Mammary Disease

Assoc. Prof. Dr. Gözde
YÜCEL TENEKECİ

MAMMARY GLAND DEVELOPMENTAL ANOMALIES

The mammary bud may **fail to develop** or **develop in excess**.
These anomalies involve the **nipple, glandular parenchyma, or both**.

- **Hypermastia / Polymastia:**
Increase in the number of mammary glands

- **Hyperthelia / Polythelia:**
Increase in the number of nipples

- **Athelia:**
Absence of the nipple

- **Hypothelia:**
Underdeveloped or small nipple

- **Agenesis / Aplasia (Amastia):**
Complete absence of mammary gland development

- **Hypoplasia (Hypomastia):**
Underdevelopment of mammary gland parenchyma

HYPERTROPHY (MAMMARY GLAND)

- Enlargement of the mammary gland
- May occur **independent of pregnancy and lactation**
- Common in **cattle**
- In dogs, often associated with:
  - **Pseudopregnancy**
  - **Galactorrhea (lactation without pregnancy)**

ATROPHY

- Occurs with:
  - Aging
  - Hormonal deficiency
  - Chronic inflammation
  - Metabolic and nutritional disorders
- Teat becomes:
  - **Small**
  - **Firm (increased consistency)**

GYNECOMASTIA

- Enlargement of the mammary gland in males

PSEUDOGYNECOMASTIA

- Apparent enlargement of the breast in males due to **increased adipose tissue**
- No true glandular proliferation
- **No milk secretion**
- Commonly associated with:
  - **Obesity**
  - **Advanced age**

MAMMARY CIRCULATORY DISTURBANCES

- Hyperemia
- Hemorrhagia
- Oedema
  - Physiological Oedema
  - Pathological Oedema ….. Inflammatoric
    Noninflammatoric

Physiological Oedema

Physiological udder edema develops during late gestation, particularly in cows, and typically resolves within 8–12 days postpartum without evidence of inflammation.

It is mainly attributed to placental hormonal influences, especially **hyperestrogenism**. Additionally, it may occur during early lactation, in the pre-abortion period, and in cases of **pseudopregnancy,** particularly in dogs.

Macroscopic Findings

• Edema is **predominantly localized in the posterior udder quarters**

• Involvement of **one half or one quarter of the udder (asymmetrical)** is **uncommon**

• Teats may appear **shortened due to swelling**

• The skin is **tense and shiny**; **pitting edema is present** (finger impressions persist after pressure)

• Edema may extend to:

– **ventral abdominal wall**

– **vulva and perineum**

– **medial aspect of the hind limbs**

• On section, the affected tissue is **wet and gelatinous**, and **clear serous fluid** may exude

Microscopic Findings

• Accumulation of **edema fluid** in:

– **subcutis**

– **interlobular connective tissue**

Pathological Edema of the Udder

- I. Inflammatory Edema

Etiology

- **Associated with mastitis (inflammatory processes of the udder)**

Macroscopic Findings

- Lesions are **usually focal**, rarely diffuse
- The affected udder is:
  – **swollen, tense, hot, and painful**
- The skin and cut surface are **hyperemic**
- Edema fluid is **turbid**, may contain:
  – **serous fluid**
  – **blood**
  – **pus**
- In severe cases, **teats may appear elongated**

Microscopic Findings

- **Edema fluid accumulation** in interstitium and parenchyma
- **Cellular infiltration** (predominantly neutrophils)
- **Hyperemia and inflammatory changes**
- In advanced cases:
  – **suppurative (purulent) inflammation**
  – **necrosis**
  – **gangrene**
  – **abscess formation**
- In chronic stages:
  – **fibrosis of the mammary tissue**

- Pathological Oedema
- I. Inflammatoric oedema
- Aetiology
- It is related mastitis.
- Macroscopical Findings
- It is generally focal rarely diffuse.
- Affected breast skin is swollen and tense, hot and painful.
- The top and cross section of the breast are hyperemic. Edema fluid is cloudy, bloody, and pus.
- In severe cases, nipples are elongated.
- Microscopical Findings
- Cellular infiltration, edema, hyperemia and other inflammatory changes in the interstitium and parenchyma.
- Purulent inflammatory changes, necrosis, gangrene, abscess develop. If it becomes chronic, fibrosis develops in the breast

