SOME HORMONAL AND BIOCHEMICAL BLOOD INDICES IN COWS WITH RETAINED PLACENTA AND Puerperal METRITIS

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Abstract

The comparison of some hormonal and biochemical blood indices in healthy cows (C) and cows affected with retained foetal membranes (RFM) or puerperal metritis (PM) was the aim of the study. Blood samples were taken between 12 and 24 h (RFM) or 8-10 d (PM) after calving. The progesterone, 17-β-oestradiol, cholesterol, glucose, ketone bodies (KB) and free fatty acids (FFA) levels were similar in all the cows examined. Cows with RFM had higher level (P < 0.05) of cortisol (37.4 nmol/l) between 12 and 24 h after calving than control animals (24.2 nmol/l). The progesterone level was higher (P < 0.05) in cows with RFM (2.61 mmol/l) versus control group (1.59 mmol/l). The cortisol concentration did not show a statistical differences between PM and C animals. These data indicate that the cholesterol, KB and FFA levels can be similar after calving in healthy and RFM or PM cows in the same farm. Cows with RFM can show a higher cortisol level immediately after calving. The progesterone level decreases slower after parturition in RFM cows in comparison to healthy ones.

Key words: cows, retained placenta, puerperal metritis, biochemical indices.

At the end of the pregnancy some pivotal physiological processes take place in the neurohormonal system and in the uterus and mammary gland of the cow. These processes prepare the cow organism to calving and the calf to the life in a new environment. The effects of these processes are the production of colostrum and milk, discharge of foetus and foetal membranes and preparing the gonads and genital tract to the next pregnancy. However, physiological changes in the neurohormonal system can lead to metabolic and immunological disorders (5, 12). In cases of unrealizable animal needs, diseases like retained foetal membranes, puerperal metritis, mastitis and hypocalcaemia occur (4, 9). Retained foetal membranes (RFM) and puerperal metritis (PM) are the frequent disturbances of the puerperal period. PM develops after RFM, but in a number of cases it can develop on its own (17).

Metabolic disorders play the most important role in the pathology of puerperal period. The energy deficiency often causes the atony or hypotony of the uterus and this is the main cause of its late involution and cleaning. Energy disturbances can start a few weeks before calving. Kuźma et al. (14) reported, that cows with RFM showed a high level of ketone bodies (KB) and free fatty acids (FFA) in the last week before parturition. Hypoglycaemia was not observed in RFM cows with high blood concentrations of KB and FFA (14). It can be related to the high level of cortisol (27), which is a cause of RFM and PM on the direct or indirect way (25). Kotwica et al. (13) noted, that the decrease in oxytocin level during the parturition is a cause of RFM. Disturbances in progesterone and oestrogen concentrations also are involved in puerperal pathology (10, 12, 22). Monget et al. (19) reported that the main factors that mediate hormonal regulation are insulin, leptin, glucose and fatty acids. These factors integrate a wide range of vital functions in the organism, and can also act directly at the ovarian level. A very important cause of RFM is stress. Persson-Waller (21) divided stress into 4 categories: physiological, metabolic, physical and psychical. RFM and PM are connected mainly with the physiological and metabolic stress (21). The atony of the uterus and immunosuppression can be the results of the mentioned conditions. This opinion is shared by other authors (3). Laven and Peters (15) described other causes of RFM and PM like: genetic and breed predisposition, time of calving (more frequent during spring and summer), length of pregnancy (after too long or too short pregnancy) and the age of cows (frequent in older animals). There are a fluctuation in the occurrence of RFM in the same herd in different years and among herds in the same year. The interesting is that a high milk efficiency in the previous lactation is not a risk factor of placental retention (7).

The aim of the study was to compare the serum levels of progesterone, 17-β-oestradiol, cholesterol, glucose, KB and FFA in healthy cows with the
parameters of animals affected with RFM and PM in the same farms.

Material and Methods

Animals and blood collection. Field trials were carried out on 36 cows with RFM, 30 with PM and 6 healthy control animals (C). The cows were of Black and White x HF breed, 2 – 8 year old, and produced 5 000 – 6 500 kg of milk in previous lactation. Cows selected for the study belonged to two farms with the same feeding, housing and environmental conditions. Blood samples were taken from the vena subcutanea abdominis, between 12 and 24 h (RFM) or at 8-10 d (PM) after parturition. At the same time after calving, blood samples were taken from control cows.

