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## **CSF and Lymphatic MRI in the Brain and Eyes**

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The clearance of metabolic waste from the central nervous system is critical for brain homeostasis, and its dysfunction is increasingly linked to the pathogenesis of neurodegenerative diseases. Investigating the complex neurofluid dynamics involving cerebrospinal fluid (CSF) circulation, the glymphatic system, and meningeal lymphatic vessels *in vivo* has been a significant challenge. However, recent advances in MRI now offer significant opportunities to visualize and quantify these pathways, opening new avenues for understanding brain health and disease.

This lecture will provide a comprehensive overview of innovative MRI methodologies designed to visualize and quantify neurofluid dynamics in the brain and eyes. The discussion will cover a range of techniques, from established methods for quantifying bulk CSF flow and tracing clearance pathways using contrast agents, to advanced non-contrast approaches. These include methods for tracking slow fluid movement, using high-resolution structural imaging to assess the parasagittal dura mater, and directly imaging meningeal lymphatic flow. Furthermore, the session will explore fMRI-based approaches for quantifying glymphatic activity and physiological CSF pulsations. The application of these advanced techniques has provided new insights into the physiology of brain clearance, and they have been applied to show how physiological states, including physical exercise, can modulate neurofluid flow. The integration of these dynamic imaging protocols enables us to capture the complex interplay between vascular, CSF, and lymphatic compartments.

In conclusion, this lecture underscores the significance of innovative MRI approaches for elucidating the physiology and pathophysiology of the brain's clearance systems. The ability to non-invasively visualize and quantify CSF and lymphatic pathways represents a major advancement in neuroimaging, with substantial implications for the early diagnosis and monitoring of neurological disorders associated with impaired waste clearance.

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