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The Functional State Of Vascular Hemostasis In Calves During The Neonatal Phase.

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ABSTRACT

The intensity of the production of hemostatically significant factors of the vascular wall to a large extent determines the fluid properties of the blood and the activity of many body functions. Of particular importance is vascular hemostasis in the early stages of ontogenesis of animals. At the same time, the hemostatic ability of the vascular wall in the neonatal phase is very important, since it determines the initial stages of the development of the ontogeny process, aspects of the growth and development of the animal. Of particular importance are antiaggregatory, anticoagulant and fibrinolytic capabilities of the vessels of calves, which directly control the functional activity of the entire hemostasis. During the examination of 31 healthy newborn calves of the black-and-white breed, the stability of the content of lipid peroxidation products in their blood was established as a result of their high activity in plasma antioxidant protection. On the background of low endotheliocytemia, healthy newborn calves were characterized by high values of vascular wall antiaggregation activity indices with individual inducers and their combinations and vascular wall anticoagulation activity with a slight increase in vascular wall fibrinolytic activity index. The constancy of the antiaggregation and anticoagulation capabilities of the vascular wall found in newborn calves with a tendency to increase its fibrinolytic capacity in many ways ensures their proper level of vascular wall control over hemostasis processes.

Keywords: calves, neonatal phase, hemostasis, vascular wall, lipid peroxidation.

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INTRODUCTION

Being in all tissues and organs, the vessels are inextricably linked with their functioning during the whole ontogenesis [1-5]. The intensity of the production of hemostatically significant factors of the vascular wall [6] largely determines the fluid properties of the blood and the activity of many body functions [7-10]. Vascular hemostasis is of particular importance in the early stages of ontogenesis of animals [11-14]. At the same time, the hemostatic ability of the vascular wall in the neonatal phase is very important, since it determines the initial stages of the development of the ontogeny process, the subsequent aspects of the growth and development of the animal [15-18] and, ultimately, its productive properties [19-21]. Thus, the antiaggregation, anticoagulant and fibrinolytic capabilities of the vessels of newborn calves directly control the functional activity of the entire hemostasis [22,23], ensuring the success of hemocirculation in the growing organism of the animal [24,25].

At the same time, the hemostatic properties of the vascular wall in newborn calves has not been assessed sufficiently and their ability to release substances with antiaggregative, anticoagulant and fibrinolytic activity into the blood has not been fully clarified. In this regard, our work aims to establish the level of hemostatic control of the vascular wall in healthy calves during the neonatal phase.

MATERIALS AND METHODS

Research was conducted in strict accordance with ethical principles established by the European Convent 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 ethic committee of Russian State Social University (Record №12 dated December 3, 2015).

The study was performed on 31 healthy newborn calves of black-and-white and Simmental breeds, which were examined and examined 5 times: for 1-2 days, 3-4 days, 5-6 days, 7-8 days and 9-10 days of life.

All animals were screened, consisting of an assessment of plasma lipid peroxidation (LPO) intensity by the level of acyl hydroperoxides (AHP) and thiobarbituric acid-active products in it using the Agat-Med kit, taking into account the antioxidant activity (AOA) of blood plasma.

The magnitude of endotheliocytemia was found out traditionally. The severity of the antiaggregation ability of the vessel wall was established using a visual micromethod for assessing platelet aggregation (AP) with ADP (0.5×10^{-4} M), collagen (1: 2 dilution of the main suspension), thrombin (0.125 units/ml), and ristomycin (0.8 mg/ml) and adrenaline (5.0×10^{-6} M) and using their combinations - ADP + adrenaline, ADP + collagen and collagen + adrenaline in the same plasma concentrations standardized by platelet count (200×10^9 platelets/l) before and after the test with temporary venous occlusion. The calculation of the index of antiaggregatory activity of the vascular wall (IAAVW) was carried out by dividing the time of the onset of AP against the background of venous occlusion by the duration of AP without it.

The level of the anticoagulant activity of the vessel wall (IACAVW) in calves was calculated during the division of the activity of antithrombin III after a temporary venous occlusion by its value before it.

The fibrinolytic activity of the vascular wall was determined by recording the time of stimulated euglobulin lysis before and after temporary venous occlusion, which causes tissue tissue activator plasminogen to be released from the vessel wall into the blood when calculating the fibrinolytic activity index of the vascular wall (IFAVW) in the course of dividing the euglobulin lysis before the occlusion its holding.

