

Formation of Detached Tail and Coiled Tail of Sperm in a Beagle Dog

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ABSTRACT. The right testis and epididymis were excised from a Beagle dog that ejaculated high percentages of sperm with detached tails and with coiled tails. Cross sections of the organs were stamped on glass slides and histological examination of the organs was performed to find the portion where sperm with the abnormal tails appear. Many sperm with tails whose axoneme was exposed near the neck region were observed in the testis and they decreased in order from the caput, to the corpus, and the cauda epididymis. Sperm with detached tails and sperm with coiled tails gradually increased in the epididymis. These findings indicate that the tails of sperm with an exposed axoneme detached in the epididymis.

KEY WORDS: abnormal tail, canine, sperm.

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Sperm with morphologically abnormal tails, e.g., exposed axonemes and coiled tails have been reported to occur in the dog as a result of oscheitis [10]. Although there have been a few reports concerning the presence of sperm with detached tails in canine ejaculated semen, the causes of the sperm tail detachment are unknown [9, 13]. The authors found a Beagle dog with a large number of sperm with detached tails and sperm with coiled tails in the ejaculated semen. Parts of its genital organs were examined, and the cause of the abnormal sperm tails was investigated.

The teratozoospermic dog, aged 2 years, was found in the Beagle colony of our university. Neither of the two bitches mated with the dog had conceived. There was no evidence of injury or inflammation of the scrotum, testes, or epididymides of the dog, and a diagnosis of teratozoospermia was made based on semen quality. Semen samples were collected by digital manipulation 5 times at 1-week intervals, and the semen quality was evaluated by the methods described previously [7]. Since the plasma testosterone (T) levels of dogs fluctuate diurnally [5, 12], peripheral vein blood samples were collected 3 times a day (9:00, 13:00, 17:00) on the same days as the semen collection. The plasma T levels were measured by radioimmunoassay [6] and the mean T level of the 3 plasma samples each day was calculated.

The right testis and epididymis of the dog were removed

under inhalation anesthesia. Cross sections of the testis and the caput, corpus, and cauda epididymis were stamped on 2 glass slides each, and the germ cells and sperm on the slides were stained with Giemsa's solution and rose-bengal solution (3 g rose-bengal, 1 μ l formalin and 99 μ l distilled water) for 15 min each to examine the cell morphology. The testis and the caput, corpus and cauda epididymis were embedded in paraffin, sectioned, and stained with PAS-hematoxylin to examine them histologically. Four Beagle dogs, aged 2–4 years, with normal semen quality were used as controls in this study. Data were analyzed for statistical significance by Student's *t* test. A P value <0.01 was considered significant.

A very high percentage of the sperm in the semen ejaculated by the Beagle dog were morphologically abnormal (Table 1 and Fig. 1). Sperm with detached tails (mean \pm S.E.; $47.6 \pm 1.8\%$) and sperm with coiled tails ($52.4 \pm 1.8\%$) each accounted for half of the abnormal sperm. The total volume of semen, total number of sperm, percentage of actively motile sperm, and percentage of viable sperm were significantly higher than the mean values for the 4 controls ($P < 0.01$) (Table 1).

The peripheral plasma T level of the teratozoospermic dog (1.5 ± 0.2 ng/ml) was significantly lower than the mean value of the 4 controls (2.4 ± 0.2 ng/ml) ($P < 0.01$).

Although all of the elongated spermatids on the glass

Table 1. Mean (\pm S.E.) quality of semen collected from the teratozoospermic Beagle dog and 4 normal Beagle dogs 5 times at 1-week intervals

Semen quality	Teratozoospermic dog	Normal dogs ^{a)}
Total volume of semen (ml)	$2.1 \pm 0.3^{**}$	12.8 ± 1.5
Total number of sperm ($\times 10^6$)	$50.0 \pm 0.7^{**}$	460.0 ± 38.4
Motile sperm (%)	$1.3 \pm 0.2^{**}$	92.4 ± 1.8
Viable sperm (%)	$51.0 \pm 1.5^{**}$	94.0 ± 1.6
Abnormal sperm (%)	$92.8 \pm 1.4^{**}$	7.6 ± 0.8
pH of total semen	$6.4 \pm 0.1^{**}$	6.8 ± 0.1

a) Means \pm S.E. in the 4 dogs.

