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Method Validation of Functional Magnetic Resonance Imaging and Electrophysiological Recording to Investigate Mechanisms of Vagus Nerve

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ABSTRACT

Vagus nerve stimulation (VNS) is used clinically to treat epilepsy and depression, but its mechanism of action is unknown. Useful techniques to study this are functional magnetic resonance imaging (fMRI) and the local field potential (LFP). fMRI relies on oxygen use in the brain to show areas where neurons are active. The LFP is an electrical signal created by neuron action potentials and other current moving across cell membranes. The most information can be gained when the two methods are used simultaneously, however, this is difficult to do. This study seeks to validate the technique of fMRI-LFP as applied to study the mechanism of VNS. The rat is used as an animal model. Previously collected data is analyzed to determine effects of stimulation on respiration, since this will affect oxygen levels in the blood. Recording electrodes of different materials are tested to find the artifact size created in an MRI environment. Iridium electrodes were found to have the smallest artifact and therefore the best performance. It is unclear whether the stimulation used affects respiration, so a simultaneous fMRI-LFP experiment is needed to interpret fMR images. More work needs to be done before fMRI-LFP recordings can be taken during VNS.

KEYWORDS

Functional magnetic resonance imaging, vagus nerve stimulation, neural activity, brain connectivity