



A Monthly e Magazine
ISSN:2583-2212

July, 2023; 3(07), 1244-1248

Popular Article

An Overview of Bovine Mastitis

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<https://doi.org/10.5281/zenodo.8132175>

Introduction

Mastitis is defined as inflammation of the udder and this is one of the common diseases of bovine which leads to economic losses. Mastitis is a multi-etiological production disease of dairy cattle. It affects both quantity as well as quality of milk produced which leads to huge economic loss to the framers. There would be some level of damage to the mammary tissue which is the main cause of drop in the milk production. Although advance dairy practices are present still prevalence of mastitis is there at good level. Occurrence in dairy herd is common during the interval between drying off and early lactation period. Mastitis is complex deleterious outcome of various causative agents. Various potential causes and source of infection for mastitis includes pathogenic organism, any trauma, toxic chemicals, unhygienic conditions, environment, climate, bad udder hygiene, from milking machine and even by contaminated hands during milking. Essential early diagnosis is the key for control and eradication of the disease. Association of pathogenic microbes and mastitis was established in 1887 but its major causes were identified during 1940's.

Based on the degree of inflammation of mammary tissue, mastitis can be classified into three types: sub-clinical, clinical and chronic mastitis. In clinical mastitis, abnormal changes in the udder would be visible like swollen and red udder along with systemic signs like fever, dullness, decrease milk production and unusual milk color with flakes or clots. In sub-clinical form of mastitis, visible abnormal changes are not there as seen in case of clinical mastitis but there would be drop in milk production and an increase in somatic cell count (SCC). In contrary to this, chronic mastitis is a long-standing case of udder inflammation from months leading to udder fibrosis and clinical signs flaring up in between the due course. Epidemiologically mastitis can be classified into contagious and environmental mastitis.



Classification of mastitis pathogens

The anatomical and physiological changes taking place in the udder during the dry period is also one of the factors leading to mastitis. Infection is related to the damage to keratin layer as keratin layer blocks the lumen of the teat canal in between the milking preventing the entry of bacteria. Immunosuppression occurs in animals body due to stress and other factors around the parturition which is strongly correlated with the high incidence of intramammary infections. Even dirty udder and farms with poor hygiene are more prone to develop clinical mastitis. Although animals are prone to mastitis throughout the lactation period but the susceptibility is maximum at two weeks post-partum. Mastitis affects animals reproductive performance and lowers its future conception rate.

Contagious	Environmental	Opportunistic
<i>Staphylococcus aureus</i>	<i>Escherichia coli</i>	<i>Non-aureus Staphylococci:</i>
<i>Streptococcus agalactiae</i>	<i>Streptococcus uberis</i>	<i>Staphylococcus simulans</i>
<i>Corynebacterium bovis</i>	<i>Streptococcus dysgalactiae</i>	<i>Staphylococcus chromogens</i>
<i>Mycoplasma spp</i>	<i>Klebsiella spp</i>	
	<i>Corynebacterium pyogenes</i>	

Economic Importance

Economic loss is due to he reduced milk production and also due to the expenses on the medical treatment and care of the animal. According to Sinha et al. (2014) 49% loss was due to decrease in milk production and 37% loss was owing to veterinary practice. The veterinary expenses include medicine cost (31%) and services (5.5%). Economic losses is more due to sub-clinical mastitis as compared to clinical mastitis.

Diagnostic Approaches

Sub-clinical mastitis is common in many dairy farms and two most routinely used diagnostic methods includes Californian Mastitis Test (CMT) and Somatic cell count (SCC). The SCC is indicative of the intramammary infection and clean udders or quarters have approximately 70,000 cells per ml. SCC value equal to or more than 2,00,000 cells/ml is indicative of subclinical mastitis in cows. Under normal conditions, macrophages constitute larger section of SCC whereas in case of mastitis leucocytes (typically neutrophils) are seen as a majority in SCC.

CMT is as cow side test which evaluates the milk's alkalinity using a detergent along with a pH indicator like, bromocresol purple. In case of positive for mastitis, there will be formation of purple vicious mass due to nucleic acid and other constituents released by lysed somatic cells. This test is useful when high number of somatic cells are present with an average of 5,00,000 cells/ml. CMT is unable to identify whether



an infection is from major or minor pathogens.

Bacterial culturing is another method which focuses on identification of the specific pathogens by plate culturing. While taking the milk sample care must be taken for any false positive result due to contamination from environment, dirty udder, soiled utensils, etc. Plate culture method is considered gold standard for identification of specific pathogens causing both clinical and subclinical mastitis.

Polymerase chain reaction (PCR) is superior to plate culture method as it helps in identification of those pathogens which cannot be identified by culture. PCR is having higher sensitivity which enables it better farm management practice. Other molecular techniques are real time quantitative PCR, next generation sequencing (NGS) methods and loop mediated isothermal amplification (LAMP). Haptoglobin is an acute phase protein which is biomarker widely used for evaluation of bovine mastitis.

