Dynamics of cortisol in calves against the background of the use of polymethylsiloxane polyhydrate as an anti-stress drug

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Abstract. Our core interest is the dynamics of cortisol in the period of delivery of calves when an environmentally safe drug polymethylsiloxane polyhydrate is being used. Experimental groups of calves received suspension of the drug at a dose of 0.1 g / kg, 0.3 and 0.5 g / kg of body weight. The cortisol level in the newborn calves was 7.12±0.06 mcg/DL, providing sufficient enzymatic activity. In calves of 5-day-old age, by the end of the colostrum period, the cortisol level significantly decreased, in the control group by 5.84 times, reaching 1.22±0.26 mcg/DL; in experimental groups 2, 3 and 4, respectively, by 6.3; 9.13 and 8.68 times (p≤0.05). When the calves reached the age of 15 days, the cortisol content in the calves in the control group was 0.10 mcg/DL; in groups 2, 3 and 4, respectively, it was 0.11; 0.12; and 0.14 mcg/DL. In comparison with the control group calves, the calves of experimental groups on the first 5 days of life, the drug at a dose of 0.1 g/kg of body weight contributed to a decrease in cortisol by 7.4%, at a dose of 0.3 g/kg-by 36.1%, at a dose of 0.5 g/kg-by 32.8%. While the drug was being used for 15 days, in groups 2, 3, and 4, the cortisol content was higher relatively to group 1 by 0.01 mcg/DL, 0.02 mcg/DL, and 0.04 mcg/DL, respectively. Therefore, for calves of 5-day-old age, the optimal cortisol concentration is 0.78-1.22 mcg/DL, for 15-day-old calves, respectively, 0.11-0.14 mcg / DL. We recommend that calves use a suspension of polymethylsiloxane polyhydrate at a dose of 0.3-0.5 g/kg of body weight on the first five days of life, followed by a dose of 0.1- 0.3 mg/kg.

1. Introduction
The industrialization of animal husbandry, accompanied by the scientific and technological revolution, has led to a wide range of problems that are based on stress. A pioneer in the study of stress was V. Kennon, who focused on the non-specific response of the body in response to various external influences [1-5]. In the course of evolution, the responses of the organism were formed in individual species as physiological features [2]. The first critical phase of the postnatal period is the act of delivery. Birth stress, change of ambient temperature, the appearance of independent breath, increased muscle activity, increased brain activity, and the dynamics of metabolic processes that increase energy consumption in newborns are regulated by glucocorticoids. The motivating moment of these processes is the activity of the adrenal cortex of the fetus, which determines its adaptive capabilities [3; 6-10].

As in the process of delivery, the body experiences stress due to the change of environmental conditions, its transition state reflects the process of adaptation to new living conditions, and is accompanied by changes in the function of all organs and systems. Determining the level of serum cortisol can be a very significant indicator in assessing the condition of newborn calves and further prediction of its viability and stability.
Objective: to determine the concentration of cortisol in the blood serum of calves from birth to 15 days of age while using polymethylsiloxane polyhydrate.

2. Materials and methods
The object of the study are newborn calves. The animals are homegrown, obtained from cows of the Kostroma breed of 3-4 years of age. Keeping the calves was carried out according to the standard technology of the farm, where all newborn calves, according to the plan of veterinary measures, are injected with serum against pasteurellosis, salmonellosis, escherichiosis, parainfluenza-3 and infectious bovine rhinotracheitis during the first day of life in accordance with the instructions for use. Serum contributes to the formation of passive immunity against these pathogens.

For the experiment, 4 groups of calves were formed with 12 calves each, the first one served as a control group and received a standard diet (colostrum and dairy products) in accordance with the feeding standards [9]. Experimental groups 2, 3 and 4, in addition to the standard diet, received a suspension of polymethylsiloxane polyhydrate 2 hours after the last feeding, respectively, at a dose of 0.1 g/kg, 0.3 and 0.5 g/kg of body weight.

Blood was taken from the jugular vein in newborn calves and in the morning (before feeding) in 5- and 15-day-old calves. Blood was obtained into vacuum tubes with coagulation activator and gel, and within 40-60 minutes delivered to the laboratory "Hemotest", where with the help of the ELISA method research on the content of cortisol in serum was performed, also the determination of biochemical parameters of blood with the help of the semi-automatic biochemical analyzer BioChem BA was performed at the Department of obstetrics, surgery and non-contagious animal diseases in Ivanovo State Agricultural Academy.

