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INVESTIGATION ON EFFECTS OF HYPERTONIC SODIUM BICARBONATE WITH AND WITHOUT LACTATED RINGER'S SOLUTION ON POTASSIUM COMPENSATION, REHYDRATION STATUS, ENDOCRINAL RESPONSE AND ACIDE-BASE BALANCE IN CALVES WITH METABOLIC ACIDOSIS

Bulent ELITOK

Afyon Kocatepe University, Faculty of Veterinary Medicine, Department of Internal Medicine, 03200-Afyonkarahisar/Turkey, E-mail: elitok1969@hotmail.com

Abstract. The study was carried out on a total of 40 calves. Twenty calves (n=20) which were treated with hypertonic sodium bicarbonate in physiological saline served as the Study Group. The remaining 20 calves, which were treated with sodium bicarbonate in physiological saline plus lactated Ringer's solution, served as the Control Group. During the study, animals received fresh milk up to 10% of their body weight, but no antibiotics were used. All of the animals were tested for clinical findings such as temperature, pulsation and respiration rates, dehydration findings, hematological findings such as white blood cell, red blood cell, hemoglobin, packed cell volume, mean corpuscular volume, mean corpuscular hemoglobin, biochemical findings such as aspartate aminotransferase, gamma glutamyl transferase, total protein, albumine, urea, creatinine, glucose, lactate and blood gas findings, such as total carbon dioxide, partial carbon dioxide and electrolytes such as potassium, sodium bicarbonate, chlorine and calcium along with base excess. All the measurements were taken before the study began and at the 1st, 3rd and 7th hours after the start of the study. The results of the study showed that metabolic acidosis in calves with diarrhea was treated more quickly with lactated Ringer's solution than with physiological saline, although the hyperosmolality and hypernatremic states were corrected with both solutions. Consequently, lactated Ringer's solution supplied a better clinical response than that of physiologic serum, and it is considered that practitioners should add it to fluid therapy for more rapid physiological correction of calves with metabolic acidosis.

Key words: Calves; Newborn animals; Metabolic acidosis; Fluid therapy; Electrolyte balance.

INTRODUCTION

Neonatal calf diarrhea remains the most common cause of morbidity and mortality at pre-weaned dairy calves worldwide. This complex disease can be triggered by both infectious and non-infectious causes. The four most important enteropathogens leading to neonatal dairy calf diarrhea are *Escherichia coli*, rota and coronavirus, and *Cryptosporidium parvum* (Maganck, V. et al. 2014)

Fluid, electrolyte, and nutrient deficiencies are crucial to preserve diarrhea in the calves (Hall et al. 1992). However, dehydration due to diarrhea is the result of the fluid loss from the extracellular compartment. This fluid loss is compensated by the passage of the intracellular fluid to the extracellular fluid, i.e., the plasma. If Na^+ ions lost by feces in diarrhea cannot be compensated, the amount of body fluids decreases. Thus dehydration and hypovolemic shock develop in advanced conditions (Roussel, A.J. 1993; Lorenz, I. and Kee, J. et al. 2007). A significant amount of total Na^+, K^+, Cl^- and HCO_3^- is lost with diarrhea and the pH of this electrolyte balance disorder resulting in diarrhea is low (Radostits, O.M. et al. 2006; Kee, J. et al. 2010) . In the case of diarrhea, plasma K^+ ions increase in the extracellular fluid, but the decrease in the cell disrupts the potential of the cell membranes and this is the main cause of death, particularly by affecting myocardium (Foster, D., Smith, G. 2009; Cho, Y. et al. 2013). If losses continue to increase and become uncompensated, systemic effects of dehydration and metabolic acidosis are formed (Hunt, E. 1992; Radostits, O.M. et al. et al. 2006). The measurement of blood gases is very important in terms of understanding the condition and severity of the disease. Blood gas parameters; PaO2, oxygenation; PaCO2, alveolar ventilation; PaO2 and PaCO2 together, gas exchange; pH, PaCO2, and HCO3- are very valuable parameters in determining acidosis and alkalosis status (Radostits, O.M. et al. 2006; Sarnaik, A. and Heidmann, S. 2007; Emiralioğlu, M., Özçelik, U. 2014).

Our aim at this study was to found out the effects of serum physiological, lactated Ringer's solution plus

hypertonic 8.4% $NaHCO_3^-$ on the blood parameters, with regard to the treatment of liquid-electrolyte and acid-base balance disorders of neonatal diarrheal calves, and provide new scientific information to clinicians and veterinary medicine.

