Structural Plasticity of Hypothalamo-Neurohypophysial System with Chronic Salt Loading

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The neurohypophysial hormones, oxytocin and arginine vasopressin mainly locate in the magnocellular neurons of the supraoptic and paraventricular nucleus in the hypothalamus. In the hypothalamic magnocellular neurons, reversible morphological changes are seen under chronic osmotic elevation such as dehydration. In the hypothalamic nuclei, this structural reorganization is postulated to be caused by retraction of glial cells from their usual positions between adjacent cell bodies and/or neighboring dendrites. In a similar fashion to the hypothalamic nuclei, the pituicytes in the neurohypophysis generally surround or enclose the axonal terminals of neurohypophysial hormones under basal conditions. 1) The low-molecular-weight microtubule-associated protein-2 (LMW MAP2) is expressed in immature and developing brains. When the rats were dehydrated with chronic osmotic stimulation, the process of MAP2-stained pituicytes was less branched due to retracting their cellular processes as compared with those of well-hydrated control. The quantitative analysis further demonstrated that water deprivation significantly reduced the cell size, perimeter and length of cellular processes of MAP2-stained pituicytes as compared with those of control. This finding that hydration states significantly and reversibly alter in vivo pituicyte shape. 2) When pituicytes were treated with adenosine, isoproterenol (β-agonist), and dibutyryl cyclic AMP (dBcAMP), the pituicyte morphology changed from flat to stellate shape. Upon treatment with dBcAMP, stress fibers within pituicyte cytoplasm disappeared, and microtubule assembled in the cellular processes and cytoplasm surrounding the nucleus. The present results reveal that pituicyte shape conversion is mediated via β-adrenergic, adenosine and endotheline and depend on rearrangement of stress fibers and microtubules.3) Light microscopic immunohistochemistry revealed that the immunoreactivity of calbindin and calretinin was contained in axonal varicose fibers in the posterior pituitary. The immunoelectron microscopic observation showed that both calbindin and calretinin localize preferentially in "active" nerve terminals. In spite of similar localization of calbindin and calretinin within the posterior pituitary, western analysis showed that moreover, dehydration with drinking of 2% NaCl solution and deprivation of drinking water increased calretinin level in the posterior pituitary as compared with well-hydrated control, but calbindin level was not changed. The present immunohistochemical findings demonstrate that both calbindin and calretinin localize in the "active" nerve terminals. However, only calretinin is up regulated with osmotic stimulation, suggesting different physiological role of calbindin and calretinin in the nerve terminals.