Aorta and aortic valve - basic principle of 2D echo assessment

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How do we see the aortic valve?

Planar views of valve anatomy in standard views
Aortic valve – oriented TTE views

Left parasternal short axis

Subcostal view

Adapted from A.Hagendorfer-EAE basic course
AV and Aorta-oriented TTE views

Left parasternal long axis

Apical long axis

Adapted from A.Hagendorfer-EAE basic course
Aorta- oriented TTE views

Suprasternal view

Adapted from A.Hagendorfer-EAE basic course
Aorta- oriented TTE views

Subcostal view

Adapted from A.Hagendorfer-EAE basic course
Aorta- oriented TTE views

Apical view

Adapted from A.Hagendorfer-EAE basic course
Aorta- oriented TTE views

Right parasternal long axis

ECHOCARDIOGRAPHIC VIEWS

- suprasternal
- right parasternal
- left parasternal
- apical
- subcostal

Adapted from A.Hagendorfer-EAE basic course
Aorta-oriented-TEE views

120° longitudinal axis view

Transverse view

Transverse view

Longitudinal view
Aortic disease

Anatomy of the ascending aorta

Nataf, P et al. Heart 2006;921345-52
How to measure ascending aorta?

Algorytm obliczania **nałężnego wymiaru** aorty wstępującej - wzór Roman’a (TTE)

<table>
<thead>
<tr>
<th>wiek (lata)</th>
<th>wymiar pnia aorty wstępującej (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18</td>
<td>1.02 + (0.98 x BSA*)</td>
</tr>
<tr>
<td>18-40</td>
<td>0.97 + (1.12 x BSA)</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>1.92 + (0.74 x BSA)</td>
</tr>
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</table>
TTE LV outflow and ascending aorta
How to measure LVOT diameter?

A = 1.2 cm; AVA = 0.44 cm$^2$
B = 1.5 cm; AVA = 0.69 cm$^2$
C = 2.1 cm; AVA = 1.35 cm$^2$
D = 1.8 cm; AVA = 0.99 cm$^2$
How to measure LVOT diameter?

LVOT diameter is measured in the parasternal long-axis view in mid-systole from the white–black interface of the septal endocardium to the anterior mitral leaflet, parallel to the aortic valve plane and within 0.5–1.0 cm of the valve orifice.
How to measure aortic valve area?

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
How to measure aortic valve area?
Important morphologic findings in parasternal view
Aortic stenosis aetiology

Aortic stenosis

Etiology

- Calcific Aortic Stenosis
- Rheumatic Aortic Stenosis
- Bicuspid Aortic Stenosis
Aortic stenosis

Congenital Etiology

Monocusp aortic stenosis

Quadricuspid aortic stenosis
Aortic stenosis

Risk Stratification: Valve Calcification

Mild calcification
Moderate calcification
Severe calcification
Aortic stenosis

Differential diagnosis

Subvalvular aortic stenosis
Supravalvular aortic stenosis
Hypertrophic Obstructive cardiomyopathy
Anuloartic ectasia and ascending aorta aneurysm

Annuloaortic ectasia with pyriform morphology

Ascending aorta aneurysm located in the upper part of the sinotubular junction.

Functional aortic regurgitation summary

<table>
<thead>
<tr>
<th>AI Class</th>
<th>Normal cusp motion with aortic dilatation</th>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>la</td>
<td>lb</td>
<td>lc</td>
<td>id</td>
</tr>
<tr>
<td>Mechanism</td>
<td>STJ dilation</td>
<td>Sinus dilation</td>
<td>Annulus dilation</td>
<td>Cusp Perforation</td>
</tr>
</tbody>
</table>

**Functional AR**

**Leaflet Disease**
Determinants of functional aortic regurgitation

regurgitation with anatomically normal aortic valve and ascending aorta aneurysm by TEE

- Annulus, Valsalva sinuses, sinotubular junction, and tubular tract dimensions
- Coaptation leaflet height: maximum distance between protodiastolic coaptation of the leaflet tips and the annulus plane.
- Diastolic tenting of the leaflets 8–10 mm
- Sinotubular junction/annulus ratio 1.6

Aortic valve repairability

TYP I b

Aortic root and valsalva sinuss aneurysm

Adapted from G. Elkhoury-Euroecho 2010
Aortic valve repairability

TYP I c
Annular dilatation

Adapted from G. Elkhoury - Euroecho 2010
Aortic valve repairability

TYP I d
Cusp perforation-Endocarditis

Adapted from G.Elkhoury-Euroecho 2010
Aortic valve repairability

TYP II
Flailed aortic cusp – whole cusp prolaps

Adapted from G. Elkhoury-Euroecho 2010
Aortic valve repairability

TYP II
Partial cusp prolaps

Adapted from G.Elkhoury-Euroecho 2010
Aortic valve repairability

**TYP II**
whole cusp prolaps

Adapted from G.Elkhoury-Euroecho 2010
Aortic valve repairability

TYP III
Cusps restriction

Adapted from G. Elkhoury - Euroecho 2010
Prediction of AV repairability

![Bar graph showing repairability and event rate for不同类型 (Type 1, Type 2, Type 3).]

La Polaine de Waroux, Circulation 2007;116;I-264
Acute aortic dissection by TTE
Entry tear location and size
Quantification and Mechanisms of AR

<table>
<thead>
<tr>
<th>Dilataton of the aortic annulus secondary to dilatation of the ascending aorta</th>
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<tbody>
<tr>
<td>Rupture of the annular support and tear in the implantation of one of the valvular leaflets</td>
</tr>
<tr>
<td>Assymetrical dissections, the heamatoma itself may displace a sigmoid below coaptation</td>
</tr>
<tr>
<td>Prolapse of the intima in the LV outflow tract through the valvular orifice</td>
</tr>
<tr>
<td>Previous aortic valve disease</td>
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## True lumen identification

<table>
<thead>
<tr>
<th></th>
<th>True lumen</th>
<th>False lumen</th>
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</thead>
<tbody>
<tr>
<td><strong>Size</strong></td>
<td>True&lt;false</td>
<td>Most often: false&gt;true lumen</td>
</tr>
<tr>
<td><strong>Pulsation</strong></td>
<td>Systolic expansion</td>
<td>Systolic compression</td>
</tr>
<tr>
<td><strong>Flow direction</strong></td>
<td>Systolic antegrade</td>
<td>Systolic antegrade flow reduced or absent or retrograde flow</td>
</tr>
<tr>
<td><strong>Communication flow</strong></td>
<td>From true to false lumen</td>
<td></td>
</tr>
<tr>
<td><strong>Contrast echo flow</strong></td>
<td>Early and fast</td>
<td>Delayed and slow</td>
</tr>
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„Atypical” Aortic Dissection (Intramural Haematoma)

Typical = Dissection flap and false lumen
„Artpirical” = No dissection flap: Medial haematoma
Aortic hematoma

Crescentic intramural haematoma in ascending aorta adjacent to the left main coronary ostium

Intramural haematoma in descending aorta

Penetrating aortic ulcer deforming the adventitia
Periaortic haematoma - thoracic aorta
Periaortic hematoma - thoracic aorta
Grading aortic atherosclerosis

- Grade I: Normal intima or mild irregularities
- Grade II: Plaques < 3mm
- Grade III: Plaques > 3 mm
- Grade IV: Protruding plaque

Thoracic aorta atheromatosis
Summary

Two-dimensional echocardiography using TTE, TEE and epicardial approach is the „first line” diagnostic tool to study morphological and functional changes of aortic valve and aorta disease.