

The fMRI Study of Visual Spatial Working Memory in Subcortical Vascular Dementia

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Objective: To study the character of brain activation of normal controls (NC) and SIVD patients recruiting a visuo-spatial working memory paradigm. To reveal the mechanism of visuo-spatial working memory impairment and functional reorganization of SIVD patients. To compare the difference of functional deactivation between NCs and SIVD patients and to analyze the underlying mechanism contributing to the current result and their clinical application.

Material and Methods: Anatomical transverse images and SE-EPI fMRI data were collected from 16 SIVD patients and 12 age and education matched NCs. The visuo-spatial working memory paradigm was arranged with mixed model design and includes two levels: easy and hard. fMRI scan lasted 4.5 minutes with 4 blocks. Each level of the paradigm comprises 2 blocks within which the onset of stimulus is randomized. fMRI data were preprocessed, estimated and analyzed with SPM package version 2.

Result: Within group analysis of easy visuo-spatial working memory task revealed main activation of the right hemisphere cortex: NCs showed activation of the right cuneus, superior parietal lobule, postcentral gyrus, inferior parietal lobule. SIVD patients showed activations of right superior and middle frontal gyrus, right precentral gyrus, right supramarginal gyrus, right superior parietal lobule, right precuneus, right lateral and superior occipital gyrus, right angular gyrus, left supramarginal gyrus, left declive culmen, left lingual gyrus and left middle occipital gyrus. Between group analysis revealed greater activation of right superior and middle gyrus (Brodmann 10 area), left superior and middle gyrus (Brodmann 6 area) in SIVD patients.

Within group analysis of hard task showed wider area of activation. NCs showed bilateral activation of pre- and postcentral gyrus, superior parietal lobule, precuneus, cuneus, angular gyrus, superior and middle frontal gyrus, lingual gyrus and middle occipital gyrus, fusiform gyrus, inferior temporal gyrus, declive culmen. SIVD patients showed not only widespread neocortex and cerebellar activation, but also activation of subcortical gray matter nuclei. During between group analysis, SIVD patients showed greater activation of bilateral superior, middle and inferior frontal gyrus, bilateral dorsal cingulate gyrus, right precentral gyrus, left insula, left lentiform nucleus (globus pallidus and putamen).

During the easy task, only NCs showed functional deactivation of bilateral superior frontal gyrus and dorsal anterior cingulate gyrus while SIVD patients showed no above threshold deactivation via different threshold and corrections. During the hard task, NCs showed wider deactivations: bilateral superior and middle frontal gyrus, bilateral temporal lateral sulcus cortex, bilateral cingulate, left superior parietal lobule and precuneus, left angular gyrus. SIVD also showed deactivation of right middle and superior temporal gyrus, left superior frontal gyrus and left insula. Between groups analysis revealed deactivation difference between NCs and SIVD patients in bilateral superior and medial frontal gyrus, bilateral precuneus, right caudate nucleus, and right lentiform nucleus, left superior and middle temporal gyrus, left middle frontal gyrus, left cingulate gyrus where normal controls show great extent of deactivation.

Conclusion: SIVD patients showed more activations than NCs under both easy and hard task, but the main difference between SIVD patients and NCs locates in the frontal lobe. SIVD patients show less deactivation, especially under easy task SIVD patients show no deactivation with various thresholds and corrections which could be a characteristic change of SIVD patients. With hard task, the main deactivation difference between NCs and SIVD patients locates in the left frontal lobe.

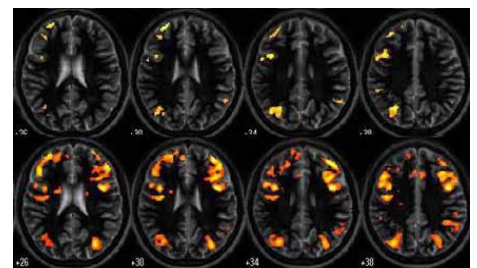


Fig1: the activation of the easy and hard (bottom line) tasks of SIVD patients.