Periaqueductal gray

The periaqueductal gray (PAG) (also known as the central gray) is the primary control center for descending pain modulation. It has enkephalin-producing cells that suppress pain.

The periaqueductal grey is the grey matter located around the cerebral aqueduct within the tegmentum of the midbrain. It projects to the nucleus raphe magnus, and also contains descending autonomic tracts. The ascending pain and temperature fibers of the spinothalamic tract send information to the PAG via the spinomesencephalic tract (so-named because the fibers originate in the spine and terminate in the PAG, in the mesencephalon or midbrain).

This region has been used as the target for brain-stimulating implants in patients with chronic pain.

Many of the currently available therapies for urinary incontinence target the peripheral autonomic nervous system, despite many etiologies residing in the central nervous system. Following previous experiments that determined the ventrolateral column of the periaqueductal gray matter (vlPAG), to be the main afferent station of bladder sensory signals, Zare et al., from the Maastricht University Medical Center, The Netherlands aimed for electrophysiological characterization of ventrolateral periaqueductal gray matter neurons (vlPAG) using single unit recording.

15 rats were anesthetized and underwent implantation with electrodes at the dome and the neck of the bladder, to electrically stimulate the detrusor. After craniotomy, a glass micropipette was inserted in vlPAG to record neuronal action potentials. The detrusor was stimulated by a series of 20 Hz pulses, for a total duration of 50 seconds at an intensity of 2 mA, for each vlPAG neuron selected. Single unit recordings were performed on a total of 26 neurons. Confirmation of electrode position was made by iontophoretic ejection of Pontamine sky blue.

The firing rate of vlPAG neurons decreased significantly during the stimulation period. Peristimulus time histogram (PSTH) analysis showed 24 out of 26 neurons to be unresponsive to stimulation. All recorded vlPAG neurons showed irregular firing patterns.

The change in firing rate may point to an overall inhibitory influence of bladder stimulation on vlPAG neurons. These data suggest an inhibitory relay station at the vlPAG, before sensory bladder signals would affect pontine micturition center. The lack of the inhibitory effect on PSTH may be due to a longer interval between neuronal response and the stimulation [1].

1)
Zare A, Schipper S, Stein W, Temel Y, van Koeveringe GA, Jahanshahi A. Electrophysiological responses of the ventrolateral periaqueductal gray matter neurons towards peripheral bladder stimulation. Brain Res Bull. 2018 Jul 14. pii: S0361-9230(18)30105-9. doi: 10.1016/j.brainresbull.2018.07.009. [Epub ahead of print] PubMed PMID: 30016723.