Added value of 3D Echocardiography in chamber quantitation

Elena Surkova, MD, PhD
Royal Brompton Hospital, London UK

Why 3D Echocardiography Makes the Difference?

• No geometric assumptions about chamber's shape/morphology
• Allows to measure, not calculate using mathematical formulas
• Volumetric analysis is not affected by foreshortening or off-axis views
LEFT VENTRICLE

• 3DE provides more accurate and reproducible assessment of LV volumes and EF than 2DE
• Closely correlates to CMR

CASE #1

LV systolic function?

2D Simpson:
• EDV 112 ml
• ESV 55 ml
• EF 51%
CASE #1  LV systolic function?

3D:
- EDV 126 ml
- ESV 70 ml
- EF 44%

- 3DE takes into account contribution of all LV walls in the ejection fraction

- Avoiding LV foreshortening
• Avoiding LV foreshortening

LV length 4Ch 94 mm

LV length 4Ch 107 mm

• Assessment of LV regional wall motion abnormalities
**Added value of 3DE in LV quantification**

**Advantages**
- Comprehensive quantitation of LV volumes, EF, sphericity, and assessment of RWMAs from a single full-volume dataset
- No geometric assumptions about LV shape
- Re-aligning planes on 3D data sets eliminates foreshortening

**Established clinical indications**
- Measurement of LV volumes
- Calculation of LV EF

**Who benefits most**
- Patients with extensive wall motion abnormalities
- Patients with abnormal LV shape

**Recommendation.** LV size should be routinely assessed on 2DE by calculating volumes using the biplane method of disks summation technique. In laboratories with experience in 3DE, 3D measurement and reporting of LV volumes is recommended when feasible depending on image quality. When reporting LV

---

**Use method-specific reference values!**

<table>
<thead>
<tr>
<th>Abnormality threshold</th>
<th>2DE</th>
<th>3DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV EDVi (ml/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>&gt;74</td>
<td>&gt;79</td>
</tr>
<tr>
<td>women</td>
<td>&gt;61</td>
<td>&gt;71</td>
</tr>
<tr>
<td>LV ESVi (ml/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>&gt;31</td>
<td>&gt;32</td>
</tr>
<tr>
<td>women</td>
<td>&gt;24</td>
<td>&gt;28</td>
</tr>
<tr>
<td>LV EF (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>&lt;52</td>
<td>&lt;52</td>
</tr>
<tr>
<td>women</td>
<td>&lt;54</td>
<td>&lt;54</td>
</tr>
</tbody>
</table>

**RIGHT VENTRICLE**

Surkova E. et al.  
*The use of multimodality imaging to assess right ventricular size and function*  

**CASE #3**  
RV systolic function?

- **TAPSE 19 mm**
- **EDA**
- **ESA**
- **FAC 28%**

- **EDV:** 186.8 ml
- **EDVi:** 100.5 ml/m²
- **ESV:** 117.1 ml
- **ESVi:** 63.0 ml/m²
- **SV:** 69.7 ml
- **EF:** 37.3 %
• Assessment of RV regional wall motion abnormalities

Added value of 3DE in RV quantification

Advantages
- The ONLY echocardiographic technique permitting quantitation of RV volumes and EF
- Incorporates all three components of the RV in a single data set
- No geometrical assumptions about RV shape

Established clinical indications
- Measurement of RV volumes
- Calculation of RV EF

Who benefits most
- All patients’ categories where RV information is clinically/prognostically important (PH, CHD, MI, RV pathology/failure)

Recommendaions. RV size should be routinely assessed by conventional 2DE using multiple acoustic windows, and the report should include both qualitative and quantitative parameters. In laboratories with experience in 3DE, when knowledge of RV volumes may be clinically important, 3D measurement of RV volumes is recommended. Although normal 3D echocardiographic values of RV
Reference values depend on age, gender and race!


<table>
<thead>
<tr>
<th>Abnormality threshold</th>
<th>3DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV EDVi (ml/m²)</td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>&gt;87</td>
</tr>
<tr>
<td>women</td>
<td>&gt;74</td>
</tr>
<tr>
<td>RV ESVi (ml/m²)</td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>&gt;44</td>
</tr>
<tr>
<td>women</td>
<td>&gt;36</td>
</tr>
<tr>
<td>RV EF (%)</td>
<td>&lt;45</td>
</tr>
</tbody>
</table>

LEFT and RIGHT ATRIA

- Biplane method of discs
- Biplane area-length method

CASE #3  LA size?

Added value of 3DE in quantification of atria

Advantages
• Comprehensive quantitation of maximum, minimum and preA volumes and function from a single dataset
• No geometric assumptions about atria shape
• Re-aligning planes on 3D data sets eliminates foreshortening

Potential clinical indications
• Measurement of maximum, minimum and preA volumes
• Calculation of phasic emptying volumes

Who benefits most
• Patients with non-standard shape of the atria
• Patients with difference in 4Ch/2Ch atria length >5 mm

Use method-specific reference values!

TAKE-HOME MESSAGES

3D Echocardiography:
- Enables actual 3D acquisition and anatomically guided direct measurements
- Avoids calculations that imply geometrical assumptions
- Validated against CMR
- Reference values are now available for all cardiac chambers
- Has unlimited repeatability
- Cost-effective and safe

THANK YOU FOR YOUR ATTENTION