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EDITORIAL

Imaging primary mitral regurgitation: the whole is better than the sum of its parts

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This editorial refers to 'The evolving role of cardiac magnetic resonance in primary mitral regurgitation: ready for prime time?' by B. Liu *et al.* doi:10.1093/ehjci/jey147.

There is the 'What we want' and the 'What we need' in the goals of imaging the mitral valve (MV) in primary mitral regurgitation (MR).[1] The delineation of the underlying morphological abnormalities of the MV, the degree of MR, and the haemodynamic consequences of MR are among the 'What we want' category. These important questions can be answered in most instances by 2D and 3D transthoracic and transoesophageal echocardiography (TTE and TOE, respectively). Liu *et al.*[2] provide an update into the potential role for cardiac magnetic resonance (CMR) imaging in the evaluation of primary MR. Not surprisingly, this excellent review confirms that 2D and 3D echo are sufficient to address the key 'What we want' issues in most circumstances, but with well-known limitations in specific circumstances. In these specific circumstances, CMR provides an avenue to reliably assess the lesion, especially the severity of MR. The measurement of regurgitant volume (RVol) and fraction (RF) is the most notable contribution of CMR in this regard. Both, right ventricle (RV) and RF can be measured by 2D echo and more recently by 3D colour flow Doppler.[3] But, the former is cumbersome, prone to errors, and not routinely done in practice, while the latter is promising as a tool but is not widely available and needs further studies to establish accuracy and feasibility. This is where CMR offers a clear incremental value and fills an important gap between guidelines or recommendations and real-world practice in the assessment of MR severity. We should all be thinking about RVol and RF measured by CMR in challenging cases rather that leaning on unreliable PISA effective regurgitatnt orifice area (EROA) or PISA-derived RV/RF by 2D or 3D echo only.[4] There is no shame for echocardiographers to seek CMR in challenging circumstances, and likewise for CMR enthusiasts to acknowledge that echocardiography works in most circumstances. Both have limitations in the real-world and there are such things as poor quality echocardiography and CMR. We have more data on the quality of echocardiography in general because much more echocardiograms are done compared with CMR, especially for MR. But, there are poorly done CMRs also, we just do not know the real-world rates of these are. So, the 'What we want' category often descends into argument about which among the modalities is superior. But, this is not relevant to the real-world practice. When high quality TTE and TOE, and equally competent physicians are available, these modalities form the cornerstone for the evaluation of primary MR. This applies even when excellent CMR services are available, because RF is not necessary in every case of primary MR. When the echo resources are limited in quality and competency, CMR may be done more often in the evaluation of MR. It is interesting to note however, that most centres with excellent CMR also tend to have at least good if not excellent echo resources. It is harder to find a centre where CMR is excellent when echo services are poor, although these do exist. This co-dependency of the quality of the two modalities is fortuitous but critical for good patient care, which is ultimately the goal of any institution.

The 'What we need' in primary MR, however does not necessarily stop with accurate, reliable, and reproducible quantification of the severity of MR. In fact, the triggers for intervention in primary severe MR are presence of symptoms or evidence of left ventricular (LV) enlargement or reduced LV systolic function (which is currently measured by ejection fraction, EF).[5] Measurement of LV size and EF is where 2D echocardiography can be unreliable especially for serial measurements during follow-up. Another instance when accuracy of these LV indices become critical for decision-making is when there is discrepancy between these and the degree of MR. There is consensus that CMR is more accurate and reproducible than 2D echocardiography for measurements of LV volumes and EF. Although the guidelines recommend end-systolic linear dimension as an index of LV size, this is based on the fact that there is very little data on outcomes based on LV volumes. But, as described in the article by Liu *et al.*,[2] there is an evolving literature on predictive value of LV volumes measured by CMR in primary MR, and these data may yet refine the guidelines in the future. But, unlike LV volumes the argument that accurate and reproducible measurement of left ventricular ejection fraction (LVEF) by CMR is necessary is less clear because 2D echo with contrast or 3D echocardiography can measure one-time EF with similar, if not the same degree of accuracy as CMR. However,

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for detection of progressive increase in LV size or decrease in EF (which is a class IIA indication for intervention in the guidelines), CMR is more reliable. But, LVEF >60% in primary severe MR does not necessarily indicate normal LV contractility, which is a key measure of myocardial function in volume overload situation. Thus, myocardial strain measurement especially global longitudinal strain (GLS) is emerging as a marker of myocardial contractility. The use of GLS as a marker of myocardial dysfunction and trigger for intervention in primary MR needs further investigation and outcomes data.[6] The CMR correlate of this index may be its unique ability to detect and quantify the myocardial scar/fibrosis burden in primary MR, and it is possible that this may predate abnormalities in GLS. Myocardial scar may also have value over and above prediction of occult LV dysfunction in that, the presence of regional myocardial scar possibly identifies high-risk substrate for malignant ventricular arrhythmias and sudden cardiac death.[7] There is also work being done to use intra-ventricular flow patterns to detect abnormal LV wall shear, which may even precede abnormalities in myocardial strain or development of fibrosis and scar. Both echocardiography and CMR can be used to map intra-ventricular flow signature. Finally, exercise response of the LV and Doppler haemodynamics in primary MR is a key option in evaluation of patients with discrepant findings compared with symptoms.[8] This option may be necessary even after CMR measurements if there is continued discrepancy. Echocardiography is uniquely suited for this purpose.

In summary, there is much for us to learn about the timing of intervention in primary MR. The past arguments of which imaging modality is better is not only short-sighted but also irrelevant to current surgical and the rapidly evolving transcatheter technologies for the treatment of MR.[9] The 'What we want' needs to be combined with the 'What we need' to truly provide a clinically useful imaging strategy to take care of the patient with primary MR. From the many modalities and indices we want one thing, that is to be able to integrate all the information to intervene in timely and successful fashion: *E Pluribus Unum*.

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