



## COMMENTARY

# Recent Advances in Noninvasive Cardiac Imaging

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In the last several years, the rate of innovation in cardiac imaging techniques has accelerated significantly. Advances have been seen in all 4 major modalities; echocardiography, nuclear (positron emission tomography (PET) and single photon emission computed tomography (SPECT), cardiac magnetic resonance imaging (CMR), and computed tomographic angiography (CTA). This issue of Cardiovascular Innovations and Applications will highlight many of these advances.

In echocardiography, strain imaging has made major inroads from a research perspective and now is doing the same in the clinic. In a number of clinical scenarios, speckle tracking strain measures, especially global longitudinal strain, adds prognostic information over and above ejection fraction [1]. This has been shown in acute MI [2], heart failure [3], valvular heart disease [4], and a number of other cardiac conditions. This is highlighted in the article authored by Hyunh and Marwick in the present issue [5]. Imaging of mechanical and electrical dyssynchrony with strain echocardiography is another important recent advance. The multi-center PROSPECT trial enrolled 498 patients in 53 centers and tested 12 echocardiographic markers of dyssynchrony using a blinded core laboratory analysis [6]. Due in part to a lack of reproducibility of the

large number of markers tested, the predictive value for clinical or LV volume response to cardiac resynchronization therapy was modest. Since the publication of this study, newer more specific markers of electromechanical dyscoordination in heart failure are being applied [7] and these are reviewed in the manuscript by Goresan [8].

In regards to advances in nuclear cardiology, several recent developments are highlighted in the reviews on SPECT by Slomka and colleagues [9] and on PET by Galazka and Di Carli [10]. In SPECT imaging, gamma camera advances including solid state detectors and more accurate detectors are leading to improved accuracy with reduced time, radiation, and cost [11]. Newer imaging agents that remain under study for PET include 18F-flurpiridaz [12]. The ability to quantify perfusion is a major strength of PET in comparison to SPECT. Increasingly, evidence points to the prognostic importance of myocardial flow reserve as measured by PET [13]. Limitations of its application remain availability and cost [11].

CMR is expanding in clinical use around the globe. Its application and growth in China is reviewed by Chen et al. in the present issue [14]. One of the newest developments in clinical CMR is the application of T1 mapping. Measuring the T1 of the myocardium without contrast or so called native T1 is particularly useful for identifying amyloidosis [15], especially in those with severe renal disease. The extracellular volume (ECV) of the myocardium can be measured by making T1 measurements before and after infusion of gadolinium-based contrast agents. ECV is elevated in the setting of interstitial fibrosis such as in hypertensive LVH [16] as

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well as myocardial inflammation and edema as in myocarditis [17]. Olausson and Schelbert review the many potential diagnostic and prognostic applications of T1 mapping in this issue [18]. Coronary MR angiography has been one of the last applications of CMR to make clinical inroads as the spatial resolution remains inferior to that of CTA. However, improvements continue to be made and these are highlighted in the review by Xie et al. in this issue [19]. Their manuscript also examines the ability of CMR to examine plaque in the coronary wall.

Calcium scoring by CT remains the most important marker of cardiovascular risk in terms of reclassification over and above Framingham risk markers. Matt Budoff and colleagues review the latest information regarding the state of Calcium scoring in 2017 [20]. The newest advances in CTA are in the realm of measuring fractional flow reserve (FFR) from angiography. This has been studied in several multi-center trials recently such as NXT [21] and PLATFORM [22]. These have shown

high diagnostic accuracy of the technique when compared to invasively measured FFR as well as equivalent clinical outcomes and quality and lower costs compared to usual care. Perfusion imaging combined with CTA also has an increasing role in the assessment of coronary artery disease. The CORE320 study showed high patient-based accuracy for identifying a >50% stenosis identified by X-ray angiography with a corresponding SPECT perfusion defect [23]. The group of James Min MD review the use of FFR and CT perfusion studies in clinical practice as well as the growing prognostic role of coronary CTA in 2 distinct papers [24, 25].

In summary, the last few years have brought significant advances in the capabilities of cardiovascular imaging for making diagnoses and assessing prognosis in cardiovascular disease. Along with institution of the increasing number of guidelines for appropriate use of cardiovascular imaging [26, 27], the care of the cardiovascular patient will continue to steadily improve.

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