

# 乳牛の分娩にともなう末梢血中エストロン,エストラジオール- 17 $\beta$ およびプロジェステロン濃度の変化

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# Plasma Estrone, Estradiol-17 $\beta$ , and Progesterone Levels during Late Pregnancy and Parturition in Dairy Cattle

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**ABSTRACT.** Levels of estrone, estradiol-17 $\beta$ , and progesterone in the peripheral plasma during late pregnancy and parturition in Holstein cows were measured by specific radioimmunoassay techniques. Estrone levels remained low until 4 weeks prepartum (<155 pg/ml), began to rise from 4 weeks until 1 day prepartum (155–2271 pg/ml), and reached a peak at parturition (2781 pg/ml). Then the levels fell to 197 pg/ml at 1 day postpartum. Changes in the plasma estradiol-17 $\beta$  levels generally resembled those for estrone levels, but the estradiol-17 $\beta$  levels were only 10–21% as compared to those of estrone levels. Progesterone levels remained high until 2 days prepartum (3.71 ng/ml), began to fall, reaching 2.52 ng/ml at 1 day prepartum and 0.75 ng/ml at parturition, and was 0.23 ng/ml at 1 day postpartum. On the day of parturition, the levels of estrogens and progesterone remained approximately constant from the beginning of opening labor pains until 1 hr postpartum.—**KEY WORDS:** dairy cattle, estrogen, parturition, peripheral plasma, progesterone.

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Levels of estrone, estradiol-17 $\beta$ , and progesterone in the peripheral plasma of bovines at around parturition have been assayed by several investigators [1–5, 7, 9–11, 13, 14]. Progesterone levels have been reported to begin to fall before parturition [1, 2, 4, 5, 7, 13, 14], but the reported time of the decline in the estrogen levels is not consistent. In some studies [2, 4, 5, 7, 9, 11], the peak in the estrogen level is on the day of parturition, and the value declines thereafter. In other studies [1, 3, 10, 13, 14], the peak in the estrogen levels occurs 1 to 2 days before parturition, and the value declines on the day of parturition. Detailed data about the estrogen levels during parturition seems to be lacking. Multiple sampling from the same animal during parturition may account for some of the variation. Therefore, this experiment was done to study in detail when estrogen levels in peripheral plasma decline around the time of parturition. To gain more information about the pattern of

progesterone secretion and its possible relationship to parturition, the peripheral plasma levels of progesterone were also measured along with those of estrogens.

## MATERIALS AND METHODS

**Animals and Blood Sampling:** Seven Holstein cows 2–5 years of age were used in this experiment. Blood from jugular vein was collected twice weekly beginning at about 45 days before the estimated time of parturition (the gestation period was taken to be 280 days) and continuing until about 7 days prepartum, daily from 7 days before to 1 day after parturition, and with greater frequency near the time of parturition. Heparinized blood was immediately cooled on ice and then centrifuged. The plasma obtained was stored at –20°C until the steroids in the sample were assayed.

**Hormone Assay:** All steroids were measured by specific radioimmunoassays.

Estrogens were extracted with ethyl acetate, and the extracts were purified by silica-gel column chromatography to remove a large amount of cholesterol from the sample before it was placed on an LH-20 Sephadex column [6, 12]. Progesterone was extracted from the plasma with hexane to remove it from contaminants. Each extract was measured by radioimmunoassay with a specific antibody for the steroid in question [8]. These methods permitted measurement of as little as 25 pg of estrone/4 ml of plasma, 25 pg of estradiol-17 $\beta$ /4 ml of plasma, and 100 pg of progesterone/0.2 ml of plasma, respectively. The intra-assay coefficients of variation were 9.5% for estrone, 11.3% for estradiol-17 $\beta$ , and 7.6% for progesterone; inter-assay coefficients of variation were 10.7% for estrone, 11.5% for estradiol-17 $\beta$ , and 10.6% for progesterone.

*Statistical Analysis:* To analyze changes in the plasma hormone concentrations, the significance of differences between groups was evaluated by analysis of variance and Duncan's new multiple range test.

