Mastitis

24

Mansour F. Hussein

Mastitis or inflammation of the mammary gland is one of the most important and costly diseases in dairy animals. It is characterized by marked loss of milk production and by physical, chemical, and microbiological changes in the milk and pathological changes in the mammary gland tissue.

Mastitis usually occurs in response to an injurious agent, with the aim of eliminating that agent and paving the way for repairing the damage it did and restoring normal udder function. In the vast majority of cases, the cause of mastitis is one or a mixture of bacterial agents. These organisms enter via the teat canal, multiplying and producing toxins in the glandular tissue and ducts of the mammary gland and consequently leading to reduced milk production, altered milk composition, and sometimes other disease signs.

Normally, the teat canal orifice is surrounded by a sphincter which keeps it closed, thus preventing bacteria from entering and milk from leaking out via the teat. In addition, the mucosal cells lining the teat canal produce keratin which forms a barrier against bacteria, and also has a bacteriostatic effect. During milking and for some time thereafter, the teat canal remains open and bacteria may be able to enter into the teat especially if there is dirt or injury near the canal's orifice. Teat injures are particularly important since they might cause partial damage to keratin or mucosal lining of the teat rendering it more susceptible to bacterial infection. From the teat canal, the bacteria enter into the glandular tissue of the mammary gland where they multiply and produce toxins, enzymes, and cell-wall components. This process, in turn, stimulates the production of numerous inflammatory mediators and attracts large numbers of inflammatory cells such as neutrophils and phagocytes, setting up an inflammatory response to destroy the invading bacteria. These cells accumulate in large numbers in the mammary gland and pass between secretory cells into the milk alveoli damaging the secretory cells and increasing somatic cell count (SCC) in the milk. Large numbers of somatic cells remain after eliminating the causative bacteria until healing of the mammary gland occurs. Besides, the clots formed by aggregation of dead mammary gland epithelial cells, leukocytes, and blood clotting factors may block small ducts and prevent complete milk removal, while damage to epithelial

A. I. Khalafalla, M. F. Hussein, *Infectious Diseases of Dromedary Camels*,
https://doi.org/10.1007/978-3-030-79389-0_24

cells and blockage of small ducts may result in the formation of scar tissue (Jilo et al., 2017). Otherwise, the inflammation may subside, tissue repair may ensue, and function may be restored.

Mastitis is an important problem in dromedary camels in all countries where these animals are reared. It causes significant economic losses primarily due to the loss of milk production and quality. Some forms of mastitis may also be part of systemic disease-causing deleterious effects on the health of the affected animals or even leading to their death. Furthermore, camel mastitis may pose hazards to human health and to the health and well-being of suckling calves (Abdelgadir, 2013; Jilo et al., 2017).

In general, mastitis is estimated to affect more than 25% of lactating dromedary camels (Abdurahman & Younan, 2004; Abera et al., 2010) and to cause up to 70% loss in milk production in some areas (Al Amin et al., 2013). However, its prevalence varies in different herds depending on geographical location, sanitary standards, general management, and efficiency of milking (Megersa, 2010). Besides, the susceptibility of lactating camels, as in other dairy animals, varies according to the stage of lactation, age, breed, and parity as well as the animal's degree of resistance and nature of the infectious agent.

24.1 Etiology

Mastitis is predominantly caused by infectious agents, the most important of which are bacteria. The primary sources of infection are the environment and the infected udders. Among the bacteria incriminated in causing camel mastitis are: *Staphylococcus aureus*, *streptococcus agalactiae*, *Staphylococcus epidermidis*, *Micrococcus* spp., *Aerobacter* spp., coagulase-negative *staphylococci*, *Pasteurella haemolytica*, *Escherichia coli,* and *Corynebacterium* spp. (Al-Juboori et al., 2013; Al-Majali et al., 2008; Almaw & Molla, 2000; Gramay & Ftiwi, 2018; Mehamud et al., 2017; Toroitich, 2013). Of these different pathogens, the most important are *Streptococcus agalactiae* and *Staphylococcus aureus* (Hawari & Hassawi, 2008; Mehamud et al., 2017). Predisposing factors include unhygienic milking procedures, heavy tick infestation, udder lesions and teat tying, or the use of teat covers to prevent calves from suckling.

