Comparison of fMRI of Motor System with Correlation Analysis and Data-driven Analysis Methods

In Chan Song, Kee Hyun Chang, Sun-Won Park, Yoon Hee Kim,
Moon Hee Han, Man Chung Han

Dept. of Radiology and Institute of Radiation Medicine, Seoul National University College of Medicine

Purpose: We describe the data-driven analysis methods using the spatial connectivity of time courses and assess these feasibility in fMRI of motor system compared to the model-driven correlation method.

Materials and Method: Functional MRI of motor system was performed on a 1.5T MR unit (Signa Horizon, USA) with a conventional CP head coil in three normal volunteers (mean age:27 yrs) and one patient with frontal lobe epilepsy (age=26 yrs). A single-shot GRE-EPI sequence (TR/TE/flip angle=3000ms/50ms/90, FOV=240 mm, matrix=64x64, slice thickness/gap=5mm/0mm, 20 axial slices) was used. A flow-sensitive conventional gradient echo sequence (TR/TE/flip angle = 50ms/4ms/60) was used for high resolution anatomical images. Finger tapping of the right thumb and index finger was carried out with the alternative movement of 2 activation and 3 rest periods (one period=24 sec) at a speed of 1/1 sec, and the total scan time was 3 minute. Convolution by 2 dimension Gaussian-shape filter were applied to all images for reducing motion artifact and all time series data were preprocessed by normalization procedure before applying three analysis methods for obtaining functional map images. The model-driven correlation method of time courses with reference vector defined by a given paradigm was applied to all raw EPI data. In the data-driven analysis methods, we computed the correlation and covariance of each pixel with its surrounding 8 pixels and used their mean values. The threshold in p value for the model-driven correlation method was set to be 0.001 to obtain the activation sites. The activation detection of left premotor cortex, their locations and the patterns of map images were compared among three analysis methods

Results: In three normal volunteers, we can obtain the successful fMRI map images of motor system by using all three analysis methods and the time series of the activation sites were well consistent with our paradigm. The left premotor cortex located at the nearly same sites was found to be strongly activated for all three methods. In one patient, no activation was found by the model-driven correlation method, but other two data-driven analysis methods could detect left premotor cortex. Its time series did not follow our paradigm.

Conclusion: The data-driven analysis methods using the spatial connectivity of correlation and covariance of each pixel were found to be feasible for detecting the activation sites similar to the model-driven correlation method. Also, our results suggest the data-driven analysis methods may be preferable to the model-driven correlation method for the investigation of the delayed or unknown neural response functions.