Is cardiac magnetic resonance ready for aortic regurgitation?

Michael Markl[1, 2], Jeesoo Lee[1], Maurice Pradella[1, 3]

[1]Department of Radiology, Northwestern University, Feinberg School of Medicine, Chicago, Illinois, United States of America
[2]Department of Biomedical Engineering, Northwestern University, McCormick School of Engineering, Evanston, Illinois, United States of America
[3]Department of Radiology, University Hospital Basel, University of Basel, Basel, Switzerland

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Correspondence to:
Michael Markl, MD, PhD,
Lester B. and Frances T. Knight Professor of Cardiac Imaging,
Departments of Radiology & Biomedical Engineering,
Northwestern University,
Feinberg School of Medicine & McCormick School of Engineering,
737 N. Michigan Avenue
Suite 1600,
Chicago, IL 60611, USA,
phone: +13 12 695 1799,
e-mail:
mmarkl@northwestern.edu

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Current European Society of Cardiology and American Heart Association guidelines highlight the importance of echocardiography for the assessment of aortic regurgitation (AR), since it is widely available and allows for comprehensive evaluation of multiple factors in one exam, such as valve morphology, jet angle, pressure half time as well as quantification of regurgitant volume (RVol) and regurgitant fraction (RF), left ventricular (LV) dimensions and function [1, 2]. However, standard 2D echocardiography is often limited by anatomic coverage, and limited inter-, intra-observer, and sonographer variability. As a diagnostic alternative, cardiac magnetic resonance imaging (CMR) offers superior image contrast with flexible 2D or 3D image orientation and is considered the clinical reference standard for LV and right ventricular (RV) volumetry [3]. In addition, 2D phase-contrast CMR can reliably measure blood flow in the aorta and has been shown to provide reproducible AR RVol and RF, which are crucial metrics associated with the heart valve disease severity [4]. However, despite the benefits of CMR over transthoracic echocardiography (TTE), only limited data on the systematic comparison of both modalities have been presented.

In the current issue of *Kardiologia Polska* (*Polish Heart Journal*), Haberka et al. present an interesting and timely study comparing TTE and CMR for the assessment of AR in a group of 49 patients [5]. The study cohort included a broad range of AR severity determined by the quantitative and semiquantitative integrative approach described in American Society of Echocardiography guidelines [3]. AR severity for all patients was also assessed using RVol and RF quantified by 2D phase-contrast CMR with the same cutoffs for the grading used by TTE. In line with previous studies [4, 6, 7], the authors demonstrated that TTE overestimated AR severity, RVol, and RF in comparison to CMR. Further investigation revealed that factors associated with AR grading discrepancies between CMR and TTE were the presence of eccentric AR flow jets (≥40° deviation from the axis perpendicular to the aortic valve). This finding illustrates a well-known limitation of 2D Doppler echocardiography which can only quantify the AR flow jet velocity component parallel to the ultrasound beam. As a result, the increased eccentricity of the AR flow jets can compromise the accuracy of TTE. However, whether the presence of an eccentric jet leads to over- or underestimation by TTE was not discussed by the authors. In addition to AR assessment, the authors compared the diagnostic value of CMR vs TTE for detecting LV remodeling impacted by AR. Their study found that, for both modalities, LV end-diastolic volume (EDV) significantly correlated with RVol, which supports the potential benefit of using EDV as an indicator of LV dilatation associated with AR [8, 9]. Furthermore, LV EDV and ejection fraction (LVEF) were higher for CMR compared to TTE. Since LV EDV and LVEF are both used to determine (surgical) intervention, this finding implies that CMR might be preferable in monitoring the progression of AR.

There are a few limitations: As the authors mentioned, there were only 5 cases of severe AR, which limits the clinical transferability of results. Second, for this type of study, it is of importance to ensure the discrepancy of measurements is primarily driven by the difference

in the technique itself and not by physiological conditions between TTE and CMR examination. Blood pressure, heart rate, and time between the TTE and CMR exams would have been good indicators for changes in subject physiology but were not reported. Third, accurate flow quantification use of 2D phase-contrast CMR requires careful 2D analysis plane orientation [10] along the aorta [11], correction for eddy-current induced background phase offset [12], and the use of sufficiently high-velocity encoding sensitivity. Finally, only half of the study cohort (n = 24) were used to compare AR flow metrics between the two modalities due to the limited applicability of the proximal isovelocity surface area (PISA) method. PISA is less suitable for AR than mitral regurgitation as the visualization of flow convergence in color Doppler echocardiography is often restricted by thickening and/or calcification of the aortic valve which is also the case in this study cohort. As the focus was to compare TTE vs CMR, other indirect volumetric methods (e.g., subtracting mitral valve stroke volume from LV stroke volume) [3] available by TTE could have been an alternative to PISA in order to improve the statistical power of the study results.

Nonetheless, the data presented in this study by Haberka et al. adds valuable information to understand the differences between the two modalities in AR assessment. Further investigation is still required to demonstrate the prognostic value of CMR-based AR assessment. TTE will thus likely remain the first-choice imaging modality to evaluate and follow-up patients with AR in clinical practice due to its wide availability. Nevertheless, the advantages of CMR are evident in its ability to provide robust and reproducible aortic flow quantification and assessment of global LV and RV function metrics. CMR could thus serve as an important clinical tool for patients with severe AR who require an accurate and comprehensive diagnosis to determine the need and timing of intervention.

Article information

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