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Advancing Diagnosis of CNS Inflammatory Demyelinating Diseases: A Systematic Review of Deep Learning Brain MRI Methodology

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Abstract

Background: Acute disseminated encephalomyelitis (ADEM), neuromyelitis optica (NMO), and multiple sclerosis (MS) are demyelinating diseases that manifest with similar MRI findings, including lesions in the brain stem. While differential diagnosis can be achieved by neuroradiologists, accurate interpretation can be challenging. Proper diagnosis is crucial, as these conditions present separate treatment approaches. With the emergence of machine learning, deep learning reconstruction (DLR) has emerged as a promising tool to enhance reading accuracy and efficiency. Thus, this literature review seeks to assess the current ability of DLR in correctly diagnose these demyelinating disorders.

Methods: An overview of the literature synthesizing information on relevant topics was conducted. Several databases were utilized, such as Pubmed, Scopus, and Google Scholar. Keywords include "deep learning MRI," "brain stem lesions," "multiple sclerosis," "NMO," and "ADEM."

Results: Current detection methods focus on morphological changes between the three diseases in conventional MRI. Neuroradiologists were able to detect additional MS brain stem lesions from MRI with DLR than conventional MRI interpretation. Furthermore, deep learning models have been developed to aid in aiding the differentiation of NMO from MS in FLAIR brain MRI. To date, there have been no studies evaluating the efficacy of DLR in the context of ADEM or in distinguishing between these three demyelinating diseases.

Discussion: The capability of machine learning in aiding medical interpretation is evolving with ongoing advancements. Although substantial progress has been made with deep learning algorithms in the diagnosis of demyelinating disorders, further research is necessary to explore its effectiveness, especially concerning ADEM.