3. Results and discussion
According to the theory of G. Selye, cortisol is the key hormone in the implementation of reactions that provide homeostasis of the body and increase resistance to stress [4; 11-12]. In the period preceding birth, cortisol induces maturation of liver enzyme systems, including enzymes of glycogenogenesis and aminotransferase, as well as differentiation of alveolar cells, synthesis of surfactant and its release into the alveoli, preventing the development of respiratory distress syndrome of newborns, stimulates the maturation of b-cells of the pancreas and small intestine epithelium, and the activity of alkaline phosphatase. An alarming prognosis may be in case of a high concentration of cortisol in the blood serum with a low body weight of newborns [1]. At birth, the average body weight of calves was 46-48 kg and more.

In the newborn calves, the hormone level was 7.12±0.06 mcg/DL, while the activity of alkaline phosphatase reached 565.5±57.37 U/l, alanine aminotransferase and aspartate aminotransferase, respectively, 13.62±1.74 and 4.82±3.98 U/l. The results indicate the formation of digestive glands and digestive tract, and the readiness of the newborn calves for extrauterine life. After birth, cortisol is involved in the transfer of the body from the fetal to the adult type of hemoglobin [8]. The hemoglobin content in the blood of the newborn calves (during the transition period) was 98.4±2.1 g/l. In this case, the effect on the body is extreme and cortisol provides a protective reaction. By 5-day age (the end of the colostrum period), the cortisol content in the blood serum of the calves of the control group is reduced by 5.84 times to the level of 1.22±0.26 mcg/DL. In the calves of groups 1, 2, 3, and 4, there was also a decrease in the amount of cortisol in the blood serum, respectively, by 6.3 times, 9.13 times, and 8.68 times (p≤0.05). Probably, polymethylsiloxane polyhydrate contributes to the elimination of intermediate metabolites formed after the introduction of serum against pasteurellosis, salmonellosis, escherichiosis, parainfluenza-3 and cattle infectious rhinotracheitis, and disposal of decay products of fetal hemoglobin and bilirubin. External factors (food, temperature, mechanical, etc.) stimulated the function of organs and systems, enzymatic activity and hemoglobin synthesis in the calves of the control and experimental groups.

At 15-day-old age, the cortisol content in the blood serum of the calves of the control group was 0.10 mcg/DL, that is, from the moment of birth, its concentration increased by more than 70 times, and
compared with the result obtained at 5-day-old age – by 12 times. In the calves of experimental group 2, the cortisol level was 0.11±0.02 mcg/DL, in experimental group 3 – 0.12±0.03 mcg/DL, in experimental group 4 – 0.14±0.04 mcg/DL.

It should also be noted that cortisol is of great importance in the development of the body, as it stimulates the synthesis of substances that affect the excitability of neurons and glycogen, catabolism of proteins in muscles and skin and gluconeogenesis, as indicated by the dynamics of total protein and glucose in the calves of the control and experimental groups.

4. Conclusion
High as well as low concentrations of cortisol in blood serum lead to abnormal results when testing liver enzymes, to changes in the rate of protein synthesis, and to impaired glucose metabolism [7]. Stress, a unique stimulant of the hypothalamic-pituitary-adrenal system, leads to an increase in the level of cortisol circulating in the blood, and in calves in the postpartum period, a cortisol level equal to 7.12 mcg/DL is a likely indicator of norm (physiological maturity of newborns). If optimal, comfortable conditions are created for calves, this indicator decreases sharply. Against the background of serum use, the cortisol level in the calves at 5-day age in the control group was higher than in the calves of the experimental groups that received a suspension of polymethylsiloxane polyhydrate.

It should be noted that the decrease in serum cortisol in the calves on the first five days of life depended on the concentration of polymethylsiloxane polyhydrate, which we observed earlier [11]. The use of the drug in the calves at a dose of 0.1 g / kg of body weight reduced cortisol by 7.4%, at a dose of 0.3 g/kg – by 36.1%, at a dose of 0.5 g/kg – by 32.8%.

The use of polymethylsiloxane polyhydrate for 15 days showed that the calves of the experimental groups had higher cortisol levels than those in the control ones. Thus, the drug at a dose of 0.1 g / kg of body weight increased the cortisol content in the blood serum by 10, % (by 0.01 mcg/DL), at a dose of 0.3 g/kg – by 20.0% (by 0.02 mcg/DL), at a dose of 0.5 g/kg – by 40.0% (by 0.04 mcg/DL). An increase in serum cortisol by 0.01-0.04 mcg/DL did not have a negative effect on the calves, but stimulated their adaptive potential, manifested in Their activity and vigorous intake of colostrum and milk.

Thus, for calves of 5-day-old age, the optimal cortisol concentration can be considered 0.78-1.22 mcg/DL, for 15-day-old calves, respectively, 0.11-0.14 mcg / DL.

Basing on the experiment, we can recommend that in the first five days of life of calves, it is advisable to use polymethylsiloxane polyhydrate at a dose of 0.3-0.5 g/kg of body weight, and at a dose of 0.1-0.3 mg/kg in the future.

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