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Acid-Base Homeostasis Indices upon Electric Neurostimulation Therapy of Calves with Acute Pulmonary Pathologies.

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ABSTRACT

The investigation was carried out on 2 groups of calves suffering from bronchial pneumonia: the first group was experimental and included 18 animals; the second group was control and included 13 calves. The first group of animals received dynamic electric neurostimulation with apparatus 'DiaDENS-PC' in mode 'THERAPY' [6-8], once every day over trigger biologically active points for 14 days. Calves of the second group received antibiotics usually used in the husbandry. Laboratory clinical analysis of the acid-base status of calf blood was carried out prior to treatment and during the convalescence period – on day 14 after commencement of treatment of animals. Blood test was done using micro-analyzer ABL-330 (Radiometer, Denmark) for the following indices: pH, carbon dioxide partial pressure (pCO₂); carbon acid concentration - pCO₃; deficit of buffer bases (BE); electrolytes – Na⁺, K⁺, Cl⁻. Analysis of the data obtained for the experimental and control group of calves indicates complete metabolic compensation of acidosis on the fourteenth day from treatment commencement and stabilization of acid-base status in calves of the first group as a result of dynamic electric neurostimulation as evidenced by: homeoprotecting level of calf blood pH, high carbon dioxide partial pressure, surplus of buffer bases, statistically significant decrease of potassium and chlorides in blood serum. So, use of 'DiaDENS-PC' as a physiotherapy aid is a rational method of neutralizing metabolic acidosis during nonspecific bronchial pneumonia of calves and stabilizing acid-base status during the convalescence period.

Keywords: acid-base homeostasis, nonspecific bronchial pneumonia, biochemical indices of acid-base balance, dynamic electric neurostimulation, 'DiaDENS-PC'.

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INTRODUCTION

Biochemical changes taking place in calf blood during bronchial pneumonia, mostly for clinical analysis indices, are described in many papers [1, 2]. However, that side of a laboratory study produces pathogenetic process characteristics of purely clinical significance and does not characterize the metabolic status of ill animals thoroughly enough. At the bottom of the pathogenetic process, acid-base homeostasis indices are more specific for this pathology, which have rather pathognomonic markers of clinical condition acuteness and efficacy of bronchial pneumonia treatment [1, 3-5].

The purpose of this work was to study acid-base homeostasis parameters during acute bronchial pneumonia in young cattle and their dynamics upon electric pulse stimulation in the course of this pathology physiotherapy using 'DiaDENS-PC'.

MATERIALS AND METHODS

The investigation was carried out in the environment of the work-study unit of dairy farm 'Mumovskoe', Atkarsky District, Saratov Region, on 2 groups of Simmental calves suffering from bronchial pneumonia: the first group included 18 experimental animals; the second group included 13 control calves.

In the first group (n=18), the therapeutic regimen of calves suffering from bronchial pneumonia used, as the base aid, dynamic electric neurostimulation with apparatus 'DiaDENS-PC' in mode 'THERAPY' [6,7,8], once every day over trigger biologically active points for 14 days. The rest of components of the pathogenetic therapy complex in this instance had a generally accepted nature.

Calves from the 2nd group (n=13) were treated with antibiotics adopted as baseline therapy in the practice of the farm veterinary service.

Laboratory clinical analysis of the acid-base status of calf blood was carried out prior to treatment and during the convalescence period – on day 14 after commencement of treatment of animals. Blood for blood chemistry analysis was sampled from jugular vein in the morning before feeding, following the aseptic and antiseptic rules. Blood test was done using micro-analyzer ABL-330 (Radiometer, Denmark) for the following indices: pH, carbon dioxide partial pressure (pCO₂); carbon acid concentration - pCO₃; deficit of buffer bases (BE); electrolytes – Na⁺, K⁺, Cl⁻.

The data were statistically processed using Statistic av. 6.0 software.

RESULTS OF RESEARCH

In the experimental and control groups of calves, prior to treatment commencement, the indices of venous blood acid-base status and electrolytic exchange in animals suffering from bronchial pneumonia had values typical for uncompensated respiratory acidosis. Significant reduction of bicarbonates (26.92±4.26 mmol/l) and deficit of alkaline reserve stock were recorded, as well as increased carbon dioxide partial pressure exceeding the physiological norm limit (71.86±7.38 mm Hg), and a trend towards blood acidification – decrease of pH. As a consequence of respiratory acidosis in the course of bronchial pneumonia, increased level of electrolytes especially potassium and chlorine ions took place (table).

