

Antibiotic therapy of metritis in Holstein cows in Volgograd region

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Abstract. The paper studied 35 Holstein cows on a dairy farm in Volgograd region in 2023. The cows received a balanced diet with corn silage, hay, concentrated forages, supplements and mineral components to ensure health and productivity as they produced 40 kg of milk with a fat content of 3.7% daily. Cows diagnosed with postpartum metritis were injected subcutaneously with ceftiofur hydrochloride at a dose of 1 mg/kg body weight. Vaginal discharge was evaluated on day 10 after diagnosis. If discharge persisted, it indicated lack of recovery. Recovery was confirmed if there was no change in the structure and vaginal discharge by day 21. The study showed that the use of ceftiofur for the treatment of cows with metritis was not negatively associated with reproductive performance and productivity of the study cows, but was strongly associated with uterine inflammation. There was no direct reduction in the association between reproductive performance and key production parameters in the study, while there was a high correlation with cow disease such as metritis. The standard deviation for cows diagnosed with metritis was 59.40, metritis + retained placenta - 7.42, metritis + uterine atony - 14.85, metritis + retained placenta + uterine atony - 3.71.

1 Introduction

After a heifer becomes a first-calf heifer, an important and complex process of regression takes place, which is necessary for re-conception. This process is triggered by uterine smooth muscle contractions, which not only change the structure and characterisation of the endometrium, but also significantly reduce the volume of the uterine cavity. In animals with normal parturition, the uterus decreases in size as quickly as possible, mainly in the first postpartum period.

According to G. Firsov et al. (2024) [1] forty days after delivery, the uterine space regains its original non-pregnancy dimensions. Postpartum uterine contractions facilitate removal of the afterbirth and intrauterine fluids, visually reducing uterine volume, but incomplete removal of contents may create conditions for opportunistic flora infection, potentially delaying the return of the uterus to its natural physiologic shape. A significant and physiologically challenging stage in the life of cows begins three weeks before calf

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birth and continues for another three weeks after this event. This process is characterized by significant shifts in metabolic processes, immune and hormonal patterns occurring throughout the cow's body. According to M. Sheldon and H. Dobson (2004) [2], all these changes can provoke a sharp decrease in the protective properties of the uterus itself and stimulate both the development of inflammation and postpartum pathologies leading to infertility.

As described in the work of I. M. Sheldon et al. (2009) [3], the occurrence of infections in the postpartum uterus stimulates the development of inflammation, leading to processes expressed by histopathological manifestations, strongly delay the stages of uterine regression after childbirth and increase the probability of embryonic death. It is known that infectious processes occurring in the uterus and, as a consequence, the development of inflammation act suppressively on the production of luteinizing hormone, impairing the growth and functionality of ovarian follicles after delivery, which negatively affects the process of ovulation in cattle. Infection with bacteria while the calf is still in the womb can provoke inflammatory processes and damage uterine tissues. This, in turn, prolongs the process of recovery of the organ after childbirth and worsens the life chances of future offspring.

Metritis is a complex infectious disease-causing inflammation in several layers of the cow endometrium, with a prevalence of 20-40% in dairy cattle in the first three weeks after calving. As shown in the studies of J. Dubuc et al. (2011) [4] and E.B. de Oliveira and al. (2020) [5] development of metritis in the dairy herd is manifested by an economic decrease in the efficiency of dairy production due to a decrease in the main production of animals - marketable milk and underproduction of young animals, as well as aggravation of the threat of early culling of productive cows. F. S. Lima et al., (2019) and F. S. Lima et al., (2019) [6, 7] costs associated with metritis include antimicrobial therapy, milk loss, reduced milk production, and impaired reproductive health.

The aim of the study was to determine how antibiotic therapy with ceftiofur for clinical postpartum metritis in cows affects uterine postpartum recovery processes and the cow's ability to lactate.

2 Materials and methods

2.1 Objects of research

The research was conducted in 2023 at the dairy complex Agricultural enterprise LLC "Donskoe", Volgograd region. The experiment involved 35 cows of Holstein breed of the second and third calving. A balanced diet was used to maintain the health and productivity of Holstein cows, which give an average of 40 kilograms of milk per day with a fat content of 3.7%. Their daily menu was dominated by corn silage and haylage, and also included concentrated feeds, various additives, enzyme complexes and mineral components.

