PERIPARTURIENT CHANGES IN CONCENTRATION OF INSULIN LIKE GROWTH FACTOR-I IN BOVINE COLOSTRUM AND IN PLASMA OF DAIRY COWS AND NEONATAL CALVES

S. Oda, H. Satoh, T. Sugawara, N. Matsunaga, K. Katoh, Y. Shoji, A. Nihei, M. Ohta and Y. Sasaki

Faculty of Agriculture, Tohoku University, Sendai, Japan.

Introduction

Insulin like growth factor I(IGF-I/Somatomedin C) may play an important role in regulating growth of young ruminant livestock. It has been reported that bovine colostrum contains high levels of growth promoting factors that stimulate DNA synthesis and cell division (Klagsbrun and Neumann, 1979). Human milk sampled at 1-day postpartum has also been reported to contain the highest level of immunoreactive IGF-I, levels falling rapidly thereafter, by 80% within 48h after delivery (Baxter et al., 1984). However, little is known concerning the relationships between the IGF-I content in bovine plasma and in colostrum, or between the concentrations of plasma GH and IGF-I in the cow around parturition. In the present experiment, we investigated the changes in concentrations of immunoreactive IGF-I in bovine colostrum and in plasma of neonatal calves for 7 days after delivery and in the plasma of the maternal dairy cows around parturition.

Materials and Methods

Six Holstein dairy cows were used. After delivery cows were milked three times daily at 08:30, 14:00 and 20:00 h. Aliquots of three colostrum samples were mixed in proportion to milk yield and were centrifuged at 25,000 x g, 4°C for 30 min. Fat was removed, and the infranatants were stored at −20°C until hormone assays. Blood samples were obtained from the cows' jugular veins by venepuncture once a day before the milking at 08:30. The blood of the neonatal calves was also sampled before the morning meal. Blood samples were centrifuged at 12,000 rpm, 4°C for 10 min and plasma samples were stored at −20°C until assay. IGF-I and GH concentrations in colostrum and in plasma were determined by radioimmunoassay using IGF-I reagent pack for RIA (Amersham, UK) and oGH antiserum (NIADDK-anti-oGH-2), respectively. The samples for IGF-I were extracted by acid-ethanol to remove IGF-I from binding protein before assay. Significant differences in hormone concentration between days within cow plasma, neonate plasma or colostrum, and between cow, neonate and colostrum at each sampling day were analyzed by analysis of variance, using General Linear Model (GLM) of the SAS program package and Duncan's multiple range test.

Results

The displacement curves of IGF-I for the acid-ethanol extracted colostrum and plasma paralleled the standard curve (data are not shown). Plasma IGF-I concentrations in cows and in calves were not significantly different between sampling days (table 1). The IGF-I levels, however, were significantly higher in calf plasma than in the cows ($p < 0.001$). The IGF-I concentration in colostrum on day 1 was markedly elevated (449 ± 8.5 ng/ml) and rapidly decreased to below the levels found in cow plasma by 5 days after parturition.

The concentration of GH in cow plasma tended to increase on days 1 and 2, but due to variation between animals this trend failed to reach statistical significance (table 2). A higher plasma GH concentration in calves than that in cows was apparent with statistically significant differences on days 4, 5 and 6. The GH concentration of colostrum was very low.

Discussion

The results of the present experiment show that the IGF-I concentration in bovine colostrum was markedly elevated for two or three days after parturition so as to exceed concentrations in blood plasma, followed by a rapid decrease reaching a lower level than that found in plasma. The rapid decrease in the IGF-I concentration in colostrum is in agreement with results for human milk

TABLE 1. IMMUNOREACTIVE IGF-I IN ACID-ETHANOL-EXTRACTED BOVINE COLOSTRUM AND PLASMA AROUND PARTURITION (ng/ml)

		Days postpartum						
	−7~−1	1	2	3	4	5	6	7
Cow	213	217^{a}	198^{a}	188^{a}	175^{a}	170^{a}	173^{a}	177^{a}
plasma	7.5	21.3	19.0	18.1	15.9	21.1	19.7	18.3
Neonate		270^{a}	289^{b}	276^{b}	260^{b}	285^{b}	312^{b}	314^{b}
plasma		27.1	17.1	23.0	21.9	24.3	19.2	18.7
Colostrum		449^{b}	372^{c}	278^{b}	159^{a}	100^{c}	82^{c}	71^{c}
		8.5	29.8	39.3	22.0	16.0	12.6	13.7

Values represent Mean (upper) ± SE (lower).
[a,b,c]Mean values in the same vertical column not sharing common letters differed significantly ($p < 0.05$).
Mean values covered by the same horizontal line were not significantly different ($p > 0.05$).

TABLE 2. IMMUNOREACTIVE GH CONCENTRATIONS IN BOVINE COLOSTRUM AND PLASMA AROUND PARTURITION (ng/ml)

		Days postpartum						
	−7~ 1	1	2	3	4	5	6	7
Cow	3.5	6.1^{ab}	7.1^{ab}	3.5^{ab}	3.5^{a}	3.2^{a}	3.6^{a}	4.4^{a}
plasma	0.4	1.7	3.0	0.7	0.8	0.6	0.6	1.1
Neonate		7.9^{a}	8.7^{a}	5.6^{a}	7.5^{b}	9.6^{b}	8.0^{b}	6.6^{a}
plasma		1.9	2.3	1.7	1.6	3.4	1.9	1.4
Colostrum		1.9^{b}	1.0^{b}	0.6^{b}	0.2^{c}	0.2^{a}	0.1^{c}	0.3^{b}
		0.3	0.1	0.1	0.1	0.1	0.1	0.2

Values represent Mean (upper) + SE (lower).
[a,b,c]Mean values in the same vertical column not sharing common letters differed significantly ($p < 0.05$).
Mean values covered by the same horizontal line were not significantly different ($p > 0.05$).

(Baxter et al., 1984). It is conceivable that the tendency for cow plasma GH to be elevated 1 or 2 days after parturition would not be enough to stimulate IGF-I release by tissues, so that plasma IGF-I was unchanged during the period of observation. It seems to be important for the neonatal calf to have high plasma concentrations of both IGF-I and GH for further growth after birth.

This work was supported by a Grant-in-Aid for Scientific Research from the Ministry of Education, Science and Culture of Japan (No. 638600-36)

(Key Words: IGF-I, GH, Parturition)

Literature Cited

Baxter, R.C., Z. Zaltsman and J.R. Turtle. 1984. Immunoreactive somatomedin-C/insulin like growth factor I and its binding protein in human milk. J. Clin. Endocrinol. Metab. 58: 955-959.

Klagsbrun, M. and J. Neumann. 1979. The serum-free growth of Balb/c 3T3 cells in medium supplemented with bovine colostrum. J. Supramol. Struct. 11:349-359.