24.2 Clinical Picture

Both clinical and subclinical mastitis may occur in camels, the subclinical form being much more prevalent than the clinical form. Clinical mastitis is easily detected by palpation and visual examination of the affected quarter, which is usually swollen, red, hot, and painful, as well as changes in the milk which can be seen using a strip-cup and which include changes in the consistency and appearance of milk, such as discoloration, watery consistency, and presence of clots, blood, or pus in the milk. Depending on the severity of disease signs, clinical mastitis can be

Fig. 24.1 Chronic Mastitis in a female dromedary camel (Courtesy of Prof. Mansour F. Hussain)

classified as acute or subacute. Chronic mastitis is occasionally seen in camels (Fig. 24.1). Gangrenous mastitis is also seen rarely in these animals.

An important feature of mastitis, whether clinical or subclinical, is the presence of a large number of leucocytes (referred to as somatic cells) in the milk.

Little is known about mastitis in Bactrian camels although subclinical mastitis has been reported in these animals on the basis of somatic cell count (SCC), California mastitis tests (CMT), and isolation of *Staphylococcus aureus* and coagulase-negative *staphylococci* from the infected quarters (Abdurahman, 1996). On the other hand, mastitis is considered to be rare and unimportant in New World camelids (Tibary et al. (2006).

24.3 Diagnosis

Clinical mastitis can be readily diagnosed on the basis of clinical signs such as swelling, redness, pain, and heat of the infected quarters as well as changes in milk consistency, color, and smell, and the presence of clots, blood, or pus in the milk. Physical trauma may or may not be seen in the affected udder. Generalized and systemic signs such as fever, anorexia, and depression may also be observed. On the other hand, subclinical mastitis, which constitutes the vast majority of mastitis in female camels, is not visually detectable; hence several indirect tests are used for its diagnosis and monitoring (reviewed by Jilo et al., 2017). These include CMT, SCC, ATP test, pH test, electrical conductivity, and other tests. According to Guliye et al. (2002), the type of bacteria has a significant effect on SCC; in she-camels with subclinical mastitis, the highest mean SCC is recorded in quarter samples from which coagulase-positive *Staphylococcus aureus* was isolated. Chronic mastitis is characterized by induration and fibrosis of the affected quarter and is relatively uncommon in camels.

Direct diagnosis of mastitis requires bacteriological culture to confirm the diagnosis and determine the causative agent.

24.4 Treatment and Control

In contrast to cattle, intramammary infusion of antibiotics for the treatment of mastitis is not recommended in camels because of anatomical features of the camel's udder, e.g., each teat may contain 2–3 teat canals which open independently, and the teat canal opening is smaller than that of the cow (Sanaa, 2005). Therefore, treatment of acute mastitis in these animals entails systemic rather than intramammary administration of antibiotics and anti-inflammatory drugs, with regular stripping of the mammary glands (Salah & Faye, 2011). Several antibiotics have been used for the treatment of camel mastitis, e.g. gentamycin, tetracycline, ampicillin, etc. Strict hygienic measures should be observed and trauma to the udder should be avoided. On the other hand, chronic mastitis is difficult to treat and often results in the loss of the affected quarter.

The main principles of mastitis control entail elimination of existing infection, prevention of new infection, and monitoring udder health status in addition to fly and insect control.

References

Abdelgadir, A. (2013, February 17–20). Mastitis in camels (*Camelus dromedarius*): past and recent research in pastoral production system of both East Africa and the Middle East. In *First International Conference on Sustainability of Camel Population and Production*, College of Agriculture and Food Science, King Faisal University, Al-Hasa, Saudi Arabia.

