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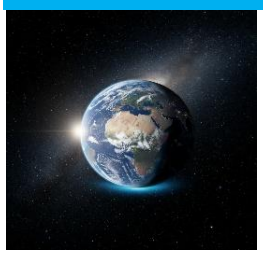

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Lactational Mastitis - Epidemiology, Etiopathogenesis, Clinical Presentation, Diagnosis and Management

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Abstract

Introduction and purpose: Breastfeeding offers numerous health advantages for both infants and mothers and is recommended worldwide. Lactational mastitis is a frequent breastfeeding problem that may cause breast pain, systemic symptoms and early weaning. This review aims to provide an overview of current knowledge on lactational mastitis, emphasizing its epidemiology, etiopathogenesis, risk factors, clinical features, diagnostic criteria and treatment options, including the influence of human milk microbiota and probiotics.

Material and methods: A narrative review was carried out using databases such as PubMed/MEDLINE, Scopus, Web of Science and the Cochrane Library. The review included systematic reviews, meta-analyses, randomized controlled trials, observational studies and international guidelines.

State of knowledge: Lactational mastitis encompasses a range of inflammatory breast conditions with various causes, including milk retention, nipple trauma, bacterial infection and disruption of microbiota balance. Increasing evidence points to the importance of milk microbiota dysbiosis in disease development. Treatment focuses on early non-drug interventions, continuation of breastfeeding and selective use of antibiotics, while emerging data suggest that probiotics may be beneficial as adjunctive or preventive strategies.

Conclusions: Lactational mastitis should be recognized as a complex inflammatory disorder rather than a simple bacterial infection. Prompt non-pharmacological treatment, breastfeeding support and careful antibiotic use are key management components, while probiotics may represent a promising adjunct in selected cases, potentially reducing recurrence and supporting breastfeeding continuation.

Keywords**:** mastitis; lactation; breastfeeding; breast milk; probiotics; human health

Content

1. Introduction

Breastfeeding is recognized as the gold standard for infant nutrition, providing significant health benefits for both the child and the mother [1,2].

Human milk is a unique food fully adapted to the needs of the infant, supplying all essential nutrients during the first six months of life. It contains appropriate proportions of fats, carbohydrates, proteins, vitamins, minerals and water and is easily digested and efficiently absorbed by the infant's body. Bioactive components play a particularly important role, including long-chain polyunsaturated fatty acids (LC-PUFA), oligosaccharides, immunoglobulins, as well as enzymes and growth factors, which support nervous system development, gastrointestinal maturation and protection against infections. Due to the presence of immunological factors, human milk strengthens the immature immune system of the infant, providing protection without triggering an inflammatory response, which underscores its exceptional importance in infant nutrition and health [3]. At the same time, lactation is associated with long-term health benefits for women, including a reduced risk of breast and ovarian cancer, type 2 diabetes and cardiovascular diseases [4].

Recommendations regarding the duration of breastfeeding emphasize its importance for the health of both the infant and the mother. Exclusive breastfeeding is recommended for approximately the first six months of life, followed by continued breastfeeding with the introduction of appropriate complementary foods. According to the position of the American Academy of Pediatrics, breastfeeding may be continued for two years or longer [5].

Despite its numerous health benefits, breastfeeding may be associated with certain lactation-related problems that affect maternal comfort and the course of feeding. One such condition is lactational mastitis, defined as inflammation of the breast tissue, which may or may not be of infectious origin [6]. It manifests with breast pain, redness or a palpable mass and is often

accompanied by fever or flu-like symptoms. Factors contributing to its development, such as milk stasis and nipple damage, have been identified [7]. Due to the widespread practice of breastfeeding and its clinical importance, lactation-related conditions, including lactational mastitis, constitute a significant public health challenge [2].

The aim of this narrative review is to present the current state of knowledge on lactational mastitis with particular emphasis on its epidemiology, etiopathogenesis, risk factors, clinical presentation, diagnostic principles and current therapeutic approaches. The review also discusses the role of dysbiosis and the microbiota of human milk, highlighting the potential significance of probiotics in the prevention and treatment of mastitis within the framework of contemporary pathophysiological and clinical concepts.

2. Material and Methods

This review focuses on lactational mastitis, with particular emphasis on its epidemiology, etiopathogenesis, risk factors, clinical presentation, diagnostic principles and current therapeutic strategies, including the role of the human milk microbiota and probiotics in the prevention and treatment of this condition.

