Neural Characteristics of Posttraumatic Stress Disorder: Functional Magnetic Resonance Imaging Studies of Combat Veterans

by

Leslie Xiaodan Yan, PhD

A dissertation submitted in partial fulfillment of the requirements for the degree
Doctor of Philosophy

Department of Basic Medical Science Program in Biomedical Imaging
New York University
September 2013

Advisor: Charles R. Marmar, MD

Abstract:

Posttraumatic stress disorder (PTSD) is a prevalent psychiatric disorder, especially among combat veterans. Understanding the neurobiology of PTSD is important for its proper diagnosis and treatment. Existing neuroimaging studies of PTSD have the following limitations: (1) most studies were conducted while subjects were engaged in an emotion challenge or trauma provocation task, whether the findings from these mental states can be generalized to other mental states are not known; (2) most studies were focused on abnormal structure and responsivity of specific brain regions, but the connectivity between different brain regions are not well studied. Therefore, the present studies investigated the magnitudes of spontaneous brain activity and functional connectivity with resting state fMRI data from male combat veterans with PTSD compared to age-, gender- and ethnicity-matched veterans without PTSD. Results have suggested that compared to the control group, PTSD subjects had lower spontaneous brain activity in the precuneus, thalamus and dorsal lateral prefrontal cortex, but higher spontaneous brain activity in the amygdala, insula, orbital frontal cortex and ventral anterior cingulate cortex; in terms of functional connectivity, PTSD subjects had lower amygdala-frontal functional connectivity, lower functional connectivity within the default mode network, lower functional connectivity between the anterior cingulate cortex and the prefrontal cortex, as well as lower functional connectivity between the insula and the default mode network, but higher functional connectivity between the amygdala and the parahippocampal gyrus, as well as higher functional connectivity between the precuneus and the putamen. The functional connectivity with different nuclei of the basal ganglia was also investigated, which revealed that PTSD subjects had lower functional connectivity with the caudate, globus pallidus and nucleus accumbens, but higher functional connectivity with the putamen. These findings suggest that PTSD are characterized by hyperactivity in the fear circuitry and hypo-activity in emotion-regulation related brain regions even at resting state, as well as increased functional connectivity within the fear circuitry accompanied by decreased functional connectivity between the fear circuitry and brain regions typically involved in emotion regulation and self-referential processing.