

Progesterone Concentration and their Seasonal Changes during the Estrus Cycle of Chinchilla

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According to the number of cornified cells, epithelial cells and leucocytes in vaginal smears the stages of the estrus cycle were determined. Estrus was typified by a vaginal smears which contains cornified cells and no leucocytes and is accompanied by vaginal perforation. The data were obtained during spring (May — June), summer (July — September) and autumn-winter (October — February). The progesterone concentration in plasma during different estrus cycle stages were measured by radioimmunoassay technique. During the chinchilla estrus cycle progesterone concentration varied between 0.1 to 14.0 ng/ml of plasma; at the metaestrus period is 7.21—9.74 ng/ml and at the proestrus period is 0.4—0.8 ng/ml. Seasonal changes in progesterone concentrations at the same pattern during the estrus cycle were also determined. The lowest progesterone level (4.19 ng/ml) were found in the summer season, whereas a significantly higher progesterone concentrations were determined in the spring (6.04 ng/ml) and in the autumn-winter (5.29 ng/ml) seasons.

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1. INTRODUCTION

Hormone patterns during the estrus cycle and the interactions between pituitary and gonadal hormones during the estrus cycle have been studied in different myomorph rodents with short estrus cycle such as hamsters (Ridley & Greenwald, 1975; Shaikh & Saksena, 1972; Saidapur & Greenwald, 1978), mice (Michael, 1976) and rats (Butcher *et al.*, 1974; Ogle & Kitay, 1977; Page & Butcher, 1982). With the exception of the guinea-pigs (Challis *et al.*, 1971; Feder *et al.*, 1968; Heap *et al.*, 1967; Joshi *et al.*, 1973), little attention has been directed towards the hormonal secretion in rodents with a long estrus cycle from suborder *Hystriocomorpha* in which belong chinchillas. There is only one report on circulating levels of progesterone during the estrus cycle of chinchillas (Bookhyser & Aulerich, 1980), seasonal fluctuations in progesterone concentrations during estrus cycle have not been reported.

In the present study we report the measure of plasma progesterone concentration in the same chinchillas in which we previously characterized vaginal smear patterns and seasonal changes in sexual cycle length (Szylarska & Gromadzka, 1984).

2. MATERIALS AND METHODS

Studies were performed on 12 chinchilla females (*Chinchilla laniger* Molina, 1782) 3–6 years old in good general health. All the animals were housed individually in the natural light. Cages were kept in room at temperature 4°C in winter and 25°C in summer, humidity was 90% and 65% respectively. Chinchilla males were housed in the same room.

Feeding system was equal for all animals. Diet consisted of concentrated feeding stuff according to Jarosz & Rzewski (1969), meadow hay, fruits or green forage and water *ad lib*.

Evidence for the estrus cycles was based on the changes in vaginal smears which were taken daily, during the whole year, with a plastic loop and stained with 0.1% Toluidine Blue. Analysis of vaginal smears were arranged to vaginal perforation which is real indication of estrus in hystricomorph rodents (Weir, 1967).

The following criteria, similar to those employed by others (Michael, 1976; Jarosz, 1973; Dobrowolska & Gromadzka, 1978), were used for identification of cycle stages: Estrus (E) — cornified cells dominated, metaestrus (M) a few cornified cells and nucleated cells, diestrus (D) — great number of leucocytes and mucus, proestrus (P) — large number of small nucleated cells.

Length of estrus cycle was on the average 35 days and varied during the years 22–27 days in spring, 33–36 days in summer and 70–90 days in autumn-winter (Szylarska & Gromadzka, 1984).

Blood was obtained from each animal in particular estrus cycle stages using bleeding technique with modification of Stoltz & Bendall (1975). This technique find application when a repeated sampling are available for obtaining serial blood samples without killing the animals and it has been reported that blood obtained by this technique yields plasma factors concentration within the normal range (Marimoto *et al.*, 1975). The tail was severed about 5 mm from the tip with a scalpel without anaesthesia. The first drop of blood was wipped off, the next drops were collected into a heparinized glass tubes 0.8–1.0 mm in diameter and 100 mm in length.

Plasma was removed after centrifugation and stored at –20°C until assayed. Progesterone levels in plasma samples were determined by directly radioimmunoassay technique according to Stupnicki (1975). Each progesterone samples was run in duplicate. Progesterone concentrations were expressed as a nanograms per milliliter of plasma (ng/ml), the lowest detectable concentration was 0.1 ng/ml, coefficients of variation within assays were 7–13%, between assays were 9–15%.

The significant differences between mean values for all the estrus cycle stages were calculated using the Student *t* test.

3. RESULTS

Progesterone levels in chinchilla females varied between 0.3–14.0 ng/ml of plasma (Fig. 1). Mean value for whole year was 5.04 ± 0.49 ng/ml.

