Echo evaluation of valve prostheses

• stenosis / obstruction
• regurgitation
• endocarditis
• embolism / thrombosis without obstruction

Recommendations for Evaluation of Prosthetic Valves With Echocardiography and Doppler Ultrasound

A Report From the American Society of Echocardiography’s Guidelines and Standards Committee and the Task Force on Prosthetic Valves, Developed in Conjunction With the American College of Cardiology Cardiovascular Imaging Committee, Cardiac Imaging Committee of the American Heart Association, the European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography and the Canadian Society of Echocardiography, Endorsed by the American College of Cardiology Foundation, American Heart Association, European Association of Echocardiography, a registered branch of the European Society of Cardiology, the Japanese Society of Echocardiography, and Canadian Society of Echocardiography

2009
Primary parameters of obstruction to flow:

- max. (AVR) and mean gradients (AVR, MVR, TVR);
- see normal values table

Additional parameters (especially in AVR if gradients ↑):

- AVR: ratio $\frac{VTI_{LVOT}}{VTI_{prosth}}$ (velocity index)
- „effective orifice area“
  = stroke volume/ $VTI_{prosth}$
  = $\pi r^2 \cdot \frac{VTI_{LVOT}}{VTI_{prosth}}$
  (not from ring size!)
- AVR:
  acceleration time (> 100 ms ?)

ASE/EAE 2009

![Graphs showing flow measurements](image)
Aortic prostheses: assessment of obstruction is often difficult

- small valve
- in mechanical valves disc motion is often impossible to assess
- pressure recovery
- „patient-prosthesis mismatch“

60yr old patient w bileaflet AVR max./mean 68 / 38 mmHg

<table>
<thead>
<tr>
<th>Valve</th>
<th>Size</th>
<th>Peak gradient (mm Hg)</th>
<th>Mean gradient (mmHg)</th>
<th>Effective orifice area (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St Jude Medical Standard Bileaflet</td>
<td>19</td>
<td>42.0± 10.0</td>
<td>24.5± 5.8</td>
<td>1.5± 0.1</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>25.7± 9.5</td>
<td>15.2± 5.0</td>
<td>1.4± 0.4</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>21.8± 7.5</td>
<td>13.4± 5.6</td>
<td>1.6± 0.4</td>
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<tr>
<td></td>
<td>25</td>
<td>18.9± 7.3</td>
<td>11.0± 5.3</td>
<td>1.9± 0.5</td>
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<tr>
<td></td>
<td>27</td>
<td>13.7± 4.2</td>
<td>8.4± 3.4</td>
<td>2.5± 0.4</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>13.5± 5.8</td>
<td>7.0± 1.7</td>
<td>2.8± 0.5</td>
</tr>
</tbody>
</table>
pressure recovery

ASE/EAE recommendations 2009

most pronounced in small bileaflet aortic prostheses and with narrow aorta
55yr old woman with double valve replacement due to rheumatic disease
50 yr old pt 4 years after AVR with stentless pericardial valve

now new LV dysfunction (EF 10%), severe MR, max. gradient 40 mmHg, cardiogenic shock
„Patient-prosthesis mismatch“

- prosthesis functions normally but is too small for patient
- effective orifice area < 0.85 cm²/m²
- relevant only in AVR
- unclear prognostic significance

AS → AVR (Nr.21 bioprosthesis) morphologically good function

preop. vmax 405 cm/s

postop. vmax 368 cm/s

eff. orifice area = 3,14•35 / 81 = 1.4 cm²; → EOI = 0.67 cm²/m²
Normal prosthetic regurgitation

bileaflet

Medtronic-Hall

Flachskampf JACC 91; 18:1493
Rule of thumb:
leakage > 20% of circumference ( > 72°) → severe
mean gradient 9 mmHg, PHT ca. 90 ms
Practical summary

• low threshold for TEE
• document postoperative gradients for comparison
• use fluoroscopy if obstruction of mechanical AVR is suspected; look at acceleration time (> 100 ms ?)
• regurgitation: get best possible pictures (TEE); compare forward VTI / stroke volume with earlier exams; in paravalvular leakage, assess circumferential extent (>20 % ?)
Figure 10 Algorithm for evaluation of elevated peak prosthetic aortic jet velocity incorporating DVI, jet contour, and AT. *PW Doppler sample too close to the valve (particularly when jet velocity by CW Doppler is ≥4 m/s). **PW Doppler sample too far (apical) from the valve (particularly when jet velocity is 3-3.9 m/s). ¤Stenosis further substantiated by EOA derivation compared with reference values if valve type and size are known. Fluoroscopy and TEE are helpful for further assessment, particularly in bileaflet valves. AVR, Aortic valve replacement.