

CIRCULATING LEVELS OF ESTROGEN AND PROGESTERONE IN FEMALE
CAMEL (CAMELUS DROMEDARIUS) DURING PREGNANCY

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ABSTRACT

Monthly blood samples from 16 pregnant camel were collected commencing from 60 d post service until the last month of gestation. Two animals aborted and two did not conceive. The average length of gestation was 398 ± 13 and 372 ± 11 d in camels carrying male and female fetus, respectively, with a mean of 383 ± 9 d. Sera were analysed for estradiol-17 beta and progesterone by radioimmunoassay. The mean estradiol levels increased progressively from a basal level of 20 pg/ml at 2 to 3 mo of pregnancy to about 450 pg/ml at the final stages of gestation. The camel bearing a male fetus had relatively lower estradiol concentrations (76.5 ± 10.8 pg/ml) as compared to those carrying a female fetus (112.3 ± 19.6 pg/ml). The mean progesterone levels fluctuated between 4 and 5 ng/ml throughout pregnancy except for a slightly lower value (2.5 ± 0.27) at 9 to 10 mo of gestation. On an average, the camels carrying a male fetus had higher progesterone levels (5.13 ± 0.69 ng/ml) than those carrying a female fetus (3.45 ± 0.28). The data suggested that the steroid hormone levels are influenced by the stage of pregnancy and sex of the fetus. Cases of unnoticed abortion and unsuccessful conception could be identified.

Key words: camel, estrogen, progesterone, pregnancy

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INTRODUCTION

India possesses about 1.1 million single-humped camel (Camelus dromedarius) concentrated in Rajasthan, Haryana, and arid zones of other states. These camels constitute the major source of transportation in the desert. Although referred to as the "ship" of the desert, little scientific attention has been paid to them. The reproductive behaviour of the female camel has been reported for Indian (1,2) and exotic camels (3-6), but the information on hormonal profiles during various reproductive phases is scarce (7-11). In our study, the peripheral levels of estrogen and progesterone in pregnant camels during the whole of gestation have been reported.

MATERIALS AND METHODS

Single-humped camel (Camelus dromedarius) belonging to the National Research Centre on Camel, Bikaner, were used for this study. The animals were maintained under standard conditions of feeding and management. In addition to stall feeding, they were allowed to browse from 9.00 a.m. to 4.00 p.m. and were watered twice daily. All the experimental animals were clinically healthy and free from diseases. The camels in heat were mated only once to a fertile camel bull and were observed for pregnancy. She-camels suspected to be pregnant (by the "cocking tail" method) were used for this study. Blood samples from 16 she-camels were collected at monthly intervals starting from 2 mo post mating until the last month of gestation. Serum was separated and stored at -15°C until analysed for estradiol-17 beta (12) and progesterone (13). The protocol and critical evaluation of assays have been reported earlier (14,15). The data were classified according to stage of pregnancy, age of dams, and sex of fetus and were statistically analysed by the method of analysis of variance as suggested by Snedecor and Cochran (16).

RESULTS

Twelve camels carried their fetus to full term, and each delivered a living calf; two probably aborted, and two did not conceive. Five camels gave birth to a male calf and seven to a female calf. No twinning was recorded.

The gestation period for the camels bearing a male and female fetus was 398 ± 13 and 372 ± 11 d, respectively, with a mean of 383 ± 9 d.

The mean serum level of estradiol-17 beta at 2 mo of pregnancy was around 20 pg/ml. This level increased progressively and attained a peak value of 450 pg/ml by the last month of gestation (Figure 1). The classification of data according to sex of fetus revealed that the overall mean estradiol level in camels bearing a male fetus was lower (76.5 ± 10.8 pg/ml) than those carrying a female fetus (112.3 ± 19.6 pg/ml). However, at no stage were the differences between camels bearing a male or female fetus statistically significant (Figure 2). The estradiol concentration was almost equal in camels of different age groups (Figure 3). In two camels that had unnoticed abortions, a fall in estrogen concentration coincided with the sharp fall of progesterone was observed. However, in one camel, subsequent peaks were observed (Table 1). The estrogen concentration in two camels that failed to conceive did not exhibit any definite trend and the levels oscillated between 5 and 40 pg/ml (Table 1).

