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Effectiveness Assessment of “DIADENS-PC” Application for Electro-Impulse Physical Therapy for Calves in Acute Form of Focal Pneumonia .

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ABSTRACT

It has been established that in healthy animals the average values of electrodermal characteristics of biologically active points had a level of electrical conductivity of 10, 11±0, 34 – 10, 01±0, 35 µA. There were fourteen biologically active points during the test route. In the process of screening of asymmetric acupuncture points in calves with an acute form of focal pneumonia using the “BIOREPER” method, constant trigger state during the course of the disease was recorded in five of the fourteen examined BAP – № 11, № 38, № 90, № 77, № 97. Decrease in the electrical conductivity of the skin was noted in the area of these acupuncture points in comparison with similar indicators of their state in the group of healthy animals. Namely, the average electrical conductivity in the under-electrode tissues of the four installed trigger BAP was kept within 8.27 ± 0.27 µA, and more contrast asymmetry took place in the acupuncture point № 97 – it was of 5.17 ± 0.33 µA. A ten-day course of electropulse stimulation of calves in combination with traditional pathogenetic therapy allows to achieve increased therapeutic effectiveness. This conclusion was established in the process of therapeutic tests of the “DiaDENS-PC” device in case of focal pneumonia in calves in an industrial experiment. This result gives reason for introduction of the method into veterinary practice. The obtained clinical information showed that in the first group of calves the application of dynamic electric neurostimulation with the “DiaDENS-PC” device caused a partial improvement in the state by the 4th day of treatment. Considerable improvement occurred by the 6th day, averagely in 5.5 ± 1.1 days. Inclusion of electrodynamic stimulation into the complex of pathogenetic therapy led to a reduction in the duration of the respiratory syndrome to 6.6 ± 1.3 days. The indicator of therapeutic effectiveness of the applied complex calculated as the ratio of the number of dead calves to the total number of animals treated with “DENAS” was 93.3%; one animal died - 6.7%. When the “DENS” device was used in therapy, the animals recovered by the 8th day (8.1 ± 1.1), two days earlier than in the control group of animals.

Keywords: pneumonia, “DIADENS-PC”, calves, laboratory researches, blood, pathanatomical picture

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INTRODUCTION

The veterinary health support of young farm animals in the development of animal breeding is particularly important, and it determines productivity, reproduction, and the growth of livestock [7]. Nevertheless, the disease incidence of this age category of animals remains high for decades [1, 2]. Diseases with the syndrome of respiratory system pathology are especially common, particularly nonspecific bronchopneumonia (focal pneumonia) in calves [4]. Mass destruction of calves with pneumonia of this nosological category significantly reduces the productivity of animal breeding, as the effectiveness of traditional remedial measures in working environment cannot be considered satisfactory [4].

Decades-long experience shows that treatment of calves with nonspecific bronchopneumonia is complicated by many circumstances that reduce its effectiveness by existing pharmacological agents. Difficulties in progress against bronchopneumonia are widely known because of the loss of the base chemotherapeutic agents which required therapeutic efficacy conditioned of a change in the biological properties of the arbitrary pathogenic microflora and the appearance of antibiotic and sulfanilamide-resistant strains [2, 10].

The method of percutaneous electric neurostimulation with the use of DENAS devices deserves attention in several fields of medicine which have the potential for improvement of the pathogenetic therapy methods of bronchopneumonia in calves. The existing theory and practice of veterinary use of physiotherapy by the method of dynamic electroneurostimulation (DENS) [3,9] speaks in favor of the practicability of using this technology with nonspecific bronchopneumonia.

This issue was investigated in the experiment from the point of view of the DENS-therapy adoptability in the veterinary technology of treating productive animals. The clinical properties of the dynamic electroneurostimulation method as one of the means for physiotherapy of the acute form of focal pneumonia in calves have been studied. Conditions for the use of devices of the "DiaDENAS-PC" type have been developed in the case of this pathology.