MATERIALS AND METHODS

Materials

The study was carried out on a total of 40 calves with diarrhea. Twenty calves were treated with Sodium Bicarbonate (HCO_3^-) in physiological saline (PS) and served as the Study Group (SG) and the remaining 20 calves were treated with HCO_3^- in PS plus along with Lactated Ringer Solution (LRs) and formed the Control Group (CG). All the measurements were taken before the study began and at the first, third and seventh hours after the start of the study. During the study, all the animals were given fresh milk up to 10% of their body weight, and no antibiotics were used.

The present study was carried out in accordance with the ethical rules of the Ethics Committee of Afyon Kocatepe University, with the reference number AKUHADYEK 197-17, and was supported by 16.KARIYER.120 reference number and the Afyon Kocatepe University Scientific Research Projects Coordination Unit (BAPK).

Method

In this study, clinical findings such as body temperature, respiration and heart rates, dehydration, appetite control and live weight gain were recorded. Hematological parameters such as total leukocyte (WBC), erythrocyte (RBC), mean corpuscular volume (MCV), hematocrit (HCT), mean cell hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) were measured with a hemocell counter. In the study, measurements of blood serum parameters such as aspartate aminotranferase (AST), gamma glutamyl transferase (GGT), albumin (ALB), total protein (TP), glucose (GLU), urea (UREA) and creatinine (CREA) were made in the Roche Cobas C111 model autoanalyzer using commericial kits.

Blood samples for blood gases were taken from a previously injected plastic injector with heparin (500 IU of liquid heparin for 1 ml of blood), and after blood was taken, the injector was sterilized by air bending and the measurements were made within 15 minutes. In the collected blood samples, pH, partial carbon dioxide (PCO_2), partial oxygen pressure (PO_2), total carbon dioxide concentration (TCO_2), base saline (BE), bicarbonate (HCO_3^-), chlorine (Cl^-), sodium (Na^+), potassium, calcium (Ca^{++}) were evaluated by portable blood gas analyzer (Epoc Portable Vet) using commercial cards.

Statistical Analyses

Descriptive statistics (distribution, mean, standard deviation, standard error, etc.) relating to measurements made primarily were included in the study. However, one-way ANOVA and Duncan test were used to test differences between groups. In addition, Repeated Measures ANOVA was used to compare repeated measures at 1, 3, and 7 hours for the same subjects. The level of significance was determined as 0.05 in the analyses made in the study and the SPSS 18.0 for Windows package program was used in the analysis of the data obtained.

RESULTS

Clinical, hematological, biochemical and immunologic findings of the animals in the study and control group are presented below.

Clinical Findings

When the heart and respiratory frequencies (P and R / min) were compared with the other groups, the highest averages were observed in the pre-study control and study group ($p < 0.05$), the P and R averages obtained at 1 ($p < 0.05$). Clinical findings such as skin elasticity, clinical presentation of dehydration, severity, and frequency of diarrhea and absorption reflexes were observed to respond well to treatment as time progressed (Table 1).

Hematological Findings

When the WBC levels were compared before the study, there was a statistically significant difference between the study and control groups ($p < 0.05$). The first and 7th-hour study groups had the lowest average of WBC, although no significant differences were seen in terms of statistics ($p > 0.05$) between the study and control groups at the same hours. RBC and HTC showed a gradual decline in their median and

fell to the lowest level at 7 hours after the study ($p < 0.05$). In opposition, the highest levels of MCHC level averages were obtained in the 7th hour post-study. MCV averages were found to be lower than the control group mean ($p < 0.05$), but significantly higher than the mean 3rd and 7th hours ($p < 0.05$). There was no statistically significant difference between the groups before and after the study in terms of HBG and MCH level averages ($p > 0.05$).

Serum Biochemical Findings

The AST and GGT levels at 1, 3, and 7 hours after the study did not show any statistically significant differences between the control and study groups at the same time points ($p > 0.05$), and the AST and GGT levels of the control and study groups and the difference between the groups was statistically significant ($p < 0.05$).

After the study, it was determined that the mean UREA and CREA decreased gradually in the later time periods and there was a statistically significant difference ($p < 0.05$) between the averages in terms of time periods.

When examined in terms of groups after the study, the TP and ALB levels increased gradually with time and this increase was statistically significant ($p < 0.05$), but there were no statistically significant differences ($p > 0.05$) between the time period and study groups.

