Clinical manifestation of comorbid endometritis and purulent-necrotic diseases in the claw area of highly productive cows

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Abstract. Recently, due to the intensification of dairy cattle breeding, there has been an increase in the concentration of cattle, while unfavorable conditions are being created for the mother herd, helping to reduce their resistance to various unfavorable factors. Therefore, the study of clinical manifestations in the comorbid course of endometritis with purulent-necrotic diseases in the area of the hooves of highly productive cows, as well as a detailed comparison of the obtained indicators with clinically healthy animals and animals with a separate manifestation of endometritis and orthopedic pathology, in our opinion, is a very relevant area for scientific research. The research was supported by the Russian Science Foundation Grant No. 24-26-00172, https://rscf.ru/project/24-26-00172/. The experiment was approved by the bioethical commission of the Department of Veterinary Medicine of the Russian Biotechnological University, regarding the humane treatment of experimental animals. The research was carried out on the basis of Voskresenskoye JSC, Voskresensky district, Moscow region, with a total population of 1,450 heads of cattle, including 830 cows. The material for the study was cows with endometritis (n=28), animals with orthopedic pathology (n=25) and with a comorbid course of postpartum endometritis and purulent-inflammatory processes in the toes (n=27). Indicators obtained from clinically healthy animals (n=23) were used as control. Using the method of one-way analysis of variance (ANOVA), we established significant changes in the indicators of rumen contractions (F = 12.44; p<0.001), respiratory movements (F = 19.28; p<0.001), pulse (F = 8.21; p< 0.001) and body temperature (F = 41.13; p<0.001).

1 Introduction

Recently, due to the intensification of dairy farming, there has been an increase in the concentration of cattle on livestock farms. At the same time, unfavorable conditions are

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created for the maternal herd, contributing to a decrease in their resistance to various opportunistic microorganisms [1-4]. It should be noted that in artificial biogeocenosis conditions close to natural ones do not always exist. At the same time, animals are often deprived of active exercise, sunlight, free choice of food, and are exposed to frequent stress, which negatively affects their physiological state [5-7]. At the same time, the compensatory capabilities of the body and its reactions to unfavorable environmental factors are not always taken into account. The indoor microclimate is also of great importance. Thus, with a high density of livestock and equipment of farms with machines, indicators such as the physicochemical and microbial composition of the air, lighting, and noise change sharply, compared with traditional ones [3, 8].

In addition, reorganized livestock farms use traditional milk production technology, preserved, fixed in the process of evolution, biogeocenosis, including animals and associations of opportunistic bacteria that cause various factor infections, often with a comorbid course [5, 9-14].

The comorbid course of gynecological and orthopedic pathology in cows leads to significant economic damage associated with a decrease in milk productivity and the costs of diagnostic, therapeutic, and preventive veterinary measures [15, 16]. The problem of a significant spread of reproductive dysfunction and purulent-necrotic lesions in the toe area of cows requires the search for new ways of early diagnosis and correction of this pathology. Impact of stress factors, significant anthropogenic pressure and inconsistency of living conditions with the physiological needs of animals, unbalanced feeding, violation of the operating regime, unsatisfactory sanitary and hygienic condition of the premises, uncontrolled use of antimicrobial drugs, the formation of farm parasitocenoses, violation of artificial insemination technology, lack of regular exercise, defective start-up animals lead to the development of a significant range of pathologies of a non-contagious nature in cows [17-21]. In turn, internal pathology in highly productive cows mainly becomes a prerequisite for the development of orthopedic, obstetric, gynecological diseases and their associated manifestations. In general, the problem of orthopedic pathology is quite acute, since in highly productive cows its level increases to 18–80%. At the same time, the milk productivity of the herd decreases by 40-50%, and up to 37% of cows are prematurely culled, which altogether leads to significant economic losses in livestock farming [13, 22].

Veterinary practice confirms the existence of a clinically pronounced associated relationship between the manifestation of obstetric diseases and orthopedic pathology in highly productive cows. In particular, postpartum metritis most often develops in cows with purulent-necrotic lesions in the distal limbs that occur before birth or in the first weeks after calving [23-26]. In addition, when a herd is significantly affected by orthopedic diseases, a sharp drop in its reproductive potential is noted due to low fertilization, prolonged postpartum anaphrodisia and a general increase in the number of infertile cows. This indicates the existence of etiological connections and certain pathogenetic patterns of the associated manifestations of disorders of reproductive processes and diseases of the limbs. However, this problem is not considered holistically and systemically, and therefore the fragmentation of therapeutic and preventive measures significantly reduces their effectiveness [27-29].

