Discrimination of Alzheimer's disease from cognitively healthy individuals: an arterial spin labeling MRI study

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Introduction.

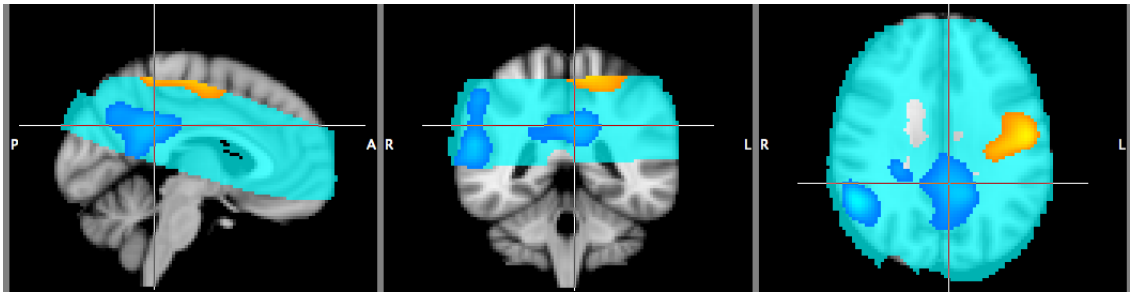
Alzheimer's disease (AD) is the most common neurodegenerative disease associated with dementia. Clinical neuroimaging such as computed tomography (CT) and magnetic resonance imaging (MRI) is becoming increasingly important in the diagnostic workup of patients with suspected or definite dementia. Structural imaging is crucial in terms of excluding possible treatable causes of dementia but can also demonstrate of specific pathology patterns and is helpful monitoring disease progression [1]. Beyond structural MRI, it has been shown that advanced imaging techniques such as single-photon emission computed tomography (SPECT), positron emission tomography (PET) and blood perfusion MRI by arterial spin labelling (ASL) have added value in detection certain perfusion and metabolic pattern that can support the diagnosis of certain neurodegenerative disease associated with dementia [2]. The aim of our study was to investigate whether ASL MRI show certain perfusion pattern in patients with AD which might be help to discriminate those patients from cognitively healthy subjects.

Material and Methods.

Eighteen AD patients and twenty healthy controls were included in this study (see [3] for details on subjects recruitment and description). MR scans were performed at 1.5T (Sonata; Siemens, Erlangen, Germany). To obtain relative cerebral blood flow (rCBF) images, we performed quantitative imaging of perfusion by using a single-subtraction second version, with a thin-section TI periodic saturation (Q2TIPS) PASL sequence (10-cm labeling slab; TE 15 ms; TI1 700 ms; TI1 stop time 1600 ms; TI2 1800 ms; TR 2500 ms) . To convert the signal intensity of the rCBF images to absolute values of CBF, we performed a singleshot EPI sequence of the fully relaxed brain tissue. The sequence was repeated 200 times, alternating labeled and control images. After subtraction, the difference images were averaged to obtain rCBF images in 9 sections (FOV 224 mm, section thickness 6 mm, interslice gap 1.5 mm). For registration we scan a high-resolution 3D T1-weighted inversion recovery sequence (TE 5.17 ms; TR 2700 ms; TI 950 ms; flip angle 8 degs; NEX 1; FOV 250 mm; section thickness 1 mm; number of sections 160; acquisition matrix 256 x 176). To minimize registration errors due to atrophy, a custom brain template or midspace was computed by calculating the geometric mean of the affine transformation matrices of all T1 scans to the MNI152 standard space. Group differences where calculated using ordinary least squares analysis (FEAT, FSL).

Results.

Relative to controls, alzheimer subjects show decreased blood flow in the right medial temporal lobe, right superior parietal region and posterior cingulate and precuneus cortices (Fig. regions shown in dark blue). These brain regions largely overlap with the extend of the default mode network described in resting state condition (DMN; [4]). Importantly, the brain perfusion was increased in AD in the left hemisphere dorsal motor areas, superior temporal gyrus and caudal extent of the frontal gyrus (Fig. regions depicted in orange; all results cluster thresholded: $z3.1;p < 0.05$; displayed on midspace template; full brain coverage mask in light blue).



Discussion and Conclusions.

Blood hypoperfusion in AD colocalizes spatially with the DMN. This fact is important as DMN is chieftly involved in memory function [4]. In addition to the hypoperfusion pattern reported, involving the posterior cingulate and precuneous [5-7], we demonstrate a significantly higher blood perfusion in a number of areas in the left hemisphere, including motor and superior temporal gyrus. These specific perfusion patterns measured by ASL-MRI suggest fundamental differences in the brain perfusion between AD patients and cognitively healthy subjects and could contribution to the diagnoses of AD-related dementia.

References.

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