MS Thesis Defense: Scott W. Harden

Thesis Title: "MICROSCOPIC ANALYSIS OF SYMPATHETIC AND PARASYMPATHETIC DISTRIBUTION, TERMINAL MORPHOLOGY, AND INTERACTION IN WHOLE-MOUNT ATRIA OF C57BL/6 MICE"

Date: March 31st, 2009 Time: 1pm Location: BMS Trailer

ABSTRACT

The sympathetic (SNS) and parasympathetic (PSNS) branches of the autonomic nervous system (ANS) innervate the heart, exerting excitatory and inhibitory influences (respectively) over cardiac functions (heart rate, AV conduction velocity, and contractility). However, the distribution and structure of SNS and PSNS innervation has not yet been well studied. Detailed characterization of the distributional organization and structural morphology of the SNS and PSNS in normal states is essential to the study of pathological autonomic remodeling. The present study utilized double immunohistochemical labeling techniques to examine tyrosine hydroxylase (TH) immunoreactive (IR) SNS and vesicular acetylcholine transporter (VAChT) IR PSNS axons and terminal structures in whole-mount atria of C57BL/6 mice. We found that: (1) The atria contain a dense network of ANS axons. TH-IR, VAChT-IR, and dual cholinergic/dopaminergic TH+VAChT-IR axons travel together in bundles on the epicardium before branching into differentiated terminal structures. (2) Parallel TH-IR and VAChT-IR axons often diverge from epicardial bundles and travel in parallel (less than 1μm apart) before forming terminal structures in the epicardium and myocardium. Such parallel SNS/PSNS axons interdigitize and have large alternating varicosities along their length adjacent to one other, suggesting possible antagonistic communication between both branches of the ANS at the prejunctional level. (3) Intrinsic cardiac ganglia (ICG) are targets for extrinsic sympathetic nerves which travel through ICG without forming large synaptic varicosities around cardiac principal neurons (PNs). (4) Small intensely fluorescent (SIF) cells (presumably chemoreceptors and/or interneurons) exist near SNS bundles, inside ICG, and in the epicardium unaccompanied by ganglia and nerve bundles. (5) The subpopulation of TH+VAChT-IR PNs within ICG form loose terminals in the atria and do not project to other PNs. (6) Both TH-IR and VAChT-IR axons innervate atrial vasculature. (7) TH-IR axons innervate fat pads adjacent to the heart. (8) SNS/PSNS parallelism is not exclusive to the atria. Similar structures exist in the esophagus, right ventricle, and small intestine. This study provides a novel and overall view of the innervation and interaction of the SNS and PSNS in the atria. This will underlie a foundation for future physiological, pharmacological, and anatomical studies of SNS/PSNS innervation, interaction, and remodeling in pathological states (such as aging, intermittent hypoxia and diabetes).

Thesis Committee:
Dr. Jack Cheng (Chair); Dr. Xiaoman Li; Dr. Sic Chan; Dr. Dinender Singla; Dr. Mingui Fu

Approved for distribution by Dr. Jack Cheng, Committee Chair.

The public is welcome to attend.