Impaired thalamic functional Connectivity in Vegetative State Detected by fcMRI

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Introduction:

Vegetative state (VS) is defined by wakefulness without awareness of self or the environment. Resting-state functional connectivity magnetic resonance imaging (fcMRI) is a novel technique that has several potential advantages over task-activation functional magnetic resonance imaging (fMRI) in terms of its clinical applicability to VS subjects. Voxel-based analyses have been employed to identify systematic impairment of associative frontoparieto–cingulate areas in different states of consciousness, such as sleep, anesthesia, coma, vegetative state, and epileptic loss of consciousness [1]. Previous positron emission tomography (PET) studies showed that VS patients have markedly impaired functions of the precuneus and posterior cingulate cortex (PCC), together with damaged prefrontal and parieto-temporal association areas [2]. Consciousness is thought to represent an emergent property of cortical and subcortical neural networks and their reciprocal projections. As a core node in these networks, the thalamus plays an important role in regulating the transformation of information flow, monitoring the consciousness state, and maintaining the wakefulness [3]. The purpose of this study is to investigate the changes of the thalamic functional connectivity (FC) network between VS patients and control subjects. The findings showed that FC in VS patients was significantly lower than that of control subjects in bilateral PCC and precuneus.

Methods:

A total of 9 subjects were enrolled in the current study, including 5 VS patients (Male/Female=2/3, age=33.2±10.1 years) and 4 healthy control subjects (Male/Female=2/2, age=33.7±9.5 years). All five patients fulfilled the international criteria for VS. For each subject, a set of high-resolution SPGR anatomical image and 6-min resting BOLD fMRI data were collected with a single-shot EPI sequence from a Siemens Trio Tim 3T scanner (TR of 2s, TE of 25 ms, slice thickness of 5 mm, 25 slices). All fcMRI analysis was carried out using AFNI software (http://afni.nimh.nih.gov/afni). The bilateral thalamus was drawn as a seed Region of Interest (ROI). The averaged voxel time series from the seed ROI were preprocessed, including 6-direction motion correction, image registration, normalization, and image smooth. Cross-correlation was performed between the average time course of ROI and each voxel time course across the entire brain for each individual. The individual correlation coefficients (CC) voxel-wise maps were averaged across group of subjects. A two-sample *t*-test was used to determine the FC changes between VS and normal groups.

Results and Discussion:

Compared to the control group, FC in VS subjects was significantly lower than that of control subjects in the bilateral PCC, and precuneus. ($p < 0.05$, corrected with cluster size 7762 mm^3), (Table 1, Fig. 1). These results have suggested that the decreased FC in the thalamic network in VS may be crucially linked to loss of consciousness. Previous studies have demonstrated that self-awareness networks encompass the PCC, precuneus cortices, medial frontal cortex, and bilateral temporoparietal junctions [2, 4]. Present results suggest that the impaired FC between the thalamus and PCC/Precuneus could be one of the underlying mechanisms of VS and the determination of FC could characterize VS and may be used as a marker to access the prognosis and evaluate treatment efficacy.

Table1. Differences in FC between VS patients and normal subjects in PCC and Precuneus

	L-PCC	L-Precuneus	R-PCC	R-Precuneus
VS	0.032±0.017	-0.132±0.014	-0.037±0.015	-0.049±0.002
Control	0.117±0.058	0.080±0.009	0.077±0.008	0.056±0.003
Z value	2.97	2.51	2.58	2.53

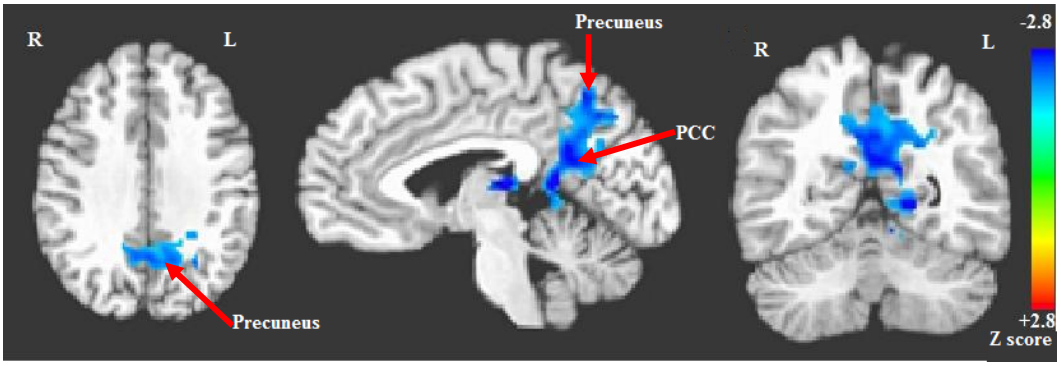

Figure1. Maps of decreased thalamic FC in VS patients compared with control subjects.

References:

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