The effects of pituitary gland, HCG, and Testosterone on the testis and spermatogenesis of the adult male toad (Bufo viridis)


Abstract:

Adult males of the toad Bufo viridis were injected with female pituitary glands, HCG and Testosterone, then testicular changes were histologically examined. pituitary glands and HCG treatment caused increase in the number of primary and secondary spermatogonia and decrease in the number of spermatocytes, spermatids and spermatozoa, but after injection of testosterone, the number of primary spermatogonia, spermatids, spermatozoa increased.

It therefor appears that HCG and pituitary gland have effects on the early stages of spermatogenesis while testosterone has stimulatory effect on the spermiation.

I Introduction:

A considerable number of studies have been performed on the regulatory mechanism of spermatogenesis in anurans, but the results reported have not always agreed in details. It is well known that the gonadal development of anurans larvae is greatly influenced by exogenous sex hormones. (Witschi, 1967). In Rana nigromaculata a sufficient amount of testosterone is needed for development of later stages of spermatogenesis and sperm preservation.

(Blair, 1946 - Iwasawa, 1985, 1986). Spermatogenetic activity has been found to resume in late spring when the concentration of androgens (testosterone plus dihydro testosterone) in the plasma is low, less than 5μg/ml (Licht, 1983 - Moore, 1980). Castration studies have provided further direct evidence for relationship between pituitary and gonadal function in the bullfrog. After castration, there is typically a gradual rise in both FSH and LH which is detectable at about 4-7 days. These data indicate that gonadal secretions (steroids?) not only influence generally pituitary secretion rate, but also the relative responsiveness of the two gonadotropins (Licht, 1985). On the other hand in anurans, there also exists a considerable literature on the effects of hypophysectomy on histological changes in testis (Lofts, 1974). Iwasawa found that in Rana nigromaculata hypophysectomy presents
spermatogonial proliferation, but has no noticeable
effect in the progress of spermatogenesis and the
maintenance of spermatozoa (Iwasawa, 1976).
Guha (et. al, 1978) demonstrated that
gonadotropin independence during the process of
spermatogenesis in the toad is acquired late in the
secondary spermatogonial phase. These data show
that the process of spermatogenesis and
development of the testis are related to
synchronous changes of plasma gonadotropins
and androgens. To analyze the effect of exogenous
gonadotropins and testosterone in Bufo viridis, the
present work was undertaken.

II Materials and Methods:

All experiments were performed on the adult
male toads of Bufo viridis collected from suburb
of Tehran with body weight 27-30g and body
length 6-7.5 cm. Room temperature was
maintained at 20-25°C and photoperiod of
12L:12D suggested by Iwasawa was used
(Iwasawa, 1984). pieces of sheep liver were
offered to the animals every 3 day as food. we
have done four experiments and in each
experiment, groups of 3 toads were studied. The
doses of administered hormones to each toad are
shown in tables 1,2,3. The pituitary glands used in
the present study were obtained from adult female
Bufo viridis and homogenized in the 0.64% NaCl
solution (Humasan, 1972). The male toads
received two female pituitary glands per day for
three successive days. The human chorionic
gonadotropin (HCG) was obtained from
I.F.SERONO S.P.A. Company. This hormone
was dissolved in the 0.64% NaCl for injection.
Testosterone hormone was obtained from
Aboreihan Company. The Testosterone
concentration was reduced by dissolving the
hormone in olive oil. 24 hour after injection of
female pituitary gland or HCG, and three days
after injection of testosterone, the testes of each
toad were fixed in bouin's solution. Then
embedded in paraffin wax. Serial sections were
cut crossly with 6μm thickness and stained with
Mayer's hematoxylin and eosin. The degree of
histological changes was judged quantitatively in
15 cross sections of testes, diameter of
seminiferous tubules were measured and the
number of spermatogenic cells were counted. The
results were tested statistically for significance by
student t-test and analysis of variance.

