Dorsal raphe nucleus

The dorsal raphe nucleus (DRN) is a heterogeneous brainstem nucleus located in the midbrain and pons. Via widespread projections, which target a multitude of brain areas, its neurons utilize many transmitters to control various physiological functions, including learning, memory and affect.

Previous studies have demonstrated that Serotonin type 3 (5-HT3) receptors are expressed in either or both the substantia nigra (SN) and the dorsal raphe nucleus (DRN) in humans, marmosets, rats and Syrian hamsters.

Belliveau et al. quantified the distribution of 5-HT3 receptors across these regions in the adult rat. Fluorescent immunohistochemistry was performed on sections of rat brain covering the entire rostro-caudal extent of the SN and DRN with antibodies specific to the 5-HT3A receptor subunit, as well as others targeting the monoaminergic markers tyrosine hydroxylase (TH) and the 5-HT transporter (SERT). The number of 5-HT3A receptor-positive, TH-positive (n = 28,428 ± 888, Gundersen's m = 1 coefficient of error [CE] = 0.05) and SERT-positive (n = 12,852 ± 462, CE = 0.06) cells were estimated in both the SN and the DRN using stereology. We found that 5-HT3A receptor-positive cells are present in the SNr (n = 1,250 ± 64, CE = 0.24), but they did not co-localise with TH-positive cells, nor were they present in the SNc. In contrast, no 5-HT3A receptor-positive cells were found in the DRN. These results support the presence of 5-HT3 receptors in the SN, but not in the DRN, and do not support their expression on monoaminergic cells within these two brain areas [1].

The other main brain entry of the information related to fluid and cardiovascular balance are the lamina terminalis (LT) and one of the sensory circumventricular organs (CVOs), the area postrema (AP). The LT, consisting of the median preoptic nucleus (MnPO) and the other two sensory CVOs—i.e., subfornical organ (SFO) and organum vasculosum of the lamina terminalis (OVLT) —is recognized as a site in the brain that is crucial for the physiological regulation of hydroelectrolyte balance. The SFO and OVLT lack a blood–brain barrier and contain cells that are sensitive to humoral signals, such as changes in plasma and cerebrospinal fluid sodium concentration (Vivas et al. 1990), osmolality (Sladek and Johnson 1983), and angiotensin II (ANG II) levels (Ferguson and Bains 1997; Simpson et al. 1978). Such unique features make the SFO and OVLT key brain regions for sensing the status of the body fluids and electrolytes. Humoral and neural signals that arrive to the two main brain entries—that is, the CVOs of the LT and within the hindbrain the AP-NTS—activate a central circuit that includes integrative areas such as the MnPO, the paraventricular (PVN), the supraoptic (SON), lateral parabrachial nucleus (LPBN), dorsal raphe nucleus (DRN), and neurochemical systems such as the angiotensinergic, vasopressinergic, oxytocinergic (OT), and serotonergic (5-HT) systems.

Once these signals act on the above-mentioned neurochemical networks, they trigger appropriate sympathetic, endocrine, and behavioral responses. Therefore, after a body fluid deficit, water and sodium intake and excretion need to be controlled to minimize disturbances of hydromineral homeostasis. In this context, hypovolemia and hyponatremia induced by body fluid depletion stimulate central and peripheral osmo–sodium receptors, taste receptors, volume and arterial/cardiopulmonary baroreceptors, and the renin–angiotensin system (RAS). This latter system, for example, acts mainly through the sensory CVOs and/or the AP to activate brain neural pathways that elevate BP, release vasopressin and aldosterone (ALDO), increase renal sympathetic nerve activity, and increase the ingestion of water and sodium [2]

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2)

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