My Approach to Assessment of Right Ventricle Function

Como eu Faço a Avaliação da Função do Ventrículo Direito

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Introduction

Right ventricular (RV) failure plays an important role in the prognosis of cardiovascular diseases, such as valvular, ischemic, and congenital heart diseases and pulmonary hypertension (PH). Therefore, its early detection has a direct impact on the morbidity and mortality.

The assessment of RV function is an echocardiographic challenge due to peculiarities related to the complex geometry limiting its single-plane visualization, restricting the use of conventional parameters to evaluate RV performance. It depends on load conditions, resulting in difficult ventricular cavity delineation and ventricular interdependence.[1]

Cardiac magnetic resonance (CMR) is the gold standard examination for RV functional and volumetric assessment; however, it has limitations of accessibility and cost.[2] Therefore, echocardiography is the most commonly used diagnostic method in daily clinical practice, with studies on several echocardiographic modalities corroborating a more accurate assessment.

How to assess the right ventricle?

Echocardiographic assessment must measure RV dimensions and perform functional evaluation. As for systolic function, it is important to highlight the association of qualitative analysis with at least two quantitative parameters.

Qualitative analysis is frequently used in practice, especially when quantitative analysis is impaired; however, it presents significant interobserver variability.[3] In routine examinations, multiple echocardiographic planes are assessed to improve accuracy, especially the RV modified apical four-chamber, parasternal long axis, and parasternal short axis views, including the proximal and distal outflow tracts (Videos 1 and 2).

Quantitative analysis includes the RV dimension measurements obtained in apical four-chamber (Figure 1), parasternal long axis, and parasternal short axis planes and anterior wall thickness (Table 1).[4] Based on a good correlation between two-dimensional end-diastolic area measurement indexed by body surface and indexed end-diastolic volume obtained by CMR and/or three-dimensional (3D) echocardiogram, these measurements are included in the assessment of disease progression in patients with congenital heart disease and PH.[2,5]

The conventional parameters recommended for assessing systolic function include measuring the tricuspid annular plane systolic excursion (TAPSE), fractional area change (FAC), systolic myocardial velocity (S') (Figure 2), and Myocardial acceleration during isovolumic contraction the last two recorded using tissue Doppler imaging (TDI). IVA is an index used only in laboratory research and not in routine practice. The myocardial performance index (MPI/Tei index) assessed by TDI allows a global analysis of systolic and diastolic function and may or may not be included in the assessment as an initial and progression measurement associated with other examinations. Reference values are shown in Figure 3, but because both TAPSE and S' velocity are influenced by age, reference values available in the literature should be considered according to the age group.[6,7]

TAPSE is a simple method routinely used with proven applicability in several conditions, such as in patients with PH. In postoperative evaluations and heart transplantations, it must be cautiously interpreted, considering the influence of pericardiotomy and other factors.[8] Therefore, in these cases, its applicability should be analyzed using comparative and progression values of the same patient.

Keywords

Ventricular Dysfunction, Right; Echocardiography; Magnetic Resonance.

