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SY17-01

Recent updates of CMR techniques

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MRI is one of the most comprehensive diagnostic tools in cardiovascular disease, but also as a highly complex examination. However, recent advances in technologies are providing new opportunities for cardiac MR (CMR). Especially, reducing total examination time for CMR imaging is one of the biggest keys to more extensive use of MRI in clinical routine. The acquisition time itself can be reduced by using shorter TR with higher gradient performance, fewer lines like Compressed Sensing (CS), Simultaneous Multi Slice (SMS) techniques, machine learning or non-Cartesian sampling like spiral as well as conventional partial Fourier and parallel imaging. And various approaches based on artificial intelligence (AI) are rapidly developing and introducing across the medical imaging areas. From the patient positioning to acquisition and analysis, it helps to speed up the workflow, scan time, post-processing and radiologists in clinical decision making as well. In that sense CMR would be the one of the greatest beneficiaries of the AI. In this lecture, recent technical advances in hardware/software, imaging sequences and reconstructions for cardiovascular imaging are presented.

Keywords : CMR techniques, Cardiovascular MRI

SY17-02

AI application in cardiovascular imaging: X-ray and cardiac CT

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The application of artificial intelligence (AI) to medicine has been a subject of great interest in recent years(1). Especially, radiological imaging is an emerging field of AI application widely, and many kinds of research have been published using chest X-ray or cardiac CT (2,3). The application of AI to chest X-ray has been the subject of many studies to find pulmonary nodules or rib fractures. Nonetheless, the diagnosis of cardiovascular disease using AI on X-ray is relatively rare. One of the reasons is that the changes in X-ray (e.g., cardiomegaly, increased pulmonary vascularity, pulmonary edema) in the presence of cardiovascular disease are difficult to label, unlike nodules or fractures. Recently, various attempts have been introduced to overcome this problem such as the application of generative adversarial network(2). Cardiac CT is a multi-potential imaging tool for assessing cardiac function as well as coronary artery disease and in diagnosing structural heart disease(4,5). The application of AI to cardiac CT begins with segmenting cardiovascular structures such as coronary artery, plaque, and cardiac chambers. In recent years, techniques for diagnosing ischemic heart disease using artificial intelligence (i.e., CT-derived fractional flow reserve) have been introduced(6). This lecture introduces the application of AI techniques that have been tried in chest X-ray and cardiac CT, along with the examples experienced at Asan Medical Center in Seoul.

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SY17-03

Magnetic Resonance Fingerprinting of Heart

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Magnetic Resonance Fingerprinting (MRF) is an emerging imaging method to simultaneously generate multi-parametric map images about proton density, T1 and T2 relaxation, B0 and B1 field in a single scan. The MRF is consist of a specific pulse sequence to having a unique magnetized signal evaluation and a dictionary-based reconstruction procedure along the Bloch equation. This MRF has advantageous natures to get a motion insensitive and accurate T1 and T2 relaxation time within shorter scan time. The MRF is attracting attention for cardiac applications to early detection of various cardiac diseases using T1 and T2 map. Cardiac MRF generates more accurate and consistent relaxivity maps than conventional mapping by considering the non-uniformity of B1 and B0 field. Despite many strengths of the MRF, it needs the technical advances to be more efficient and reproducible for the practical cardiac applications. In this lecture, we will explore the principles and technological trends of cardiac MRF to learn about this technology and discuss how to use it.

Keywords : Cardiac MRI, Magnetic resonance fingerprinting, T1 mapping, T2 mapping, Synthetic MRI

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SY17-04

T1 rho Imaging

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Cardiac magnetic resonance imaging (MRI) is a noninvasive diagnostic tool that has been widely used, particularly for evaluating myocardial characterization. Recently, the advanced MR technique has provided various quantitative parameters of myocardium, which has helped in the diagnosis of various diseases involving the myocardium. Among the quantitative parameters, T1rho refers to the time constant of the spin-lattice relaxation in a rotating frame and represents the lattice processes occurring at a much lower frequency. Thus, T1rho can provide valuable information for tissue characterization as the spin-lattice relaxation measures the rate of energy exchange between an excited proton and its surroundings. If the magnetic field becomes weaker, the T1 relaxation time decreases and the spin-lattice interaction increases which, consequently, can increase the molecular sensitivity for surroundings. To obtain T1 relaxation at a low magnetic field strength, T1rho imaging uses a spine-locking radio frequency pulse, and the spine-lattice relaxation in a rotating frame of locking pulse means T1 rho. By using three different spin locking time periods (10 ms, 30 ms, and 50 ms), T1 rho decay curve can be obtained and a quantitative value of T1rho can be calculated. However, T1 rho imaging has certain limitations, including SAR, B0 and/or B1 field inhomogeneity, motion during spin lock, and the need for fast imaging. To overcome these problems, it is mandatory to optimize the T1rho sequence. In this lecture, I will briefly review the literature of T1rho imaging, present how to optimize T1rho sequence using clinical MR machines, and discuss the clinical utilities and limitations of cardiac T1rho imaging in the diagnosis of various cardiac diseases.

Keywords : CMR, T1rho, Myocardial characterization