The Effects of Vagus Nerve Stimulation on Hypertensive Heart Disease Rats
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Introduction
• Hypertension (HTN) is one of the strongest risk factors for cardiovascular diseases. Chronic HTN will lead to hypertensive heart disease.
• HTN and hypertensive heart disease are related with the unbalanced sympathetic and parasympathetic nervous activities.

Objective
• Monitoring the in-vivo therapeutic effects of chronic VNS on HTN and HTN induced heart disease using ECG and blood pressure measurement telemetry system.
• Investigating the possible mechanisms: cardiac electrical remodeling (using optical mapping) and structure remodeling (using histology).

Methods
Dahl salt-sensitive (DS) rats (n=6) were fed with high salt diet (8% NaCl) and randomly divided into 2 groups: HTN VNS (n=3); HTN Sham (n=3).
The right cervical vagus nerve and common carotid artery bundle were stimulated with Vagal nerve stimulator (Houston, TX, USA. Frequency: 20Hz; pulse width: 500µsec; current: 1mA; Duty cycle: 12%).

Fig.1. Cyberonics 105 VNS stimulator

The DSI transmitters (HD-S11, DSI Inc., MN, USA) were used for real-time ECG and blood pressure monitoring in rats.
Optical mapping using voltage sensitive dye was performed for visualizing electrical activity in ex-vivo left (LV) and right (RV) ventricles of Langendorff-perfused hearts.

Fig.2 Experimental design time line

Results: In-vivo

Fig.3 Typical samples of ECG and blood pressure

Fig.4 Mean arterial (MAP) and pulse pressure (PP)

Fig.5 MAP after day 0 VNS

Results: Ex-vivo

Fig.7 Spatial distribution of APD

Fig.8 Mean APD vs. basic cycle lengths (BCL)

Fig.9 APD heterogeneity index (µ) & conduction velocity (CV)

Fig.10 Gross morphology

Conclusions & Discussion
• By week 6, both MAP and PP significantly increased, demonstrating successful induction of HTN by a high salt diet in HTN VNS and HTN Sham rats.
• After 4 weeks of VNS treatment, the increase of MAP and the number of arrhythmia episodes in HTN VNS rats were significantly smaller than that observed in HTN Sham rats.
• Signs of cardiac remodeling were observed via gross morphology.
• Four weeks of VNS led to an increase in APD, decreased APD heterogeneity, and increased CV of impulse propagation in HTN rat hearts.
• VNS affects the dynamical complexity of arrhythmias.

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References
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