

DOCTORAL THESIS

Electroacupuncture vs vagus nerve stimulation for epilepsy

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Electroacupuncture vs Vagus Nerve Stimulation for Epilepsy

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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 Pentylene-tetrazole (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

Declaration	i
Abstract	ii
Acknowledgements	iv
Table of Contents	vi
List of Tables	xiv
List of Figures	xv
List of Abbreviations	xvii
Chapter I General Introduction	1
1.1. Overview on epilepsy.....	2
1.2. Definitions and classifications.....	3
1.2.1. What is epilepsy?	3
1.2.2. What is seizure?	4
1.2.3. Classifications for epilepsies and seizures.....	5
1.2.3.1. Seizures.....	5
1.2.3.1.1. Partial (focal, local) seizures.....	5
1.2.3.1.2. Generalized seizures (convulsive or nonconvulsive).....	8

1.2.3.1.3. Unclassified.....	8
1.2.3.2. Epilepsies.....	9
1.2.3.2.1. Idiopathic epilepsies.....	9
1.2.3.2.2. Symptomatic epilepsies.....	11
1.2.4. Refractory epilepsy.....	11
1.3. Neuropathological changes associated with epilepsy.....	13
1.4. Role of neurotransmitters in epileptogenesis.....	14
1.4.1. Opioids.....	14
1.4.2. Somatostatin and neuropeptide Y.....	17
1.4.3. Corticotropin-releasing hormone and corticotropin.....	18
1.4.4. Thyrotropin-releasing hormone (TRH).....	19
1.4.5. The second messengers in epilepsy.....	20
1.5. Pathophysiological substrates associated with epilepsy.....	22
1.5.1. Thalamocortical circuits and other connections.....	23
1.5.2. Modulation of thalamic action by brainstem afferents.....	25
1.6. Putative mechanisms of epilepsy.....	26
1.7. Vagus nerve stimulation (VNS).....	31
1.7.1 History of VNS.....	31
1.7.2. The VNS apparatus.....	33

1.7.2.1. Components of the apparatus.....	33
1.7.2.1.1. Implanted and disposable components.....	33
1.7.2.1.2. Programming & Patient Components.....	36
1.7.2.2. Surgical procedures.....	36
1.7.2.3. Parameters settings.....	37
1.7.3. Peripheral and central structures related to VNS.....	42
1.7.3.1. The vagus nerve.....	42
1.7.3.2. Cerebral structures involved in VNS.....	45
1.7.3.2.1. Thalamic responses to VNS.....	50
1.7.3.2.2. Other changes in the brain by VNS.....	51
1.7.4. Long-term seizure control and quality-of-life benefits by VNS.....	52
1.7.5. Safety and tolerance.....	54
1.7.6. Potential antiseizure mechanisms of VNS.....	55
1.7.6.1. EEG alteration induced by VNS.....	55
1.7.6.2. Cerebral blood flow changes during VNS	57
1.7.6.3. Conclusions.....	62
1.8. Epilepsy in TCM.....	63
1.8.1. Potential role of acupuncture against epilepsy.....	64
1.8.2. Acupuncture and Meridian theory.....	65

1.8.3. Acupoints selected for epilepsy treatment.....	67
1.8.4. Acupoints used in this study.....	68
1.8.5. Possible risks by acupuncture during treatment of epilepsy.....	72
1.9. Animal epilepsy models.....	73
1.10. Aims of this study.....	75

Chapter II Comparison of VNS vs EA Effects on Cortical Epileptiform

Activities--Electrocorticography (ECoG) Recording.....	78
2.1. Introduction.....	79
2.1.1. The role of cortex in epilepsy.....	79
2.1.2. VNS and cortex.....	80
2.1.3. Recording of cortical activities.....	80
2.1.4. Acupuncture and cortical epileptic activities.....	81
2.2. Materials and Methods.....	83
2.2.1. Animal and surgery.....	83
2.2.2. Electrocorticography for recording epileptiform activities.....	85
2.2.3. VNS and EA stimulation.....	85
2.2.4. Recording procedures.....	86
2.2.5. Statistical analysis.....	87

