Role of 2D and 3D in Aortic Stenosis
Tips and Tricks

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No conflicts, disclosures
Severity of AS

<table>
<thead>
<tr>
<th>Velocity</th>
<th>Valve area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>2.6 – 3.0 m/sec</td>
</tr>
<tr>
<td>Moderate</td>
<td>3.0 – 4.0 m/sec</td>
</tr>
<tr>
<td>Severe</td>
<td>&gt; 4.0 m/sec</td>
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</tbody>
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Otto J Am Coll Cardiol 2006; 47: 2141-51
AHA/ACC Guidelines for Valvular Heart Disease, Circulation 2006
Pearl 1

Listen to the patient → Look at the valve
Pearl 2: Anatomy of the Valve
(Always see at the valve before putting colors)
Aortic Stenosis

- Common Etiological Factors

  Congenital Bicuspid

  Degenerative

  Rheumatic: Associated with mitral valve disease
Pearl 3: See the morphology of valve

Degenerative

Rheumatic

<table>
<thead>
<tr>
<th></th>
<th>Degenerative</th>
<th>Rheumatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td></td>
<td>( )</td>
</tr>
<tr>
<td>Thickness</td>
<td></td>
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<td>-</td>
<td>+</td>
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Table: Comparison of Degenerative and Rheumatic Valve Morphology
Case

- 70 year old female
  - Increasing dyspnea
  - Fatigue
- Cardiac auscultation
  - Harsh, systolic ejection murmur
  - Holodiastolic murmur
Pearl 4: Zoom up
LVOT Diameter = 2.0 cm

LVOT TVI = 34 cm
CW Doppler: Apical Window

CW Doppler: Right Parasternal

Pearl 5: Take doppler from all windows.
Echo findings

LV outflow = Aortic flow

- $AVA = \frac{(LVOT \ diam)^2 \times 0.785 \times TVI_{LVOT}}{TVI_{AV}}$

- $AVA = (2.0 \ cm)^2 \times 0.785 \times 34 \ cm \div 152 \ cm = 0.70 \ cm^2$
3D TEE in Aortic Stenosis

Bland-Altman Analysis

Correlation (A) and agreement (B) between 3-D SA by 3-D TEE and AVA by Doppler continuity equation method.

Correlation (A) and agreement (B) between 2-DCSA by 2-D TEE and AVA by Gorlin formula.

3D Echo of Aortic Valve

Pearl 6: Adjust gain settings, watchful for dropouts
3D Echo of Bicuspid Aortic Valve
Flow independent index of severity

Pearl 7: AV area by Planimetry
Real Time 3D TEE in assessment of AS

Are there any differences in the Doppler and Catheter derived Aortic gradients?

YES
Catheterization formulae for valve area attempt to derive the *anatomic area* whereas the Doppler continuity equation reports the area to which the flow is constricted or *effective valve area*.

*Rev Cardiovasc Med. 2005;6(1)23-32*
The impact of a stenosis on pressure and flow depends not only on the cross-sectional area of the orifice but also on the three-dimensional geometry of the leaflets proximal to the orifice.


Gilon et al JACC 2002; 40: 1479-86
Live 3D Echo for AS

Pearl 8: Thick slice

- A simplified 3D technique is a "thick slice" 2D examination, can obtain AS AVA more often than a "thin slice" 2D echocardiogram.

- This 3D AVA correlates well with 2D AVA and correlates better with continuity equation AVA suggesting that the effective AS orifice is more of a "tunnel" than a "flat ring."

Suradi et al. Echocardiography 2010; 27(8): 1011-20
Pearl 8: Dimensionless Index

(LVOT TVI / AV TVI)

- <0.25 indicates severe Aortic Stenosis
- Helpful in Atrial Fibrillation, Prosthetic valve
Challenge

Aortic Stenosis with Low Output, Low Gradient or Failed Ventricle
• 63 years old female
• Dyspnoea and chest pain
• BP: 106/70 mmHg
LV dysfunction
Aortic stenosis
+1 Aortic regurgitation
+2 Mitral regurgitation
Aortic valve

LVOT d = 2.2 cm
LVOT TVI = 13 cm

AV gradient = 20 mmHg
AV TVI = 51 cm

AV area 0.97 cm²
Low Flow Low Gradient Aortic Stenosis

- Fixed AS with afterload mismatch
- Relative AS from inability to open valve (coexisting cardiomyopathy)
Pearl 9: Dobutamine Challenge

Fixed (True) Aortic Stenosis

decreased SV secondary to afterload mismatch
likely to benefit from AVR

Pseudo-aortic Stenosis

coe-xistant cardiomyopathy
unlikely to benefit from AVR

Low Contractile Reserve

don’t know, (calcified, ejection time, TVI ratio)
Pseudo vs True Stenosis

**Relative AS**

Increase in valve area $> 0.3 \text{ cm}^2$
No significant increase in gradient ($< 5 \text{ mm Hg}$)

**Fixed AS**

Increase of $> 10 \text{ mm Hg}$ in mean gradient
No significant change in valve area ($< 0.2 \text{ cm}^2$ increase)
Low flow state
Dobutamine Infusion

<table>
<thead>
<tr>
<th></th>
<th>REST</th>
<th>DOBUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>TVI</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Mean Gradient</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>AV area</td>
<td>0.97</td>
<td>1.05</td>
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</table>
AV replacement with 25 mm aortic valve conduit
Post-op Echo 3 months
Future Directions

- Aortic valve assessment with absolute cut-off points cannot be relied upon for clinical decision-making and it should be considered in combination with flow rate, pressure gradient, ventricular function as well as functional status.


- In future, complex measures integrating the ventricular, valvular and vascular components of the disease may allow better assessment of valve and optimal timing of intervention.
“Not everything that counts can be counted and not everything that can be counted counts”

- Albert Einstein