BOVINE MASTITIS - A DISEASE OF CONCERN FOR HUMAN HEALTH

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Abstract: Mastitis is an inflammation of the udder and is common in dairy herds causing important economic losses. Milk and milk products provide a wealth of nutrition benefits. Various infections of the udder may be pathogenic to man. The streptococci in mastitis may be responsible for certain low grade infection in man. In tuberculosis and infectious abortion in cattle, infection may be localized in the udder. Staphylococcal toxins or "metabolites" in milk from cows with mastitis have been responsible for gastroenteritis in man. Cases of mastitis are occasionally responsible for sore throat and scarlet fever. Raw milk from cows, sheep, or goats that has not been pasteurized to kill harmful bacteria can carry dangerous bacteria such as *Salmonella, E. coli*, and *Listeria*, which are responsible for causing numerous food borne illness. These harmful bacteria can seriously affect the health of human beings consume raw milk, or eats food made from raw milk. However, the bacteria in raw milk can be especially dangerous to people who have low immunity, pregnant women, old age people, and children. Pasteurization destroys all of these organisms and probably their toxins as well but when milk is being sold without pasteurization all cases of mastitis should be regarded as potentially dangerous and milk from cow suffering from the disease be carefully excluded. Mastitis cannot be eradicated but can be reduced to low levels by good management of dairy cows. Therefore, the objectives of this paper are: -To provide information about mastitis and To provide information on public health significance of mastitis due to milk borne disease as well as awareness about animals mastitis.

Key words: - Mastitis, Raw milk, Immunity, *Salmonella, E. coli*, and *Listeria*.

Introduction: - Mastitis is the inflammation of the parenchyma of the mammary gland regardless of the cause. It is a complex disease, with a number of factors contributing to the level of mastitis in a herd, including environment, management, and udder physiology and cow health. Pathogens causing mastitis in cattle are divided into major pathogens that cause clinical mastitis and minor pathogens that cause subclinical mastitis. Among major pathogen includes *S. agalactiae, S. aureus,* and *M. bovis. Coagulase negative Staphylococcus* species such as *Staphylococcus hyicus* and *Staphylococcus chromogen*, which are commonly isolated from milk samples and the teat canal, are from minor pathogens. The most important changes in the milk includes like discoloration, the presence of clots and the presence of large numbers of leukocytes (Wilson et al., 1997).

Milk is a vehicle of infectious agent and excellent medium for the growth of many pathogenic bacteria. Some of the main reasons why milk is an important transmitter of disease to human are: it is relatively good medium for microorganisms to grow and is most likely to be contaminated easily during its production. The major bacteria that can be transmitted through milk and produce disease in man include *Mycobacterium bovis* and *Brucella* species from infected udder. Furthermore, most bacteria causing mastitis like *Staphylococcus aureus* and *Listeria monocytogenes* can also be transmitted through milk and milk products (Heeschen, 1994).

Bovine Mastitis: - Domestic cattle have played a central role in human society for centuries. They provide essential sources of meat, milk, other dairy products, fertilizer for crops, clothing, and animal traction.

Definition and Aetiology: - The disease is the infection of milk synthesizing alveolar tissue and is clinically manifested by gross abnormality of milk associated with pathological changes of udder in the form of pain, udder oedema, fibrosis, and indurations, the extent depending on the severity of infection (Sharma *et al*., 2010).

Etiology: - Mastitis is caused by many bacteria, fungi and viruses. The predominant organism is *Staphylococus aureus* followed closely by *Streptococcus agalactiae*. The other bacteria causing mastitis in cows and buffaloes are *E.coli, Str. uberis, Str. dysgalactiae, Str.zooepidermicus, Str. faeclis,Str.pyogen, Camphylobacter jejuni, Klebsiella* spp.Fungal agents like *Trichophyton* spp., *Aspergillus fumigates*, yeasts like *Candida* spp., *Cryptococcus neoformans* and algae like *Prototheca trispora* and *P.zopfi* can cause mastitis. Virus causing IBR, BVD, FMD, cow pox, pseudo-cowpox and ulcerative mammilitis does not play a major role in producing mastitis but they may predispose the cow to bacterial mastitis (Sharma *et al.*, 2010).

