Cardiovascular Magnetic Resonance Can Improve the Precision for Left Ventricular Filling Pressure Assessment.

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This commentary refers to “Left atrial volume and left ventricular mass for pulmonary capillary wedge pressure assessment with cardiovascular magnetic resonance. Accurate enough for clinical use?” By Genovese *et al*.

We thank Genovese *et al* for their interest in our manuscript “Cardiac magnetic resonance identifies raised left ventricular filling pressure: prognostic implications”. Echocardiography remains the mainstay for left ventricular filling pressures (LVFP) assessment, and that is unquestionable for several reasons highlighted in Figure 1. However, current echocardiographic based integrated models have several issues. Firstly, the echocardiographic approach has been shown to have limited accuracy in patients with pulmonary hypertension (PH) (1). More recently, in a large cohort of patients (n=1,967), Pak et al demonstrated that from the patients categorized into raised LVFP by integrated echocardiographic approach (n=346), 56.9% patients with normal LVFP on invasive assessment (2). In addition, in the group of patients with normal LVFP by echocardiography, 31% had raised LVFP. Moreover, 8% of the total cohort was in undetermined group. To summarise, the accuracy of the complex integrated approach by echocardiography is not any better. Moreover, the precision of those measurements to make longitudinal assessment of LVFP remains challenging in clinical practice. Conversely, cardiac magnetic resonance (CMR) is highly reproducible (3), and the relevant parameters can be easily obtained using standard clinical protocols.

As the authors identify, the sensitivity of our CMR derived model was modest (32%). However, importantly the specificity was high (92%) (4). Furthermore, the relationship with survival of the CMR model was preserved and in fact was non-inferior to invasive assessment. As the authors suggest, the important comparison is with echocardiography-based models; the sole non-invasive method currently deployed in clinical practice. In our study, the concordance of the echocardiography-based model with invasive PCWP was very low (diagnostic accuracy of 25%). This is largely reflective of the large heterogeneous study population and the difficulty

applying these models in standard clinical practice with varying operators and expertise. The previously mentioned large observational study by Pak *et al* similarly concluded that the echocardiographic algorithm did not perform very well to include or exclude elevated filling pressures in an unbiased sample, especially in individual patients. The CMR model may therefore, despite the modest sensitivity, offer improved specificity and reproducibility above current echocardiographic models and this is likely to be the key role in clinical practice. However, the CMR model does have limitations (Figure 1) as it only incorporates geometric parameters, left atrial (LA) volume and left ventricular (LV) mass.

Finally, we endorse the authors views that future models will need to embrace the function and deformation of the LA and LV to represent dynamicity, and this will be a key avenue of future work. We read with interest the recent work by Genovese *et al* demonstrating the incremental and additive role of echocardiographic derived LA expansion index over standard echocardiographic models (5). Such models are likely to be further improved with the use of CMR based parameters that may be more easily obtained and reproducible that their echocardiographic counterparts.

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Figure 1. Non-invasive assessment of left ventricular filling pressure by Echocardiography and CMR – complimentary roles in clinical practice.