The mean progesterone concentration in the serum of pregnant camels was slightly higher during early pregnancy but otherwise fluctuated between 4 and 5.5 ng/ml throughout gestation except for a mild fall between Mo 9 and 10 of pregnancy (Figure 4). The levels in camels bearing a male fetus were significantly ($P < 0.01$) higher than those carrying a female fetus (Figure 5). The mean values were 5.13 ± 0.59 and 3.45 ± 0.28 ng/ml, respectively. This difference was more pronounced between 4 and 8 mo of gestation. Classification of data according to chronological age of camels (Figure 6) showed that the progesterone levels were lowest in camels up to 5 yr old (2.2 ± 0.32), intermediate in animals above 10 yr old (3.98 ± 0.32), and highest in camels between 5 and 10 yr old (5.56 ± 0.71 ng/ml). Data on two camels that presumably aborted revealed that the high progesterone levels were maintained up to mid-pregnancy, followed by an abrupt fall to levels below 0.5 ng/ml or to undetectable levels (Table 1). Progesterone concentration in the serum of two camels that failed to conceive was either basal (0.5 ng/ml) or undetectable (Table 1).

DISCUSSION

All camels under study gave birth to a single calf with no incidence of twinning; the sex ratio between male and female calves was found to be 41.6:58.4. A low incidence of 0.4% twinning but a higher percentage (56.1%) of male fetus in the Camelus dromedarius has been reported by Musa and Abusineina (5). The mean gestation period of 383 d is similar to that observed by other workers (1,17). The longer gestation in dams carrying a

