No. 0841

The Study of Neuronal Networks Response to Water Homeostasis Emergency

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Summary

Water homeostasis is a critical challenge to survival for land mammals. Mice display increased locomotor activity when dehydrated, a behavior that improves the likelihood of locating new sources of water and simultaneously places additional demands on compromised hydration levels. The neurophysiology underlying this well-known behavior has not been previously elucidated. We report that the anti-diuretic hormone vasopressin is involved in this response. AVP and oxytocin directly induced depolarization and an inward current in orexin/hypocretin neurons. AVP-induced activation of orexin neurons was inhibited by a V1a receptor (V1aR) selective antagonist and was not observed in V1aR knockout mice suggesting an involvement of V1aR. Subsequently activation of phospholipase Cb triggers an increase in intracellular calcium by both calcium influx through non-selective cation channels and calcium release from calcium stores in orexin neurons. Intracerebroventricular injection of vasopressin or water deprivation increased locomotor activity in wild type mice, but not in transgenic mice lacking orexin neurons. V1aR knockout mice were less active than wild type mice. These results suggest that the activation of orexin neurons by AVP or oxytocin has an important role in the regulation of spontaneous locomotor activity in mice. This system appears to play a key role in water deprivation-induced hyperlocomotor activity, a response to dehydration that increases the chance of locating water in nature.