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Cardiac MRI: Advanced technique

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In cardiac MRI, most techniques have significant limitation due to the motion from beating heart and breathing. There has been active progress in adapting MRI methods which are used in the other organ overcoming the limits.

T1ρ relaxation time provides a new contrast that shows higher contrast in macromolecules. Normal T1 relaxation time is dependent on longitudinal magnetization interactions with surrounding environment. T1ρ contrast is occurred by spin lattice relaxation mechanism in rotating frame. The mechanism is sensitive to B0 and B1 inhomogeneity. In case of cardiac MRI, furthermore, there are greater B0, B1 inhomogeneity and sensitivity due to motion. Despite these difficulties, T1ρ MRI is a promising technique for tissue characterization in the myocardium without contrast agents.

Diffusion weighted MRI has a high sensitivity to small changes in tissue features that is also becoming a hurdle in the cardiac diffusion imaging. Cardiac diffusion MRI provides unique information on the structure, organization, and integrity of the myocardium without the contrast agents. To achieve the cardiac DWI, reducing components of bulky motion and shorten preparing time are necessary. Recently, higher gradient amplitude can be used for diffusion gradients by improving hardware performance shorting the diffusion time. In addition to this, a technique that the canceling coefficients of bulky motion is realizing diffusion imaging in CMR.

CEST (Chemical Exchange Saturation Transfer) MRI is a novel imaging technique for metabolic imaging.

The CEST signal is acquired by detecting indirectly the water signal caused by transferring of selectively saturated exchangeable protons or molecules. Cardiac CEST, also, has difficulties with long scan time, residual cardiac and respiratory motion and B0 field variations induced by respiratory motion. To overcome these, reducing motion techniques are applied such as ECG and respiratory gating, radial readout, and navigation echo. Using cardiac CEST, early metabolic changes could be detected before functional and structural changes.

Significant challenges remain in overcoming technological limits in a CMRI. Nevertheless, CMRI offers clinicians and researchers an increasingly promising way to diagnose, risk stratify and tailor the treatment of patients with cardiomyopathy.

Keywords: Cardiac MRI, T1roh, DWI, CEST, Advanced MR technique