45th Annual International Congress of the
EGYPTIAN SOCIETY OF CARDIOLOGY
CardioEgypt 2018

3D Echocardiography Assessment of the Right Ventricle

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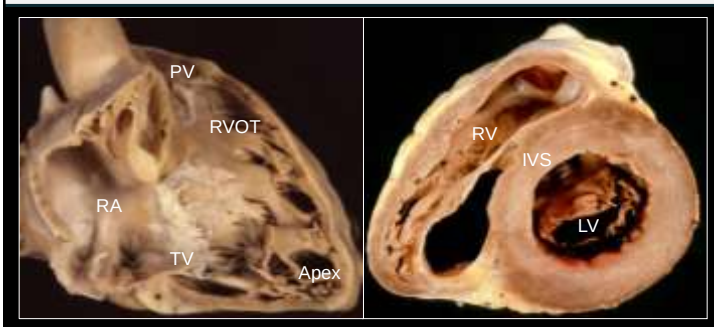
CLINICAL QUESTIONS

- RV size

- Global systolic function

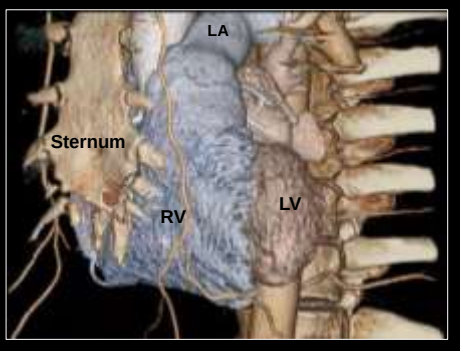
- Regional systolic function and RV mechanics
- RV shape

CHALLENGES IN RV ASSESSMENT BY ECHOCARDIOGRAPHY

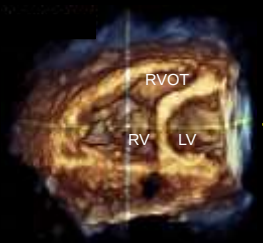


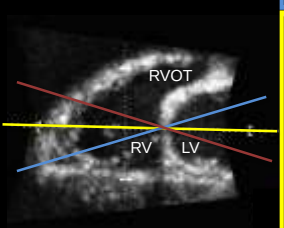
Images: courtesy of
Dr. F. Paletra and Dr. C. Basso

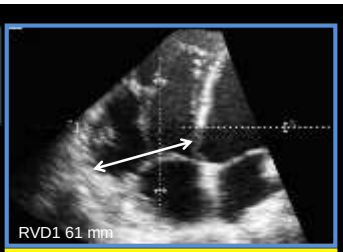
- Unfavorable location within the thoracic cavity
- Complex 3D anatomy
- Prominent trabeculation
- Limited number of anatomical landmarks
- Complex mechanism of RV contraction

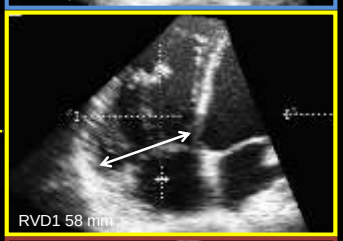


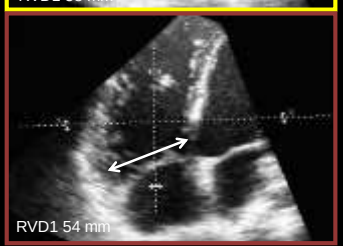
Minor alterations in 2D plane orientation – significant changes in RV diameters





