean pressure gradient</td>
<td>Enlarged right atrium ≥ moderate</td>
</tr>
<tr>
<td>Inflow time–velocity integral</td>
<td>Dilated inferior vena cava</td>
</tr>
<tr>
<td>$T_{1/2}$</td>
<td></td>
</tr>
<tr>
<td>Valve area by continuity equation $^a$</td>
<td></td>
</tr>
<tr>
<td>≥ 5 mmHg</td>
<td></td>
</tr>
<tr>
<td>&gt; 60 cm</td>
<td></td>
</tr>
<tr>
<td>≥ 190 ms</td>
<td></td>
</tr>
<tr>
<td>≤ 1 cm$^{2a}$</td>
<td></td>
</tr>
</tbody>
</table>

$^a$ : Continuity equation methods include variable area, constant area and pressure half-time methods.
PULMONIC STENOSIS
PULMONIC STENOSIS

Causes:
• Congenital
• Rheumatic
• Carcinoid Syndrome
A. Determine valve morphology and mobility of the leaflets
ECHO EVALUATION OF PULMONIC STENOSIS

B. Measure the peak velocity and gradient across the valve
# ECHO EVALUATION OF PULMONIC STENOSIS

## Table 11
Grading of pulmonary stenosis

<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak velocity (m/s)</td>
<td>&lt;3</td>
<td>3–4</td>
<td>&gt;4</td>
</tr>
<tr>
<td>Peak gradient (mmHg)</td>
<td>&lt;36</td>
<td>36–64</td>
<td>&gt;64</td>
</tr>
</tbody>
</table>
• Echocardiography is the primary non invasive imaging tool for the assessment of valve stenosis

• Echocardiographic evaluation should include determination of valve morphology, measurement of valve area, transvalvular gradient and velocity as well as to look for other associated abnormalities

• It is essential to combine all 2D and Doppler data in grading the severity of stenosis and not relying only in one specific parameter.