DOCTORAL THESIS

Electroacupuncture vs vagus nerve stimulation for epilepsy

Zhang, Jianliang

Date of Award:
2009

Electroacupuncture vs Vagus Nerve Stimulation for Epilepsy

ZHANG Jianliang

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

Principal Supervisor: Dr. ZHANG Hongqi

Hong Kong Baptist University

May 2009

Abstract

Vagus nerve stimulation (VNS) has been in use to treat refractory epilepsy for twenty years. Though quite effective in some patients to eliminate seizure, its overall improvement rate is only about 50%. Acupuncture has a long history (>3,000 years) for the management of epilepsy in China. However, the mechanisms of the two remedies are not well understood and their efficacies have not been compared in controlled experimental conditions. This study has examined the acute actions of VNS and EA and compared their effects between high and low stimulation intensity settings by recording electrocorticography, and extracellular activities of the sensorimotor cortex and thalamus in the rats with epileptiform activities induced by Pentylenetetrazole (PTZ). Additionally, the influence of VNS at different intensities on neuronal baseline activities has been assessed.

Experiments were performed on anesthetized SD rats. Electrocorticography was recorded from of the sensorimotor areas at the left parietal cortex, and the extracellular neuronal activities were recorded in the same cortical region and the ventrobasal (VB) thalamus. The recording paradigm was such that the baseline activities were recorded first as a control, followed by PTZ administration to induce the brain epileptiform activities. Electroacupuncture (EA) stimulation of "Dazhui" acupoint and VNS were delivered in random order, and the post-treatment recordings were compared with pre-treatment activities.

The main findings were as followed. **1.** With electrocorticography recordings, inhibition on epileptiform activities in the cortex by VNS at 1mA and 3mA were 24.2% (n=16, $P<0.001$) and 47.5% (n=18, $P<0.05$). At the same intensities by EA, the inhibition rates were 35.1% (n=15, $P<0.01$) and 58% (n=25, $P<0.01$) respectively; **2.** With extracellular recordings in the cortex, VNS at 1mA and 3mA decreased the epileptiform activities by 26.4% (n=17) and 39.6% (n=15). The reduction after EA at such intensities were 19.5% (n=14) and 40.8% (n=13); **3.** In the thalamus, 1mA/3mA VNS reduced epileptiform activities by 44.5% (n=23) and 29.8% (n=20) whereas 1mA/3mA EA led to a similar reduction 56% (n=29) and 51.7% (n=20); **4.** For the impact on baseline VB thalamic neuronal activities, VNS at 0.5mA, 1.0mA, 1.5mA and 2.0mA produced the reduction to 26.1% (n=113), 27.3% (n=101), 28% (n=96) and 29.7% (n=91) respectively ($P>0.05$). In general, there were no significant differences ($P>0.05$) between inhibitions of either

different treatments at the same intensity, or the same treatment at different intensities, except 1mA VNS gave rise to greater effects on thalamic epileptiform activities than 3mA VNS ($P<0.05$).

The current study demonstrated that **1.** Both VNS and EA may inhibit the PTZ-induced epileptiform activities in the rat brain; **2.** EA is comparable to VNS in anti-epileptic effects; **3**. High intensity stimulation is not necessary for EA; **4.** One of the mechanisms of these treatments, at least for VNS, is by inhibiting neuronal baseline activities and excitability. **5.** The disruption of the epileptiform activities in corticothalamic connection might be one of the potential mechanisms underlying the antiseizure action of VNS and EA; Considering the potential side-effects, comfort and the financial costs, acupuncture might be a good alternative therapy to VNS for epilepsy.

Table of Contents