2.3. Results.....	88
2.3.1. PTZ induced epileptiform activities in the cortex.....	88
2.3.2 Effects of VNS on PTZ induced epileptiform activities.....	90
2.3.3. Effects of EA on PTZ induced epileptiform activities.....	94
2.3.4. Comparison of inhibitory effects between VNS and EA.....	96
2.4. Discussions.....	98
2.4.1. VNS intensity and effects.....	99
2.4.2. EA intensity and effects.....	100

Chapter III Effects of VNS vs EA on Normal and Epileptic Cortical

Activities--Extracellular Recordings.....	103
3.1. Introduction.....	104
3.2. Materials and methods.....	108
3.2.1. Surgical preparations.....	108
3.2.2. Epilepsy model and VNS/EA stimulation procedures.....	109
3.2.3. Recording procedures and data acquisition.....	109
3.2.4. Histological verification and statistical analysis.....	111
3.3. Results.....	111
3.3.1. PTZ induced cortical neuronal epileptiform activities.....	112

3.3.2. Effects of VNS on PTZ induced cortical neuronal epileptiform activities..	114
3.3.3. Effects of EA on PTZ induced cortical neuronal epileptiform activities....	117
3.3.4. VNS effects on baseline cortical neuronal activities in normal animals.....	118
3.3.5. EA effects on baseline cortical neuronal activities.....	122
3.4. Discussions.....	123
3.4.1. Antiseizure effects on the cortex by VNS.....	123
3.4.2. Antiseizure effects of EA on the cortex.....	125
3.4.3. Comparison of the inhibitory effects between VNS and EA	127
Chapter IV Antiseizure Effect by EA vs VNS in Rat Thalamus.....	129
4.1. Introduction.....	130
4.1.1. Role of thalamus in seizure generation and propagation.....	130
4.1.2. Vagal projections to the thalamus.....	132
4.1.3. Thalamic role in antiseizure effect by VNS.....	133
4.2. Materials and Methods.....	136
4.2.1. Surgical preparations.....	136
4.2.2. Epilepsy model.....	137
4.2.3. Stimulating procedures.....	137
4.2.4. Recording procedures and data acquisition.....	137

4.2.5. Statistics and histology.....	141
4.3. Results.....	141
4.3.1. Neurons' response properties and locations.....	141
4.3.2. PTZ induced epileptiform activities.....	144
4.3.3. Effects of VNS on epileptiform activities.....	144
4.3.4. EA effect on epileptiform activities.....	149
4.4. Discussions.....	150
4.4.1. Thalamic involvement in epilepsy.....	151
4.4.2. EA effect on epilepsy.....	153
4.4.3. Acute antiepileptic effects.....	154
4.4.4. Chronic antiepileptic mechanisms.....	155
4.4.5. Stimulus-response relations.....	156
4.4.6. Summary.....	158

Chapter V Effects on VB Thalamic Neuronal Baseline Activities by VNS at

Different Intensities.....159

5.1. Introduction.....	160
5.2. Materials and Methods.....	161
5.2.1. Surgical preparations.....	161

5.2.2. Stimulation procedures.....	162
5.2.3. Data acquisition, analysis and histology.....	163
5.3. Results.....	163
5.3.1. Effects of 0.5mA VNS on thalamic neuronal baseline activities.....	164
5.3.2. Effects of 1.0mA VNS on thalamic neuronal baseline activities.....	168
5.3.3. Effects of 1.5mA VNS on thalamic neuronal baseline activities.....	168
5.3.4. Effects of 2mA VNS on thalamic neuronal baseline activities.....	171
5.3.5. Comparison of inhibition rates by VNS at different output currents.....	171
5.4. Discussions.....	173

Chapter VI Summary, General Conclusions, Clinical Implications and

Future Considerations.....176

6.1. Summary and general conclusions.....	177
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6.2. More cautious interpretation of the lab results of this study for clinical application and future considerations.....	179
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6.3. Future considerations.....	181
---------------------------------	-----

References184

List of Publications.....254

Curriculum Vitae258