MATERIALS AND METHODS

The study included the solution of two technological issues: the instrumental determination of the localization of optimal reflexogenic positions for the use of the "DiaDENS-PC" device in the acute form of focal pneumonia in calves by the method of reflex diagnostics and the determination of practical therapeutic schemes for the physiotherapy for animals by dynamic electric neurostimulation method.

3 groups of 10 calves at the age of 2-3 months were used in the experiment: healthy (control), animals with nonspecific bronchopneumonia and convalescents. The experiments were carried out in accordance with the requirements for setting control, selecting analogues, observing the same conditions of keeping and feeding animals during the research period.

The diagnosis of nonspecific bronchopneumonia was based on epizootological, clinical, postmortem studies, as well as a complex of laboratory, clinical and serological analyzes performed in the conditions of the Saratov Regional Veterinary Laboratory.

Reflexodiagnostic examination of calves was carried out according to the program "BIOREPER" in the basic variant for corporal biologically active points (BAP) of cattle and in the current treatment course in accordance with the guidelines for the use of the DiaDENS-PC device [5]. Electrodermal characteristics in the field of biologically active points, namely the dynamics of electrical conductivity and the testing voltage were analytical information on the biophysical state of corporal BAP.

The "test-route" for 14 acupuncture points was studied according to the nomenclature of N.E. Kazeev to assess the bioelectric parameters of corporal BAP in calves in norm and in the acute form of focal pneumonia and during the recovery period [1,8,10]: №10, №11, №17, №36, №38, №41, №42, №43, №71, №73, №74, №77, №90, №97. There was an empirically provided connection with pathogenetic processes in case of bronchopneumonia in cattle.

External electrodes of the DiaDENS-PC device were used to perform the measurements. They were engaged with biologically active points by means of a liquid layer - physiological solution.

Dynamic electric neurostimulation – DENS – as a method of physiotherapeutic treatment of calves in the acute form of focal pneumonia was tested on 24 calves that made up the experimental group; 26 calves had a control appointment. Dynamic electric neurostimulation therapy of animals of the experimental group was used in conjunction with common means of pathogenetic therapy of nonspecific bronchopneumonia in calves, including prescribing of gentamicin intramuscularly at a dose of 5 ml once a day for five days, injection of the vitamin complex “trivit” at a dose of 5 ml once, and daily intravenous injections with the composition of 1 ml of a 20% solution of caffeine sodium benzoate, 2 ml of 10% calcium chloride, 20 ml of 5% glucose. The animals of the second group were treated only with the indicated set of medications.

DENS-therapy was implemented by the DiaDENS-PC device (product license of the Federal Service On Supervision In Sphere Of Public Health Services And Social Development Of the Russian Federation for № FSR 2009/06317 dated May 6, 2010). The technological basis for its application was the “The Manual for dynamic electrostimulation using DiaDENS” by V. V. Chernyshev [7,8]. The reflexotherapy formulation was determined by a set of identified acupuncture points – BAP – with asynchronous (trigger) electrodermal parameters in the range of biologically active points of the established test route. The scheme of electrodynamic therapy included the impact on the trigger acupuncture points revealed by the “BIOREPER” method. The device was used in the “THERAPY” mode at a frequency of 60 Hz and power ED-2 in a stable way. The duration of the procedure was established at the rate of one minute per 1 kg of live weight of the animal. The course of treatment included daily sessions of electrodynamic stimulation once a day for 10 days.

Effectiveness of therapy for acute form of focal pneumonia in calves of both groups was assessed by changes in the dynamics of the clinical state, laboratory (hematological, biochemical) and instrumental indicators. Daily clinical observation of animals in groups was carried out for two weeks from the beginning of treatment, taking into account the general state, death and recovery period. Blood for laboratory research was taken twice: at the beginning of treatment and with clinical recovery on the 14th day.

The obtained results are processed by the conventional method of variational statistics.

