The ability of ferroglukin, fosprenil and hamavit combination in correction of hemostasis functional state of new-born calves with iron deficit

ABSTRACT

New-born calves are still often found with iron deficit. This state influences negatively on their growth, health, and development, to some extent due to hemostasiopathy development. Therefore, great scientific and practical significance for veterinary science and physiology is given to the search of approaches to effective correction of new-born calves’ hemostasiopathy in lack of iron conditions. It seemed to be perspective to evaluate the influence degree of traditionally ferroglukin applied at iron deficit in combination with metabolism stimulators (fosprenil and hamavit) on new-born calves’ hemostasis system indices. During our research it was established that new-born calves with iron deficit have also decreased plasma antioxidant protect-ability, intensification of lipids’ peroxidation processes, increase of platelets’ hemostatic activity and blood coagulation system along with decrease of vascular wall’s ability to bind it. In our study we found that combination of ferroglukin, fosprenil and hamavit given to new-born calves with iron deficit showed improved plasma antioxidant and lipid peroxidation activity, normalization of thrombocyte activity, positive dynamics of hemostasis vascular and plasma components were also observed. Iron deficit of new-born calves can be considered the model of hemostasis abnormality. With its help we can try different means and their combinations to remove hemostasiopathy. The obtained results allowed us to consider the usage of fosprenil and hamavit combination on the background of ferroglukin to be unsufficient in order to reduce the hemostasiopathy in new-born calves with iron deficit.

Keywords: new-born calves; iron deficit; hemostasis system; ferroglukin; fosprenil; hamavit.

1. INTRODUCTION

The aims of durable and well-planned investigations of cattle physiology are the following-to accelerate the processes of its growth, to increase its productivity [1], to work out modern prophylaxis of different abnormalities and to create approaches for removal of appeared pathology [2]. It is very important to accumulate knowledge about different sides of calves’ physiological processes at the very beginning of their ontogenesis [3] because of special significance of the phase of birth for a laying the foundation for milk and meat productivity of cattle. At the present moment it is assumed that the leading role in support of hemostasis during the whole ontogenesis belongs to blood and its hemostatic mechanisms influencing heavily the way of individual development [4,5] with the help of hemocirculation processes. So, activity changes of hemostasis processes change activity of hemocirculation in tissues and organs, and, thus influence the common state of a body [6]. In previous research it was found that in homeostasis deviations, especially in case of a young organism, there can happen quick increased of hemostasis components’ activity able to lead to microcirculation disturbance [7]. Basic works in this field were conducted on a human being [8,9,10]. Being based on their results we managed to make a conception of the presence of age-specific dynamics of hemostasis components’ activity [11,12], most vulnerable its mechanisms and the potential of different influencing variants on a body aiming at hemostatic processes optimization. Because of great social significance of thrombosis development in case of cordial pathology [13,14] many researchers’ attention is still devoted to haemostatic changes in given patients [15,16,17]. They investigated different aspects of hemostasiopathy pathogenesis of cordial diseases. As a result, the possibility of its correction was found. It can be done not only with the help of medicines [18,19], but also with the help of traditionally applied means [20,21]. It has great significance for biological investigations as it allows to minimize application of medicines.

Taking everything into consideration, we have large scientific and practical interest to estimate the hemostasis state of new-born calves in conditions of different dysfunctions. We are also eager to find some ways of a body state correction which can positively influence the signs of hemostasiopathy. We thought to be perspective and to take iron deficit as a model of hemostasis abnormality, as it is often found in new-born calves, and try to work on an effective way of correction of all the hemostasis system components. The given model seemed to be approved as it should result in the decrease of hemoglobin content in blood and activity lowering of iron-bearing enzymes which suppress protein synthesis and activity of cellular functions [22]. Furthermore iron deficit was estimated as a state accompanied by changes in the whole body’s activity. It also leads to abnormalities of all the components of hemostasis system.

Moreover, the investigations aimed to eliminate the hemostasiopathy in calves having iron deficit and they had a great scientific and practical significance. Worked out at the given state variants of
2 MATERIALS AND METHODS

2.1 Materials

The work was fulfilled with 34 newborn calves having the signs of erythrogenesis and decrease of iron content in their bodies (serum iron 12.3±0.10μmol/l, siderocytes 1.6±0.05%, hemoglobin 95.0±0.29 g/l, erythrocytes 4.1±0.13x10¹²/l). The control group consisted of 29 healthy new-born calves.

