Development of Spermatogenic Function in the Sex Maturation Process in Male Cats

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ABSTRACT. The spermatogenic function and plasma testosterone (T) level in the sex maturation process were investigated as to 180 mixed breed cats ranging from 4 months to 2 years in age to be castrated. Testis/epididymis weights reached a peak at 10 and 8 to 9 months of age, respectively. In the testis, sperm appeared at 5 months of age. At 7 months of age, sperm were observed in 96.2% of the cats. In the tail of the epididymis, sperm appeared in 46.9% of the cats at 6 months of age and in all cats at 8 or more months of age. Furthermore, the mean plasma T level rapidly increased at 8 months of age, and reached a peak (2.64 ± 0.68 (SE) ng/ml) at 10 months of age. Three of 180 cats (1.67%) had unilateral cryptorchidism. These results suggest that the spermatogenic function in male cats becomes mature at 8 to 10 months of age.

KEY WORDS: male cat, sexual maturity, spermatogenesis, testosterone, testis.

Domestic cats are seasonally polyestrous animals. In female cats, puberty begins at an average age of 8 to 10 months [3, 7]. Male cats are known to be non-seasonal breeders [10], but several studies have suggested the influence of seasons on the spermatogenesis [4, 5].

In mature male cats, some studies have investigated testis weight [4], testicular histology [2, 9, 11], plasma testosterone (T) levels [1, 4, 5, 11, 13], testicular venous blood T levels [11], and epididymal sperm [9, 12].

No recent studies have further investigated the development of spermatogenesis and secretion of sex hormones in the sex maturation process in male cats. As studies on pre-pubertal male cats, Sanchez et al. histologically evaluated Leydig cells [9] and seminiferous tubules [8] in the sex maturation process, and Elcock and Schoning [2] histologically evaluated the testis and epididymis with respect to age, but they did not investigate spermatogenic function; Sanchez et al. [8] reported that spermatogenesis became mature at 8 months of age or older in a small number of cats.

In this study, we investigated the development of spermatogenesis in the sex maturation process by using the testis and epididymis of male cats to be castrated. We also examined the changes in plasma T levels.

MATERIALS AND METHODS

Animals: We used 180 male mixed breed cats ranging from 4 months to 2 years in age to be castrated in an animal hospital (Kanagawa, Japan).

Orchiectomy: Orchiectomy was performed under general anesthesia. For anesthesia, 0.05 mg/kg of medetomidine hydrochloride (Domitor®, Meiji Seika Kaisha, Ltd., Tokyo, Japan) was intramuscularly administered, and 15 min later, 2 mg/kg of ketamine hydrochloride was intramuscularly administered. The entire testis and epididymis were extirpated.

Measurement of testis/epididymis weights: In resected specimens, the testis was isolated from the epididymis. Left and right testis/epididymis weights were measured.

Appearance of sperm in the testis and tail of epididymis: To investigate the appearance of sperm in the testis and tail of the epididymis in the sex maturation process, the cut surface of each organ was stamped with physiological saline on a slide glass. In addition, rose bengal staining was performed to investigate the presence or absence of sperm under a microscope.

Measurement of plasma testosterone levels: To investigate the changes in T levels in the sex maturation process, 1 ml of blood was collected through the jugular vein under general anesthesia prior to surgery. Immediately, blood samples were centrifuged, and stored at −40°C until measurement of hormone levels. Prior to blood collection, informed consent was obtained from the keepers of the male cats. T levels were measured by radioimmunoassay (RIA) [10].

Statistical analysis: Data obtained in this study were analyzed with Student’s t-test and a P value of <0.05 was regarded as significant.

RESULTS

Body weight: Body weight of male cats in the sex maturation process is expressed as the mean ± SE with respect to age, as shown in Fig. 1. Mean body weight of male cats was 2.1 ± 0.2 kg at 4 months of age, and then increased. At 10 months of age, mean body weight reached a peak (4.7 ± 0.2 kg). At 11 months of age, mean body weight was 3.83 ± 0.31 kg, and was noticeably lower than that at 10 months of age, but then increased again.

Testis/epididymis weights: Left and right testis weights in the sex maturation process are shown in Fig. 2. Left and right epididymis weights are shown in Fig. 3. Three
(1.67%) of 180 cats had unilateral cryptorchidism, and were excluded from our data. Two cats had left cryptorchidism, while the remaining one had right cryptorchidism.

There was no laterality in testicular growth. Testis weight was increased in proportion to body weight. At 10 months of age, mean left/right testis weights reached a peak (1.8 g). At 11 months of age, mean left/right testis weights were decreased to 1.5 g, but there were no marked differences between 10 months of age and 11 months of age. Thereafter, mean left/right testis weights were approximately 1.5 g.