RESULTS OF RESEARCH

It has been established that in healthy animals the average values of electrodermal characteristics of biologically active points had a level of electrical conductivity of 10,11±0,34 – 10,01±0,35 µA. During the test route there were fourteen biologically active points. In the process of screening of asymmetric acupuncture points in calves with an acute form of focal pneumonia using the “BIOREPER” method, a constant trigger state during the course of the disease was recorded in five of the fourteen studied BAP – № 11, № 38, № 90, № 77, № 97 (tab. 1). In the area of these acupuncture points, the electrical conductivity of the skin was decreased in comparison with similar indicators of their state in the group of healthy animals, namely, the average electrical conductivity in the subelectrode tissues of the four installed trigger BAT was kept within 8.27 ± 0.27 µA, and more contrast asymmetry took place in the acupuncture point № 97 - at the level of 5.17 ± 0.33.

Table 1: The results of acupuncture diagnostics in the baseline survey of experimental groups of calves on the electrodermal parameters of corporal biologically active points

№№ BAP	Electrodermal indicators in BAP in calves of experimental groups, µA					
	Healthy (n=10)		With bronchopneumonia (n=10)		Recovered (n=10)	
	conductivity, µA	operating voltage, V	conductivity, µA	operating voltage V	conductivity, µA	operating voltage, V
№10	10.58±0.28	1.78±0.25	10.53±0.49	1.46±0.21	10.01±0.22	1.52±0.23
№11	10.47±0.31	1.32±0.22	8.01±0.45*	2.68±0.21*	10.23±0.18	1.41±0.22
№17	10.68±0.31	1.83±0.18	10.01±0.44	1.29±0.21	10.64±0.22	1.36±0.21
№36	10.11±0.34	1.76±0.22	10.32±0.48	1.17±0.22	10.54±0.24	1.52±0.23
№38	10.54±0.33	1.33±0.19	8.31±0.45*	2.67±0.21*	10.21±0.21	1.64±0.21
№41	10.53±0.31	1.54±0.24	8.08±0.41*	2.35±0.23	10.11±0.22	1.37±0.19

№42	10.31±0.38	1.22±0.21	10.75±0.23	1.94±0.21	10.61±0.23	1.44±0.23
№43	10.41±0.31	1.34±0.22	10.44±0.21	1.79±0.19	10.19±0.21	1.34±0.23
№71	10.19±0.33	1.67±0.23	10.11±0.19	1.53±0.23	10.20±0.22	1.69±0.24
№73	10.63±0.32	1.82±0.21	10.71±0.19	1.77±0,17	10.31±0.21	1.52±0.21
№74	10.01±0.35	1.75±0.22	10.21±0.17	1.70±0,17	10.55±0.23	1.35±0.23
№77	10.64±0.31	1.37±0.21	9.91±0.19	1.68±0,17	10.62±0.21	1.27±0.21
№90	10.57±0.34	1.64±0.23	8.11±0.21*	2.29±0,23*	10.12±0.22	1.71±0.22
№ 97	10,27±0,27	1.72±0.21	5.17±0.33*	3.31±0,23*	10.44±0.23	1.53±0.18

Note: reliability of the differences between healthy and sick calves *P<0,05.

In convalescents, the average values of electrical conductivity in trigger BAP tended to stabilize at a level characteristic for healthy calves – 10.12 ± 0.22 - 10.44 ± 0.23 µA.

The test voltage in the trigger points in the acute form of bronchopneumonia in calves was 2.29 ± 0.23 - 3.31 ± 0.23 V, in comparison with the control which was 1.32 ± 0.22 - 1.72 ± 0.22 V, extended by 0.97 V and 1.59 V the usual bioelectric level of BAP in healthy animals.

The indicators of electrical conductivity and test voltage at the acupuncture points had correlation dependence in the dynamics of the physiological state of animals. Namely, in calves with bronchopneumonia after seven days the electrical conductivity and the test voltage in the trigger corporal BAT took the values of healthy animals and remained within 10.01 ± 0.22 - 10.62 ± 0.21 µA and 1.27 ± 0.21 - 1.71 ± 0.22V respectively after a study in two weeks .

The tested scheme of DENS-therapy based on the electropulse effect on five trigger acupuncture points showed the result characterized by the data of Table 2. BAP - №11, №38, №90, №77, №97 were revealed by the “BIOREPER” method.

