An event-related fMRI study on phase specific patterns of cortical activity for working memory in schizophrenia patients

W. Li[1], Y. Zhang[2], Q. Zhang[3], and G. Yang[2]

[1]department of Radiology, Tianjin medical university General Hospital, Tianjin, Tianjin, China, People's Republic of, [2]Tianjin medical university, [3]Tianjin Medical University

Background and purpose

Recently, some investigators found that different cortex were activated at encoding, maintenance and retrieval phases of working memory (WM) in normal subjects [1,2]. In this study we aimed to investigate patterns of cortical activity and loading effect at three phases of working memory in schizophrenia using event-related fMRI (ER-fMRI), and to explore the relationship between WM deficit of schizophrenia and the three cognitive processes.

Methods

Twenty right-handed paranoid and undifferentiated schizophrenia patients (diagnosed according to DSM-□, 10 male, 10 female, age range from 24 to 50,and average 36 years,) and 20 matched healthy subjects were recruited for the study after signed a written consent. Two Sternberg item recognition task (SIRT) with different load level (low and high level trial contained 5 and 7 digits respectively) were used during the study. Each run included 32 trials (low level, 16; high level, 16), each trial last for 20s (encoding phase 2s, maintenance phase 6s, retrieval phase 2s, interval duration 10s). Functional MRI were acquired on a GE 1.5T Twin speed MR scanner with GRE-EPI sequence (TR/TE=2000/60ms, thickness=5mm, slice gap=0.5mm, FOV=24×24cm, matrix=64×64, 26 slices covered whole brain). SPM2 was used to process the data. Significant threshold of t-test at voxel level for functional areas was $p<0.05$ (corrected).The regions including more than 10 consecutive activated voxels were regarded as functional areas. The activated areas at each phase on two load levels were obtained with group analysis. Load dependent activity for each phase was identified with inter-group analysis. Activity difference between schizophrenia subjects and normal subjects for each phase was also identified with inter-group analysis.

Results

During encoding phase, activated regions include visual association cortices in the occipital and temporal lobes, bilateral posterior parietal cortex (PPC), bilateral premotor area (PMA), right cerebellum, and left precentral gyrus. The majority of above mentioned areas showed enhanced activity in high load level **(Fig 1)**. Compared to normal subjects, aforementioned areas also demonstrated increased activation in schizophrenia. During maintenance phase, bilateral ventral lateral prefrontal cortex (VLPFC) and right precuneus lobe were activated. For high load level, activation of bilateral PPC, right DLPFC and bilateral occipital lobes increased **(Fig 2)**. Compared to normal subjects, left VLPFC, bilateral PPC, right PMA, left DLPFC, bilateral occipital lobe demonstrate increased activation in schizophrenia. During retrieval phase, left precentral gyrus, left postcentral gyrus, left SMA, bilateral PMA and left DLPFC showed activation. For high load level, right PMA, left precentral gyrus, right cerebellum, right DLPFC and bilateral occipital lobe showed increased activation **(Fig 3)**. Compared to normal subjects, left PMA, bilateral cerebellum, bilateral precentral gyrus, left precentral gyrus, left postcentral gyrus and left DLPFC displayed increased activation in schizophrenia.

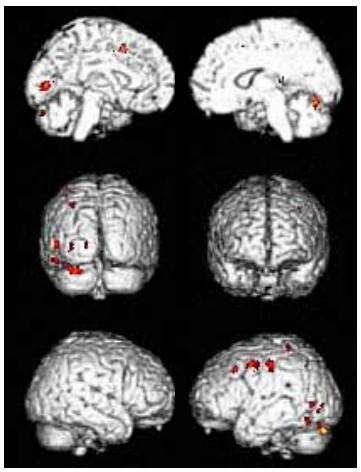


Fig 1

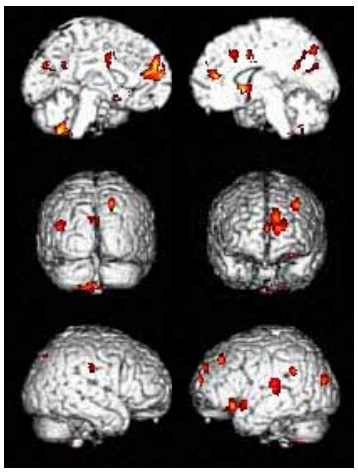
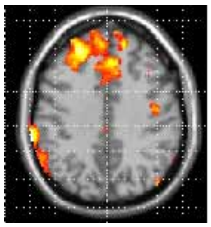
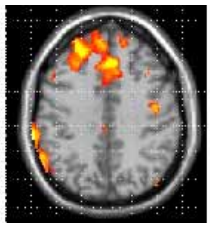


Fig 2





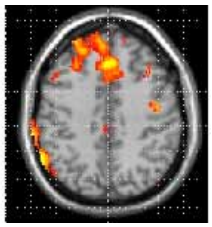


Fig 3

Conclusion

WM deficits are not the result of specific cognition process impairment, but the coordinated result of the abnormity at encoding, maintenance and retrieval phase. Schizophrenia patients couldn't optimize resources utilities and show ineffective, increased brain activity across the three phases.

Reference

1. Manoach DS, et al. Neuroimage, 2003, 20: 1670-1684. 2. Cairo TA, et al. Brain Res Cogn Brain Res, 2004, 21: 377-387