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Synthetic MR: Clinical applications in neuroradiology

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Abstract

Purpose: Synthetic MR is a quantitative MRI method that measures tissue relaxation times and generates multiple contrast-weighted images using suitable algorithms. The present article principally discusses the multiple dynamic multiple echo (MDME) technique of synthetic MR and briefly describes other quantitative MR sequences.

Methods: Using illustrative cases, various applications of the MDME sequence in neuroradiology are explained. The MDME sequence allows rapid quantification of tissue relaxation times in a scan duration of 5-7 minutes for full brain coverage. It also has the additional advantages of myelin quantification and automatic segmentation of brain volumes.

Results: Applications including reducing scan time, improved detection of demyelinating plaques in Multiple Sclerosis (MS), objective assessment and follow-up for brain atrophy in neurodegenerative MS and dementia cases, and applications in stroke imaging and neuro-oncology are discussed. Uses in the pediatric population, including assessment of brain development and progression of myelination in children, evaluation of white matter disorders, and evaluation of pediatric and adult epilepsy, are elaborated. Quantitative evaluation by synthetic MR is discussed, which allows homogenization and objectification of the radiology data and can serve as a valuable source for artificial intelligence and future multicentre studies. A brief discussion on the technique, other quantitative MR methods, and limitations of the MDME sequence is also presented.

Conclusion: The article intends to provide an explicit and comprehensive review of the applications of synthetic MR in neuroradiology, exploring its potential as a routine sequence in daily neuroimaging practice.

Keywords: MDME; Multiple dynamic multiple echo; Quantitative MR; Synthetic MR.