Linking Alzheimer's Disease microRNA Biomarkers with Calcium Dyshomeostasis

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Alzheimer's disease (AD) is associated not only with amyloid β and tau pathology but also with early disturbances in neuronal calcium homeostasis and signaling. Increasing evidence indicates that altered calcium regulation contributes to synaptic dysfunction, neuroinflammation, and neurodegeneration in AD.

Circulating microRNAs (miRNAs) have emerged as promising minimally invasive biomarkers reflecting complex molecular mechanisms underlying AD. Our previous studies identified a plasma panel of miRNAs altered in early AD[1]. Emerging evidence indicates that several of these miRNAs are linked to pathways involved in neuronal calcium homeostasis, synaptic signaling, oxidative stress, and neuroinflammation, suggesting a potential connection between circulating miRNA biomarkers and calcium dyshomeostasis in AD.

This lecture will discuss current evidence connecting AD-associated miRNAs with calcium dysregulation in the central nervous system, including their potential involvement in NMDA receptor signaling, CaMKII/calcineurin pathways, synaptic excitability, mitochondrial dysfunction, and amyloid β-related neuronal stress. The presented findings support the concept that circulating miRNAs may represent not only diagnostic biomarkers of early AD but also molecular indicators of disturbed calcium signaling and brain–periphery communication.

Understanding the miRNA- calcium axis may provide new insights into AD pathomechanisms and support the development of novel diagnostic and therapeutic strategies targeting early neurodegenerative processes.

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[1] *Wojda U et al. Panel of microRNA biomarkers in blood for diagnosis of Alzheimer's disease. European Patent EP3449009, 2021*.