The most interesting change was found in the GLU levels. On days 1, 3, and 7 after the study, both control and study groups had a gradual increase in GLU levels over time, and this increase was statistically significant in terms of timescales. As a matter of fact, significant differences were observed statistically between the control and study groups' GLU averages at the 1st and 3rd hours after the study ($p < 0.05$) and it was observed that the control group levels were higher than those of the study group at this time period.

Blood Gas Analyses Findings

It was determined that the mean values of pH, PCO_2 and TCO_2 were found to be statistically significant ($p < 0.05$) in both groups at the 1st, 3rd and 7th hours in terms of both study and control groups when compared to pre-study. Interestingly, pO_2 levels were within normal limits in all groups, but pre-study high levels decreased significantly ($p < 0.05$) from statistically significant ($p < 0.05$), and there was no significant difference between groups at each time point ($p > 0.05$).

The most striking finding is that there were found to be significant differences in the HCO_3^- levels of the control groups after each study period (bicarbonate given). However, this statistic was noticed at the 7th hour of the difference and there was no difference between the control and the study groups' HCO_3^- levels at the 7th hour.

It was found that the highest LACT levels did not show any significant difference in terms of pre-study control and study groups ($p > 0.05$), the control group showed similarity to the 7th hour average, and the mean of all other time period control groups was lower than the LACT mean of the study groups).

It was determined that the K^+ levels showed a gradual decrease with time and this decrease was faster and statistically significant ($p < 0.05$) than in the study group ($p < 0.05$). Contrary to this situation, the highest Na^+ level averages were obtained in the control group at the 3rd and 7th hours. When compared to the other groups, this difference was statistically significant ($p < 0.05$). Chlor levels were found to be faster in the study group ($NaCl^-$given group) than in the control group at all time intervals, and this difference was statistically significant ($p < 0.05$). It was also found that each time progression of Ca^{++} levels made a difference between the study groups, that these reached the highest level at the 7th hour and that the differences were statistically significant ($p < 0.05$) (Table 5).

DISCUSSIONS

Respiratory problems which lead to reduce oxygen-binding capacity of the hemoglobin are frequently seen in respiratory acidosis (Greenbaum 2004). Clinical respiratory problems and the high respiratory frequencies obtained in this study can be considered as a sign of this. Özcan and Akgül (2004) reported similar findings and reported that clinical symptoms of cold, moderate and severe dehydrated diarrhea were abundant in calves given 8.4% $NaHCO_3$, 0.9% $NaCl^-$ and 5% dextrose in appropriate amounts and times.

It has been reported that dehydration-related increases in blood parameters such as HTC and HB in diarrheal calves have been observed to decrease significantly after fluid therapy (Özcan, C., Akgül, Y. 2004). It was determined that the pre-study high levels of WBC, RBC, HTC, MCV measurements in this study showed a gradual decrease with the onset of the study, as the high levels were initially higher due to diar-

rhea-induced dehydration. In our study, there was no difference between the groups in terms of HB levels and it was seen that the hematological findings including the HB level obtained were in agreement with the findings reported by Öcal et al. (2006). In our study, although there were significant differences in HTC levels between the two groups at different time periods, no significant difference was observed between LR and SF groups at the same time. Similar findings have been reported by Martini et al. (2013).

In this study, when compared with pre-treatment groups, AST, GGT, and UREA and CREA concentrations were gradually decreased in terms of time intervals in both control and study groups with the start of treatment. Conversely, however, TP and ALB concentrations, which were low for the pre-study, gradually increased in the later time periods in both groups after the study started. The most interesting change was in GLU levels. The highest GLU level was observed in the 7th-day control group, and the lowest GLU levels were measured in the pre-study control and study group. In all time periods, the GLU levels were higher in the control group than in the study group, and this is thought to be due to the metabolism of lactate in the fluid given in the control group to GLU.

