Testicular Function of Scrotal Testes after the Cryptorchidectomy in Dogs with Unilateral Cryptorchidism

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ABSTRACT. Cryptorchidectomy was performed in 6 adult dogs with unilateral cryptorchidism. In these dogs, semen samples were collected weekly from 2 weeks before cryptorchidectomy till 24 weeks after the operation. Peripheral venous blood samples were collected from all the dogs at intervals of 4 weeks, and spermatic venous blood samples and testicular tissue specimens were obtained at the time of the removal of cryptorchid and scrotal testes.

In the scrotal testes the testosterone level of spermatic venous plasma was lower, and the number of germ cells in the seminiferous tubules was smaller than those in the testis of the normal dogs at the time of cryptorchidectomy. However, semen volume and number of sperms increased gradually, and sperm abnormality decreased after the operation. Semen quality became close to that of the normal dog 20 weeks after the operation or later. Furthermore the plasma testosterone levels and the number of germ cells increased to the same as those in the normal dog at 24 weeks after the operation. Therefore, it was concluded that in the dogs with unilateral cryptorchidism the cryptorchid testis disturbed the testicular function of the scrotal testis. —KEY WORDS: cryptorchidism, dog, semen, spermatogenesis, testosterone.


In unilateral cryptorchid (CR) animals neither spermatid nor spermatozooon is seen in any CR testis. However, the unilateral CR animals have fertility because of spermatogenesis in the scrotal testis [5]. The present authors, as well as several investigators [8, 23], have recognized that the spermatogenic function of the scrotal testis was inferior to the testis of the normal animal. Therefore, in unilateral CR animals it is considered that the spermatogenic function of the scrotal testis may be unsatisfactory on account of a congenital defect or the presence of some inhibitory factor (for example, the CR testis).

The purpose of this paper is to examine for the cause of the unsatisfactory spermatogenic function of the scrotal testis in dogs with unilateral CR. Semen quality and histological changes in the testes were investigated and peripheral and spermatic venous blood plasma testosterone levels measured before and after the cryptorchidectomy.

MATERIALS AND METHODS

Six adult dogs (1 to 3 years old) with congenital CR were used. CR testes in the abdominal or inguinal position were removed in all of them under anesthesia with sodium pentobarbital. The scrotal testes were removed from these dogs 24 weeks later.

Semen samples were collected weekly by digital manipulation from all the dogs beginning with 2 weeks before the cryptorchidectomy. Each sample was examined for semen volume, the total number, motility, viability, and abnormality of sperms, and immature sperm rate by the methods described previously [12].
Peripheral venous blood samples were collected at intervals of 4 weeks and spermatic venous blood samples were collected at the times of the removal of CR and scrotal testes to determine plasma testosterone levels by radioimmunoassay, which had been described previously [11].

The excised testicular tissues were fixed in Bouin's fluid, cut into sections 3 μm thick and stained with PAS-hematoxylin. The seminiferous tubules in the testes were observed at 9 of the cycle of seminiferous epithelium by the method described previously [11]. The diameters of the seminiferous tubules were measured and the numbers of type A spermatogonia, pachytene primary spermatocytes, and round spermatids counted.

RESULTS

Semen quality: Fig. 1 shows mean values of semen quality in the 6 dogs after the cryptorchidectomy.

The mean value of semen volume was below 2 ml until 9 weeks after the operation. It increased gradually, thereafter, and reached about 5 ml 20 weeks after the operation or later. The mean value of total sperm number was more than 160×10^6 before the cryptorchidectomy. It decreased, however, to less than 140×10^6 between 1 and 8 weeks after the operation. Then it increased gradually to reach 250–290×10^6 14 weeks after the operation or later. Sperm motility and sperm viability were 2.8–3.5 and 83–85%, respectively, before the cryptorchidectomy. Though sperms decreased temporarily in number after the operation, they increased in motility and viability. Their motility exceeded 3.5 and their viability 85% 13 and 7 weeks after the operation, respectively. Sperm abnormality was 15–17% and immature sperm rate 9–11% before the cryptorchidectomy. As a result of a temporary increase after the operation, sperm abnormality was 26% and immature sperm rate 17% 3 and 4 weeks after the operation, respectively. Then, they decreased gradually. The mean values of sperm abnormality and immature sperm rate were less than 14% and 8%, respective-

