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NOTE

CHANGES IN SERUM ELECTROLYTES OF HOLSTEIN COWS WITH PERIPARTURIENT DISEASES

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ABSTRACT

Blood samples were obtained from 85 Holstein cows in a dairy farm during the two months prepartum, at parturition and the two months postpartum. The electrolytes measured were sodium, potassium, chloride, calcium, inorganic phosphorus, magnesium and iron. At parturition, the levels of chloride, calcium, inorganic phosphorus and iron were lower ($P<0.05$) than values at other periods. No significant difference was observed in serum sodium and potassium levels ($P>0.05$). Concentration of magnesium was greater ($P<0.05$) at parturition as compared with pre- and postpartum periods. Illness or disease occurred in 12 out of 85 cows at parturition or thereafter. Postparturient metritis, uterine prolapse, milk fever, retained placenta and mastitis were diagnosed. Under the disease conditions, the concentrations of sodium and chloride did not change. In cows suffering from postparturient metritis and uterine prolapse, the concentrations of calcium and phosphorus decreased but concentration of magnesium and iron increased as compared to values at the time of parturition. In milk fever and retained placenta, the concentration of calcium and phosphorus decreased as compared to values at the

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time of parturition. In contrast, the concentration of magnesium increased in milk fever and retained placenta. Concentration of potassium was also decreased in milk fever. The results of this study indicated that the most important change in serum electrolytes is at parturition. Also, there is a significant alteration in serum electrolytes of cows with periparturient diseases.

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تغییرات الکترولیت های سرم گاوهای هولشتین در بیماری های پیرامون زمان زایمان

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به ترتیب استادیار آسیب شناسی بالینی دانشکده دامپزشکی دانشگاه شیراز، شیراز و مربی بخش فیزیولوژی دانشکده دامپزشکی دانشگاه کرمان، کرمان، ایران.

چکیده

نمونه های خون ۸۵ راس گاوهولشتین از یک گاو داری گاو شیری در خلال دوماه قبل از زایمان، زمان زایمان و دوماه بعد از زایمان جمع آوری گردیدند. الکترولیت های اندازه گیری شده عبارت بودند از: سدیم، پتاسیم، کلر، کلسیم، فسفر، منیزیوم و آهن. در زمان زایمان، میزان کلر، کلسیم، فسفر و آهن کمتر از مقادیر آنها در سایر زمان ها بود. هیچ تفاوت معنی داری در میزان سدیم و پتاسیم سرم مشاهده نشد. در زمان زایمان، افزایش معنی داری ($P<0/05$) در

غلظت منیزیوم سرم مشاهده شد. دوازده راس از ۸۵ راس گاو مورد مطالعه در زمان زایمان و بعد از آن به متریت بعد از زایمان، پرولاپس رحم، تب شیر، جفت ماندگی و تورم پستان مبتلا شدند. در این بیماری ها، غلظت های سدیم و کلرسرم تغییری نشان ندادند. در متریت بعد از زایمان و پرولاپس رحم در مقایسه با زمان زایمان، غلظت کلسیم و فسفر کاهش یافته و غلظت منیزیوم و آهن افزایش نشان داد. در تب شیر و جفت ماندگی، در مقایسه با زمان زایمان، غلظت پتاسیم کاهش نشان داد. نتایج این مطالعه نشان می دهد که مهمترین تغییرات در الکترولیت های سرم در زمان زایمان رخ داده و الکترولیت های سرم در گاوهای مبتلا به بیماری های پیرامون زمان زایمان تغییرات مهم و معنی داری نشان می دهند.

INTRODUCTION

Electrolyte profiles have been used to predict periparturient problems and fertility, diagnosis of metabolic diseases and assessment of nutritional status in animals (11). Evaluation of the concentration of various electrolytes in blood is a valuable tool for assessing the clinical status of a herd of animals and that of an individual animal. These parameters are most helpful when interpreted in conjunction with herd history, clinical signs and laboratory tests (3). The purpose of the present study was to examine variations in the serum electrolytes of Holstein cows in peripartum period and diseases.

