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Characterization of early hippocampal changes in aging and Alzheimer's disease using advanced MRI

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A trophy of the hippocampus is a key pathological hallmark of Alzheimer's disease (AD). An interest of imaging early changes of hippocampus has emerged in recent years due to the advent of ultra-high field MR. Conventional imaging tools to evaluate the hippocampal changes due to aging and AD include volumetric MRI to assess hippocampal atrophy, which however tends to be a late stage disease marker. This work is to discuss recent advances in microstructural, metabolic and vascular MRI to better characterize early changes of hippocampus due to aging and dementia. These advanced MRI techniques include:

- 3D susceptibility-weighted imaging (SWI) with enhanced tissue susceptibility image contrast to better identify hippocampal subfields1 and their subtle microstructural changes that are not available on conventional MRI.
- Dynamic contrast-enhanced (DCE) MRI using a small dose of Gadolinium-based contrast agent to evaluate the leakage of the blood-brain barrier (BBB)

in hippocampus. BBB disruption can occur in early/ preclinical stages of AD2; and in vivo and non-invasive assessment of BBB permeability in humans would be clinically critical for intervention and prevention of the disease.

 Ultra-high-resolution (UHR) diffusion MRI to assess the micro-architectures including microstructural organization and connectivity of hippocampal circuits3. The detailed information of functional architecture and internal circuitry derived from UHR diffusion MRI will create fibre connectivity-based atlas of human hippocampus and its surrounding structures based on in vivo imaging on clinical scanners.

The clinical translation of these advanced techniques will be straightforward, enabling the direct assessment of early and subtle changes in many brain dysfunctions including dementia for better diagnosis and early intervention.

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