The electrophysiological effects of electrical stimulation on intrinsic cardiac ganglia in a rabbit heart failure model

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Topic(s):
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Background/Introduction
It is well recognised that the complex neuronal hierarchy of the autonomic nervous system is important in the pathology of heart disease. The intrinsic cardiac nervous system (ICNS) is a rich network of cardiac nerves and distinct intrinsic ganglia at the level of the heart, capable of influencing cardiac function. Understanding the role of this network in autonomic dysregulation in heart failure (HF) is therefore important.

Purpose
To assess the effect of electrical stimulation of intrinsic cardiac ganglia on heart rate and atrioventricular conduction in a coronary artery ligation model of heart failure.

Methods
Coronary ligation (HF; n=7) and sham (n=4) surgeries were performed on NZW rabbits. After 8 weeks of recovery, hearts were retrieved for Langendorff perfusion. Animals that had undergone no prior surgery were used as a control group (n=14). Electrical stimulation was applied at discrete sites within the ICNS and the effects on sinus rate, atrioventricular conduction, left ventricular pressure and monophasic action potential duration (APD) were measured. Ex-vivo cardiac MRI was used to confirm apical myocardial scarring in the HF group. Data presented as mean ± SEM, p < 0.05 considered significant.

Results
Stimulation within all ganglia produced either bradycardia, tachycardia or a biphasic brady-tachycardia. Electrical stimulation of the right atrial (RA) and right neuronal cluster (RNC) regions produced the greatest chronotropic responses in all groups. In HF, bradycardic responses were exaggerated during stimulation of the RNC (figure. 1A), whilst tachycardic responses were exaggerated during stimulation of both the RNC and RA regions (figure.1B). Stimulation of the left neuronal cluster (LNC) resulted in the smallest decrease in heart rate in all groups. Significantly increased lesion volumes were evident in HF when compared to sham (627±122mm³ vs 0±0mm³ respectively).

Conclusions
Stimulation within the ICNS indicates that clusters of neurons are capable of independent selective effects on different cardiac functions. In a rabbit infarct model of HF, this capability is altered suggesting neural remodelling and a possible role of this network in disease which may present as a therapeutic target.
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Figure 1. The effects of heart failure on chronotropic responses to electrical stimulation of intrinsic cardiac ganglia.