Connectivity matrix analysis of depression-related network in patients with post stroke depression

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Purpose

Poststroke depression (PSD) is not only an important clinical issue but also may provide a unique window into the pathophysiology of depression.[1] In the present study, we investigate the possible alteration in functional connectivity (FC) within salient network (SN) associated with PSD using resting-state functional magnetic resonance imaging (rs-fMRI).

Methods

Fifteen PSD patients (64.9 ± 13.4 years, 10 females) with unilateral left or right MCA infarction and age matched healthy controls (63.3 ± 6.09 years, 10 females) were recruited. All patients underwent rs-fMRI within a month from onset of stroke. The BDI was used to evaluate the severity of depression. All subjects signed an informed consent for the study and the rs-fMRI study protocol was approved by the Institutional Review Board. All MRI data were acquired with a 3.0T MR scanner (HD, General Electric Healthcare). Resting-state BOLD images were obtained using an EPI sequence (TR = 2000 ms, TE = 30 ms, flip angle = 90, matrix = 64 x 64, and FOV = 210 mm). Image processing of rs-fMRI data were carried out with the SPM5 (http://www.fil.ion.ucl.ac.uk/spm/). Functional Connectivity SPM5 toolbox (http://web.mit.edu/swg/software.htm) was used for identification of the SN and 15 independent SN seeds. The FC matrices between SN seeds were plotted using MATLAB v. R2010b in a color map.

Results

Figure 1 displays functional connectivity maps of the SN for healthy controls(Fig. 1A) and PSD patients(Fig. 1B) that showed the SN-specific FC predominantly in contralesional hemisphere in PSD patients compared to healthy controls (FDR p <0.05). Our FC matrix analysis of SN has revealed that ipsilesional and contralesional functional connectivity patterns of brain regions within SN in PSD patients were extensively altered compared to healthy controls.(Fig. 2 and 3) In the ipsilesional hemisphere, PSD patients showed positive correlation of the mPFC with DLPFC, amygdala, and insula while healthy controls showed negative correlation of the mPFC with these brain regions. In the contralesional hemisphere, PSD patients showed positive correlation of the ACC with limbic regions while healthy controls showed negative correlation of the ACC with limbic regions.

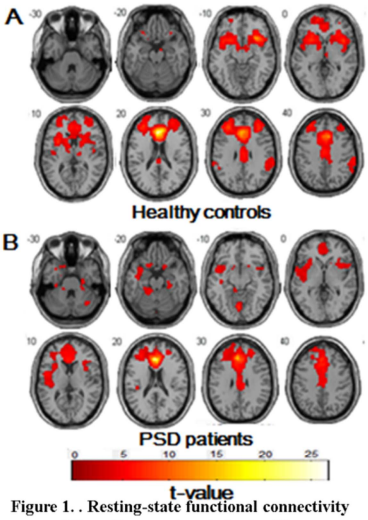

Figure 1. . Resting-state functional connectivity maps of the salience network for healthy controls(A) and PSD patients(B) at FDR P<0.05

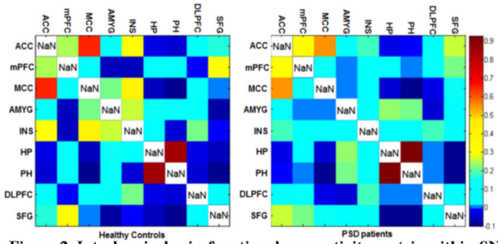

Figure 2. Intrahemispheric functional connectivity matrix within SN-seeds in the ipsilesional hemisphere, averaged across groups

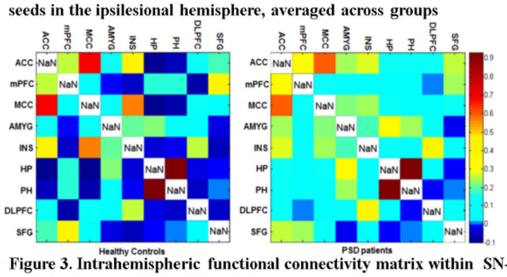

Figure 3. Intrahemispheric functional connectivity matrix within SN-seeds in the contralesional hemisphere, averaged across groups.

Discussion

Our results seem to suggest that extensive alterations in resting-state functional connectivity within SN in each hemisphere could have led to a disruption of the balance between excitatory and inhibitory mechanisms within the SN in PSD patients. This finding is in agreement with previous studies in MDD patients showing that the alterations of functional connectivity within SN may represent failure to effectively regulated activity in SN [2]. More specifically, because limbic structures in the SN are known to involve in perception of negatively valenced stimuli or experiencing of negatively valenced affective states, we speculate that the negative correlations between limbic and dorsal frontal regions shown in healthy controls effectively inhibit negative emotion. However, in PSD patients, these correlations become positive to lead dysregulation of negative emotion and thus prolonged negative emotion is maintained.

Conclusion

The current connectivity matrix analysis of SN has demonstrated that functional connectivity patterns of brain regions within SN in PSD patients were extensively altered compared to healthy controls. In addition, the breakdown of negative correlation between limbic and dorsal frontal regions suggests that the inhibitory process to prevent prolonged negative emotion seems to be impaired in PSD patients.

References

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