** $P < 0.01$, in comparison with the normal dogs.

slides stamped with the testis of the teratozoospermic dog were morphologically normal (Fig. 2-a), many sperm with tails in which the axoneme was exposed near the neck



Fig. 1. Sperm with detached tails and sperm with coiled tails in semen ejaculated by the teratozoospermic dog. Rose-bengal stain, $\times 400$.

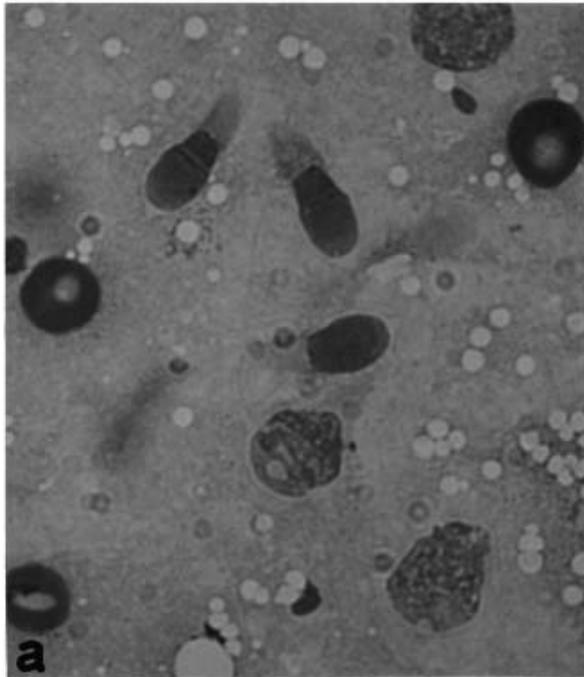


Fig. 2. Elongated spermatids (a) (Giemsa stain) and a spermatozoon with exposed axoneme (b) (Rose-bengal stain) on a glass slide stamped with the testis of the teratozoospermic dog. $\times 1,000$.

region were observed (Fig. 2-b)(Table 2). The total percentages of sperm with abnormal tails on the glass slides stamped with the epididymis were much higher than the mean values for the controls (Table 2). The percentages of sperm whose axoneme was exposed decreased gradually in order from the caput, to the corpus, and the cauda epididymis, whereas the percentages of sperm with detached tails and sperm with coiled tails increased in the same order (Table 2). No sperm with both exposed axoneme and coiled tail were observed in the epididymides.

Small numbers of germ cells and sperm were observed histologically in the seminiferous tubules of the testis (Fig. 3-a), and atrophy of the nuclei of epithelial cells in the caput, corpus and cauda epididymis was noted (Fig. 3-b).

Morphological abnormalities of the tail and axoneme of sperm are a cause of asthenozoospermia [2], and such abnormalities have been shown to be caused by chromosomal defects in some cases in men [11]. The father and grandfather of the teratozoospermic dog in this study had semen of normal quality, and no clear cause of exposure of the axonemes of the testicular sperm and the poor T secretory function of the testis was identified in this study, but a large number of sperm with detached tails present in the ejaculate were thought to have lost their tails during passage of the sperm through the epididymis. Spermatogenic and epididymal dysfunction and atrophy of the epithelial nuclei in the epididymis in the dog have been reported to be induced by insufficient T secretion by the testes [7, 8]. Abnormal pH and osmotic pressure values in epididymal fluid caused by the poor T secretory function of the testes

Table 2. Percentages of abnormal sperm with detached tails, exposed axonemes and coiled or bent tails in the right testes and caput, corpus, and cauda epididymides of the teratozoospermic Beagle dog and 4 normal Beagle dogs

Organs	Teratozoospermic dog			Normal dogs ^{a)}		
	Detached tails	Exposed axonemes	Coiled tails	Detached tails	Exposed Axonemes	Coiled or bent tails
Testes	0	44	0	0	0	0
Epididymides						
Caput	16	30	6	0	0	4.7 ± 0.5
Corpus	31	17	21	0	0	6.0 ± 0.4
Cauda	37	8	43	0	0	7.0 ± 0.7

Means ± S.E. in 4 dogs.

