Neuroimaging Based Detection of Alzheimer’s disease

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Background: The diagnosis of Alzheimer’s disease (AD) at an early stage when brain damage not yet advanced will be a pivotal for any treatment approach to prevent or delay the onset of AD dementia. Brain changes including the deposition of the protein amyloid-beta (Aß) along with neurodegeneration precede the onset of clinical symptoms of AD by many years. Aß deposits in the brain can be found in about 30% of elderly cognitively healthy subjects (preclinical AD) and subjects with mild cognitive impairment (MCI, called prodromal AD), which is associated with increased risk to develop dementia. The use of biomarkers of neurodegeneration including neuroimaging (MRI & FDG-PET) has recently been proposed for the early diagnosis of AD by the National Institute of Aging (NIA) and European expert consensus groups. We and others have shown that core neuroimaging biomarker candidates including hippocampus grey matter atrophy (MRI) and temporo-parietal hypometabolism (FDG-PET) are predictive of the development of AD dementia. However, the implementation of neuroimaging for clinical application is not yet warranted due to insufficient diagnostic accuracy (<80% accuracy) of such measures.

Aim: To develop new multimodal neuroimaging markers using sophisticated multivariate statistics including machine learning algorithms for the early detection of AD.

Methods: Prediction models of AD will be developed on the basis of large-scale open source data bases on neuroimaging and biochemical biomarkers of AD such as ADNI, AIBL as well as the multimodal data set that is currently being collected by us at the Institute for Stroke and Dementia Research at the University of Munich Hospital. Structural MRI (T1 MR, DTI, FLAIR, SWI), functional MRI (resting state, memory activation paradigm), EEG (64 channel high spatial resolution), and PET (FDG, amyloid tracer, microglia tracer) are being collected in elderly healthy controls, preclinical AD, prodromal AD and AD dementia.

Advanced statistical methods including subspace clustering other pattern recognition methods will be applied to extract core imaging features for the early detection of AD. Proteomics in blood and cerebrospinal fluid samples may be implemented in the future.

Students with an interest in biomedical informatics/engineering and human MRI imaging are encouraged to apply.