Abdalmalek (1987) reports that TP and ALB levels decrease in *Escherichia coli*, corona, and rotavirus-infected diarrhea while the levels of urea decrease, but that the levels of GLU increase. In our study, low levels of GLU, unlike those reported by the researcher, could be attributed to lack of animal ingestion and insufficiency of lactate metabolism. As a matter of fact, it is reported that a loss of normocyclic anion develops in cases of diarrhea and lactic acidosis is always present in cases and high blood LACT level as it can not be detected (Cieza, J.A. et al. 2013). A higher blood serum BUN/creatinine ratio than 20/1 indicates prerenal azotemia and lack of perfusion (Hanna, J.D. et al. 1995). The fact that the ratio of UREA and CREA measured in this study is high and that there is a presence of metabolic acidosis is a sign of a problem in kidney buffer mechanisms. In our study, we found a gradual increase in TP and ALB levels at baseline, which was low at the beginning, and the results we obtained showed that TP and ALB levels in diarrheal calves were high before treatment and this was consistent with what is reported by many researchers (Kiowa et al. 1990). It differs from Özcan and Akgül (2004), who reported that the high level was due to hemoconcentration.

When the blood pH was compared to the post-study, it was found that it was significantly lower before the study, that it was rapidly normalized after treatment, and that no significant difference was observed between the effects of PS and LRs on pH. These findings are consistent with findings reported in a similar study (Martini, W.Z. et al. 2013).

It has been reported that low TCO_2 levels are indicative of metabolic or respiratory acidosis, the differential can be determined by the change in HCO_3^- concentration, and the low concentration of HCO_3^- can only indicate metabolic acidosis (Narins and Gardner 1981). In our study, the decrease in TCO_2 levels, accompanied by HCO_3^- levels, proves that the case is metabolic acidosis. We also found that the findings support the finding that LRs was more effective than PS in normalizing serum HCO_3^- levels (Martini, W.Z. et al. 2013) when compared with the findings of PS.

Metabolic acidosis develops in diarrheal frogs as a response to intracellular K+ extracellular space, extracellular H^+, Na^+, and Cl^- into the intracellular space. As a result of these transitions, blood K^+ level increases and Na+ level decreases (Lewis, L.D., Phillips, RW. 1978). In our study, high K^+, low Na^+ and Cl^- levels in pre-treatment groups in diarrheal calves were consistent with those reported by the researcher (Özcan, C., Akgül, Y. 2004; Radostits, O.M. et al. 2006).

Serum physiologic and LRs are both crystalloid fluids and are widely used for the reconstitution of liquid electrolyte balance (Maier, R.V. 1997). However, it has been reported that LRs, which has better effects on the heart and acid-base balance and oxygen excretion, is more compatible with body fluids (Martini, W.Z. et al. 2013) when compared to NaCl with high Na^+ and Cl^- levels and 5.0 pH. In our study, it was also observed that the LR solutions did not make a difference according to $NaCl^-$ in terms of K^+ levels, the Na^+ and Cl^- levels were higher in the $NaCl^-$ given group, but the LRs was more effective in the healing the general rehydration and electrolyte balance. Unlike our study, Mahajan et al. (2012) reported that there was no significant difference in the healing effects of PS and LRs on the blood pH in children with acute diarrhea.

Consequently, LRs use resulted in a better clinical response than $NaCl^-$ illustrated by a more rapid and more appropriate physiological correction and calves with metabolic acidosis were cured using this treatment.

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Table 1. *Comparison of body temperature, heart and breath freakiness averages statistic in control group and experimental group animals*

Parametrs/Groups	Temperature (°C)	Pulse rate (frequency/min)	Respiration rate (frequency/min)
Control Group (n=20)			
	X±SD	X±SD	X±SD
Pre-study	41.60± 0.40[a]	104.20± 5.00[a]	80.00±6.10[a]
After study (1st Hour)	40.50± 0.30[b]	98.10± 4.00[b]	64.00± 5.20[b]
After study (3rd Hour)	39.20± 0.10[c]	94.05± 4.20[c]	52.00± 4.10[c]
After study (7th Hour)	39.30± 0.20[c]	86.05± 3.00[d]	46.00± 4.30[d]
Study Broup (n=20)			
Pre-study	41.80± 0.40[a]	105.00± 4.00[a]	79.00±5.00[a]
After study (1st Hour)	40.60± 0.50[b]	99.20± 4.00[b]	66.00± 5.10[b]
After study (3rd Hour)	39.30± 0.30[c]	95.00± 3.10[c]	54.00± 4.40[c]
After study (7th Hour)	39.20± 0.40[c]	87.00± 3.00[d]	47.00± 4.20[d]

[a,b,c] The difference between the averages of groups carrying different letters in the same column is statistically significant ($p<0.05$). X: Mean, SD: Standard Deviation

Table 2. *Results of statistical analysis of animals hematological examination findings*