Thus, in modern technological conditions of dairy farming there is an acute problem of effectively ensuring the health and low level of reproduction of a highly productive herd. It is associated, first of all, with a high rate of lactation of cows, which significantly changes the hormonal, metabolic and immune status, increases the susceptibility to internal, obstetric, gynecological and orthopedic diseases of a comorbid and associated nature; reduction in productive longevity and significant premature culling of cows. At the same time, the most common reason for a decrease in cow reproduction is the associated development of orthopedic and obstetric diseases [30-32].
In connection with the above, the study of their etiological relationships, common triggering and pathogenetic mechanisms is relevant, since it will allow us to establish diagnostic and prognostic criteria for the associated course of orthopedic, obstetric and gynecological pathologies, develop appropriate treatment and preventive measures, and improve the level of health and reproductive function of cows. Therefore, the study of clinical manifestations in the comorbid course of endometritis with purulent-necrotic diseases in the area of the hooves of highly productive cows, as well as a detailed comparison of the obtained indicators with clinically healthy animals and animals with a separate manifestation of endometritis and orthopedic pathology, in our opinion, is a very relevant area for scientific research.

2 Materials and methods

The research was supported by the Russian Science Foundation Grant No. 24-26-00172, https://rscf.ru/project/24-26-00172/. The experiment was approved by the bioethical commission of the Department of Veterinary Medicine of the Russian Biotechnological University, regarding the humane treatment of experimental animals. The research was carried out on the basis of Voskresenskoye JSC, Voskresensky district, Moscow region, with a total population of 1,450 heads of cattle, including 830 cows. The material for the study was cows with endometritis (n=28), animals with orthopedic pathology (n=25) and with a comorbid course of postpartum endometritis and purulent-inflammatory processes in the toes (n=27). Indicators obtained from clinically healthy animals (n=23) were used as control.

Orthopedic medical examination was carried out monthly, which made it possible to determine the degree and nature of deformities, the intensity of destruction of the hoof horn, as well as the dynamics of hoof diseases in cows during the calendar year. In this case, special attention was paid to the condition of the hooves (the presence of deformations) and the hoof horn (the presence of pockets, shells, delamination’s, cracks), as well as the position of the thoracic and pelvic limbs.

In animals with purulent-necrotic lesions in the area of the fingers in the postpartum period, obstetric and gynecological medical examination was carried out based on clinical manifestations, using transrectal palpation and ultrasound scanning of the genital organs with a Scanner Falco device at a frequency of 8 MHz, according to methods accepted in veterinary reproductive medicine. During the clinical examination of the animals, attention was paid to the condition of the vulva, pain, local temperature, the presence or absence of discharge from the genitals, their quantity, color, smell and consistency. A vaginal examination was carried out using a vaginal speculum, taking into account the condition of the mucous membrane of the vagina and cervix, its integrity, rigidity, topographic location of the cervix and the degree of its dilatation, as well as the nature and volume of uterine discharge. During the examination of the ovaries, their size, shape, tissue consistency, and the presence of follicles and corpora lutea were recorded. During the ultrasound examination, the size and echo density of tissues, their homogeneity, and the echo character of functional and pathological structures were determined.

During a clinical examination of experimental animals, rumen contractions were measured for 5 minutes, body temperature, pulse and respiration were measured for 1 minute. The results obtained were processed statistically and presented in table form.

3 Results and discussion

In the process of evolution, various microorganisms have adapted to parasitize the tissues and organs of animals: viruses, bacteria, fungi, protozoa, helminths and arthropods. In this
regard, at the present stage there is an acute problem of the circulation of parasitocenoses on livestock farms, which can cause a fairly wide range of pathologies in cattle, in some cases with a comorbid course [11, 20].

During an orthopedic medical examination of 830 heads of cows, we identified 28 animals with postpartum purulent-catarrhal endometritis, 25 cows with orthopedic pathology and 27 heads of cows with a comorbid course of purulent-necrotic lesions in the toes and acute purulent-catarrhal postpartum endometritis. It was found that in experimental cows, purulent pododermatitis, wounds and ulcers of the interdigital fissure, and Rusterholtz's ulcer were most often recorded during orthopedic medical examination. The occurrence of interdigital phlegmon and Mortellaro's disease were noted much less frequently. It was found that in most cases the localization of purulent-inflammatory processes was recorded on the pelvic limbs.