## RESULTS

The mean peripheral plasma levels of estrone, estradiol-17 $\beta$ , and progesterone from 6 weeks before until 1 day after parturition are shown in Fig. 1. Estrogen levels were low 6 to 4 weeks prepartum. Estrone and estradiol-17 $\beta$  averaged 155 and 33 pg/ml, respectively, in plasma at 4 weeks before parturition, and both had nearly trebled by week 2 prepartum. These increases continued, and the values peaked at parturition when estrone and estradiol-17 $\beta$  averaged 2781 and 391 pg/ml, respectively. Plasma progesterone averaged 6.70 ng/ml at 6 weeks before parturition. This value declined gradually from week 2 to day 2 prepartum. At 2 days prepartum, the plasma progesterone averaged 3.71 ng/ml, and then declined rapidly ( $P < 0.01$ ) to 2.52

ng/ml at 1 day postpartum.

The mean peripheral plasma levels of estrone, estradiol-17 $\beta$ , and progesterone during parturition are shown in Table 1. The individual steroid patterns in two cows during the last week of gestation are shown in Figs. 2 and 3. Estrogen levels were high until 1 hr postpartum. Thereafter plasma estrogens declined rapidly ( $P < 0.01$ ); estrone and estradiol-17 $\beta$  averaged 197 and 34 pg/ml at 1 day postpartum, respectively. The plasma progesterone levels dropped significantly at the beginning of opening labor pains ( $P < 0.01$ ), when progesterone averaged 0.79 ng/ml. This mean level declined to 0.23 ng/ml by 1 day postpartum.

## DISCUSSION

A precipitous drop in estrogen levels associated with parturition in cows has been reported from many laboratories [1-5, 7, 9-11, 13, 14], but the reported time of the decline is not always the same. Arije *et al.* [1], Dobson and Dean [3], Peterson *et al.* [10], Smith *et al.* [13], and Symons [14]

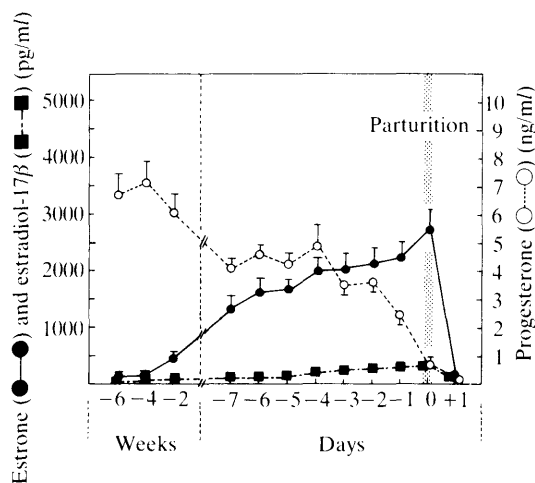


Fig. 1. Changes in the concentrations of estrone, estradiol-17 $\beta$ , and progesterone in the peripheral plasma of seven cows from 6 weeks before to 1 day after parturition. Vertical lines indicate standard error of the mean.

Table 1. Concentrations of estrone, estradiol-17 $\beta$ , and progesterone in the peripheral plasma of seven cows during parturition

Time of blood sampling	Concentrations of steroids (Mean $\pm$ SE)		
	Estrone (pg/ml)	Estradiol-17 $\beta$ (pg/ml)	Progesterone (ng/ml)
1 day prepartum	2271 $\pm$ 218 <sup>a)</sup>	308 $\pm$ 36*	2.52 $\pm$ 0.32*
Beginning of opening labor pains	2690 $\pm$ 281*	351 $\pm$ 44*	0.79 $\pm$ 0.14**
Allantoic sac broken	2716 $\pm$ 361*	356 $\pm$ 43*	0.71 $\pm$ 0.14**
Parturition	2781 $\pm$ 329*	391 $\pm$ 42*	0.75 $\pm$ 0.14**
1 hr postpartum	2555 $\pm$ 107*	446 $\pm$ 48*	0.58 $\pm$ 0.19**
1 day postpartum	197 $\pm$ 50**	34 $\pm$ 9**	0.23 $\pm$ 0.06**

a) Between \* and \*\* differ at a level of  $P < 0.01$  (Duncan's new multiple range test).

