Brain correlates of acupuncture-induced heart rate changes in Carpal Tunnel Syndrome patients and healthy controls – a combined autonomic and fMRI study

Abstract

INTRODUCTION: Autonomic nervous system (ANS) response to acupuncture may be an important mechanism for acupuncture's clinical effectiveness in treating chronic pain. My study focused on evaluating brain correlates of heart rate changes following electroacupuncture in Carpal Tunnel Srndrome (CTS) patients and healthy controls (HCs). My objectives were to 1) use electrocardiogram (ECG) to characterize autonomic response to acupuncture, and 2) use functional magnetic resonance imaging (fMRI) to map the central autonomic network (CAN), the network that controls ANS. **METHODS**: We collected concurrent ECG and fMRI data from l1 HCs and 7 CTS patients during 5 minute electroacupuncture sessions. Electroacupuncture was applied in an event related design with pseudo-randomized inter-stimulation intervals. I determined heart rate (HR) response for each stimulation event based on ECG data, and categorized events by HR decrease (orienting response, OR) and increase (defense response, DR). I produced three fMRI group maps: all acupuncture events, OR vs. DR events and high OR vs. [on, OR events. **RESULTS**: Autonomic data showed that all subjects experienced both OR and DR. and on average the CTS group experienced OR, whereas the HC group did not show significant HR change. Imaging results showed that in the HC group, OR events produced activation in the hippocampal formation and deactivations in the posterior cingulate. In the CTS group, OR events produced deactivations in the cingulate cortex, periaqueductal grey (PAG), and amygdala. In general, both HC and CTS groups showed activations in the somatosensory cortex and insula following acupuncture, but while the HC group had deactivation in the pre-frontal cortex the CTS group experienced activation. **DISCUSSION:** Seemingly identical electroacupuncture stimuli can produce divergent autonomic responses across time in an individual, and CTS patients experienced more prominent OR on average than HC subjects. Functional MRI data indicated that CAN involves cognitive, limbic, and sensorimotor regions as well as the PAG. Brain activity for OR events differs from that for DR events by producing greater deactivations across the implicated circuitry. Brain activity for CTS patients differs from that for HC subjects by encompassing greater recruitment of higher cognitive prefrontal cortical regions.