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Electrolyte Changes of Blood and Rumen Juice in Experimental Abomasal Diseases of Goats

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실험적으로 유발시킨 산양의 제4위질병에 있어서 혈액 및 제1위액의 전해질치 변화

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요 약 : 반추수의 제4위질병시 혈액 및 제1위액의 전해질치 변화에 관해 알아보기 위해 산양을 대상으로 실험적으로 제4위좌측전위, 제4위우측전위 및 제4위염전을 유발시켰다. 혈청내 Cl^-치는 제4위좌측전위, 제4위우측전위 및 제4위염전 모두에서 시간이 경과함에 따라 감소경향을 나타내었으며 이러한 경향은 제4위우측전위 및 제4위염전에서 더욱 현저하였다. 혈청내 K^+ 농도는 제4위좌측전위 및 제4위우측전위에서는 실험 120시간 이후부터 감소경향을 나타내었으며, 제4위염전에서는 24시간 이후부터 심한 감소경향을 나타내었다. 혈청내 Na^+치는 제4위좌측전위 및 제4위우측전위에서는 각각 48시간 및 72시간 이후부터 감소경향을 나타내었으며, 제4위염전에서는 24시간 이후부터 유의한 감소경향을 나타내었다. 제1위내 Cl^-치는 제4위좌측전위 및 제4위우측전위에서는 48시간 이후부터, 제4위염전에서는 12시간 이후부터 시간이 경과함에 따라 증가경향을 나타내었으나 K^+ 및 Na^+농도는 유의한 변화가 인정되지 않았다.

Key words : electrolyte, serum, rumen juice, goat, abomasal disease

Introduction

Diseases of the abomasum in ruminants associated with metabolic disturbances, lactational stress and nutritional disorders are recognized more frequently than the past time[6,18]. These diseases include left-sided displacement of the abomasum (LDA), right-sided displacement of the abomasum (RDA), abomasal torsion (TA), abomasal ulcers and dietary abomasal impaction[2,3,9,17-19,22,24]. The distribution and prevalence of abomasal diseases in ruminants is world wide and increasing[18,19]. Although a part of the increase is the results of improved diagnostic techniques and increased awareness of their occurrence, perhaps some of the increase may be real because of economic pressure included fed large quantities of grain, limited exercise, all of which may contribute to abomasal diseases[18,24]. Even though diagnostic methods and surgical techniques have been developed, because of irreversible abomasal atony, the

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recovery rate is low, and the condition cause substantial economic loss[14,18]. One of means of minimizing the loss depends on the effective medical services and preventive regimens based on knowledges of the etiologic factors and pathogenesis of abomasal diseases[4,5,9-11,18,19,24]. Unfortunately, the etiologic factors and pathogenesis remain obscure. Therefore, this study was undertaken to determine the valuable etiologic factors or pathogenesis for the abomasal diseases in ruminants.

Materials and Methods

Animals

Healthy sixteen Korean native goats, 1 year old, were divided into 4 groups (LDA, RDA, TA and control). Goats were placed in the confinement stall for a week before the experimemt to allow it to become accustomed to its surroundings. The goats were abundantly provided with fresh water and diet.

Surgical operation

Abomasal disorders in Korean native goats were experimentally induced. Surgical operation of LDA, RDA and TA was carried out under condition of absence of concurrent complicating diseases[14]. The control group of goats underwent incision as the experimental group, but no any surgical operation.

Sampling procedures

Blood and rumen juice for electrolyte analysis were collected before and at 12, 24, 48, 72, 120 and 168 hours after surgical operation respectively. The blood samples were collected by jugular venipuncture into glass vials without anticoagulant. The serum was separated and stored at -80°C until analysis. The ruminal juices were obtained by puncture with a 8 cm long-needle inserting through the ventral sac of the rumen[20]. Ruminal fluid was centrifuged at 1200 g for 10 min. The supernatant were stored at -80°C until analysis.

Measurement of electrolyte

Serum and rumen juice chloride ion concentrations were measured by coulometry (Corning 925, UK). Potassium and sodium ions concentrations in serum and rumen juice were measured by flame photometry(Corning 435, UK).

Statistical analysis

The student's t-test was used for the detection of significant differences between control and experimental group. A p value of less than 0.05 was considered statistically significant.

Results

Serum Cl^-, K^+ and Na^+ concentrations

The changes in the Cl^- content of serum during abomasal displacement are shown in Fig 1. The serum Cl^- concentrations in LDA were decreased sig-

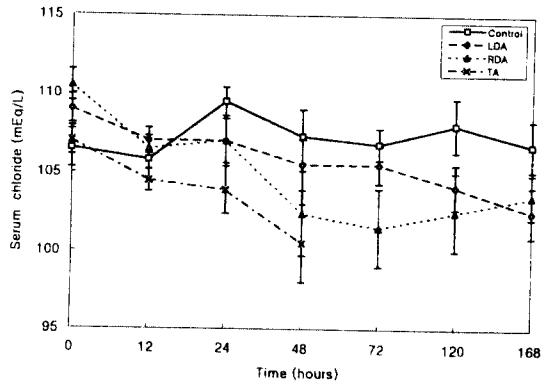

Fig 1. Change of serum chloride ion levels in experimentally induced abomasal disorders of goats (Mean±SD).

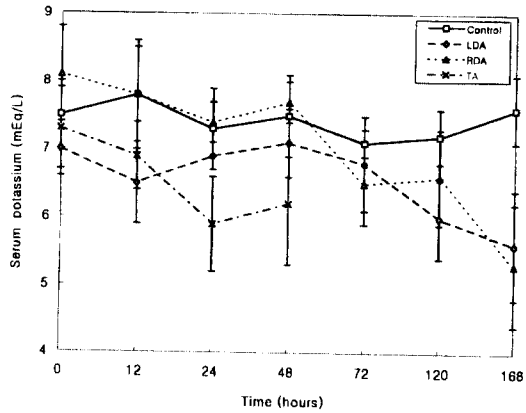

Fig 2. Change of serum potassium ion levels in experimentally induced abomasal disorders of goats (Mean±SD).

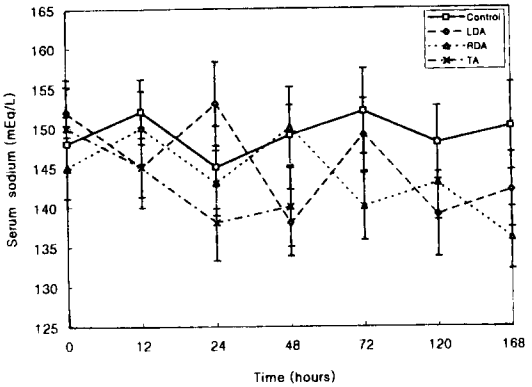

Fig 3. Change of serum sodium ion levels in experimentally induced abomasal disorders of goats (Mean±SD).

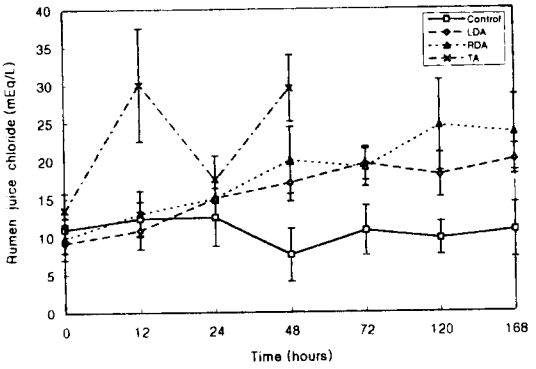

Fig 4. Change of rumen juice chloride ion levels in experimentally induced abomasal disorders of goats (Mean ±SD)

nificantly from 120 hours after operation ($p<0.05$). The serum Cl^- concentrations in RDA and TA were significantly decreased further from 48 and 24 hours ($p<0.05$ or $p<0.01$).

As can be seen in Fig 2, the serum K^+ concentrations in LDA and RDA tended to decrease from 120 hours after operation ($p<0.05$ or $p<0.01$). The serum K^+ concentrations in TA were decreased further from 24 hours ($p<0.01$).

The serum Na^+ concentrations in LDA, RDA and TA were gradually decreased from 48, 72 and 24 hours after operation respectively ($p<0.05$) (Fig 3).

Rumen juice Cl^-, K^+ and Na^+ concentrations

Since the volume of the rumen contents was not known, only the relative changes will be considered.

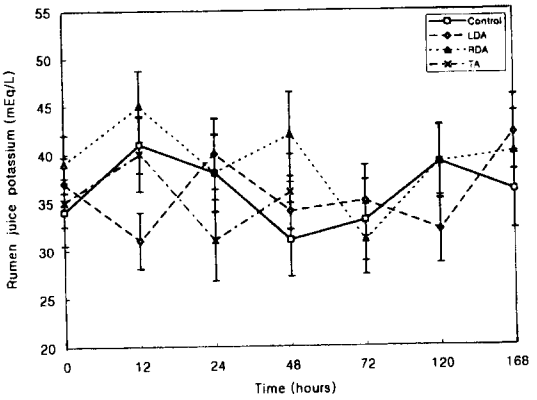

Fig 5. Change of rumen juice potassium ion levels in experimentally induced abomasal disorders of goats (Mean ±SD)

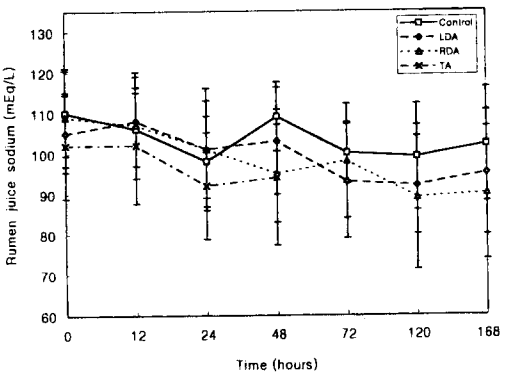

Fig 6. Change of rumen juice sodium ion levels in experimentally induced abomasal disorders of goats (Mean ±SD).

As can be seen in Fig 4, the rumen Cl^- concentrations in LDA and RDA were gradually increased with the lapse of time and then significantly increased by 48 hours after operation and continued to increase throughout the experimental period ($p<0.01$). The rumen Cl^- concentrations in TA were significantly increased further by 12 hours after operation ($p<0.01$).

The changes of rumen K^+ and Na^+ concentrations in LDA, RDA and TA were not showed significantly during experimental period (Fig 5 and Fig 6).

Discussion

Diseases of the abomasum which cause stasis and

accumulation of ingesta, fluid and gas in the organ result in varying degrees of dehydration and alterations in electrolyte values[4,10,13,16,23,25-27]. In ruminants, the process by which HCl is secreted from the gastric mucosal cell involves the removal of a chloride ion from the circulation and the return of a bicarbonate ion to the circulation[16,24,25]. Under normal conditions, HCl moves out of the abomasum and into the intestinal tract to be buffered and reabsorbed[1,7,13,21,25]. But abomasal displacement in ruminants beings to the acid secretions refluxed into the forestomachs and sequestered[10,13,19,23,24]. In the present study, hypochloremia occurred progressively after surgical operation of LDA, RDA and TA. There was a decrease in the serum Cl^- concentration in accordance with the lapse of time. The serum Cl^- concentrations of RDA and TA were further lower than those of LDA. Whereas, the rumen Cl^- concentrations in LDA and RDA were gradually increased by 48 hours after operation. And the rumen Cl^- concentrations in TA were increased further with the lapse of time after 12 hours. These results showed that HCl secreted by the gastric mucosal cell refluxed into the forestomachs and sequestered. And right-side abomasal displacement and abomasal torsion seemed to cause more serious clinical pathological changes than left-side abomasal displacement.

Sometimes hypokalemia have been recognized in ruminants with abomasal diseases[26,27]. In the present experiment, hypokalemia occurred progressively after surgical operation of LDA, RDA and TA. The serum K^+ concentrations of LDA and RDA tended to decrease by 120 hours after operation compared with those of control goats. The serum K^+ concentrations of TA tended to decrease further with the lapse of time from 24 hours. The gradual decrease in serum K^+ concentrations also reflected severity of displacement or torsion. But the concentration of rumen K^+ did not change significantly during the experimental period. These results suggested that the hypokalemia was not caused by any excessive loss of potassium in rumen. One possible explanation for the hypokalemia is a shift of potassium ions from the blood to the intracellular fluid space as a result of the alkalosis[12,13,15,24,26,27].

Changes in serum concentrations of Na^+ probably reflected dehydration as well as its accumulation in the abomasal fluids[12,22]. In this study, serum Na^+ concentrations of LDA, RDA and TA tended to gradually decrease. But the concentrations of rumen Na^+ did not change significantly. These results suggested that hyponatremia was caused by rather dehydration than by any excessive loss of sodium in rumen.

From these results, hypochloremia, hypokalemia, hyponatremia, and increase of rumen Cl^- concentration are valuable clinical pathological changes that occur in abomasal displacement of ruminants.

Conclusion

Goats with surgically prepared LDA, RDA and TA were used as a model in the study of blood and rumen electrolyte value for the abomasal diseases in ruminants.

The serum Cl^-, K^+ and Na^+ concentrations of LDA, RDA and RTA were decreased in accordance with the lapse of time compared with those of control goats. These decrease were more significant in RDA and TA.

The rumen Cl^- concentrations of LDA, RDA and TA were gradually increased with the lapse of time, and these changes were more significant in TA. The changes of rumen K^+ and Na^+ concentrations in LDA, RDA and TA were not showed significantly throughout the experimental period.

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