All the investigations in the present work were conducted in full correspondence with ethical norms and recommendations on humanization of work with laboratory animals containing “The European Convention on the protection of vertebrate animals used for experiments or in other scientific purposes” (Strasbourg, 1986).

2.2 Methods

The state of lipids' peroxidation (LPO) in animals' plasma was found out according to the quantity of thiobarbituric acid – active products in it with the help of a set by the firm “Agat-Med” (Russia) and acylhydroperoxides with the account of antioxidant activity level of the liquid part of blood [26].

Platelets' number in calves' blood was found by their calculation in Gorjaev's chamber. Platelets' aggregation was registered by visual micromethod [10] with some inducers: with ADP (0.5x10⁻⁴ M), with thrombin (0.125un/ml), with collagen (dilution 1:2 of the main suspension), with ristomicin(0.8 mg/ml), with epinephrine (5x10⁻⁶ M) in plasma with standardized quantity of thrombocytes in it (200x10³ /l).

Disaggregation capabilities of a vascular wall were defined with the help of a probe with temporal (200x10⁻⁶ tr) occlusion on the basis of visual micromethod of thrombocyte aggregation registration [10] with all the applied inducers. We calculated the value of vascular wall disaggregation activity index (VWDAI) while dividing platelets aggregation period on the background of venous deadlock on the time of platelets aggregation appearance without it. The index value of vascular wall anticoagulation activity of examined calves was also calculated by dividing of antithrombin III activity after venous occlusion on its value before it [27]. Vascular control over fibrinolytic blood activity was found out by calculating of index value of vascular wall fibrinolytic activity while dividing the time of euglobulinlysis before occlusion on lysis time after it [27].

The state of plasma hemostasis was evaluated according to duration of activated partial thromboplastin period (APTP), prothrombin period and thrombinic period with the help of generally accepted methods [27].

The correction of iron deficit state of new-born calves was made using ferroglukin intramuscularly, once from the calculation of 15mg of iron on 1kg of body mass, fosprenil- 0.1mg/kg intramuscularly in the morning as liquid feeding for 6 days and hamavit– 0.1ml/kg intramuscularly dissolved in 3ml of liquid feeding for 6 days beginning simultaneously with ferroglukin application. The evaluation of the animal health state was made two times – at their birth and on the 7th day of life. Because of the absence of reliable differences between the results of both investigations, control values of each index are presented by one figure – a simple average between them. Examination of calves having iron deficit was fulfilled twice – at their birth and on the next day after correction finish (the 7th day of life). The results were processed by Student's criterion (t). Statistical processing of received information was made with the help of a programme packet “Statistics for Windows v. 6.0”, “Microsoft Excel”. Differences in data were considered reliable in case p<0.05.

RESULTS AND DISCUSSION

The examined newborn calves with iron deficit had usual for the given state weakness, limpness, absence of interest to the environment, paleness of rhino scope and slime layers. These animals were noted to have increased LPO activity in plasma (acylhydroperoxide 3.42±0.012 D₃₃₃/1ml, thiobarbituric acid- active products 5.19±0.019μmol/l at value depression of blood liquid part antioxidant activity 22.0±0.23%). The values of these indices under control were equal to 1.45±0.010 D₃₃₃/1 ml, 3.46±0.012 μmol/l and 33.7±0.15%, correspondingly.
Platelets’ quantity in new-born calves’ blood corresponded to norms. Besides, platelets’ aggregation of animals with iron deficit turned out to be reliably increased (table). Their earliest platelets’ aggregation appeared in response to collagen \( (19.8\pm0.15\%) \), a bit later it developed with ADP and with ristomycin, still later in response to thrombin \( (37.9\pm0.21\%) \). The latest platelets’ aggregation of calves with iron deficit appeared under epinephrine influence \( (68.2\pm0.25\%) \). New-born calves with iron deficit were found to have VWDAI decrease in relation to all the applied inductors (table). The lowest VWDAI value belonged to collagen, a bit higher VWDAI value was for thrombin, still higher VWDAI value was with ristomycin, ADP and epinephrine. The examined animals with iron deficit were noted to have decrease of vascular wall anticoagulant capabilities found according to the index value decrease of vascular wall anticoagulant activity. Fibrinolytic features of these animals’ vessels were also weakened—the index of vascular wall fibrinolytic activity turned to be decreased at 13.0%.

New-born calves with iron deficit were also characterized by APTT increase \( (42.3\%) \) and prothrombin period \( (42.6\%) \) accompanied by some intensification of thrombin period \( (8.7\%) \).