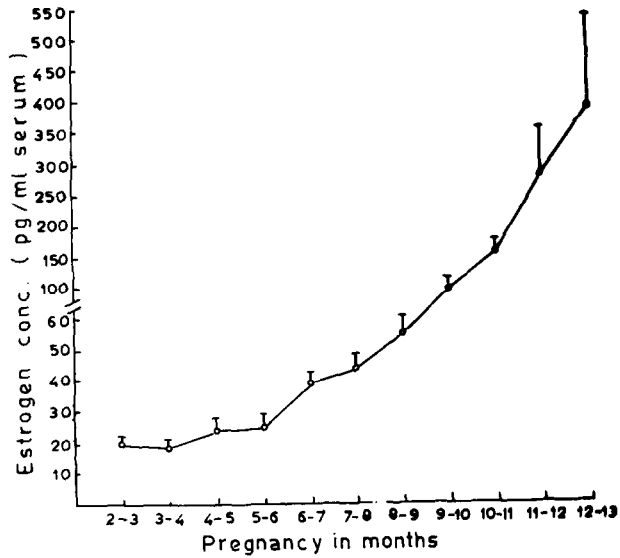


FIG. 1. MEAN (\pm SEM) ESTROGEN LEVELS IN PREGNANT CAMEL

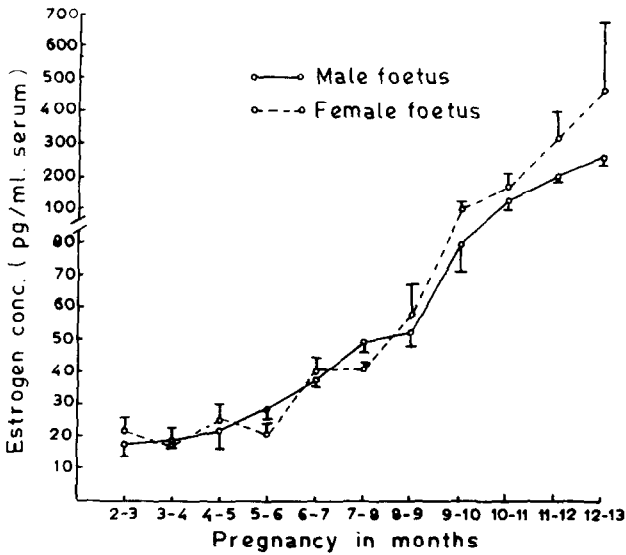


FIG. 2. MEAN (\pm SEM) ESTROGEN LEVELS IN PREGNANT CAMEL BEARING MALE AND FEMALE FOETUS

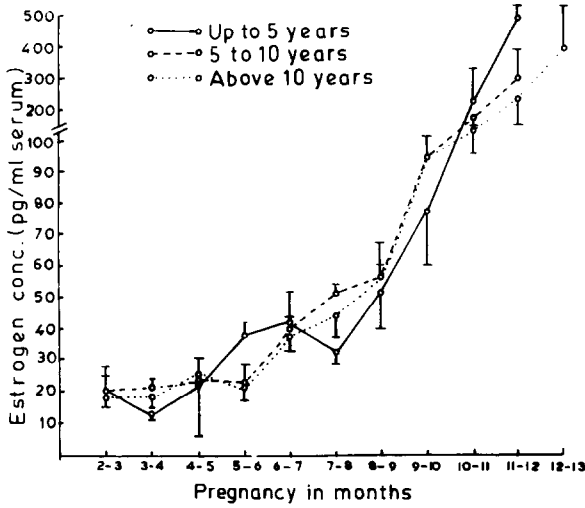


FIG. 3. MEAN (\pm SEM) ESTROGEN LEVELS IN PREGNANT CAMEL OF DIFFERENT AGE GROUPS

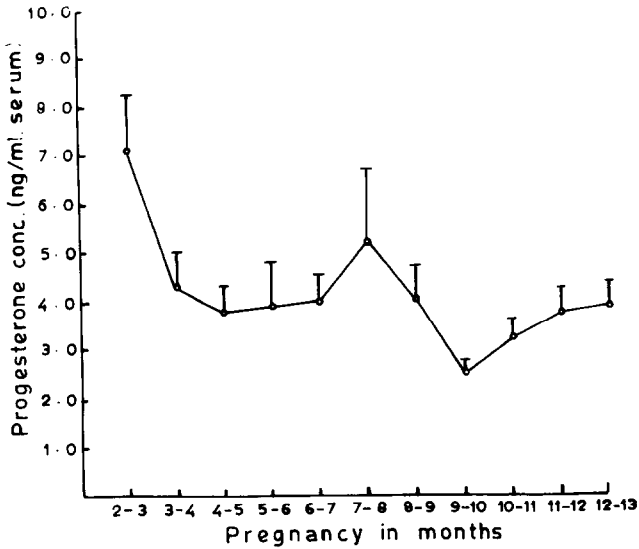


FIG. 4. MEAN (\pm SEM) PROGESTERONE LEVELS IN PREGNANT CAMEL

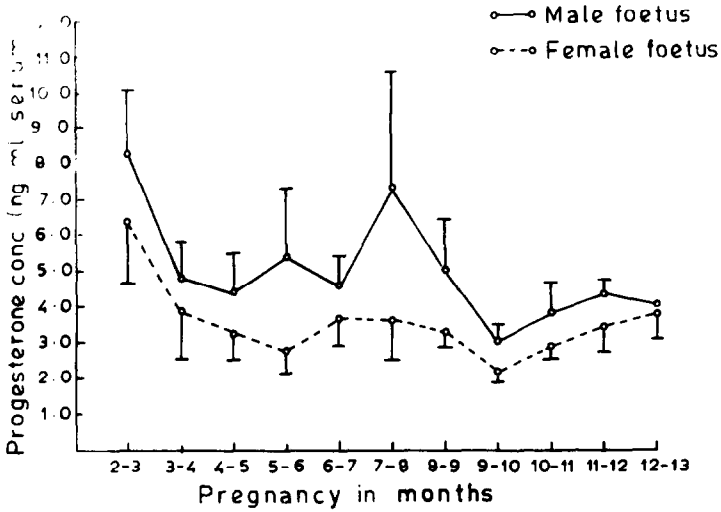


FIG. 5. MEAN (\pm SEM) PROGESTERONE LEVELS IN PREGNANT CAMEL BEARING MALE AND FEMALE FOETUS.

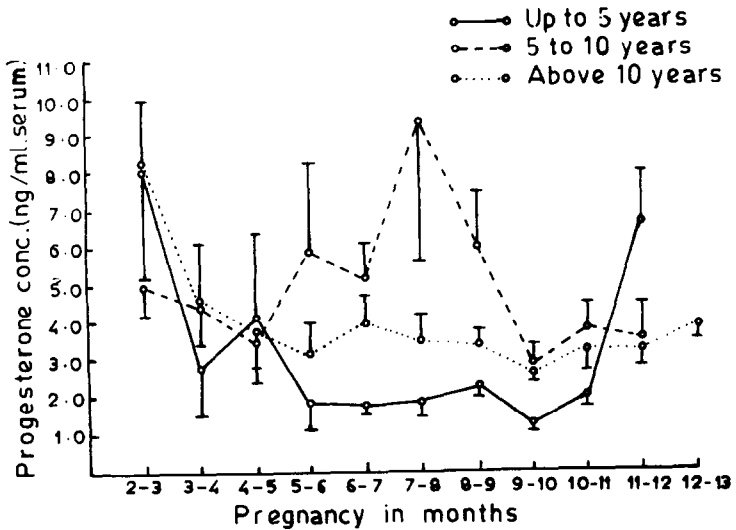


FIG. 6. MEAN (\pm SEM) PROGESTERONE LEVELS OF PREGNANT CAMEL OF DIFFERENT AGE GROUPS.

