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Physiological Features Of Vascular Hemostasis In Cows Beginning To Lactate.

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ABSTRACT

Being a transport channel and regulator of blood parameters, the vessels of the body are closely connected with all its systems and organs. This relationship is realized through the hemostatic properties of the vascular wall, changing at different stages of ontogenesis. At the same time, the severity of vascular wall control over the processes of hemostasis in cows that have begun to lactate is not assessed adequately. During the examination of 43 healthy cows during the first 60 days of lactation, a tendency was found for an increase in the content of acyl hydroperoxides and thiobarbituric acid-active products in their blood with a tendency to weaken their plasma antioxidant potential. Against the background of a low level of endotheliocytemia in healthy lactating cows, a tendency was found to lower the values of the antiaggregation indexes of the vascular wall with all tested inducers and their combinations. For their endotheliocytes, physiological contraction of antithrombin III production was found to be characteristic, providing the necessary level of anticoagulants of vascular origin in their blood. At the same time, the secretion of plasminogen tissue activators, detected during the creation of temporary ischemia of the venous wall, in cows in the first 60 days of lactation also had a tendency toward weakening.

Keywords: cows, onset of lactation, hemostasis, vascular wall, lipid peroxidation.

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INTRODUCTION

The functioning of the body in different conditions and at different stages of ontogenesis can occur with varying degrees of tension of regulatory systems [1-4]. A very important element in maintaining homeostasis is the hemostatic system [5-7]. A serious component of it is considered vascular hemostasis [8,9]. Its morphological basis is the structure of the vascular wall [10].

Performing the role of the transport channel of the blood of the organism, the vessels are closely connected with all its systems and organs [11]. Throughout ontogenesis [12], the generation of biologically active substances in the cellular elements of blood vessels largely determines the state of hemostasis as a whole due to the synthesis of compounds in them with antiaggregatory, anticoagulant and fibrinolytic ability, regulating the blood properties of the blood and the optimum microcirculation in tissues of productive animals [13,14]. In this regard, the elucidation of the hemostatic features of the vascular wall at different stages of ontogenesis, including after calving and at the beginning of lactation, is of great biological importance, since its functional activity largely determines the adaptation of the animal to the current physiological state and contributes to the maximum realization of the productive qualities of the animal [16-20]. At the same time, the severity of vascular wall control over the processes of hemostasis in cows that have begun to lactate has been studied very little. Until now, in the first 60 days of lactation, cows have not determined its antiaggregatory, anticoagulant and fibrinolytic properties. In connection with the existing gaps in the system of modern physiological knowledge, the present study was planned and conducted, the purpose of which is to find out the level of hemostatic activity of the vascular wall in healthy cows during the first 60 days of lactation.

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 ethic committee of Russian State Social University (Record №12 dated December 3, 2015).

The study included 43 healthy cows per day of calving of black-and-white and simmental breeds. Their examination and examination were carried out 4 times: on the day of calving, on the 20th day, the 40th day and the 60th day of lactation.

In all cases, the activity of plasma lipid peroxidation (LPO) was determined by the content of acyl hydroperoxides (AHP) and thiobarbituric acid (TBA) -active products with the Agat-Med kit with the evaluation of the antioxidant activity (AOA) of the liquid portion of blood. The severity of endotheliocytemia was recorded in the blood of all calves with the help of a Goryainov chamber. Anti-aggregation activity of the vessel walls was determined in a sample with a temporary venous occlusion based on a visual micromethod for recording platelet aggregation (AP) with ADP (0.5×10^{-4} M), collagen (1: 2 dilution of the main suspension), thrombin (0.125 units/ml), ristomitsinom (0.8 mg/ml) and adrenaline (5.0×10^{-6} M), as well as with their combinations - ADP and adrenaline, ADP and collagen and collagen and adrenaline in the same concentrations with a standardized platelet count in the studied plasma (200×10^9 platelets) before and after temporary venous occlusion. Subsequently, the calculation was made of the index of antiaggregatory activity of the vascular wall by dividing the duration of AP in the plasma obtained against the background of temporary venous stasis by the time that AP appears in the plasma without it.

