Preliminary Study of Olfactory on Alzheimer's disease using BOLD-fMRI at 3.0T

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Introduction

Sense of smell declines in aging and in Alzheimer's disease has been observed. The very high sensitivity and specificity of odor identification tasks in discriminating betwe Alzheimer's patients and normals suggests that they reflect the presence of underlying neuropathology.

Purpose

The current study was to investigate the central activity after olfactory stimulation in AD and normal aging using functional magnetic resonance imaging (fMRI).

Materials and Methods

The investigation involved 2 groups:12 patients with diagnosis of mild to moderate dementia in Alzheimer's disease （AD）according to the criteria of the NINCDS-ADRI DSM-III-R and ICD-10.(6 male, 6 female, mean age 71),12 normal healthy age-matched controls(6 male, 6 female). All participants are right-handed.

Odor sensitivity and identification were examined in normal aging and Alzheimer's disease (AD). fMRI was performed on Philips Achieva 3.0 T MR scanner using SE and I sequences. Functional MR imaging studies were obtained in the same plane as T1-weighted images in an axial plane by using echo planar imaging.(FOV=230, mat scan=64*64, slice/thickness/gap=26/4.5/0, TR/TE=2000/30ms, flip angle=90). Odorant was delivered to orthonasal in ten 12-s on, 58-s off cycles. fMRI data acquired usin perception-based template was processed using SPM2. The threshold of SPM was P < .001, and the volumes of activation and distribution of clusters were compared in grou

Results

(1) The average UPSIT score of the AD(32.1+/-1.2) was significantly lower than that of the aging(34.1=/-1.5)(p =.0004). (2) Aging group showed significant activation major olfactory brain structures, including left hippocampal sulcus ,right parahippocampal cortex, right thalamus, right orbitofrontal cortex, right insular cortex ,right infer temporal gyrus, bilateral superior temporal gyrus and right vermis. Some other regions also observed ,including right pons ,right angular gyrus, right precuneus, ri inferiorparietal lobule，which were rarely mentioned in previous olfactory research. (3) AD group showed significantly lower activation than normal aging group in so regions(left hippocampal sulcus , right parahippocampal cortex, right thalamus, right angular gyrus, right inferiorparietal lobule.) (p <.001), consistent with lower UPS scores. The number of activation regions is less than that of nomal aging. (4) Interestingly, some regions only observed in AD group, including left insula lobe,right super parietal lobe,right lingual gyrus, left middle temporal gyrus. (5) In all participants ,activations were right predominant. We also compared activation of male and female, a only found activation in bilateral superior temporal gyrus and left superior parietal lobule were stronger in male group than in female group. (p <.001).

CONCLUSIONS:

(1)Brain activation in AD can be observed in most of the olfactory brain structures that are activated in normal aging, but the number of activation regions is less, and the activation volume and intensity of AD are lower than those in normal aging. (2) Brain activation of olfactory stimulation is right predominant. (3) Activation in some regions is only found in AD, and it may be the result of compensation mechanism. (4) fMRI is an useful method for central function research in AD.

Reference

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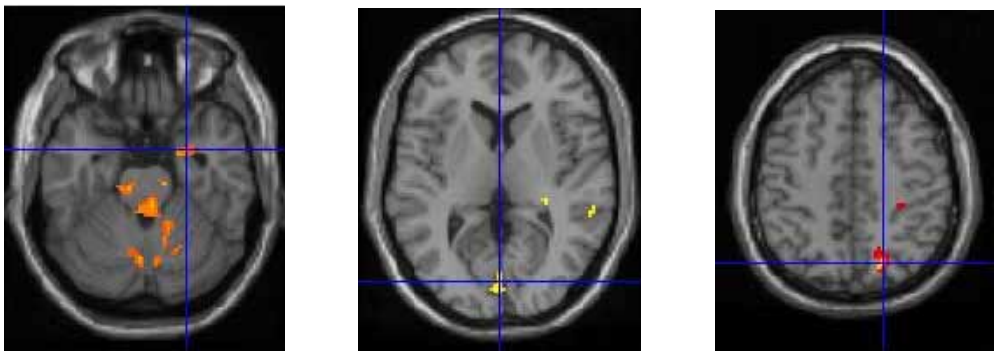

a Left hippocampal sulcus b right lingual gyrus c left superior parietal lobule

Figure 1. a. activation regions of olfactory center in all participants; b. activation regions only found in AD. ; c. activation regions stronger in male than in female.