Department of Anatomy (Gross Anatomy and Neuroanatomy)

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General Summary

Our department's research activities have focused on neuroanatomy and gross anatomy. In neuroanatomical research, organizations of neuronal networks and their development are investigated with morphological and electrophysiological methods to elucidate brain function and diseases. Our primary interests are the quantitative architecture and dynamics of neural circuits and their relationships. In gross anatomical research, the functional importance of variations of organ systems is explored in human cadavers and animals.

Research Activities

To integrate and broadcast neural information, local microcircuits and global macrocircuits interact within certain specific nuclei of the central nervous system. The structural and functional architecture of this interaction was addressed for the caudal nucleus of the tractus solitarius (NTS), a relay station of peripheral viscerosensory information processed and conveyed to brain regions concerned with autonomic–affective and other interoceptive reflexive functions.

Differential ascending projections from the caudal NTS: an interface between local microcircuits and global macrocircuits

To integrate and broadcast neural information, local microcircuits and global macrocircuits interact within certain specific nuclei of the central nervous system. The structural and functional architecture of this interaction was addressed for the caudal NTS, a relay station of peripheral viscerosensory information. Axon collaterals of most small NTS cells establish excitatory or inhibitory local microcircuits likely to control the activity of nearby NTS cells and transfer peripheral signals to efferent projection neurons. At least 2 types of cells that constitute efferent pathways from the caudal NTS were distinguished: (1) greater numbers of small cells, seemingly forming local excitatory microcircuits via recurrent axon collaterals, that project specifically and unidirectionally to the lateral parabrachial nucleus and (2) much smaller numbers of cells that likely establish multiple global connections, mostly via the medial forebrain bundle or the dorsal longitudinal fascicle, in a wide range of brain regions, including the ventrolateral medulla, hypothalamus, central nucleus of the amygdala, bed nucleus of the stria terminalis, spinal cord dorsal horn, brainstem reticular formation, locus coeruleus, periaqueductal gray, and periventricular diencephalon (including the epithalamus).

The evidence presented here suggests that distinct caudal NTS cell types distinguished by projection patterns and related structural and functional features participate differentially in the computation of viscerosensory information and the coordination of global macro-

networks in a highly organized manner.

Publications

Kawai Y. Spatiotemporal Structure and Dynamics of Spontaneous Oscillatory Synchrony in the Vagal Complex. *Front Neurosci.* 2018 Dec 18; **12:** 978. doi: 10.3389/fnins.2018.00978. eCollection 2018.
Kawai Y. Differential Ascending Projections From the Male Rat Caudal Nucleus of the Tractus Solitarius: An Interface Between Local Microcircuits and Global Macrocircuits. *Front Neuroanat.* 2018 Jul 24; **12:** 63. doi: 10.3389/fnana.2018.00063. eCollection 2018.