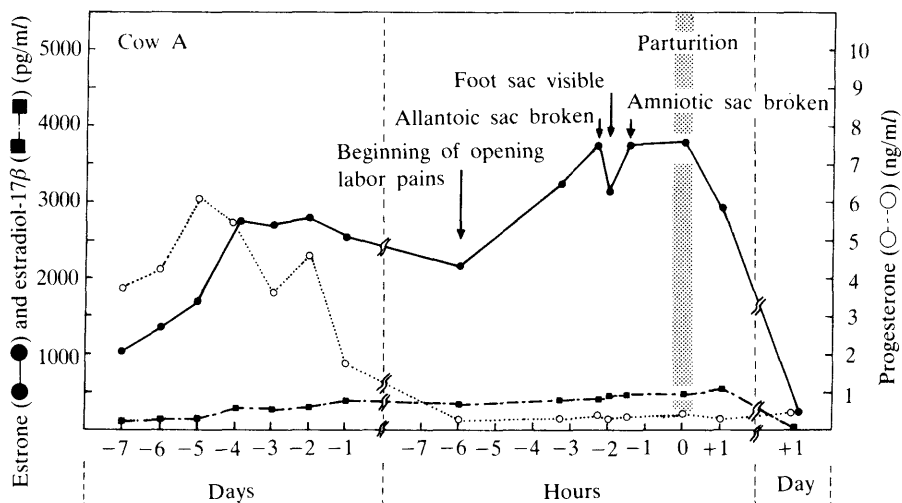


Fig. 2. Changes in the concentrations of estrone, estradiol-17 $\beta$ , and progesterone in the peripheral plasma of cow A around parturition.

reported that levels of estrogen increased only until 1 to 2 days before parturition and then decreased. In this study, however, levels of estrone and estradiol-17 $\beta$  continued to increase until parturition and then decreased rapidly postpartum. These changes in the estrogen level were similar to those reported by Chew *et al.* [2], Erb *et al.* [4], Henricks *et al.* [5], Kaker *et al.* [7], Mather *et al.* [9], and Robertson [11]. It is difficult to explain why the reported time of estrogen decline is different. Perhaps differences arise from different specificities of the

antibodies used or to other difference in the assay procedures. In this study, estrone and estradiol-17 $\beta$  in the cow plasma were assayed specifically by coupling purification on silica-gel and Sephadex LH-20 column chromatography. For the determination of the immunoreactive estradiol-17 $\beta$ , rabbit antibody against estradiol-17 $\beta$ -6-oxime-BSA was used. This antiserum showed no cross-reaction with epimeric estrogen, estradiol-17 $\alpha$ .

Detailed data about estrogen levels in the cow on the day of parturition are not yet

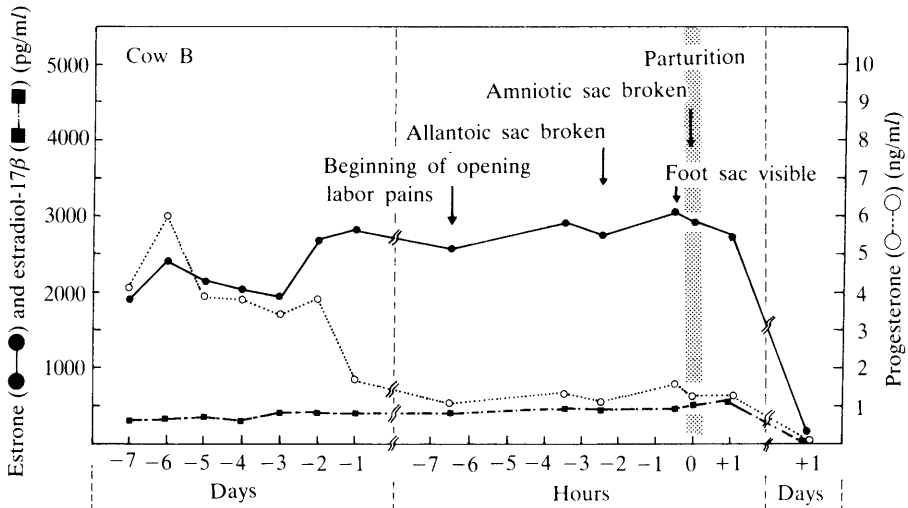


Fig. 3. Changes in the concentrations of estrone, estradiol-17 $\beta$ , and progesterone in the peripheral plasma of cow B around parturition.

available. In this study, the estrogen levels remained almost constant from the beginning of opening labor pains until 1 hr postpartum. If most of the estrogen in cows is derived from the placenta, placental function may continue until parturition.

The progesterone levels found in cows here were in good agreement with the results obtained by Arije *et al.* [1], Chew *et al.* [2], Erb *et al.* [4], Henricks *et al.* [5], Kaker *et al.* [7], Smith *et al.* [13], and Symons [14]. These authors also reported a decrease in the progesterone concentration about 2 days before parturition.

