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The Effects of Unilateral Castration on the Remaining Testicle of the Dog.

By

L. SARGUNAS.

The aim of these experiments was to study the possible effects of one-sided castration upon the testicle that remained in the body, the attention being principally directed to the quantitative relations between the generative and the interstitial tissues.

The indications found in the literature pertaining to the question are rather contradictory, and attention is mainly directed to the problem which tissues of the gonads are to be regarded as producers of the hormones.

The first systematic experiments in one-sided castration were made by NOTHNAGEL (1886) on rabbits. Among others he treated 12 adult animals which were killed 3-6 months after the operation. Though after the experiment in the separate animals the weight of the testicles had markedly changed (positively as well as negatively), yet the limits of fluctuation of weight remained the same as before the experiment. From this NOTHNAGEL concludes that a hypertrophy of the remaining testicle cannot be spoken of, as the hystology of the testicle did not differ from that of a normal one.

RIBBERT (1890, 1895) performed a one-sided castration on 8 rabbits, 2 guinea-pigs, and 1 dog (the age of the animals is not indicated) and compared them afterwards with control animals of the same age. In almost all cases the remaining testicle showed a greater size than that of the control animal, the seminiferous tubules having become wider.

KYRLE (1911) did not observe any macroscopic or microscopic difference in the control testicles of 2 half-castrated dogs.

In his experiments with rabbits LIPSCHÜTZ (1922, 1923) found that the effect of one-sided castration upon the testicle remaining in the body depends on the age of the animal at the moment of the operation. In adult animals one-sided castration does not cause a hypertrophy of the remaining testicle.

HETT (1924) basing on observations upon a hare thinks that onsided castration causes a compensatory increase of the other testicle, and that in this case hyperplasia, not hypertrophy, takes place. This hyperplasia relates only to the generative part of the testicle.

In his experiments of unilateral castration SALLER (1933) was the first to adopt the exact method of quantitative definition when studying the relations between the tissues of the testicle. Therefore the results of his experiments shall be examined more in detail. SALLER worked upon young, adult, and old white mice. Here we are interested only in the adult stage. SALLER submitted 14 adult mice (under 2 years) to one-sided castration and killed them 41—86 days after the operation. He found that in 10 cases the left testicle (that had remained in the body) was larger than the right testicle; in 4 cases it was smaller (in 3 cases the difference was quite insignificant) and only in one case the weight of the testicle was reduced almost by half. These results agree in general with those obtained by NOTHNAGEL and RIBBERT with rabbits, and this proves, in his opinion, that unilateral castration may cause an increase as well as a reduction in size; sometimes even no change may be observable; yet in most cases an increase takes place.

In defining quantitatively the separats component parts of the testicles SALLER found that in 9 cases the generative tissues had increased, that in 1 case there was no change observable, but that in 4 cases a reduction of the generative tissues had taken place (rather insignificant in 3 cases). Equally in 9 cases the interstitial tissues had increased, but in 5 cases a marked decrease of these tissues was observed. In 4 cases the quantitave relation of the generative and the interstitial tissues had changed to the advantage of the generative tissues, in 2 cases it had remained unchanged, and in 8 cases the change had been to the advantage of the interstitial tissues. These results cause SALLER to question STIEVE'S (1921) conclusion based on the few experiments of HACKENBRUCH (1888) that after a unilateral castration the interstitial tissues become less in proportion to the generative tissues. On the ground of the results of his expe-

riment SALLER thinks that, speaking cautiously, the most we can say is that unilateral castration in mice does not cause any marked changes in the quantitative relations between the interstitial and the generative tissues, but that the insignificant changes heretofore established rather seem to be to the advantage of the interstitial tissues.

The one case in the series of experiments (specimen G 58) where the histological difference between both testicles is really striking (while the right testicle is quite normal, the left shows a marked reduction of the germinal epithelium) is explained by SALLER by the fact that the remaining testicle had unexpectedly been displaced into the abdominal cavity. But as the experiments of BOUIN, of KYRLE, of SAND and of other investigators prove, such a displacement of the testicle into the abdominal cavity always causes a degeneration of the germinal epithelium.

SALLER finds that in general one-sided castration causes in adult white mice a compensatory increase of the remaining testicle; this increase evidently touches in like manner the interstitial as well as the generative tissues; yet in the final result this increase is expressed in figures that do not exceed the normal limits of fluctuation of weight of the testicle and its component parts.

Further ROWLAND's (1934) experiments in unilateral castration of white mice must be mentioned. In these cases the remaining testicle showed neither hypertrophy nor microscopic changes.

Materials and Methods.

3 adult small (about the size of a fox-terrier) dogs were made use of. The age of the two animals experimented on was not known for certain, but they seemed 4—5 years old. The control animal was about 2 years old.

