Anatomical and molecular analyses used to reevaluate the assignment of neurons in the sacral autonomic nervous system

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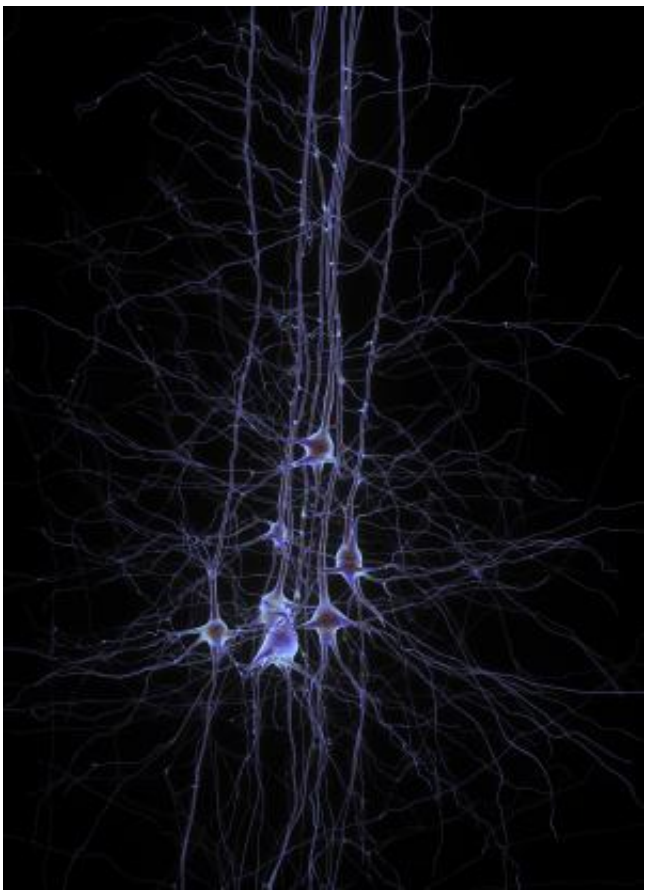

This is a group of neurons. Credit: EPFL/Human Brain Project

(Medical Xpress)—A team of researchers with Institut de Biologie de l'École Normale Supérieure in France and University College London

has used both anatomical and molecular analyses of neurons in the sacral autonomic nervous system to show that such neurons need to be reassigned from the parasympathetic to the sympathetic arm of the autonomic nervous system. In their paper published in the journal *Science*, the researchers describe their analysis of a type of neuron found in the pelvis and why they believe it should be reclassified. Igor Adameyko with the Karolinska Institutet in Sweden offers a Perspective piece on the work done by the team in the same journal issue and further describes a type of biomedical device called a neural dust implant that is being used in electroceutical treatment of damaged nerves.

The autonomic nervous system controls bodily functions that are not consciously directed such as digestion and reproduction, and has historically been divided into two main arms, parasympathetic and sympathetic—the first is generally associated with reactions to circumstances, such as instigating the processes involved in the fight-or-flight reflex, while the second is generally associated with relaxation and inhibition. Prior research has found that these two types differ in some respects—those in the sympathetic system generally have adrenergic fibers, for example, while those in the parasympathetic system tend to have cholinergic fibers.

In this new effort, the researchers were focusing on a group of neurons located in the mouse pelvis, in the sacrum, which is at the base of the spine—prior research has shown they serve as intermediaries between the central nervous system and several organs—they have also up till now been classified as belonging to the parasympathetic system. But now, it appears that might have to change. The researchers have found evidence that suggests they belong in the sympathetic camp. Transcriptional analysis showed that precursor cells for the neurons expressed the transcription factor Sox10, but not Phox2b, which is typically characteristic of neurons in the sympathetic system. While molecular analysis showed that the formation of ganglia was nerve-

independent, another characteristic of the neurons in the sympathetic system. Taken together, the evidence indicates that a reclassification is in order.

More information: I. Espinosa-Medina et al. The sacral autonomic outflow is sympathetic, *Science* (2016). DOI: 10.1126/science.aah5454

Abstract

A kinship between cranial and pelvic visceral nerves of vertebrates has been accepted for a century. Accordingly, sacral preganglionic neurons are considered parasympathetic, as are their targets in the pelvic ganglia that prominently control rectal, bladder, and genital functions. Here, we uncover 15 phenotypic and ontogenetic features that distinguish pre- and postganglionic neurons of the cranial parasympathetic outflow from those of the thoracolumbar sympathetic outflow in mice. By every single one, the sacral outflow is indistinguishable from the thoracolumbar outflow. Thus, the parasympathetic nervous system receives input from cranial nerves exclusively and the sympathetic nervous system from spinal nerves, thoracic to sacral inclusively. This simplified, bipartite architecture offers a new framework to understand pelvic neurophysiology as well as development and evolution of the autonomic nervous system.