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Research Article

Concentrations of Some Minerals in Cows with Retained Placenta and Abortion

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Abstract: This study was undertaken to investigate the relationship between blood levels of Ca, Zn, Mg, K, and Na and the occurrence of retained placenta and abortion in cows. Serum samples from 34 cows were analyzed (18 with retained placenta, 10 without retained placenta (control), and 6 that had aborted).

Ca and Zn levels in cows with retained placenta were significantly lower than those in the control group. The serum Zn levels of aborted cows were higher ($P < 0.001$) than those of cows with retained placenta. Cows in the control group and those with retained placenta were divided into subgroups based on age (3, 4-6, 7-9 years old), type of parturition (normal, dystocia), and sex of calves (male, female). The serum Ca concentration of 3-year-old cows with retained placenta was significantly higher ($P < 0.05$) than that of those 7-9 years old. It is concluded that lower serum Ca and Zn levels in cows may induce placenta retention.

Key Words: Retained placenta, abortion, mineral substance, cow.

Retensiyo Sekundinarumlu ve Yavru Atan İneklerde Bazı Mineral Madde Düzeyleri

Özet: Bu araştırmada, retensiyo sekundinarum oluşumu ile serum Ca, Zn, Mg, K ve Na düzeyleri arasındaki ilişki araştırıldı. Toplam 34 ineğin (18 retensiyolu, 10 kontrol ve 6 yavru atan) serum örneklerinin analizi yapıldı.

Retensiyo sekundinarumlu ineklerde serum Ca ve Zn düzeylerinin kontrol grubuna göre düşük ($P < 0,01$, $P < 0,001$) olduğu belirlendi. Serum Zn değerleri yavru atan ineklerde retensiyo sekundinarumlu gruba göre daha yüksekti ($P < 0,001$). Retensiyo sekundinarum ve kontrol grubu inekler, doğum şekli (normal, güç), yavru cinsiyeti (erkek, dişi) ve yaşa (3, 4-6 ve 7-9 yaş) göre alt grublara ayrıldı. Retensiyo sekundinarumlu 3 yaş grubu ineklerde serum Ca düzeylerinin 7-9 yaş grubu ineklere göre yüksekti ($P < 0,05$). Retensiyo sekundinarumlu ineklerde tespit edilen düşük serum Ca ve Zn düzeylerinin retensiyo sekundinarum şekillenme riskini artırabileceği düşünüldü.

Anahtar Sözcükler: Retensiyo sekundinarum, abort, mineral madde, inek.

Introduction

Retained placenta (RP) may result from a number of factors, such as abortion, forced labor, delayed gestation, early parturition, uterine atony, infections, and seasonal and hormonal disorders. In addition, it is well known that deficiencies of some vitamins and minerals induce or predispose animals to RP (1-3).

The physiological delivery of the placenta after parturition requires adequate and regular uterine contractions. The deficiency in secretions of $PGF_{2\alpha}$ and oxytocin and serum Ca concentration, which maintain adequate contraction of the uterus, may cause RP, increase the risk of dystocia and delay the involution of the uterus (3-5).

Some researchers (6,7) reported that a low serum Ca concentration plays an important role in the development of RP in cows, while others (8,9) found that the Ca concentration was at the physiological level, indicating that Ca has virtually no role in the development of RP. Meanwhile, Carson et al. (10) investigated the high

incidence of dystocia, RP and puerperal metritis in a dairy herd. They found that when these animals were fed a ration enriched with supplemental bone meal for the previous 3 months the incidence of dystocia was reduced from 75% to 10%, the RP rate from 35% to 8% and the puerperal metritis rate from 70% to 10%. The serum Ca concentration in these cows was reported to increase from 8.98 mg/dl to 10.26 mg/dl with this type of diet.

It has been reported that the low serum concentrations of various minerals including Zn, Mg and K in cows before parturition might cause or increase the risk of RP (7,11).