The literature search was conducted using international scientific databases, including PubMed/MEDLINE, Scopus, Web of Science and the Cochrane Library. In addition, clinical guidelines, expert consensus statements and recommendation documents issued by scientific societies and international organizations were included, such as those from the World Health Organization (WHO), the American Academy of Pediatrics (AAP) and the Academy of Breastfeeding Medicine (ABM).

The review included systematic reviews and meta-analyses, randomized controlled trials, cohort and observational studies, clinical protocols and recommendations, as well as selected review and experimental studies addressing the microbiota of human milk. The identified publications were subjected to qualitative analysis for their relevance to the objectives of the review.

3. Epidemiology of Lactational Mastitis

Lactational mastitis is one of the most common health problems among breastfeeding women [8]. Its global prevalence ranges from 2% to 33%, while in the United States it affects approximately 10% of breastfeeding women [8]. This wide range reported in studies is mainly due to differences in disease definitions, levels of breastfeeding support and case-reporting methods. Low socioeconomic status and the relatively limited number of studies conducted in resource-limited settings also influence the reported prevalence [8].

Lactational mastitis most commonly develops within the first 2-3 weeks postpartum, with the majority of cases (75-95%) occurring during the first three months [8]. Cohort analyses confirm that the incidence of lactational mastitis is highest during the first postpartum month and gradually declines thereafter [9]. The condition may lead to breast pain, localized erythema and systemic symptoms such as fever and in some cases may result in breast abscess (approximately 3-11%) [10]. Moreover, mastitis can affect the duration of exclusive breastfeeding, thereby limiting health benefits for both the mother and the infant [9,10].

Factors determining differences in prevalence include not only socioeconomic conditions but also access to lactation support, maternal education and breastfeeding practices. These factors influence both the risk of developing mastitis and its reporting in epidemiological studies [8].

For this reason, authors emphasize the need to develop standardized diagnostic tools and to conduct high-quality epidemiological studies, particularly in populations that have been underrepresented to date [8,9].

4. Etiopathogenesis of Lactational Mastitis

Mastitis is an inflammatory condition of the mammary gland characterized by a tissue response to mechanical or infectious factors. The inflammatory process may have various origins - from mechanical milk stasis to bacterial infection - and results in changes in both breast tissue structure and the chemical composition and physical properties of milk [11,12].

4.1 Non-infectious Lactational Mastitis

The non-infectious form of lactational mastitis is primarily associated with milk stasis resulting from incomplete emptying of the breast during feeding [11,12]. It occurs when milk is not completely emptied from the gland, which may result from improper positioning of the infant during feeding, limited sucking ability, infrequent feeding or partial obstruction of the milk ducts [12]. Consequently, local pain, swelling, redness and tissue induration of the breast may develop. In such cases, continuing breastfeeding and adequately emptying the gland - either manually or with a breast pump - is crucial for resolving the problem [11]. Inadequate breast emptying may lead to persistent discomfort and, in severe cases, increase the risk of infectious complications [12].

4.2 Infectious Lactational Mastitis

The most common infectious agents causing mastitis are bacteria colonizing the skin or milk ducts, primarily Staphylococcus aureus, coagulase-negative staphylococci and various species of the genus Streptococcus [11,12]. Less frequently, Gram-negative bacteria (e.g., Escherichia coli) are isolated and occasionally atypical organisms, such as Salmonella, Mycobacterium, Candida or Cryptococcus, may be involved. Microorganisms can enter the milk ducts through microfissures in the nipple or, in rare cases, via hematogenous spread [12].

Bacterial infection induces a local inflammatory response in the breast, activating immune cells and releasing pro-inflammatory cytokines, which manifests as erythema, tenderness, swelling and occasionally fever and other systemic symptoms [12,13]. The presence of bacteria in milk also affects its chemical and physical composition - mastitis caused by Staphylococcus aureus is associated with reduced milk sugar content, whereas coagulase-negative staphylococci are linked to decreased protein levels. These changes may affect the taste of milk and impair effective sucking by the infant [12].

4.3 Dysbiosis and the Role of the Microbiota

In recent years, increasing attention has been paid to the role of mammary gland dysbiosis in the etiopathogenesis of lactational mastitis. Regardless of its origin, mastitis is increasingly

viewed as a disruption of the breast's microbiological balance, which may be influenced by the maternal gut microbiota through the so-called gut-breast axis [11]. In subclinical mastitis, increased leukocyte counts in milk and localized activation of the inflammatory response are observed even in the absence of overt bacterial infection [11,13].

