

FEMALE GENITAL SYSTEM PATHOLOGY

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What is the benefit of knowing this system?

- It enables the understanding of **reproductive mechanisms**.
- It helps in the **evaluation of developmental anomalies**.
- It supports the **establishment of healthy animal populations**.
- It provides an **important economic contribution by increasing livestock productivity**

Female Genital System – Determination of Sex

Sex is evaluated at different levels:

- **Chromosomal sex:** Depends on the chromosomal structure of **XX or XY**.
- **Gonadal sex:** Determined according to the **histological structure of the gonad** (ovary or testis).
- **Ductal sex:** Depends on the presence of genital structures developing from the **Müllerian and Wolffian ducts**.
- **Phenotypic sex:** Evaluated according to the **appearance of the external genital organs**.

Chromosomal sex → determines gonadal sex → influences phenotypic sex.

Chromosomal Sex Abnormalities

Chromosomal abnormalities:

- 1. Structural abnormalities**
- 2. Numerical abnormalities**

In these animals, gonadal developmental retardation is generally observed rather than the formation of mixed organs.

Structural abnormalities

- Loss of the short arm of the Y chromosome
- Formation of an isochromosome

Isochromosome formation:

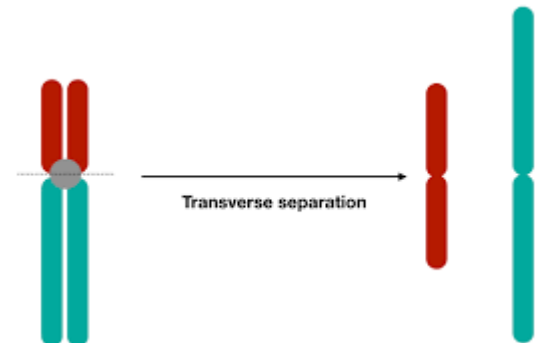
One arm of a chromosome is duplicated, while the other arm is absent.

In these cases:

- The animal generally exhibits a **female phenotype**
- The gonads have a **streak gonad** structure

Examples included in this group:

- XXX females
- XO females (Turner syndrome)