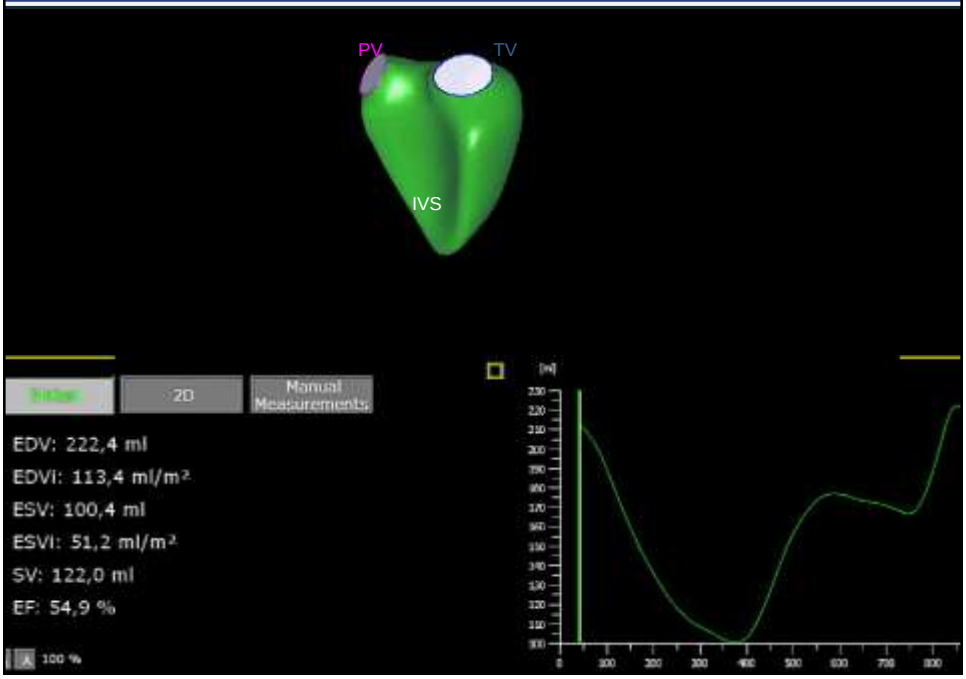






Surkova E, et al.
The use of multimodality imaging to assess right ventricular size and function
Int Journal of Cardiol. 2016

RV SIZE & FUNCTION: 3D ECHOCARDIOGRAPHY

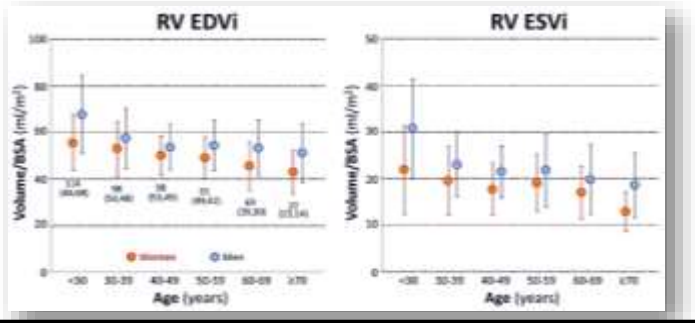


Reference values

Abnormality threshold	Gender	3DE
RV EDVi (ml/m²)	men	>87
	women	>74
RV ESVi (ml/m²)	men	>44
	women	>36
RV EF (%)		<45

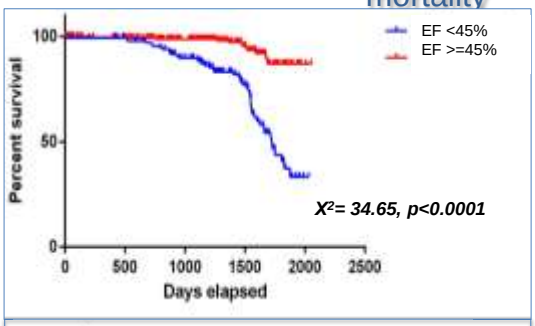
Lang RM, et al. ***Recommendations for cardiac chamber quantification***. EHJ Cardiovasc Imaging, 2015

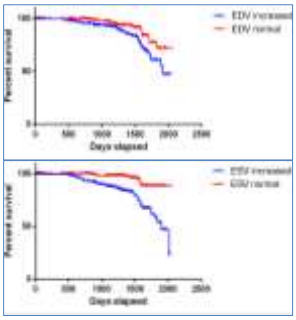
Reference values depend on age, gender and race