MATERIALS AND METTHODS

This study was performed using blood samples from 85 Holstein cows from a dairy farm in Fars province. The cows had at least two calvings and their weights ranged from 450 to 500 kg. The blood samples were taken from

the coccygeal vein in 10 ml vacutainer (venoject) glass tubes every month at 7th and 8th month of pregnancy, at parturition and first and second month after parturition from December to July. In peripartum period, the clinical signs and laboratory tests of diseased cows were recorded. Blood serum was separated by centrifugation at 3000 rpm (15 min) and stored in a deep freeze at -20° C, until used. Sodium and potassium were determined by a flame photometer (FLM2, Canada) and calcium and magnesium by using an atomic absorption (Shimadzu AA-670, Japan). Determination of serum chloride, inorganic phosphorus and iron was carried out by mercuric nitrate (Schales), ammonium molybdate and chromazurol B (CAB) methods, respectively (23).

Data were analysed by one-way ANOVA, using SPSS/PC software and Duncan's multiple range test was used to detect significant differences amongst means.

RESULTS

Changes in serum electrolytes of Holstein cows during late pregnancy, at parturition, during postpartum period and in periparturient diseases are presented in Tables 1 and 2, respectively. At parturition, the levels of chloride, calcium, inorganic phosphorus and iron were lower ($P<0.05$) than values at other periods. No significant difference was observed in serum sodium and potassium levels ($P>0.05$). Concentration of magnesium was greater ($P<0.05$) at parturition as compared with pre- and postpartum periods. Illness or disease occurred in 12 out of 85 cows at parturition or thereafter. Postparturient metritis, uterine prolapse, milk fever, retained placenta and mastitis were diagnosed. Under the disease conditions, the concentrations of sodium and chloride did not change. In cows suffering from postparturient metritis and uterine prolapse, the concentrations of calcium and phosphorus decreased but concentration of magnesium and iron increased as compared to values at the time of parturition.

In milk fever and retained placenta, the concentration of calcium and phosphorus decreased as compared to values at the time of parturition. In

contrast, the concentration of magnesium increased in milk fever and retained placenta. Concentration of potassium was also decreased in milk fever.

Table 1. Means ± SE of serum electrolytes of Holstein cows (n=85) at late pregnancy, parturition and postpartum periods.

Period	Na^+ mmol l^{-1}	K^+ mmol l^{-1}	Cl^- mmol l^{-1}	Ca^{++} mg dl^{-1}	P mg dl^{-1}	Mg^{++} mg dl^{-1}	Fe^{++} µg dl^{-1}
7th month of pregnancy	152.67 ±0.97	4.81 ±0.07	102.80^{b†} ±0.66	9.88^{d} ±0.13	7.37^{c} ±0.12	2.92^{c} ±0.04	203.30^{c} ±4.67
8th month of pregnancy	152.34 ±0.96	4.78 ±0.08	105.01^{b} ±0.70	8.12^{b} ±0.10	4.81^{a} ±0.05	2.68^{b} ±0.06	166.19^{b} ±2.97
Parturition	151.85 ±0.91	4.77 ±0.08	92.83^{a} ±0.68	7.43^{a} ±0.12	4.35^{a} ±0.20	3.01^{d} ±0.10	151.85^{a} ±3.36
One month after parturition	151.64 ±0.79	4.84 ±0.07	103.25^{b} ±0.76	8.90^{c} ±0.20	6.63^{b} ±0.23	2.74^{b} ±0.08	195.54^{c} ±3.55
Two months after parturition	151.26 ±0.98	4.72 ±0.08	102.30^{b} ±0.68	9.78^{d} ±0.18	6.67^{b} ±0.27	2.40^{a} ±0.08	209.76^{d} ±4.20

† In each column, means with common superscript do not differ significantly using Duncan's multiple range test (P>0.05).

Table 2. Changes in serum electrolytes of Holstein cows in periparturient diseases ($\bar{x}$ ± SE)†.

Disease	No.of Cases	Na^+ mmol l^{-1}	K^+ mmol l^{-1}	Cl^- mmol l^{-1}	Ca^{++} mg dl^{-1}	P mg dl^{-1}	Mg^{++} mg dl^{-1}	Fe^{++} µg dl^{-1}
Retained placenta	3	158.00 ±1.73	5.16 ±0.28	93.43 ±0.23	6.30 ±0.12	4.10 ±0.08	3.47 ±0.02	223.33 ±12.70
Post-parturient metritis	2	158.00 ±1.41	5.50 ±0.56	90.25 ±1.34	6.03 ±0.05	3.40 ±0.14	3.45 ±0.21	195.00 ±1.41
Mastitis	3	149.50 ±1.41	5.22 ±0.07	96.05 ±0.84	8.41 ±0.15	7.67 ±0.07	3.10 ±0.07	198.50 ±1.41
Uterine prolapse	2	159.00 ±1.41	4.95 ±0.07	112.00 ±1.41	6.12 ±0.28	3.95 ±0.07	3.58 ±0.10	171.00 ±1.41
Milk fever	2	139.00 ±1.41	4.20 ±0.00	92.80 ±1.41	4.10 ±0.14	1.85 ±0.07	4.55 ±0.48	122.50 ±0.70

†. Compared with values for normal cows at parturition (see Table 1).

DISCUSSION

No significant difference was observed in serum sodium and potassium levels at 1 and 2 months prepartum, at parturition and at 1 and 2 months postpartum ($P>0.05$). Serum sodium has the least variable concentration among all metabolites in the profile test (17). The results of this study are in agreement with those reported by Murtuza *et al.* (14) and Gibasiewicz (8). The findings of this study reveal that the lowest concentration of chloride was noted at parturition time which is in agreement with the results of Murtuza *et al.* (14) and Pathak and Janakiraman (16).

The lowest concentration of calcium was found at the time of parturition. Ciani *et al.* (1) showed that, in buffaloes, plasma levels of calcium were minimum at parturition, while the levels of parathormone, cholecalciferol and calcitonin were maximum at the same time. The finding of the lowest concentration of inorganic phosphorus at the time of parturition is in agreement with the results reported by Murtuza *et al.* (14) and Quayam *et al.* (18). Furll *et al.* (7)reported that, in healthy cows, the net acid-base excretion in urine, and inorganic phosphorus in serum decreased at parturition. In our study, the highest concentration of magnesium was found at the time of parturition which is in agreement with those reported by Kaneko (12) and Stogdale (22). Singh *et al.* (21) reported that, in buffalo, the concentration of magnesium increased, preceded by a continuous decline in early, mid and late pregnancy.

The lowest concentration of serum iron was found at the time of parturition which was probably due to increased demand of fetus at this stage of development (16). It can be concluded that the most important changes in serum electrolytes observed in this study were at the time of parturition.

In this study, postparturient diseases occurred in 12 out of 85 cows at parturition or thereafter. Postparturient metritis, uterine prolapse, milk fever, retained placenta and mastitis were diagnosed. In these diseases, the concentration of sodium and chloride did not change. In postparturient

metritis and uterine prolapse as compared with the time of parturition, the concentrations of calcium and phosphorus decreased but the concentrations of magnesium and iron increased. Hypocalcemia and hypophosphatemia could lead to reduced muscle tone of the uterus which in turn might lead to postparturient metritis and uterine prolapse (5, 10). The cause of increase in iron concentration in these cases is unknown. In milk fever and retained placenta, the concentration of calcium and phosphorus decreased as compared with values at the time of parturition. In contrast, the concentration of magnesium increased in milk fever and retained placenta. Also, in milk fever the concentration of potassium decreased. Shukla *et al.* (20) reported that the level of serum calcium and inorganic phosphate was low in cases of retained placenta as compared with normally calved cows. Inadequate nutrition and improper ratio of calcium to phosphorus have been incriminated as factors predisposing to retained placenta (6,13,15). In milk fever, the pathogenic mechanism responsible for the rapid and precipitous decrease in calcium and phosphorus levels in the blood are complex and involve several interrelated factors (4, 12, 13).

Total and ionized calcium levels decrease progressively beginning several days before parturition. The development of parturient hypocalcemia in dairy cows might be the result of an inadequate response of the parathyroid glands to the substantial demands for calcium imposed by the mineralization of fetal bones and the initiation of lactation (2, 12). Gut absorption of dietary calcium may not meet the primary demand of lactation initiation until bone calcium mobilization is established (2, 12, 19). Hayashi *et al.* (9) reported that in cows with milk fever the concentrations of plasma calcium and potassium were significantly lower as compared with normal cows. This may be the reason why these cows normally show no tetany. In milk fever, serum magnesium concentration may increase proportionally as calcium declines (12). Stogdale (22) reported that mild hypermagnesemia occurs during parturition in cows with typical milk fever symptoms and hypocalcemia.

Curtis *et al.* (5) reported that there were highly significant associations between parturient hypocalcemia and retained fetal placenta and mastitis.

Also, there was a significant association between parturient paresis and mastitis. The results of this study indicated that the most important change in serum electrolytes occurs at parturition. Also, there is a significant alteration in serum electrolytes of cows with periparturient diseases.

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