Oxytocin (Oxt) /ˌɒksɪˈtoʊsɪn/ is a mammalian neurohypophysial hormone that acts primarily as a neuromodulator in the brain.

Oxytocin plays roles in sexual reproduction, in particular during and after childbirth. It is released in large amounts after distension of the cervix and uterus during labor, facilitating birth, maternal bonding, and, after stimulation of the nipples, breastfeeding. Both childbirth and milk ejection result from positive feedback mechanisms.

Recent studies have begun to investigate oxytocin's role in various behaviors, including orgasm, social recognition, pair bonding, anxiety, and maternal behaviors. For this reason, it is sometimes referred to as the "love hormone". There is some evidence that oxytocin promotes ethnocentric behavior, incorporating the trust and empathy of in-groups with their suspicion and rejection of outsiders. Furthermore, genetic differences in the oxytocin receptor gene (OXTR) have been associated with maladaptive social traits such as aggressive behaviour.[4]

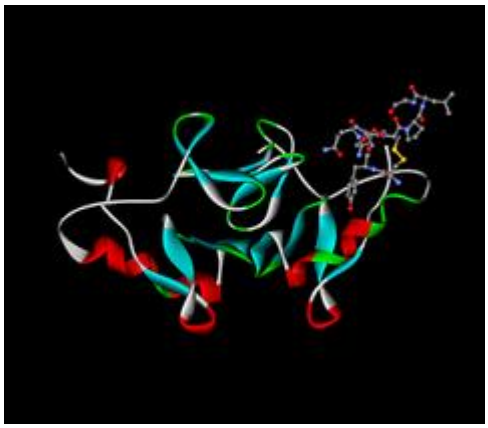
Discovery

The word *oxytocin* was derived from Greek ὀξύς, *oxys*, and τόκος, *tokos*, meaning "quick birth", after its uterine-contracting properties were discovered by British pharmacologist Sir Henry Hallett Dale in 1906. The milk ejection property of oxytocin was described by Ott and Scott in 1910 and by Schafer and Mackenzie in 1911.

The nine amino acid sequence of oxytocin was elucidated by Vincent du Vigneaud *et al.* and by Tuppy in 1953and synthesized biochemically soon after by du Vigneaud et al. in 1953. Oxytocin was the first polypeptide hormone to be sequenced and synthesized

Structure and relation to vasopressin

Oxytocin is a peptide of nine amino acids (a nonapeptide).



Oxytocin (ball-and-stick) bound to its carrier protein neurophysin (ribbons)

The structure of oxytocin is very similar to that of vasopressin (cys – tyr – phe – gln – asn – cys – pro – arg – gly – NH_2), also a nonapeptide with a sulfur bridge, whose sequence differs from oxytocin by two amino acids. A table showing the sequences of members of the

vasopressin/oxytocin superfamily and the species expressing them is present in the vasopressin article. Oxytocin and vasopressin were isolated and synthesized by Vincent du Vigneaud in 1953, work for which he received the Nobel Prize in Chemistry in 1955.

Oxytocin and vasopressin are the only known hormones released by the human posterior pituitary gland to act at a distance.

Actions

Oxytocin has peripheral (hormonal) actions, and also has actions in the brain. Its actions are mediated by specific, high-affinity oxytocin receptors. The oxytocin receptor is a G-protein-coupled receptor that requires Mg^{2+} and cholesterol. It belongs to the rhodopsin-type (class I) group of G-protein-coupled receptors.

Peripheral (hormonal) actions

The peripheral actions of oxytocin mainly reflect secretion from the pituitary gland. (See oxytocin receptor for more detail on its action.)

- Letdown reflex: In lactating (breastfeeding) mothers, oxytocin acts at the mammary glands, causing milk to be 'let down' into subareolar sinuses, from where it can be excreted via the nipple. Suckling by the infant at the nipple is relayed by spinal nerves to the hypothalamus. The stimulation causes neurons that make oxytocin to fire action potentials in intermittent bursts; these bursts result in the secretion of pulses of oxytocin from the neurosecretory nerve terminals of the pituitary gland.

