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*Review scientific paper***BASIC PRINCIPLES OF MASTITIS THERAPY******Miodrag RADINOVIĆ*, Ivana DAVIDOV, Zorana KOVAČEVIĆ,
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Abstract: Mastitis is one of the most important health problems in dairy cows. In addition to the health aspect and the apparent impact on animal welfare, mastitis is the largest financial cost in dairy farms due to treatment costs and rejected milk because of the withdrawal period, as well as permanently reduced milk production or complete lactation interruption in heavy form of mastitis. The procedure and the outcome of the treatment depend on the form of udder inflammation, degree of tissue alteration, timing of treatment initiation and the application of adequate preparations or the appropriate procedure. The outcome of therapy can be full restitution of parenchyma and its function or deterioration of the glandular parenchyma and filling with connective tissue. Nowadays, in conditions of intensive milk production, mastitis therapy is only part of a mastitis control program that puts mastitis prevention at the forefront. In case of clinical mastitis, it is necessary to apply therapy during lactation.

Key words: mastitis, udder, therapy

INTRODUCTION

Mastitis control programs have been implemented in dairy farms. Regardless of the different approaches in different production conditions, most programs include the prevention of mastitis, treatment of clinical mastitis in different stages of lactation and treatment of subclinical mastitis during the dry period. These are general guidelines and the choice of adequate therapy depends on each case. Severity of the illness, local changes and changes in the general condition, prospects for successful therapy, the cost of the therapy and withdrawal period for milk and meat should be taken into consideration. In addition to the applied therapy the treatment of animals

including proper milking to eliminate the secretion from the udder, enhanced hygiene, especially milking hygiene is also important to cure mastitis. Antimicrobial therapy is still an important component in the control of mastitis in the milk production system (Erskine et al., 2003; Oliver et al., 2011). The following groups of drugs are commonly used in the treatment of mastitis: penicillin's, sulphonamides, quinolones antibiotics and aminoglycoside. In addition to antimicrobial therapy, mastitis treatment may include other pharmacological groups of drugs such as nonsteroidal anti-inflammatory drugs (DE Graves and Anderson, 1993;), corticosteroids, vitamins, cytokines

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(Daley et al., 1991; Sordillo et al. 1993) and vaccines (Tyler et al., 1993). These drugs can be administered in different ways, using systemic or intra mammary administration (Erskine et al., 1993).

Antibiotic therapy in the lactation phase also involves the rejection of milk due to the presence of antibiotic residues, and for this reason, it is preferable for subclinical mastitis to be treated during the dry period, as it avoids the rejection of milk thus reducing the cost of therapy. In addition to antibiotic therapy, symptomatic therapy is applied with the aim of reducing the local inflammation of the mammary gland, causing a subjective improvement and providing a better effect of antibiotics due to increased perfusion of the mammary gland. Supportive therapy is also important as it enables faster recovery of the animal and restoration of milk supply. This aspect of therapy is often neglected in practice although the importance of supportive therapy is indisputable (Boboš et al. 2012, 2014; Milanov et al. 2017; Katić 2012).

When choosing a therapy it is important to identify the causative agent of mastitis. According to the significance and the way in which the infection occurs, causative agents can

be divided into two groups: environmental and contagious (Radinović et al., 2013). Contagious pathogens include *Staphylococcus aureus*, *Streptococcus agalactiae*, *Mycoplasma* and *Corynebacterium bovis*. Environmental pathogens are Coliform organisms and environmental streptococci. Contagious pathogens live primarily in the udder, on the skin, in the teat canals or elsewhere on the body of the cow. Environmental pathogens are mostly present in the bedding, mats and equipment but can also be found on cows. Infection caused by contagious pathogens most commonly occurs during milking and infection caused by environmental pathogens between milking periods. Contagious agents are more likely to cause long-lasting subclinical infections and may be present in a large number of animals. Environmental pathogens most often cause clinical forms of mastitis which last for a short time and are not present in a large number of animals. This difference in clinical presentation also requires different diagnostic protocols. While acute clinical forms of mastitis can be easily diagnosed by clinical examination of udder or animals, subclinical forms are diagnosed using various tests to detect a secretion disorder.

Mastitis diagnosis

A clinical examination of the udder is performed as a routine method in order to establish the diagnosis of clinical mastitis on the farms of high milk yielding cows. Clinical examination of the udder is a simple, fast and economical method that is performed daily, providing valuable information on the animal's health status (Klaas et al., 2004). The examination consists of an assessment of the general health status of animals, as well as examination of the mammary gland by adsppection and palpation. During adsppection the udder is observed from all sides to determine its shape and size, symmetry,

changes to the skin of either the udder or teats. Palpation is most commonly performed after milking, each individual quarter of the udder is examined from the tip of the udder papillae to the udder parenchyma. Special attention is paid when examining supramammary lymph nodes. Udder pain, temperature and parenchyma induration can be determined by palpation. Examination of cows with painful udder can be difficult, so it is necessary to fix the animal to avoid injuries. When examining, it is necessary to provide good lightening to see abnormalities in the udder more easily.