The animals were divided into experimental groups according to their qualification by the nature of vaginal secretion. Observations of vaginal secretions were characterized as follows: the first category (1 point) includes odorless, natural lochia that are viscous, transparent, and red or brown in color. The second category (2 points) includes cloudy, mucousy discharge dotted with pus. The third category (3 points) is described as mucous discharge that has no foul odor and contains less than fifty percent pus. The fourth category (4 points) is an odorless mucopurulent discharge of white, yellow, or red-brown color with a very high pus content of over fifty percent. Finally, the fifth category (5 points) includes stinky, thin liquids of a gray or watery type that may be colored red-brown and contain fragments of necrotic tissue. Cows showing vaginal discharge with a score of five were

categorized as having metritis. A careful study of the animals was conducted by feeling the uterus directly rectally to monitor the natural reduction in uterine size after delivery. Cows with postpartum inflammation had a large and flabby uterus with a discharge that emitted an unpleasant, irritating odor.

Initial studies aimed at identifying risks contributing to failure in the early prevention of metritis through postpartum uterine therapy covered unchanged variables such as the number of previous births in the cow, the treatment applied and daily milk yields. We carried out an analytical evaluation of productive qualities, which consisted of data on the time between calving's of one and the same animal, insemination index, fat content and protein content of milk, content throughout lactation, number of calving's in females (heifers vs. adult cows), and percentage of eliminated individuals. In the experimental group (antibiotic therapy) there were 16 cows with metritis. In the control group (no therapy) there were 15 cows. Four cows were excluded from the experiment due to antimicrobial therapy (hoof lesions). For antibiotic selection, the sensitivity of cultures was determined by disk-diffusion method.

In dairy cattle breeding, ceftiofur is recommended as a first-line antibacterial drug in the treatment of metritis, as it shows high efficacy and does not require cessation of milk use. Ceftiofur hydrochloride for injection (BelVitonipharm) 1 mg ceftiofur per 1 kg of animal weight was administered subcutaneously to cows diagnosed with postpartum metritis.

On the tenth day after cows were diagnosed with metritis, a secondary evaluation of uterine discharge was performed. If cattle with this disease continued to have vaginal discharge, it was an indication that clinical recovery had not been achieved. It was considered that elimination of uterine apparatus diseases was achieved when no changes in the structure, as well as pathological vaginal discharge, were observed by the twenty-first day.

2.2 Statistical methods

The results of the study were formalized through the creation of model samples accompanied by a 95% confidence interval. Stat Plus Pro (AnalystSoft) statistical data processing program served as a tool for detailed examination of the presented information.

3 Results and Discussion

An inverse correlation was found between milk yield and the development of inflammatory uterine disease in cows, i.e., a tendency to reduce milk yield correlated with an increased risk of metritis. In other words, the more abundant the milk yield, the lower the probability of this disease.

We carried out an analytical evaluation of productive qualities, which consisted of data on the time between calving's of one and the same animal, insemination index, fat content and milk protein. It was found that the above-mentioned indicators did not show a direct correlation with the manifestations of various reproductive pathologies in the studied cows.

Table1. Distribution of obstetric and gynaecologic diseases among cows of the experimental group (n=16).

Disease	Number	Percentages
Metritis	16	100
Metritis+Placental retention	2	12.5
Metritis+Uterine atony	4	25
Metritis+ Placental retention +Uterine atony	1	6.25

The study revealed a pattern (probability = 0.072) between the presence of placenta postpartum and the duration of interruption between births. Logistic regression analysis revealed that inflammatory processes in the postnatal period are due to a range of different causes (Table 1).

Reduced milk production in cows was associated with inflammatory diseases of the reproductive system: reduced milk production is generally associated with an increased risk of uterine inflammation. Conversely, high milk yields tended to indicate a lower chance of disease occurrence. In addition, if cows did not have metritis, the probability of their daily milk yield being reduced was extremely low at only 0.92 (Table 2).

Table 2. Values of statistical indicators of obstetric and gynecologic diseases among cows of the experimental group (n=16).

