Differences in Organization of Neural Oxytocin Receptor Reflects Differences in Sex Behavior and Parental Care

Ryan A. Funke
raf06909@sjfc.edu

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Abstract
Oxytocin (OXT) is a neuropeptide synthesized in the hypothalamus and stored in the posterior pituitary gland. Its most known functions include being involved in the stimulation of the uterus during childbirth and allowing for milk letdown in the process of lactation after birth. OXT has also been implicated to play a role in parental care and sex behavior. Specific binding to brain oxytocin receptors (OXTR) was observed by in vitro receptor autoradiography with an iodinated OXT analogue in the monogamous prairie vole (Microtus ochrogaster) and the polygamous montane vole (Microtus montanus). What was found was that OXTR density in the prairie vole was highest in the prelimbic cortex, bed nucleus of the stria terminalis, nucleus accumbens, midline nucleus of the thalamus, and the lateral amygdala. In contrast, OXTR density in the montane vole was highest in the lateral septum, ventromedial nucleus of the hypothalamus, and cortical nucleus of the amygdala. Prairie voles show a high level of parental care in both naïve and postpartum individuals, whereas montane voles show a much higher level of parental care postpartum. Differences in OXTR distribution were also seen in two additional species of voles, the monogamous pine vole (Microtus pinetorum) and the polygamous meadow vole (Microtus pennsylvanicus). The receptor distribution of two other neurotransmitter systems that play a role in the mediation of social behavior (benzodiazepines and μ opioids) were also studied but showed little comparable differences between monogamous and polygamous species, which further highlights the importance of OXTR distribution as a mediator of social behavior.

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Differences in Organization of Neural Oxytocin Receptor Reflects Differences in Sex Behavior and Parental Care

Ryan Funke
Department of Biology, St. John Fisher College, 3690 East Avenue, Rochester, NY 14618.

Abstract

Oxytocin (OXT) is a neuropeptide synthesized in the hypothalamus and stored in the posterior pituitary gland. Its most known functions include being involved in the stimulation of the uterus during childbirth and for milk letdown in the process of lactation after birth. OXT has also been implicated to play a role in parental care and sex behavior. Specific binding to brain oxytocin receptors (OXTR) was observed by in vitro receptor autoradiography with an iodinated OXT analogue in the monogamous prairie vole (Microtus ochrogaster) and the polygamous montane vole (Microtus montanus). What was found was that OXTR density in the prairie vole was highest in the prelimbic cortex, bed nucleus of the stria terminalis, nucleus accumbens, midline nucleus of the thalamus, and the lateral amygdala. In contrast, OXTR density in the montane vole was highest in the lateral septum, ventromedial nucleus of the hypothalamus, and cortical nucleus of the amygdala.

Prairie voles show a high level of parental care in both naïve and postpartum individuals, whereas montane voles show a much higher level of parental care postpartum. Differences in OXTR distribution were also seen in two additional species of voles, the monogamous pine vole (Microtus pinetorum) and the polygamous meadow vole (Microtus pennsylvanicus). The receptor distribution of two other neurotransmitter systems that play a role in the mediation of social behavior (benzodiazepines and µ opioids) were also studied but showed little comparable differences between monogamous and polygamous species, which further highlights the importance of OXTR distribution as a mediator of social behavior.

<table>
<thead>
<tr>
<th>Area of brain</th>
<th>Montane</th>
<th>Prairie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acc</td>
<td>3.6 ± 0.6</td>
<td>23.8 ± 5.7</td>
</tr>
<tr>
<td>AmL</td>
<td>9.1 ± 1.6</td>
<td>20.2 ± 2.9</td>
</tr>
<tr>
<td>BNST</td>
<td>7.4 ± 2.0</td>
<td>23.6 ± 3.9</td>
</tr>
<tr>
<td>Midline thal.</td>
<td>5.3 ± 3.5</td>
<td>14.7 ± 3.5</td>
</tr>
<tr>
<td>LSI</td>
<td>8.4 ± 2.1</td>
<td>22.7 ± 1.3</td>
</tr>
<tr>
<td>VMN</td>
<td>22.0 ± 2.3</td>
<td>13.0 ± 3.0</td>
</tr>
</tbody>
</table>

Specific binding of [3H]flunitrazepam ([3H]JDOGA) in monogamous and polygamous mice. Values are means ± SEM of three to six animals (three male and three female) and are expressed as fmol/mg of tissue.

Male and female voles were used, weaned at 21 days of age and housed with same sex littermates until 45-90 days of age, at the time they were used for receptor autoradiography experiments.

References


Future Directions

Perform further oxytocin antagonist (OTA) studies on monogamous non-human primates

Block the neurotransmitter OXT from binding to the receptor and observe changes in social behavior.

Knock out gene that encodes for OXT and study if monogamous behavior continues as a result of binding by the benzodiazepine or µ-opioid mechanism.