![Image of clinical examination of experimental animals]

**Fig. 1. Conducting a clinical examination of experimental animals**

In cows with orthopedic pathology, the clinical manifestation of acute purulent-catarrhal endometritis was noted on days 4-6 after birth. At the same time, the discharge from the uterus of viscous yellow-brown or grayish-white lochia, sometimes with flocculent areas of destroyed coruncules and decomposing fragments of the placenta, was recorded. On days 8-12, all animals had abundant discharge of mucopurulent exudate from the vagina. At the same time, in animals, the vaginal mucosa was hyperemic, edematous, painful, with an increase in local temperature. Most cows showed depression, refusal to feed, and an increase in general body temperature to 40°C.

Based on clinical studies, the negative impact of orthopedic pathology in cows on the development of acute purulent-catarrhal endometritis in the postpartum period has been established (Table 1).
Table 1. Clinical indicators for comorbid endometritis and purulent-necrotic diseases in the claw area of highly productive cows

<table>
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<tr>
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<th>Healthy cows (n=23)</th>
<th>Groups of sick cows</th>
<th>ANOVA test</th>
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<td></td>
<td>I (n=28)</td>
<td>II (n=25)</td>
<td>III (n=27)</td>
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<tr>
<td>Rumen contractions, min⁻¹</td>
<td>M±SD</td>
<td>5.08±0.95 (***</td>
<td>5.85±0.84 (***</td>
<td>4.95±0.83 (***</td>
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<tr>
<td></td>
<td>95% CI</td>
<td>4.71 – 5.45</td>
<td>5.50 – 6.20</td>
<td>4.62 – 5.28</td>
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<tr>
<td>Breathing, min⁻¹</td>
<td>M±SD</td>
<td>14.35±1.94</td>
<td>15.46±2.24</td>
<td>17.06–19.09</td>
</tr>
<tr>
<td>Pulse, min⁻¹</td>
<td>M±SD</td>
<td>70.26±6.57</td>
<td>83.96±6.77</td>
<td>84.00±18.81</td>
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<tr>
<td></td>
<td>95% CI</td>
<td>67.41 – 73.10</td>
<td>81.34–86.59</td>
<td>76.55–91.44</td>
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<tr>
<td>Temperature, °C</td>
<td>M±SD</td>
<td>38.15±0.19</td>
<td>38.59±0.31</td>
<td>38.89±0.24</td>
</tr>
<tr>
<td></td>
<td>95% CI</td>
<td>38.06 – 28.24</td>
<td>38.47–38.71</td>
<td>38.78–39.98</td>
</tr>
</tbody>
</table>

Note: I – cows with endometritis; II – patients with orthopedic pathology of the cow; III – cows with comorbid endometritis and orthopedic pathology; M – arithmetic mean; SD – standard deviation; 95% CI - 95% confidence interval; ANOVA – one-way analysis of variance; * (p<0.05), ** (p<0.01); *** (p<0.001) – significance of the difference between the indicators of cows of groups I–III and healthy ones (Tukey’s test); ◊ (p<0.05), ◊◊ (p<0.01), ◊◊◊ (p<0.001) – significance of the difference between the indicators of cows of groups I and II (Tukey’s test); ◊◊ (p<0.01); ◊◊◊ (p<0.001) significance of the difference between the indicators of cows of groups I and III (Tukey’s test); ⸙ (p<0.05); ⸙⸙ (p<0.01); ⸙⸙⸙ (p<0.001) significance of the difference between the indicators of cows of groups II and III (Tukey’s test).

Using one-way analysis of variance (ANOVA), significant changes in the rumen contraction index were established (F = 12.44; p<0.001). In this case, it is possible to reject the null hypothesis that the rate of rumen reduction in animals of different groups refers to the same general population. Subsequently, Tukey's multiple comparison analysis was performed for detailed statistical analysis of differences between different groups of animals. Thus, a significant (p<0.001) decrease in the number of rumen contractions in animals with endometritis and cows with comorbid endometritis and orthopedic pathology was established by 1.23 and 1.26 times, respectively. It should be noted that when comparing the indicators of scar reduction between groups I and II, we found a significant (p<0.01) increase in this indicator in animals with orthopedic pathology by 1.15 times, from 5.08±0.95 to 5.85±0.845 5 min⁻¹. In addition, we also noted a significant (p<0.01) decrease in the number of rumen contractions when comparing the indicators of cows of groups II and III, by 1.18 times, from 5.85 ± 0.84 to 4.95 ± 0.83 5 min⁻¹.

