Anxiey disease: Decreased of functional connectivity in left superior temporal gyrus (GTs) and right GTs

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Introduction

Recent advances in phenomenology, neurobiology, and treatment of anxiety disorder have shown a remarkable similarity between the physiological and behavioral consequences of response to a conditioned fear stimulus and a panic attack. The critical pathways ask for an extensive involvement of limbic system [2], which is particularly important in responding and storing information on a real or perceived threat. Nevertheless, these bottom-up approaches are potentially problematic because they often affect multiple sites and thus may confound inferences about brain-behavior relationship. Neuronal circuits involved in the pathophysiology of anxiety are not yet fully understood.

Materials and Methods

Subjects Twenty right-handed subjects were included in this study, and were divided into two groups. The anxiety (P) group (n=11; 7 male, mean age 42 years) consisted of patients meeting DSM-IV criteria for a principal diagnosis of anxiety disorder. The control (C) group consisted of volunteers free of psychiatric symptoms, and was matched on age and gender (n=9; 7 male) with the panic patients. The subjects underwent noninvasive functional magnetic resonance imaging while listening actively to (1): emotionally neutral word alternating with no word as the control condition (CN, PN), and (2): threat-related words alternating with emotionally neutral word as the experimental condition (CT, PT). Each word was presented in pseudorandom order in each 16s block of 12 words of the same type. Eight alternating blocks of neutral words were presented for about 256s. The subject was only asked to passively listen to each word.

Data Acquisition All MRI data were obtained on a 1.5-Tesla scanner (Marconi EDGE ECLIPSE) equipped with a prototype fast gradient system for echo-planar imaging. A T2* weighted, gradient recalled echo-echo planar imaging sequence was obtained for functional images (TE, 40ms; TR, 2500ms; 90º flip angle; NEX, 1; FOV, 24cm; resolution, 64×64 matrix). A total of 144 images were acquired per subject during each 4-min-and-48-sec scan session.

Data Analysis The statistical analysis was performed to find significant activations in two tasks for two groups. Based on group t-test, we chose two anatomically defined regions: left superior temporal gyrus (GTs) and right GTs. Then, based on individual t-map, the voxel with the largest t-value within two regions was taken as the subject-specific peak voxel. We define clusters based on faces and edges, but not corners, so each voxel has 18 neighbors. Subject-specific averaged time series were extracted by averaging the time series of 19 voxels. Since healthy control subjects showed no significant activation (corrected, p<0.05) during processing of anxiety word to neutral word, region of interest during processing of neutral word to no word was used as substitution. The connectivity degree η_{ij} between the node i and the node j is used to identify the change of the functional connectivity associated with differential tasks, *i.e.*, $\eta_{ij}=e^{-\xi d}$, where ξ is a real positive constant, measuring how the strength of the relationship decreases with the distance between the two nodes (ξ is a subjective selection and is here fixed to $\xi=2$), and d_{ij} is the distance between the two nodes, calculated as a hyperbolic correlation measure [3]. This calculation is as follows: $d_{ij}=(1-Coh_{ij})(1+Coh_{ij})$ where Coh_{ij} represents coherence between the two nodes [4]. Coherence is the normalized cross-covariance function in the spectral domain, *i.e.*, $Coh_{ij}(\lambda)=|f_{ij}(\lambda)|/f_{ii}(\lambda)f_{jj}(\lambda)$, where $f_{xy}(\lambda)$ is the cross-spectrum of x and y at frequency λ, and $f_{xx}(\lambda)$ and $f_{yy}(\lambda)$ are the respective power-spectra of x and y. Moreover, we just consider coherence in low-frequency (0-0.15 Hz).

Results and Discussion

In Fig. 1, we present threshold t map (p<0.05, corrected) from analysis of activations during two experiments for two groups. Patients were significant different from normal controls on two experiments. Figure 2 shows the connectivity degree of left Gts and right Gts in two tasks across all subjects. Comparing during processing neutral word to blank, a significant decrease (p<0.001) in functional degree was observed during processing of threaten word to neutral word ($\eta=0.5636$ for CN, $\eta=0.555$ for CT, $\eta=0.5616$ for PN, $\eta=0.4926$ for PT). The connectivity degree identifies that functional interactions change with differential task. This result suggests decreased information flow among two brain region during processing of anxiety word to neutral word in anxiety patients.

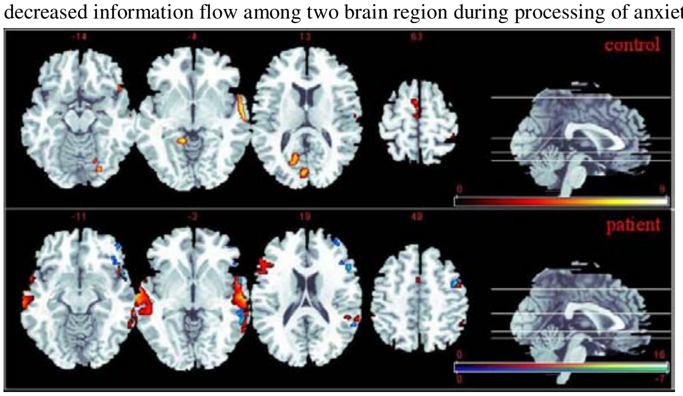

Fig. 1. Statistical t map reveals activations during processing of emotional neutral words to no words (hot orange) and during processing of threaten words to neutral words (winter blue) in two groups.

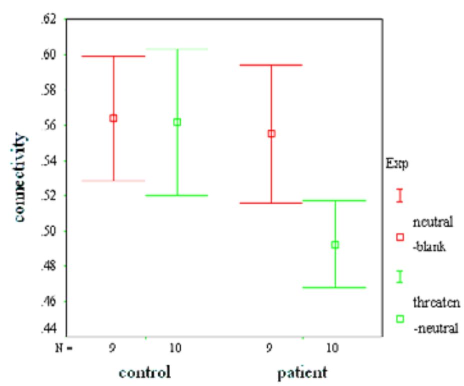

Fig.2. Difference in η between two tasks among 9 control subjects, 11 patients.

Reference

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