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Editorial

Dynamic Rapid Cardiac Magnetic Resonance Fingerprinting

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▸ See the article "Dynamic Cardiac Magnetic Resonance Fingerprinting During Vasoactive Breathing Maneuvers: First Results" in volume 31 on page 71.

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Multiparametric cardiac magnetic resonance (CMR) imaging has revolutionized the differential diagnosis of various cardiovascular diseases. Traditional CMR is based on the late gadolinium-enhanced sequence to differentiate among cardiovascular diseases by evaluating the gross myocardial fibrosis. In recent years, T1- and T2-mapping have been introduced as promising methods to characterize the myocardial tissue, allowing the pixel-wise quantification of T1 and T2 signal values in the myocardium.[1] Therefore, the mapping sequence is considered a robust tool to diagnose and estimate the prognosis of various cardiac diseases. However, the CMR scanning time is relatively long, and patients with heart diseases may have difficulties holding their breath. For the conventional mapping sequence, the patient is required to hold their breath for approximately 11–15 heartbeats (hb), and this process is repeated several times for each segment.[1] Cardiac magnetic resonance fingerprinting (cMRF) is a new groundbreaking tool to quantify the cardiac tissue parameters in a single scan.[2] Conventional T1- and T2-mapping sequences are obtained separately and require numerous breath-holds, whereas cMRF allows a rapid and simultaneous quantification of both T1 and T2 myocardial mapping values.[2] This novel technique uses pulse sequences with varying parameters, such as flip angle, repetition time, and preparation pulses, to generate unique tissue signals. After the cMRF scan, the signals are compared with predefined dictionary entries to determine the closest match.[2]

In this issue of the *Journal of Cardiovascular Imaging*, Hopman and colleagues[3] published "Dynamic Cardiac Magnetic Resonance Fingerprinting During Vasoactive Breathing Maneuvers: First Results," using an advanced rapid cMRF acquisition method that obtains images in 15 and 5 hb. This study examined nine healthy volunteers who underwent both conventional T1- and T2-mapping (Modified Look-Locker inversion recovery [MOLLI] and T2-prepared balanced steady state free precession [SSFP]) and cMRF with 15-hb and 5-hb methods.[3] The T1 values in the cMRF (15 hb: 1,359 ± 97 ms, 5 hb: 1,357 ± 76 ms) were significantly higher than the conventional T1 values (MOLLI: 1,224 ± 81 ms; $p < 0.001$). In contrast, the cMRF T2 values (15 hb: 29.6 ± 5.8 ms, 5 hb: 30.5 ± 5.8 ms) were significantly lower than conventional T2 values (prepared balanced SSFP: 41.7 ± 6.7 ms; $p < 0.001$).[3] There was no significant difference in the mapping values between the 15-hb and 5-hb cMRF sequences.[3] Additionally, the authors used the 5-hb cMRF sequence for dynamic imaging

using vasoactive breathing maneuvers. These maneuvers were performed with paced hyperventilation for 60 seconds, followed by a voluntary long breath-hold of 60 seconds. The myocardial T2 values were reduced after a period of hyperventilation-induced vasoconstriction, whereas the T1 values were constant. The authors speculated that lower T2 values reflect a reduced myocardial blood flow.[3] This study suggests the possibility of replacing the conventional stress CMR imaging with pharmaceutical agents. In addition, rapid cMRF is expected to be useful for patients who have difficulties holding their breath, allowing the acquisition of multiple slices in a short scan time.

However, there are still limitations in cMRF. As observed, the cMRF mapping values were significantly different from those obtained with the conventional mapping technique.[3] Several previous studies have reported that the T1 and T2 cMRF mapping values were generally lower than conventional mapping. Whereas the T1 values were higher and T2 values lower than the conventional CMR mapping in the study by Hopman and colleagues.[3-5] Since several confounders have been addressed, optimization and validation of the pulse sequences are needed for precise and consistent measurements of the mapping values in cMRF.[6] Another limitation of this study is that the authors examined only healthy subjects. The research on this novel dynamic cMRF method with vasoactive breathing maneuvers should be expanded in future studies with the aim of determining myocardial flow changes in patients with coronary artery disease and cardiomyopathies. A follow-up multicenter study of rapid dynamic cMRF in a large population is needed to verify whether this novel tool can provide advanced quantitative and physiological information on the myocardial tissue in the near future.

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Conflict of Interest

The author has no financial conflicts of interest.

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