Estrogen affects Signaling Activity and Responses in Mouse Vomeronasal Sensory Neurons

Ian McDaniels, Suraj Cherian, Chun Yang, and Rona J. Delay, Department of Biology,
University of Vermont

Abstract

The study of pheromone detection can tell us a great deal about the physiological bases of behavior. The vomeronasal organ (VNO) detects chemicals via receptors in the microvilli of vomeronasal sensory neurons (VSN). Little is known, however, about how the signaling properties of VSNs are regulated. In the mammalian brain, steroid hormones have been shown to influence the firing rate of neurons. The characteristics of the effects that have been seen suggest that genomic, as well as rapid, non-genomic neuronal effects are elicited by steroid hormones. To investigate whether 17β estradiol influences the signaling of mouse VSNs, RT-PCR was used to identify the presence of estrogen receptors ER-α and GPR30 in the VNO, the latter of which has been shown to elicit rapid neuronal effects in other neurons. Using isolated cell immunofluorescent imaging, GPR30 has been found to be present in the cell soma, dendrite, dendritic knobs, and microvilli of VSNs. To assess whether estradiol influences the physiology of VSNs, perforated patch clamp and calcium imaging experiments were conducted. The patch clamp experiments revealed that estrogen can influence VSNs by decreasing spontaneous firing, hyperpolarizing the cell membrane, and reducing urine induced current responses and action potentials. The calcium imaging experiments revealed that estrogen does not show a strong effect on calcium levels inside the cell, indicating that voltage and current responses could be occurring via an intracellular regulatory system independent of calcium channels. Further study of the possible mechanisms behind the recorded effects of estrogen on VSNs will help elucidate the relationships between pheromonal detection, endocrine activity, and mammalian behavior.