Peripheral Plasma Androgen Levels in the Male Dog from Birth to Sexual Maturity

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(Received 17 October 1986/ Accepted 25 October 1986)


KEY WORDS: androgen, dog, sexual maturity.

As the study for the process of sexual maturity in male dogs, an observation was made on chronological changes in the plasma level of androgen up to the time of sexual maturity. Androstenedione (A), 5α-dihydrotestosterone (DHT), and testosterone (T) have been measured mostly in mature male dogs [1, 2, 4, 8, 13-17, 20 22]. There are a few reports [5, 6, 15, 16] on blood levels of androgen in male dogs before sexual maturation. Interrelations among these 3 androgens or their actions on the sexual organs have not yet been well understood.

In the present studies, RIA was used to estimate peripheral plasma levels of the 3 androgens in dogs over a period from birth to sexual maturity.

The time required for male dogs to reach sexual maturity may depend upon the genetic factor, on the raising environment. Four male beagles (Nos. 29, 30, 31, and 34) of the same litter were selected from the authors’ line bred colony in this experiment. They were weaned at 45 days of age and housed individually.

Blood samples were collected at birth and selected periods described in Fig. 1 between 9:00 and 11:00 a.m. up to 48 weeks after birth. Blood was taken from the jugular vein by 16 weeks of age and later from the radial vein of the forearm, heparinized, and separated to plasma by a refrigerated centrifuge at 3,000 rpm for 15 min. The plasma sample was stored at -20° C until a use for assay. Androgen levels were estimated by RIA methods reported by Makino et al. [11], Ojika et al. [12], and Yoshida et al. [23]. Antisera were prepared against A-3-carboxy-methyl-oxime-BSA, DHT-11α succinate-BSA, and T-11α-succinate-BSA.

The lower limit of sensitivity was 20 pg/sample for each of the three androgens. The intra- and interassay coefficients of variation were 11.0 and 13.9%, for A, 12.0 and 8.0% for DHT, and 9.9 and 13.5% for T. The rats of recovery for A, DHT, and T were 73%, 64%, and 70%.

Changes in average plasma levels of the 3 androgens in the 4 dogs are shown in Fig. 1.

**Plasma level of A:** At birth, the A level was relatively high. This level was maintained until 16 weeks of age. During a period from 20 to 28 weeks of age, it decreased significantly to 0.27 ng/ml on the average (0.02-0.69 ng/ml). After 30 weeks of age, it increased again to 0.85 ng/ml on the average (0.55-1.62 ng/ml).

**Plasma level of DHT:** The DHT level was low (0.19 ng/ml on the average) throughout the experimental period. It was much lower levels (0.07-0.09 ng/ml) were observed at 24 weeks of age.

**Plasma level of T:** The T level was relatively high, at birth. It decreased between 4 and 22 weeks of age with a slight increase at 8 weeks of age. After 26 weeks of age, it increased rapidly and showed a peak of 2.38 ng/ml at 28 weeks of age. Thought decreased temporarily to 1.40 ng/ml 2 weeks later, it remained at relatively high levels after 32 weeks of age.

Significant correlations (p<0.01) were observed between A and DHT levels in 2 dogs, Nos. 29 and 30 (r=0.845 and 0.680), and between DHT and T levels in 2 dogs Nos. 31 and 34 (r=0.529 and 0.593). No correlations were found between A and T levels in any dogs.

Plasma T level was relatively high at birth and then decreased. It remained at a low level for a long period. The same pattern of changes in plasma T level has been observed in rats [3, 9]. The low T level observed at 4 weeks of age may be caused by an interruption of the effect of maternal gonadotropins and related to the degeneration of Leydig cells [9, 21]. The rapid increase in T level at 26-28 weeks of age was preceded by the rapid morphological development of the anterior pituitary gland at 20 to 24 weeks of age, reported previously [19]. Moreover, the rapid increase in T level coincided with the rapid development of the testis between a period from 24 to 32 weeks of age reported.
Fig. 1. Average peripheral plasma androgen levels in 4 male dogs from birth to sexual maturity. •—•: androstenedione, ○--○: 5α-dihydrotestosterone, ▼: testosterone.

previously [19]. Gonadotropins released from the developing anterior pituitary gland would stimulate the testes to secrete T.

Hart and Ladewig [5, 6] reported that the T level in male dogs increased gradually in the course of sexual maturity up to 340 days of age, but that it did not exceed 0.5 ng/ml. In the present experiment, the T level was 1.67 ng/ml at 48 weeks of age. According to the data by Takeishi et al. [15, 16] the T level in male dogs at 10 months of age was 1.84 ng/ml. The reason why Hart and Ladewig obtained such a low T level is unknown.

Inaba et al. [8] pointed out that androgen was secreted episodically in mature dogs in the daytime. In the present experiment the T level at 28 weeks of age and later fluctuated rather remarkably. Therefore, it seemed that episodic secretion of androgen might begin to start some time later than 28 weeks of age.

To define the time of sexual maturation, the much studied are required on the property of the semen, the ability of mating, and other conditions for successful conception. Takeishi et al. [16] reported that male beagles reached sexual maturity some time between 44 and 54 weeks of age. However, judging from our data concerning the development of the reproductive organs [19] and the ability to secrete androgen, it could be proposed that male dogs reach sexual maturity earlier than 44 weeks of age. Takeishi et al. [16] used beagles of the same litter as in the present experiment. There was still such a noticeable difference in the age of maturity, suggesting a considerable variation even among the same breed of male dogs. A and T are known to be predominant androgens released from the testis. In the present experiment the T level was generally higher than the A level. It has been clarified that the A level is higher than the T level in premature bulls and male rats, and that the T level, in turn, higher than the A level after puberty [7, 10]. Species' difference in the change of a dominant androgen during a course of sexual maturation may be attributed to a difference in the main pathway of biosynthesis of androgens between species as suggested Tremblay et al. [18].

REFERENCES


要約
雄犬の性成熟にともなう末梢血中 androgen 量（短報）：筒井敏彦・辻淳子・河上栄一・山田隆一・天野正・内竜（日本獣医畜産大学 獣医臨床繁殖学教室）——雄犬について、出生時から性成熟（48週齢）に至るまでの末梢血中 androgen を RIA 法によって測定した。androstenedione は20-28週齢で平均9.27ng/mlであったが、その前後では、約0.8ng/mlであった。5α-dihydrotestosterone は、全期間を通じて低く、平均0.19ng/mlであった。26週齢からtestosterone が急増して28週齢でピーク（平均2.38ng/ml）を示し、その後、かなり変動があったが2ng/ml前後の高値を示した。