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Functional Activity Of Vascular Hemostasis In Calves Of Plant Nutrition.

Zavalishina S Yu*.

Russian State Social University, st. V. Pika, 4, Moscow, Russia, 129226.

ABSTRACT

Currently, there is no doubt that the vessels are not only the drainage system through which blood moves, but also regulators of its physical state and many life processes throughout the body. Synthesis of biologically active substances with antiaggregatory, anticoagulant and fibrinolytic activity in the walls of blood vessels largely controls the state of hemostasis as a whole at all stages of individual development. At the same time, the functional activity of the vessels in calves at this stage of ontogenesis has not been elucidated very well, which made it possible to set a goal in this study to establish the hemostatic possibilities of the vessel walls in early ontogenesis in calves of plant nutrition. Against the background of a low level of endotheliocytemia in healthy calves of vegetable nutrition, a tendency towards an increase in the antiaggregatory activity of the vascular wall was found. For endotheliocytes of plant nutrition calves is characterized by increased production of antithrombin III and tissue plasminogen activators. In early ontogenesis, an increase in the antiaggregation, anticoagulation and fibrinolytic abilities of the vascular wall occurs in calves in the phase of plant nutrition, which in many respects ensures optimal adaptation of the animal to this stage of ontogenesis.

Keywords: early ontogenesis, calves, phase of plant nutrition, hemostasis, vascular wall.

**Corresponding author*

INTRODUCTION

The hemostasis system is a very physiologically significant system for ensuring homeostasis at any age [1-5]. All its components are very active and physiologically very important for life support [6-9].

Currently, it is clear that the vessels are not only a drainage system through which blood moves, but it is also a component of the hemostasis system [10-13] and a regulator of many life processes throughout the body [14,15]. Synthesis of biologically active substances with antiaggregatory, anticoagulant and fibrinolytic activity in the walls of blood vessels largely controls the state of hemostasis as a whole at all stages of individual development [16-20]. Vascular hemostasis is of great biological importance during the entire early ontogenesis [21-24] and is of particular importance for the growth and maturation of the calf with the maximum disclosure of its productive potential in the phase of plant nutrition. At the same time, the functional activity of the vessels in calves at this stage of ontogenesis has not been elucidated very well, which made it possible to set a goal in this study to establish the hemostatic possibilities of the vessel walls in early ontogenesis in calves of plant nutrition.

MATERIALS AND METHODS

Research was conducted in strict accordance with ethical principles established by the European Convention on protection of the vertebrata used for experimental and other scientific purposes (adopted in Strasbourg March 18, 1986, and confirmed in Strasbourg June 15, 2006) and approved by the local ethics committee of Russian State Social University (Record №12 dated December 3, 2015).

The study was performed on 39 healthy calves of vegetative nutrition of black-and-white and Simmental breeds, taken under observation for 91 days of life. Their examination and examination were carried out 4 times: for 91 days, 6 months, 9 months and 12 months of life.

In animals, the intensity of plasma lipid peroxidation (LPO) was assessed taking into account the level of acyl hydroperoxides (AHP) and thiobarbituric acid (TBA) -active products in it by the Agat-Med kit when registering the antioxidant activity (AOA) of the liquid blood portion. All calves found out the level of endotheliocytemia. The state of antiaggregation potential of the vessel walls was determined using a sample with temporary venous occlusion, assessing platelet aggregation (AP) using a visual micromethod with ADP (0.5×10^{-4} M), collagen (dilution 1: 2 of the main suspension), thrombin (0.125 units/ml), ristomycin (0.8 mg/ml), H_2O_2 (7.3×10^{-3} M) and adrenaline (5.0×10^{-6} M) and when using their combinations - ADP+adrenaline, ADP+collagen and collagen+adrenaline in the same concentrations in platelet-standardized plasma (200×10^9 platelets) before and after temporary venous occlusion. The index of antiaggregatory activity of the vascular wall was calculated by dividing the duration of AP against the background of venous stasis for the time of AP development without it.

The state of anticoagulant activity of the vascular wall in calves was detected by the value of the index of anticoagulant activity of the vessel wall, calculated by dividing the activity of antithrombin III (AT III) in plasma after temporary venous occlusion by its activity without it.

The severity of vascular wall control over the fibrinolysis process was established during the calculation of the fibrinolytic activity index of the vascular wall by dividing the time of euglobulin lysis to a temporary venous occlusion by the time of lysis after it. The results are processed by the criterion (t) Student.

RESULTS OF THE STUDY

In the liquid part of the blood of calves, taken under observation, there was a tendency to a decrease in the amount of the primary products of lipid peroxidation – acyl hydroperoxides (from 1.44 ± 0.11 D₂₃₃/1 ml to 1.35 ± 0.12 D₂₃₃/1 ml) and secondary - thiobarbituric acid-active compounds (from 3.40 ± 0.18 μmol/l to 3.18 ± 0.26 μmol/l). The found intensity of lipid peroxidation was possible due to the rather high activity of the antioxidant protection of their plasma, increasing from $32.5 \pm 0.19\%$ on the 91st day of life to $35.1 \pm 0.15\%$ by the year of life.