Acute mastitis; İnflammatoric oedema

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- **II. Non-Inflammatory Pathological Edema of the Udder**

Etiology

- **General or local circulatory disturbances**
- **Prolonged recumbency** → pressure on veins → impaired venous return
- **Hypoproteinemia**, associated with:
  – cachexia
  – chronic parasitism
  – anemia
- **Management-related factors**:
  – improper milking
  – delayed milking

- Edema is typically **diffuse**, often involving **all udder quarters**
- The udder appears:
  – **enlarged to varying degrees**
  – **skin tense, smooth, and shiny**
  – **mildly hyperemic**
- In severe cases:
  – Animals may have **difficulty standing or walking**
  – Adopt a **wide-based stance** due to udder enlargement
- Marked edema may lead to:
  – **skin rupture**
  – leakage of **clear serous fluid**, especially around the teats
- **Secondary bacterial infection** may occur, leading to:
  – purulent inflammation
  – gangrenous changes
  – or progression to **chronic edema**

MASTITIS

General term used for **inflammation of the mammary gland**

- Inflammation involves:
  - **Mammary parenchyma**
  - **Milk ducts**
  - **Interstitium**
- Inflammatory changes in:
  - **Parenchyma → Mastitis**
  - **Milk ducts → Galactophoritis**
- These conditions are **often observed together**

DEVELOPMENTAL DISORDERS OF THE MAMMARY GLAND, NIPPLE, AND PAPILLARY DUCT

- **Pendulous (large, sagging) udder**
- **Funnel-shaped teat orifice**
- **Short or incompletely closed teat canal (papillary duct)**
- Other congenital anomalies

TEAT CANAL (DUCTUS PAPILLARIS) DEFENSE MECHANISMS

- The epithelium of the teat canal is rich in fatty acids and produces **bactericidal secretions** (e.g., **lactenin**).
- Damage to the teat canal epithelium (e.g., during improper procedures or repeated/unnecessary cannula insertion) reduces or eliminates this protective effect.
- As a result, **bacteria can enter the teat more easily**, multiply within the ducts, and spread into the mammary gland.

MILKING-RELATED RISK FACTORS

- In animals with narrow teats/udder conformation, **complete milking may not occur**, and residual milk remains.
- Retained milk provides an excellent **nutrient source for bacterial growth**, increasing the risk of mastitis.

- During the dry period, **lactoferrin is high** to protect the gland from infection.
- At the onset of lactation, the mammary gland shifts to **milk production**.
- Therefore, **lactoferrin decreases**, while nutrients (lactose, citrate) increase.
- This creates a more favorable environment for **bacterial growth**.

- Lactoferrin binds iron and **limits bacterial growth**.
- During early lactation, **lactoferrin levels are low**.
- This results in **increased free iron in the mammary gland**.
- **Coliform bacteria rapidly utilize this iron**, leading to infection.
- Therefore, **mastitis risk increases in the puerperal period**.

ROUTES OF MASTITIS INFECTION

Galactogenic infection (most common)
• Infection enters through the **teat canal**.
• Usually affects **a single mammary lobe/quarter**.
• Predisposing factors (e.g., milking errors, teat damage) play an important role.
• Common agents: *Streptococcus agalactiae*, *Staphylococcus aureus*.

Percutaneous infection
• Occurs due to **skin injury or wounds** of the udder.
• Pathogens enter through damaged skin and spread via **lymphatic vessels**.

Hematogenous infection (rare)
• Pathogens reach the mammary gland via the **bloodstream** from other organs.
• Usually affects **multiple lobes/quarters**.
• Often associated with **septicemia**.