Table: Indices of acid-base status and electrolyte level in blood serum of calves suffering from bronchial pneumonia during therapeutic dynamic electric neurostimulation

Index	Control Group (n=18)		Experimental Group (n=13)	
	Before Treatment	After (day 14)	Before Treatment	After (day 14)
pH	7.23±0.02**	7.35±0.03	7.25±0.02	7.09±0.03**
pCO ₂ , mm Hg	71.86±7.38	65.54±6.22**	73.20±4.04	61.04±6.47**
pCO ₃ , mmol/l	26.92±4.26	36.15±4.19**	32.04±1.42	18.69±1.9**
BE, mmol/l	-3.45±4.39	7.90±4.21**	1.25±1.41	-14.54±1.91**
Na ⁺ , mmol/l	146.11±4.54	141.01±6.34	133.89±9.57	141.00±6.34*

K ⁺ , mmol/l	6.08±0.20	4.82±0.24**	6.26±1.10	4.88±0.46**
Cl ⁻ , mmol/l	101.06±4.16	91.57±2.27**	89.72±1.04	95.32±1.91**

Note: * - p < 0.05; ** - p < 0.01.

In the course of treatment of the first experimental group of calves with a complex of aids including dynamic electric neurostimulation, changes normalizing acid-base blood status occurred (table). Blood reaction returned to reference level of 7.35±0.03 at standard carbon dioxide partial pressure equal to 65.54±6.22 mmol/l, increase of bicarbonates to 6.15±4.19mmol/l and alkaline reserve to 7.90±4.21mmol/l (p < 0.01).

The electrolyte content in calf blood serum was characterized by decrease to physiological values, which particularly related to the concentration of potassium ions (4.82±0.24 mmol/l) and chloride ions (91.57±2.27 mmol/l), in the process of acidosis recession and improvement of the clinical condition of animals (p < 0.01).

Animals of group 2 (control), which received conventional treatment, during analysis of day 14 after commencement of therapeutic procedures, still had a considerably decreased concentration of bicarbonates (18.69±1.9 mmol/l) and obvious deficit of alkaline reserve stock (-14.54±1.91mmol/l). The tendency to decrease of pH (7.09±0.03) in calves after treatment was accompanied with a drop of carbon dioxide partial pressure (61.04±6.47 mm Hg) at a statistically significant growth of the content of sodium (141.00±6.34 mmol/l) and chlorides (95.32±1.91 mmol/l) and decrease of potassium (4.88±0.46mmol/l) in blood serum (p < 0.01).

So, the acid-base and electrolyte misbalance observed in calves during bronchial pneumonia should be attributed to results of considerable hypoxia of the body, impaired function of blood buffer systems and, probably, insufficient renal function as well [1].

Comparison of data obtained between the experimental and control groups of calves indicates complete metabolic compensation of acidosis on the fourteenth day after commencement of treatment and stabilization of acid-base condition in calves of group 1 as a result of dynamic electric neurostimulation, as evidenced by: homeo protecting level of calf blood pH, high carbon dioxide partial pressure, surplus of buffer bases, statistically significant decrease of potassium and chlorides in blood serum.

In calves of the control group, the acid-base condition on day 14 after commencement of conventional therapy should be determined as aggravation of uncompensated respiratory metabolic acidosis, which was indicated by blood pH value corresponding to the lower limit of norm, increased partial pressure of carbon dioxide, and deficit of buffer bases, the blood content of true bicarbonates being within the normal limits (p < 0.01).

CONCLUSION

Considering the information obtained concerning the nature of effect of the electric pulse method of physiotherapy in the form of dynamic electric neurostimulation with apparatus 'DiaDENS-PC' on calves during bronchial pneumonia, there are grounds to assert that DENS is a correctional aid for acid-base misbalance in pathogenesis and its stabilization during convalescence.

Based on the results obtained, use of 'DiaDENS-PC' to reduce manifestation of metabolic dysfunction during bronchial pneumonia of calves as part of a combined therapy can be recommended for improving calf treatment efficacy.

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