In early ontogenesis, low endotheliocytemia was observed in calves of plant nutrition, which tended to decrease during observation (1.9 ± 0.09 cells/ μl for 91 days of life and 1.6 ± 0.14 cells/ μl per 12 months).

In the calves that made up the observation group, a gradual increase in the index of antiaggregatory activity of the vascular wall was found with respect to all the inductors tested and their combinations. The maximum value of the index of antiaggregatory activity of the vascular wall was noted for ADP due to the greatest inhibition of AP with this agonist in the sample with temporary venous occlusion. The value of the index of antiaggregatory activity of the vascular wall with adrenaline, H_2O_2 and collagen was slightly inferior to it. Even less was the antiaggregation index of the vascular wall with thrombin (rising from 1.55 ± 0.11 to 1.62 ± 0.12) and with ristomycin (increasing from 1.56 ± 0.09 to 1.63 ± 0.14). The indices of antiaggregatory activity of the vascular wall with simultaneous use of several inductors were lower in absolute values, but also experienced a tendency to increase from 91 days to 1 year of life, indicating an increase in synthesis in the vessel wall in calves of plant nutrition of antiaggregants.

In the liquid part of the blood of healthy calves from the 91st day to 12 months. Life marked increase in the activity of antithrombin III by 7.4%. This was accompanied by an increase in its production in endotheliocytes, which was reflected in an increase in antithrombin III blood plasma after temporary venous occlusion (the index of the anticoagulant activity of the vessel wall per phase increased by 5.9%).

In the observed animals, as the age increased, an acceleration of 11.4% of the time of spontaneous euglobulin lysis was detected. This was accompanied by an increase in their secretion of tissue plasminogen activators detected in the sample with temporary ischemia of the venous wall (the total increase in the index of fibrinolytic activity of the vascular wall during the phase was 6.2%).

DISCUSSION

Plant nutrition in calves is a serious stage of early ontogenesis, ensuring the intensity of growth and maturation of the body in the existing environmental conditions, ensuring the maximum possible achievement of their productive qualities [25]. A prominent role in this is played by the walls of the vessels penetrating all the organs and tissues of the animal. It has now become clear that they are not only a system by which blood is mechanically moved, but through the release of a number of substances that regulate platelet aggregation, coagulation and fibrinolysis [26,27], largely determine the liquid properties of blood [28].

The low content of lipid peroxidation products in plasma in calves of vegetable nutrition leads to a slight alteration of endotheliocytes and the formation of hemostatically important substances optimal in them.

In the last phase of early ontogenesis, the phase of plant nutrition in calves, there is an increase in vascular wall control over the adhesion process of platelets as a result of an increase in the release of prostacyclin and nitric oxide from it, which reduces the expression level of collagen receptor glycoproteins I-IIa and VI on the blood plates [29]. This is evidenced in the study, the prolongation of AP time with collagen against the background of temporary venous occlusion. In addition, in the phase of plant nutrition in the calf vessels, the level of von Willebrand factor synthesis decreases, which additionally weakens the adhesion of the blood platelets.

The gradual enhancement of formation of physiological antiplatelet agents in the vascular wall detected in calves of plant nutrition is accompanied by a decrease in the binding of strong aggregation agonists (collagen and thrombin) to their receptors on the platelet membrane. This provides a weakening in the blood platelets of phospholipase C activity, slowing down the phosphoinositol pathway activation of platelets and phospholirination of the proteins of the contractile system. In the phase of plant nutrition in calves, there is an increase in synthesis of prostacyclin and nitric oxide in the vessel wall, which reduces the effect on platelets of weak aggregation inducers (ADP and adrenaline) and decreases the expression of fibrinogen receptors (GPIIb-IIIa) with depression of phospholipase A_2 , providing an arachidone expression, providing an arachidone A_2 output, providing an arachidone output, providing an arachidone release membrane phospholipid platelets [30].

The revealed enhancement of the antiaggregation properties of the vascular wall in calves in the phase of plant nutrition in relation to double and triple combinations of aggregation inducers indicated a pronounced

increase in the synthesis of disaggregating substances in it, significantly lowering platelet aggregation in real bloodstream conditions [31].

The increase in the formation of anticoagulant and fibrinolytic substances, AT III and tissue plasminogen activator in it, is important in ensuring age-related enhancement of the atrombogenic capacity of the vascular wall in calves of plant nutrition and time of spontaneous euglobulin lysis.

CONCLUSION

In early ontogenesis, an increase in the antiaggregation, anticoagulation and fibrinolytic abilities of the vascular wall occurs in calves in the phase of plant nutrition, which in many respects ensures optimal adaptation of the animal to this stage of ontogenesis.

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