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#### REFERENCES

1. Arije, G. R., Wiltbank, J. N. and Hopwood, M. L. 1974. Hormone levels in pre- and post-parturient beef cows. *J. Anim. Sci.* 39: 338-347.
2. Chew, B. P., Keller, H. F., Erb, R. E. and Malven, P. V. 1977. Periparturient concentrations of prolactin, progesterone and the estrogens in blood plasma of cows retaining and not retaining fetal membranes. *J. Anim. Sci.* 44: 1055-1060.
3. Dobson, H., and Dean, P. D. G. 1974. Radioimmunoassay of oestrone, oestradiol-17 $\alpha$  and -17 $\beta$  in bovine plasma during the oestrous cycle and last stages of pregnancy. *J. Endocrinol.* 61: 479-486.
4. Erb, R. E., D'Amico, M. F., Chew, B. P., Malven, P. V. and Zamet, C. N. 1981. Variables associated with peripartum traits in dairy cows. VIII. Hormonal profiles associated with dystocia. *J. Anim. Sci.* 52: 346-358.
5. Henricks, D. M., Dickey, J. F., Hill, J. R. and Johnston, W. E. 1972. Plasma estrogen and progesterone levels after mating, and during late pregnancy and postpartum in cows. *Endocrinology* 90: 1336-1342.
6. Ichikawa, S., Morioka, H. and Sawada, T. 1972. Acute effect of gonadotrophins on the secretion of progestins by the rat ovary. *Endocrinology* 90: 1356-1362.
7. Kaker, M. L., Murray, R. D. and Dobson, H. 1984. Plasma hormone changes in cows during induced or spontaneous calvings and the early post partum period. *Vet. Rec.* 115: 378-382.
8. Makino, T. 1973. Radioimmunoassay of plasma sex steroids. *Folia Endocrinol. Jap.* 49: 629-645.
9. Mather, E. C., Garverick, H. A., McBurney, R. E., Schmitt, D. L. and Day, B. N. 1973. Plasma estradiol in Holstein and beef cows during the periparturient period. *J. Dairy Sci.* 57: 1090-1092.
10. Peterson, A. J., Hunter, J. T., Welch, R. A. S. and Fairclough R. J. 1975. Oestrogens in bovine fetal and maternal plasma near term. *J. Reprod. Fert.* 43: 179-181.

11. Robertson, H. A. 1974. Changes in the concentration of unconjugated oestrone, oestradiol-17 $\alpha$  and oestradiol-17 $\beta$  in the maternal plasma of the pregnant cow in relation to the initiation of parturition and lactation. *J. Reprod. Fert.* 36: 1-7.
12. Sawada, T., and Ichikawa, S. 1978. Sites of production of sex steroids: secretion of steroids from x-irradiated and polycystic ovaries of rats. *Endocrinology* 102: 1436-1444.
13. Smith, V. G., Edgerton, L. A., Hafs, H. D. and Convey E. M. 1973. Bovine serum estrogens, progestins, and glucocorticoids during late pregnancy, parturition and early lactation. *J. Anim. Sci.* 36: 391-396.
14. Symons, A. M. 1973. Levels of oestrogen and progesterone in the plasma of the cow during the last month of pregnancy. *J. Endocrinol.* 56: 327-328.

## 要 約

乳牛の分娩にともなう末梢血中エストロン，エストラジオール-17 $\beta$ およびプロジェステロン濃度の変化：沢田 勉・木村英司・藤本泰裕・松永 寛<sup>1)</sup>・森 純一（大阪府立大学農学部家畜臨床繁殖学教室，<sup>1)</sup>大阪府農林技術センター畜産部）——正常分娩したホルスタイン種経産牛7頭について，分娩前及び分娩経過中の末梢血中エストロン（E<sub>1</sub>），エストラジオール-17 $\beta$ （E<sub>2</sub>）及びプロジェステロン（P）濃度をラジオイムノアッセイ法により測定した。E<sub>1</sub>値は分娩前4週までは155pg/ml以下であったが，その後次第に上昇し，分娩日には最高値2781pg/mlを示した。分娩経過中は変動がなく，分娩翌日には197pg/mlに低下した。E<sub>2</sub>値はE<sub>1</sub>値の約10～21%であったが，その分泌動態はE<sub>1</sub>値に並行していた。分娩前2日までP値は3.71ng/mlであったが，分娩前日には2.52ng/mlに低下し，分娩日にはさらに0.75ng/mlに低下し，分娩経過中から分娩翌日にかけては変動がなかった。