TESTICULAR HYPERTROPHY IN RATS

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(Received 3rd October 1969, revised 5th December 1969)

Experiments on hypertrophy of the testis have been carried out by Lipschutz (1922) who stated there was accelerated growth of the contralateral testis which rapidly reached maximum weight, but that no true hypertrophy occurred after unilateral orchidectomy. Grant (1955) stated that an increase in testicular volume occurred after unilateral orchidectomy in three albino rats. Shellabarger (1963) stated there was no increase in testicular weight after removal of a single testis. Being an endocrine organ, the interstitial cells, including Leydig cells, of the remaining testis should reflect the effects of unilateral castration. Since spermatogenesis is hormonally controlled, the seminiferous tubule might be expected to respond by enhancing gamete production as do solitary remaining ovaries after unilateral spaying. The present work was designed to re-examine the above observations.

One hundred and fifty Sprague-Dawley rats weighing 80 to 100 g were used in the experiments. The animals were divided into three groups. The control group (Group 1) consisted of fifty rats, which were weighed and kept for 4 weeks, and then killed and re-weighed at autopsy. The testes were also removed and weighed.

Group 2 consisted of fifty rats, each of which was subjected to right unilateral orchidectomy. These were killed 4 weeks later and weighed. The remaining testis was removed, weighed, fixed in Zenker's solution, sectioned at 6 μ thickness, and stained with haematoxylin and eosin.

Group 3 also consisted of fifty rats, each of which was subjected to right unilateral orchidectomy. Testosterone cypionate, 0·05 ml, was injected twice a week subcutaneously for a total of 10 mg testosterone weekly. These rats were then killed 4 weeks later and weighed. The remaining testes were weighed and fixed, and then sectioned and stained with haematoxylin and eosin.

The value was calculated by testicular weight over body weight of each animal (TW/BW in Table 1). All the testes were sectioned at right angles to their longitudinal axes at the widest point and a complete cross-section count of both the tubules and interstitial cells was made. The tubular diameters were then measured.

The average pre-operative body weight was 87 g for the rats in Group 1, 82 g for those in Group 2, and 83 g for those in Group 3, while the average weight at autopsy was 236 g, 212 g and 200 g, respectively.

The average weight for the left testis of rats in Group 1 at autopsy was 1·30 g, while the average weight of the remaining testis in Group 2 was 1·27 g,
and Group 3 was 1·06 g. Thus, averaging each animal's testicular weight over body weight gave the following values: Group 1, 0·538±0·013%; Group 2, 0·611±0·015%; Group 3, 0·548±0·013%. It can, thus, be seen that there is no appreciable difference in the values for the rats in Group 1 and Group 3.

The tubular count of the controls showed 854 in the left testis. In the Group 2 rats, the original tubular count of the right testis was 836, while that for the left testis at autopsy was 850. In the Group 3 rats, the original count of the right testis was 823, while that for the left testis at autopsy was 818. The tubular counts fall within the range of error indicating that there is no increase in testicular tubules in either the Group 2 or the Group 3 rats.

The average complete cross-section count of the interstitial cells in the controls was 863, while that for the Group 2 rats was 924, and for the Group 3 rats was 411. This shows a 7% increase in the interstitial cells of the Group 2 rats compared with the controls, and a 50% decrease in the interstitial cells in the Group 3 rats.

**Table 1**

**MEASUREMENT OF PARAMETERS CONNECTED WITH TESTICULAR HYPERTROPHY FOR RATS IN THREE DIFFERENT TREATMENT GROUPS**

<table>
<thead>
<tr>
<th>Treatment group</th>
<th>Body weight at autopsy (g)</th>
<th>Testicular weight at autopsy (g)</th>
<th>Interstitial cells</th>
<th>Tubular count</th>
<th>TW/BW* (°/o)</th>
<th>Tubular size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control—1</td>
<td>236</td>
<td>1·30</td>
<td>863</td>
<td>854</td>
<td>0·538±0·013†</td>
<td>0·12 to 0·15</td>
</tr>
<tr>
<td>Unilateral orchidectomy—2</td>
<td>212</td>
<td>1·27</td>
<td>924</td>
<td>830</td>
<td>0·611±0·015†</td>
<td>0·12 to 0·15</td>
</tr>
<tr>
<td>Unilateral orchidectomy plus testosterone—3</td>
<td>200</td>
<td>1·06</td>
<td>411</td>
<td>818</td>
<td>0·548±0·013†</td>
<td>0·10 to 0·15</td>
</tr>
</tbody>
</table>