Malnutrition is thought to be one of the most important factors in non-infectious abortion in cows and heifers. It may even lead to the development of abnormalities in the fetus and embryonic death in the early period of gestation. The inadequate supplementation of a ration with vitamins A and E, beta-carotene, iodine, Se, Cu and Zn may also induce abortion in the advanced stage of gestation in cows (1,12,13).

The objective of the present study was to investigate the relationship between blood serum concentrations of Ca, Zn, Mg, K and Na and the development of RP and abortion in cows. The effects of age, type of parturition and sex of calves on the levels of serum minerals with regard to the development of RP were also studied.

Materials and Methods

Thirty-four cows 3-9 years old were used. Eighteen of the cows had RP, 10 were controls (without RP) and 6 had aborted at 3-7 months of gestation. Of these, 17 were Swiss-Brown, 12 were Holstein, 3 were Simmental and 2 were indigenous breed cows. They were randomly selected from among animals brought to the obstetrics and gynecology clinic of the Faculty of Veterinary Medicine, Fırat University, Elazığ.

These animals were fed a ration of wheat straw and concentrated feed, according to the owners. They were divided into 3 groups. The cows with undelivered placenta within the first 12 h of delivery were assigned to the RP group; those that delivered the placenta within 12 h were assigned to the control group; and those that had abortions between 3 and 7 months of gestation were assigned to the aborted group. Cows in the control group and those with RP were divided into subgroups based on age (3,4-6,7-9 years old), type of parturition (normal, dyctocia), and sex of calves (male, female). A 10 ml blood sample from each animal was taken from the jugular vein 2 or 3 days after parturition using sterile blood collecting tubes. The samples were centrifuged at 3000 rpm for 20 min and the serum samples were stored at -20 °C until analyzed.

Serum Ca, Zn and Mg concentrations were analyzed with an atomic absorption spectrophotometer (Perkin Elmer 370 Model) and serum K and Na concentrations with a flame photometer (Petracourt PFP1) (14). The statistical analysis of the differences between groups and ages was determined with ANOVA, significance of differences with Duncan's test and the difference between type of parturition and sex of calves with the Mann-Whitney U test (15). The results are expressed as mean ± SEM. A level of $P < 0.05$ was considered statistically significant.

Results

It was determined that mean serum concentrations of Ca and Zn in the RP group were significantly lower ($P < 0.01$, $P < 0.001$, respectively) than those in the control group. It was found that serum Zn concentrations in the aborted cows and control group were significantly greater ($P < 0.001$) than that in the RP group. The serum Mg, K and Na concentrations of the aborted cows did not differ significantly ($P > 0.05$) from those of the cows with and without RP (Table 1). When type of parturition and sex of calves were evaluated in the RP and control groups, it was detected that these variables had no significant ($P > 0.05$) effect on serum Ca, Zn, Mg, K and Na concentrations (Tables 2,3). Serum Ca concentration in 3-year-old cows with RP was higher than in those 7-9 years old (Table 4), but no difference was seen according to age in the control group (Table 5).

Discussion

There is a significant relation between metabolic and puerperal disorders, and nutrition deficiencies after parturition in cows. Minerals such as Ca, Zn, Mg, K and Na are obtained from the diet and play an essential role in metabolic and physiological activities (3-5).

The normal plasma concentration of Ca, Zn, Mg, K and Na in cows were regarded as 8-12 mg/dl (16), 0.4-

Table 1. Serum Ca, Zn, Mg, K and Na concentration in the cows with and without RP, and abortion.

	RP (n = 18)	Abortion (n = 6)	control (n = 10)
Parameters	Mean ± SE	Mean ± SE	Mean ± SE
Ca (mg/dl)	6.48 ± 0.32[a]	7.64 ± 0.35[ab]	9.41 ± 0.39[b]
Zn (mg/l)	0.34 ± 0.02[c]	0.57 ± 0.04[d]	0.71 ± 0.04[d]
Mg (mg/dl)	2.19 ± 0.13	1.83 ± 0.25	2.14 ± 0.24
K (mmol/l)	4.85 ± 0.28	4.37 ± 0.25	4.68 ± 0.23
Na (mmol/l)	135.95 ± 5.15	136.99 ± 13.7	131.26 ± 9.61

([a,b]): P < 0.01, ([c,d]): P < 0.001.
The difference between the values marked with various letters in the same line is significant.