There was no laterality in epididymal growth, as demonstrated for the testis, but there was a slight laterality at 8 and 9 months of age. Epididymis weight was gradually increased in comparison to testis weight. Left epididymis weight reached a peak at 8 months of age. Right epididymis weight reached a peak at 9 months of age. Thereafter, left/right epididymis weights were slightly decreased, but were slightly higher than the peak values at 2 years of age.

**Appearance of sperm in the testis and tail of the epididymis:**

The appearance of sperm in the testis and tail of the epididymis is shown in Table 1. In the testis, there were no sperm at 4 months of age. At 5 months of age, sperm were observed in 5 (23.8%) of 21 cats. At 8 or more months of age, sperm were observed in all cats.

In the tail of the epididymis, there were no sperm at 5 months of age. At 6 and 7 months of age, sperm were observed in 23 (46.9%) of 49 cats and in 21 (80.8%) of 26 cats, respectively. At 8 or more months of age, sperm were observed in all cats.

In each animal, there was no laterality in the appearance of sperm in the testis or tail of the epididymis.

**Changes in plasma T levels:** The changes in plasma T levels in the sex maturation process in male cats is shown in Fig. 4. The mean plasma T level was 0.8 ng/ml or less at 4 to 7 months of age, but then rapidly increased to 2.1 ± 0.50 ng/ml at 8 months of age. The value was noticeably higher than that at 7 months of age (p<0.01). At 10 months of age, the mean plasma T level reached a peak (2.64 ± 0.68 ng/ml). At 11 months of age, the mean level was decreased to 1.31 ± 0.68 ng/ml, although there was no marked difference between 10 months of age and 11 months of age. The mean level was increased to 1.52 ± 0.37 ng/ml at 2 years of age.

**DISCUSSION**

This study is the first to further investigate spermatogenic function in the sex maturation process in a large number of cats.
male cats. This study is the first report in which the spermatogenic function was investigated in the sex maturation process in male cats.

In this study, body weight, testis weight, and the plasma T level reached a peak at 10 months of age, as reported in female cats by Jemmett & Evans [3] and Povey [7]. Epididymis weight reached a peak at 8 to 9 months of age. There was slight laterality in epididymis weight at 8 to 9 months of age, but the reason for the difference was unclear. This may have been associated with a small number of cats. In the testis, sperm were observed in 23.8% of the cats at 5 months of age. In the tail of the epididymis, sperm appeared at 6 months of age. At 7 and 8 or more months of age, sperm were observed in 80.8% and 100% of the cats, respectively. In this study, the spermatogenic function became active from 5 to 6 months of age, and was considered mature at 8 months of age. This was consistent with the histological findings of the testis reported by Sanchez et al. [8]. We did not observe sexual behaviors, but sex maturation may be achieved at 10 months of age, since testis weight and the plasma T level reached a peak at 10 months of age. This was similar to the period required for sex maturation in female cats.

In this study, we examined the presence or absence of sperm alone in the testis and tail of the epididymis, but did not investigate sperm motility or histology. Furthermore, the plasma T level was slightly lower than that without anesthesia, as reported by Carter et al. [1], since blood was collected under general anesthesia. We previously investigated diurnal changes in the plasma T level in male adult cats, and found marked episodic diurnal changes [11]. In the results of this study, there were also marked changes in the plasma T level 8 or more months of age. This may have been associated with episodic T secretion in male adult cats.

In this study, body weight, testis/epididymis weights, and plasma T levels reached a peak, and then decrease, but the reason for the decrease was unclear. Some studies have reported that the photoperiod, that is, seasons, may influence testis weight [5] and plasma T levels in male cats. Others have indicated that seasons do not influence the epididymal sperm count or sperm motility [10, 11]. The test cats used in this study may have been affected by domestic artificial lighting in addition to the natural photoperiod. Therefore, the status of breeding differed among the animals, and it was difficult to review seasonal factors.

In this study, cryptorchidism was observed in 3 (1.67%) of 180 cats. Millis et al. [6] reported cryptorchidism in 25 (1.86%) of 1,345 cats. They indicated that the incidence of cryptorchidism was high in Persian cats, and that the incidence was 1.40% in other cats. Since the interval required for sex maturation and the incidence of cryptorchidism may differ among breeds, this study included mongrel cats.

We investigated the development of the spermatogenic function in male cats by using testis, epididymis, and plasma specimens from cats to be castrated. The results suggest that the spermatogenic function in male cats becomes mature 8 to 10 months after birth.

REFERENCES