Conducted correction of calves’ state provided them with iron deficit improvement of the common state and their activity, increase of their serum iron level to the control values \( (29.3\pm0.12\ umol/l) \). On the background of ferroglukin, fosrenil and hamavit combination examined calves were found to have evident plasma content decrease of acylhydroperoxides \( (2.16\pm0.010\ D_{295}/1\ ml, p<0,01) \) and thiobarbituric acid-active products \( (4.12\pm0.014\ umol/l, p<0,01) \) at the increase of antioxidant activity to 29.1±0.09% (p<0,01).

The process of correction of animals having at the beginning iron deficit was accompanied by invariability of platelets’ quantity in their blood and some slowdown of platelets’ aggregation. Besides, animals’ platelets most actively responded to aggregation with collagen, ADP and ristomycin, less actively—with thrombin and adrenaline addition into plasma (table).

The examined calves after conducted application were noted to have evident VWDAI increase in relation to all the applied inductors (table). The minimum index was VWDAI value with thrombin. Other VWDAI values were a bit higher and had a tendency of approaching the control values. Newborn calves with iron deficit received iron preparation in combination with metabolically active means were noted to have a tendency to the index increase of vascular wall anticoagulant activity and the index rise of vascular wall fibrinolytic activity on 9.5%.

Thanks to complex application we reached APTT slowdown on 42.6% at simultaneous decrease of prothrombin period on 42.8%. It allowed them to get normalized. Besides, the value of thrombin period, defining the activity of fibrinogen transition into fibrin, of these calves increased at 8.9% and reached control level.

Realization of genetically defined growth and development processes of living organisms takes place at constant influence of numerous factors of environment and internal environment [28] on an organism. Physiological peculiarities of their influence are mostly expressed by the optimum of living beings’ blood content [29] especially as far as hemostasis system components’ activity is concerned [30]. Besides, any disturbances in an organism are accompanied by negative dynamics of hematomatological indices [31,32] including parameters of hemostasis system [33,34]. It becomes clear, that on one the basis of hemostasiosopathy development in case of examined new-born calves we have not only found iron deficit but also found during investigation depression of plasma antioxidant protection during investigation, which, as previous works showed, causes LPO activation in it. Increase of peroxidation in plasma damages structures of blood platelets and vessels and affects their functions [35,36]. Acceleration of platelets’ aggregation of new-born calves with iron deficit points at the increase of their receptors’ sensitivity to outside stimulating impacts. Besides, active development of platelets’ aggregation in response to ristomycin in case of calves with iron deficit should be regarded as consequence of their sensibility increase to von Willebrand Factor. Besides, acceleration of platelets’ aggregation appearing in these animals indirectly tells about the increase of exchange processes of arachidonic acid with surplus thromboxan A2 formation [37] in their blood platelets. Weakening of vascular hemostasis functional abilities of animals with iron deficit became apparent allowing of vessels’ disaggregation features. It was evidently caused by the decrease of generation in their walls of prostacyclindir nitric oxide molecules [38]. At the same time the examined calves were noted to have weakening of vessels’ anticoagulant and fibrinolytic abilities because of production depression of anticoagulant – antithrombin III and tissue activators of plasminogen in them.

Found acceleration of prothrombin period of new-born calves with iron deficit pointed at their evident activity intensification of outer mechanism of plasma hemostasis starting. Its basis was activity increase of coagulation factors participating in it[39]. Early APTP appearance was connected with their activation of coagulation factors participating in the inner way of hemocoagulation. Acceleration
of blood coagulation final stage pointed at the intensive change of fibrinogen into fibrin in case of examined calves [17]. Application of ferroglukin, fosprenil and hamavit combination made new-born calves with iron deficit state feel saturation of their bodies with iron, positive dynamics of red blood and common animals’ state indices. Fulfilled impact on examined calves’ bodies was accompanied by lowering of their LPO processes intensity in plasma what weakened its damaging influence on endothelium and liver platelets. Found weakening of platelets’ aggregation of calves with iron deficit state after getting ferroglukin, fosprenil and hamavit combination is mostly the consequence of positive impact of these means’ combination on innerthrombocyte LPO, receptor and postreceptor platelets’ functioning mechanisms [38]. Developing in these conditions increase of the period of platelets aggregation as a response to ristomicin, pointed at lowering of adhesion cofactor – von Willebrand Factor [19] in these calves’ blood.

