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Reproductive behavior of small animals

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Abstract

Normal and abnormal reproductive behavior of dogs and cats, and known and proposed hormonal bases for these behaviors are addressed. Emerging information includes use of oxytocin to promote pair-bonding between dam and offspring and the possible effect of prolactin in inhibiting sexual behaviors.

Keywords: Sexual behavior; Breeding; Mothering; Dog; Cat

1. Introduction

Reproductive behavior has been well described in most species, but the underlying physiologic basis of sexual behavior has not received the same attention. An understanding of information from laboratory animal species and research in humans may promote differing approaches to diagnosis and treatment of abnormalities of reproductive behavior in dogs and cats.

2. Endocrinology

Oxytocin is a peptide hormone, released from the posterior pituitary, secondary to neurologic stimulation. The two stimuli best documented to cause oxytocin release are pressure of the head of a puppy into the cervix during whelping (Ferguson's reflex) and suckling of the mammary glands by the pups. In both instances, nerve cells in the

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hypothalamus that produce oxytocin are stimulated to fire. During breeding, oxytocin may cause smooth muscle contractions in the female's reproductive tract, improving movement of spermatozoa to the site of fertilization. Oxytocin causes synchronized contractions of the uterus during parturition and contributes to further dilation of the cervix. During lactation, oxytocin stimulates letdown of milk into the mammary glands. Blood oxytocin concentrations are high in dams while they are nursing. The quantity of oxytocin secreted may be correlated with efficiency of milk production in some species [1]. Oxytocin also has been associated with increased sexual receptivity in some species and may be involved in formation of the normal pair-bond between dams and offspring [2].

Prolactin is a protein hormone that induces milk production and stimulates normal maternal behavior. Its production is stimulated during pregnancy and concentrations of prolactin in blood rise sharply at the time of whelping, as other hormone concentrations abruptly decrease. Hyperprolactinemia has been associated with abnormal reproductive behavior and function in humans [3]. Prolactin also may be involved in the refractory period exhibited by most animals for a time after mating; in humans, prolactin concentrations in blood increase after orgasm [4].

Estrogen, produced from the granulosa cells of the ovary, causes the physical and behavioral changes we associate with estrus in dogs, including vulvar swelling, exudation of serosanguinous vulvar discharge, and attraction of male dogs [5,6]. The predominant estrogen secreted in dogs is estradiol-17β. There are two types of estrogen receptors, named estrogen receptor α (ER α) and ER β. Distribution of these receptors within the brain varies, presumably because activation of these receptors elicits different behaviors [7]. Concentration of estrogen receptors in the brain also varies with physiologic status of the animal; fasted animals had a decline in receptor number and a decline in mating behavior [8,9]. Estrogen may stimulate genes for production of opioids and oxytocin; these are thought to provide mild pain relief and to decrease anxiety. This may be what allows a female to stand to be bred when such contact usually would be considered an attack. Finally, naturally occurring products in plants that activate estrogen receptors, phytoestrogens, may be associated with irregular estrous cycles in some species [10].

After ovulation, the corpora lutea secrete progesterone. Progesterone is responsible for pregnancy maintenance and to that end, it promotes secretion of intrauterine glands to support the fertilized eggs, stimulates development of the mammary glands, and induces maternal behavior. Secretion and effect of progesterone are complex, also involving co-activator proteins and brain chemicals [11]. Progesterone can, in some circumstances, activate oxytocin receptors [12]. Progesterone receptors are activated more quickly if the animal is primed with estrogen. Behavioral effects of excessive progesterone are inhibitory; feral cats receiving an oral progesterone-type compound in food showed fewer estrous cycles, lack of sexual interest and loss of ''social status'' [13]. These changes probably are due to negative feedback of progesterone to the hypothalamus and pituitary, decreasing pulsatile release of GnRH and FSH. Abrupt decline in progesterone concentrations and a subsequent rise in prolactin cause many of the normal mothering behaviors seen in dogs, including nesting and maternal aggression. Loss of progesterone at birth is thought to be part of the complex causing ''the baby blues'' in women.

During embryonic development, the testes secrete Mullerian inhibiting factor, which prevents development of the female tubular reproductive tract, and testosterone, which