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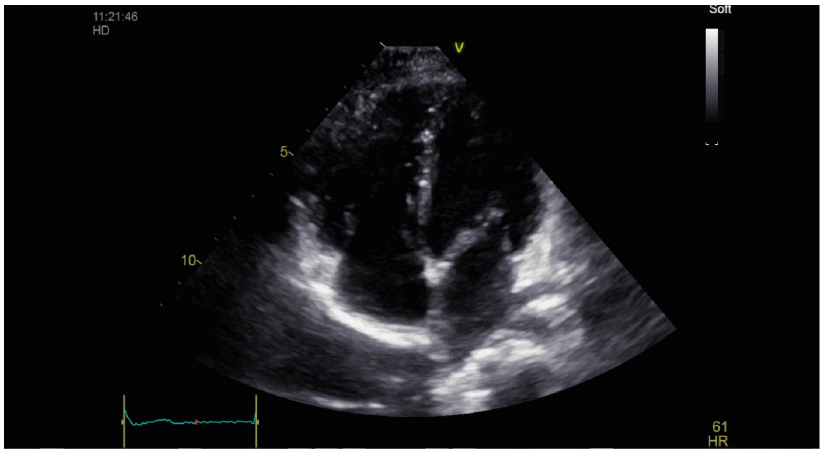
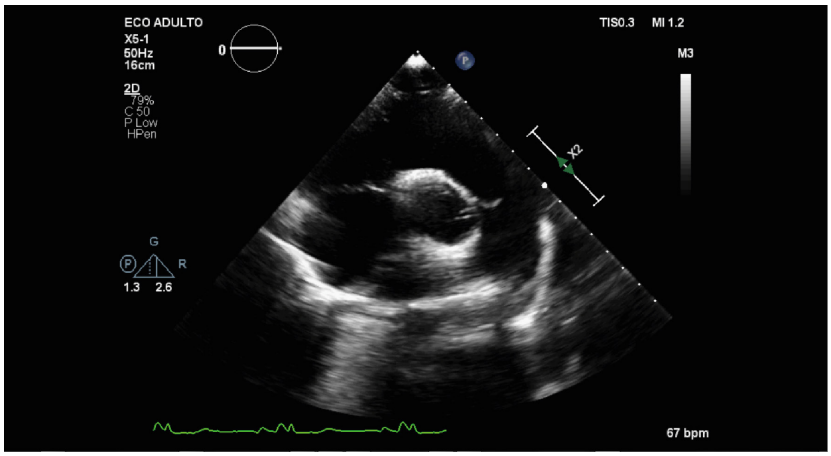
Editorial



Video 1 – *Qualitative analysis of RV systolic function. Apical four-chamber plane focusing on the right ventricle.*



Video 2 – *Qualitative analysis of RV systolic function. Short axis parasternal plane assessment of the proximal and distal outflow tract.*

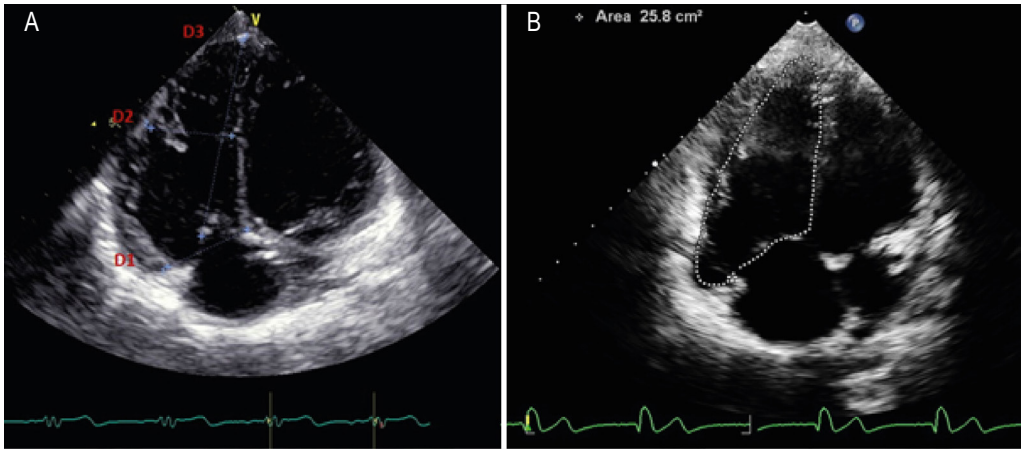


Figure 1 – *(A) Evaluation of the right ventricle dimensions in the apical four-chamber plane. Basal portion (D1); medial portion (D2); longitudinal portion (D3). (B) End-diastolic RV planimetry.*

FAC is a parameter that has a good correlation with ejection fraction obtained by CMR.[9] In cases of severe RV hypertrophy and when ventricular cavity delineation is impaired, the use of color flow mapping has been associated with defining delineation and improving accuracy.

The study of new echocardiographic modalities, such as myocardial deformation indexes (strain; strain rate) and 3D echocardiography, associated with conventional parameter analysis, has improved the accuracy of RV function assessment.

The two-dimensional strain obtained using the speckle tracking technique (STE-2D) allows global and regional analysis of the longitudinal RV function (Video 3), being an early marker of functional changes and presenting a good correlation with ejection fraction obtained by CMR.[10] STE-2D values vary with age and types of software used.