The severity of the vascular anticoagulation properties of animals was assessed by the value of the index of the anticoagulant activity of the vessel wall, which was obtained by calculation by dividing the plasma activity of antithrombin III after its temporary venous occlusion by its activity in the plasma before it was performed.

The state of control from the vascular wall over the blood fibrinolytic capabilities was found during the calculation of the index of fibrinolytic activity of the vascular wall by dividing the duration of euglobulin lysis before temporarily applying a cuff to a vein by the duration of lysis in plasma obtained on its background. The results obtained in the work were processed using Student's criterion (td).

RESULTS OF THE STUDY

During the first 60 days of lactation, in the liquid part of the blood of the observed cows, there was a tendency to increase the level of the LPO-AHP products by 11.9% and TBA-compounds by 12.2%, reaching $1.32 \pm 0.007 D_{233}/1 \text{ ml}$ by the end of the observation and $3.04 \pm 0.010 \mu\text{mol/l}$, respectively. Registered features of the peroxidation process were possible as a result of their high plasma antioxidant potential, which tends to a physiological decline from $42.0 \pm 0.21\%$ per day of calving to $37.9 \pm 0.26\%$ on day 60 of lactation.

For cows that started lactation, high integrity of the endothelial lining of blood vessels was typical, as indicated by low endotheliocytemia ($1.3 \pm 0.02 \text{ cells}/\mu\text{l}$ per day of calving and $1.5 \pm 0.07 \text{ cells}/\mu\text{l}$ on day 60 of lactation).

Table. Indicators of vascular hemostasis in cows beginning to lactate

| Registered parameters | Lactation, n=43, M±m | | | |
|--|----------------------|----------------------|----------------------|----------------------|
| | calving | 20 lactation days | 40 lactation days | 60 lactation days |
| index antiaggregatory activity of the vascular wall with ADP | 1.97±0.011 | 1.94±0.008 | 1.91±0.005 | 1.88±0.006 |
| index antiaggregatory activity of the vascular wall with collagen | 1.88±0.003 | 1.84±0.005 | 1.80±0.008 | 1.76±0.004 |
| index antiaggregatory activity of the vascular wall with thrombin | 1.75±0.007 | 1.72±0.003 | 1.69±0.008 | 1.64±0.009 |
| index antiaggregatory activity of the vascular wall with ristomycin | 1.76±0.005 | 1.72±0.010 | 1.69±0.007 | 1.66±0.008 |
| index antiaggregatory activity of the vascular wall with epinephrine | 1.92±0.004 | 1.87±0.005 | 1.82±0.003 | 1.77±0.007 |
| index antiaggregatory activity of the vascular wall with ADP + epinephrine | 1.72±0.004 | 1.68±0.007 | 1.63±0.005 | 1.59±0.006 |
| index antiaggregatory activity of the vascular wall with ADP +collagen | 1.62±0.002 | 1.58±0.006 | 1.53±0.008 | 1.50±0.009 |
| index antiaggregatory activity of the vascular wall with epinephrine + collagen | 1.72±0.007 | 1.69±0.006 | 1.64±0.009 | 1.61±0.005 |
| Antithrombin III activity after transient venous occlusion,% | 218.7±0.25 | 209.1±0.14 p<0.05 | 197.7±0.08 p<0.05 | 190.9±0.24 p<0.05 |
| The index of anticoagulant activity of the vascular wall | 1.56±0.010 | 1.52±0.006 | 1.49±0.007 | 1.47±0.005 |
| The time of spontaneous euglobulin lysis after temporary venous occlusion, minutes | 212.4±0.45 | 214.5±0.34 | 217.5±0.29 | 217.8±0.37 |
| Index of fibrinolytic activity of the vascular wall | 1.67±0.004 | 1.62±0.005 | 1.59±0.007 | 1.56±0.008 |

Note: p - the reliability of the dynamics of indicators during the observation.

During the first 60 days of lactation, the cows included in the study showed a physiological decrease in the antiaggregation index of the vascular wall with all inducers used and their combinations (see table). The highest index of antiaggregatory activity of the vascular wall was noted for ADP due to the maximum inhibition of AP with this agonist in the sample with temporary venous occlusion. The level of the antiaggregatory activity index of the vascular wall with adrenaline and collagen was slightly lower. Even lower was the index of antiaggregatory activity of the vascular wall with thrombin (by the end of the observation 1.64 ± 0.009) and ristomycin (by the end of the observation 1.66 ± 0.008), the magnitudes of which also decreased during the entire study period. The indices of vascular wall aggregation activity with simultaneous use of two inductors, although lower in absolute values, also tended to decrease in cows from calving up to 60 days of lactation, indicating a physiological decrease in the production of antiplatelet agents in lactating cows.

