



Editorial

Should cardiac CT replace echocardiography to assess RV function before tricuspid valve surgery?☆



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Compared with the literature concerning left valvar disease [1], the data concerning tricuspid regurgitation (TR) is very limited. Recently, the prevalence, and distribution patterns of significant (\geq moderate) TR in the Community were described by the Mayo Clinic group. TR was shown to be prevalent ($\approx 0.55\%$), increasing up to 3% in patients ≥ 75 years, with similar prevalence to aortic stenosis [2]. Furthermore, community patients with isolated severe tricuspid valve (TV) disease, presented with progressive right heart failure, and excess mortality even in the absence of other cardiac or systemic comorbidities [2,3]. The erroneous notion, that TR would correct itself once the left heart problem had been addressed, has restrained surgical repair or replacement in the past. Yet, despite newer data showing that TR does not improve with correction of left heart failure, and the guideline recommendations to intervene in patients with symptomatic TR [4,5], isolated TV surgery remains very rare even today (≈ 800 surgeries p/year in the USA), particularly in comparison with nearly 1.6 million Americans estimated to have \geq moderate-severe TR [2,6]. The rarity of TV surgery is driven by a high perceived operative mortality, still $\approx 9\%$ in the contemporary USA national sample [6]. Appropriate patient selection and optimal timing for TV surgery are crucial in yielding an optimal outcome, but there is a lack of objective criteria to guide clinicians. Assessment of RV function is a critical component of preoperative planning, because impaired RV function pre-surgery negatively impacts functional and survival outcomes. Moreover, predicting and monitoring

postoperative RV function are also critical for patient management, because the presence of refractory RV dysfunction after cardiac surgery is associated with high in-hospital mortality [7–9]. Although echo is invaluable in assessing TR and identifying other cardiac abnormalities, the complex geometry of the right ventricle (RV), poor acoustic windows, technical limitations, and dynamic changes in RV loading conditions make it difficult to attain accurate and reproducible measurements of RV size or function [10]. Cardiac magnetic resonance imaging (MRI) can provide more accurate assessment of RV volumes and function. However, considering practical issues such as cost, concomitant arrhythmia and poor compliance for MRI of patients with TR, evaluation of RV and TV annulus by computed tomography (CT) can offer a useful alternative.

Given these challenges in quantification of RV function in patients with TR, XXX et al. report in this new issue of International Journal of Cardiology the results of a novel approach to assess RV function in patients with severe TR referred for TV surgery using retrospective analysis of pre-operative cardiac CT for the prediction of postoperative RV dysfunction. The authors retrospectively reviewed echo and CT data of 100 consecutive patients who underwent cardiac CT and subsequently received TV surgery. CT parameters included maximal annular diastolic diameter (4C, 3C, short axis), RV volume (end diastole, end systole), and the derived RV stroke volume and ejection fraction. Preoperative cardiac CT and echo parameters were analyzed in univariate and multivariate analyses to identify significant predictors for postoperative RV dysfunction, both in the entire study population and in the subgroup of patients without preoperative dysfunction. Cutoffs for RV dysfunction included fractional area change $< 35\%$, TAPSE < 1.7 cm, and tricuspid annular velocity (S') < 9.5 cm/s [10]. RV dysfunction was defined as $> 50\%$ of the parameters below the lower cutoff.

RV dysfunction was common post TV surgery and occurred in 46% of all patients and 30% of patients without RV dysfunction before surgery. The only preoperative echo parameters associated with postoperative RV dysfunction were severe TR, wider tricuspid annulus, higher systolic pressure, larger end systolic and diastolic area and presence of preoperative RV dysfunction. The only preoperative CT parameters associated with postoperative RV dysfunction were wider TV annulus and larger RV (end diastolic and end systolic) volumes.

In adjusted analysis, only CT derived TV annulus diameter and RV volume, and preoperative echo RV dysfunction were independent predictors for postoperative RV dysfunction in the entire cohort. However, only CT derived parameters were independent predictors for

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postoperative RV dysfunction among patients without preoperative RV dysfunction. The c-statistic of the CT model was better than that of echo model for predicting post-operative RV dysfunction.

The potential advantages of performing cardiac CT before TV surgery include: better visualization of the annulus and adjacent anatomic structures, improved estimation of RV volumes, RV ejection fraction, limited human measurement error and good reproducibility. These are especially important in patients with TR because they provide insights into the mechanism of TR, improve the ability to plan the type of surgery and ring size, and improve risk stratification. Furthermore, accurate assessment of end diastolic and systolic RV volume and their difference may help quantify TR volume by subtracting forward echo derived forward stroke volume from RV total ejection volume. Still, it is important to remember that although performing cardiac CT before TV surgery seems to be a leap in the right direction, there are still several important limitations. First, the use of contrast in CT may limit its applicability in a significant proportion of TR patients that frequently suffer from renal dysfunction. Second, there is still inadequate data on how CT assessment of the TV and RV is influenced by machine settings. Third, it is still unknown how CT assessment influences hard clinical endpoint (such as mortality or heart failure). Fourth, the presence of preoperative and postoperative RV dysfunction was based on echo parameters, although MRI is considered the standard modality. Fifth, the study was limited by its retrospective nature and selection bias because only patients with history of previous valve surgery, suspected to have prosthetic valve dysfunction, or with inconclusive echo imaging were analyzed. Yet, despite numerous limitations, the use of preoperative cardiac CT may develop to be a reproducible method to quantify TR

and RV function, assess exact annular diameter and help better planning and risk assessment of patients with severe TR, avoiding the need for complex calculations, and geometric or hemodynamic assumptions. Furthermore, it may become a powerful research tool for evaluation of physiology in different types of TR.

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