Bovine Serum LH, GH, and Prolactin During Late Pregnancy, Parturition and Early Lactation[1] (37276)

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Factors which normally cause parturition and initiate lactation are still obscure. Experimental or pathogenic alteration of the endocrine milieu of fetus or mother can terminate pregnancy and induce lactation (1, 2) or prolong gestation (3, 4) in cattle. While these observations have provided useful information in attempting to explain parturition and initiation of lactation, interpretation is restricted since these conditions are not normal. Interpretation of existing literature would benefit by a description of normal endocrine changes in maternal serum near parturition. Therefore, our objective in this experiment was to describe changes in serum luteinizing hormone (LH), growth hormone, and prolactin concentration in bovine serum during late gestation, parturition and early lactation.

Materials and Methods. Jugular blood (40 ml) was collected via venipuncture from each of 34 pregnant heifers twice weekly from 26 to about 6 days prepartum, twice daily (0800 and 1700 hr) from 6 days before to 5 days after parturition then twice weekly until first estrus or day 25 postpartum, whichever occurred first. Following parturition, heifers were observed twice daily for signs of estrus. In addition, beginning 1 week postpartum, ovarian activity was monitered by twice weekly rectal palpations to aid in determining first estrus.

Blood (40 ml) was mixed with 31.7 mg oxalic acid crystals, centrifuged (6500*g*, 20 min, 4°) and the plasma was mixed with 27.8 mg $CaCl_2$ to promote clotting. After 48 hr at 5°, samples were centrifuged to remove fibrin and serum was frozen until assayed for hormones. Prolactin, growth hormone and LH were quantified by double antibody radioimmunoassay as previously described from our laboratory (5–7). Analysis of variance with orthogonal contrasts evaluated differences in hormone concentration between days. Progesterone, estradiol, estrone, and total corticoid concentration in serum from 10 of these heifers were reported previously (8).

Results. Average duration of gestation for the 34 heifers was 279.2 days with a range of 272–291 days. Serum prolactin concentration during the prepartum period averaged 70 ng/ml on Day —26, increased gradually to 111 ng/ml on Day —9, then decreased ($p < 0.01$) to 78.5 ng/ml on Day —5 (Fig. 1). Therafter, average prolactin concentration in the serum remained unchanged ($p > 0.05$) through Day —2.5 but it increased ($p < 0.01$) at —2 and —1.5 days and reached a peak of 285 ng/ml at 1 day before parturition (Fig. 2). Serum collected at parturition averaged 217 ng/ml, less

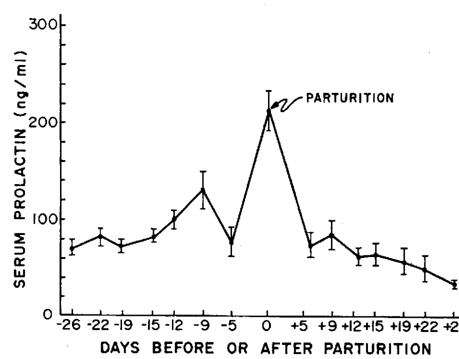

FIG. 1. Bovine serum prolactin from 26 days prepartum through 26 days postpartum.

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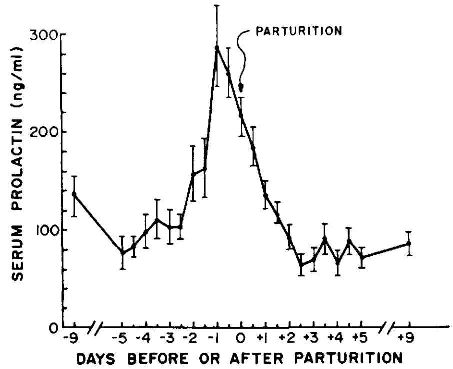

FIG. 2. Bovine serum prolactin from 9 days prepartum through 9 days postpartum.

($p < 0.01$) than the prolactin peak 24 hr earlier. The decline from the peak was linear ($p < 0.01$) through 2 days postpartum. Orthonogal contrasts revealed that the average prolactin concentration was greater ($p < 0.01$) during late pregnancy (Day 26–5 prepartum) than during early lactation (Day 5–26 postpartum).