In the result of applied impact animals having at the beginning iron deficit got some strengthening of disaggregation, anticoagulant and fibrinolytic vessels’ features. Only the basis of found changes there was not reached the control level of production intensification of prostacyclin, nitric oxide, antithrombin III and tissue activator plasminogen [29] in vascular endothelium of these calves. Found in examined animals on the background of applied impact slowdown of prothrombin period reflected normalization of hemocoagulation processes along the outer way mainly on behalf of production lowering of factors participating in it in liver[1]. Happened on the background of correction slowdown of initially accelerated APTT was accompanied by weakening of generation activity, normalization of coagulation factors and especially factor XII. Happened duration slowdown of hemocoagulation final stage, which state was judged by thrombin period, pointed at weakening of fibrinogen transformation into fibrin to control level in examined calves.

As the result of our investigation becomes clear that in the case of application of ferroglukin, fosprenil and hamavit combination to new-born calves with iron deficit, we can provide normalization of hemocoagulation and positive dynamics of the rest hemostasis system components.

3. CONCLUSION

Iron deficit of new-born calves can be considered as the case of hemostasis abnormality. With its help we can try different means and their combinations to remove hemostasiopathy. It is caused by the facts that new-born calves having iron deficit are characterized by lowering of blood plasma antioxidant protection, intensification of LPO processes in it, increase of thrombocyte hemostatic activity and hemocoagulation at depression of vascular wall capabilities to slowdown of these processes. Because of the presence of iron deficit in new-born calves it is approved to use iron preparation. For strengthening of its impact on a body there were prescribed stimulating metabolism and anabolism means – fosprenil and hamavit. In our work we found that in case of their application to new-born calves it’s possible to strengthen antioxidant protection, weaken LPO activity, decrease thrombocyte activity, produce positive dynamics of hemostatic features of vascular wall and normalization plasma hemostasis. The received results allow us to consider the usage of combination of fosprenil and hamavit on the background of ferroglukin to be unsufficient for removal of hemostasiopathy in new-born calves with iron deficit.

REFERENCES


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**Table. Parameters of hemostasis in newborn calves with iron deficiency treated with ferroglukin, fosprenil and hamavit**

<table>
<thead>
<tr>
<th>Consider indicators</th>
<th>Calves with iron deficiency, n=34, M±m</th>
<th>Calves with iron deficiency, n=29, M±m</th>
</tr>
</thead>
<tbody>
<tr>
<td>platelet aggregation with ADP, s</td>
<td>25.0±0.10 29.6±0.05</td>
<td>40.2±0.08</td>
</tr>
<tr>
<td>p&lt;0.05 p&lt;0.01</td>
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<tr>
<td>platelets’ aggregation with collagen, s</td>
<td>19.8±0.15 24.9±0.04</td>
<td>31.4±0.08</td>
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<tr>
<td>p&lt;0.05 p&lt;0.01</td>
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<tr>
<td>platelets’ aggregation with thrombin, s</td>
<td>37.9±0.21 46.6±0.16</td>
<td>53.8±0.07</td>
</tr>
<tr>
<td>p&lt;0.05 p&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>platelets’ aggregation with ristomicin, s</td>
<td>22.5±0.16 38.6±0.07</td>
<td>48.0±0.12</td>
</tr>
<tr>
<td>p&lt;0.01 p&lt;0.01</td>
<td></td>
<td></td>
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<tr>
<td>platelets’ aggregation with epinephrine, s</td>
<td>68.2±0.25 85.3±0.06</td>
<td>97.6±0.06</td>
</tr>
<tr>
<td>p&lt;0.01 p&lt;0.01</td>
<td></td>
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</tr>
<tr>
<td>VWDAI with ADP</td>
<td>1.44±0.003 1.58±0.003</td>
<td>1.68±0.008</td>
</tr>
<tr>
<td>p&lt;0.01 p&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VWDAI with collagen</td>
<td>1.33±0.005 1.48±0.008</td>
<td>1.58±0.003</td>
</tr>
<tr>
<td>p&lt;0.01 p&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>activated partial thromboplastin period, s</td>
<td>27.0±0.29</td>
<td>39.8±0.33</td>
</tr>
<tr>
<td>p&lt;0.05 p&lt;0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>prothrombinic period, s</td>
<td>12.2±0.25</td>
<td>17.3±0.15</td>
</tr>
<tr>
<td>p&lt;0.05 p&lt;0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>thrombinic period, s</td>
<td>15.8±0.19</td>
<td>17.2±0.21</td>
</tr>
<tr>
<td>p&lt;0.01 p&lt;0.05</td>
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</tbody>
</table>
Legend: $p$ - reliability of differences of indicators between the control and the initial state of the calves with iron deficiency, $p_1$ – reliability of dynamics of indicators in calves with iron deficiency on the background of correction.