Interference of Default Mode Neural Network by Visual Stimulation and Subject's Attention Depending on the Resting Functional MRI

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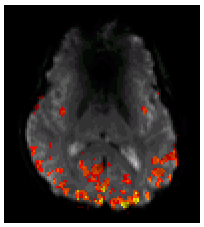
Background : In recent years, the default mode neural network is described by the resting functional BOLD MRI without task-related stimulation, which shows BOLD signal fluctuations correlated with the functional related regions. This signal fluctuation has been investigated on spontaneous low-frequency (0.012 ~ 0.1Hz) in the blood oxygen level–dependent (BOLD) MRI signal reflecting networks in the prefrontal and posterior cingulate cortices, basal ganglia and visual cortex (1,2). This technique has been applied to some patients in the clinical settings, and the usefulness for the clinical diagnosis was suggested. The purpose of the present study was to know the influence of the stimulation from the outside and the subject's attention to the extracted default neural network area, and whether the visual attention changes the default neural network area or not.

Methods : Eight healthy subjects aged between 21 and 32 years (mean 25 ± 4 years) were participated in the study. MR images were acquired on a 3.0T clinical instrument (GE Signa HDxt 3.0T) using an 8-channel head coil. For the resting state without visual stimulation, subjects were measured with their eyes close during the measurement times of 9 minutes. As the visual interference, moving pictures were displayed through the goggles put on the subjects and they looked at the movies on the measurement duration of 9 minutes. The independent component analysis (MELODIC, FSL, Oxford University) was conducted to extract spontaneous signal fluctuation. The components of low frequency fluctuations which were localized in the primary motor cortex (PMC), supplementary motor cortex (SMA) and visual cortex were picked up, The correlation coefficient between the signal time courses in the extracted area and the picked-up model component was calculated by the cross-correlation analysis.

Results : The extracted network of the visual-related regions in the occipital lobe without and with visual stimulation were shown in Fig.1(a) and (b), respectively. The area of the extracted network without visual stimulation was relatively larger than that with visual stimulation. The extracted network of the motor-related area in the frontal lobe without and with visual interference was shown in Fig. 2(a) and (b), respectively. The extracted area was measured in each subjects and summarized in Table 1. In both visual and motor-related regions, the extracted area of the default neural network with visual stimulation were significantly smaller than those with visual stimulation. However, the correlation coefficients in the extracted areas did not show any statistical difference between with and without visual stimulation.

Conclusion : The default mode neural network would be interfered or localized in the smaller area by the stimulation from the outside and subject's attention. In the case of clinical application to patients, the stimulation from the outside should be removed and it is considered that the psychological resting state is important to apply this technique for the clinical diagnosis.



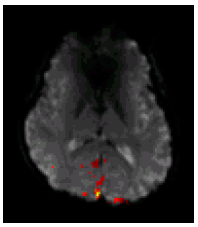
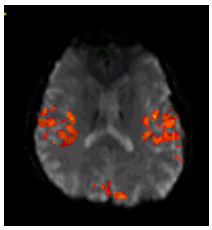


Fig.1 (a) no stimulation (b) with stimulation



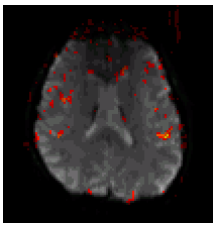


Fig.2 (a) no stimulation (b) with stimulation

Table1: Measured area of extracted network area without and with visual stimulation

	Without stimulation (mm^2)	With stimulation (mm^2)	P values
Visual-related region	369±226	178±72	0.028
Motor-related region	404±261	178±85	0.035

References : 1.Robunson. BMC Neuroscience 2009 10;137, 2.Peter Fransson.HBM 2005 26;15-29