

HBCI

Human brain clearance system imaging

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Aims, research questions and working hypothesis

The increasing interest in brain waste clearance has led to great insights into the way cerebrospinal fluid (CSF) acts as a lymphatic-like system. Current knowledge on brain clearance mechanisms is mostly based on invasive experimental studies performed in rodents using microscopy, which is a technique that cannot be applied in humans. MRI, however, is an excellent candidate to provide information on brain clearance dynamics in humans as CSF, the waste carrier, has different magnetic properties compared to blood and tissue. The HBCI consortium aims at developing clinically applicable brain clearance imaging biomarkers.

Means/methods implemented by the consortium

We designed a set of imaging biomarkers sensitive to disturbances in brain clearance using MRI; the different biomarkers range from established invasive methods using contrast agent injections to new, fully non-invasive strategies. We demonstrate the functionality of these biomarkers in characterizing brain clearance driving forces in healthy volunteers, as well as brain clearance disturbances in various neurodegenerative disorders.

What are the outcomes of the project? (*milestones achieved, key results obtained*)

Imaging of the glymphatic system was achieved in healthy volunteers, and driving forces were compared between different brain regions. Sleep studies are currently being set up to investigate how deep sleep impacts the glymphatic system.

Moreover, several developed biomarkers were exchanged between sites, which allowed to investigate changes in the brain clearance system in patients with sporadic cerebral amyloid angiopathy (CAA), with hydrocephalus as well as with mild cognitive impairment.

Significance and impact of the work on the field

The development of biomarkers to study the clearance system in humans creates new opportunities to explore this system in both healthy individuals and those with neurodegenerative diseases, potentially shedding light on how impaired clearance contributes to pathology.

Next steps and future challenges

Next steps include further investigation of the acquired data in various neurodegenerative diseases as well as the simultaneous MRI-EEG measurement of brain clearance during sleep.