Redefining MRI:
From Image to Insight

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iMRI Invited

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Imaging Neuro Fluid Dynamics Using 17O-Labeled Water MRI

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17O-labeled water is a stable isotope tracer that enables direct visualization of water molecules using MRI and has emerged as a novel molecular imaging technique for noninvasive evaluation of neurofluid dynamics, including cerebrospinal fluid (CSF) and extracellular fluid (ECF). 17O is the only stable oxygen isotope detectable by MRI, allowing safe administration without radiation exposure. In this lecture, we present the technical development of neurofluid imaging using 17O-labeled water MRI and its applications to neurological diseases.

Our research group has developed MRI methods using 17O-labeled saline (PSO17) administered intravenously, intra-arterially, and intrathecally to investigate brain water dynamics from multiple perspectives. By utilizing the T2-shortening effect of 17O-labeled water on proton MRI, dynamic evaluation can be performed even on conventional clinical MRI scanners, enabling quantitative assessment of water movement, exchange, and clearance.

In particular, intrathecal administration studies in patients with normal-pressure hydrocephalus and dementia have demonstrated delayed CSF clearance and findings suggestive of glymphatic dysfunction, successfully visualizing abnormalities of neurofluid circulation that are difficult to evaluate using conventional structural imaging. Furthermore, animal studies using ALS and cardiac arrest models have shown that abnormalities in water permeability and intracerebral distribution can be detected, providing important insights into subtle alterations of fluid dynamics associated with neurodegeneration and brain injury.

More recently, quantitative neurofluid dynamics information obtained from 17O-labeled water MRI has been integrated with AI-based analysis, potentially enabling early diagnosis and disease evaluation of neurodegenerative disorders, including Alzheimer's disease. As a molecular imaging technique directly targeting water molecules themselves, 17O-labeled water MRI is expected to have broad applications ranging from basic neuroscience research to clinical neuroimaging.

Keywords: *17O, Water, MRI, Neurofluid*