Average serum growth hormone for the interval 26–9 days before parturition fluctuated between 4.8 and 3.8 ng/ml (Fig. 3) but differences between means were not significant ($p > 0.05$). Growth hormone in serum collected 9 days before parturition averaged 3.8 ng/ml and gradually increased to 6.0 ng/ml at 0.5 day prepartum (Fig. 4). Serum growth hormone was markedly increased at parturition averaging 10.0 ng/ml; significantly greater ($p < 0.01$) than the comparable average 0.5 day before. Growth hormone was still increased at 0.5 day after parturition (9.4 ng/ml) but decreased linearly ($p < 0.05$) thereafter to 5.0 ng/ml on Day 4. Average serum growth hormone during late pregnancy (Day 26–5 prepartum) was, on the average, less ($p < 0.05$) than during early lactation (Day 5–26 postpartum).

Serum LH concentration was uniformly low through late pregnancy (av. 0.6 ng/ml), unchanged at parturition and remained low through Day 5 postpartum. But LH increased ($p < 0.01$) 100% between Days 5 and 9 postpartum and continued high throughout the remainder of the sampling period (Fig. 5). Within-day correlations between serum LH and estradiol, estrone, progesterone and corticoids showed no meaningful trends.

Discussion. Markedly increased serum prolactin shortly before parturition has been reported for the cow (9), goat (10, 11), sheep (12-15) and rat (16). Similar to changes in Figs. 1 and 2, Schalms and Karg (9) observed peak prolactin (> 300 ng/ml) in bovine serum prolactin at 1 day before parturition; prolactin decreased 50% by parturition and reached values comparable to the prepartum baseline by 2 days postpartum. Prepartum changes in serum prolactin of goats (11) essentially parallel those reported here for the cows; a gradual increase from Day —30 to —10, a decline at Day —5 and a subsequent increase to a peak at 1 day prepartum. The reason for the decrease in prolactin at Day —5 is not clear; correlations between prolactin and steroid hormones on Day —5 were not significant ($p > 0.05$). Perhaps the copious and seemingly continuous availability of prolactin for at least 2 days prior to parturition may be importantly involved in the initiation of lactation.

In view of reports describing increased serum prolactin following acute stress in cows (5, 17), an equally tenable hypothesis is that the partum increase in prolactin results from pain associated with delivery. One argument against this hypothesis is that the rise in serum prolactin precedes, by several days, onset. of propagative and coordinated uterine contractions (18, 19).

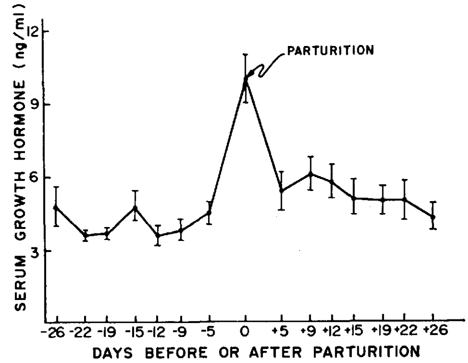

FIG. 3. Bovine serum growth hormone from 26 days prepartum through 26 days postpartum.

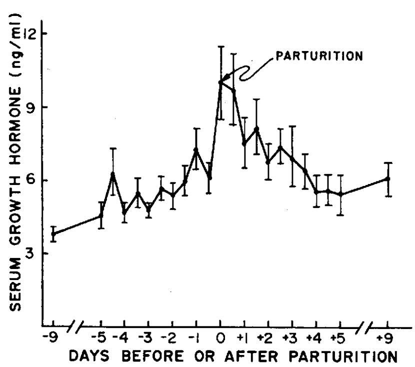

FIG. 4. Bovine serum growth hormone from 9 days prepartum through 9 days postpartum.

Possibly the changes in estradiol, estrone and progesterone (8) may be the mechanism for the coincident increase in prolactin in these same sera. But, within-day correlations between these steroids and prolactin revealed no meaningful trends. In contrast to the bovine, serum prolactin does not decrease in goats (11) or rats (16) following parturition. This difference may be due to differences in nursing intensity and frequency since restricting suckling caused a rapid postpartum decrease in serum prolactin in rats (16) and goats (11).

