



Neuro 1

SY04-1

MRI Perspectives on Periarterial Flow and Glymphatic Transport

Bio Joo

Gangnam Severance Hospital, Korea

The periarterial (paravascular) space (PVS) plays a central role in brain fluid dynamics, serving as a key interface between cerebrospinal fluid (CSF) and interstitial fluid (ISF). Once regarded as a passive extension of the subarachnoid space (SAS), the PVS is now recognized as a structured conduit for CSF–ISF exchange and a core component of the glymphatic system. Understanding its dynamics is fundamental to clarifying how the brain clears metabolic waste and maintains homeostasis.

Recent studies suggest that CSF flow within the subarachnoid space (SAS) is compartmentalized rather than uniformly distributed. Structural boundaries, including specialized pial membranes and arachnoid trabeculae, delineate partially segregated periarterial flow domains that define distinct pathways for efficient solute transport and clearance.

Periarterial flow is primarily driven by cardiac pulsation, with additional contributions from vasomotion and respiratory pressure gradients. MRI studies have demonstrated a phase-dependent coupling between arterial wall motion and local CSF displacement. Aging and disease modify these interactions, as arterial stiffening, perivascular space enlargement, and diminished pulsatility collectively reduce flow efficiency and impair glymphatic transport. MRI provides unique tools for noninvasively characterizing periarterial flow. Techniques such as diffusion-based approaches including dynamic DWI and low-b DTI, phase-contrast MRI, and spin-labeling methods such as velocity-selective labeling MRI or ALADDIN have enabled visualization of slow, oscillatory fluid motion adjacent to arteries. These developments allow detailed mapping of flow directionality, waveform features, and physiological variations along the cerebral vasculature.

This lecture will highlight MRI-based strategies for visualizing and quantifying periarterial flow. By integrating structural and dynamic insights, it aims to clarify which specific characteristics of the periarterial space are essential for maintaining central nervous system homeostasis and waste clearance. Ultimately, it underscores the significance of applying diverse and advanced MRI techniques to unravel the mechanisms of periarterial flow and to advance our understanding of glymphatic transport in both health and disease.