

Short Commentary

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What Echocardiographic Measure Should Be Used to Assess Right Ventricular Function in Tetralogy of Fallot?

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Description

The assessment of right ventricular (RV) function in patients with congenital heart disease is the focus of significant research and clinical interest. The RV's anterior position in the chest, complex geometric shape, and unique pattern of contractility make the assessment of RV function by conventional 2-dimensional parameters challenging [1-3]. In Tetralogy Of Fallot (TOF) in particular, investigators have studied multiple non-invasive measures to evaluate the RV's systolic function, including Tricuspid Annular Plane Systolic Excursion (TAPSE), Fractional Area Change (FAC), isovolumic acceleration time, tissue doppler-derived tricuspid systolic velocity (S'), longitudinal peak systolic strain, stress echocardiography, and more recently three-dimensional echocardiography [4-6]. Although the use of these methods has been suggested in particular for the follow up of patients with TOF, pulmonary regurgitation, progressive RV dilation, and dysfunction, the clinical utility of certain parameters remains undefined.

When deciding how to approach the assessment of RV function in TOF by echocardiography, which measures should be reported for clinical use? The American Society of Echocardiography has proposed a variety of diagnostic imaging modalities for the evaluation of patients with TOF, with a focus on older patients with repaired TOF [4]. This report suggests the complementary use of different modalities to assess RV function, all of which have inherent limitations. However, we propose a few specific methods to be used in clinical practice. Fractional area change (FAC) is measured in squared centimeters (cm²) on a modified apical 4-chamber view by 2-dimensional echocardiography, but can also be measured using speckle-tracking software. First, the area of change is traced along the RV endocardium during both diastole and systole. Second, the RV diastolic area is subtracted by the RV systolic area, and then divided by the RV diastolic area, to produce the FAC calculation. This is a relatively easy and reproducible parameter that has at least modest correlation with cardiac magnetic resonance imaging (CMR) data [7-9], FAC should be utilized more often, especially given the limitations of other 2-dimensional parameters (such as TAPSE) in patients with structurally-abnormal or surgically-altered right ventricles, such as TOF [10,11].

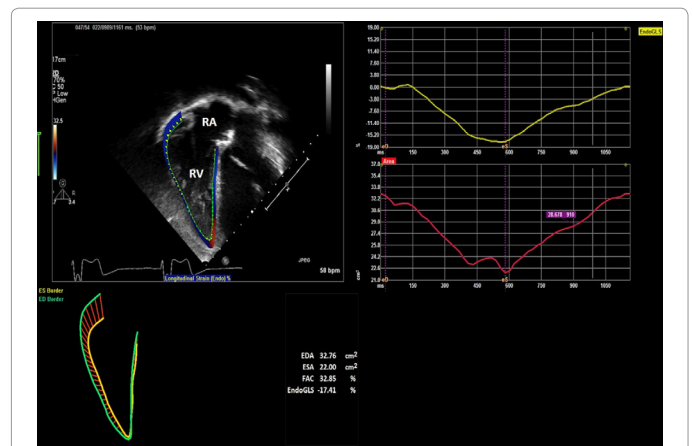


Figure 2: Right ventricle fractional area change obtained with TomTec™ software. RA, right atrium; RV, right ventricle.

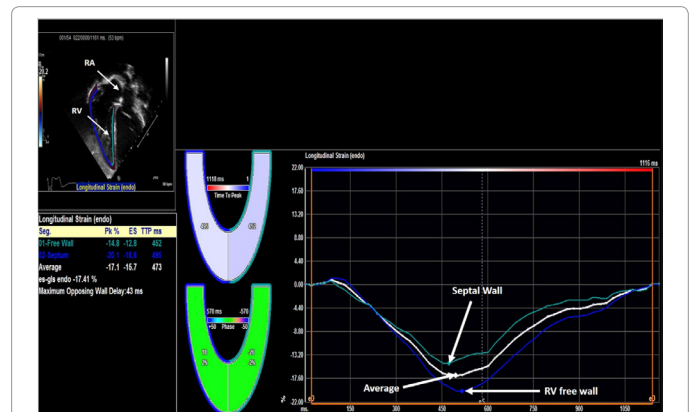
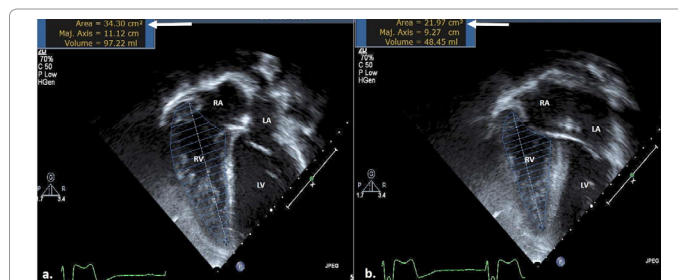


Figure 3: Right ventricle global longitudinal strain (TomTec™). The curves demonstrate segmental wall motion of the right ventricular septal and free walls. RA, right atrium; RV, right ventricle.



FAC: Fractional Area Change; RA: Right Atrium; RV: Right Ventricle; LA: Left Atrium; LV: Left Ventricle.

Figure 1: Fractional area change measurement obtained during end-diastole (a) and end-systole (b) in the right ventricle of a patient with tetralogy of Fallot. The arrows demonstrate the measured areas during diastole and systole. The calculated FAC [(34.3-21.97)/34.3]=35.9%.

Recent studies have shown that myocardial deformation is applicable to patients with TOF. Global longitudinal RV strain is a measure of intrinsic myocardial contractility that calculates cardiac deformation as a percentage change in length [12-14]. It is quantitative,

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angle-independent, and less dependent on loading conditions compared to other echocardiographic measures, which is a particularly convenient characteristic when dealing with volume loaded RVs in patients with TOF [15-17]. After training personnel and achieving adequate reproducibility, global longitudinal RV strain appears to be a sensitive measure of ventricular function, as evidence suggests that strain is affected prior to changes in other more blunt measures of function [18]. Therefore, strain is the next parameter that should be added to the clinical echocardiography report. At present, and until normative data are well established and the variability among vendors is reduced, we suggest its use primarily in the follow-up of individual patients over time, where changes in RV peak systolic longitudinal strain may precede overt changes in ejection fraction and therefore alert the clinician [19].

Examples of these specific methods being utilized in clinical practice are shown in the accompanying Figures 1-3 from an adolescent male with TOF and absent pulmonary valve, who underwent initial surgical repair with a conduit from the right ventricle to the pulmonary artery and closure of the ventricular septal defect in infancy, followed by conduit replacement at 12 years of age. As a medical community with interest in improving outcomes for patients with TOF, our collective goal should be to better understand RV mechanics, apply the best imaging tools to accurately quantitate RV function, identify patients at increased risk who may require more frequent monitoring or earlier intervention, predict clinical or procedural outcomes, and ultimately provide the scientific evidence that guides the care and treatment of our patients.

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