Effect of photic changes and olfactory impairment on reproduction in female 
South Indian gerbil

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Effect of exposure to constant light (CL), blinding and olfactory bulbectomy (OBX) on reproduction of adult and weanling female Taterra indica cuvieri was investigated. In adult females, CL induced changes in estrus cyclicity. Weanlings subjected to CL showed reduced ovarian weight. Blinding did not bring about changes in estrus cyclicity and reproductive organ weight (ovary and uterus) of either adults or weanlings. Estrus cyclicity of both adults and weanlings were affected consequent to OBX. In weanlings, OBX lowered the ovarian and uterine weight.

Reproductive cyclicity of female mammals is influenced by environmental factors, especially photic and olfactory cues. Photic cues are found to influence reproduction in female rodents. Constant light disrupts estrous cycle in laboratory rats as indicated by persistent estrus, and reduced the ovarian weight. State of constant darkness such as blinding adversely affects reproduction in female rats, hamsters and mice. Blinding reduces uterine and ovarian weight in laboratory rats and uterine weight in hamsters. Weanling hamsters subjected to constant darkness exhibit delayed vaginal opening and low ovarian and uterine weight.

Though olfactory cues have been found to influence female reproductive physiology of rodents, the impact of olfactory impairment is varied. Bilateral olfactory bulbectomy eliminates the female voles's preference for familiar males. In mice it results in irregular estrous cycles, and prevents the shortening of estrous cycle in the presence of males. By contrast, in laboratory rats, bilateral olfactory bulbectomy does not disrupt the estrous cycle. Olfactory bulbectomy is reported to reduce ovarian weight in rats and mice. However, according to Moss, olfactory bulbectomy of rats does not bring about any change in the weight of ovaries.

The present investigation attempts to elucidate the effect of constant light, blinding (constant darkness) and olfactory bulbectomy on estrous cycle, reproductive organ weight and onset of sexual maturity in this species.

Materials and Methods
Adult females (150-160 g) showing regular estrous cycle and 30 days old weanlings were employed in the investigations. All animals were individually housed in polypolypropylene cages under natural ambient temperature and photoperiod. Wood shavings and paper bits were used for bedding. Animals were maintained on laboratory rat feed and water ad libitum.

For exposure to constant light (CL), the animals were kept continuously under a fluorescent light source (4500 lux). Blinding (constant darkness) was induced by administering 0.2-0.3 ml of absolute alcohol (Merck, Germany) into vitreous chamber of eye under mild ether anaesthesia. Following this an antiseptic ointment was applied on the eye. Success of blinding was later confirmed by behavioural tests.

Olfactory bulbectomy (OBX) and sham operation (SOBX) were conducted according to the method described earlier. For this, animals were anaesthetised with pentabarbitol sodium and after exposing the skull, three narrow cuts were made over the region of olfactory bulbs with a dental bit. This piece of the skull
bone with one side intact, was gently lifted and olfactory bulbs were removed using a fine bent forceps. Success of the surgery was ascertained by behavioural tests.

Vaginal smears of females were monitored daily for 24 days, prior to experimentation and again from the 7th day onwards following exposure to CL/blinding/OBX. To evaluate the effect of CL/blinding/OBX on onset of sexual maturity, data on the age of vaginal opening and occurrence of estrous cycle was collected.

Adult animals were sacrificed 90 days after surgery and the weanlings at 150 days of age, and the weight of the ovary and uterus were recorded.

Data was analyzed by Student’s t test and non-parametric statistical techniques such as Fisher exact probabilities test, Wilcoxon Signed Rank test and Wilcoxon-Mann-Whitney test.

Results

Constant light increased the duration of proestrus stage in adult females (Table 1), while all the females continued to show estrous cycle (Table 2). Though reproductive organ weight remained unaltered among adults exposed to CL (Fig. 1), ovarian weight was reduced in weanlings raised under CL (Fig. 2).

Blinding of adult females did not adversely affect their estrus cyclicity (Tables 1, 2) or weight of the reproductive organs (Fig. 1). Blinding effects on weanlings were similar to those of adults (Table 2, Fig. 2).

After olfactory bulbectomy, majority (5/7) of adult females failed to show regular estrous cycle (Table 2) and exhibited prolonged diestrus (Table 1). Among weanlings, bulbectomy reduced the proportion of individuals showing estrous cycle (Table 2). Ovarian and uterine weight was also reduced in weanlings (Fig. 2).

Discussion

Photoperiod is one of the most important environmental factors influencing reproduction. T. indica cuvieri females exposed to CL showed changes in estrous cyclicity. Proestrus stage, the sexually receptive stage, was prolonged consequent to CL. Generally, the females of this species become receptive to males on proestrus day soon after onset of darkness. However, in adult females exposed to CL, the receptivity period was shifted to morning following the proestrus, obviously, indicating changes in the circadian periodicities of estrous cyclicity. In laboratory rats, exposure to CL results in persistent estrus7. Such a persistent estrus was not observed either in adults or weanlings of T. indica cuvieri exposed to CL.

\[ \text{Fig. 1—Uterine and ovarian weights of adult T. indica cuvieri subjected to CL, blinding and OBX (Bars represent \pm SE values)} \]

\[ \text{NS—Not significant, Student’s t test, two tailed} \]

