Characterization of direction-specific vagus nerve spikes in a freely moving rodent

Toya Okonogi[1], Yu Shikano[1,2], Yuya Nishimura[1], Akihiro Yamanaka[3], Yuji Ikegaya[1], Takuya Sasaki[1,4]

[1]Lab. Chem. Pharmacol., Grad. Sch. Pharmaceut. Sci., Univ. Tokyo, [2]Dept. Neuropsychiatry., Keio Univ. Sch. Med., [3]Dept. Neurosci. II., Res. Inst. Environ. Med., Nagoya Univ., [4]JST PRESTO

The vagus nerve is a parasympathetic nerve and plays a critical role in the regulation of autonomic functions to maintain homeostasis including heart rate, respiratory rhythms and gastric motility. It remains largely unknown about vagal physiological functions in naïve behavior due to technical limitations of vagal spike recordings. Here, we developed a vagal spike recording technique with a cuff-shaped electrode in a freely moving rodent animal while simultaneously monitoring central and peripheral bioelectrical signals. The spike rates of both afferent and efferent fiber types increased simultaneously following increased locomotion and were higher in novel environment than in familiar one. The electrode contains multiple recording sites to identify afferent and efferent vagal spikes. For manipulating vagus nerve spikes, we used two strains of transgenic mice expressing channelrhodopsin2, a photosensitive protein, in afferent and efferent vagal fibers. These results provide novel insights into vagal physiological function and make a new step forward to uncover a neurophysiological basis underpinning the brain-body axis.