* TW = testicular weight; BW = body weight.
† Group 2:3, P<0·01; Group 3:1, P>0·05; Group 2:1, P<0·05.

The seminiferous tubular diameter ranged from 0·15 to 0·12 mm in both Group 1 and Group 2 rats. In the Group 3 rats, it varied from 0·15 to 0·10 mm (see Table 1). Although attempts were made to section testes at right angles to their long axes, the cut of the tubules may have been slanted. Our findings were based on the average measurement on those tubules that were round, on the assumption that these were sectioned at right angles to the tubules.

Hypertrophy of the remaining organ after its mate has been removed has been discussed for various organs including the testis. It has been assumed that, in the testis, there would be either an accelerated growth or true hypertrophy following unilateral orchidectomy.

In the above experiments, there was definite hypertrophy of the contralateral testes of the rats in Group 2, both when the testicular weights were compared with Group 1, and also in calculating the value of testicular weight in relation to body weight between Group 1 and Group 2. It was found that there was no increase in the tubular count in Group 2 and Group 3 animals compared to the controls. The variation observed may be due to statistical error.

Clermont & Huckins (1961) found an approximately 300-fold increase in the
tubular length between the 17th day of embryonic life and full development. The basic plan of organization of the sex cords was maintained in the adult. It was concluded that there was no increase in the number of tubules, but only an increase in their size and length. Our findings seem to indicate that after the rat has become fully adult, the tubules do not undergo any further increase in diameter following unilateral orchidectomy. It is interesting that the interstitial cell count of the hypertrophied testis in Group 2 apparently showed an average increase of over 7% compared with the control Group 1, and this was fairly consistent for all the rats in both experimental groups. The increase in the weight of the testis after unilateral orchidectomy is probably due in part to the increase of the interstitial cells, and not to true hypertrophy of the tubules. This may explain why, if killed in old age where the interstitial cell count is not an important factor, the weight of the remaining testis in the unilaterally-orchidectomized rat and in the control rat may be approximately the same.

Clermont & Harvey (1967) stated that the spermatogenic process is neither slowed down nor accelerated by excess testosterone propionate. They did say that following an injection of testosterone (3 mg for 13 to 60 days), certain types of the spermatids will drop 20 to 40% below the normal value, but did not mention any increase or decrease in the interstitial cells.

In experiments involving the Group 3 rats, the relationship of body weight to testicular weight did not significantly increase compared with the controls, although in half the cases there was a relative decrease in testicular size compared with the controls. At the same time, however, there was a definite decrease in size of the rats, which brought the average body weight to testicular weight ratio within the limit of the control rats.

The average complete cross-section count of the seminiferous tubules of the Group 3 rats did not show any significant change in number or size, though those for the smaller testis present in half the rats of the group did seem to have a slight change in size, which corresponded to the smaller size of the rat. There was a distinct decrease in the interstitial cell count to approximately 50% that of the control count. This could be because testosterone injection causes suppression of interstitial cells.

It is uncertain how much of the increase in the size of the testis following unilateral orchidectomy is caused by an increase in the number of intratubular elements, such as spermatids and type A spermatogonia, or in the extratubular elements, such as the interstitial cells, compared with a true hypertrophy of the tubules themselves. It was also noted that, after the injection of testosterone, the average size of the rat decreased compared with the control rat and the rat subjected to unilateral orchidectomy, and that the fur texture changed from a smooth white to a rough white with a yellow tinge. No conclusion can be drawn from these observations at present.

REFERENCES