Epidemiology:-Mastitis occurs throughout the world and is a very common disease causing problem to the dairy industry and play a important role in transmission of zoonotic disease.

The organism can enter the udder through various routes:-

1. By hands of milkers:-It is the most common mode of transmission wherein hands of a person after milking a cow with mastitis get contaminated with bacteria.

2. Trauma or injury to the teat:-injury to teats and udder may be due to physical agents like wires, fencing, sharp objects, and rough surface.

3. Intra mammary infusions:-This is the common mode of transmission of Fungi.

4. Haematogenous: - The common example is tuberculosis mastitis wherein the organism from the lesions gets into the blood and then localize in the udder producing mastitis.

5. Inhalation: - The organism like mycoplasma enters the animals through inhalation and gets into respiration tract. Then they enter the blood and trough circulation, localized in the udder.

Pathogenesis: - Inflammation of the mammary gland predominantly occurs via the teat canal except in the case of tuberculosis, leptospirosis and brucellosis where the method of spread may be haematogenous. The development of mastitis can be explained in terms of three stages as invasion, infection and inflammation. The invasive stage refers to the time in which pathogens move from the teat end to the milk through the teat canal. The infection stage is the stage in which the pathogens multiply rapidly and invade the mammary tissue. The stage of inflammation is the stage with varying degrees of clinical abnormalities of the udder and with systemic effects from mild to per acute as well as gross and subclinical abnormalities of the milk (Radostits *et al*., 2007).

Table:-1 Classification of Mastitis and Clinical Findings:-

S.No.	Types of Mastitis	Causative Agents	Clinical Signs
	Per acute mastitis	*Stap. aureus, E.coli, Coryne. Pyogens, Klebsiella* spp.	High fever (105-107)^{0}F. Sudden Drop in milk production. Rapid pulse & respiratory rates. Udder becomes warm, Hard and painful to touch. The secretion can be watery or blood tinged.
	Acute mastitis	*Strep. Agalactiae, Mycoplasma mycoides, Pseudomonas* spp. and Fungi	Locally the secretions can be watery and blood tinged initially, but later on , it may be yellowish and pus like. The supra mammary lymph nodes are enlarged and slight to moderate udder oedema occurs.
	Sub acute mastitis	*Stap. aureus, Strep. Agalactiae,*	The systemic signs are not seen and the local signs are less marked.
	Subclinical mastitis	*Stap. aureus, Strep. Agalactiae,*	Systemic and apparent local signs are not noticed thus it can be detected by laboratory tests.
	Chronic mastitis	*Stap. Aureus, Mycobacterium bovis, Nocardia, Cryptococcus neoformans*	Decrease in size of udder, which is hard upon palpation and nodules can be felt. Milk may contain few clots.
	Gangrenous mastitis	*Stap. Aureus*	Moderate fever Decrease in milk production. One or more quarters may be affected Skin of the affected part of udder becomes blue. Skin slough off affected part of udder.

Diagnosis: - Diagnosis of clinical mastitis is based on the Visualization and palpation of the udder: In clinical mastitis the udder may turn hard, red, and hot to the touch. Palpation of the udder may be painful to the cow. These symptoms arise from the changes in vascularity and blood flow of the gland when inflamed. **Visualization of the milk**: - Gross changes in the milk may be observed at the time of milking such as the presence of flakes, clots or serous milk. This is the most common means of detection of clinical mastitis. Stripping the first few squirts of milk from each quarter into a strip cup at the beginning of milking is a preferred method of detecting flakes or clots in the milk. Diagnosis of subclinical infection is more problematic. Sub clinical mastitis is characterized by normal milk and requires indirect tests such as Somatic Cell Count (SCC) that includes white blood cells (WBC) and occasionally sloughed epithelial cells. The California mastitis test (CMT) is the commonly used screening test for sub clinical mastitis. Culturing for microbial examination of both individual cow and bulk milk samples are used in the

identification of pathogens. There are also chemicals like potassium hydroxide (10%) for detection of mastitis condition from milk sample.

Prevention and control:-

1. Good hygienic measures are important since it is referred as a managemental problem.
2. Regular testing of the udder and milk for mastitis should be done and the affected animals be treated quickly.
3. Dry cow therapy also helps in preventing the disease.
4. Polyethylene coil implantation is passed through teat orifice and implanted in the teat cistern.
5. Different types of vaccine have been used in different countries with various ways of administration like i/m, s/c, intra mammary into or near the supra mammary lymph node and into the udder tissue.