Time/ Parameters	Groups	WBC (m/mm3)	RBC (m/mm3)	HB (g/dl)	HCT %	MCV(fl)	MCH (pg)	MCHC (g/dl)
		X±SD	X±SD	X±SD	X±SD	X±SD	X±SD	X±SD
Pre-study	C	26.42±3.64[a]	9.20±0.42[a]	9.30±1.30	56.40±3.70[a]	60.94±2.28[a]	10.40±0.66	16.56±1.64[d]
	S	27.02±3.36[a]	9.30±0.66[a]	9.20±1.40	57.38±3.50[a]	59.62±2.48[a]	10.04±0.48	16.18±1.84[d]
After study (1st Hour)	C	22.38±2.82[b]	8.60±0.40[b]	8.60±1.30	45.80±4.20[b]	52.80±2.30[b]	10.38±0.56	18.84±1.60[c]
	S	23.16±2.41[b]	8.64±0.48[b]	8.50±1.42	46.30±4.60[b]	53.20±2.60[b]	10.04±0.68	18.96±1.78[c]
After study (3rd Hour)	C	17.18±2.34[c]	8.48±0.24[b]	9.20±1.34	36.28±2.60[c]	42.86±2.40[c]	10.96±0.74	24.28±1.86[b]
	S	17.80±2.56[c]	8.54±0.60[b]	8.94±1.16	37.36±3.40[c]	43.26±2.20[c]	10.98±0.94	23.94±1.68[b]
After study (7th Hour)	C	15.28±2.54[d]	7.80±0.32[c]	9.00±0.60	32.60±3.00[d]	42.12±2.60 [c]	11.13±1.38	27.08 ±1,14[a]
	S	15.02±2.43[d]	7.86±0.24[c]	8.80±0.62	33.40±2.30[d]	42.36 ±2.40[c]	11.09±1.48	26.34 ±1,20[a]

[a,b,c,d,e] The difference between the averages of groups carrying different letters in the same column is statistically significant ($p<0.05$).

X: Mean, SD: Standard Deviation, C: Control Group, S: Strudy Group

WBC: White blood cell, RBC: Red blood cell, HB: Hemoglobin, HCT: Hematocrit, MCV: Mean corpusculer volume, MHC: Mean corpuscular hemoglobin, MCHC: Mean corpuscular hemoglobin concentraion

Table 3. *Results of the statistical analysis of the metabolic profile of the calves in the control and study groups*

Time/ Parameters	Groups	AST (µkat/L)	GGT (µkat/L)	TP (g/dl)	ALB (g/dl)	URE (mg/dl)	CREA (mg/dl)	GLU (mg/dL)
		X±SD	X±SD	X±SD	X±SD	X±SD	X±SD	X±SD
Pre-study	C	3.01±0.42[a]	0.73±0.07[a]	5.78±0.34[b]	2.18±0.36[b]	86.48±5.44[a]	4.04±0.38[a]	36.84±2.18[f]
	S	3.13±0.47[a]	0.73±0.07[a]	5.46±0.36[b]	2.24±0.47[b]	88.24±5.72[a]	4.22±0.44[a]	37.18±3.04[f]
After study (1st Hour)	C	2.70±0.43[b]	0.61±0.08[b]	5.76±0.58[b]	2.34±0.32b[b]	70.16±4.38[b]	3.28±0.32[b]	53.62±3.14[c]
	S	2.73±0.40[b]	0.61±0.07[b]	5.68±0.40[b]	2.36±0.48[b]	72.64±5.12[b]	3.36±0.68[b]	42.86±2.40[e]
After study (3rd Hour)	C	2.38±0.33[c]	0.54±0.05[c]	5.90±0.76[b]	2.48±0.54[b]	66.22±5.00[c]	3.02± 0.40[c]	64.28±2.76[b]
	S	2.39±0.26[c]	0.53±0.04[c]	5.86±0.78[b]	2.40±0.44[b]	65.85±4.72[c]	3.05± 0.26[c]	46.74±2.60[d]
After study (7th Hour)	C	2.19±0.37[d]	0.43±0.05[d]	6.44±0.68[a]	3.10±0.56[a]	60.74±5.10[d]	2.56± 0.34[d]	70.82±4.64[a]
	S	2.20±0.44[d]	0.44±0.05[d]	6.32±0.76[a]	3.08±0.68[a]	61.45±3.86[d]	2.61± 0.42[d]	65.48±3.20[b]

[a,b,c,d,e,f] The difference between the averages of groups carrying different letters in the same column is statistically significant ($p<0.05$).