III results:

Pituitary - treated group: After administration of
6 pituitary glands depigmentation was observed in
the most part of the testis. Testes became enlarged
and seminiferous tubules in these enlarged testes
were expanded and became transparent, as they
were clearly seen with naked eye. In histological
studies, after administration of 2 pituitary glands,
noticeable changes were not found in the number
of the nest of spermatogenic cells, while in groups
that were treated with 4 and 6 pituitary glands, the
number of primary and secondary spermatogonia
increased significantly (Figs 1,2,3). The number
of spermatids and spermatozoa in the toads treated
with 4 pituitary glands decreased (Table 1).

HCG-treated group: The size of left and right
testes was not equal and generally one testis
Table 1: Experimental procedure and results of t-test student diameter of seminiferous tubules and the number of spermatogenic cells after injection of HCG. (Mean ± SD)

<table>
<thead>
<tr>
<th>Group</th>
<th>Diameter of seminiferous tubules (µ)</th>
<th>Primary spermatogonia</th>
<th>Secondary spermatogonia</th>
<th>Primary spermatocytes</th>
<th>spermatids</th>
<th>spermatooza</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>217.6±24.9</td>
<td>5.92±3.61</td>
<td>3.01±2.27</td>
<td>1.88±1.20</td>
<td>0.95±0.89</td>
<td>7.55±3.1</td>
</tr>
<tr>
<td>2 Pituitary</td>
<td>228.1±22.16</td>
<td>3.81±0.84</td>
<td>2.50±0.92</td>
<td>1.33±0.83</td>
<td>0.66±0.31</td>
<td>7.03±1.69</td>
</tr>
<tr>
<td>P</td>
<td>0.1</td>
<td>0.05</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Control</td>
<td>221.05±30.60</td>
<td>4.71±2.65</td>
<td>2.09±1.34</td>
<td>3.55±2</td>
<td>2.35±1.59</td>
<td>8.47±1.97</td>
</tr>
<tr>
<td>4 Pituitary</td>
<td>254.5±50.99</td>
<td>8.22±2.02</td>
<td>2.94±2.38</td>
<td>3.61±2.18</td>
<td>1.32±3.98</td>
<td>6.68±1.87</td>
</tr>
<tr>
<td>P</td>
<td>0.05</td>
<td>0.01</td>
<td>0.1</td>
<td>0.1</td>
<td>0.01</td>
<td>0.05</td>
</tr>
<tr>
<td>Control</td>
<td>221.6±30.98</td>
<td>3.05±2.20</td>
<td>2.19±1.76</td>
<td>4.82±1.73</td>
<td>2.3±1.5</td>
<td>9.3±2.56</td>
</tr>
<tr>
<td>6 Pituitary</td>
<td>263.8±36.02</td>
<td>5.23±1.40</td>
<td>4.94±1.58</td>
<td>5.25±0.99</td>
<td>2.27±1.30</td>
<td>8.29±2.89</td>
</tr>
<tr>
<td>P</td>
<td>0.01</td>
<td>0.01</td>
<td>0.001</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Table 2: Experimental procedure and results of variance diameter of seminiferous tubules and the number of spermatogenic cells after injection of HCG (Mean ± SD).

<table>
<thead>
<tr>
<th>Group</th>
<th>Diameter of seminiferous tubules (µ)</th>
<th>Primary spermatogonia</th>
<th>Secondary spermatogonia</th>
<th>Primary spermatocytes</th>
<th>spermatids</th>
<th>spermatooza</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>208.61±31.95</td>
<td>4.53±1.96</td>
<td>1.8±2.46</td>
<td>4.87±1.21</td>
<td>4.13±3.41</td>
<td>9.2±4.31</td>
</tr>
<tr>
<td>25 IU HCG</td>
<td>244.61±27.01</td>
<td>6.01±2.4</td>
<td>2.47±1.26</td>
<td>2.53±1.47</td>
<td>0.45±0.60</td>
<td>6.05±1.84</td>
</tr>
<tr>
<td>50 IU HCG</td>
<td>238.9±23.1</td>
<td>5.04±2.25</td>
<td>1.89±1.1</td>
<td>0.2±0.35</td>
<td>4.74±1.97</td>
<td>7.29±2.44</td>
</tr>
<tr>
<td>100 IU HCG</td>
<td>247.5±56.32</td>
<td>7.14±2.28</td>
<td>3.69±2.32</td>
<td>1.44±1.65</td>
<td>1.48±0.86</td>
<td>8.26±2.00</td>
</tr>
<tr>
<td>F</td>
<td>3.52</td>
<td>4.018</td>
<td>2.82</td>
<td>7.164</td>
<td>12.45</td>
<td>3.41</td>
</tr>
<tr>
<td>P</td>
<td>0.05</td>
<td>0.01</td>
<td>0.05</td>
<td>0.001</td>
<td>0.001</td>
<td>0.05</td>
</tr>
<tr>
<td>dr</td>
<td>27</td>
<td>1.63</td>
<td>1.8</td>
<td>2.06</td>
<td>1.64</td>
<td>2.06</td>
</tr>
</tbody>
</table>
Table 3: Experimental procedure and results of analysis of variance diameter of seminiferous tubules and the number of spermatogenic cells after injection of testosterone. (Mean ± SI)