In the blood of healthy cows from the day of calving to the 60th day of lactation, an increase in the level of antithrombin III was noted against the background of temporary venous occlusion by 14.6% (tab.). At the same time, it was also characteristic of them to lower the index of the anticoagulant activity of the vessel wall, which was 6.1% during the observation time.

All observed cows found a clear tendency to an increase in the time of spontaneous euglobulin lysis against the background of temporary venous occlusion, totaling 2.5%. At the same time, in these cows in the first 60 days of lactation, the secretion of plasminogen tissue activators provoked by temporary ischemia of the venous wall also had a slight tendency to weaken (the fibrinolytic activity index of the vascular wall decreased by 7.0% during the first 60 days of lactation).

DISCUSSION

Being a very productively significant function, lactation in calving cows is an important stage of ontogenesis, which significantly influences the process of adaptation of the organism to very dynamic environmental conditions and prepares it for fertilization and new pregnancy [21]. A large role in this process is played by the state of the synthetic abilities of the walls of blood vessels, which bind together the animal's body [22,23]. Performing various functions, the vascular wall due to a number of mechanisms is closely connected with all systems and organs, largely controlling the state of the fluid properties of blood due to the synthesis in it of substances regulating platelet aggregation, coagulation and fibrinolysis processes [24,25].

Low plasma LPO activity in cows beginning to lactate provides low alteration of vascular wall endotheliocytes, which contributed to the optimal level of formation of hemostatically important substances in them.

During the first 60 days of lactation in healthy cows, a slight tendency to a decrease in the level of vascular wall control over the adhesive ability of the blood platelets was revealed, since their high level, which is necessary during pregnancy, is no longer required during lactation. This happened at least by two mechanisms. The first is associated with some weakening of the depressive effects of the vascular wall on the density of collagen receptor glycoproteins Ia - IIa and VI on the platelet membrane. This was judged by reducing the time of AP with collagen against the background of temporary venous occlusion. The second mechanism of increasing the adhesion of platelets in cows during the first 60 days of lactation is associated with increased synthesis of von Willebrand factor vessels, which is a cofactor of this process [26].

Against the background of a slight decrease in the synthesis of the vascular wall of physiological antiaggregants, a gradual increase in the fixation of strong aggregation agonists (collagen and thrombin) to their own receptors on the platelet membrane is observed, which contributes to an increase in phospholipase C activity in the blood plates, stimulating the phosphoinositol stimulation of cytophocyte cytoskeleton cells and physiologic cytoplasmic cytoplasm, and stimulating phospholipase C activity. proteins of the contractile system. Against the background of a gradual decrease in the course of the onset of lactation in the vessel wall of the synthesis of prostacyclin and nitric oxide, the effect on platelets of weak inducers of aggregation (ADP and epinephrine) increases. This is realized through an increase in the expression of fibrinogen receptors (GPIIb-IIIa) and an increase in the functional activity of phospholipase A2, which limits the release of arachidonic acid from platelet membrane phospholipids [27].

A certain physiological decrease in the severity of antiaggregation ability of the vascular wall in cows that started to lactate, detected by the combined use of aggregation inducers, indicated a decrease in initial high, necessary for calving, necessary for pregnancy and disaggregating substances not needed for lactation.

Great importance in ensuring adequate general atrombogenic ability of the vascular wall in cows after calving belongs to some weakening of the excessive formation of anticoagulant and fibrinolytic substances in it, which primarily include the physiological anticoagulant - antithrombin III and tissue plasminogen activator.

CONCLUSION

In cows during the first 60 days of lactation, there is a decrease in the physiological limits of antiaggregation, anticoagulation and fibrinolytic activity of the vascular wall, contributing to the necessary adaptation of the animal to the completion of pregnancy, the start of lactation and preparation for new insemination.

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