Table 2. Mean serum Ca, Zn, Mg, K and Na concentration in the cows with and without RP animals according to type of parturition.

	RP		Control	
	Dystocia (n = 10)	Normal Parturition (n = 8)	Dystocia (n = 3)	Normal Parturition (n = 7)
Parameters	Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE
Ca (mg/dl)	6.47 ± 0.51	6.48 ± 0.39	7.51 ± 1.17	9.96 ± 1.09
Zn (mg/l)	0.34 ± 0.02	0.33 ± 0.02	0.86 ± 0.24	0.67 ± 0.17
Mg (mg/dl)	2.30 ± 0.21	2.05 ± 0.12	1.79 ± 0.40	2.18 ± 0.25
K (mmol/l)	4.96 ± 0.47	4.74 ± 0.26	4.34 ± 1.85	4.38 ± 0.55
Na (mmol/l)	137.41 ± 9.34	134.12 ± 2.00	156.18 ± 8.04	124.15 ± 10.82

Table 3. Mean serum Ca, Zn, Mg, K and Na concentrations in the cows with and without RP according to sex of calves.

	RP		Control	
Parameters	Male (n = 10) Mean ± SE	Female (n = 8) Mean ± SE	Male (n = 4) Mean ± SE	Female (n = 6) Mean ± SE
Ca (mg/dl)	6.05 ± 0.29	7.00 ± 0.61	9.65 ± 0.92	9.22 ± 1.60
Zn (mg/l)	0.31 ± 0.01	0.37 ± 0.01	0.65 ± 0.17	0.76 ± 0.23
Mg (mg/dl)	2.12 ± 0.12	2.27 ± 0.24	2.37 ± 0.48	1.95 ± 0.24
K (mmol/l)	4.87 ± 0.24	4.81 ± 0.58	5.22 ± 0.79	3.70 ± 0.59
Na (mmol/l)	133.27 ± 6.74	139.30 ± 8.32	132.55 ± 18.8	130.24 ± 10.9

0.6 mg/l (17), 1.8-2.3 mg/dl (4), 3.9-5.8 mmol/l, and 132-152 mmol/l, respectively (18). In this study, the average serum Ca was 6.48 ± 0.32, 9.41 ± 0.39 and 7.64 ± 0.35 mg/dl; Zn was 0.34 ± 0.02, 0.71 ± 0.04 and 0.57 ± 0.04 mg/l; Mg was 2.19 ± 0.13, 2.14 ± 0.24 and 1.83 ± 0.25 mg/dl; K was 4.85 ± 0.28, 4.68 ± 0.23 and 4.37 ± 0.25 mmol/l and Na was 135.95 ± 5.15, 131.26 ± 9.61 and 136.99 ± 13.75 mmol/l in RP, control and aborted cows, respectively. The values, except for Ca and Zn levels in RP cows, are within the normal physiologic values as indicated by previous research (3,16,17).

Table 4. Mean serum Ca, Zn, Mg, K and Na concentrations in cows of different ages with RP.

	3 years old (n = 3)	4-6 years old (n = 10)	7-9 years old (n = 5)
Parameters	Mean ± SE	Mean ± SE	Mean ± SE
Ca (mg/dl)	7.52 ± 0.94[a]	6.61 ± 0.45[ab]	5.58 ± 0.28[b]
Zn (mg/l)	0.39 ± 0.02	0.31 ± 0.01	0.36 ± 0.01
Mg (mg/dl)	1.88 ± 0.24	2.21 ± 0.11	2.33 ± 0.41
K (mmol/l)	4.68 ± 0.37	4.94 ± 0.32	4.75 ± 0.82
Na (mmol/l)	140.56 ± 1.69	134.06 ± 6.66	136.96 ± 14.18

([a,b]): ($P < 0.05$)
The difference between the values marked with various letters in the same line is significant.

