Right here, right now!

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The right heart and particularly the right ventricle (RV) have gained interest these last years. It is now well-admitted that the RV plays an increasingly recognized role in determining symptoms and outcomes in multiple conditions. Although cardiac magnetic resonance imaging (cMRI) remains the gold standard for evaluation of RV ejection fraction, echocardiography is still the initial evaluation tool due to its availability and portability. Moreover, newer echocardiographic techniques including 3D evaluation and global longitudinal strain, can improve our evaluation of RV function.

The RV has a peculiar and complex morphology and function. RV adaptation to disease is mainly determined by the degree of pressure overload, volume overload, and alterations in intrinsic contractility. These situations have a distinct clinical course and require different therapeutic approach although they may frequently coexist in various degrees.

The most used parameters to evaluate RV morphology or function with M-mode or 2D echocardiography are presently linear parameters in parasternal views such as anteroposterior diameter, the tricuspid annular plane systolic excursion, alternatively the basal segment systolic velocity, and the RV fractional area change derived from apical four-chamber views. Although these parameters are quite easy to measure, they are subject to many limitations, and their accuracy, reliability are poor with a huge overlap with controls making cMRI the reference method for the RV evaluation. More recently RV free wall longitudinal strain has emerged as a feasible and reproducible measure of RV systolic function but some inherent limitations to the technique and the intervendor system variability require more investigations before it could be used in the routine clinical practice.

Evolution in transducer technology and software has made 3D echocardiography an attractive modality to circumvent the limitations of 2D echocardiography for the evaluation of RV geometry and function. However, acquisition, optimization, and evaluation of 3D datasets require expertise and training as well as adapted software dedicated to the right heart. Its feasibility in groups with expertise is usually estimated around 75% but much lower in patients with assist devices and with a poorer correlation with cMRI volumes in dilated RV. Specific acquisition windows have been recommended, a sufficiently high volume rate (20–30 vps) is needed, a good quality imaging is required as well as the collaboration of the patient to take a correct breathhold. Moreover, patients with arrhythmia are more challenging and usually excluded. Although the one beat acquisition can partially solve this issue, the price to pay is usually a decrease in spatial resolution. To date, the contouring of the RV remains semi-automatic and requires often manual corrections. Finally, RV ejection fraction (RVEF) is only one way to evaluate RV dysfunction but if pressure overload eventually leads to RV failure, the relationship is not always linear. Some patients present with RV failure despite relatively normal pulmonary artery pressure. Others have preserved RV function despite considerable elevation of RV afterload. Concept of ‘ventricular-arterial coupling’ referring to the relationship between ventricular contractility and afterload has been proposed to improve the accuracy of echocardiography for estimating cardiopulmonary haemodynamics and can also be studied using 3D echocardiography. In the present retrospective study, the authors aimed to demonstrate the prognostic value of RV dysfunction measured by 3D echocardiography in a cohort of 412 patients from one institution and to validate the partitioning of RV dysfunction in tertiles to predict mortality and major adverse cardiac events (MACE) in a validation cohort of 446 patients from another institution. They have shown an additional prognostic value of RVEF in patients with heart diseases, and identify the partition values of RVEF to stratify the risk of cardiac death and MACE. This confirms cMRI data on previous smaller cohorts and represents a major step forward for echocardiographic evaluation of RV dysfunction and its prognostic value.

In the concept of ejection fraction (EF) has been used to define ventricular function in two ways. First, when screening for normal vs. abnormal, one uses a statistical definition—two standard deviations below the mean. For the LV, this has been calculated as an EF of 53%, whereas for RV it has been defined as 45% by 3D echocardiography. The second way is to derive cut-off values to prognosticate or guide therapy. Examples of this are the classical demonstration that mortality increases exponentially as the left ventricular ejection fraction
get the true feasibility to obtain fully analysable and analysed 3D RV datasets would be to attempt this measure in a large consecutive cohort. The authors suggest that new technologies based on artificial intelligence and deep learning will be helpful in the near future to tackle some of these issues. This represents a whole other challenge, as the first published algorithm was successful in fully automated analysis in 32% of subjects—and more disturbing—only an expert could discern which subjects did not require manual adjustment and in whom the algorithm could be run independent of human supervision.

Right here, right now? As with everything in medicine, the answer is, ‘it depends’. From this encouraging study performed in two disparate but expert centres, RV EF by 3D echocardiography clearly demonstrates incremental prognostic information, graded by practical partition cut-offs. These investigators have previously established normal cut-off ranges for RVEF and RV volumes using 3D echocardiography and some consider these data the most robust in determining normal reference ranges for RV size and systolic function. We now are shown that normal vs. abnormal is insufficient and additional grades of dysfunction can prognosticate. But on the flipside, can the conclusions be widely applied to all patients? Questions still remain about feasibility of the technique and generalizability of the findings across numerous conditions. Despite these caveats... we should all aim to incorporate 3D echocardiographic RV assessment right now to enable stronger conclusions to be made in the future without necessarily relying on cMRL.

Conflict of interest: Rudski - minor share holding in GE < $10,000.00

References