5. Risk Factors for Lactational Mastitis

Lactational mastitis develops as a result of the interaction of multiple factors related to breast anatomy, feeding practices, peripartum behaviors and individual maternal characteristics [9,14]. These factors may coexist, leading to impaired milk drainage, tissue damage and an intensified inflammatory response within the mammary gland.

One of the most significant risk factors for mastitis is nipple damage, such as fissures, excessive dryness and soreness [9,14]. These changes often occur in the early stages of lactation and are closely associated with difficulties in proper infant latch. Damaged nipples facilitate microbial entry and enhance the local inflammatory response, thereby increasing the risk of mastitis [9].

Impaired breast emptying also plays a crucial role. Recurrent milk stasis and blocked milk ducts are among the strongest risk factors associated with the disease [9,14]. These phenomena may result from infrequent feeding, skipped feeds, improper sucking technique or mechanical pressure on the breast. Repeated milk stasis promotes increased intraductal pressure and induces a localized inflammatory response [14].

Improper breastfeeding-related behaviors are also relevant. Studies have shown that incorrect feeding positions, improper milk expression techniques and insufficient nipple hygiene are associated with an increased risk of mastitis [14].

Among factors related to maternal characteristics and the postpartum course are primiparity, a previous episode of mastitis during earlier lactations, breast trauma and cesarean delivery [9,14]. Particularly important is a history of mastitis, which is associated with an increased risk of recurrence in subsequent breastfeeding periods, possibly reflecting persistent feeding patterns, anatomical predispositions or individual immune response characteristics [9].

Psychosocial and postpartum-related factors may also contribute. Postpartum mood disorders, as reported in the literature, together with insufficient postpartum rest and increased psychological stress during the puerperium are associated with a higher incidence of mastitis [14]. These factors may indirectly affect lactation by disrupting feeding rhythms, impairing effective breast emptying and weakening immune defense mechanisms.

6. Clinical Presentation - Local and Systemic Symptoms and Disease Course

Lactational mastitis is a common clinical problem in the postpartum period and can significantly affect maternal health and the continuation of breastfeeding. The condition is characterized by a heterogeneous clinical presentation, including both local and systemic symptoms of varying severity. The overlap between infectious and non-infectious inflammatory features may make the diagnosis of mastitis challenging.

Lactational mastitis encompasses a spectrum of inflammatory disorders of the mammary gland, ranging from mild forms associated with milk stasis, through non-infectious and bacterial inflammation, to more advanced conditions that may progress to breast abscess [15]. The disease usually begins locally in one segment of the breast and, without appropriate management, may spread to a larger area of the gland [16].

Local symptoms include breast pain, tenderness, localized warmth, swelling and erythema, often with a wedge-shaped appearance [16,17]. On palpation, induration or a painful infiltrate may be present. With disease progression, an inflammatory mass may develop and in the case of an abscess, a fluid collection may be palpable, sometimes with fluctuation [15,16].

Systemic symptoms are common and include fever (usually >38.5°C), chills, malaise, myalgia, fatigue, headache and occasionally nausea and vomiting [16,17]. Importantly, systemic symptoms may also occur in non-infectious mastitis as a manifestation of a systemic inflammatory response rather than bacterial infection per se [15,17].

The clinical course of mastitis is often dynamic and gradual, reflecting its nature as a continuous process. Milk stasis and narrowing of the milk ducts may lead to non-infectious inflammatory mastitis, which under favorable conditions may progress to acute bacterial mastitis and

subsequently to phlegmon or abscess [15,17]. It is estimated that approximately 3-11% of women with acute mastitis develop a breast abscess [15,16].

7. Diagnosis and Diagnostic Workup of Lactational Mastitis

7.1 Clinical Diagnosis

The diagnosis of mastitis during lactation is primarily clinical, based on medical history and physical examination [16,17]. Key elements include assessment of local breast symptoms and the presence of systemic signs. The examination should focus on inflammatory signs, palpable masses, tenderness, nipple damage and the overall condition of the patient [16].

Lack of clinical improvement after 24-48 hours of conservative treatment or antibiotic therapy should prompt further diagnostic evaluation [15,16].

7.2 Role of Laboratory Tests

Routine laboratory tests, such as complete blood count or C-reactive protein levels, have limited diagnostic value, as they only reflect the presence of inflammation and do not reliably distinguish infectious from non-infectious mastitis. They are not recommended in typical, uncomplicated cases [15,17].

