Effect of constant light, blinding, castration or pinealectomy on gonadal and accessory organ weights (Mean + SE) in male gerbils

Treatment	N	BW (g)	Testes (mg)	Accessory organs (mg)
Controls	11	76.3 ± 2.5	1249 ± 37	247.5 ± 19.4
Constant light	4	72.8 ± 1.6	1073 ± 34[b]	159.0 ± 11.0[b]
Blind	5	72.3 ± 3.7	1098 ± 27[b]	179.4 ± 10.1[b]
Castrate	2	102.5 ± 16.5	—	3.9 ± 0.3[c]
Pinealectomy	5	74.4 ± 5.3	1146 ± 45	173.6 ± 19.7[a]

[a] $P < 0.02$ vs. controls. [b] $P < 0.01$ vs. controls. [c] $P < 0.001$ vs. controls.

significant differences in body or testicular weights were noted, although accessory organ weights were slightly depressed (Table). Either blinding or maintenance under constant light caused a significant reduction in testes and accessory organ weights when these organs were compared to those of control animals. However, in experiment 3, breeding pairs of gerbils maintained under constant light for their entire reproductive life span showed no impairment of breeding capability as measured by total number of litters produced, number of young per litter, ability to raise young to weaning, or occurrence of postpartum estrus.

The data relating to body weight and ovarian and uterine weights of female gerbils from the first experiment agree with previously published normal growth data for similarly-aged female gerbils[9]. The literature concerning chronic administration of melatonin to normal male or female rats is controversial with references supporting a progonadotrophic, antigonadotrophic or no effect on the gonads and accessory organs[2]. In some species, such as the ferret[10], melatonin delayed estrus despite exposure to long photoperiods, while in the weasel[11], melatonin decreased testis size as measured by palpation. The present data indicate that melatonin is antigonadotrophic in male and female gerbils. Whether other pineal indoles or polypeptides would also inhibit reproductive organ growth is unknown. The observation that the thymuses or melatonin-treated males were significantly elevated while accessory organs were depressed is consistent with the hypothesis that there were less circulating androgen levels.

Blinding in some species such as the hamster leads to dramatic involution of the testes as well as the accessory organs. In the rat, however, blinding alone has little or no effect of testicular weight unless it is combined with other potentiating procedures such as anosmia, androgen sterilization or underfeeding[2]. Gonadal weights of blinded gerbils were significantly reduced but total involution, as previously seen in the hamster[2], was not observed. Although constant light also apparently depressed reproductive organ growth, supporting data from the breeding colony indicate that pairs maintained under constant illumination are fully capable of producing as many litters as pairs in alternating light-dark conditions, in our colony and as previously described in the literature[12]. Whether blinded gerbils are capable of reproducing has not yet been investigated.

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Proestrous Gonadotropin Levels in Thyroparathyroidectomized Female Rats

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Summary. Intact and TPTx animals showed the expected afternoon increase in serum LH, FSH and prolactin levels. But the afternoon increase in serum LH levels in TPTx rats was less than that observed for intact animals ($p<0.01$). Neither serum prolactin nor FSH levels were altered by TPTx.

Increasing evidence implicates thyroxine as a phasing agent for several rhythmic endocrine functions[4-6]. We previously reported that thyroidectomy in the female was followed by a reduction in the number of eggs ovulated[7] and recently we observed a marked phase shift in the LH and prolactin rhythms in male rats after thyroidectomy[6].

The present study was undertaken to evaluate the effect of thyroidectomy on the serum proestrous pattern of circulating gonadotropins in the female rat.

Materials and methods. Only adult female Sprague-Dawley (Charles River, CD) rats housed under conditions of controlled lighting (fluorescent illumination from 04.00 to 18.00 h) and temperature (24 ± 2 °C) were used in the present study. Thyroparathyroidectomy (TPTx) was performed surgically at approximately 40 days of age. 30 days later blood collection procedures for obtaining serum LH, FSH and prolactin were initiated. After surgery TPTx rats were indiscriminately housed 2/cage with intact or TPTx animals. Vaginal smears were taken 6 days a week. This served not only to assess the ovarian cycle but also to familiarize the animals with activity in the animal quarters, opening of their cage, and removal from the cage. All treatment and collection procedures, assigned and carried out according to a randomized block design, were done outside the animal quarters. Purina Laboratory Chow and tap water were available ad libitum.

The methods used to assess non-stress serum levels of LH, FSH and prolactin were similar to those described previously[8].

