Redefining MRI:
From Image to Insight

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Glymphatic Imaging: Bridging Research and Clinical Practice

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1) Background
The glymphatic system plays a central role in brain waste clearance and fluid homeostasis and has been increasingly implicated in cognitive decline, Alzheimer's disease, cerebral small vessel disease, and other neurologic disorders. However, current contrast-enhanced imaging methods for glymphatic assessment remain invasive, time-consuming, and impractical for routine clinical use.

2) Purpose
This lecture aims to introduce a clinically feasible, non-contrast MRI framework for glymphatic evaluation and to review its potential relevance across a range of neurologic diseases.

3) Imaging Framework
The proposed multiparametric 3.0T MRI protocol can be completed within approximately 23–30 minutes and is based on a "five-gateway" model of glymphatic assessment. It includes evaluation of cerebrospinal fluid production through the choroid plexus, arterial pulsatility using 2D phase-contrast MRI, water exchange and aquaporin-4-related function using diffusion-prepared arterial spin labeling, perivascular fluid transport using DTI-ALPS, and meningeal lymphatic drainage using IR-ALLADIN. Key quantitative biomarkers include choroid plexus volume, the cortical arterial pulsatility index at the centrum semiovale level (PICSO), the blood–brain barrier water exchange rate (Kw), the DTI-ALPS index, and signal change related to meningeal drainage.

4) Conclusion
By focusing on a protocol implementable on standard 3.0T MRI systems, this lecture highlights the translational shift of glymphatic imaging from experimental neuroscience to practical neuroradiologic application. Glymphatic MRI may serve as a promising imaging biomarker for early diagnosis, risk stratification, treatment monitoring, and longitudinal follow-up.

Keywords: *Glymphatic system, MRI, Choroid plexus, 2D phase contrast MRI, DTI-ALPS, AQP4, Meningeal lymphatics*