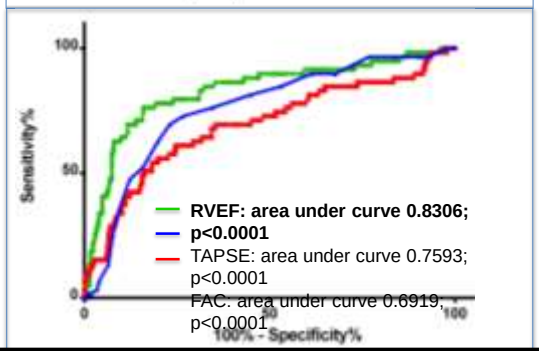


Maffessanti F, et al. Circulation CV Imaging 2013

3D RV EF, EDVi and ESVi are significant predictors of all-cause mortality

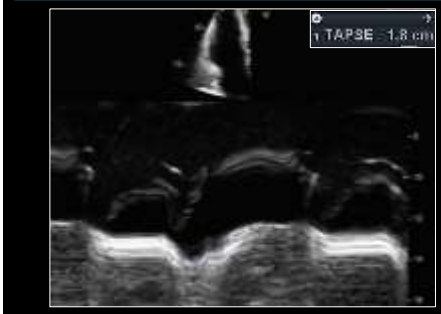


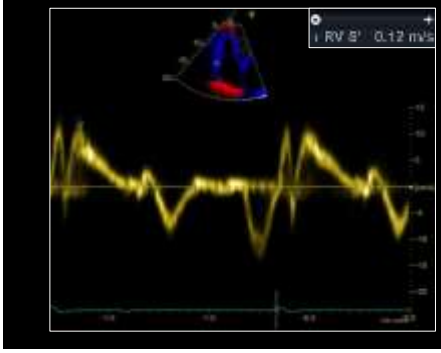


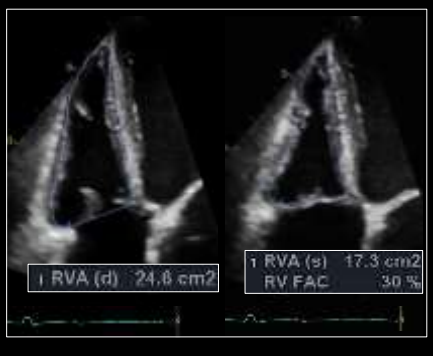


E.Surkova, et al.
3DE right ventricular volumes and EF predict mortality in unselected patients with various cardiac diseases
EHJ-CVI, 2017

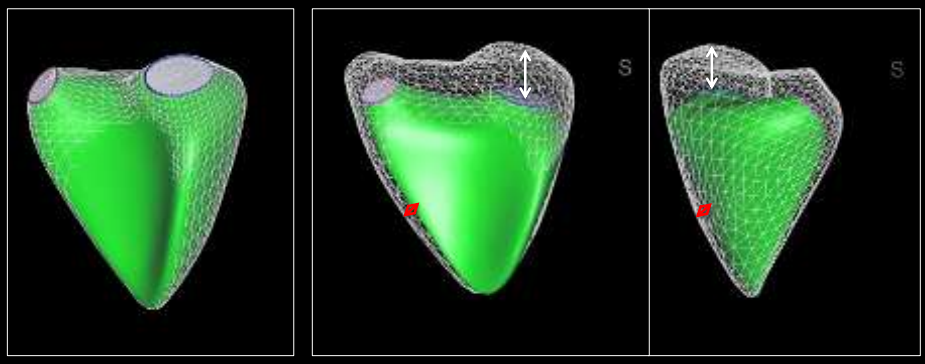
CLINICAL CASE 1: RV Function?







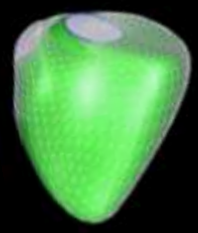
LONGITUDINAL & RADIAL FUNCTION: 3D ECHOCARDIOGRAPHY