On August 8th, 1935, two dogs were submitted to one-sided castration by Dr. K. KAŅEPS, assistant at the Faculty of Veterinary Medecine; in both the left testicle was removed. The removed testicle was directly weighed and fixed in ZENKER's fluid, after which of different parts of the testicle 10 micron thick sections were made and stained with haematoxylin and eosin. The method of quantitative hystological analysis, as described in detail by SCHINZ and SLOTOPOLSKY (Handbuch der biologischen Arbeitsmethoden, herausg. von ABDERHALDEN. Abt. V, Teil 3 B, Heft 4), was adopted in the further treatment of the preparations. On 0,5 mm thick cardboard and with the help of a drawing apparatus 8—9 drawings were made of the different parts of the testicle, magnified × 150, and in a uniform field of vision. Only the interstitial tissues were

drawn, i. e. the groups of Leydig cells together with the pertaining connective tissue and blood-vessels, avoiding as far as possible those portions of the sections which contained large blood-vessels. After this the relative areas were cut out and weighed, and from the numbers obtained the absolute weight of the separate component tissues was computed as well as their percentile relations.

The first dog was killed on the 63rd, and the second on the 77th day after the operation. The removed right testicles were treated as above indicated.

The testicles of the control animal were removed on October 13th, 1937, and treated in the same way.

Results of the Experiments.

The extirpated left testicle of the **first animal** experimented on showed a weight of 4,15 g.

After completing the relative drawing and weighing the areas corresponding to the separate components of the tissues it appeared that of the total weight of the cardboard circle (31,35 g) 2,87 g or 9,16% corresponded to the interstitial tissues and 28,48 g or 90,84% to the generative tissues (see Table 1). Thus this testicle contained 0,38 g of interstitial tissues (9,16% of 4,15 g) and 3,77 g of generative tissues (90,84% of 4,15 g), the relation of the weight of the interstitial and the generative tissues being **1:9,9.**

Table 1. The first dog (the left testicle).

No. of the preparation	Total weight of the cardboard circle	Interstitial tissues	Generative tissues
1	31,35	2,99	28,36
2	31,35	2,68	28,67
3	31,35	3,44	27,91
4	31,35	2,80	28,55
5	31,35	3,42	27,93
6	31,35	3,00	28,35
7	31,35	2,52	28,83
8	31,35	2,15	29,20
9	31,35	2,80	28,55
Average	31,35	2,87	28,48
%	100%	9,16%	90,84%

The right testicle of the same animal that had been extirpated on the 63rd day after the operation weighed 5,38 g. Of the total weight of the cardboard circle 2,42 g or 7,72% were represented

by the interstitial tissues and 28,93 g or 92,28% by the generative tissues (see Table 2). The absolute weight of the interstitial tissues in this testicle formed 0,42 g, and that of the generative tissues — 4,96 g. The relation of the weight of the interstitial and the generative tissues is **1:11,9.**

Table 2. The first dog. 63rd day after the operation (the right testicle).

No. of the preparation	Total weight of the cardboard circle	Interstitial tissues	Generative tissues
1	31,35	2,97	28,38
2	31,35	2,13	29,22
3	31,35	2,36	28,99
4	31,35	2,23	29,12
5	31,35	3,10	28,25
6	31,35	2,52	28,83
7	31,35	1,86	29,49
8	31,35	2,16	29,19
Average	31,35	2,42	28,93
%	100%	7,72%	92,28

The left testicle of the **second animal** experimented on weighed 6,26 g. Of the total weight of the cardboard circle 3,03 g or 9,67% were represented by the interstitial tissues, and 28,32 g or 90,33% by the generative tissues (see Table 3). Thus this testicle contained 0,61 g of interstitial tissues and 5,65 g of generative tissues. The relation of the weight of the interstitial tissues and of the generative tissues is **1:9,3.**

Table 3. The second dog (the left testicle).

No. of the preparation	Total weight of the cardboard circle	Interstitial tissues	Generative tissues
1	31,35	3,05	28,30
2	31,35	3,03	28,32
3	31,35	2,44	28,91
4	31,35	2,71	28,64
5	31,35	2,77	28,58
6	31,35	3,31	28,04
7	31,35	3,93	27,42
8	31,35	2,99	28,36
Average	31,35	3,03	28,32
%	100%	9,67%	90,33%

The right testicle of the second dog that had been extirpated on the 77th day after the operation weighed 7,02 g. Of the total weight of the cardboard circle 2,53 g or 8,07% were formed by the interstitial tissues and 28,82 g or 91,93% by the generative tissues (see Table 4). The absolute weight of the interstitial tissues of this testicle was 0,57 g and that of the generative tissues — 6,45 g. The relation of the weight of these tissues is **1:11,3.**

Table 4. The second dog. 77th day after the operation (the right testicle.)

No. of the preparation	Total weight of the cardboard circle	Interstitial tissues	Generative tissues
1	31,35	3,00	28,35
2	31,35	2,26	29,09
3	31,35	2,10	29,25
4	31,35	2,75	28,60
5	31,35	2,22	29,13
6	31,35	2,77	28,58
7	31,35	2,39	28,96
8	31,35	2,72	28,63
Average	31,35	2,53	28,82
%	100%	8,07%	91,93%

From these figures it may be seen that after the operation the testicle of the first dog had increased in weight by 29,6%, the generative tissues having increased by 31,6% and the interstitial tissues by 10,5%. The quantitative relation between the interstitial and the generative tissues had changed by 20,2% to the advantage of the generative tissues.