Electrical conductivity test detects the increase in the conductivity of the milk due to increased concentration sodium and chloride in milk and loss of potassium and lactose. However, there are other factors which alters the conductivity of milk like cow's age and lactation. There have been association of mastitis with release of inflammatory mediators and reactive oxygen species. Significant changes in the levels of serum interleukins, acid glycoproteins, haptoglobin and tumor necrosis factor.

Treatment approaches in mastitis

An effective mastitis control program needs early detection of the causative agent, understanding the pathogenesis, timely screening of animals, implementing good management practices and preventing the contamination and spread. Successful treatment of mastitis depends on various factors including causative agent, stage of lactation, concurrent systemic diseases, previous history of SCC and physiological state of animal.

Antibiotic therapy can be used for prevention as well as for curative treatment of mastitis. As a prophylactic measure dry cow antibiotic therapy is used. Antibiotics should be used with care based upon history, etiology of mastitis, antibiotic sensitivity test and based on recommended therapeutic principles. Indiscriminate use of antibiotics leads loss of antibiotic sensitivity. Simultaneous administration of antibiotics via intramammary and systemic route increases the efficacy of treatment. This might be due the higher concentration of antibiotics in mammary tissue. Mastitis caused by staphylococcus develops resistance to antibiotics because of their adaptation to environment, formation of biofilm and development of micro abscesses. Two protocols used in antibiotic therapy are dry cow therapy and lactation therapy. In lactation therapy, antibiotics are used during the lactation period and it is beneficial in treating the sub-clinical mastitis caused by contagious pathogens. In dry cow therapy, antibiotics are supplemented during dry period and aimed to extinguish current intramammary infections.

Iodine based and glycolic acid-based post milking disinfectants provides post milking teat barrier and helpful in preventing post milking infection. Use of non-steroidal anti-inflammatory drugs along with



antibiotics is more effective and results in lower SCC, drop in milk production and reduced culling rates. Modern technique like bacteriophage endolysin involves release of endolysin from bacteriophages which are effective against gram positive pathogen. Endolysins are proteins which helps phages to escape from the bacterial cell by degrading the peptidoglycan layer of cell wall of bacteria. Many peptidoglycan hydrolases are effective in treating the infections caused by Staphylococcus group of bacteria. Bacteriophages are viruses which have potency to infect bacterial cell and kill them. They can replicate exponentially and target the specific pathogen. Several bacteriophages are identified to target organisms including *Staphylococcus aureus*, *Klebsiella oxytoca* and *E. coli*. A modification is introduced which is use of phage cocktail instead of a single bacteriophage. This phage cocktail is superior and effective in treatment of Staphylococcus aureus infections. Probiotics are gaining popularity in treating the inflammatory conditions. Though many organisms have been evaluated for their probiotic activity but lactic acid bacteria are most popular ones. Lactic acid bacteria are used in teat dips, feed supplements and intramammary inoculations to treat mastitis as they have immunomodulatory property. These bacteria forms a biofilm protective biofilm after colonizing the udder that inhibits mastitis causing pathogens. The lactic acid bacteria *Lactobacillus casei* BL23 in the bovine epithelial cells infected with *Staphylococcus aureus* have the ability to modulate innate immune response. This will lead to reduced expression of several pro-inflammatory cytokines like IL6, IL8, IL-1alpha, IL-1Beta and tumor necrosis factor gamma.

Immunotherapy is an immunologically based treatment for mastitis. An increase in various milk markers related to white blood cells and epithelial cell functions including lactoferrin, serum amyloid A, SCC and NAGase is related to the interleukin-2 injection. Application of anti-recombinant *Streptococcus uberis* adhesion molecule showed decreased clinical symptoms of mastitis and lower bacterial counts. Stem cells of bovine mammary epithelial cells can be utilized for treatment of mastitis induced structural and cytogenetic defects in udder. The mesenchymal stromal cells derived from bone marrow have in vivo bactericidal activity against methicillin resistant *S. aureus* in rat model. These mesenchymal stem cells have the ability to modulate inflammatory response. Lactoferrin which is a whey protein have limited anti-bacterial and anti-inflammatory activities that can be utilized for treating mastitis. Its anti-bacterial effect arises its iron binding required for bacterial growth and it can be potentiated in combination with several antibiotics like Penicillin-G. Nutrition is another important factor helpful in improving immunity against the infections and supply of antioxidants. Trace mineral supplements in injectable form containing zinc, magnesium, selenium and copper reduces the incidence of chronic clinical mastitis. Supplementing with vitamins A, D3, E and H increases the expression of host defence genes and helpful in recovery from sub-clinical mastitis.



Reference

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