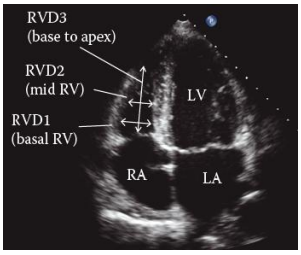
RIGHT VENTRICLE

RV SIZE & MORPHOLOGY

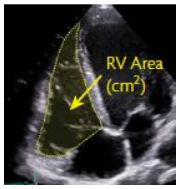
The RV is more complex to assess by echo than the left, forming a triangular or crescent-shaped structure around the LV. It is smaller (2/3 in the apical 4C), thinner-walled, more heavily trabeculated and contains a moderator band that stretches between the free wall and the septum and winds around the RV apex obliquely.. The RV is anatomically situated anteriorly to the LV and is therefore closer to the chest wall. The RVOT is not trabeculated and leads to the pulmonary valve. Various measurements of the RV have now been validated by the BSE, and RV dimensions should generally be measured in the apical 4C view.

RV dimensions- modified apical 4C, at end-diastole as follows:

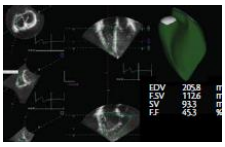
- Basal RV end diastolic diameter (**RVD1**)
- Mid-RV end diastolic diameter (**RVD2**)
- RV base-to-apex (long axis) end diastolic length (**RVD3**): not recommended by EACVI
- Basal RV:LV ratio: may be used to demonstrate RV dilatation



RV area can be measured in the modified apical 4C, tracing around the endocardial border to obtain an outline of the cavity area. Measure area at end-diastole and end-systole to allow quantitative assessment of RV function. RV end-systolic area > 20 cm^2 is a marker of poor outcome

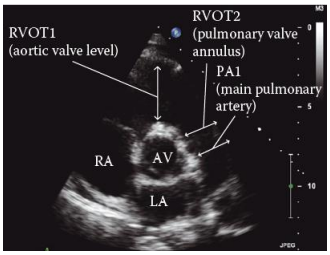


3D RV volumes: dedicated multi-beat 3D acquisition, with minimal depth and sector angle (for a temporal resolution > 20–25 vps, views per segment) that encompasses entire RV cavity.

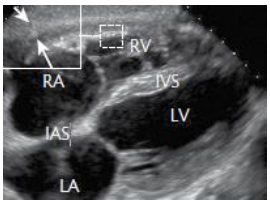


RVOT and PA dimensions- PSAX (AV level)

- RVOT diameter at AV level (**RVOT1**)
- RVOT diameter at PV annulus level (**RVOT2**)
- Main pulmonary artery diameter (**PA1**)



The thickness of the RV wall is ideally measured, at end-diastole, from the anterior wall of the RVOT in the PLAX, or preferably using the RV wall in the **subcostal view**, below the tricuspid annulus at a distance approximating the length of anterior tricuspid leaflet, when it is fully open and parallel to the RV free wall. PSAX and apical 4C also may give clue about RVH.



RVH is indicated by a wall thickness >5 mm and commonly indicates RV pressure overload (but may also be seen in hypertrophic and infiltrative cardiomyopathies). Common causes of RVH include:

- Pulmonary hypertension
- COPD
- Pulmonary valve stenosis- causes pressure overload and RVH, akin to AS in the LV causing LVH.
- Pulmonic regurgitation
- VSD
- Tetralogy of Fallot
- Congenitally corrected transposition of the great vessels: the morphological RV becomes the systemic ventricle, leading to RVH
- High altitude
- Cardiac fibrosis
- Athletic heart syndrome

Assessment of RV function- although much of RV function can be attributed to longitudinal function, changes in radial function may be important in some pathologies. Assessment of RV function is often made **qualitatively**, using 'eyeball' assessment of RV contractility. A more **quantitative** approach to RV function can also be taken, using one or more of the following parameters:

1. **Tricuspid annular plane systolic excursion (TAPSE)**: obtain an M-mode trace of an apical 4-chamber view whilst placing the cursor so that it passes through the lateral tricuspid annulus.
2. **Peak tissue Doppler tricuspid annulus systolic velocity (s')**: with TDI, the velocity of the tricuspid annulus is recorded from the apical window showing the expected systolic (S′) and diastolic (E′ and A′) tissue velocities, similar to the left ventricular TDI recordings. The peak S′ velocity reflects RV longitudinal shortening (a value < 11 cm/s indicates RV dysfunction)
3. **Longitudinal strain and systolic strain-rate**. Unlike velocity, which does not necessarily reflect active displacement (scarred segments may be tethered by adjacent normal segments), strain measures deformation and should be a better modality for identifying active contraction. In research studies, MVI-derived strain and strain rate have been used to characterise global and regional RV function, but in clinical practice the technique is not reliable enough. Speckle tracking may hold promise for angle-independent measurement of myocardial displacement, but results are only preliminary at this stage.
4. **Fractional area change**: trace the RV endocardium in the apical 4-chamber view at end-diastole and end-systole.
5. **Tei index (myocardial performance index)** is a measure of both systolic and diastolic function and is independent of heart rate (but cannot be used in an irregular rhythm such as AF). It is s a PW Doppler derived index comparing the total RV isovolumic times with the ejection time. Tei index = $(IVCT_{RV} + IVRT_{RV}) \div ET_{RV}$. To calculate the Tei index use PW through the TV (to measure the duration of RV systole) and the PV (to measure the ejection time). A normal Tei index for RV is < 0.4 *(<0.4 for RV)*, with higher values indicating worsening RV function. The Tei index principle can also be used to assess LV function as well as RV function.
6. **RV ejection fraction** is load dependent, often overestimates RV systolic performance and is not recommended. Moreover, the Simpson's method is limited to single plane when assessing RV EF

Hints:

ARVC is a rare cause of RWMA; ischaemic heart disease, PEs and bundle branch block are more common causes.

RANGE OF RV SIZE & FUNCTION

	Normal	**Mild**	**Moderate**	**Severe**
A4c- **Basal** RV end diastolic diameter (**RVD1**) (cm)	2.0–**2.8**	2.9-3.3	3.4-3.8	≥3.9
A4c- **Mid** RV end diastolic diameter (**RVD2**) (cm)	2.7–**3.3**	3.4–3.7	3.8–4.1	≥4.2
A4c- **Base to apex** end diastolic length (**RVD3**) (cm)	7.1–**7.9**	8.0–8.5	8.6–9.1	≥9.2
RV:LV ratio	≤ 0.66			
RV free wall thickness (cm)	< **0.5**			
RVOT diameter at AV level (**RVOT1**) (cm)	2.5–**2.9**	3.0–3.2	3.3–3.5	≥3.6
	Regional RV akinesia, dyskinesia or aneurysm and **RVOT diameter** ≥3.2 cm (or ≥1.9 cm/m^2) in PLAX is a major criterion of **ARVC**			
RVOT diameter at PV annulus level (**RVOT2**) (cm)	1.7–**2.3**	2.4–2.7	2.8–3.1	≥3.2
Main PA diameter in PSAX (**PA1**)	1.5–**2.1**	2.2–2.5	2.6–2.9	≥3.0 (suggestive of PH)
RV diastolic area (cm^2)	11–**28**	29–32	33–37	≥38
RV systolic area (cm^2)	7.5–**16**	17–19	20–22	≥23
RV Fractional area change (%)	**32**–60	25–31	18–24	≤17
	Regional RV akinesia, dyskinesia or aneurysm and **fractional area change** ≤33% in apical 4C is a major criterion of **ARVC**			
TAPSE (mm)	**16**–20	11–15	6–10	≤5
Peak tissue Doppler tricuspid annulus systolic velocity (s')	≥ 11 cm/s			
RV EF (%)	45 ± 5			

Anatomic variants related to the RV mimicking pathology on echocardiography

- **Moderator Band**: a prominent muscular ridge that stretches between the RV free wall and is particularly well seen from the apical window
- **Lushka's muscle** is an accessory papillary muscle of the septal leaflet of the TV sometimes seen in the RVOT
- Catheters and pacemaker leads
- Muscle bundles/trabeculations