CLASSIFICATION OF MASTITIS

Morphological Classification

- Catarrhal–purulent mastitis and **galactophoritis**
- **Purulent (suppurative) and apostematous mastitis**
- **Subclinical mastitis (bovine)**
- **Acute severe mastitis (mastitis acuta gravis)**
- **Interstitial mastitis**
- **Granulomatous mastitis**

Aetiological Classification

- **Streptococcal mastitis**
- **Staphylococcal mastitis**
- **Coliform mastitis**
- **Corynebacterium (Actinomyces) pyogenes mastitis** *(= Trueperella pyogenes)*
- **Mycoplasma mastitis**
- **Nocardiosis (Nocardia mastitis)**

Catarrhal-Purulent Mastitis & Galactophoritis

Affects one or more mammary lobes

- Usually has a short course
- May become chronic if not treated
- Severity depends on:
  - Virulence of the agent
  - Host susceptibility
- Subclinical cases may occur

→ No clinical signs

→ Cause economic loss (↓ milk yield)

Aetiology (General)

- Most common agents:
  – **Streptococcus spp.**
  – **Staphylococcus spp.**
  – **Mycoplasma spp.**
- • Important species in cattle:
  – *Streptococcus agalactiae*
  – *Streptococcus uberis*
  – *Staphylococcus aureus*
- • Other agents:
  – *Mycoplasma bovis* (contagious, chronic, treatment-resistant)
  – *Acholeplasma laidlawii*
- • Additional causes:
  – *Chlamydia spp.*
  – *Coxiella burnetii*
  – *Leptospira spp.*
  – Fungi (e.g., *Candida*)
  – Viruses (usually secondary role)

Non-infectious Predisposing Factors

Trauma (improper milking)
- Incomplete milking
- Nutritional imbalance
- High-protein diet
- Ruminal acidosis

Acute mastitis, inflammatoric oedema

Acute Mastitis – Macroscopic Findings

- Involves one or more lobes
- Milk is watery and contains clots
- Purulent cases:
→ Yellow to reddish-yellow exudate
- Udder:
– Swollen (mild–severe)
– Firm (loss of spongy consistency)
– Hyperemic and moist on cut surface
- Skin: tense and stretched
- Lymph nodes: enlarged
- Edema in subcutis and interstitium

Acute Mastitis – Histopathology

- Hyperemia and edema
- Neutrophil-dominant inflammation
- Alveoli:
– Dilated and filled with exudate
– Desquamated epithelial cells
- Lumen contents:
– Milk + neutrophils + debris
- Ducts: similar inflammatory changes (**galactophoritis**)

Chronic Mastitis – Macroscopic Findings

- Interstitial fibrosis is prominent
- Udder becomes:
  – Firm
  – Indurated
- Milk ducts may be obstructed
- Retention cysts may develop
- Cut surface:
  – Irregular cavities
  – Watery or turbid contents

Chronic Mastitis – Microscopic Findings

Two patterns:

1. Atrophic form

- Parenchymal loss
- Increased fibrous tissue
- Reduced gland size

→ *Mastitis chronica atrophicans*

2. Hypertrophic form

- Fibrosis + glandular hyperplasia
- Enlarged mammary tissue

→ *Mastitis chronica hypertrophicans*

Mastitis Purulenta

- Diffuse purulent mastitis is considered a form of acute mastitis
- Morphologically similar to catarrhal mastitis
- Often regarded as a progression or subtype
- Macroscopic findings:
  – Affected areas appear yellowish
  – Ducts and cistern filled with purulent exudate
- Histopathology:
  – Marked neutrophil infiltration
  – Mainly in ducts and interstitial tissue

Microscopic Findings (Progression)

Early stage

• Edema and hyperemia

• Neutrophil infiltration

• Beginning mononuclear cell infiltration

(lymphocytes, plasma cells, macrophages)

Intermediate stage

• Mononuclear cells increase and may predominate

• Fibroblasts proliferate

• Early connective tissue formation

Late stage

• Prominent fibrosis

• Angiogenesis (capillary proliferation)

• Granulation tissue formation

• Lesions become:

→ Firm (indurated)

→ Nodular (palpable)

Apostematous Mastitis

Develops from purulent mastitis
• Characterized by abscess formation

• Usually seen in subacute or chronic stages

• Abscess features:
– One or multiple
– Size varies (lentil → walnut → larger)
– Located in one or several lobes

• Gross appearance:
– Creamy yellow pus
– Surrounded by fibrous capsule

• Advanced cases:
– Fistulation to the skin
– Visible on cut surface

Summer Mastitis (Cattle)

Severe form of purulent mastitis

- Also called:
  - Pyogenic mastitis
  - Summer mastitis
- Common agent:
  - *Trueperella (Arcanobacterium) pyogenes*
- Other bacteria:
  - *Fusobacterium necrophorum*
  - *Peptostreptococcus spp.*
  - *Streptococcus dysgalactiae*
  - *Streptococcus uberis*

Why is it called "Summer Mastitis"?

- It occurs mainly during the summer months
- Warm and humid conditions favor bacterial growth
- **Biting flies (e.g., *Hydrotaea irritans*) act as mechanical vectors**
- Flies carry bacteria to the teat and facilitate infection

Often associated with **abscess formation**

- Thick, yellow-green purulent exudate
- Chronic cases:
  – Encapsulated abscesses
  – Fistulas to skin
  – Ducts and cistern filled with pus
- Remaining parenchyma may appear normal

Subclinical Mastitis

Definition

• A **clinical term**: no visible signs in the udder or milk
• Inflammation is present but **not clinically apparent**

Etiology / Predisposing Factors

• Most commonly caused by
– *Streptococcus agalactiae*
– *Staphylococcus aureus*
• Associated with
– Poor milking hygiene
– Faulty milking practices
– Contaminated milking equipment

Clinical Features

- No obvious clinical signs
- Udder appears normal
- Milk appears normal
- **Decreased milk yield**

Diagnosis

- **Increased somatic cell count (SCC)**
  – Typically **>200,000 cells/mL**
- Detected by screening tests (e.g., CMT)

Histopathological Findings

- Mild **focal inflammation**
- Early stage: **neutrophils**
- Chronic stage:
  – **Mononuclear cells** (lymphocytes, macrophages)
  – **Increase in connective tissue**

Key Point

- Often progresses to **chronic interstitial mastitis**
- Major cause of **economic loss** (reduced milk production)

Mastitis acuta gravis (Severe acute mastitis)

Aetiology

• Usually associated with **coliform bacteria (especially *E. coli*)**
• Also: *Staphylococcus*, *Streptococcus*, *Klebsiella*, *Clostridium*, *Pseudomonas*
• Often **mixed infections**
• Endotoxin release plays a major role (especially in coliform mastitis)

General Characteristics

• Peracute / acute onset
• Severe clinical course
• Poor response to treatment
• May result in **death**

Clinical Findings

- Marked depression, systemic illness
- Udder: **swollen, hot, very painful**
- Skin: **red → dark red / purple**
- Milk: ↓ or absent
- Secretion: **watery, bloody, foul-smelling ± fibrin**

Macroscopic Findings

- Severe **edema (gelatinous appearance)**
- Interstitial tissue expanded
- **Diffuse hemorrhage and necrosis**
- Possible **gas formation** (depending on agent)
- Tissue: soft → later necrotic
- Advanced cases: **gangrene, sequestration**

Histopathological Findings

- Severe **hyperemia and thrombosis**
- **Neutrophil-dominated infiltration**
- **Fibrinous and hemorrhagic exudate**
- Extensive **necrosis of parenchyma**
- Bacteria may be visible in tissue
- In some cases: **gas bubbles (clostridial infection)**

Special Forms

- **Mastitis phlegmonosa** → diffuse purulent inflammation of interstitium
- **Necrotic / gangrenous mastitis** → tissue death, poor prognosis

Mastitis interstitialis

Inflammation primarily affecting the **interstitial tissue** of the mammary gland
• Usually **non-purulent** and often **chronic**