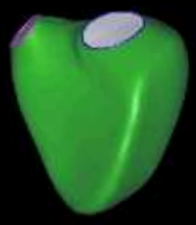
RV SHAPE: 3D ECHOCARDIOGRAPHY

Healthy volunteer

CCTGA: Systemic RV

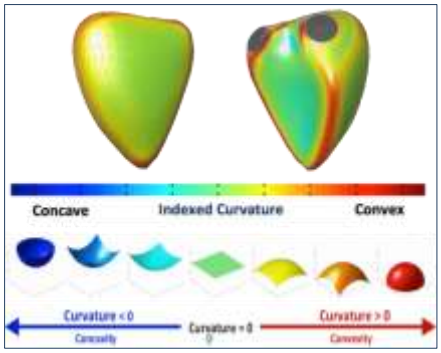


RV Volume overload

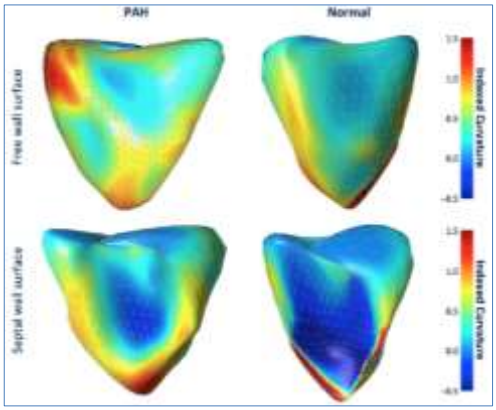


LV Dilatation with rEF

RV SHAPE & CURVATURE: 3D ECHOCARDIOGRAPHY



The curvature of the RV inflow tract was a more robust predictor of death than RV EF, RV volumes, or other regional curvature Indices.



K. Addetia, et al. ***3DE-based analysis of RV shape in pulmonary arterial hypertension****. EHJ-CVI, 2015.*

RV SHAPE & CURVATURE: 3D ECHOCARDIOGRAPHY

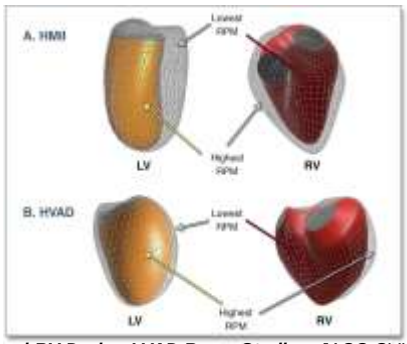
Reference values for the RV curvature are available

Table 2 Normal values for regional curvature

Region	Overall		
	ED	ES	P
Apical free wall	2.38 ± 0.24	2.45 ± 0.34	<.01
Body free wall	1.17 ± 0.06	1.13 ± 0.10	<.01
Apical septum	0.51 ± 0.34	0.52 ± 0.43	.55
Body septum	0.24 ± 0.15	0.25 ± 0.18	.11
RVOT	1.42 ± 0.11	1.31 ± 0.12	<.01
RVIT	1.27 ± 0.16	1.20 ± 0.13	<.01

K. Addetia, ... E.Surkova, et al. ***Morphologic Analysis of the Normal RV Using 3DE–Derived Curvature Indices.*** *JASE, 2018.*

Insight into LV and RV shape and morphology with increasing pump speeds may have an impact on LVAD speed optimization.



K. Addetia, et al. ***3D Morphological Changes in LV and RV During LVAD Ramp Studies.*** *JACC-CVI,*

Strengths and limitations of 3D echocardiography in assessing the RV

Major advantages	• **Direct measurements of volumes and EF** • **No geometric assumptions** • **Higher accuracy and reproducibility than 2DE parameters** • **Additive prognostic value in congenital and acquired heart diseases** • **Novel 3DE-based methods allow to assess:** ✓ **relative contribution of longitudinal and radial contractility to RV EF,** ✓ **RV shape**
Major limitations	• Need of stable cardiac rhythm and patients' cooperation • Severely dilated RV may be difficult to encompass in a 3D data set • Requires good image quality

TAKE HOME MESSAGES

Recommendations. 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.

- 3DE should be performed in all patients' categories where RV information is clinically/prognostically important:
  - ✓ PH,
  - ✓ Congenital heart disease,
  - ✓ Heart failure,
  - ✓ MI,
  - ✓ ARVC,
  - ✓ RV pathology/failure

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THANK YOU FOR YOUR ATTANTION