Histology of the Magnacellular Supraoptic Nucleus of Hypothalamus in Madras Red Sheep (Ovis aries)

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The hypothalamus together with a group of highly heterogeneous structures referred to as the limbic system, are key neuronal elements involved in maintaining homeostatis (Saper, 1990). The hypothalamus is closely involved in a wide variety of behavioral, autonomic, visceral, and endocrine functions. However, the hypothalamus is the least well understood area of the hypothalamo-pituitary axis. Hence, the present study on histology and micrometry of the supraoptic nucleus in Madras Red sheep was carried out.

Materials and Methods

The heads were collected from 35 Madras Red ewes and divided into five age groups, viz. prepubertal, (4 to 6 months), pubertal (7 to 18 months), pregnant (1.5 to 2.5 years), lactating (2 to 4 years) and dry (4 to 8 years) animals. The head of each animal collected was flushed with 2% sodium citrate solution through common carotid arteries of both sides to wash out the blood clots. Subsequently the heads were perfused individually with various standard fixatives, viz. 10% neutral buffered formalin, Zenker’s fluid, Carnoy’s fluid and Bouin’s fluid.

Hypothalamus was dissected out from the brain by outlining its cranial limit as optic chiasma, caudal limit as caudal border of the mammillary body and the lateral limits as lateral margins of the mammillary body. All tissues collected as above were processed by routine Alcohol-Benzene schedule and paraffin blocks were made. Sections were cut at 5-7 mm thickness for histological study. The sections were stained with the standard histological and histochemical techniques.

Micrometry was done using the Carl Zeiss Videoplan image processing system and Image Pro 5.1 (Olympus) software. The diameter of the nerve cell body and nuclei were recorded for 30 randomly selected neurons (with clearly visible nucleus and nucleolus) in the hypothalamic supraoptic nucleus (SON) of all the age groups of sheep. The observations were subjected to statistical analysis.

Fig. Photomicrograph of hypothalamus of pubertal sheep showing supraoptic nucleus with medium sized multipolar neurons grouped above the optic chiasma (OC). SON – Supraoptic nucleus. H&E x 100

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Results and Discussion

The supraoptic nucleus was well defined and straddled the anterior part of the optic tract, just above and behind the optic chiasma. It curved over the lateral part and located caudal to the midline of the optic chiasma and appeared as an ovoid nucleus. Bhattacharya and Saigal (1987) reported that the supraoptic nucleus was situated in the ventromedial part of the hypothalamus with densely packed smaller neuronal cell group which appeared ventral to the fornix, and caudal to the preoptic region in goats.

The supraoptic nucleus comprised of small to moderate sized multipolar cells and Nissl substance with eccentrically placed nuclei which had well-marked nucleoli. In contrast, Lucy et al. (2009) reported that the supraoptic nucleus showed mostly bipolar neurons in the hypothalamus of 5 months old goat fetuses. The neuroglial cells and blood capillaries were frequently seen in between the neurons and nerve fibres in the hypothalamus of prepubertal, pregnant and lactating sheep. The cell boundaries of these neurons were intensely stained by Bielschowsky’s silver staining method. The rich Nissl substance contained in the neuropil stained dark blue by toluidine blue and Windle’s thionine methods. The SON was PAS positive, mostly clustered along the periphery of the cell and made the region around the nucleus clear in all the age groups of sheep. The round or oval nucleus of the neurons was noticed in the centre of the neuropil. The nucleus appeared as clear circular area and contained a darkly stained round nucleolus in the centre. The nuclei were larger in size in the neurons of prepubertal (6.83 ± 0.21), pregnant (7.73 ± 0.24) and lactating animals (7.76 ± 0.23) but decreased in pubertal (6.53 ± 0.21) and dry (6.73 ± 0.21) animals.

Nerve cells of supraoptic nuclei exhibited the neurosecretory material as fine to coarse granules both in the soma and nerve tracts that pass to the neurohypophysis. The nerve fibres from the supraoptic nucleus extended to the posterior lobe of the hypophysis through the infundibular stalk as in human (Clemente, 1985). Shally (1978) confirmed that the releasing hormones were small peptides synthesized as neurosecretion by neurons in the hypothalamus and further transported to the hypophysis.

The neurons measured only 10.56 ± 0.33 mm during prepubertal age but increased to 11.56 ± 0.29 in pubertal and 13.74 ± 0.37 in pregnant sheep. They were 15.21 ± 0.47 mm in lactating sheep but significantly decreased to 12.06 ± 0.41 mm in dry sheep. This clearly indicated that along with the paraventricular nucleus, the supraoptic nucleus also involved in the regulation of reproduction and development of mammary gland through hormones of pituitary gland. Theodosis et al. (1981) observed structural changes in supraoptic nucleus, which were associated with the synchronization of neuronal activity, during pulsatile release of oxytocin in response to suckling, during lactation in rats.

References