Etiology

• Frequently associated with **viral infections**:
– Maedi-Visna virus (sheep)
– Caprine arthritis-encephalitis virus (goats)

• Other causes:
– *Brucella spp.*
– *Listeria spp.*
– *Leptospira hardjo*
– *Prototheca spp.*

Pathogenesis

- Predominantly **interstitial involvement**
- Minimal luminal exudation
- Often related to **systemic or chronic infections**

◆ Histopathological Findings

- Interstitial infiltration by:
  – **Lymphocytes**
  – **Plasma cells**
  – **Macrophages**
- Progressive **fibrosis** in chronic cases

Mastitis granulomatosa

Chronic mastitis characterized by **granuloma formation**

Etiology

• **Multifactorial**, commonly associated with:
– *Mycobacterium spp.* (tuberculosis)
– *Actinobacillus spp.*
– *Nocardia spp.*
– Fungi
– *Prototheca spp.*
– Occasionally *Staphylococcus spp.*

Pathogenesis

• Occurs in **persistent infections**
• Associated with **cell-mediated immune response**
• Granuloma formation depends on **host resistance and agent virulence**

Histopathological Findings

- Typical granulomas with:
  – Central **necrosis (± caseation)**
  – **Macrophages / epithelioid cells**
  – **Multinucleated giant cells**
  – Peripheral **fibrous tissue**

- Not all infections produce granulomas
- Some may show **exudative inflammation instead**

Cutaneous Lesions of the Mammary Gland

Localized Diseases

Urticaria

- Pale red to pink, **well-demarcated, raised swellings**
- Caused by **hypersensitivity reactions**
- Triggers:
  – Insect bites
  – Allergens
  – Feed-related factors

Burn (Sunburn)

- Erythema and irritation of teats due to **UV exposure**
- More common in **non-pigmented skin**

Frostbite

- Occurs in **cold, wet, and windy conditions**
- May progress to **necrosis or gangrene**

Photodermatitis

- Hypersensitivity to sunlight
- Associated with:
  – Certain plants (clover, buckwheat, vetch)
  – Drugs (e.g., phenothiazine)
- Findings:
  – Erythema
  – Edema
  – Crust formation (especially in unpigmented teats)

Localized Infectious / Inflammatory Skin Lesions

Acne

- Small **pustular lesions** around teat base
- Caused by **pyogenic bacteria**
- Involves **sebaceous glands**

Furunculosis

- Deep infection of **hair follicles**
- Forms **boil-like lesions**

Impetigo

- Superficial pustular dermatitis
- Common agents:
  – *Staphylococcus spp.*
  – *Streptococcus spp.*
- Heals **without scarring**

Skin Gangrene (Udder)

• Due to:
– Trauma (cold, heat)
– Chemical irritation
– Insect bites
– Secondary bacterial infection

• Leads to **necrosis and tissue loss**

Eczema / Exanthema

- Caused by:
  – Poor hygiene
  – Parasites (e.g., mange)
  – Nutritional factors
- Findings:
  – Erythema
  – Pustules
  – Crust formation
  – Fissures and thickening of teat skin

Bovine Herpes Mammillitis

- Caused by **Bovine Herpesvirus**
- Clinical findings:
  – Vesicles → rupture → **erosions and ulcers**
  – Covered by **necrotic crusts**
- Histopathology:
  – Ballooning degeneration
  – Intercellular edema
  – Syncytial cells
  – **Intranuclear inclusion bodies**

Smallpox (Cowpox-like lesions)

• Papules → pustules → crusts
• Characteristic **umbilicated lesions**
• Presence of **Guarnieri bodies** (cytoplasmic inclusions)

Vaccinia

• Transmitted from vaccinated milkers
• Similar to cowpox but usually milder

Paravaccinia (Pseudocowpox)

• Mild lesions
• No umbilication
• No Guarnieri bodies

Papillomatosis

• Caused by **papillomavirus**
• Wart-like proliferative lesions
• Histology:
– Papillary projections
– Mild intranuclear inclusions