

Plasma Corticoid Levels During Early Postnatal Life in Calves¹ (39223)GENARO A. LOPEZ² AND ROBERT W. PHILLIPS

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There do not appear to be data available on plasma levels of aldosterone and progesterone in the newborn calf. Previous studies on plasma corticoid concentration in the neonate of this species have been confined to the measurement of 17-hydroxycorticosteroids (1-4). In addition, evidence as to whether the calf is born with an adequate or poor supply of circulating adrenocorticoids is controversial. In this regard, several studies (2-4) have shown in normal neonatal calves that plasma cortisol levels vary with age, with the highest concentration seen during the first day following birth. Furthermore, these data (2-4) indicated that the initial high levels of plasma cortisol decreased toward the adult concentration within the next few days. Moll (5), however, favors the view that calves are born with immature adrenals and thus are poorly equipped to cope with environmental changes. There is also disagreement as to whether corticosterone is present in plasma at birth (2, 6). The present study was, therefore, designed to determine if the calf has increased plasma corticoid levels at birth, which may contribute to a rapid adaptation to conditions of extra-uterine life.

Materials and methods. Five healthy, male, colostrum-fed dairy calves were utilized. The animals were less than 24 hr old at the start of the trials. They were kept in a room at $22 \pm 3^\circ$ and were fed 1-2 liters of warm milk twice daily after blood collection. Heparinized serial blood samples from catheterized jugular veins were collected at 12-hr intervals. The samples were centrifuged at 14,500g for 20 min, and the plasma was

removed and stored at -20° until assayed.

Radioimmunoassays for aldosterone (7) and progesterone (8), and competitive protein-binding assays for cortisol and corticosterone (9) were used for the measurement of these hormones in plasma. Initial purification of the corticoids was accomplished by descending paper chromatography (10). Statistical evaluation of hormonal changes with age was made using the Student's *t* test (11) at four different days during the first week of life.

Results. Table I illustrates the changes in plasma corticoid concentration observed during the first week of life. Aldosterone levels appeared significantly decreased by Day 3 in relation to those seen on Day 1. By Day 8, plasma levels of this hormone showed no further decrease and were comparable to those observed on Day 3.

Similarly, plasma levels of progesterone and cortisol were significantly lower on Day 8 than their corresponding values during the first 24 h.

Conversely, corticosterone changes were not significantly different at the four times tested.

Discussion. The cortisol data reported above agree with other studies of neonatal calves (2-4), in which high plasma levels of this steroid were found at birth followed by a decrease toward the adult concentration in the next few days. Plasma values for this hormone seen on Day 1 in this study (331.6 ± 58.6 ng/ml) are higher than those reported in calves by Dvorak (4) during the first 16 hr of life (120 ng/ml), and by Day 8 the difference persisted (107.5 ± 31.4 ng/ml compared to 60 ng/ml). The higher values may be due to a greater sensitivity of our assay over the Porter-Silber reaction utilized by that investigator.

We have found no data pertaining to plasma progesterone levels in neonatal calves to allow a comparison with the data

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TABLE I. PLASMA CORTICOID LEVELS MEASURED IN FIVE NORMAL CALVES DURING THE FIRST WEEK OF LIFE

Age (days)	Corticoids ^a			
	Aldosterone (pg/ml)	Progesterone (pg/ml)	Cortisol (ng/ml)	Corticosterone (ng/ml)
1	533.6 ± 159.2	396.5 ± 72.9	331.6 ± 58.6	11.4 ± 1.5
2	364.8 ± 115.3	300.5 ± 55.1	241.3 ± 40.3	16.4 ± 4.0
3	238.1 ± 53.4*	225.4 ± 55.6	232.4 ± 36.5	10.5 ± 2.8
8	246.0 ± 56.9*	176.3 ± 38.3*	107.5 ± 31.4**	9.1 ± 2.7

^a Mean ± standard error.

* Significantly different ($P < 0.05$) from Day 1 value.

** Significantly different ($P < 0.01$) from Day 1 value.

reported in this paper. As seen with cortisol, its plasma concentration had significantly decreased by 8 days of age.

Plasma aldosterone concentration in the newborn calf also has not been previously reported. This study demonstrates that, similarly to cortisol and progesterone, plasma levels of aldosterone 1 week after birth were significantly lower than those observed during the first 24 hr. The values seen for this hormone on Day 3 of this study (238.1 ± 53.4 pg/ml) are comparable to levels of 259 ± 117 pg/ml reported for human neonates during the first 3 days of life (12).

Plasma corticosterone levels did not change significantly during the first week of life although they did fluctuate slightly.

The present data support the view that the calf has elevated plasma levels of adrenocorticoids during the early postnatal period, which may contribute to its adaptation to the extra-uterine environment. The data also point to cortisol as the major glucocorticoid in the neonatal calf, and additionally show that corticosterone is present at birth, which supports the findings of Khan *et al.* (2) rather than those of Balfour (6). It is possible, however, that the chemical procedure employed by the latter investigator (6) was not capable of detecting the already low circulating levels of corticosterone in the bovine neonate as measured by present methodology.

Elevated plasma corticoid levels at birth, which subsequently decrease with age, have also been reported in lambs (13) which like the calf are born in a precocious state of development. In species such as the rat (14), monkeys (15), and humans (16), which are immature in development at birth, low

plasma corticoid levels have been observed at that time.

The data reported here support the view of Milkovic and Milkovic (17) that the reactivity of the pituitary-adrenocortical system during the first few days of life is quite variable and appears to be species dependent. Alternative hypotheses are plausible, which could account for the increased plasma corticoid levels observed in this study. For instance, there is a peak of plasma cortisol in the dam at parturition which could be transferred across the placenta and result in increased circulating levels in the neonate, but this would seem unlikely to persist for several days. It is also possible that the capacity for hepatic corticoid catabolism matures during early neonatal life and thus, that the initially increased levels are due to a lower turnover rate rather than to increased release. Whatever the cause, it appears that in species which are developmentally precocious at birth and which must immediately fend for themselves in a hostile environment, elevated plasma corticoid levels are present at that time.

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