The evaluation of peak systolic longitudinal strain has been incorporated in routine practice to follow-up several cardiovascular conditions. However, it depends on software availability and operator experience. Reference values are available in the literature for adult and pediatric age groups.[4,11] The global value should be used for patients with congenital heart disease, including the septum and considering ventricular interdependence.[12]

3D echocardiogram is another modality that has improved the quantitative assessment of RV systolic and diastolic volumes and ejection fraction estimation (Video 4). It is an alternative to CMR presenting with no contraindications. This technique eliminates geometric interference and allows a digital reconstruction of the RV endocardial surface including all its segments. Several studies comparing ventricular volumes and ejection fractions obtained by CMR showed a good correlation, with the tendency of the 3D echocardiogram to underestimate volumes.[13,14] However, this modality is not routinely performed and is used for specific clinical conditions and laboratory research.[4]

Therefore, the described parameters must always be

Table 1- Normal RV dimension values.

Right ventricle dimensions	Normal reference value* (mm)
Basal portion	25-41
Medial portion	19-35
Longitudinal portion	59-83
Longitudinal parasternal RVOT	20-30
Short proximal parasternal RVOT	21-35
Short distal parasternal RVOT	17-27
Anterior wall thickness	1-5

*RVOT: right ventricular outflow tract. *Reference values.[4]*

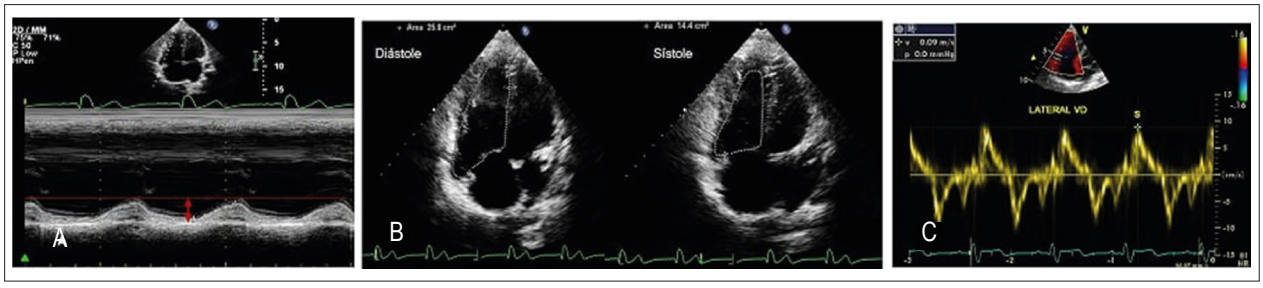


Figure 2 – *Conventional parameters for assessing right ventricle systolic function. (A) Tricuspid annular plane systolic excursion (TAPSE). (B) Fractional area change (FAC) registered by the difference between the end-diastolic and end-systolic areas/end-diastolic area. (C) Spectral curve obtained by tissue Doppler analysis at the level of the tricuspid valve ring. Peak myocardial wave velocity during systole (S'). RV = right ventricle.*

