



Maternally activated connections of the ventral lateral septum reveal input from the posterior intralaminar thalamus

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Abstract

The lateral septum (LS) demonstrates activation in response to pup exposure in mothers, and its lesions eliminate maternal behaviors suggesting it is part of the maternal brain circuitry. This study shows that the density of pup-activated neurons in the ventral subdivision of the LS (LSv) is nearly equivalent to that in the medial preoptic area (MPOA), the major regulatory site of maternal behavior in rat dams. However, when somatosensory inputs including suckling were not allowed, pup-activation was markedly reduced in the LSv. Retrograde tract tracing identified various brain regions potentially influencing LSv neuronal activation through their projections. Among all, anterograde tract tracing confirmed that the posterior intralaminar thalamic nucleus (PIL), implicated in processing touch-related stimuli, targets the pup-activated region of the LSv. Moreover, nerve terminals containing the maternally induced PIL neuropeptide parathyroid hormone 2 (PTH2), were found to form synaptic connections with c-Fos activated LSv neurons using electron microscopy. Confirmation of PTH2 + PIL fibers projecting to LSv was achieved by retrograde tract tracing methods. Furthermore, double retrograde injections revealed that neurons within the PIL can project to both LSv and MPOA, suggesting their simultaneous regulation by PIL input. We also established that septal neurons activated by the pups in the mother are GABAergic and send inhibitory projections to the MPOA and other components of the maternal brain circuitry. This implies that the LSv and MPOA form an interconnected subcircuit in the maternal brain network, which is primarily driven by somatosensory input from the pups via the PIL PTH2 + neurons.

Keywords mother · suckling · parathyroid hormone 2 · tuberoinfundibular peptide 39 · medial preoptic area

Abbreviations

3rd Third ventricle
 AAV Adenoassociated virus
 ac Anterior commissure

ACo Anterior cortical amygdaloid nucleus
 AHA Anterior hypothalamic area, anterior part
 AHiPL Amygdalohippocampal area, posterolateral part
 AHiPM Amygdalohippocampal area, posteromedial part
 AM Anteromedial thalamic nucleus
 APir Amygdalopiriform transition area
 APTV Anterior pretectal nucleus, ventral part
 ArcN Arcuate nucleus
 AVPe Anteroventral periventricular nucleus
 BDA Biotinylated dextran amine
 BLA Basolateral amygdaloid nucleus, anterior part
 BMA Basomedial amygdaloid nucleus, anterior part
 BMP Basomedial amygdaloid nucleus, posterior part
 BNST Bed nucleus of the stria terminalis
 BSA Bovine serum albumin
 CA1 Field CA1 of the hippocampus
 CA3 Field CA4 of the hippocampus
 cc Corpus callosum

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