Abdurahman, O. A. (1996). The detection of subclinical mastitis in the bactrian camel (Camelus bactrianus) by somatic cell count and California mastitis test. *Veterinary Research Communications, 20*(1), 9–14.

Abdurahman, O. A.-S., & Younan, M. (2004) The udder health. In Farah and Fisher (Ed.), *Milk and meat from the camel handbook on product and processing* (pp. 73–76). vdfhochschulerleg AG and der ETH Zurich.

Abera, M., Abdi, O., Abunna, F., & Megersa, B. (2010). Udder health problems and major bacterial causes of camel mastitis in Jijiga, Eastern Ethiopia: Implication for impacting food security. *Tropical Animal Health and Production, 42*(3), 341–347.

Al Amin, M. A., Alqurashi, A. M., Elsheikh, A. S., & Yasin, T. E. (2013). Mastitis incidence and causative bacterial agents isolated from lactating she-camel (*Camelus dromedarius*). *Journal of Agriculture and Veterinary Science, 2*(3), 7–10.

Al-Juboori, A., Kamal, N., & Sindhu, J. (2013). Prevalence of some mastitis causes in dromedary camels in Abu Dhabi, United Arab Emirates. *Iraqi Journal of Veterinary Science, 28*, 9–14.

Al-Majali, A. M., Al-Qudah, K. M., Al-Tarazi, Y. H., & Al-Rawashdeh, O. F. (2008). Risk factors associated with camel brucellosis in Jordan. *Tropical Animal Health and Production, 40*, 193–200.

Almaw, G., & Molla, B. (2000). Prevalence and etiology of mastitis in camels (*Camelus dromedarius*) in Eastern Ethiopia. *Journal of Camel Practice and Research, 7*, 97–100.

Gramay, S., & Ftiwi, M. (2018). Camel milk production, prevalence and associated risk factors of camel Mastitis Inaysaita Woreda Afar Regional State, North East Ethiopia. *ARC Journal of Animal and Veterinary Sciences, 4*(3), 17–37.

Guliye, A. Y., Van Creveld, C., & Yagil, R. (2002). Detection of subclinical mastitis in dromedary camels (*Camelus dromedarius*) using somatic cell counts and the N-acetyl-beta-D-glucosaminidase test. *Tropical Animal Health and Production, 34*(2), 95–104.

Hawari, A. D., & Hassawi, D. S. (2008). Mastitis in one humped she-camels (*Camelus dromedarius*) in Jordan. *Journal of Biological Sciences, 8*, 958–961.

Jilo, K., Galgalo, W., & Mata, W. (2017). Camel mastitis: A review. *MOJ Ecology & Environmental Science, 2*(5), 00034. https://doi.org/10.15406/mojes.2017.02.00034

Megersa, B. (2010). *Epidemiology of major camel disease in Borana low land, Southern Ethiopia*. Dry Lands Coordination Group Report (pp. 1–2).

Mehamud, J., Megersa, M., Abebe, M., & Ahmed, N. (2017). Prevalence, risk factors and major bacterial causes of camel mastitis, in Gursum District, eastern Hararghe, Ethiopia. *Global Veterinaria, 18*(3), 203–208.

Salah, S. K., & Faye, B. (2011). Detection of subclinical mastitis in dromedary camels (*Camelus dromedarius*) using somatic cell counts, California mastitis test and udder pathogen. *Emirates Journal of Food and Agriculture, 23*(1), 48–58.

Sanaa, O. Y. (2005). Bacterial diseases of the reproductive system of camels (*Camelus dromedarius*) in Eastern Sudan. *Journal of Animal and Veterinary Advances, 4*(7), 642–644.

Tibary, A., Fite, C., Anouassi, A., & Sghiri, A. (2006). Infectious causes of reproductive loss in camelids. *Theriogenology, 66*(3), 633–647.

Toroitich, C. K. (2013). *Prevalence of mastitis and associated risk factors in lactating one-humped camels in west Pokot County. Kenya* [MSc thesis]. University of Nairobi, Kenya.