Ultra-High Field Cardiovascular MRI: Challenges

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The realization of the potential advantages of 7T cardiovascular MRI is challenging due to a number of technical and practical issues (1). For example, the clinical application of 7T MRI is limited by safety issues related to stents and other devices. Many patients with ischemic heart disease have undergone previous stent implantation and extensive safety testing is required before these patients can undergo 7T cardiac examinations.

Practical issues with ECG gating, RF coil technology and acquisition techniques for functional assessment, coronary imaging and flow quantification have been addressed in initial studies (2-4). A next challenge will be to integrate MRI acquisition schemes for delayed enhancement myocardial imaging and T2-weigthed sequences at 7T. Furthermore, it is challenging to develop phosphorus and proton spectroscopy of the myocardium at 7T. Moreover, improving and developing techniques for vessel wall imaging in small and medium sized vessels may be a potential application at 7T. All these techniques have shown their potential value at lower field strengths and have to be translated to higher field strengths.

The potential gain in spatial resolution at 7T may help to identify microinfarcts and vessel wall thickening and inflammation with the aid of contrast agents. Infarct characterization may potentially be more accurate for defining the various infarct zones and peri-infarct zone. Initial studies have shown the potential of 7T coronary imaging as compared to 3T imaging (4). This study revealed that contrast-to-noise ratios between blood and epicardial fat, enhancement of signal-to-noise ratios and vessel sharpness improve at 7T as compared to a similar acquisition protocol at 3T. These initial studies were limited to right coronary artery visualization. A challenge is to improve coil technology resulting in improved penetration depth of the current transmit-receive coil technology for imaging also the left coronary artery system. Ultimately, the challenge is to demonstrate the added value of the ultra-high field applications over existing technologies for clinical use.

References

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