Diseases Spread Through Milk- Public Health Significance:

Milk borne infection:-

Raw (unpasteurized) milk has been found to participate in spreading out of illnesses caused by *Mycobacterium bovis*, *Brucella abortus*, *Staphylococcus aureus*, Listeria Monocytogenes, *Campylobacter jejuni*, Salmonella, Staphylococci species, and *E. coli*. With severe clinical mastitis, abnormalities of milk are easily observed and milk is discarded by the producer. Such milk normally would not enter the food chain. But when milk of cows with subclinical mastitis, which is with no visible changes, is accidentally mixed into bulk milk, it enters into food chain and can be dangerous to humans. Although pasteurization is likely to destroy most of human pathogens, there is concern when raw milk is consumed or when pasteurization is incomplete or faulty (Jayarao et al., 2006).

1. Septic sore throat plus otitis (Streptococcal pharyngitis):-***Streptococcus pyogenes*** (Gram+ve cocci, β-haemolytic and catalase -ve). Sequels of this case in sever non-treated conditions either Streptococcal glomerulonephritis or rheumatoid fever. **Sources of contamination:** Mastitis caused by infection of udder via infected handlers. Secrete and excreta (saliva, sneezing, coughing, stool, urine, etc.) of infected or carriers handlers. Indirectly via contaminated water, flies, soils, milk equipment, etc.

2. Bovine tuberculosis.- It is caused by ***Mycobacterium tuberculosis var bovis***. The main source of infection is the consumption or raw unpasteurized milk. Two types for transmission through milk either directly via tuberculous mastitis forms (acute caseating, chronic nodular and chronic diffuse granulomatous) or indirectly via tuberculous enteritis, hepatitis, nephritis and pulmonary type; and by both ways (directly & indirectly) by generalized or miliary or disseminated tuberculosis (Its name comes from a distinctive pattern seen on a chest X-ray of many tiny spots distributed throughout the lung fields with the appearance similar to millet seeds—thus the term "miliary" tuberculosis). Miliary TB may infect any number of organs, including the lungs, liver, and spleen. It is a complication of 1–3% of all TB cases.

3. Brucellosis (Bang's disease, contagious abortion, undulant or Malta or Mediterranean Sea fever):- It is a public health problem in developing countries with adverse health implications both for animals and human beings as well as economic implications for individuals and communities. It is an occupational hazard with those particularly at risk such as laboratory workers, veterinarians, abattoir workers, farmers and animal keepers either living in close proximity with animals or handling aborted fetus and animal products that contaminated by Brucella agents (Radostits et al., 2000, FAO et al., 2006 & Jim et al., 2012). Brucellosis, caused by *Brucella abortus* or *B. melitensis*, is also an important bacterial zoonosis that is usually associated with consumption of unpasteurized cheese and milk (International Society for Infectious Diseases 2007c). The organism enters via alimentary tract, conjunctival mucosae, respiratory tract or skin. At the site of entery, they are likely to be ingested by either mononuclear cells or polymorphonuclear leucocytes. They function as facultative intracellular parasites, causing chronic disease, which usually persists for life. Four species infect humans: *B. abortus*, *B. canis*, *B. melitensis*, and *B. suis*. *B. abortus* is less virulent than *B. melitensis* and is primarily a disease of cattle. *B. canis* affects dogs. *B. melitensis* is the most virulent and invasive species; it usually infects goats and occasionally sheep. *B. suis* is of intermediate virulence and chiefly infects pigs. Symptoms include profuse sweating and joint and muscle pain. Brucellosis has been recognized in animals and humans since the 20th century. Efficient heat processing like pasteurization or boiling or increase ripening of cheese (increased acid environment) will destroying these G-ve intracellular coccobacilli.

(FAO, WHO & OIE. 2006).