Table 2: Comparative therapeutic effectiveness of dynamic electric neurostimulation with nonspecific bronchopneumonia in calves

Indicator	Therapeutic regimen	
	With the inclusion of DENS-therapy	The usual therapeutic complex
Number of calves, heads	24	26
Dynamics of changes in the clinical state of animals during therapy, days:		
- partial improvement	3.2±1,4	4.2±1.1
- significant improvement	5.5±1.1	6.9±1.4
- relief of respiratory syndrome	6.6±1.3	7.8±1.3
Recovery period, days	8.1±1.1	10,6±1,4
Mortality , %	6.7	13.4
Remained sick , %	0	26.8
Therapeutic effectiveness ,%	93.3	76.6

The obtained clinical information showed that in the first group of calves the application of dynamic electroneurostimulation with the “DiaDENS-PC” device caused a partial improvement in the state by the fourth day of treatment. Significant improvement occurred by the 6th day, averagely in 5.5 ± 1.1 days. Inclusion of electrodynamic stimulation into the complex of pathogenetic therapy led to a reduction in the duration of the respiratory syndrome up to 6.6 ± 1.3 days. The indicator of therapeutic effectiveness of the applied complex was calculated as the ratio of the number of died calves to the total number of animals treated with DENAS, and it was 93.3%; one animal died - 6.7%. When using the DENS regimen, the animals recovered by the 8th day (8.1 ± 1.1), two days earlier than in the control group of animals.

Treatment with conventional means led to the recovery by 10.6 ± 1.4 days in the control group in the acute form of focal pneumonia in calves. However, 26.8% of the calves needed longer treatment and more complicated therapy; 13.4% of calves died, the therapeutic effect was 76.6% (table 3).

Results of hematological and biochemical characteristics of the calves' clinical state obtained during the application of DENS pointed to activation of reparation processes in calves during the period of DENS application. The use of DENS-physiotherapy did not cause adverse clinical manifestations in animals (table 3).

Before the appointment of therapeutic measures, the clinical status of the sick calves in the experimental and control groups corresponded to the picture common for the acute course of focal pneumonia during clinical blood analysis. Blood values were characterized by a slightly reliable ($P < 0.05$) decrease in the number of red blood cells to $5,1 \pm 0,32 \cdot 10^{12}/l$ ($7,3 \pm 0,14 \cdot 10^{12}/l$ in norm); the hemoglobin amount dropped to $111,2 \pm 4,1$ g / l in comparison with clinically healthy calves $165 \pm 2,5$ g / l; leukopenia - decrease in the number of leukocytes in the blood - was $5.5 \pm 0.17 \cdot 10^9 / l$. Significant deviations in ESR were noted - it reduced up to 45 ± 2.3 mm / h, which in norm is 8.0 ± 1.1 mm / h (table 3).

The proteinogram was characterized by a decrease in the albumin content and an increase in the level of globulins against a background of a slight decrease in the total protein. The amount of total protein decreased to $64.9 + 0.9$ g / l (at a rate of $66.7 + 0.8$ g / l), mainly due to a decrease in albumins to $22.1 + 0.8$ g / l in severe cases.

Table 3: The results of the laboratory blood study of sick calves of the experimental and control groups in the comparative therapy of the acute form of focal pneumonia