<table>
<thead>
<tr>
<th>Group</th>
<th>Diameter of seminiferous tubules (μ)</th>
<th>Primary spermatagonia</th>
<th>Secondary spermatagonia</th>
<th>Primary spermatocytes</th>
<th>spermatids</th>
<th>spermatogonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>216.52±28.54</td>
<td>4.69±1.75</td>
<td>6.72±3.64</td>
<td>2.19±1.84</td>
<td>1.72±1.1</td>
<td>11.02±4.18</td>
</tr>
<tr>
<td>Testosterone (0.5)</td>
<td>255.65±39.59</td>
<td>5.53±1.56</td>
<td>7.31±2.68</td>
<td>7.27±1.81</td>
<td>2.91±1.45</td>
<td>10.99±4.01</td>
</tr>
<tr>
<td>μg/BW/day</td>
<td>257.49±31.62</td>
<td>5.73±1.62</td>
<td>5.1±1.37</td>
<td>6.1±2.51</td>
<td>4.35±1.38</td>
<td>11.48±3.62</td>
</tr>
<tr>
<td>Testosterone (2.5)</td>
<td>259.71±43.02</td>
<td>5.73±1.62</td>
<td>4.86±1.28</td>
<td>6.08±2.57</td>
<td>5.48±1.38</td>
<td>11.48±3.62</td>
</tr>
<tr>
<td>Testosterone (5)</td>
<td>245.45±21.03</td>
<td>6.51±1.30</td>
<td>1.99±1.39</td>
<td>3.55±1.75</td>
<td>5.31±1.50</td>
<td>17.11±2.31</td>
</tr>
<tr>
<td>P</td>
<td>24.60</td>
<td>1.15</td>
<td>1.66</td>
<td>1.55</td>
<td>1.04</td>
<td>3.11</td>
</tr>
<tr>
<td>P</td>
<td>24.60</td>
<td>1.15</td>
<td>1.66</td>
<td>1.55</td>
<td>1.04</td>
<td>3.11</td>
</tr>
<tr>
<td>P</td>
<td>24.60</td>
<td>1.15</td>
<td>1.66</td>
<td>1.55</td>
<td>1.04</td>
<td>3.11</td>
</tr>
</tbody>
</table>
FIGS. 1–6: Cross sections of testes. Magnification is the same in all photomicrographs. (1) In control, all of germ cells in spermatogenesis are seen. (2,3) Pituitary gland injection. Secondary spermatogonia, primary spermatocytes and spermatids are seen. (2) After 4 pituitary glands injection. (3) After 6 pituitary glands injection. (4,6) HCG - treated toads. Spermatogenesis is stimulated. (4). 25 IU HCG - treated toad. (5) 50 IU HCG - treated toads. (6) 100 IU HCG - treated toad.

FIGS. 7, 8: Cross sections of testes. Testosterone - treated toads. (7) After injection of 5 μg / BWg / day testosterone, spermatocytes spermatids spermatozoa are seen. (8) After injection of 10 μg / BWg / day testosterone, Numerous spermatozoa are seen.
FIGS. 1–6: Cross sections of testes. Magnification is the same in all photomicrographs. (1) in control, all of germ cells in spermatogenesis are seen. (2,3) Pituitary gland injection. Secondary spermatogonia, primary spermatocytes and spermatids are seen. (2) After 4 pituitary glands injection. (3) After 6 pituitary glands injection. (4,6) HCG - treated toads. Spermatogenesis is stimulated. (4). 25 IU HCG - treated toad. (5) 50 IU HCG - treated toads. (6) 100 IU HCG - treated toad.

