Resting state network abnormalities in Alzheimer's disease: beyond the default mode network

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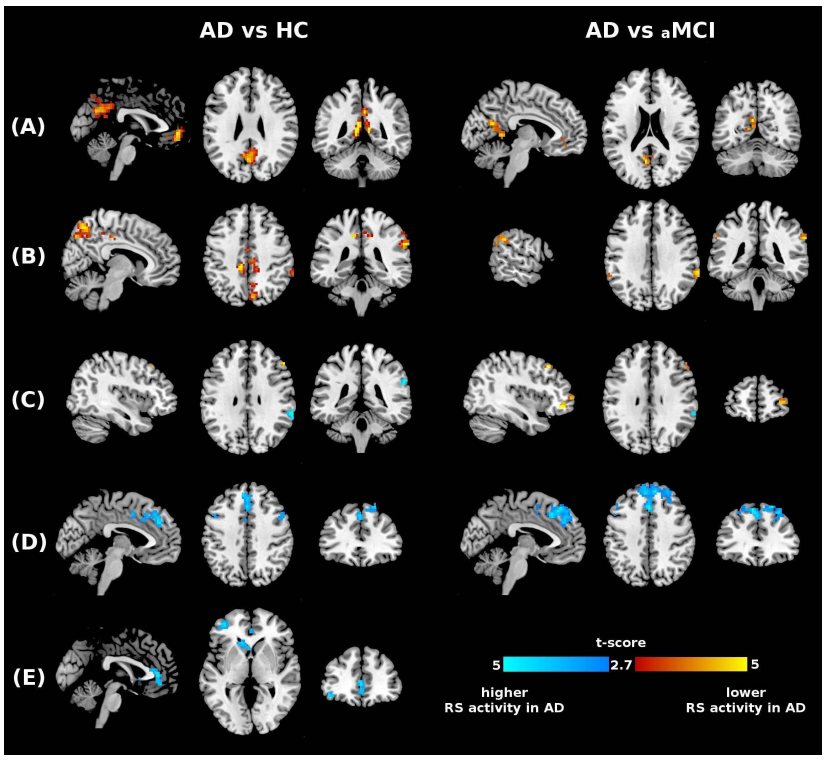
Introduction. Several studies of Alzheimer's disease (AD) patients demonstrated alterations of the default mode network (DMN) [1]. Recent studies suggested that in AD a decreased parieto-temporal functional coactivation is coupled with an increased prefrontal coactivation [2,3]. To date, how resting state networks (RSNs) other than the DMN are affected by AD, and whether their functional changes occur early in the course of the disease have not been fully investigated yet.
Objective. To investigate whether RSNs are affected in AD and amnestic mild cognitive impairment (aMCI) patients, and whether they are related to gray matter (GM) atrophy and cognitive functioning.
Methods. Using RS functional MRI (fMRI), the coactivation patterns of the DMN, as well as the fronto-parietal, executive, and salience networks were explored in 13 AD patients and 12 aMCI patients relative to 13 healthy controls (HC).
Results. Compared with HC and aMCI, AD was associated with an opposing coactivation effects in the DMN (decreased) and frontal networks (enhanced). The only RS abnormality found in aMCI patients compared with HC was a precuneus coactivation reduction in the DMN. Results obtained after GM volume correction suggested that GM volume loss accentuated RS fMRI differences between patients and HC, especially in the frontal regions, but most RSN group differences could not be explain by atrophy alone. Cognitive impairment correlated with enhanced executive network coactivation in aMCI patients, and with a reduced coactivation of the same network in AD patients.

Figure. Contrasts of the RSNs between (left columns) patients with AD and healthy controls, and (right columns) patients with AD and patients with aMCI. Color maps represent significant voxels ($p<0.05$, false discovery rate corrected) in the corresponding contrast. T values are color-coded with red to yellow (from 2.7 to 5.0) = lower RS fMRI signal in AD vs. other groups, and cyan to blue (from 2.7 to 5.0) = higher RS fMRI signal in AD vs. other groups.



Conclusions. AD is associated with an alteration of large-scale functional brain networks, which extends well beyond the DMN. The limited resources of the parieto-temporal cortex of AD patients may be paralleled, in an attempt to maintain cognitive efficiency, by an increased prefrontal coactivation. A medial parietal RS fMRI signal change seems to be present since the early phase of AD.
References. [1] Fox, Greicius Front Syst Neurosci 2010 4, 19. [2] Wang et al., Hum Brain Mapp 2007 28, 967-978. [3] Zhou et al., Brain 2010 133, 1352-1367.