Indicator	Units	Experimental group ¹		Control group ²	
		Before treatment	After treatment	Before treatment	After treatment
Complete blood count :					
erythrocytes	$10^{12}/l$	$5.1 \pm 0,32$	$7,0 \pm 0,2$	$5,1 \pm 0,32$	$6,9 \pm 0,23$
hemoglobin	g/l	$111,2 \pm 4,1$	$126,1 \pm 4,2$	$111,6 \pm 4,1$	$118,5 \pm 0,42$
hematocrit	%	$0,37 \pm 0,01$	$0,36 \pm 0,01$	$0,37 \pm 0,01$	$0,36 \pm 0,01$
ESR	mm/h	$45,4 \pm 2,3$	$8,0 \pm 1,4$	$43,4 \pm 1,8$	$7,8 \pm 2,1$
leucocytes	$10^9/l$	$5,5 \pm 0,17$	$9,66 \pm 0,2$	$6,1 \pm 1,09$	$7,2 \pm 0,23$
eosinophils	%	$4,3 \pm 0,1$	$0,5 \pm 0,2$	$3,3 \pm 0,1$	$1,1 \pm 0,2$
young	%	-	-	$3,2 \pm 0,09$	-
banded neutrophils	%	$16,5 \pm 0,7$	$4,8 \pm 0,14$	$12,4 \pm 0,34$	$7,4 \pm 0,18$
segmentonuclear neutrophils	%	$13,6 \pm 0,91$	$32,7 \pm 1,4$	$6,4 \pm 0,8$	$23,1 \pm 2,1$
lymphocytes	%	$60,1 \pm 7,1$	$52,4 \pm 1,2$	$67,1 \pm 5,19$	$58,9 \pm 6,1$
monocytes	%	$4,9 \pm 0,12$	$4,6 \pm 0,12$	$1,9 \pm 0,01$	$4,7 \pm 0,484$
Biochemical blood test :					
total protein	g/l	$64,9 \pm 0,9$	$67,2 \pm 0,8$	$64,5 \pm 0,6$	$66,9 \pm 0,8$
albumins	g/l	$22,1 \pm 0,3$	$26,4 \pm 0,5$	$23,6 \pm 0,7$	$25,4 \pm 0,5$
globulins	g/l	$41,4 \pm 0,5$	$39,9 \pm 0,6$	$41,8 \pm 0,8$	$40,8 \pm 0,6$
α_1 - globulins		$4,1 \pm 0,2$	$3,3 \pm 0,2$	$4,7 \pm 0,2$	$3,8 \pm 0,2$
α_2 - globulins		$8,3 \pm 0,2$	$7,1 \pm 0,3$	$8,9 \pm 0,3$	$7,9 \pm 0,3$
β - globulins		$8,1 \pm 0,3$	$8,7 \pm 0,2$	$8,0 \pm 0,2$	$8,4 \pm 0,2$
γ - globulins		$20,5 \pm 0,3$	$20,9 \pm 0,3$	$20,2 \pm 0,3$	$20,6 \pm 0,2$

Note: ¹ - application of DENS-therapy; ² - application of the usual therapeutic complex for the treatment of nonspecific bronchopneumonia. Reliability of differences between healthy and sick calves * $P < 0,05$.

The study of calves after treatment showed normalization of the clinical status of animals in both groups (table 3).

Thus, our studies were aimed at finding an approach to justify practicability of using dynamic electroneurostimulation for more effective solution to the problem of treating non-specific

bronchopneumonia in calves in production conditions. Research revealed certain advantages of this method in comparison with practiced exclusively chemotherapeutic agents of treating calves in acute form of focal pneumonia.

Comparing the obtained data with the existing information about the effectiveness of many chemotherapeutic agents tested in the acute form of focal pneumonia [2,4,6,9,10], the effectiveness of the scheme with DENS usage should be considered to be sufficiently high. In general, these facts indicate that the use of physiotherapy in a variant of dynamic electroneurostimulation is a promising mean in the complex therapy of acute form of focal pneumonia in calves. Moreover, non-pharmacological treatment significantly reduces the costs of performing therapeutic measures.

CONCLUSION

The use of electroacupuncture diagnostics of corporal acupuncture points by the "BIOREPER" method is practically rational for the development of prescription support for DENS-therapy in the acute form of focal pneumonia. Technological capabilities of the "DiADENS-PC" allow to differentiate with a sufficient degree of reliability the biophysical parameters of corporal acupuncture points that have the therapeutic value in bronchopneumonia in calves.

The device allows to instrumentally test biophysical anomalies of trigger character in corporal BAP which determine the prescription basis of the technology of acupuncture therapeutic use of DENS in acute form of focal pneumonia in calves.

The treatment regimen which involves the use of DENS in combination with conventional therapy showed increased therapeutic potential. The efficacy was up to 93.3% which reduced the duration of treatment by two days and the lethality by 6.7%. These arguments make its practical application in the acute form of focal pneumonia more preferable in comparison with many conventional medicinal prescriptions.

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