![Graph of semen quality](image-url)

Fig. 1. Mean values (Mean±S.E.) of semen quality in 6 adult dogs with unilateral cryptorchid from 2 weeks before cryptorchidectomy to 24 weeks after the operation.
SCROTAL TESTES IN UNILATERAL CRYPTORCHID DOGS

ly, 20 weeks after the operation or later. There was a significant difference in semen volume, total sperm number, sperm motility and viability between just before the operation and 24 weeks after the operation in all dogs (P<0.01).

Peripheral and spermatic venous plasma testosterone levels: Fig. 2 shows the plasma testosterone levels of peripheral and spermatic venous blood in the 6 dogs. In all the dogs the peripheral venous plasma testosterone level was below 2.0 ng/ml at the time of the cryptorchidectomy. In 4 of these dogs, however, it exceeded 2.0 ng/ml 16 weeks after the operation or later. The spermatic venous plasma testosterone level was lower in the CR testis (18.7–40.0 ng/ml) than in the contralateral one (25.6–44.0 ng/ml) at the time of the cryptorchidectomy. It increased in all the scrotal testes, exceeding 50 ng/ml 24 weeks after the operation. There was a significant difference in peripheral and spermatic venous plasma testosterone levels between just before the operation and 24 weeks after the operation in all dogs (P<0.01).

Histological findings of testes: Histological findings of the testes in the dogs are shown in Table 1 and Fig. 3. In all the dogs the mean diameter of seminiferous tubules in the CR testis was about three-fifths of that in the scrotal one at the time of the cryptorchidectomy. The mean diameter of seminiferous tubules in the scrotal testes was longer at 24 weeks after the cryptorchidectomy than at the time of operation. Particularly, there was a significant difference in that between just before the operation and 24 weeks after the operation in 3 of the 6 dogs (P<0.01).

The seminiferous tubules of the scrotal testes contained more spermatogonia and primary spermatocytes than those of the CR ones. Neither spermatid nor spermatozoa was seen in any CR testis. In the scrotal testes, the seminiferous tubules contained spermatozoa and the mean number of type A spermatogonia, pachytene primary spermatocytes and round spermatids were larger at 24 weeks after the cryptorchidectomy.

![Graph showing plasma testosterone levels](image)

**Fig. 2.** Peripheral and spermatic vein plasma testosterone levels in 6 unilateral cryptorchid adult dogs after cryptorchidectomy.
Table 1. Mean diameter of seminiferous tubules, and the number of germ cells per cross section in testes of 6 unilateral cryptorchid adult dogs 0 and 24 weeks after cryptorchidectomy

<table>
<thead>
<tr>
<th>Dog No.</th>
<th>Weeks after operation</th>
<th>Diameter of tubules (μm)</th>
<th>Type A spermatogonia</th>
<th>Pachytene primary spermatocytes</th>
<th>Round Spermatids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cryptorchid</td>
<td>Scrotal</td>
<td>Cryptorchid</td>
<td>Scrotal</td>
</tr>
<tr>
<td>108</td>
<td>0</td>
<td>135±4</td>
<td>198±8</td>
<td>0.3±0.1</td>
<td>0.6±0.1</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>-</td>
<td>242±8**</td>
<td>-</td>
<td>0.7±0.1</td>
</tr>
<tr>
<td>117</td>
<td>0</td>
<td>117±4</td>
<td>178±7</td>
<td>0.2±0.1</td>
<td>0.3±0.1</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>-</td>
<td>220±7**</td>
<td>-</td>
<td>0.7±0.1**</td>
</tr>
<tr>
<td>126</td>
<td>0</td>
<td>134±3</td>
<td>203±7</td>
<td>0.3±0.1</td>
<td>0.5±0.1</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>-</td>
<td>241±7**</td>
<td>-</td>
<td>0.9±0.1**</td>
</tr>
<tr>
<td>130</td>
<td>0</td>
<td>142±5</td>
<td>221±6</td>
<td>0.2±0.1</td>
<td>0.3±0.1</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>-</td>
<td>238±6</td>
<td>-</td>
<td>0.8±0.1**</td>
</tr>
<tr>
<td>137</td>
<td>0</td>
<td>106±2</td>
<td>205±7</td>
<td>0.2±0.1</td>
<td>0.3±0.1</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>-</td>
<td>221±6</td>
<td>-</td>
<td>0.6±0.2**</td>
</tr>
<tr>
<td>144</td>
<td>0</td>
<td>145±3</td>
<td>227±8</td>
<td>0.3±0.1</td>
<td>0.5±0.1</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>-</td>
<td>233±4</td>
<td>-</td>
<td>0.8±0.1**</td>
</tr>
</tbody>
</table>