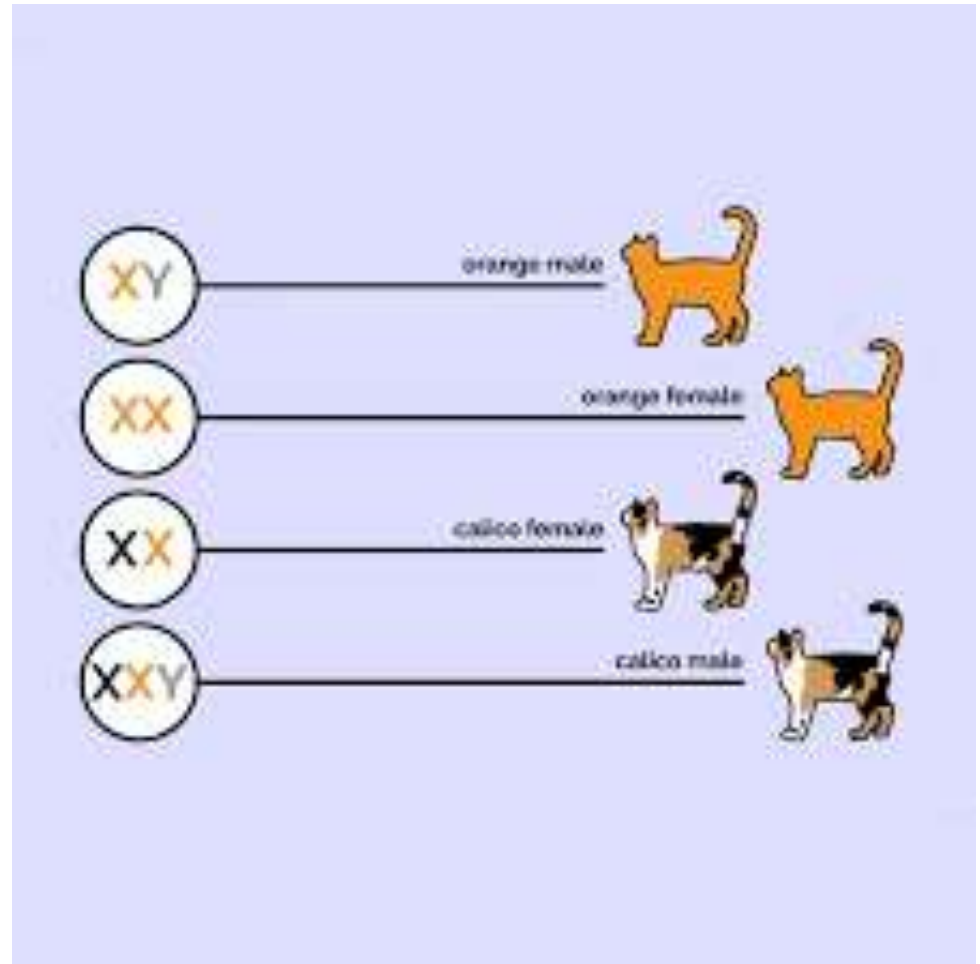


Numerical abnormalities

- Duplication of the sex chromosome
- XXY males (Klinefelter syndrome)
- XYY females

In these animals, generally:

- The external genital organs exhibit **male characteristics**



Chimerism

It is the presence of cell populations with **different chromosomal structures in an individual.**

- **XX / XY chimerism**
- **Phenotypic sex ambiguity**

Various chimerism cases have been described in **carnivores.**

The most common example in domestic animals:

- **Freemartin calf**

Gonadal Sex Abnormalities

Hermaphroditism (Intersex) – The condition in which **genital organs or sexual characteristics belonging to both female and male are present in the same animal.**

In short, this term refers to a situation where **chromosomal, gonadal, or phenotypic sex differs in an individual.**

– True hermaphroditism

- Both **ovarian and testicular tissue** are present in the same individual.

– Pseudohermaphroditism

- The **gonad** is of a single type
- However, the **external genital organs** show characteristics of the **opposite sex**

Sex Reversal

It is the condition in which **gonadal sex does not follow chromosomal sex.**

That is:

- **Testis** development in individuals with an **XX** chromosomal structure
- or
- **Ovary** development in individuals with an **XY** chromosomal structure.

OVARIES

Ovaries – Congenital Anomalies

Developmental anomalies of the ovaries may occur due to various causes.

Main causes:

- Spontaneous cases of unknown etiology
- Genetic disorders
- Chromosomal abnormalities
- Hormonal disorders

General characteristics:

- Rarely observed in domestic and laboratory animals
- May be unilateral or bilateral
- In most cases, additional developmental abnormalities are present in the internal and external genital system

Spontaneous Anomalies of Unknown Etiology

The main anomalies included in this group are:

- **Agenesis** (complete absence of ovarian development)
- **Ovarian fusion**
- **Positional anomalies**
- **Supernumerary or accessory ovaries**
- **Hypoplasia**
- **Gonadal dysgenesis**
- **Freemartinism**

Ovarian Hypoplasia

(Hereditary Gonadal Hypoplasia)

It is a **hereditary disease** observed in **Swedish Mountain cattle**.

Characteristics:

- Transmitted by an **autosomal recessive gene**
- Shows **incomplete penetrance**

Distribution:

- More frequently observed in the **left ovary**
- Approximately **9% of the cases are bilateral**