7.3 Indications for Microbiological Testing

Microbiological tests, including human milk cultures, are not routinely recommended in acute mastitis [16,17]. They may be considered in cases of treatment failure, severe or recurrent disease, suspected infection with resistant organisms (e.g., MRSA) or in the presence of an abscess requiring aspiration [15-17]. It should be noted that bacteria may also be present in cultures from non-infectious mastitis, which further limits the specificity of this test [17].

7.4 Imaging Diagnostics

Breast ultrasonography is the imaging modality of choice for diagnosing complications of mastitis. It is indicated in cases of lack of clinical improvement, suspicion of abscess or phlegmon or a persistent inflammatory mass. Ultrasound allows differentiation between

parenchymal inflammation and purulent collections and enables image-guided aspiration [15,16].

If a solid lesion persists after aspiration, bloody fluid is obtained or malignancy is suspected, further diagnostic workup is required. Mammography is not a first-line examination in breastfeeding women but may be performed in selected cases [16].

7.5 Differential Diagnosis

The differential diagnosis of lactational mastitis includes both lactation-related conditions and disorders unrelated to breastfeeding [15-17]. The most important among these are breast engorgement, ductal narrowing, galactocele, phlegmon, breast abscess, breast cyst and inflammatory breast carcinoma [15-17]. Particular attention should be paid to inflammatory breast carcinoma, which may clinically mimic mastitis and should be considered in cases with atypical presentation or lack of response to treatment [16,17]. In addition, when systemic symptoms predominate without clear signs of breast inflammation, other sources of infection, such as urinary tract infection or endometritis - especially after cesarean delivery - should be considered [16].

8. Treatment of Lactational Mastitis

8.1 Non-Pharmacological Management

The cornerstone of mastitis treatment is the continuation of breastfeeding, even in the presence of pain or inflammation, as regular breast emptying reduces milk stasis and limits disease progression. Breast emptying techniques such as frequent feeding, the use of various breastfeeding positions and milk expression with a breast pump when necessary [15]. Table 1 presents the most commonly used breastfeeding positions and their main characteristics (based on [18]).

Table 1. Common Breastfeeding Positions and Their Main Features (based on [18]).

Feeding Position	Characteristics

Side-lying position	Mother and baby lie on their sides; baby's head at breast level; recommended for mothers with large breasts; often used immediately after birth
Classic position	Sitting in a chair or armchair, baby on the forearm; common for everyday feeding; support under back and baby recommended
Biological position	Semi-reclined, baby rests on mother's abdomen; useful for breastfeeding difficulties such as fast let-down or milk stasis in lower breast quadrants
Underarm hold	Baby positioned beside mother, supported by forearm, feet behind mother's back; useful for twins or asymmetric baby positioning
Cross-cradle position	Baby rests on the arm opposite the breast being fed; pillow support helpful; especially for infants with low muscle tone, weak suck or preterm babies

Supportive management of lactational mastitis involves both lifestyle measures and proper breastfeeding techniques. Adequate rest and hydration help the body cope with inflammation, while lactation education - including guidance on correct latch and early recognition of mastitis symptoms - reduces the risk of recurrence and facilitates timely intervention [8]. Home care strategies, such as using cold compresses to reduce swelling, applying gentle pressure toward the lymph nodes and wearing a supportive bra are recommended, whereas aggressive breast compression, deep massage or intensive heat application should be avoided as they may exacerbate tissue injury and inflammation [15,19].

8.2 Pharmacological Treatment

In cases of severe symptoms or suspected bacterial infection, antibiotic therapy is indicated. The choice of antibiotic depends on the suspected pathogen and the patient's condition, with

Staphylococcus aureus and various Streptococcus species, which are the most commonly organisms [15]. Antibiotics should be used only when clinically indicated and not for prophylactic purposes [8,15]. First-line treatments typically include dicloxacillin, flucloxacillin and cephalexin, while clindamycin or trimethoprim-sulfamethoxazole are used as second-line therapies [19].

Analgesic and anti-inflammatory treatments, notably nonsteroidal anti-inflammatory drugs, may be used to relieve pain and breast swelling [15].

8.3 Role of Probiotics in the Treatment of Lactational Mastitis

In recent years, probiotics have increasingly been considered as an alternative or adjunctive approach for the treatment and prevention of lactational mastitis, particularly in the context of rising antibiotic resistance and concerns regarding the safety of pharmacotherapy during lactation [19,20]. Lactational mastitis is currently viewed not only as a bacterial infection but also as a condition associated with dysbiosis of the human milk microbiota, providing a rationale for microbiome-modulating therapies [19-21].

