PERIPHERAL PLASMA PROGESTERONE AND CORTICOID LEVELS AT PARTURITION IN THE SOW

D. B. Killian, H. A. Garverick and B. N. Day

Missouri Agricultural Experiment Station, Columbia 65201

Summary

Plasma levels of progesterone and corticoids were determined in eight sows prior to, during and following parturition. A statistically significant diurnal variation was observed with morning samples having a higher level of corticoids. Progesterone levels decreased through the last day of gestation to a low level at day 1 postpartum. Mean corticoid levels increased during the last 24-hr. prepartum and returned to prepartum levels within 36 hr. of farrowing. The elevation in corticoid levels is interpreted to be a result rather than a cause of parturition.

Introduction

In recent years, control of time of parturition in farm animals by exogenous hormones has become possible. Parturition has been successfully induced in sheep (Adams and Wagner, 1970; Evans, Wagner and Adams, 1971; Bosc, 1972) and cattle (Adams and Wagner, 1970; Evans et al., 1971; Smith et al., 1971; Garverick et al., 1972) with a single dose of 10 to 40 mg of dexamethasone, a synthetic glucocorticoid. However, extremely high doses of the compound were required to induce parturition in horses and pigs (Alm, Sullivan and First, 1972; North, Hauser and First, 1972).

The present study was conducted to determine the relationship between plasma levels of progesterone and glucocorticoids in the sow at normal parturition. The primary objective was to examine indicated species differences in hormonal mechanisms controlling parturition as a preliminary to the investigation of alternative methods for the induction of parturition in the sow.

Materials and Methods

Eight crossbred gilts weighing from 115 to 136 kg were used in this study. All were bred at 7 to 9 months of age. At 6 to 42 days prior to parturition a Silastic catheter* (I.D. 1.01 mm, O.D. 2.16 mm) was surgically implanted in the anterior vena cava, and the gilts were tethered in a building with slotted, concrete floors until completion of the study, which was conducted over a period of 7 months. The temperature did not exceed 30 C in the summer and fall and was maintained at 16 C during the winter months. Light was automatically regulated to 14 hr. of light and 10 hr. of darkness (8 pm to 6 am). The animals were fed immediately prior to the collection of a blood sample.

Three gilts were bled twice daily at 8 am and 8 pm to observe any diurnal variation in hormone levels. The remaining five animals were bled daily in the morning until 2 days prior to parturition when samples were taken at least twice daily. Morning samples from the two groups of animals were combined for statistical analysis of hormonal changes associated with parturition. Blood samples were centrifuged and stored immediately at -20 C.

Progesterone and corticoid levels were determined using the competitive protein binding procedure described by Neill et al. (1967) with the following modifications. Individual recoveries were obtained by adding 0.002 uCi of [1,2-3H]progesterone and [1,2-3H]hydrocortisone to each extraction tube. Progesterone and corticoid recovery rates for this method averaged 84% and 88%, respectively.

A plasma volume of 0.6 ml was first extracted with 5 ml of reagent-grade petroleum ether for progesterone assay. In view of the nearly perfect duplication of progesterone values observed by Henricks, Guthrie and Hand-
lin (1972) using either a petroleum ether extract of porcine plasma or an extract subjected to thin-layer chromatography, the petroleum ether extract analyzed in the present study is considered to represent progesterone concentration without a significant bias due to the presence of other progestins. Furthermore, a maximum of two percent of the corticoids were found to be extracted with petroleum ether.

Corticoids were subsequently extracted with 5 ml of reagent-grade dichloromethane with no further purification and will be referred to as total corticoids.

Dog plasma used as a source of CBG was first eluted from a Sephadex G25 column with phosphate buffer (pH 7.2). A more efficient scintillation cocktail (toluene: Triton X-100) was used in place of Bray's solution.

A pooled sample of plasma from barrows was analyzed with each assay. The pooled progesterone and corticoid values (mean ± SE) for the nine determinations were 0.2 ± 0.09 ng/ml and 26.8 ± 1.5 ng/ml, respectively.