X: Mean, SD: Standard Deviation, C: Control Group, S: Strudy Group

AST: Aspartate aminotransferase, GGT: Gamma glutamyl transferase, TP: Total protein, ALB: Albumin, UREA: Ürea, CREA: Creatinine, GLU: Glucose

Table 4. *Blood Gas Analysis Results*

Time/ Parameters	Groups	pH	HCO_3^- (mmol/L)	BE (mEq/L)	pCO_2 (mmHg)	pO_2 (mmHg)	TCO_2 (mmol/L)	LACT (mmol/L)	K^+ (mmol/L)	Na^+ (mmol/L)	Cl^- (mmol/L)	Ca^{++} (mmol/L)
		X±SD	X±SD	X±SD	X±SD		X±SD	X±SD	X±SD	X±SD	X±SD	X±SD
Pre-study	C	7.29±0.08^{c}	15.85±0.86^{d}	-9.56±0.80^{a}	33.88±1.28^{d}	98.16 ±2.20^{a}	16.88±0.64^{d}	1.88±0.43^{c}	10.28±0.86^{a}	114.32±4.34^{e}	88.28±5.12^{d}	0.78±0.03^{d}
	S	7.30±0.04^{c}	16.12±0.68^{d}	-9.92±.0.96^{a}	34.24±1.38^{d}	96.44 ±2.76^{a}	17.06±0.58^{d}	1.92±0.04^{c}	10.46±0.92^{a}	116.28±4.66^{e}	89.14±6.06^{d}	0.82±0.04^{d}
After study (1st Hour)	C	7.32±0.04^{b}	17.88±0.49^{c}	-6.86±0.74^{b}	36.64 ±1.46^{c}	92.30 ±3.48^{b}	18.86±0.66^{c}	2.48±0.18^{a}	8.08±0.76^{b}	132.82±3.68^{bc}	98.28±4.16^{c}	1.22±0. 06^{c}
	S	7.31±0.06^{b}	17.38±0.60^{c}	-7.06±0.88^{b}	36.04 ±1.32^{c}	91.66 ±3.24^{b}	18.86±0.66^{c}	1.58±0.28^{d}	8.76±0.64^{ab}	120.46±5.25^{d}	104.00±3.46^{a}	1.38±0.04^{c}
After study (3rd Hour)	C	7.32±0.02^{b}	19.26±0.44^{b}	-5.48±0.76^{c}	38.42 ±1.64^{b}	87.60 ±3.20^{c}	20.92±0.74^{b}	2.04±0.44^{bc}	7.06±0.42^{c}	138.38±3.82^{a}	97.34±3.28^{c}	1.52±0.05^{b}
	S	7.32±0.04^{b}	18.90±0.58^{b}	-5.96±0.78^{c}	38.28 ±0.68^{b}	86.44 ±3.78^{c}	20.68±0.82^{b}	1.34±0.32^{d}	7.16±0.42^{b}	130.22±4.60^{c}	102.60±3.34^{b}	1.76±0.02^{b}
After study (7th Hour)	C	7.34±0.08^{a}	22.34±0.63^{a}	-2.38±0.40^{d}	43.76 ±0.86^{a}	82.64 ±3.30^{d}	23.90±0.76^{a}	1.86±0.28^{c}	5.78±0.32^{d}	137.12±3.16^{a}	96.04±3.10 ^{c}	2.04±0.03^{a}
	S	7.33±0.04^{a}	21.96±0.52^{a}	-2.68±0.86^{d}	43.08 ±0.80^{a}	83.14 ±3.82^{d}	23.54±0.60^{a}	0.86±0.34^{e}	6.46±0.30^{c}	134.28±2.18^{b}	98.22±2.86^{c}	2.20±0.02^{a}

^{a,b,c,d,e} The difference between the averages of groups carrying different letters in the same column is statistically significant ($p<0.05$). X: Mean, SD: Standard Deviation, C: Control Group, S: Strudy Group

HCO_3^-: Bicarbonate, BE: Base excess: pCO_2: Partial karbondioxyde preasure, pO_2: Partial oxygen preasure, TCO_2: Total carbondioxyde, LACT: Lactate, K^+: Potassium, Na^+: Sodium, Cl^-: Chlor, Ca^{++}: Calcium