Contralateral Hyper-Connectivity in Patients with Unilateral Carotid Stenosis

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Background: Carotid artery stenosis (CAS) can cause cerebral hypo-perfusion and alter the psychomotor function and corresponding sensorimotor connectivity. Previous studies utilized the contralateral healthy hemisphere as the reference for comparison. However, it is plausible that the hypo-perfusion of the stenosis hemisphere may lead to a compensatory effect on other brain areas. To verify this conjecture, we targeted on the connectivity disparity between patients with CAS and healthy controls, rather than inter-hemispheric comparisons.

Methods: We recruited 27 patients with unilateral internal CAS (≥60%, age: 66.9±9.0, 23 males) and 27 normal subjects (age: 63.5±9.4, 17 males) for the MRI assessments (Normal and PRE, respectively). Twenty-three patients received the carotid artery stenting and completed the one-month follow up (POST). All subjects were scanned in a 3T SIEMENS Trio MRI scanner with GE-EPI sequence in a resting state (TR/TE=2000/30 ms, voxel size=3.4×3.4×4.0 mm, 33 slices, Flip angle=90°, 180 measurements). The fMRI scans were preprocessed using SPM8, and seed-correlation analyses of the sensorimotor network (seeded at the primary motor cortex, M1, of the healthy side) were performed using REST. We performed group comparisons using the two-sample t-test (Normal vs. PRE) and paired t-test (POST vs. PRE) on the corresponding Z-maps. Statistical thresholds were set as AlphaSim corrected p<0.05.

Results: Consistent with previous studies, the inter-hemispheric connectivity between bilateral M1s was greatly reduced in patients before stenting, but resumed normal after carotid revascularization (Fig.1B). However, resting thalamo-cortical connectivity (TCC) in the healthy side was more enhanced in patients than that in Normal group (Fig.1A). One-month after revascularization, the hyper-connectivity of the healthy side remained elevated in patients, compared to that in the Normal group.

Conclusions: Prior to carotid revascularization, we found that TCC is hypo-connected in the stenosis hemisphere but hyper-connected in the healthy side, suggesting the occurrence of compensation effect within the sensorimotor network. Physiological indicators, such as perfusion, shall be considered in the following investigations for revealing physiological mechanisms underlying the hyper-connectivity phenomenon.

Reference: