FIELD STUDY OF THE RELATIONSHIP BETWEEN CLINICAL MASTITIS AND METRITIS AND MANAGEMENT CONDITIONS OF CROSSBRED DAIRYCOWS IN NINEVEH PROVINCE, IRAQ

Ali Jadaan Al-Hamada
College of Veterinary Medicine, University of Mosul, Mosul 41002, Iraq

Received on:20.05.2026
Accepted on:04.06.2026

ABSTRACT

A longitudinal field study was conducted from July 2021 to January 2022 to investigate the proposed relationship between mastitis and metritis in crossbred dairy cows. The CMT and cytobrush technique were used to screen mastitis and metritis, respectively. All CMT-positive milk samples were subsequently subjected to bacteriological analysis. Data were collected and analyzed from 40 clinically healthy cows. Mastitis was prevalent in 5 of 40 cows (12.5%, 95% CI: 2.9, 19.3). Cows with mastitis had a longer interval between calving and first breeding service than those without mastitis. Farmer-reported histories indicated a lower conception rate in cows affected by mastitis after the first breeding. A direct correlation was observed between mastitis and metritis. The findings of this study indicate that mastitis and metritis may have aserious relationship due to clinical and bacteriological coordination symptoms.

***Keywords*:** Dairy cow, metritis, mastitis, management, relationship.

Introduction

The connection between cow mastitis and metritis is a major issue in dairy management (Rail *et al*., 2023). A complicated interaction between metabolic stress, common bacterial infections, and systemic inflammation, especially during the postpartum phase, links the two disorders (Bor^{o} *et al*., 2024). Mastitis during breeding has been associated with adverse effects on reproductive capacity (Ibrahim *et al*., 2023). The prevalence of metritis and mastitis varies greatly between herds and can be influenced by environmental, genetic, and management variables (Ren *et al*., 2024). Nonetheless, studies have continuously demonstrated a high co-occurrence rate and a notable detrimental effect on afflicted cows (Damarny, 2021). In medicine, when one disease manifests, the risk of another is significantly increased ina phenomenon known as co-occurring action (Rail *et al*., 2023). Metritis is considered a risk factor for improving clinical mastitis and vice versa due to many reasons like hormonal disturbance stress during parturition, reduce immunity and lack of uterine defense mechanism due to secretion of cortisol from the body which leading to increase opportunity for bacterial growth. According to some researchers, metritis is more likely to be diagnosed in cows with clinical mastitis (Dolechecka *et al*., 2019).

The effect of mastitis on reproductive performance involves follicular development failure, oocyte function irregularity, and lack of ovulation (Dolecheck *et al*., 2019). It may also contract the luteal phase and extend the estrous interval, affecting the maintenance of pregnancy and embryonic progress (Edelhoff *et al*., 2020). Mastitis has been associated with a high number of services per conception (NSPC), increased pregnancy loss at first service, and prolonged calving-to-first-service intervals (CFSI) (Krishnan *et al*., 2023).

According to many studies on dairy cows, only a few percentages of cows had both clinical metritis and mastitis, with the occurrence of both infections being exchanged between 0.14 and 0.44 (Ren *et al*., 2024). Another study found that the co-occurrence is more frequent (Rial *et al*., 2023). Some researchers have found that the combined impact of both disorders is more unfavorable to fertility and general health than each complaint alone (Akter *et al*., 2023). Bacteria responsible for mastitis are commonly categorized as either contagious or environmental (Cervinkova *et al*., 2013). Contagious pathogens, such as *Streptococcus agalactiae*, *Mycoplasma* spp., *Staphylococcus aureus*, and *Corynebacterium bevies,* exist in the udder and are typically spread from cow to cow during milking (Lakew *et al*., 2019). Environmental pathogens, such as *Klebsiella* spp., *Escherichia coli*, *Streptococcus dysgalactiae*, and *Streptococcus uberis*, are derived from different cow's surroundings (Harmon, 1994).

Public bacteria recorded from metritis cases included gram-positive cocci, such as *Enterococcus* species and *Streptococcus*, as well as gram-negative bacteria, such as*Klebsiella pneumonia* and *Escherichia coli*, which are normally recovered from metritis. *Ureaplasma*, *Mycoplasma*, *Gardnerella vaginalis*, and *Staphylococcus* species are examples of additional pathogens (Harmon, 1994).

The city of Mosul in Iraq is one of the country's major livestock areas, with an estimated 400,000 head of livestock. Despite this number, the production of meat and milk remains insufficient to meet national demand, in this part since the high prevalence of mastitis (Sumaya *et al*., 2020). Although some studies have examined the prevalence of bovine mastitis in the region, data on its impact on the reproductive performance and uterine health in crossbred dairy cows are lacking (Al-Dabbag, 2012).

This study aimed to investigate the possible impact of mastitis on uterine health and reproductive performance in crossbred dairy cows in the Mosul Province, Iraq.

Materials and Methods

Methodological evaluation protocol

Corresponding author: E-mail: gaddan76@gmailcom, Phone: +9547503958221

This field study was conducted at the College of Veterinary Medicine and the affiliated Veterinary Teaching Hospital in Mosul, Iraq. A total of 40 crossbred dairy cows were recruited in this study. Twenty cows presented at the Veterinary Teaching Hospital with clinical signs of mastitis.

Clinical mastitis was diagnosed using standard procedures of California mastitis test (Rochmah *et al*., 2026) employed at the hospital and clinic, including physical examination of the udder and milk. All cows were managed under similar conditions, with hand milking performed twice daily (as the owners claimed) in all weather and climatic conditions of Mosul.

Estrus detection was carried out by visual observation of behavioral signs. The pregnancy diagnosis was confirmed through rectal palpation 60 days after natural mating.

Study design

This longitudinal study was conducted on 40 clinically healthy crossbred dairy cows. This study aimed to assess the impact of mastitis on reproductive performance over time. Reproductive performance indicators included metritis incidence. All animals in this study involved cows suffering from mastitis with a case history of abortion, dystocia, and failure to conceive as reproductive markers recorded with mastitis form or abnormal milk content or levels, as owners claimed.

Detection of clinical mastitis

Milk samples were collected from dairy cows following standard hygienic procedures. The udder and teats were thoroughly cleaned and dried prior to sample collection. Each teat end was disinfected using a gauze sponge or cotton swab moistened with 70% ethanol. To reduce contamination, the first stream of milk from each quarter was discarded. Sterile gloves were worn throughout the procedure, and aseptically collected milk samples from each cow.

The collected samples were stored in sterile containers and immediately placed in an ice box for transportation to the University of Mosul laboratory. Samples were either cultured immediately upon arrival or stored at -20 °C until bacterial isolation.

The CMT clinical signs and case history were used to screen the dairy cows for clinical mastitis (Rust *et al*., 2023). From each quarter, 2 mL of milk was placed in the corresponding cup of a CMT paddle. Then, an equal volume of CMT reagent was added to each cup. The paddle was gently rotated in a circular motion for 15 s on a horizontal plane. The formation of a gel-like substance indicates a positive reaction. The CMT results were scored based on gel formation as follows: 0 = negative, 1 = weak positive, 2 = distinct positive and 3 = strong positive. Clinical examination of the genital system was performed using sterile vaginal speculum with a light source, and swabs were collected in broth media in the same way described by Basheer and Taha (2008).

Examination of the reproductive system

Reproductive system examination or criteria for metritis included ultrasonographic examination to differentiate abnormal figures by sonography specialization person, combined with laboratory examination of white blood cell titer in same way described by Kasimanickam *et al*. (2025).

Ultrasonographic examinations

USG were performed for both the udder and female genital system to further detect abnormal figures or lesions, sand storm figures, or star-shaped appearance with hyperechoic and strong reflection of wall margins in both uterine horns or udder quarters.

Bacterial isolation

Bacterial samples for bacterial isolation were collected by opening the cervix when the animal was in estrus using a modified cytobrush tool, which was inserted through the cervix with sterile cotton and collected swabs. The swabs were collected in a sterile test tube with nutrient broth in the same way described by Basheer and Taha (2008), where they were clarified media for isolation and differentiation. Bacterial examinations were performed in a bacteriological laboratory related to the College of Veterinary Medicine of Mosul.

Laboratory analysis

Uterine fluid, which was examined in a diagnostic laboratory affiliated with the College Veterinary Teaching Hospital, showed numerous polymorphonuclear inflammatory cells, confirming metritis.

Statically analysis

This study's data involved classified and differentiation criteria. Only the percentage of infection was calculated for analysis between infection and disinfection cases. Sigma Stat (Jandel Scientific Software V3.1) was used in this study.

Ethical Approval

This study was approved by the Animal Ethics Committee of the College of Veterinary Medicine of Mosul University (permit number: UM.VET.2021.84). The procedures were explained to the owners prior to sampling.

Results and Discussion

Ultrasonography results

Ultrasonographic examination revealed turbid fluid and poorly defined images in both the udder and uterus of all affected cows (Figures 1 and 2).

Laboratory Findings

Laboratory analysis revealed the presence of numerous polymorphonuclear inflammatory cells, ranging from 5% to 18%, in cows with mastitis (Kelly *et al*., 2000). These findings support the presence of infection in the udder. The CMT results showed a color change in the reagent, indicating a positive reaction consistent with inflammation (Figures 3 and 4). For metritis, same procedure to calculate polymorphonuclear in fluid sample 14%e"in same way described by (Lee *et al*., 2018).

Bacterial culture

The relative isolation of clinical mastitis and the uterus is caused by bacteria such as *Mannheimia hemolytica,* while *Klebsiella, Proteus mirabilis*, and *Pseudomonas aeruginosa* are the bacteria isolated from the uterus. *Escherichia coli*, *Staphylococcus* species, and *Streptococcus* species were isolated from both the uterus and udder (Table 1). Bacteriological culture of milk samples from cows with mastitis revealed the presence of *E. coli* and *S. aureus*, which were

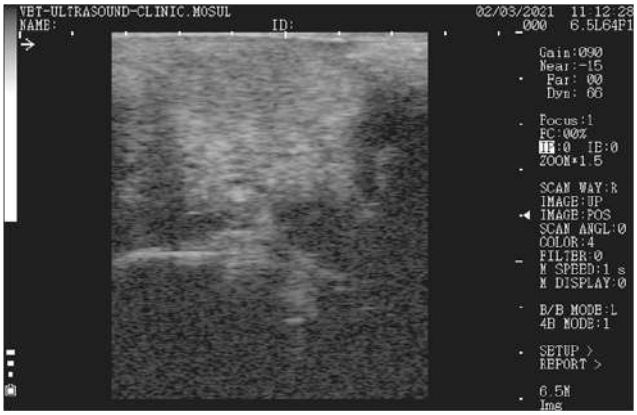

Figure 1: Shows the accumulation of hypoechoic, turbid fluid within the udder, indicative of inflammation.

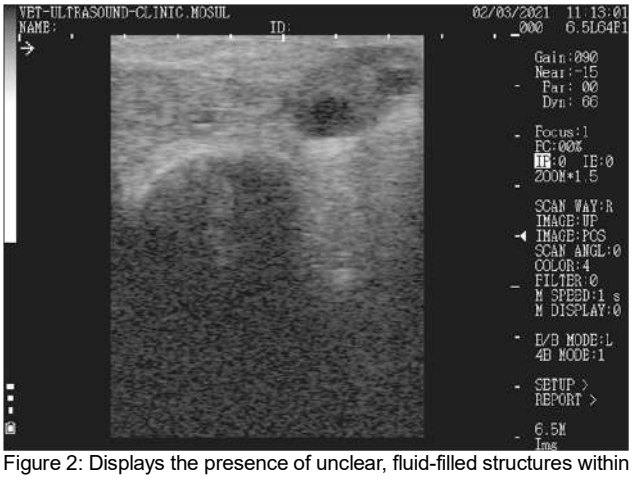

Figure 2: Displays the presence of unclear, fluid-filled structures within the uterus, consistent with uterine inflammation.

Table 1: Relative isolation of bacteria causing clinical mastitis

Organ	Type of bacteria present
Udder	*Staphylococcus aureus* *Escherichia coli* *Streptococcus agalactiae* *Mannheimiahemolytica* *Streptococcus pyrogens*
Uterus	*Escherichia coli* *Klebsiella pneumoniae* *Staphylococcus epidermidis* *Staphylococcus aureus* *Proteusmirabilis* *Pseudomonas aeruginosa*

also found in uterine samples (Table 1).

To the best of our knowledge, this is the first study to investigate the relationship between mastitis and metritis in local crossbreed dairy cows in Iraq to determine whether a correlation exists between udder infection (mastitis) and uterine infection (metritis) in Iraqi crossbreed cows.

Mastitis-metritis-agalactia syndrome, also known as postpartum dysgalactia syndrome, is well-documented in sows, where it has been associated with significant postparturient complications, including piglet mortality (Jenny

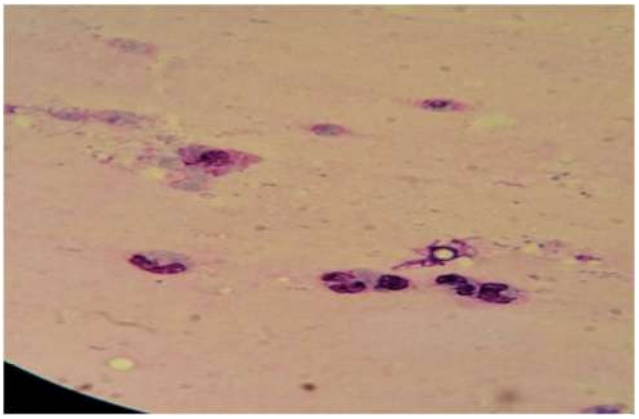

Figure 3: High concentration of polymoorphononuclear inflammatory cells in uterine fluid, stained with Giemsa (40X magnification).

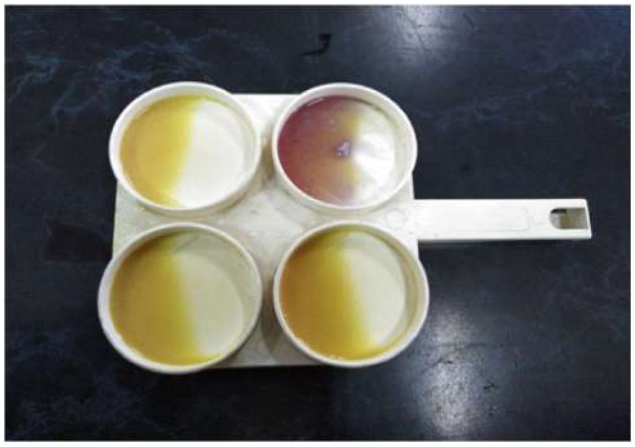

Figure 4: Colour change in the CMT reagent, indicating a positive reaction suggestive of mastitis in the tested milk sample

et al., 2015). Similarly, all cows diagnosed with mastitis also exhibited varying degrees of uterine inflammation ranging from subacute to chronic metritis. Ultrasonographic examination supported these findings, which revealed uterine abnormalities even in cows presented to the veterinary hospital solely for mastitis treatment.

Bacteriological culture of milk samples from cows with mastitis revealed the presence of *E. coli* and *S. aureus* in uterine samples. This finding refers to a close association between udder and uterus infections in the same animals. The results of this study are consistent with those of previous studies that found that uterine bacterial toxins and bacterial species may reach the mammary gland through the bloodstream, or conversely, mammary infections may contribute to uterine complications, especially in cows that had a previous experience of abortion through different stages of pregnancy (Dahi *et al*., 2020).

Infection may be transmitted by various factors, such as contact with infected animals, lactation stage, grazing type, management practice, barn hygiene, and husbandry system (Cobrica *et al*., 2020). The results of this study found that the bacterial species associated with mastitis and metritis in this study are analogous to those reported by other researchers (Abebe *et al*., 2016).

Notably, from the results of this study, researchers recorded

the first isolation of *M. hemolytica* from mastitis cases in Iraq, marking a significant finding that may need further research into emerging pathogens affecting dairy cattle in this region.

Conclusions

This study found that mastitis could be a widespread and persistent problem in dairy cows, with an unofficial impact on reproductive performance. Mastitis and metritis were associated, particularly in cows that demonstrated repeat breeding and reduced conception rate. Bacteria most commonly isolated from cows with mastitis were *Staphylococcus aureus*, followed by *E. coli* and *Mannheimia haemolytica.* This study provides evidence that mastitis and metritis are interrelated conditions that adversely affect the fertility of dairy cows. These results highlight the urgent need for mastitis control programs in Iraq and support the development of national strategies to improve the reproductive health and productivity of dairy herds. The study recommended that a veterinarian should focus on udder health along with routine uterine examination to determine the potential of combined infection.

Acknowledgements

We thank the livestock farmers who participated in this study. The author is grateful to the Mosul University/ Collage of Veterinary Medicine for all the facilities to complete this research.

Author's contributions

Ali Jadaan Al-Hamada was responsible for the experiment design, data analysis, interpretation, and experimental procedures and wrote the manuscript.

Conflict of interest

The author declares that there are no conflicts of interest regarding the publication of this article.

References

Abebe R, Hatiya H, Abera M, Megersa B and Asmare K (2016) Bovine mastitis: prevalence, risk factors and isolation of *Staphylococcus aureus* in dairy herds at Hawassa milk shed, South Ethiopia. *BMC Vet. Res.* **12**(1):270. https://doi.org/10.1186/s12917-016-0905-3.

Akter MI, Maoya Z, Hasan MM and Juyena NS (2023) Effects of clinical mastitis on reproductive performances in dairy cows. *J. Sci. Technol. Res.* **5**(1):1-7. https://doi.org/10.3329/jscitr.v5i1.73994.

Al-Dabbagh SYA **(2012)**. Bovine mastitis caused by gram negative bacteria in Mosul. *Iraqi J. Vet. Sci.* **26**(1):11-16.

Basheer EB and Taha MB (2008) Comparative study of some local therapeutics for endometritis in cows. *Iraqi J. Vet. Med.* **22**(2):89-99.

Borº A, Borº SI and Flori'tean VC (2024) Mastitis impact on high-yielding dairy farm's reproduction and net present value. *Front. Vet. Sci.* **10**:1345782. https://doi.org/10.3389/fvets.2023.1345782.

Cervinkova D, Vlkova H, Borodacova I, Makovcova J, Babak V, Lorencova A, Vrtkova I, Marosevic D and Jaglic Z (2013) Prevalence of mastitis pathogens in the milk of clinically healthy cows. *Vet. Med.* **58**:567-575.

Cobirka M, Tancin V and Slama P (2020) Epidemiology and classification of mastitis. *Anim.* **10**(12):2212. https://doi.org/10.3390/ani10122212.

Dahl MO, De Vries A, Galvão KN, Maunsell FP, Risco C and Hernandez JA (2020) Combined effect of mastitis and parity on pregnancy loss in lactating Holstein cows. *Theriogenology* **143**:57-63. https://doi.org/10.1016/j.theriogenology.2019.12.002.

Damarany AI (2021) Influence of mastitis on resumption of ovarian activity and postpartum reproductive measurements in Baladi cows. *Egypt. J. Anim. Prod.* **58**(3):99-112. https://doi.org/10.21608/ejap.2021.90697.1021.

Dolecheck KA, García-Guerra A and Moraes LE (2019) Quantifying the effects of mastitis on the reproductive performance of dairy cows: A meta-analysis. *J. Dairy Sci.* **102**(9):8454-8477. https://doi.org/10.3168/jds.2018-15127.

Edelhoff INF, Pereira MHC, Bromfield JJ, Vasconcelos JLM and Santos JEP (2020) Inflammatory diseases in dairy cows: Risk factors and associations with pregnancy after embryo transfer. *J. Dairy Sci.* **103**(12):11970-11987. https://doi.org/10.3168/jds.2020-19070.

Harmon RJ (1994) Physiology of mastitis and factors affecting somatic cell counts. *J. Dairy Sci.* **77**(7):2103-2112. https://doi.org/10.3168/S0022-0302(94)77153-8.

Jenny B, Vidondo B, Pendl W, Kümmerlen D and Sidler X (2015) Evaluation of risk factors for mastitis-metritis-agalactia in pig farms in Switzerland. *Schweiz. Arch. Tierheilkd.* **157**(12):689-696. https://doi.org/10.17236/sat00047.

Kasimanickam R, Bhowmik P, Kastelic J, Ferreira J and Kasimanickam V (2025) From infection to infertility: Diagnostic, therapeutic and molecular perspectives on postpartum metritis and endometritis in dairy cows. *Anim.* **15**(19):2841. https://doi.org/10.3390/ani15192841.

Kelly AL, Tiernan D, O'Sullivan C and Joyce P (2000) Correlation between bovine milk somatic cell count and polymorphonuclear leukocyte level for samples of bulk milk and milk from individual cows. *J. Dairy Sci.* **83**(2):300-304. https://doi.org/10.3168/S0022-0302(00)74878-8.

Krishnan LM, Christy RJ, Anbiah SV and Imayavaramban V (2023) Analysis of host-specific risk factors associated with the occurrence of bovine clinical mastitis in Tamil Nadu. *J. Entomol. Zool. Stud.* **41**(4D):3104-3110. https://doi.org/10.60151/envec/LZIT9219.

Lakew BT, Fayera T and Ali YM (2019) Risk factors for bovine mastitis with the isolation and identification of *Streptococcus agalactiae* from farms in and around Haramaya district, eastern Ethiopia. *Trop. Anim. Health Prod.* **51**(6):1507-1513. https://doi.org/10.1007/s11250-019-01838-w.

Lee SC, Jeong JK, Choi IS, Kang HG, Jung YH, Park SB and Kim IH (2018) Cytological endometritis in dairy cows: Diagnostic threshold, risk factors and impact on reproductive performance. *J. Vet. Sci.* **19**(2):301-308. https://doi.org/10.4142/jvs.2018.19.2.301.

Ren X, Lu H, Wang Y, Yan L, Liu C, Chu C, Yang Z *et al.* (2024) Phenotypic and genetic analyses of mastitis, endometritis and ketosis on milk production and reproduction traits in Chinese Holstein cattle. *Anim.* **14**(16):2372. https://doi.org/10.3390/ani14162372.

Reza VH, Mehran FM, Majid MS and Hamid M (2011) Bacterial pathogens of intramammary infections in Azeri buffaloes of Iran and their antibiogram. *Afr. J. Agric. Res.* **6**(11):2516-2521.

Rial C, Laplacette A, Caixeta L, Florentino C, Peña-Mosca F and Giordano JO (2023) Metritis and clinical mastitis events in lactating dairy cows were associated with altered patterns of rumination, physical activity and lying behaviour monitored by an ear-attached sensor. *J. Dairy Sci.* **106**(12):9345-9365. https://doi.org/10.3168/jds.2022-23157.

Rochmah ER, Raharjo D, Hidanah S, Effendi MH, Witaningrum AM and Warsito SH (2023) Effectiveness of the California mastitis test (CMT), reductase test and alcohol test for dairy cows subclinical mastitis detection. *J. Agro Veteriner* **7**(1):18-22. https://doi.org/10.20473/agrovet.v7i1.51443.

Rust JD, Christian MJ, Vance CJ, Bolajoko MB, Wong JT, Allan FK and Peters AR (2023) A study of the effectiveness of a detergent-based California mastitis test (CMT), using Ethiopian and Nigerian domestic detergents, for the detection of high somatic cell counts in milk and their reliability compared with the commercial UK CMT. *Gates Open Res*. **5**:146. https://doi.org/10.12688/gatesopenres.13369.2.

Sumaya YA, Mahmoud EN and Al-Chalaby (2020) Bacterial bovine mastitis in Iraq: A review. *Basrah J. Vet. Res*. **19**(2):76-102.