4. Listeriosis:- It is caused by ***Listeria monocytogenes*** and ***Listeria ivanovii***. Polymorphic disease from encephalomyelitis to abortion to unique food poisoning to skin lesions to etc. *Listeria monocytogenes* is ubiquitous G+ve motile bacteria in the environment. The main route of acquisition of *Listeria* is through the ingestion of contaminated food products. *L. monocytogenes* has been isolated from a variety of foods such as raw milk, pasteurized fluid milk, cheeses (particularly soft-ripened varieties), ice cream, raw vegetables, fruits, fermented

raw-meat sausages, raw and cooked poultry, raw meats (of all types), raw and smoked fish, and seafood. Soft cheese, unpasteurized milk and unpasteurized pate are potential dangerous its ability to grow at temperatures as low as 0°C permits multiplication in refrigerated foods. At refrigeration temperature, such as 4°C, the amount of ferric iron can affect the growth of *L. monocytogenes*. Cutaneous type is rarely detected, and largely confined to veterinarians who are handling diseased animals, most often after a listerial abortion. L. monocytogenes may invade the gastrointestinal epithelium. Once the bacterium enters the host's monocytes, macrophages, or polymorphonuclear leukocytes, it becomes blood-borne (septicaemia) and can grow. Its presence intracellular in phagocytic cells also permits access to the brain and probably trans placental migration to the foetus in pregnant women.

5. Campylobacteriosis :- Campylobacteriosis is caused by a bacteria called Campylobacter jejuni (je-june-eye), which is found worldwide in the intestinal tracts of animals. The bacteria are spiral shaped and can cause disease in animals and humans. People get campylobacteriosis from eating (oral) raw or undercooked poultry or meat, raw (unpasteurized) milk, raw clams, food contaminated with faeces or un chlorinated water. The bacteria can also be spread through direct contact with infected pets or livestock.

6. Staphylococcal infection:- The staphylococci are gram-positive cocci that tend to be arranged in irregular clusters or bunch of grapes formation. They are facultative anaerobic (fermentative), catalase positive, oxidase negative, non-motile. The pathogenic staphylococci are: *S. aureus*, *S. intermedius* and *S. hyicus* (Quinn *et al*., 2002). The usual symptoms of staphylococcal infection develop within 1 to 6 hours; headache, muscular cramping and marked prostration are observed in more severe cases. Usually the infection is self limiting and symptoms persist for more than 24 hours (Varnam and Evans, 1991).

1. **Method of Pasteurization:-** Is a process of heating a food, which is usually a liquid, to a specific temperature for a predefined length of time with a pressure and then immediately cooling it after it is removed from the heat. This process slows spoilage caused by microbial growth in the food. Unlike sterilization, pasteurization is not intended to kill all micro-organisms in the food. Instead, it aims to reduce the number of viable pathogens so they are unlikely to cause disease. Commercial-scale sterilization of food is not common because it adversely affects the taste and quality of the product. Certain foods, such as dairy products, may be superheated to ensure pathogenic microbes are destroyed. Milk is an excellent medium for microbial growth, and when stored at ambient temperature bacteria and other pathogens soon proliferate. Pasteurization found to kill **3** major milk borne pathogens: ***Mycobacterium tuberculosis***, ***Brucella spp***. and ***Coxiella burnetii***.

Types of Pasteurization: There are basically two methods of pasteurization in use today- *batch* and *continuous flow*. In the batch process (batch pasteurizer, **right**) , a large quantity of milk is held in a heated vat at 149°F./65°C for 30 minutes, followed by quick cooling to about 39°F./4°C. In the continuous flow process (continuous flow pasteurizer, **below, right**)-also known as HTST, for high temperature, short time, milk is forced between metal plates or through pipes heated on the outside by hot water. While flowing under pressure, the milk is held at 161°F/72°C for at least 16 seconds. Before being chilled back to 39°F./4°C. or cooler, it flows through a heat exchanger to pre-warm cold milk just entering the system.

Conclusion: - The udder is a not infrequent source of certain bacteria, especially streptococci and staphylococci, dangerous to man. Veterinarians have a vital role in educating immune compromised clients on the risks from mastitis milk disease, as well as the steps that can be taken to decrease risk. Educational material such as signs and brochures may be distributes. The bacteria, Viral and fungal agents that are transmitted through milk and cause disease problems in man are bacteria causing mastitis in cattle. The major bacteria that can be transmitted through milk and produce disease in man include *mycobacterium bovis*, Brucella abortus, *Staphylococcus aureus*, *Listeria monocytogenes* and *Campylobacter jejuni* from affected udder due to localization from their septicemic phase.

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