Table 1. Serum estrogen (pg/ml) and progesterone (ng/ml) levels in female camels that had unnoticed abortions or failed to conceive

Malady	Camel No.	Serum Constituent	Pregnancy in days											
			61-90	91-120	121-150	151-180	181-210	211-240	241-270	271-300	301-330	331-360	361-390	
Abortion	661	Estrogen	5.0	27.5	-	36.0	-	47.0	65.0 ^a	16.5	7.8	8.4	5.0	
		Progesterone	8.6	6.8	-	5.1	-	4.9	4.0 ^a	0.35	0.31	1.0	0.27	
697		Estrogen	7.2	-	16.5 ^a	-	6.2	9.4	9.4	5.0	16.5	12.5	2.4	
		Progesterone	8.6	-	6.0 ^a	-	2.0	b	0.38	0.35	b	b	-	
Failure of conception	583	Estrogen	14.5	23.0	8.2	9.8	13.0	14.0	10.5	-	-	37.0	-	
		Progesterone	0.68	b	b	b	b	b	-	-	-	-	-	
596		Estrogen	6.3	-	-	5.0	13.5	32.5	5.8	11.5	-	5.0	-	
		Progesterone	0.33	-	-	0.50	0.31	0.36	0.22	0.42	-	-	-	

a Indicates the probable time of abortion.

b Nondetectable.

- Samples not available.

male fetus could be due to modulation of fetal hormones. It is now well documented that fetal adrenocorticoid hormones are instrumental in triggering parturition (18). How this triggering mechanism is delayed in the case of the male fetus needs further investigation.

The estrogen levels showed a progressive increase with gestation. Disagreeing with these observations, Elias et al. (10) found estrogen levels between 100 and 150 pg/ml from 60 to 270 d of gestation, followed by rising levels until a peak value of 606 ± 120 pg/ml occurred at 12 mo of pregnancy. In spite of the presence of the corpus luteum, follicular development during early pregnancy has been reported (19) and high levels of estrogen in allantoic fluid on the day of parturition have been demonstrated, indicating placenta as well as the probable source of estrogens (10). The contribution from both of these sources is probably responsible for rising levels of estrogens during pregnancy.

The estrogen levels were not affected by the sex of the fetus or the age of dams, indicating that these factors are innocuous in influencing the estrogen levels in the pregnant camel. In two camels the fall of estrogens concomitant with that of progesterone supported the occurrence of abortion in these animals. The fluctuating levels of estrogens in two nonpregnant camels confirm the existence of a follicular wave in the ovary (20,21).

The serum progesterone concentration remained more or less constant throughout gestation. The corpus luteum in the pregnant camel remains at nearly the same size and weight throughout pregnancy (19). A constant secretion rate of progesterone from the corpus luteum may be responsible for constant peripheral levels in the camel. Contrary to these observations, Elias et al. (9) showed that the progesterone levels in the pregnant camel elevated progressively after 2 mo of gestation, attaining a peak at 5 mo followed by a gradual decline until the day of parturition. Although the trends obtained in these two studies differ, levels above 1 ng/ml of serum are essential for maintenance of pregnancy in this species. It was also observed that camels bearing a male fetus had significantly higher progesterone levels than those carrying a female fetus. A sexual dimorphism in progesterone levels during pregnancy has also been reported in cattle (22) and rhesus monkeys (23). Further evidence shows that fetal hormones may influence the placental biosynthesis of progesterone (24,25). A more or less similar mechanism probably exists in the camel as well. The highest progesterone level in camels 5 to 10 yr old suggests the period of most active sexual life which corresponds to sexual maturity.

Two camels in which the serum progesterone dropped sharply at 4 to 5 and 8 to 9 mo of gestation to levels below 0.5 ng/ml did not deliver any calf after completion of gestation, leading us to believe that they had unnoticed abortions while out for browsing. The two camels showing progesterone levels below 0.5 ng/ml throughout the post mating period either did not conceive due to failure of ovulation (9) or suffered from embryonic death (3). These levels corresponds to the nonbreeding season with absence of corpus luteum in the ovary (10). The results of this investigation not only provide basic information on hormone levels of the pregnant Indian camel but also suggest that casual monitoring of progesterone levels may be of clinical and diagnostic importance to reveal the true reproductive status of camel.

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