The total weight of the testicle of the second dog had increased by 12,1% after the operation; the generative tissues showed an increase of 14,1% while the interstitial tissues had decreased by 7%. The quantitative relation Interstitial Tissues: Generative Tissues had changed by 21,5% to the advantage of the generative tissues. .

Thus in both cases an increase in the total weight of the testicle had taken place; in one case the increase had touched the interstitial as well as the generative tissues; in the second case only the generative tissues showed an increase while the interstitial tissues had even decreased.

The left testicle of the **control animal** weighed 16,10 g and the right testicle 10,79 g.

The left testicle contained 9,4% of interstitial tissues and 90,6% of generative tissues (see Table 5). Thus the absolute weight of the interstitial tissues in this testicle formed 1,51 g and that of the generative tissues — 14,59 g. Interstitial Tissues: Generative Tissues = **1:9,6.**

Table 5. The left testicle of the Control Animal.

No. of the preparation	Total weight of the cardboard circle	Interstitial tissues	Generative tissues
1	22,44	2,36	20,08
2	22,44	1,79	20,65
3	22,44	2,06	20,38
4	22,44	2,25	20,19
5	22,44	2,14	20,30
6	22,44	2,38	20,06
7	22,44	1,79	20,65
8	22,44	2,15	20,29
Average	22,44	2,11	20,33
%	100%	9,4%	90,6%

The right testicle of the control animal contained 11,45% or 1,24 g of interstitial tissues and 88,55% or 9,55 g of generative tissues (see Table 6). Interstitial Tissues: Generative Tissues=**1:7,7.**

Table 6. The right testicle of the Control Animal.

No. of the preparation	Total weight of the cardboard circle	Interstitial tissues	Generative tissues
1	22,44	2,80	19,64
2	22,44	2,67	19,77
3	22,44	2,40	20,04
4	22,44	2,22	20,22
5	22,44	2,65	19,79
6	22,44	2,52	19,92
7	22,44	3,09	19,35
8	22,44	2,19	20,25
Average	22,44	2,57	19,87
%	100%	11,45%	88,55%

When comparing both testicles of the control animal we see that the left testicle is larger than the right testicle by 49,2% and that this testicle contains 52,7% more of generative tissues. The difference in the quantitative relation between the interstitial tissues and the generative tissues of this testicle, when compared with the right testicle, shows an increase of 24,6% to the advantage of the generative tissues.

Comparing the quantitative relation between the interstitial tissues and the generative tissues in both testicles in all three dogs we find:

In the right testicle of the first dog experimented on an increase of 20,2% to the advantage of the generative tissues.

In the right testicle of the second dog experimented on an increase of 21,5% to the advantage of the generative tissues.

In the left testicle of the control animal an increase of 24,6% to the advantage of the generative tissues.

As these few numeric results are almost astonishingly identical it seems that it may perhaps not be too hasty to conclude from them that one-sided castration in adult dogs has no influence on the testicle remaining in the body of the animal. Such a conclusion may, moreover, be justified by the fact that similar results have been obtained in experiments with other animals. (Dogs — KYRLE, 1911; rabbits — LIPSCHÜTZ, 1922, 1923; mice — SALLER, 1933).

Summary.

Two adult dogs were submitted to one-sided castration and killed on the 63rd resp. the 77th day after the operation, after which the quantitative relations of the interstitial tissues and the generative tissues in the testicles of these dogs were calculated. The results were compared with those obtained from the testicles of the control animal, and it was found that the differences in the quantitative relations between the interstitial tissues and the generative tissues in the testicles of the dogs submitted to one-sided castration were the same as in dogs that had not been operated.

Acknowledgements. In conclusion may I be permitted to express my most heartfelt thanks to the Director of the Institute of Comparative Anatomy and Experimental Zoology, Prof. Dr. N. G. LEBEDINSKY, for the possibility granted to me of carrying out this work and for the kind supervision during the same. My thanks are also due to Dr. K. KAŅEPS for the performing of the operation in question.

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Vienpusējas kastrācijas iespaids uz ķermenī palikušo sēklinieku.

(Mēģinājumi ar suņiem.)

L. Sargunas.

Darba nolūks bija noskaidrot vienpusējas kastrācijas eventuālo iespaidu uz ķermenī palikušo sēklinieku pie pieaugušiem suņiem, piegriežot galveno vērību ģenerātīvo audu un starpaudu kvantitātīvajām attiecībām.

Kā materiāls izlietāti 3 pieauguši suņi.

Izdarīta vienpusēja kastrācija diviem suņiem, kas nonāvēti 63. un 77. dienā pēc operācijas, pēc kam ar kvantitātīvās histoloģiskās metodes palīdzību aprēķinātas starpaudu un ģenerātīvo audu attiecības šo suņu sēkliniekos. Iegūtie rezultāti salīdzināti ar kontroles dzīvnieka sēkliniekiem, pie kam izrādījās, ka puskastrēto suņu sēkliniekos starpaudu un ģenerātīvo audu attiecības ir tādas pat kā nekastrētajam sunim.