POSSIBLE CENTRAL MECHANISM OF LONG-TERM HEAT ACCLIMATION

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Background - Several studies reveal repetitive heat exposure enhances neuronal plasticity in the thermoregulatory center and suggest a possible contribution of neuronal modifications to the establishment of heat acclimation. However, the central mechanism of heat acclimation has not been fully elucidated. In this study, we examined the effects of heat exposure on proliferation and differentiation of progenitor cells in rat hypothalamus. Procedure - Male Wistar rats were initially maintained at an ambient temperature (Ta) of 24°C. Then, heat-exposed rats (HE) were subjected to a constant Ta of 32°C, while control rats (CN) were kept at an Ta of 24°C. Bromodeoxyuridine (BrdU) was injected daily into the rats’ abdominal cavity for 5 consecutive days after commencing heat exposure. On the 6th, 13th, 23rd, 33rd, 43rd and 53rd day of heat exposure, rats were anesthetized and brains were removed. Results - Immunohistochemical analysis on day 6 of heat exposure showed that in the ependymal layer of the third ventricle, the number of BrdU-immunopositive (BrdU+) cells of HE was significantly greater than that of CN. The BrdU+ cells seemed to have migrated into the hypothalamic parenchyma thereafter. In HE, the number of BrdU+ cells double-stained by neuronal nuclei, a marker of mature neurons, increased abruptly after 43 days of heat exposure by about 7 times. This was not the case in CN, and in rats exposed to heat for only 6 days (additional experiment). The majority of the rest of BrdU+ cells in the hypothalamus of HE were stained with doublecortin, a marker of immature neurons. Some of BrdU+ cells were surrounded by synaptophysin-positive structures in HE. In addition, some BrdU+ cells had immunoreactivity for the oligodendrocyte marker in the HE rat hypothalamus. In contrast, few BrdU+ cells expressing the astrocyte marker was detected in HE rat hypothalamus. Conclusion - The results suggest that heat exposure facilitates proliferation of neuronal progenitor cells in the hypothalamus and promotes differentiation to neurons, which might be have certain relation to establishing long-term heat acclimation in rats.