Previous Abstract

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Spectral Spatiotemporal and Causality Analysis of Human Somatomotorsensory N Network

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Objective: The human somatosensory network has been investigated by non-invasive neuro techniques, including magnetoencephalograhy (MEG), and functional MRI (fMRI). Previou has been shown that the contralateral primary somatosensory (SI) and bilateral secondary somatosensory areas (SII) are activated following median nerve stimulation. More recently, functional interaction of SI and SII areas in the beta band (~20 Hz) has also been demonstra In the present study, we used electric median nerve stimulation and motor responses to eluc characteristics of this neural network by fMRI, MRI, and MEG. Both spatiotemporal and sp spatiotemporal maps of neural activities were estimated [2]. Subsequent network analysis b Structural Equation Modeling (SEM) [3] indicates dynamic causal interactions between regi the network subserving the sensorimotor tasks.
Methods: We delivered stimuli exceeding the motor threshold to the right median nerve (0. duration; random inter-stimulus-interval, min: 3 s; 120 trials). The subject was asked to flex index finger after stimulus. An identical experimental paradigm was used in both MEG and experiments. We used a 306-channel whole head MEG system (Elekta Neuromag Ltd., Hels Finland) for MEG measurement. fMRI and MRI experiments were performed on a 3T scan (Siemens Medical Solutions, Erlangen, Germany).
We used minimum-norm estimate [4] to calculate the spatiotemporal maps of neural activiti both fMRI and MEG data. We also employed wavelet analysis on the MEG data to reveal p locking between the contralateral SI and the ipsilateral SII [2]. After revealing region-of-int (ROIs), we specified anatomical connections for subsequent Structural Equation Modeling (analysis. Dynamic SEM paths were estimated from time-resolved data covariance matrices MEG/fMRI/MRI minimum-norm estimates.

Results & Discussion: Bi-hemispheric SI/MI and ipsilateral SII were found active using co 70% fMRI and MEG data (Fig.1A). Contralateral SII was detected using the phase locking (PLV) at 17 Hz (Fig. 1B). The time courses of the estimated dipole at these 4 ROIs were sh Fig. 2. Left SI and SII showed significant activity around 90 ms. Right MI was found most a 250 ms. Using the anatomical connection between ROIs shown in Fig. 3A, we estimated the coefficients with a millisecond resolution (Fig. 3B). Strong left S1 to left SII causal influenc estimated around 30 ms. All paths showed significant values at 90 ms. Around 250 ms, path right hemisphere M1 and inter-hemispheric SII connections showed significant activity.
Conclusions: In this study, we demonstrated the spatiotemporal and spectral spatiotempora anlaysis of combined MEG/fMRI/MRI data to elucidate the structure of the neural network sensorimotor tasks in human brain. We also showed the dynamic causal interaction betwee of the neural network using Structural Equation Modeling.
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