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Protocol for vagus nerve stimulation in anesthetized pigs (subject-2)

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Protocol status: Working
We use this protocol and it's working

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Abstract

The Vagus nerve innervates a number of thoracic and visceral organs. Exogenous nervous signal, for example, Vagus nerve stimulation (VNS) provides a route to modulating their function for therapeutic purposes. However, the relationship between VNS parameters and organ responses is poorly understood as evidenced by a number of failed human trials, for example, in the heart failure space.
This study will contributes to our understanding of the relationship between VNS parameters and the organ responses. It does so by mapping VNS parameters (at a fine resolution) to their immediate neural and cardiac effects in 2 pigs under anaesthesia.

Troubleshooting

Equipment Setup

1 We do the setup of the BIOS A1 System (electrophysiology).

1.1 Load BIOS Neurotool software for neural recording acquisition and stimulation.

1.2 Place cuff electrodes in saline. Take impedance measurement to confirm system is functional.

Animal Preparation

2 We prepare the animal before the surgery.

2.1 Animal under anesthesia breathing naturally.

2.2 Intubate the animal and start mechanical ventilation.

2.3 Place the pig in supine position and mark incision.

Surgery

3 We do the nerve preparation and device implantation.

3.1 Installation of the vitals monitoring (respiratory pressure, ECG, blood pressure).

3.2 Make incision on the neck and expose 8cm of the left vagus nerve.

3.3 Cuff installation:
- Installation of cuff A most rostrally (record1)
- Installation of cuff C most caudally
- Installation of cuff B closer to cuff A (record2)

Distance from the center of cuff A to center of cuff C is 5.4mm. Distance from the center of cuff A to center of cuff B is 1.7mm.

Data Acquisition Validation

4 We validate the quality of the physiological and neural signals.

4.1 Visually validate the quality of the vitals. For the ECG, the r-peaks should be clearly visible to ensure a good extraction of the heart rate.

4.2 Neural signals validated using BIOS neural analytics pipeline. Analyses looks for presence of underlying endogenous signals (e.g. respiration), afferent<>efferent velocity spectrum decomposition, among others.

Stimulation Protocol

5 Once we validated the quality of the data acquisition systems, we start the stimulation protocol.

5.1 Set the the following stimulation parameters in BIOS Neurotool software:
- Pulse width: 500us
- Train duration: 5s
- Stimulation shape: monophasic
- Polarity: anodic

5.2 Conduct a grid search by doing the cartesian product of the frequency and current parameters.
- Frequency: {2Hz, 10Hz, 20Hz, 30Hz}
- Current: {0.05mA, 0.5mA, 1mA, 1.5mA, 2.5mA}

After each stimulation, wait for the physiological signals to return to baseline.

Termination

6 Once testing is complete, the animal is terminated.