THE FAILURE OF THE PINEAL GLAND REMOVAL
IN NEONATAL ANIMALS
TO INFLUENCE REPRODUCTION

By
Fred A. Kincl and G. Benagiano

ABSTRACT

One and five day old male and female rats were pinealectomized and their reproductive function studied when they matured. In females the fertility index was similar to untreated or sham operated groups. However, the females matured 8 to 9 days earlier as evidenced by the opening of the vaginal membrane. In males pinealectomy had no influence on testes development and accessory sex tissue weights. It is concluded that the regulatory function of the pineal gland with respect to gonadal function is a minor one.

There has been suspicion that the pineal gland in mammals may play a role in the mechanism(s) concerned with the regulation of gonadal functions, but the evidence has been ambiguous. In man some cases of delayed puberty were attributed to tumours of corpus pineale, whereas in other decreased function of this gland caused by teratomas was stated to be the reason for precocious puberty (Kitay & Altschule 1954). In rats the gland was credited with regulating the incidence of vaginal cornification induced by constant illumination (Gittes & Chu 1965). Melatonin, a substance synthesized specifically by this organ, was said to have this function (Chu et al. 1964; Melisaac et al. 1965). It was also reported that repeated injections of this substance caused atrophy of the pituitary gland and gonads in mature females (Adams et al. 1965), and males (Reiss et al. 1963; Thieblot & Blaise 1963; Hoffman & Reiter 1965).

On the basis of these observations the epiphysis was called a true endocrine
gland and melatonin a hormone playing a role in regulating gonadal function (Wurtman & Axelrod 1965).

On the other hand, Ebels & Prop (1965) in a carefully designed study were unable to substantiate these findings. They injected 150 µg of melatonin daily into rats exposed to continuous illumination and found that this did not affect gonadal weights of the oestrus cycle.

This communication reports on experiments designed to investigate the function of the gonads in pinealectomized neonatal rats. Similar experiments in hamsters failed to show any influence of pinealectomy on the function of the gonads.

MATERIALS AND METHODS

Infant rats were subjected to surgery at approximately 24 hours or 5 days of age. The younger animals were prepared for surgery by hypothermia, the older animals were anaesthetized with ether. After surgery all animals were kept without further treatment. Vaginal smears were taken from day 60 to 70 of life. Afterwards, the females were caged with normal males for 10 days to study fertility. The fertility index in pinealectomised males was not studied. Instead the weights of gonads, accessory sex tissues and microscopic evaluation of testes was used. At autopsy the cranium was opened and checked macroscopically for completeness of pinealectomy.

RESULTS AND DISCUSSION

Fertility and oestrus incidence of female rats pinealectomized on day 1 or 5 of life is shown in Table 1. As is apparent from Table 1, the removal of the

<table>
<thead>
<tr>
<th>Age in days at pinealectomy</th>
<th>No. of animals</th>
<th>Percentage oestrus incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fertile</td>
<td>Total</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 1.
The effect of pinealectomy on fertility and vaginal cycling of female rats.

a Wistar strain.

* Unpublished experiments.

** Some of the experiments here reported were done at the Endocrine Laboratories, Madison, Wisconsin under the supervision of Dr. Elva G. Shipley.

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gland whether on day 1 or 5 of life, had no influence on the incidence of cycling changes of the vaginal epithelium. The litter size of rats in the treated groups was normal and ranged from 7 to 13 which was similar to unoperated controls. The sex distribution of offspring was apparently normal. Females which did not conceive within the 10 days breeding period all had well developed ovaries, containing many recent corpora lutea. Hence the failure to breed cannot be attributed to the treatment.

Results of detailed study on both males and females autopsied at the age of 60 days is presented in Tables 2 and 3. In males the only noticeable effects were increased body weights seen in animals pinealectomized on day 5 of life. In this group accelerated body growth was also reflected in increased weight of the testes, ventral prostate and seminal vesicles. The seminiferous epithelium was mature and free sperms were frequently seen in the lumina. Females

\[\text{Table 2.}\]
The effect of pinealectomy on organ weights in 60 day old male rats*.

<table>
<thead>
<tr>
<th>Age in days at pinealectomy</th>
<th>No. of animals</th>
<th>Body wt., g ± S. E.</th>
<th>Tissue weights, mg ± S. E.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Testes</td>
<td>Ventral prostate</td>
</tr>
<tr>
<td>0</td>
<td>8</td>
<td>211 ± 6</td>
<td>2270 ± 18</td>
</tr>
<tr>
<td>1*</td>
<td>6</td>
<td>240 ± 4</td>
<td>2820 ± 57</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>238 ± 7</td>
<td>2800 ± 40</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>271 ± 6</td>
<td>2950 ± 34</td>
</tr>
</tbody>
</table>

* Sprague-Dawley strain.

\[\text{Table 3.}\]
The effect of pinealectomy on organ weights in 60 day old female rats*.

<table>
<thead>
<tr>
<th>Age in days at pinealectomy</th>
<th>Body wt., g ± S. E.</th>
<th>Ovarian response**</th>
<th>Vaginal introitus days ± S. E.</th>
<th>Average No. of C. L. ± S. E.</th>
<th>Ovaries</th>
<th>Uterus</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>165 ± 5</td>
<td>9/10</td>
<td>46 ± 2.5</td>
<td>12.2 ± 1.6</td>
<td>52.7 ± 4.9</td>
<td>229 ± 24</td>
</tr>
<tr>
<td>1*</td>
<td>163 ± 2</td>
<td>8/8</td>
<td>41 ± 2.5</td>
<td>14.0 ± 0.9</td>
<td>59.0 ± 3.4</td>
<td>221 ± 16</td>
</tr>
<tr>
<td>1</td>
<td>189 ± 1</td>
<td>8/8</td>
<td>37 ± 0.7</td>
<td>16.1 ± 1.6</td>
<td>70.2 ± 3.7</td>
<td>299 ± 24</td>
</tr>
<tr>
<td>5</td>
<td>185 ± 3</td>
<td>9/9</td>
<td>38 ± 1.8</td>
<td>16.9 ± 1.3</td>
<td>71.6 ± 2.7</td>
<td>322 ± 23</td>
</tr>
</tbody>
</table>

* Sprague-Dawley strain.

** Ovarian response = Number of rats with corpora lutea (C. L.)/total number of rats.

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pinealectomized on day 5 of life as well as on day 1 of life were heavier than controls. The vaginal membrane in these two groups opened earlier than in controls; the difference was 8 and 9 days respectively which represents roughly two cycles.

From these preliminary studies it appears that the regulatory function, if any, of the pineal gland in the rat with respect to the gonads is a minor one. Its extirpation, as early as the first day of life, has no apparent adverse effects, and the animals are able to reproduce. It has some inhibitory action on puberty as evidenced by earlier opening of the vagina in the pinealectomized females. The increase in body weights, which hitherto has not been reported may also be of importance. Further experiments on the influence of pinealectomy in neonatal rats on the function of the other endocrine organs are in progress.

REFERENCES


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