Table 5. Mean serum Ca, Zn, Mg, K and Na concentrations in cows of different ages in the control group.

	3 years old (n = 3)	4-6 years old (n = 3)	7-9 years old (n = 4)
Parameters	X ± SE	X ± SE	X ± SE
Ca (mg/dl)	9.60 ± 0.75	7.75 ± 0.71	10.57 ± 1.92
Zn (mg/l)	0.70 ± 0.04	0.45 ± 0.08	0.92 ± 0.29
Mg (mg/dl)	1.82 ± 0.32	1.82 ± 0.21	2.53 ± 0.48
K (mmol/l)	4.24 ± 0.32	3.91 ± 0.84	4.79 ± 1.08
Na (mmol/l)	105.82 ± 0.37	130.91 ± 19.04	144.25 ± 14.4

In research (6,7) carried out on blood samples taken from cows prior to parturition, 24 h after parturition and postpartum first week, it is suggested that the serum Ca concentration of RP animals (6.27 ± 0.18 mg/dl) was lower than that in postpartum cows without RP (7.40 ± 0.18 mg/dl). Some researchers (8,9,19) indicate that a significant difference is not seen between animals with and without RP. Bari et al. (20) stated that Ca affected the development of RP and the serum Ca concentration was 6.89, 6.65 and 6.37 mg/dl 1 week before, during and 12 h after parturition, respectively, in cows with RP. On the other hand, these values were reported as 9.09, 8.61 and 8.53 mg/dl, respectively, in cows without RP. The average serum Ca concentrations in cows with RP were lower than the values of those without RP in the research. This finding is in agreement with the results of some other researchers (6,7,20).

The serum Zn concentration of the RP and control groups immediately before parturition were respectively 0.58 and 1.16 mg/l, with 3.33 and 4.34 mmol/l for K and 1.91 and 3.32 mg/dl for Mg (11). Bari et al. (20) stated that Mg concentration was 1.75 and 2.84 mg/dl and the differences were significant. Zhang et al. (7) suggested that Zn and Mg concentrations of the blood serum in the RP group prior to parturition and after parturition were lower than those in the control animals. Other researchers (21-23) indicated that low levels of minerals lead to a predisposition to RP in cows. In this research, even if the serum Zn (0.34 ± 0.02 mg/l) level in cows with RP was significantly lower than that in the control (0.71 ± 0.14 mg/l) group, no difference was identified among the groups in respect of K and Mg levels. In the present study, the findings related to Mg and K were different from the results of other studies (7,11,20). The reason for such a difference may be related to variations in feeding, breed and types of the dairy animals (24).

It was suggested in many studies (2,25,26) that dystocia in cows increased RP incidence. Sevcik et al. (21) stated that the blood serum Ca, Na and K concentrations

did not differ between normal cows and those with dystocia. On the other hand, Bostedt (27) indicated that the serum Ca and Mg concentrations in cows and heifers after dystocia were higher than those in cows with normal parturition. In this research, no differences were seen in respect of Ca, Zn, Mg, K or Na levels between the RP and control groups depending on the parturition type. These results are consistent with previous research (21).

Mutiga et al. (9) indicated that calf sex in RP cows had no effect on plasma Ca levels. Öcal et al. (19) stated that the serum Ca level in cows having a male calf with RP was higher than that in cows having a female calf (9.39 and 8.68 mg/dl). In the present research, no difference was determined among Ca, Zn, Mg, K or Na levels depending on calf sex in the RP and control groups.