- Uterine contraction: Important for cervical dilation before birth, oxytocin causes contractions during the second and third stages of labor. Oxytocin release during breastfeeding causes mild but often painful contractions during the first few weeks of lactation. This also serves to assist the uterus in clotting the placental attachment point postpartum.
  Social behavior and wound healing: Oxytocin is also thought to modulate inflammation by decreasing certain cytokines. Thus, the increased release in oxytocin following positive social interactions has the potential to improve wound healing. A study by Marazziti and colleagues used heterosexual couples to address this possibility. They found increases in plasma oxytocin following a social interaction were correlated with faster wound healing. They hypothesized this was due to oxytocin reducing inflammation, thus allowing the wound to heal faster. This study provides preliminary evidence that positive social interactions may directly impact aspects of health.

- The relationship between oxytocin and human sexual response is unclear. At least two uncontrolled studies have found increases in plasma oxytocin at orgasm – in both men and women. Plasma oxytocin levels are notably increased around the time of self-stimulated orgasm and are still higher than baseline when measured five minutes after self arousal. The authors of one of these studies speculated that oxytocin's effects on muscle contractibility may facilitate sperm and egg transport.

In a study measuring oxytocin serum levels in women before and after sexual stimulation, the author suggests it serves an important role in sexual arousal. This study found genital tract stimulation resulted in increased oxytocin immediately after orgasm. Another study reported increases of oxytocin during sexual arousal could be in response to nipple/areola, genital, and/or genital tract stimulation as confirmed in other mammals. Murphy et al. (1987), studying men, found oxytocin levels were raised throughout sexual arousal with no acute increase at orgasm. A more recent study of men found an increase in plasma oxytocin immediately after orgasm, but only in a portion of their sample that did not reach statistical significance. The authors noted these changes "may simply reflect contractile properties on reproductive tissue".
Oxytocin evokes feelings of contentment, reductions in anxiety, and feelings of calmness and security around the mate. This suggests oxytocin may be important for the inhibition of the brain regions associated with behavioral control, fear, and anxiety, thus allowing orgasm to occur. Oxytocin also functions to protect against stress. Meta-analyses conducted in 2003 demonstrated that oxytocin can alleviate mood and reduce stress with a good efficiency.

- Due to its similarity to vasopressin, it can reduce the excretion of urine slightly. In several species, oxytocin can stimulate sodium excretion from the kidneys (natriuresis), and, in humans, high doses can result in hyponatremia.

- Increasing trust and reducing fear: In a risky investment game, experimental subjects given nasally administered oxytocin displayed "the highest level of trust" twice as often as the control group. Subjects who were told they were interacting with a computer showed no such reaction, leading to the conclusion that oxytocin was not merely affecting risk-aversion. Nasally administered oxytocin has also been reported to reduce fear, possibly by inhibiting the amygdala (which is thought to be responsible for fear responses).
  Oxytocin affects social distance between adult males and females, and may be responsible at least in part for romantic attraction and subsequent monogamous pair bonding.

Actions within the brain

- Sexual arousal: Oxytocin injected into the cerebrospinal fluid causes spontaneous erections in rats,
  Maternal behavior: Female rats given oxytocin antagonists after giving birth do not exhibit typical maternal behavior.

- MDMA (ecstasy) may increase feelings of love, empathy, and connection to others by stimulating oxytocin activity via activation of serotonin 5-HT1A receptors, if initial studies in animals apply to humans.

Drug forms

Synthetic oxytocin is sold as proprietary medication under the trade names Pitocin and Syntocinon, and as generic oxytocin. Oxytocin is destroyed in the gastrointestinal tract, so must be administered by injection or as nasal spray. It has a half-life of typically about three

minutes in the blood, and given intravenously does not enter the brain in significant quantities – it is excluded from the brain by the blood–brain barrierOxytocin nasal sprays have been used to stimulate breastfeeding, but the efficacy of this approach is doubtful.

Injected oxytocin analogues are used for labor induction and to support labor in case of difficult parturition. It has largely replaced ergometrine as the principal agent to increase uterine tone in acute postpartum hemorrhage. The tocolytic agent atosiban (Tractocile) acts as an antagonist of oxytocin receptors; this drug is registered in many countries to suppress premature labor between 24 and 33 weeks of gestation. It has fewer side effects than drugs previously used for this purpose (ritodrine, salbutamol, and terbutaline).

Excessive dosage or long-term administration (over a period of 24 hours or longer) have been known to result in tetanic uterine contractions, uterine rupture, postpartum hemorrhage, and water intoxication, sometimes fatal.