A meta-analysis of randomized clinical trials demonstrated that oral probiotic supplementation during pregnancy significantly reduced the incidence of lactational mastitis compared with placebo (RR: 0.49; 95% CI: 0.35-0.69) [20]. Furthermore, a significant reduction in bacterial counts in milk was observed following probiotic supplementation in both women with mastitis and healthy women, suggesting a beneficial effect on the microbiological homeostasis of the mammary gland. Subgroup analyses indicated that Lactobacillus fermentum and Lactobacillus salivarius strains contributed to a reduction in bacterial load in human milk [20].

Clinical studies also indicate that probiotic supplementation may reduce the severity of inflammatory symptoms associated with mastitis. Decreased levels of interleukin-8 (IL-8) in human milk have been observed, a cytokine that plays an important role in mammary gland inflammation [20,21]. An association between reduced IL-8 levels and improvement in clinical symptoms, such as breast pain, has been observed, although this relationship was not consistently statistically significant across studies [20].

The role of probiotics in mastitis is also explained by the concept of the gut-breast and oral-breast axes. According to this hypothesis, commensal bacteria originating from the maternal gastrointestinal tract or oral cavity may migrate to the mammary gland and influence milk microbiota composition and local immune responses [21]. Disruption of gut microbiota promotes increased permeability of the intestinal and blood-milk barriers, potentially exacerbating breast inflammation, whereas probiotic administration helps restore microbiological balance and reduce inflammatory responses [21].

From a clinical perspective, probiotics are considered safe during pregnancy and lactation, with reported adverse effects generally being mild and transient [20]. Reviews on mastitis treatment emphasize that probiotics such as Lactobacillus salivarius and Lactobacillus fermentum may, in selected cases, serve as alternatives or adjuncts to antibiotic therapy, although most available interventions remain at the clinical trial stage [19].

Available data suggest that probiotics may play an important role in the prevention and treatment of lactational mastitis by limiting bacterial colonization of human milk, modulating inflammatory responses and restoring microbiota balance [19-21]. At the same time, authors emphasize the need for further high-quality randomized studies to clearly define optimal strains, doses and treatment regimens for breastfeeding women [19-21].

8.4 Treatment of Breast Abscess in the Course of Lactational Mastitis

A potential complication of lactational mastitis is breast abscess, which develops as a result of uncontrolled bacterial infection [15]. Treatment most commonly involves drainage of the accumulated fluid. Ultrasound-guided needle aspiration is the preferred method, whereas surgical drainage is reserved for large, multiloculated or treatment-resistant abscesses [15,22]. Some studies, however, have shown that even abscesses larger than 5 cm in diameter can be effectively treated with repeated needle aspiration, reducing the risk of scarring, milk fistula formation and premature cessation of lactation [23]. An important component of therapy is the continuation of breastfeeding or regular milk expression, which facilitates ductal drainage and reduces the risk of infection recurrence [15].

9. Conclusions

Lactational mastitis should not be viewed solely as a bacterial infection but rather as a spectrum of inflammatory disorders of the mammary gland in which impaired milk outflow, localized inflammatory response and microbial dysbiosis play key roles. This perspective allows for more accurate clinical assessment and helps avoid excessive and unjustified antibiotic use.

Effective management of lactational mastitis is based on early non-pharmacological intervention, such as continuation of breastfeeding, proper breast emptying and lactation education. Antibiotic therapy should be reserved for cases with clear signs of bacterial infection or lack of improvement after conservative treatment, while microbiological and imaging diagnostics should be applied selectively, depending on disease course and complication risk.

Increasing importance is being attributed to modulation of the human milk microbiota in the prevention and treatment of mastitis. Probiotics, particularly Lactobacillus fermentum and Lactobacillus salivarius, demonstrate promising clinical potential, although their routine use requires further high-quality randomized studies.

Early identification of risk factors, an interdisciplinary approach to the care of breastfeeding women and individualized treatment strategies are crucial for reducing mastitis-related complications, minimizing disease recurrence and preventing premature discontinuation of breastfeeding.

Disclosure

Author's Contribution

The author conceived the study, performed the literature review, analyzed the data and wrote the manuscript. The author has read and approved the final version of the manuscript.

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Conflicts of Interest

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