<table>
<thead>
<tr>
<th>Group</th>
<th>Proestrus (mg)</th>
<th>Estrus (mg)</th>
<th>Metestrus (mg)</th>
<th>Diestrus (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before exposure to CL (n = 10)</td>
<td>5.6 ± 0.3</td>
<td>5.3 ± 0.3</td>
<td>3.3 ± 0.3</td>
<td>9.8 ± 0.8</td>
</tr>
<tr>
<td>After exposure to CL (n = 10)</td>
<td>7.3 ± 0.3</td>
<td>4.9 ± 0.3</td>
<td>2.7 ± 0.4</td>
<td>9.1 ± 0.8</td>
</tr>
<tr>
<td>Before blinding (n = 6)</td>
<td>5.8 ± 0.3</td>
<td>4.8 ± 0.7</td>
<td>3.3 ± 0.5</td>
<td>10.0 ± 0.7</td>
</tr>
<tr>
<td>After blinding (n = 6)</td>
<td>5.3 ± 0.6</td>
<td>4.7 ± 0.4</td>
<td>3.4 ± 0.3</td>
<td>9.7 ± 0.5</td>
</tr>
<tr>
<td>Before OBX (n = 7)</td>
<td>5.5 ± 0.4</td>
<td>5.4 ± 0.4</td>
<td>3.4 ± 0.3</td>
<td>9.9 ± 0.3</td>
</tr>
<tr>
<td>After OBX (n = 7)</td>
<td>2.6 ± 0.2</td>
<td>1.6 ± 0.3</td>
<td>0.9 ± 0.5</td>
<td>18.9 ± 0.2</td>
</tr>
<tr>
<td>Before SOBX (n = 7)</td>
<td>5.7 ± 0.5</td>
<td>4.9 ± 0.6</td>
<td>3.5 ± 0.3</td>
<td>9.8 ± 0.7</td>
</tr>
<tr>
<td>After SOBX (n = 7)</td>
<td>5.5 ± 0.3</td>
<td>5.0 ± 0.1</td>
<td>3.7 ± 0.8</td>
<td>9.8 ± 0.7</td>
</tr>
</tbody>
</table>

Statistical comparisons were made using Wilcoxon signed rank test (two tailed)

NS—Not significant, *P<0.01, **P<0.001
Table 2—Regular estrous cycle and vaginal opening of *Tatera indica cuvieri*

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Exposed to CL</th>
<th>Blinding</th>
<th>Sham OBX</th>
<th>OBX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adult Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular estrous cycle**</td>
<td>10/10</td>
<td>8/6</td>
<td>7/7</td>
<td>2/7+</td>
<td></td>
</tr>
<tr>
<td>Weanling</td>
<td>9/10</td>
<td>8/10</td>
<td>9/10</td>
<td>8/10</td>
<td>2/10+</td>
</tr>
<tr>
<td>Age of vaginal opening <em>(days)</em></td>
<td>93.8 ± 9.2</td>
<td>92.8 ± 7.7NS</td>
<td>103.0 ± 9.1NS</td>
<td>92.7 ± 9.0NS</td>
<td>73.6 ± 5.7NS</td>
</tr>
</tbody>
</table>

**Values indicate proportion [**P**<0.01], Fisher exact probabilities test (two tailed)
*Wilcoxon-Mann-Whitney test (one tailed)
NS—not significant

Fig. 2—Uterus and ovarian weights of weanling *Tatera indica cuvieri* subjected to CL, blinding and OBX (Bars represent ± SE values). Student's *t* test [NS—Not significant, +P<0.005, **P<0.001].

CL failed to induce significant changes in ovarian and uterine weight of adult females, but the ovarian weight was lowered in weanlings. However, in laboratory rats, CL is reported to increase uterine weight and decrease ovarian weight. Maturational indicators, viz. onset of first estrous (Table 2) and age at vaginal opening (Table 2) remained unaltered in CL exposed gerbils.

As reported in laboratory rats, binding fails to elicit any noticeable change on the estrous cycle of either adults or weanlings of *T. indica cuvieri*. However, in golden hamsters aphotic condition leads to elimination of estrus. Reproductive organ weight of adult *T. indica cuvieri* remained unaffected after blinding. In hamsters and rats, binding induces reduction in ovarian weight with uterine weight remaining unaffected.

Blinded gerbil weanlings, in the present study, did not show any delay in onset of sexual maturation (Table 2). Reiter and Ellison have reported that in young laboratory rats blinding does not influence the age at vaginal opening and ovarian weight, though uterine weight is considerably reduced. However, other reports indicate that exposure to constant darkness results in delay in vaginal opening and reduction in ovarian weight in laboratory rats, with several females displaying prolong diestrus. In mice and hamsters, OBX results in irregular estrous cycle. In voles, which are induced ovulators, OBX prevents estrous and subsequent ovulation.

Absence of any effect on ovarian and uterine weight in adult OBX gerbils as noticed in this study is consistent with the reports in rats. However, in weanlings of *T. indica cuvieri*, OBX induced significant decrease in ovarian and uterine weight. This is consistent with the report in young rats.
References

26. Carter C S, Physiol Behav, 10 (1973) 47.