



KSMRM Educational Course 1

교육세션 1-3

Advances in Cardiac MRI: Efficiency, AI, and Quantitative Imaging

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Cardiac Magnetic Resonance (CMR) is a key modality for cardiovascular assessment, offering superior tissue characterization and functional evaluation. However, its clinical use is often limited by long acquisition times, motion artifacts, and reliance on gadolinium-based contrast agents. Recent innovations aim to overcome these challenges, focusing on efficiency, artificial intelligence (AI), and quantitative imaging. Efficient protocol design is essential for reducing scan time while maintaining diagnostic quality. Techniques such as compressed sensing and parallel imaging accelerate acquisitions, improving patient comfort and workflow. Deep learning (DL) has further advanced cine imaging by enabling substantial undersampling and reconstructing high-quality images with improved temporal resolution, reducing breath-hold requirements and enhancing feasibility in patients with arrhythmia.

Motion correction remains critical. AI-driven retrospective algorithms and free-breathing acquisition schemes effectively mitigate artifacts from respiration and cardiac irregularities, improving image reliability and expanding applicability to patients unable to comply with breath-hold commands.

A major shift in CMR is the move toward quantitative imaging. Quantitative perfusion imaging provides absolute myocardial blood flow measurements, offering reproducible and objective ischemia assessment. Multi-parametric mapping, including T1, T2, and extracellular volume (ECV), enables detailed tissue characterization. Magnetic Resonance Fingerprinting (MRF) further enhances efficiency by acquiring multiple parametric maps in a single scan.

Post-processing is also evolving with AI. Automated segmentation tools deliver rapid and reproducible quantification of ventricular volumes and function, reducing inter-observer variability. Virtual Native Enhancement (VNE) represents a significant advance in contrast-free imaging, generating late gadolinium enhancement (LGE)-like images from native T1 maps and cine data, eliminating the need for gadolinium and improving safety for patients with renal impairment.

The integration of AI-driven reconstruction, motion correction, and quantitative imaging is transforming CMR into a faster, more reliable, and diagnostically powerful tool, paving the way for precision cardiology and broader clinical adoption.

Keywords: Cardiac MRI, Deep learning, Virtual enhanced imaging, Multi-parametric imaging, Quantitative perfusion imaging