In cardiac magnetic resonance imaging (MRI), myocardial longitudinal and transverse relaxation times (T1 and T2) are sensitive to alterations in myocardial tissue composition. Therefore, quantitative measurement of these relaxation times can be used as an imaging marker of diseased myocardium. Accurate quantification of tissue relaxation times has been the research focus of numerous investigators over the past 4 decades. While these techniques were mostly abandoned due to the difficulty of achieving accurate and reproducible measurement and standardization, many have resurfaced. With advances in motion correction, fast imaging by balanced steady-state free-precession (SSFP), and parallel imaging reconstruction there are numerous techniques for reproducible measurement of myocardial T1 and T2 times. Huang et al2 proposed a combination of T2 magnetization preparation with SSFP imaging for myocardial T2 mapping (T2Prep-SSFP). For T1 mapping, Messroghli et al3 proposed a modified Look–Locker sequence (MOLLI) based on the SSFP sequence for quantification of myocardial T1 times. These original techniques have been continuously refined and are now widely available by most vendors as part of their tissue characterization package.

Clinically, myocardial T1 and T2 mapping are collected separately using different scans. These sequences perform T1 or T2 mapping of one slice in a single breath-hold, resulting in an excessive number of scans in an already lengthy cardiac MRI exam. To reduce exam duration, several investigators pursued combining T1 and T2 mapping sequences.4–6 These techniques are generally based on interleaving data collection for T1 and T2 mapping using a combination of inversion recovery and T2 preparation sequences. Recently, Hamilton et al7 applied MR fingerprinting (MRF) to enable simultaneous measurement of T1 and T2 mapping, demonstrating this technique’s feasibility to measure myocardial T1 and T2 in a single scan.

In this issue of the Journal of Magnetic Resonance Imaging, Hamilton et al8 sought to compare T1/T2 measurements, repeatability, and image quality of their MRF technique to clinically available MOLLI and T2Prep-SSFP sequences in 58 healthy young adult subjects with no known cardiovascular disease. Like their original article, the current study demonstrates the potential of MRF in myocardial tissue characterization. MRF measurements yield similar T1 and T2 values as our current clinical T1 and T2 mapping sequences, albeit with lower measurement precision. The authors should be congratulated for pursuing an innovative simultaneous T1 and T2 mapping approach. This study greatly informs the reader on the performance of MRF for myocardial T1 and T2 measurements. There are known differences in T1 and T2 measurement accuracy and precision using different acquisition schemes.9 MRF T1 measurements, for example, are reported to be higher than MOLLI T1 maps, with notably lower precision. However, lower precision did not have an effect on subjective image perception by the three independent radiologists who rated MRF images higher than those of the individual sequences. There are several differences between MRF and clinical T1 and T2 mapping sequences, which may have contributed to these differences. Motion correction was not integrated into the MRF sequence, which most likely causes artifacts and the reported loss in precision in tissue characterization.10 MRF also uses patient-specific dictionary-based reconstruction, while conventional T1 and T2 mapping sequences use simple curve fitting. These differences may contribute to differences in performance between the two sequences. It is worth noting that a loss in precision is not unique to MRF and affects other simultaneous T1 and T2 mapping sequences as well.

Cardiac MRI exams are notoriously long, with numerous breath-holds. Therefore, any advance toward reduced exam time is highly desired. One of the benefits of MRF is reducing the scan time by combining two separate data collection techniques for T1 and T2 mapping, which could translate into a nearly 50% time reduction for T1/T2 mapping. Undoubtedly, we will continue debating the performance of various myocardial tissue characterization techniques for years to come. However, the fundamental
question remains: How will $T_1$ and $T_2$ measurements impact patient care and what will be an acceptable accuracy/precision trade-off for these measurements? For $T_1$ and $T_2$ mapping, lack of a standardized approach has been the major hurdle in the clinical adoption of these techniques. As an innovative community of investigators, we will continue to develop novel approaches to measure tissue parameters; however, we also need to be cautious that continuous advances in our field may not necessarily contribute to improved patient care or adoption of these techniques in routine clinical practice. Implementation of these approaches across different vendors and field strengths remains difficult. Aside from the debate on accuracy/precision, we also need to make our cardiac MRI exams easier to administer, shorter, and more comfortable for patients. The proposed MRF approach tackles the long scan time of cardiac MRI exams. I commend the authors on their accomplishment and anticipate their innovative MRF technique to advance our field of myocardial tissue characterization and further reduce cardiac the MRI exam time.

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