Biochemical analysis. The following biochemical parameters were determined: blood concentration of KB according to the method of Göschke in the modification of Filar et al. (6), C.V.% (intra-assay coefficient of variation) – 7.96; plasma concentration of FFA (11); serum concentration of glucose by oxidase method (Biodata Diagnostic tests), sensitivity – 0.035 ∆mAbs on mmol/L, C.V.% - 2.4; and serum concentration of total cholesterol by colorimetric method (Alfa Diagnostics tests), sensitivity – 1.6 ∆mAbs on mg/dL, C.V.% - 3.38.

Hormonal analysis. Serum concentrations of progesterone, 17-β oestradiol and cortisol were determined by immunoenzymatic methods (Biodata Diagnostic tests). The sensitivity of these tests were: progesterone 0.15 ng/ml, C.V.% – 3.9; 17-β oestradiol 5 pg/ml, C.V.% - 3.9 and cortisol 0.36 ng/ml C.V.% - 3.7.

Data analysis. All the results were statistically analysed with the use of t-test for independent samples and linear correlation coefficient.

Results

Tables 1 and 3 contain results of hormonal and biochemical examinations of RFM cow blood. As can be seen from the Table 1 progesterone and cortisol levels in RFM cows were higher than those in control animals. These differences were statistically significant (P < 0.05). Tables 2 and 4 present results of hormonal and biochemical examinations of PM cow blood. Cows with PM were characterised by a little lower oestradiol level and higher concentrations of progesterone and FFA in comparison to healthy animals. These differences were not statistically significant.

In cows with RFM a positive correlation was detected between progesterone and cortisol levels (r=0.43; P < 0.05), and negative correlation between glucose and FFA levels (r = -0.34; P < 0.05). In PM cows positive correlation was detected between concentrations of glucose and cholesterol (r = 0.32; P < 0.05) and CB and FFA (r = 0.41; P < 0.05) and negative correlation between glucose and FFA concentrations (r = -0.46; P < 0.05). Other correlation coefficients were not statistically significant.

Table 1

Mean hormonal parameters in blood collected between 12 and 24 h after parturition from cows with retained foetal membranes (RFM; n=30) and control healthy cows (C; n=6)

<table>
<thead>
<tr>
<th>Group of cows</th>
<th>Progesterone nmol/l</th>
<th>17-β oestradiol pmol/l</th>
<th>Cortisol nmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFM</td>
<td>2.61 ± 1.43 a</td>
<td>78.6 ± 34.7</td>
<td>37.4 ± 17.5 a</td>
</tr>
<tr>
<td>C</td>
<td>1.59 ± 1.18 b</td>
<td>75.8 ± 30.6</td>
<td>24.2 ± 13.1 b</td>
</tr>
</tbody>
</table>

a,b - significant difference (P<0.05); ± SD

Table 2

Mean hormonal parameters in blood collected on 8–10 d after calving from cows with puerperal metritis (PM; n=30) and control healthy cows (C; n=6)

<table>
<thead>
<tr>
<th>Group of cows</th>
<th>Progesterone nmol/l</th>
<th>17-β oestradiol pmol/l</th>
<th>Cortisol nmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>1.60 ± 1.31</td>
<td>74.8 ± 41.8</td>
<td>25.3 ± 16.1</td>
</tr>
<tr>
<td>C</td>
<td>1.34 ± 0.86</td>
<td>81.2 ± 31.8</td>
<td>22.7 ± 12.4</td>
</tr>
</tbody>
</table>

± SD

Table 3

Mean biochemical parameters in blood collected between 12 and 24 h after parturition from cows with retained foetal membranes (RFM; n=30) and control healthy cows (C; n=6)

<table>
<thead>
<tr>
<th>Group of cows</th>
<th>Cholesterol mmol/l</th>
<th>Glucose mmol/l</th>
<th>Ketone bodies µmol/l</th>
<th>Free fatty acids µmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFM</td>
<td>2.08 ± 0.83</td>
<td>1.99 ± 0.80</td>
<td>765 ± 427</td>
<td>608 ± 250</td>
</tr>
<tr>
<td>C</td>
<td>2.17 ± 0.84</td>
<td>2.35 ± 0.67</td>
<td>754 ± 296</td>
<td>603 ± 282</td>
</tr>
</tbody>
</table>

± SD
between the 3rd and 7th d after calving and cortisol level RFM and PM cows the progesterone level was higher of progesterone. Watson (26) reported that during the second week after calving was somewhat induced calving. In PM cows the level of progesterone level is connected with the start of the ovarian cycle. As

8 versus about 11 pmol/l). The increase in oestradiol statistically lower in comparison to healthy ones (about 3 pg/ml (4-11 pmol/l). In PM cows this increase was slower and on 15 -16 d after parturition the level was statistically lower in comparison to healthy ones (about 8 versus about 11 pmol/l). The increase in oestradiol level is connected with the start of the ovarian cycle. As a result of postpartum disorders the later start of oestrogen production and longer interpregnancy period was described (8).