Mean±S.E.
Cell counting was made in 10 seminiferous tubules of stage 9.
** Significantly different from scrotal testis at the time of the operation (P<0.01).

Fig. 3. Histological findings of testes in an adult unilateral cryptorchid dog after cryptorchidectomy. PAS-hematoxylin, ×100.
A: Cryptorchid testis at the time of the operation.
B: Scrotal testis at the time of the operation.
C: Scrotal testis 24 weeks after the operation.

than at the time of operation. This difference was significant in all the dogs, except one (P<0.001). Sertoli and Leydig cells were slightly atrophic in the CR testes. They seemed to be normal in morphology in the scrotal testes at the cryptorchidectomy and 24 weeks after the operation.
DISCUSSION

In normal adult dogs it was reported that semen volume was 4–12 ml, total sperm number 300–500×10⁶, sperm motility 3–4, sperm viability 80–90%, and sperm abnormality 10–20% [1, 2, 7, 9, 19, 20, 25]. Semen quality in the present experimental dogs before the cryptorchidectomy was inferior to that in normal dogs. Moreover, in those dogs the peripheral and spermatic venous plasma testosterone levels at the cryptorchidectomy were lower than those in normal dogs (these peripheral and spermatic venous plasma testosterone levels were 2–4 and about 150 ng/ml, respectively) [4, 10, 21, 22]. The authors previously reported that the mean numbers of type A spermatogonia, pachytene primary spermatocytes, and round spermatids were 0.5, 7.4, and 28.5, respectively, in the seminiferous tubules of the normal adult dogs [11]. In the unilateral CR dogs germ cells in the seminiferous tubules of the scrotal testis were obviously fewer than those of the testis in the normal dog. In the former dogs after the cryptorchidectomy, however, semen quality, histological findings of the scrotal testis, and spermatic venous plasma testosterone level approached those in the normal dog. It was supposed that these changes might have been induced by an increase in testosterone-producing Leydig cells in the contralateral testis. The CR testis may produce some inhibitor which restrains the gonadotropin secretion of the pituitary or directly the androgen secretion of the scrotal testis. As a result of the disappearance of the inhibitor after the cryptorchidectomy, the secretion of LH, FSH and androgen may possibly increase and stimulate spermatogenesis in the scrotal testis [3, 15, 24]. It was reported that in puppies with experimental unilateral cryptorchidism the scrotal testis was disturbed in development by auto-immunization for germ cells [14]. However, in genital unilateral CR dogs no existence of such auto-immunization is known. Compensatory hypertrophy of the remaining testis was detected in unilaterally castrated rabbits and sheep, but not in mice, rats or dogs [6, 13, 16, 17, 18]. The authors did not either detect compensatory hypertrophy of the remaining testis in unilaterally castrated dogs (unpublished data). Therefore, in this paper, it was considered that in the unilateral CR dogs there might have been an improvement in the spermatogenic function of the scrotal testis, without being accompanied with compensatory hypertrophy after the cryptorchidectomy.

REFERENCES

Japanese).