The results of the research are processed by the criterion (td) of Student.

RESULTS

In the blood of the observed animals, during the neonatal phase, the concentration of primary plasma LPO products — AHP and secondary — thiobarbituric acid-active substances remained stable, averaging during the phase 1.43±0.10 D_{233}/1 ml and 3.47±0.17 µmol/l, respectively. This activity of LPO was possible due to the

consistently high antioxidant protection of the plasma of animals during the first 10 days of life - their AOA experienced only minor fluctuations, averaging 34.1±0.29% during the neonatal phase.

In newborn calves, the high integrity of the endothelial layer of blood vessels was established, which could be judged by the low level of endotheliocytemia during the observation period (on average 1.5±0.08 cells/µl).

In animals included in the observation group, IAAVW was observed to be consistent with respect to all inductors used and their combinations. The maximum were IAAS for ADP and adrenaline, which was provided by the greatest inhibition of AP with these agonists in the sample with temporary venous occlusion. They somewhat inferior to IAAVW with collagen. Lower still were IAAVW with thrombin (at the beginning of the phase 1.49±0.10, at its end 1.52±0.07) and ristomitsin (at the beginning of the phase 1.50±0.08, at its end 1.49±0.07), also retain stability during the phase of colostrum. The values of the aggregation activity of the vascular wall in the case of the use of two inductors at once were slightly lower in absolute values, but also remained without significant fluctuations throughout the entire observation.

The work found that in healthy calves during the neonatal phase, a consistently high level of antithrombin III is recorded (at the beginning of the phase 98.6 ± 0.19%, at its end 98.0 ± 0.17%). This was accompanied by the stability of the release of antithrombin III by endotheliocytes (IACAVW at the beginning of the phase 1.31±0.06, at its end 1.31±0.04).

For the examined newborn calves, a slight shortening of the duration of spontaneous euglobulin lysis, characteristic of the phase of 4.6%, was characteristic. It was found that the severity of secretion of tissue plasminogen activators, caused as a result of temporary ischemia of the venous wall in calves during the neonatal phase, tended to increase (IFAVW by 6.6%).

DISCUSSION

It is precisely known that in the neonatal phase, the functions of all organs and systems are very active, ensuring the adaptation of the animal to the conditions of existence [26-30]. An important regulator of hemostasis in the body of a newborn animal is the vascular wall [31]. Its functional activity in the blood provides the necessary level of factors controlling hemocoagulation and, thus, the homeostasis of a growing organism [32-34].

Low activity of lipid peroxidation of blood in newborn calves leads to low alteration of endotheliocytes [35], largely creating the basis for high antiaggregatory activity of the vessel wall, evidently as a result of maintaining high synthesis activity of prostacyclin and NO in it [36-40].

In healthy newborn calves, there is probably sufficient control from the vascular wall over the number of collagen receptors GPIa-IIa and VI on the platelet membrane, villebrand factor production by vascular structures and its binding to receptors for it - (GPIv) on the surface of blood plates [41- 43].

The consistently high release from the vessels of physiological antiaggregants in newborn calves inhibits the fixation of strong agonists of aggregation — collagen and thrombin to the corresponding receptors on the platelet membrane [44], weakening phospholipase C [45] and inhibiting, thereby, the phosphoinositol platelet activation and fostoinite and phosphate fibrinosylation and phosphoriocyte phosphorus inhibition and phosphoridine C of the 45 [46,47]. A powerful release of antiplatelet agents by the vessels inhibits the combination of weak aggregation inducers (ADP and adrenaline) with their receptors, causing low expression of fibrinogen receptors (GPIIv-IIIa) and low phospholipase A_2 activity, thereby limiting arachidonic acid metabolism and thromboxane synthesis [48,49].

A prominent role in ensuring the high atrombogenic activity of the vascular wall in calves during the neonatal phase belongs to the constancy of its anticoagulant and unexpressed enhancement of fibrinolytic properties [50,51]. This is associated with stably high production of antithrombin III in the endothelium of anticoagulant and a slight increase against the background of weak LPO in the vascular wall of plasminogen activators [52,53].

CONCLUSION

The stability of plasma LPO found in newborn calves largely determines the constancy of the antiaggregation and anticoagulation capabilities of the vascular wall with a simultaneous tendency for its fibrinolytic ability to increase, in many respects providing the animals with an adequate level of vascular wall control over the hemostatic process in the bloodstream.

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