The method of one-factor analysis of variance (ANOVA) revealed significant changes in the indicator of respiratory movements in animals of different groups (F = 19.28; p<0.001). It was shown that in animals of groups II and III a highly significant (p<0.001) increase in respiration was observed by 1.26 and 1.27 times, respectively, when compared with the indicators of clinically healthy animals (Tukey’s test). It was established that when comparing the indicators of cows of groups I and II, a significant (p<0.001) increase in this indicator was revealed by 1.17 times, from 15.46±2.24 to 18.08±2.46 min⁻¹ (Tukey’s test). In addition, a significant (p<0.001) increase in respiratory movements was revealed by 1.18 times, from 15.46±2.24 to 18.22±2.08 min⁻¹ (Tukey’s test), when comparing the indicators of cows I and III groups.
Using the method of one-way analysis of variance (ANOVA), we established significant changes in the pulse rate in animals of different groups (F = 8.21; p < 0.001). It was found that in cows and animals with endometritis with a comorbid course of endometritis and orthopedic pathology, a significant (p < 0.001) increase in pulse was recorded by 1.19 and 1.19 times, when compared with the indicators of the control group (Tukey’s test).

Using the method of one-factor analysis of variance (ANOVA), we also established significant changes in body temperature in animals of different groups (F = 41.13; p < 0.001). It has been shown that in animals of groups I–III, when compared with the indicators of clinically healthy cows, there is a highly significant (p < 0.001) increase in body temperature by 1.01 times, 1.02 times and 1.02 times, respectively (Tukey’s test). In addition, we identified a significant (p < 0.05) increase in body temperature by 1.00 times, from 38.59±0.31 to 38.78±0.21 °C, when comparing the indicators of cows of groups I and II (Tukey’s test). We also established a highly significant (p < 0.001) increase in body temperature in cows with comorbid endometritis and orthopedic pathology when compared with animals with acute postpartum endometritis by 1.01 times, from 38.59±0.31 to 38.89±0.24 °C (Tukey criterion).

### 4 Conclusion

In experienced cows that had damage to the limbs before or after birth, the likelihood of gynecological diseases associated with morphological disorders in the ovaries increased. The significant spread of these types of pathology is the direct cause of prolonged anaphrodisia in cows and a decrease in the level of reproduction of the herd with a high incidence of limb diseases. It has been established that the clinical manifestation of the comorbid course of orthopedic and obstetric-gynecological pathology has a more severe clinical manifestation than in the course of individual diseases. Using the method of one-way analysis of variance (ANOVA), we established significant changes in the indicators of rumen contractions (F = 12.44; p < 0.001), respiratory movements (F = 19.28; p < 0.001), pulse (F = 8.21; p < 0.001) and body temperature (F = 41.13; p < 0.001). Tukey's multiple comparison analysis was performed to provide detailed statistical analysis of differences between different groups of animals. A significant (p < 0.001) decrease in the number of rumen contractions in animals with endometritis and cows with comorbid endometritis and orthopedic pathology was established by 1.23 and 1.26 times, respectively. When comparing indicators of scar reduction between groups I and II, a significant (p < 0.01) increase in this indicator in animals with orthopedic pathology was revealed by 1.15 times. There was also a significant (p < 0.01) decrease of 1.18 times in the number of rumen contractions when comparing the indicators of cows of groups II and III. In animals of groups II and III, a highly significant (p < 0.001) increase in respiration was observed by 1.26 and 1.27 times, when compared with the indicators of clinically healthy animals. When comparing the indicators of cows of groups I and II, a significant (p < 0.001) increase in this indicator by 1.17 times was revealed. A significant (p < 0.001) increase in respiratory movements by 1.18 times was revealed when comparing the indicators of cows of groups I and III. In cows and animals with endometritis with a comorbid course of endometritis and orthopedic pathology, a significant (p < 0.001) increase in pulse rate of 1.19 and 1.19 times is recorded, when compared with the indicators of the control group. It has been shown that in animals of groups I–III, when compared with the indicators of clinically healthy cows, there is a highly significant (p < 0.001) increase in body temperature by 1.01 times, 1.02 times and 1.02 times, respectively. In addition, a significant (p < 0.05) increase in body temperature by 1.00 times was revealed when comparing the indicators of cows of groups I and II; A highly significant (p < 0.001) increase in body temperature was also established in comorbid endometritis and orthopedic pathology when compared with animals with acute postpartum endometritis by 1.01 times.
References