



KSMRM Educational Course 1

교육세션 1-1

Brain MRI: Conventional and Advanced Imaging Techniques and Their Clinical Applications

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Magnetic resonance imaging (MRI) provides superior tissue contrast compared with computed tomography (CT), enabling reliable differentiation between cortex and white matter as well as pathological and normal tissues. Brain MRI is therefore widely used in neuroradiology and can be divided into conventional and advanced imaging techniques.

Conventional sequences include T1-weighted imaging (T1WI), T2-weighted imaging (T2WI), fluid-attenuated inversion recovery (FLAIR), T2*-weighted gradient echo (GRE) or susceptibility-weighted imaging (SWI), contrast-enhanced T1WI, diffusion-weighted imaging (DWI), and MR angiography. T1WI offers excellent anatomical detail and delineation of gray–white matter, while T2WI and FLAIR highlight lesions with increased water content such as tumors, edema, infection, or ischemia. T2* GRE and SWI are highly sensitive to hemorrhage, microbleeds, and iron deposition, and contrast-enhanced T1WI reveals blood–brain barrier disruption in tumors and inflammatory lesions. DWI is indispensable for detecting acute ischemic stroke and also aids tumor evaluation.

Advanced techniques extend the diagnostic utility of brain MRI. Perfusion imaging (DSC, DCE, ASL) assesses cerebral blood flow and volume, contributing to tumor grading and stroke penumbra evaluation. MR spectroscopy provides metabolic information, while functional MRI (fMRI), typically using blood-oxygen-level-dependent (BOLD) contrast, maps functional brain regions. Diffusion tensor imaging (DTI) enables tractography for presurgical planning, and quantitative susceptibility mapping (QSM) quantifies iron, myelin, and calcium, serving as a biomarker for neurodegenerative diseases.

Keywords: Brain MRI, Conventional imaging techniques, Advanced imaging techniques