During the proestrus period the progesterone concentration was very low (0.58 ± 0.33 ng/ml), it increased progressively at the estrus (4.28 ± 0.48 ng/ml) to reach a maximum level at the metaestrus (8.17 ± 0.76 ng/ml) after which it declined steadily at the diestrus period (2.79 ± 0.32 ng/ml) and low values were observed at the next proestrus period.

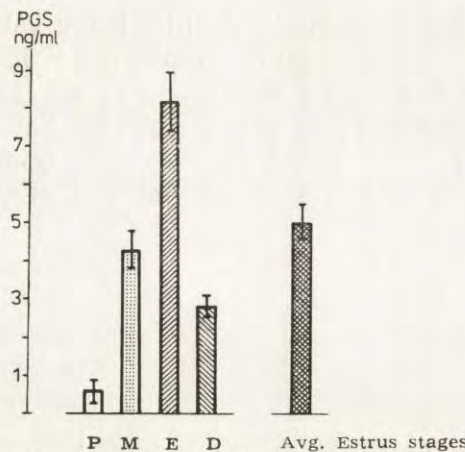


Fig. 1. Concentration of progesterone in chinchilla plasma obtained during three investigated seasons at different stages of the estrus cycle ($\bar{x} \pm SE$). Vertical bars represents the standard errors (SE).

Table 1

Progesterone concentration (ng/ml) in plasma of chinchilla females at different stages of the estrus cycle in three investigated seasons (mean values $\pm SE$).

^{1, 2, 3} Indicate the significant differences between the seasons.

Season (months)	Estrus cycle, stage	Mean $\pm SE$	Range Min. — Max.
Season I (May — June)	E	5.45 \pm 1.29 ¹	2.4—7.4
	M	9.74 \pm 1.88	5.0—14.0
	D	3.40 \pm 0.95	1.4—3.7
	P	0.50	0.1—0.7
Season II (July — Sept.)	E	3.26 \pm 0.67 ^{1, 2}	1.7—4.3
	M	7.21 \pm 1.62	2.6—14.9
	D	2.02 \pm 0.43 ³	1.2—3.2
	P	0.40	0.1—0.8
Season III (Oct. — Febr.)	E	4.38 \pm 0.12 ²	4.2—4.6
	M	8.15 \pm 0.74	6.4—12.5
	D	3.23 \pm 0.29 ³	2.3—3.9
	P	0.80	0.1—1.6

Basing on the whole year's observations of chinchilla's delivery (Szy-larska & Gromadzka, 1984) progesterone concentration was determined in three following seasons:

I — remained from May to June,

II — remained from July to September,

III — remained from October to February.

The same pattern of progesterone concentration consisted one major surge in metaestrus has been observed in three investigated seasons (Fig. 2).

The highest progesterone concentrations (6.04 ± 1.07 ng/ml) were found in season I (May to June). A little lower values we obtained in season III (Oct. to Febr., 5.29 ± 0.70 ng/ml), the lowest progesterone concentrations (4.19 ± 0.89 ng/ml) were found in the II season (July to Sept.).

During the whole year progesterone level at the proestrus period varied between 0.1 to 0.8 ng/ml, at the estrus from 1.7 to 6.8 ng/ml, at the metaestrus from 6.4 to 14.4 ng/ml and at the diestrus from 1.4 to 3.9 ng/ml.

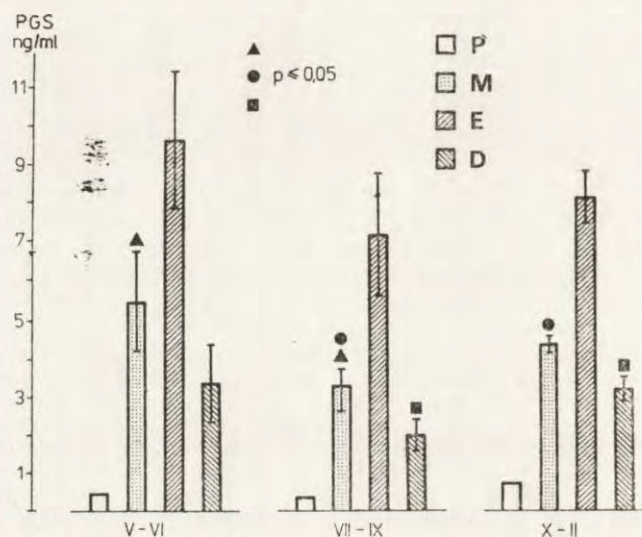


Fig. 2. Seasonal changes in progesterone concentrations at different stages of the chinchilla estrus cycle.

Mean values and standard errors are given. Symbols above columns indicate significant differences between stage of the cycle. P — proestrus, M — metaestrus, E — estrus, D — diestrus.

4. DISCUSSION

Presented in this paper progesterone concentration patterns during estrus cycle were rather in agreement with that described previously by Bookhyser & Aulerich (1980). They constated that the lowest mean progesterone value was during the 6 days period included the first day of vaginal perforation; 4—8 days latter there was a dramatic rise in plasma progesterone and the highest level of the steroid was found in the luteal phase.