Table 4
Mean biochemical parameters in blood collected on 8–10 d after calving from cows with puerperal metritis (PM; n=30) and control healthy cows (C; n=6)

<table>
<thead>
<tr>
<th>Group of cows</th>
<th>Cholesterol mmol/l</th>
<th>Glucose mmol/l</th>
<th>Ketone bodies µmol/l</th>
<th>Free fatty acids µmol/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td>2.11 ± 0.85</td>
<td>2.24 ± 0.95</td>
<td>738 ± 377</td>
<td>656 ± 295</td>
</tr>
<tr>
<td>C</td>
<td>2.35 ± 0.87</td>
<td>2.54 ± 0.88</td>
<td>727 ± 316</td>
<td>572 ± 276</td>
</tr>
<tr>
<td>± SD</td>
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</tbody>
</table>

**Discussion**

The frequency of RFM and PM can increase during higher milk production in a herd (2, 18, 24). However, we suppose, that the frequency of postpartum diseases is not dependent on high milk yield. It is a result of insufficient feeding of high-efficient animals. The energetic, mineral and vitamin deficiency and the wrong balance of an alimentary dose lead to metabolic disorders, loss of acid-base equilibrium, hormonal system changes and even to suppress activity of the immune system (16).

The late luteolysis and intensive combustion of spare fat predispose to increased progesterone level after parturition (10, 19). In our study the RFM cows had a statistically higher level of progesterone in the first 2 days after calving in comparison to control group. RFM cows had higher level of cortisol in comparison to healthy ones. The similar results were noted by Krommatitsuk et al. (12) in cows with RFM after an induced calving. In PM cows the level of progesterone during the second week after calving was somewhat higher than in healthy cows. Watson (26) reported that PM cows were characterized by a longer increased level of progesterone.

Zraly et al. (29) in similar study showed, that in RFM and PM cows the progesterone level was higher between the 3rd and 7th d after calving and cortisol level was higher between the 5th and 8th d after parturition in comparison to cows without postpartum disturbances. The level of 17-β oestradiol decreased faster in cows after physiological calving. In our investigations results were a very similar. The cows with RFM were characterized by statistically higher progesterone and cortisol levels in comparison to control animals.

Statistical differences in the concentration of serum oestradiol between RFM or PM and C cows were not detected in the first and second week after calving. It can indicate that the beginning of ovarian cycle is independent from FMR or PM to 10 d after calving. Sheldon et al. (22) reported that between the 7th and 16th d after calving the level of oestradiol increased from 1 to 3 pg/ml (4-11 pmol/l). In PM cows this increase was slower and on 15 -16 d after parturition the level was statistically lower in comparison to healthy ones (about 8 versus about 11 pmol/l). The increase in oestradiol level is connected with the start of the ovarian cycle. As a result of postpartum disorders the later start of oestrogen production and longer interpregnancy period was described (8).

In our study the sick cows had glucose and cholesterol levels similar to the lower limit of physiological norm: 2.22 mmol/l of glucose and 2.33 mmol/l of cholesterol (23). The FFA and KB concentrations often surpassed upper limit of physiological norm (600 µmol/l of FFA and 861 µmol/l – KB). The levels of cholesterol, KB and FFA were similar in healthy and sick cows. Kužma et al. (14) found that subclinical ketosis was in about 30% of cows with RFM during two weeks after parturition. In 35% of healthy cows concentrations of KB and FFA increased just at 2-3 weeks after calving and maintained during the first trimester of lactation. The glucose level in blood of RFM cows was higher during peripartum period than that in healthy cows (14). In our investigations cows had KB and FFA levels in upper physiological limit. This indicates a deficit of energy with a lipolysis and subclinical ketosis. Cows having ketosis and fatty degeneration of the liver are often resistant to insulin (1, 10). Wischral et al. (28) observed an increase in oestriadiol level and decrease in FFA level in cows with RFM. The increased FFA level, decreased glucose level and decreased activity of aspartate aminotransferase during the last month of pregnancy is an predisposing factor for RFM and PM (17).

As conclusion it can be stated, that 17-β oestradiol, cholesterol, glucose, KB and FFA levels can be similar during the first hours and 8 – 10 d after calving in healthy and RFM or PM cows in the same farm. The progesterone and cortisol concentrations can be statistically higher in RFM cows and not statistically higher in PM cows than in healthy ones.

**References**