Indicator	Metritis	Metritis +Placental retention	Metritis + Uterine atony	Metritis + Placental retention + Uterine atony
StdDev	59.40	7.42	14.85	3.71
1Q Tukey	16	2	4	1
1Q N-1	37	4.63	9.25	2.31
3Q Tukey	100	12.5	25	6.25
3Q N-1	79	9.88	19.75	4.94
Average	58	7.25	14.5	3.63

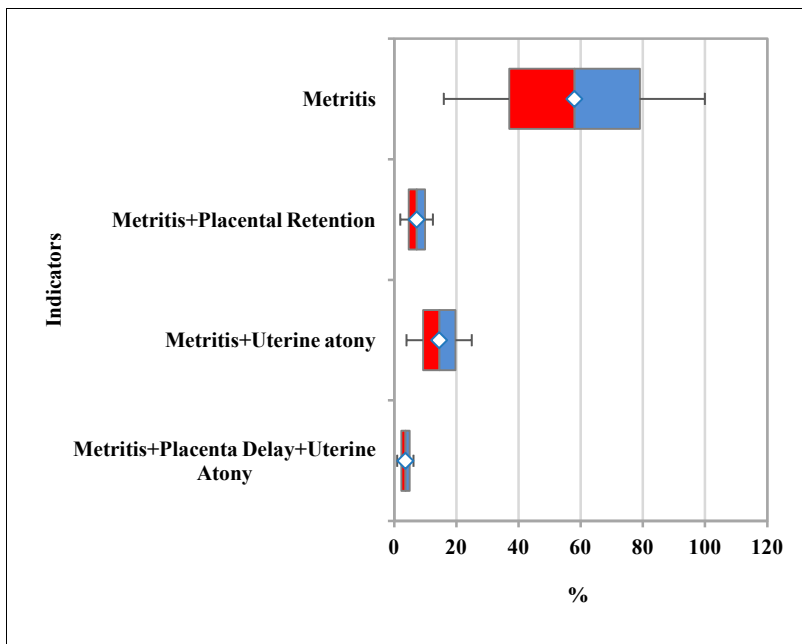


Fig. 1. Box-and-whisker diagram of obstetric and gynaecologic diseases in cows of the experimental group.

In the studied cows, the diagnosis of "postpartum metritis" was made on the basis of significantly enlarged uterus with reduced muscle tone, characterised by abundant foul-smelling vaginal discharge, with or without febrile syndrome. The conclusions drawn from our observations unequivocally allow us to note that first-calf heifers have an increased risk of of metritis and uterine atony (Figure 1). J. Dubuc et al, (2011) [4] reported that this is consistent with previous studies. According to P. Pinedo et al. (2020) [8], the risk of metritis and placental retention (Figure 1) is higher in first-calf heifers than in second-calf

cows because they need more assistance in calving. According to I. M. Sheldon and H. Dobson, (2004) [2], P. R. Menta et al, (2024) [9], J. G. Prim et al, (2024) pathological labour is almost always accompanied by the process of obstetrics, and the manipulations carried out always increase the likelihood of bacterial contamination of the birth canal and infection of the uterus itself, leading to metritis.

In the study we conducted, we found that metritis caused a negative effect indirectly affecting milk production. These studies are supported by the findings previously reported by F. S. Lima et al, (2019), J. G. Prim et al, (2024) [10], they found a decrease in milk production at the beginning of the lactation process in cows with metritis. G. Firsov et al., (2024) [1] report that it was found that one of the reasons for the decrease in milk production may be a significant decrease in energy consumption with feed due to decreased appetite and as a consequence a decrease in the energy required for the processes of milk synthesis. At the same time not strong enough correlation between metritis and milk yield was revealed, which, quite possibly, can be connected with quite effective therapeutic effect of antibiotic ceftiofur. There is a need to recommend ceftiofur as a therapeutic agent for postpartum metritis.

It was found that the chances of cows recovering after the secondary examination were the same for treated and untreated cows. However, individuals with metritis that received veterinary care showed an earlier onset of pregnancy compared to their untreated congeners. Moreover, treated cows showed reproductive performance at the same level as cows in the control group. This situation emphasizes the usefulness of therapy to restore reproductive performance of cows that have suffered from postpartum metritis, and there is a lack of postpartum diagnostic procedures to determine the presence of metritis.

4 Conclusion

Postpartum metritis has a significant effect on both reproductive and productive performance of lactating dairy cows. Ceftiofur treatment was effective in reducing the adverse effects on reproductive performance. The most important risk factors for postpartum metritis were cows with dystocia, twins, retained fetal membranes or a combination of these, these results are consistent with those of other research groups.

It is concluded that to equal the reproductive performance of metritis-free cows, the group treated with antibiotics needed to cure more animals than those not treated. In conclusion, it should be noted that in the process of metritis therapy of cows with ceftiofur, there was no negative correlation of reproductive and main productive indices values, contrary to the high correlation with the disease of cows with metritis. In addition, metritis therapy using ceftiofur antibiotic significantly prevented the farm from milk yield reduction and economic losses in general.

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