Non-stress blood samples were obtained by removing rats individually from the animal quarters at 08.00, 10.00, 13.00, 16.00 and 20.00 h on the day of proestrous to an adjacent preparation room where they were rapidly decapitated (<20 sec following cage opening). Blood from the trunk was collected and centrifuged following clot formation. Serum was removed, frozen and stored for subsequent analysis. Immediately after decapitation a vaginal smear was taken and rats were laporatomized and the uteri exposed. Only females showing a vaginal smear indicative of proestrus on the day of blood collection and uterine ballooning (and/or the increased uerine vascularity associated with early proestrus) were included in the present study.

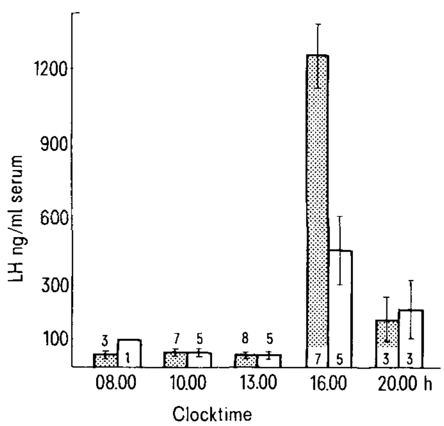

Fig. 1. Effect of thyroparathyroidectomy on proestrous serum LH levels. In this and subsequent illustrations, the number of animals per treatment group is indicated at the base of the columns, vertical lines indicate standard error. ▒, Control; □, TPTx.

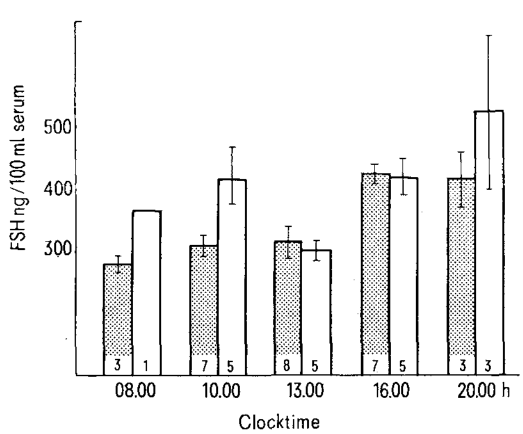

Fig. 2. Effect of thyroparathyroidectomy on proestrous serum prolactin levels. ▒, Control; □, TPTx.

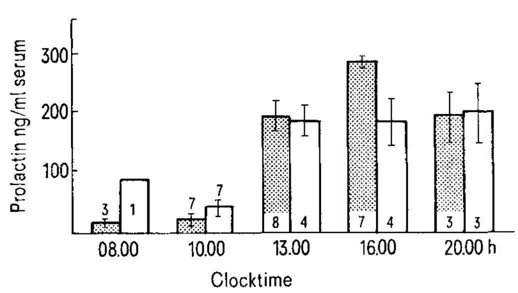

Fig. 3. Effect of thyroparathyroidectomy on proestrous serum prolactin levels. ▒, Control; □, TPTx.

Radioimmunoassays. Serum samples were analyzed for LH, FSH and prolactin using double antibody radioimmunoassays. The materials used were provided by the NIAMID-Rat Pituitary Program. Anti-rabbit γ-globulin was prepared locally in sheep. Details of the procedure used have been published[9]. Concentrations of gonadotropins were expressed in ng/ml on the basis of the standards supplied (RP-1).

Statistical probabilities were derived from analysis of variance and Student's t-test.

Results. Terminal body weights were not recorded, however, TPTx rats were markedly smaller than intact animals. TPTx animals also showed irregular reproductive cycles particularly toward the latter part of the study.

LH. As evidenced in Figure 1, serum LH levels in intact animals fluctuated with the expected phasing and amplitude, i.e., the proestrous 'surge' occurred at 16.00 h. TPTx rats showed evidence of a similar rhythm but the amplitude was significantly reduced ($p<0.01$). The 16.00 h LH levels in intact rats were significantly higher than LH levels at all other time periods and were significantly greater ($p<0.01$) than the 16.00 h levels in TPTx rats.

FSH. Serum FSH levels in intact animals were higher in the late afternoon and evening than in the morning (Figure 2), i.e., 16.00 and 20.00 h levels were higher ($p<0.01$) than 08.00 and 13.00 h but not 10.00 h levels. Only the 10.00 h time point showed a difference ($p<0.01$) between intact and TPTx FSH levels.

