Dendritic signaling in olfactory circuits

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The olfactory bulb is the first place in the brain where olfactory information is processed. While synaptic transmitter release occurs from axon nerve terminals in most brain regions, dendritic transmitter release is a major mode of signaling in local circuits of the olfactory bulb. Here, principal mitral and tufted (M/T) cells make dendrodendritic synaptic contacts with GABAergic granule and periglomerular (PG) cells. M/T cell dendrites release glutamate onto the dendritic spines of granule and PG cells, which in turn, release GABA back onto M/T cell dendrites. These reciprocal synaptic circuits underlie self and lateral dendrodendritic inhibition and are believed to play an important role in olfactory information processing. However, the cellular mechanisms governing dendrodendritic signaling are unclear. Recent electrophysiological and optical studies using rat olfactory bulb slices have begun to elucidate the mechanisms underlying dendrodendritic transmission. Dendritically released glutamate and GABA can have both local and diffuse actions in the bulb. Surprisingly, activation of NMDARs plays a crucial role in triggering GABA release from olfactory bulb interneurons. The slow kinetics of NMDAR-mediated synaptic currents appear especially effective at bringing interneurons to threshold for activating dendritic calcium spikes that trigger GABA exocytosis. Using paired whole-cell recordings, we find that dendritic calcium spikes can be evoked in interneurons by powerful glutamatergic input from individual M/T cells. This talk will highlight recent studies examining these and other factors underlying the mechanisms and modulation of dendritic signaling in olfactory bulb circuits.