The progesterone patterns found in chinchilla females during estrus cycle was similar to those found in common voles (Dobrowolska & Gromadzka, 1978) in which progesterone determination showed a significantly higher concentration in plasma collecting during meaestrus than in all other stages.

It is difficult to make a comprehensive comparison between levels of progesterone in the cyclic chinchillas and those of others hystri-

comorph rodents. Many previous studies used only guinea-pigs (Challis *et al.*, 1971; Feder *et al.*, 1968; Joshi *et al.*, 1973; Heap *et al.*, 1967) whereas the other species from this suborder have not been investigated yet or reported on small numbers of animals with no repeated sampling during the estrus cycle: green acouchi (Rowlands *et al.*, 1970) and cuis (Tam, 1973). The level of progesterone reported in this study for cyclic chinchilla females varied between 0.1 to 14.0 ng/ml. This is higher than those found for guinea pigs (0.5—2.8 ng/ml; Challis *et al.*, 1971; 0.3—3.9 ng/ml; Feder *et al.*, 1968), green acouchi (12.6 ng/ml; Rowlands *et al.*, 1970), voles (1.8—7.69 ng/ml; Dobrowolska & Gromadzka, 1978) and rats (2.0—7.0 ng/ml; Butcher *et al.*, 1974), lower than those found for cuis (18 ng/ml; Tam, 1973), Syrian hamsters (0.8—18.2 ng/ml; Saidapur & Greenwald, 1978) and mice (5.0—64.0 ng/ml; Michael, 1976).

In the natural population the seasonal changes of environment, especially of photoperiod, affect the breeding stage (Charlton *et al.*, 1976; Rollag & Niswender, 1976; Ravault & Ortavant, 1977; Dobrowolska & Gromadzka, 1983). In the wild chinchillas have a breeding season from April to September (Pearson, 1948). In our latitude chinchillas are a polyestric animals however they have a major breeding period between November to May (Weir, 1967; Jarosz, 1973) or between November to April (Szylarska & Gromadzka, 1984). In the present study we have found the lowest progesterone concentrations during the summer season and significant higher concentrations during the spring and autumn-winter seasons — both are the breeding period in the investigated chinchillas.

It seems that the sexual activity in chinchillas depends on the increasing daylight as suggested by Wessell (1963). Similar relation seems to be indicated by our study which show that the maximum intensification of chinchilla's sexual function is between December to January (main delivery peak was found in March) (Szylarska & Gromadzka, 1984). In the summer months the reproductive function in chinchillas decreased parallel to decrease in progesterone concentration. This last occurrence may be due to a high prolactin level during long daylight period (Relkin, 1972; Bittman & Goldman, 1979), which may caused a morphological luteolysis in chinchillas as well as in rats (Beck *et al.*, 1977).

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SEZONOWA ZMIENNOŚĆ STĘŻENIA PROGESTERONU W CYKLU ESTRALNYM
U SAMIC SZYNSZYLA MAŁEGO

Streszczenie

Badano zmiany stężenia progesteronu w kolejnych fazach cyklu estralnego oraz sezonową zmienność stężeń tego hormonu w cyklu estralnym u samic szynszyla małego (*Chinchilla laniger* Molina, 1782).

Fazę cyklu estralnego określano na podstawie zmian w obrazie cytologicznym wymazów pochwowych: ilości zrogowaciałych i jądrzastych komórek nabłonka pochwy oraz ilości leukocytów. Ruję określano na podstawie charakterystycznego obrazu cytologicznego wymazów i zmian w wyglądzie zewnętrznych narządów rodnych.

Badania przeprowadzono w trzech okresach roku: okresie pierwszym trwającym od maja do czerwca, drugim trwającym od lipca do września i trzecim trwającym od października do lutego.

Stężenie progesteronu w osoczu krwi oznaczano radioimmunologicznie. Stwierdzono, że stężenie tego hormonu w czasie cyklu estralnego u samic szynszyla waha

się od 0,1 do 14,0 ng/ml osocza osiągając wartości najwyższe w fazie metaestrus (7,21—9,74 ng/ml) a wartości najniższe w fazie proestrus (0,4—0,8 ng/ml) (Ryc. 1).

Taki charakter zmian stężenia progesteronu w cyklu estralnym nie zmienia się sezonowo, zmieniają się natomiast istotnie średnie stężenia progesteronu w cyklu. Wartości najniższe notowano w sezonie letnim (od lipca do września, $4,19 \pm 0,83$ ng/ml), w pozostałych dwóch sezonach średnie stężenia progesteronu w cyklu było istotnie wyższe ($6,04 \pm 1,07$ ng/ml w okresie od maja do czerwca, $5,29 \pm 0,70$ ng/ml w okresie od października do lutego) (Tabela 1, Ryc. 2).