Some researchers (2,28) suggest that there is a relation between the age of the animal and RP; thus RP incidence increases with age. In research conducted by Erb and Martin (29) on 1401 cows, it was stated that the RP rate in 2-year-old cows was lower than that in cows 4 years old. Öcal et al. (19) reported that cows 2-3 years old with RP had higher serum Ca (9.41 and 8.72 mg/dl) levels than cows 3-6 years old. In this research, the serum Ca concentration of the cows with RP in the 3 years old group was higher than that in the cows in the 7-9 years old group ($P < 0.05$). No difference was noted between age groups in respect of Zn, Mg, K or Na levels. Such a decrease in vitamin D receptors, which increase the Ca absorption from the intestines that occurred due to aging, may be considered the result of low Ca levels in older cows. It was determined that no difference was seen among the various age groups or the control group.

It was indicated that Zn deficiency in cows could cause abortion. The plasma Zn concentrations in cows that had aborted were lower than those in cows that had not. Therefore, it might occur due to increased $PGF_{2\alpha}$ hormone levels in the blood at the time of parturition (13). Graham et. al. (22) stated that the serum Zn concentration in aborting cows was lower than that in cows not aborting and insufficient Zn in feeds played an important role in the loss of the fetus. It was indicated that even if Ca levels increased in aborting cows due to Brucella infection, Mg levels decreased and such a difference might occur due to the effect of Brucella (23). In this research, it was determined that the serum Ca, Mg, K and Na levels did not differ in the aborting cows in the RP or control group. However, even if Zn levels were higher when compared to the cows with RP ($P < 0.001$) and lower compared to the control group, no difference was determined. Abortion could be caused by infectious and other non-infectious reasons other than the mineral substance deficiency in the blood since it has a multidirectional etiology.

In conclusion, it was determined that serum Ca and Zn concentrations in animals with retention secundinarium were lower than those in animals without RP. In addition, other parameters remained the same between the groups. It may be considered that lower blood serum Ca and Zn may be influential in retained fetal membrane. Therefore, the quantity of the mineral substances should be taken into consideration prior to parturition in the diets of cows.

References

1. Alaçam, E.: Evcil Hayvanlarda Doğum ve İnfertilite. Medisan Yayınevi, Ankara. 2002.
2. Laven, R.A., Peters, A.R.: Bovine retained placenta: aetiology, pathogenesis and economic loss. Vet. Rec., 1996; 139: 465-471.
3. Hurley, W.L., Doane, R.M.: Recent developments in the roles of vitamins and minerals in reproduction. J. Dairy Sci., 1989; 72: 784-804.
4. McDowell, L.R.: Minerals in Animal and Human Nutrition, Academic Press, London. 1992.
5. Morrow, D.A.: The role of nutrition in dairy cattle reproduction. In: Morrow, D.A. Ed. In: Current Therapy in Theriogenology. W.B. Saunders Co., Philadelphia. 1980; 449-455.
6. Shukla, S.P., Kharche, K.G., Parekh, H.K.B.: Calcium and phosphorus in relation to retained placenta in cross-bred cows. Indian Vet. J., 1983; 60: 183-188.
7. Zhang, C.K., Ye, J.P., Chen, J.H.: The changes of mineral contents of serum during the dry period and prior to and after calving in dairy cows with retained placenta. Chinese J. Vet. Med., 1992; 18: 10-11.
8. Lotthammer, K.H.: Comparative studies of the course of mineral, metabolite, enzyme and hormone levels in blood serum ante partum in dairy cows with and without later retained placenta. Dtsch. Tierarztl. Wochenschr., 1983; 90: 427-433.
9. Mutiga, E.R., Mbai, K., Tsuma, V.T., Karitu, P.T., Ojiayo, S.O.: Incidence and causes of retained placenta in smallholder dairy herds. Indian Vet. J., 1993; 70: 333-336.

10. Carson, R.L., Caudle, A.B., Riddle, H.E.: The relationship between narrow calcium-phosphorus ratio and reproductive problems in a dairy herd: a case report. Theriogenology, 1978; 9: 505-507.

11. Stancioiu, N., Constantinescu, D.: Variation in the concentration of some blood minerals in cows with normal calving and with retained placenta. Medicina Veterinara, 1983; 26: 29-31.