FIGS. 7, 8: Cross sections of testes. Testosterone - treated toads. (7) After injection of 5 μg / BWg / day testosterone, spermatocytes spermatids spermatozoa are seen. (8) After injection of 10 μg / BWg / day testosterone, Numerous spermatozoa are seen.
enlarged (depigmentation was observed in enlarged one.) As it has been shown in table 2, the seminiferous tubules have expanded noticeably in 100IU HCG-treated group. After treatment with HCG, the number of primary and secondary spermatogonia increased and conversely the number of primary spermatocytes, spermatids and spermatozoa decreased (Figs.4,5,6).

In the groups, treated with 50 IU HCG, the number of primary spermatocyte was significantly less than other groups.

Testosterone-treated group: Depigmentation was clearly seen in groups treated with 2.5µg/gBW/day testosterone. Maximum increase in the lumen of seminiferous tubules was observed in the toads treated with 5µg/gBW/day testosterone. After administration of 10µg testosterone, a noticeable decrease in the tubular lumen relative to the other

groups occurred. Comparing with control group, the number of primary spermatogonia, spermatids and spermatozoa were increased and the number of secondary spermatogonia and primary spermatocytes decreased (Figs. 7,8).

Comparing experimental groups with each other showed that increased amount of administered testosterone caused decrease in the number of secondary spermatogonia, spermatids and increase in the number of spermatozoa (Table 3).

Changes in the number of germ cells are shown in Figs. 9-11.

In addition to microscopic changes, we examined male sexual responsiveness. Increase in occurrence of claspers was used as an indicator of male sexual behavior. 24 hour after injection 4 pituitary glands, or 200 IU HCG
IV Discussion

External observation in the testes of the toads treated with pituitary gland or HCG showed enlargement and depigmentation. It is concluded that depigmentation is related to expansion of the seminiferous tubules and disturbance of interstitial tissue. The results of histological studies reveal that after administration of the pituitary glands, the number of primary and secondary spermatogonia increase while the number of spermatids and spermatozoa do not change. We have seen mobile spermatozoa in the urine of the male toads in the end of each experimental period. Since the number of spermarids and spermatozoa did not change, in spite of increase in the number of primary and secondary spermatogonia, it can be concluded that spermatozoa are liberated from seminiferous tubules. Therefore it appears that administration of specific number of pituitary gland induces spermiation in addition to increase in the number of the primary and secondary spermatogonia. The results of HCG-treated group reveal that after

exhibited clasping behavior, also the male toads received daily 0.25 mg testosterone accompanying 50 IU HCG for 4 days showed clasping, but testosterone injection alone for 12 days failed to restore courtship behavior.
treatment with HCG, not only the number of secondary spermatogonia increases, but also spermatogenic process is induced. Spermiation in 100 IU HCG-treated group is significant compared with the other HCG-treated groups. This finding suggests that different doses of HCG have different effects, a high dose of HCG, in addition to stimulation of spermatogonia proliferation, induces spermiation. Also with regard to chemical similarity between HCG and LH, probably, HCG has a stimulatory effect on the testosterone secretion of the gonads. Presumably this effect may happen with a higher dose of HCG. It seems that stimulation of spermiation after 100 IU HCG administration is related with stimulation of testosterone secretion. Since injection of special dose of testosterone alone causes increase in the number of primary spermatogonia, spermatids or spermatozoa, therefore it seems that changes in the number of spermatogenic cells is relative to specific dose of testosterone. It is noticeable that, after administration of 10μg testosterone diameter of the seminiferous tubules decrease. This result maybe attributable to liberation of spermatozoa from seminiferous tubules in this group.

Acknowledgment

The authors wish to thank Dr R.A Khavari - Nejad for his effort in statistical analysis and also wish to thank Dr A.Haeri Rohani for his advice.

References