When it comes to subclinical mastitis, it is necessary to apply tests to detect disturbed udder secretion. California mastitis test is most suitable for field work. It is based on the effect of alkyl aryl sulfonate on the DNA polymer from leukocyte, it separates DNA, while protein content forms a gel. There is a loss of cell membrane in all cells present in the milk sample, which allows DNA of these cells to react with

the KMT reagent forming a gel. The first squirt of milk is discarded, and then the milk is poured into a testator with four separate segments, one for each quarter of the udder. For the purpose of proving the presence of mastitis in milk, aerobic cultivation in nutrient medium was applied. For the successful isolation of the causative agent it is crucial to prevent sample contamination and fake positive findings.

Intramammary treatment

Local application of antibiotics has numerous advantages over systemic application. The effect of the drug is achieved faster, the drug is applied directly to the site of the pathological process. The unwanted effects that may appear in systemic antibiotic use are avoided. Due to the lower dosage rate, this is also financially more favorable. Some authors recommend the combination of intramammary and systemic treatment (Erskine et al. 2003) of severe form of mastitis. Namely, the treatment of mastitis involves the use of intramammary preparations which are usually a combination of several antibiotics and usually one corticosteroid or parenteral injections which usually include one antibiotic. Intramammary preparations for cows during lactation period are used in the treatment of clinical and subclinical mastitis. They are most common in the form of intramammary suspensions and traps and are infused into teat canals using an injector. However,

intramammary administration has certain limitations, such as restricted milk flow due to swelling, fibrin accumulation or damaged teat canal epithelium. Then the existence and strength of the barrier of connective tissue in inflamed areas. In addition to the appropriate antibiotic, some mastitis-containing preparations contain corticosteroids to reduce udder inflammation. Systemic administration of antibiotics in combination with intramammary administration showed the best results. Milking can affect the effectiveness of this therapy and the duration of antibiotic secretion through milk. As a rule, the cow should not be milked for at least six hours after the intramammary administration of the antibiotic. After the end of this period it is desirable to milk the cow and eliminate the secretion from the udder. Many owners mistakenly avoid milking 24 hours after the intramammary application of antibiotics and delay the recovery process.

Systemic therapy

In the treatment of severe forms of clinical mastitis, especially when there is a change in the general state of the animal, primarily in form of apathy and appetite discontinuation, it is necessary to apply systemic therapy. In order to achieve the best effect, intravenous antibiotic administration is the best approach. There are many different types of antibacterial drugs of different chemical structures. The most commonly used antibiotics are: beta-lactam,

aminoglycosides, lincosamins, tetracyclines, macrolides, polypeptides and combinations of trimethoprim and sulfonamides. More recently, clinical trials are performed with inhibitors of enzyme DNA gyrase (fluoroquinolones) in terms of their suitability for use in the treatment of mastitis. It is known that fluoroquinolones administered parenterally, especially norfloxacin, achieve high concentrations in milk (10 times more than in serum) and this

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advantage can be used for parenteral treatment of acute mastitis therapy.

For the success of parenteral mastitis therapy, the following factors have a major impact: in acute

mastitis distribution of blood flow in the udder is very important while in chronic mastitis, the age and strength of tissue layers determine the success of the therapy to a large extent.

Expressing Milk Therapy

Expressing milk also has significance for the recovery of the animal, because expressing of the changed secretion accelerates the restoration of the function of the changed udder parenchyma. Also, expressing results in ejection of bacteria and their toxins as well as products of inflammation and damaged udder tissue. Sometimes it is necessary to administer oxytocin before expressing milk in order to improve milk ejection and remove residual milk. This also has

a prognostic effect because if a certain amount of milk has been milked after administration of oxytocin, it indicates that there is still preserved parenchyma. Pain accompanying udder palpation can also affect the therapy so analgesics should be applied before expressing milk. If milk stops flowing well through the papillary duct a syringe can be used for complete removal of secretion.

Osmotic therapy

In order to remove accumulated secretion it is recommended to administer a solution in the mammary gland to dilute the secretion. This is achieved by hypertonic solutions that are applied to the affected area in large quantities. Sulfonamide solutions with a bacterostatic effect can also be used for this. The application can be

repeated after 6 to 12 hours (Boboš i sar, 2015). 10% glucose solution can be used on the affected areas in an amount of up to 1000 ml. A better effect is achieved if antibiotics are added to this solution. Glucose solution, in addition to osmotic effects, also plays a role in the activation of macrophages.

CONCLUSION

Mastitides therapy is as complex as their etiology. Therapy success, in spite of the application of all of the above, is often semi-successful, and parenchyma remains damaged with a reduced or completely intermittent function. Because of this, acute mastitis therapy must be applied rapidly and thoroughly with a

combination of the above methods. Isolation of the microorganism, causative agent of mastitis, significantly increases the effectiveness of the therapy. Therefore, udder health condition must be under constant control so that adequate therapy of mastitis can be carried out in time.

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