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Imaging the Invisible: Present and Future of Glymphatic MRI

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The glymphatic system is a recently discovered cerebrospinal fluid circulation pathway responsible for clearing metabolic waste from the brain, and it has drawn significant attention in studies of brain health and neurodegenerative diseases. This lecture will provide an overview of the structural and functional characteristics of the glymphatic system, as well as the physiological factors that regulate it (e.g., sleep, vascular pulsation). In particular, we will examine its associations with neurodegenerative disorders such as Alzheimer's disease and Parkinson's disease and discuss its clinical implications.

In addition, we will comprehensively review the latest MR imaging techniques used to noninvasively evaluate and visualize the glymphatic system. Representative approaches such as dynamic intrathecal/intravenous contrast-enhanced MR imaging and diffusion tensor imaging (DTI) will be introduced, with a focus on their technical principles, advantages and limitations, and clinical applicability. Furthermore, through the presentation of clinical research cases utilizing intravenous contrast-enhanced MR imaging—which is less invasive than intrathecal administration—we aim to enhance understanding of the glymphatic system.

Keywords: Glymphatic system, Neurodegenerative disorders, MR imaging techniques