12. Bedwal, R.S., Bahuguna, A.: Zinc, copper and selenium in reproduction. Experientia, 1994; 50: 626-640.

13. Graham, T.W., Giri, S.N., Daels, P.F., Cullor, J.S., Keen, C.L, Thurmond, M.C., Dellinger, J.D., Stabenfeldt, G.H., Osburn, B.I.: Associations among prostaglandin F2 alpha, plasma zinc, copper and iron concentrations and fetal loss in cows and mares. Theriogenology, 1995; 44: 379-390.

14. Joseph, S.A., Roger, W.G.: Clinical Chemistry. Little, Brown and Company, Boston. 1985.

15. Hayran, M., Özdemir, O.: Bilgisayar İstatistik ve Tıp. İkinci baskı, Hekimler Yayın Birliği, Ankara. 1996; 320-355.

16. Ballantine, H.T., Herbein, J.H.: Potentiometric determination of ionized and total calcium in blood plasma of Holstein and Jersey cows. J. Dairy Sci., 1991; 74: 446-449.

17. Mills, C.F.: Biochemical and physiological indicators of mineral status in animals: copper, cobalt and Zn. J. Anim. Sci., 1987; 65: 1702-1711.

18. Altuntaş, A., Fidancı, U.R.: Evcil hayvanlarda ve insanda kanın biyokimyasal normal değerleri. Ankara Üniv. Vet. Fak. Derg., 1993; 40: 173-186.

19. Öcal, H., Türköz, Y., Çetin, H., Kaygusuzoğlu, E., Rişvanlı, A., Kalkan, C.: Retensiyo sekundinarumlu ineklerde kan serumu kalsiyum (Ca) ve fosfor (P) düzeyleri üzerine çalışma. Turk. J. Vet. Anim. Sci., 1999; 23 (Suppl. 3): 591-595.

20. Bari, M.Z., Saeed, M.A., Bashir, I.N., Shoaib, H.M.: Comparative study on serum levels of calcium, magnesium and phosphorus in cows with and without retention of placenta. Indian J. Anim. Nutr., 1996; 13: 63-66.

21. Sevcik, A., Elecko, J., Kacmarik, J.: Effect of parturition on some components of mineral metabolism in cows. Folia Vet., 1980; 24: 89-101.

22. Graham, T.W., Thurmond, M.C., Gershwin, M.E., Picanso, J.P., Garvey J.S., Keen, C.L.: Serum zinc and copper concentrations in relation to spontaneous abortion in cows: implications for human fetal loss. J. Reprod. Fertil., 1994; 102: 253-262.

23. Darmono, A., Sudibyo, A.: Concentrations of calcium, magnesium and copper in serum samples of cattle known to be positive for brucellosis in Indonesia. Penyakit Hewan, 1990; 22: 59-61.

24. Kulkarni, B.A., Talvelkar, B.A.: Blood metabolic profiles in crossbred lactation cows. Indian J. Anim. Sci., 1993; 63: 716-719.

25. Correa, M.T., Curtis, C.R., Erb, H.N., Scarlett, J.M., Smith, R.D.: An ecological analysis of risk factors for postpartum disorders of Holstein-Friesian cows from thirty-two New York farms. J. Dairy Sci., 1990; 73: 1515-1524.

26. Samad, R.M.H., Islam, T.S.: Factors associated with placental retention in dairy cattle. Indian J. Dairy Sci. 1989; 42: 720-723.

27. Bostedt, H.: Studies on the calcium, inorganic phosphate and magnesium content of the blood serum of cattle in relation to difficulties at parturition. Zentralbl. Veterinarmed., 1974; 20: 172-178.

28. Stevenson, J.S., Call, E.P.: Reproductive disorders in the periparturient dairy cow. J. Dairy Sci., 1988; 71: 2572-2583.

29. Erb, H.N., Martin, S.W.: Interrelationships between production and reproductive diseases in holstein cows: age and seasonal patterns. J. Dairy Sci., 1980; 63: 1918-1924.