The physiological significance of increased growth hormone at parturition is equivocal. Growth hormone is influenced less by physical stimuli than is prolactin (5) but may be increased by stress of surgery (20). Unlike prolactin, the first observed increases in growth hormone occurred at parturition, possibly a result of stimuli associated with birth of the calf. Alternatively, rapidly changing levels of serum estrogens may cause increased serum growth hormone, since estradiol and estrone peaked at about 2 days prepartum (8). Trenkle (21) observed a significant increase in serum growth hormone concentration in animals fed diethylstilbestrol. However, within-day correlations between serum growth hormone reported here and estradiol or estrone (8) revealed no meaningful pattern.

Growth hormone appears to be essential for normal lactation (22). Cowie (23) reported that hypophysectomized goats need growth hormone to maintain normal lactation; even when the goats were given prolactin, insulin, corticoids, and thyroid hormone, removal of growth hormone resulted in an immediate drop in milk production. Slightly higher serum growth hormone after than before parturition may be associated with whole body metabolic changes induced by lactation causing an increased demand for nutrients.

Failure to detect significant changes in serum LH during late gestation around parturition and during early lactation in cows confirms the work of others (24). Luteinizing hormone is released during the normal estrous cycle of cows following a precipitous decrease in serum progesterone and an increase in serum estrogen (25). The sequence of changes in ovarian steroids in these samples (8) were reminiscent of those during proestrus in cows (25), yet serum LH remained unchanged. In fact, during the majority of our sampling period, LH remained at a low level similar to that characteristic of prepubertal heifers (26).

Exogenous LH enhanced progesterone

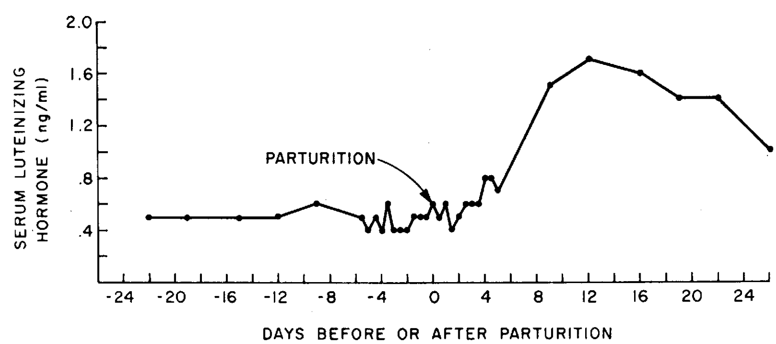

FIG. 5. Bovine serum luteinizing hormone from 26 days prepartum through 26 days postpartum.

synthesis *in vivo* (27) and *in vitro* (28) in the bovine and antibovine LH decreased progesterone in serum (28). But the fall in serum progesterone 2–3 days prior to parturition in cows (8) is not due to decreased availability of LH (Fig. 3).

Possibly the increase in LH beginning 6–9 days postpartum may be due to early follicular development and some estrogen secretion well in advance of first estrus. On the average, the first observed estrus occurred at 20 days after parturition and palpation of the ovaries revealed no ovulations before first estrus.

Summary. Jugular blood was collected from 34 Holstein heifers from 26 days before parturition until 26 days postpartum or until first estrus. Serum prolactin varied between 80 and 110 ng/ml until Day 2 prepartum when it increased markedly to peak of 285 ng/ml at 1 day prepartum. Prolactin decreased linearly ($p < 0.01$) from the peak until 2 days after calving, stabilized at about 90 ng/ml until Day 9, and gradually declined until day 26 (36 ng/ml). Postpartum (Day 5–26) prolactin was lower ($p < 0.05$) than prepartum (Day 26–5) prolactin. Growth hormone followed a pattern similar to prolactin but peaked 24 hr later, at parturition, and decreased from the peak to concentrations characteristic of prepartum values by Day 4 postpartum. Serum growth hormone during late pregnancy (Day 26–5) was lower ($p < 0.05$) than during early lactation (Day 5–26). Serum LH was consistently low (0.4–0.8 ng/ml) until Day 9 postpartum when it increased to about 1.5 ng/ml until first estrus.

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