Statistical analysis consisted of a paired t-test to measure statistical significance of diurnal variation observed in corticoid levels, and an analysis of variance (nested classification), coupled with Duncan's new multiple range test to determine significant day-to-day changes in progesterone and corticoid levels. The rapid rise observed in corticoid levels during the last 48 hr. prior to parturition was subjected to regression analysis.

Results

Diurnal Variation. A diurnal variation was observed in corticoid levels until 24 hr. prior to parturition, and then again following parturition. The concentrations of corticoids in morning samples were significantly higher than evening levels (P < .05). The mean morning level

![Graph](image-url)
was 19.7 ± 2.4 ng/ml as opposed to 14.6 ± 3.4 ng/ml for the evening samples. Progesterone concentrations showed no diurnal variation, with a mean morning level of 5.5 ± 0.5 ng/ml and an evening mean of 5.2 ± 0.5 ng/milliliter.

**Hormonal Changes at Parturition.** The mean progesterone concentration was observed to remain fairly stable, between 8 and 10 ng/ml for the last 3 weeks of gestation (figure 1) until day -3 when it dropped from 10 ng/ml to 5.5 ng/ml and continued to drop until day 1 postpartum when levels of less than 1 ng/ml were observed. When means for six animals with complete data for the 14-day period starting at day -7 were analyzed, a significant difference among days was present. Mean levels observed after farrowing were significantly lower than those seen prior to day 2 prepartum (P < .05).

Mean prepartum corticoid levels remained consistently between 20 and 35 ng/ml except for a peak at days -16 and -15 attributed to extraordinarily high levels detected in two animals for the first sample following surgery (figure 2). At around 24 hr. before parturition, mean corticoid levels began to rise and peaked at a concentration of 51 ng/ml on day 0 and then returned to prepartum levels by 36 hr. following parturition.

Although there was no statistically significant difference in mean levels among days, the regression (b = 0.37) of plasma concentration of corticoids on hours for the 48-hr. period immediately preceding parturition was significant (P < .01).

Corticoids reached peak levels of 30 to 96 ng/ml at the time of parturition in seven of eight sows. In one sow plasma corticoids increased to 50 ng/ml at 8 hr. prior to parturition and then decreased to 20 ng/ml during farrowing.

**Discussion**

The diurnal variation observed in corticoids is comparable to that observed by Whipp, Wood and Lyon (1970) in immature Specific Pathogen Free boars. The mean morning level
Peripheral progesterone levels declined rapidly during the last 3 days of gestation in seven of eight animals observed. The values observed in the exceptional animal increased steadily from 3.1 ng/ml on day -2 to 17 ng/ml during parturition. There were no unusual circumstances to explain this deviation. It also seems unlikely that this increase was influenced by corticoid levels as one animal with a concentration of 96 ng/ml of corticoids at parturition was found to have only 3.1 ng/ml of progesterone in the same blood sample.

Corpora lutea have been shown to be the principle source of progesterone in the pregnant pig. Short (1956) was not able to demonstrate
the presence of progesterone in late term placentae of the pig, and du Mesnil du Buisson and Dauzier (1957) have shown that ovariectomy as late as day 106 results in abortion. Kimura and Cornwell (1938) and Masuda et al. (1967) found that progesterone content of pig corpora lutea decreased during the last 2 weeks of gestation. Masuda et al. (1967) found this change to be mirrored in the ovarian venous blood. The results of the present study indicate that peripheral progesterone levels also decrease prior to the onset of parturition in the pig.

By 36 hr. following parturition progesterone levels in peripheral blood were similar to those observed by Stabenfeldt et al. (1969) and Henricks et al. (1972) during estrus in the sow, indicating that the corpora lutea become completely non-functional soon after parturition.

Although a statistical difference was not present between the mean morning levels of corticoids for the last week prepartum and the peak observed at parturition, diurnal variation in corticoid levels was masked at parturition and concentrations returned to prepartum levels soon after parturition, which suggest that there was in fact a change in maternal corticoid levels at parturition. Furthermore, the time of occurrence of this hormonal change (figure 3) suggests that the increased plasma concentration of corticoids is a result rather than an initiator of parturition.

**Literature Cited**


