Dual vagal cardiac efferent pathways

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The anatomical work performed by Cheng and colleagues (2) presented in this issue of the American Journal of Physiology-Regulatory, Integrative and Comparative Physiology provides evidence for specific innervation patterns arising from select populations of neurons in the medulla oblongata to neurons that are clustered in adjacent regions within a mammalian intrinsic cardiac ganglionated plexus. As such, the techniques depicted in this study provide the anatomical substrate with which one can study how populations of parasympathetic efferent preganglionic neurons located in different medullary regions innervate select populations of cholinergic efferent postganglionic neurons within one or more intrinsic cardiac ganglionated plexus.

The nucleus ambiguus (NA) plays a pivotal role in the reflex regulation of heart rate, and a number of studies have focused on various aspects of its functional importance (3, 9). For instance, it has long been known that the baroreceptor reflex, which constitutes a major control mechanism of circulation (6, 7, 10, 11), evokes powerful excitation of these vagal cardioinhibitory neurons (8).

It has long been held that the major vagal motoneuron pool of the heart is the NA. The second major site of vagal efferent preganglionic axons, the dorsal motor nucleus (DmnX), was considered to be much less important for the control of the heart (3). Despite the consensus that the majority of medullary neurons that exert control over cholinergic neurons on the heart lie concentrated in the NA, fewer being found in the dorsal motor nucleus (DmnX) and in the zone in between these two regions, the select function of cardiac motor neurons in these different regions remains to be fully elucidated.

One of the major functional inferences to be derived from the anatomical studies of Dr. Cheng and colleagues lies in the fact that preganglionic motor neurons in the NA and DmnX may exert preferential control over separate populations of neurons within the intrinsic cardiac ganglionated nervous system. Furthermore, efferent axons arising from these two populations of preganglionic motor neurons course in different nerves to innervate divergent populations of intrinsic cardiac cholinergic postganglionic neurons.

That premotor neurons in the DmnX and the NA project axons to different populations of neurons within one intrinsic cardiac ganglionated plexus provides an impetus for investigating more fully the functional connectivity of medullary neurons with neurons located throughout the intrinsic cardiac nervous system. The relevance of the anatomical findings presented by these authors also has bearing on the issue concerning whether the cholinergic efferent system can be best represented as exerting global control vs. precise regional control over diverse cardiac tissues. In previous experiments, it was found that the baroreceptor reflex to the heart is independent of an intact DmnX (1), which seems to speak against a prominent role of this area in generally mediating cardiovascular reflexes. However, because the NA and DmnX innervate nonoverlapping populations of cardiac principal neurons, the posterior region may have importance for other cardiopulmonary reflexes, such as C fiber-evoked bradycardia (5). Thus this work provides an important framework with which to further study the selective nature of cardiac control, a subject matter that remains poorly understood.

REFERENCES

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