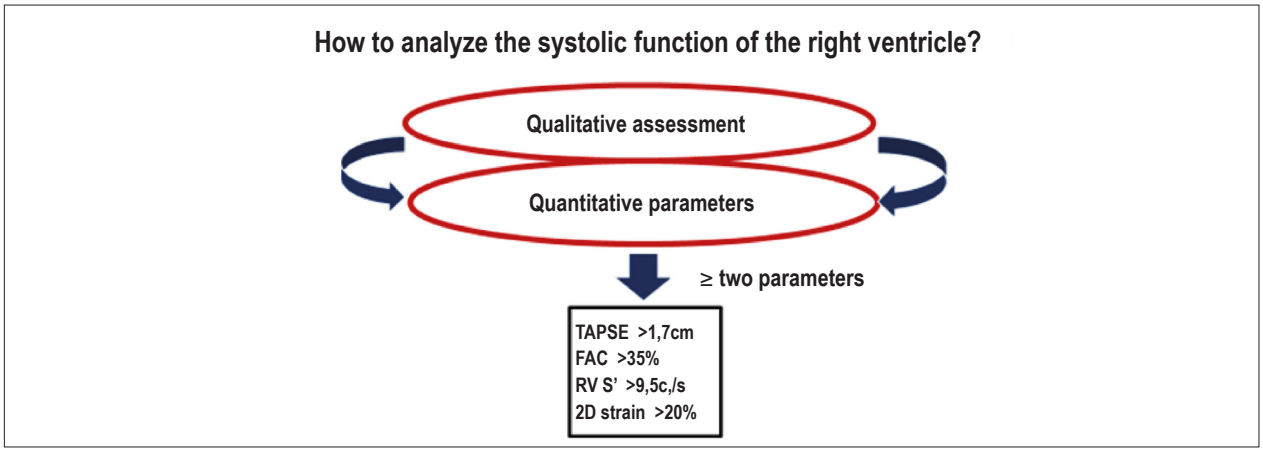
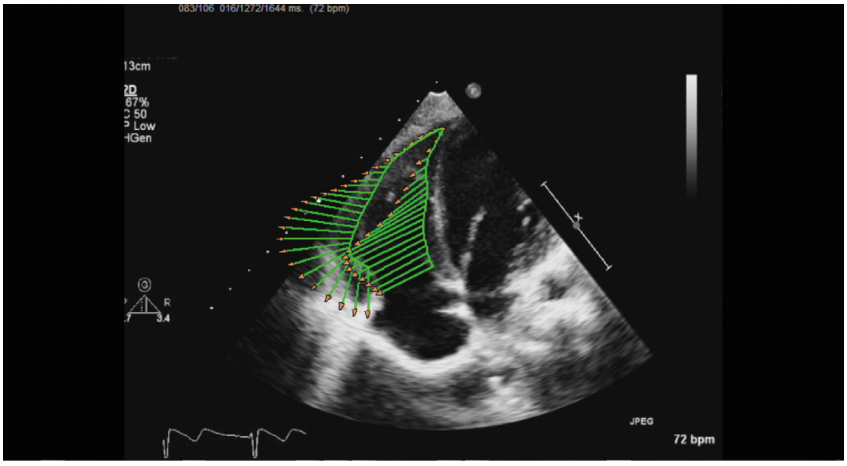
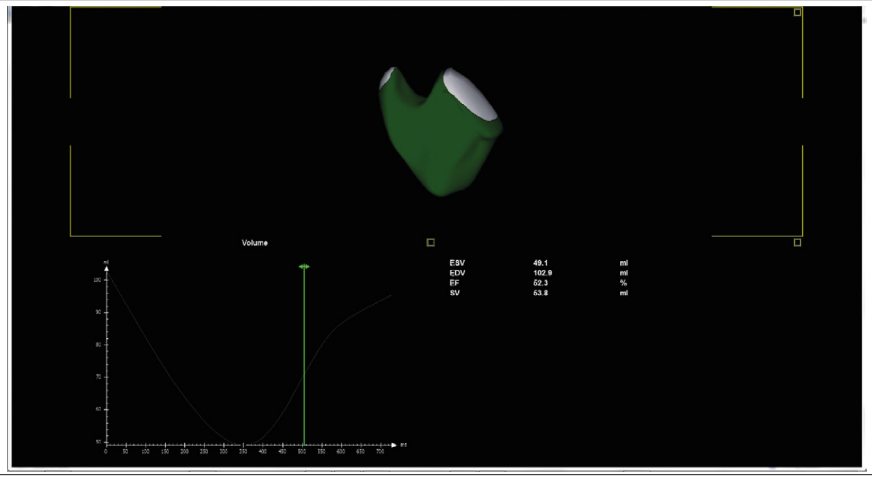


Figure 3 – *Assesment of right ventricle systolic function.*



Video 3 – *Speckle tracking technique to assess the RV systolic longitudinal strain.*



Video 4 – *Three-dimensional reconstruction of the right ventricle.*

evaluated using criteria and common sense, considering the examiner's experience and adequate image acquisition quality. Therefore, in case of a technical impairment, its inclusion in the quantitative assessment of systolic function is not recommended.

Conflict of interest

The author have declared that they have no conflict of interest.

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