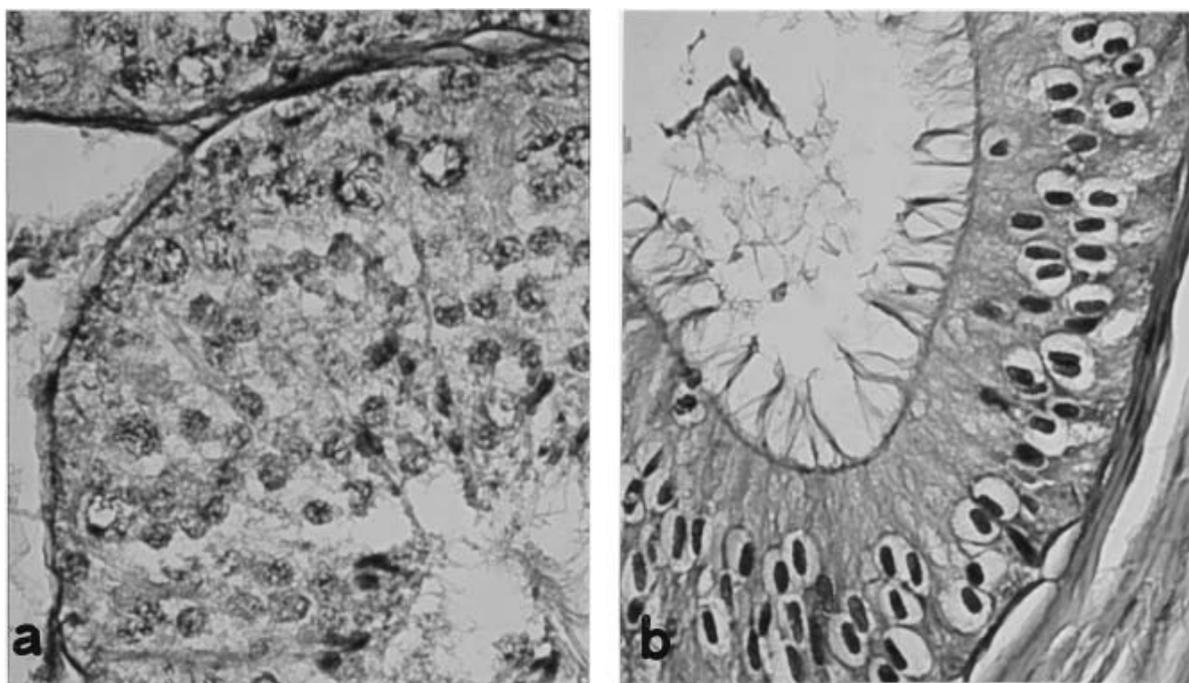


Fig. 3. Histological appearance of the testis (a) and corpus epididymis (b) of the teratozoospermic dog. PAS-hematoxylin stain. × 400. Small numbers of germ cells and sperm are seen in the seminiferous tubules (a), and the atrophy of the epithelial cell nuclei in the epididymis (b) are observed.

induce a decrease in actively motile sperm and the occurrence of sperm with coiled tails and sperm with detached tails in the bull [1, 3], pig [4], and dog [1, 7, 8]. Therefore, it is assumed that insufficient T secretion by the testes in the teratozoospermic dog caused the detachment and coiling of the sperm tails in the epididymides. It seems that it will be necessary to investigate the cause of the occurrence of sperm with exposed axonemes by electron microscopy in the near future.

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