Prolactin. The afternoon increase in serum prolactin levels was clearly evident in both intact and TPTx rats (Figure 3). However, in contrast to the pattern in serum LH, the prolactin increase was more prolonged. In both groups afternoon serum prolactin levels 13.00, 16.00 and 20.00 h were different ($p<0.01$) from their respective morning (08.00 and 10.00 h) levels. Significant differences were not observed between TPTx and intact prolactin levels.

[1] The excellent technical and secretarial assistance of S. HEMELT and D. LANDMAN is gratefully acknowledged.
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Discussion. That thyroid hormones influence pituitary-ovarian function is not a new observation [7,11–13]. In fact, it is generally recognized that significant reductions in circulating thyroid hormones are accompanied by altered reproductive function. Sustained hypothyroidism in rats results in the production of polycystic ovaries in response to HCG or PMS administration [14,15] and irregular or complete absence of menstrual cycles accompanies hypothyroidism in monkeys and humans [10,11]. Early speculation that the cessation of cycling associated with hypothyroidism is due to decreased blood LH levels [10–12] has been confirmed subsequently by a bioassay of pituitary LH levels [16,17] and immunoassay of serum LH concentration [13].

Consistent with these observations, LH levels in TPTx rats in the present study were significantly lower than those in controls. Whether the reduction in the proestrous LH levels during the 'surge' period (i.e. 16.00 h proestrus) accounts for the reduced ovulation numer we previously reported for TPTx rats is not known [7]. Other variables such as decreased ovarian sensitivity to LH and/or a reduction in the number of follicles may have been involved since the number of eggs shed reflects the interaction of a number of variables.

The decreased LH levels observed in the present study differs markedly from that observed for TPTx male rats [6]. TPTx male rats showed a marked phase shift along with an increase in the 24 h mean level [6]. Likewise the serum prolactin response to TPTx in the female rat differed markedly from that observed previously for TPTx male animals. TPTx male rats showed a decrease in the 24 h mean level and presented a 9 h phase shift in the serum prolactin rhythm [6] whereas TPTx females showed no change in level or phase of the proestrous prolactin rhythm.

Recently BRUNI et al. [13] reported that thyroidectomized male and female rats with intact gonads showed significant decreases in serum FSH as well as LH. However, in the present study serum FSH in TPTx rats showed a tendency to be higher than the FSH levels in intact animals. The explanation for this difference is not known but differences in experimental protocol may account for this discrepancy. BRUNI et al. [13] compared serum diestrous LH levels (control) with those collected 20–26 days after the appearance of persistent leucocytic smears (thyrodectomized). In the present study consideration was confined to evaluating serum FSH levels during the proestrous period.

Although our previous study using male rats suggested that thyroid hormone is involved in the phasing of both LH and prolactin rhythms [6] data obtained in the present study indicates that in the female rat only the amplitude of the LH rhythm is affected by thyroidectomy. Thus there appears to be a marked sex difference in the interaction of these hormone systems.

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Adenyl Cyclase Activity at Different Environmental Temperatures in the Isolated Rat Anterior Pituitary Membranes

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Summary. The effect of different environmental temperatures on adenyl cyclase was studied. An increase in temperature appears to increase TRH-induced activity of adenyl cyclase, and possibly causes an increased sensitivity to the hormone. Cyclic AMP levels of the pituitaries showed change at different environmental temperatures.

Several studies [1,2] indicate that there is a cyclic AMP-adenyl cyclase-phosphodiesterase system in the thyrotrophic cells of the anterior pituitary, which is under the control of TRH, and thyroid hormones. It is evident that thyrotrophin releasing hormone (TRH) is the principal regulator of thyrotrophin (TSH) secretion and biosynthesis [2–4]. It was also demonstrated that ^{3}H labelled TRH binds to mouse thyrotrophic membrane preparations [5], and to rat pituitary membrane receptors [6], as well as to plasma membranes of bovine anterior pituitaries [7].

In a previous study [8], we did not discover any correlation between the increase from the level of cyclic AMP, and TSH secretion from the pituitary gland. We also found that TRH does not increase cyclic AMP accumulation in vitro in the gland. In another study [9], results showed an increase of 90% in the cyclic AMP level in pituitaries of rats exposed to 37 °C for 4 days. From this recent work, it appears that adenyl cyclase activity is significantly increased in rats that have been exposed to 37 °C, and is greatly decreased in rats exposed to 4 °C.

Materials and methods. 1. *Adenyl Cyclase activity*. The anterior pituitary glands from 4 groups (20 rats in a group) of male rats weighing 150–200 g, Hebrew University Sabra strain, exposed to 22 °C, control group, 34 °C (21 days) 37 °C and 4 °C (4 days), were removed, and

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