Gonadal Dysgenesis

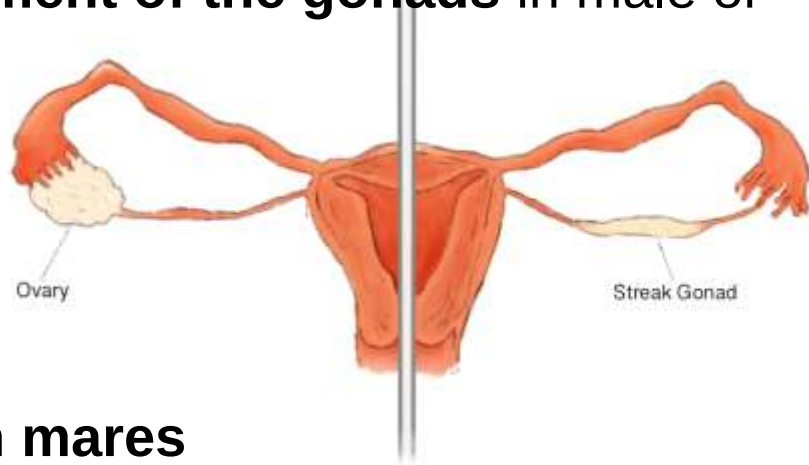
- It is the **abnormal development of the gonads** in male or female animals.

Causes:

- Chromosomal anomalies
- Genetic disorders

Example:

- XO gonadal dysgenesis in mares



In some cases:

- It may also occur **without genetic or chromosomal abnormalities**.

For example: **freemartinism**

XO Gonadal Dysgenesis in Mares

It is the analog of Turner syndrome in humans.

Karyotype: 63, XO

Characteristics:

- One **X chromosome is missing**
- The ovaries appear small and streak-like
- The uterus is hypoplastic

Clinical findings:

- Estrus is not observed
- The cervix is open
- The vulva is smaller than normal

Freemartinism

- It is **a form of ovarian dysgenesis.**

Occurrence:

- Occurs in **heterosexual twin pregnancies**
- When **one twin is male** and the **other is female**

Result:

- The **female offspring is sterile**

Heterosexual twin pregnancy

|
Placental vascular anastomosis

|
Transfer of hormones from the male fetus

|
Abnormal gonadal development in the female fetus

|
Sterile female (Freemartin)

Male fetus → produces **AMH** → hormone enters female twin through shared blood → **female reproductive organs fail to develop normally** → **freemartin female (sterile).**

Progressive–Regressive Changes

Hypertrophy

Atrophy

Ovarian Hypertrophy

- In many animals, the **ovary enlarges with age**.
- **Increase in fibrous tissue** following degeneration of the **corpus luteum**
- **Vascular lesions**

Additionally:

- In **repeated pregnancies**, the ovary becomes **firm**
- After **unilateral ovariectomy**, **compensatory hypertrophy** occurs in the remaining ovary.

Ovarian Atrophy

- It is observed in **severe chronic diseases**.

Causes:

- Long-term systemic diseases
- Severe stress

Findings:

- Follicles become smaller
- The corpus luteum is small
- Ovarian function decreases

Ovulation Papilla (Tag)

After ovulation:

- A **blood clot** and **remnants of follicular fluid** remain on the ovarian surface.

Later:

- A **ligament forms**
- This structure gradually becomes a **fibrous strand**

This **fibrous structure** may extend between:

- The **ovary**
- The **ovarian bursa**
- The **oviduct**

During **rectal examination**, it **easily ruptures** and **does not affect fertility.**

Ovarian Physiology in Cows, Ovarian Endocrinology

Hormone	Source	Main Effect
GnRH	Hypothalamus	Stimulates the secretion of FSH and LH from the pituitary gland
FSH	Anterior pituitary	Initiates follicular development
LH	Anterior pituitary	Induces ovulation and luteinization
Estrogen (E2)	Granulosa cells	Estrus behavior and uterine proliferation
Progesterone	Corpus luteum	Preparation for pregnancy, suppression of LH secretion
PGF2 α	Uterus	Regression of the corpus luteum
Inhibin	Granulosa cells	Decreases FSH secretion

Stages of the Estrous Cycle and Associated Ovarian and Hormonal Change

Phase	Ovary	Dominant hormone	Event
Proestrus	Follicle grows	Estrogen ↑	Regression of the corpus luteum (CL)
Estrus	Dominant follicle	Estrogen ↑	LH peak → ovulation
Metestrus	New CL forms	Progesterone ↑	Luteinization
Diestrus	Functional CL	Progesterone ↑↑	Preparation for pregnancy

Cysts Within and Around the Ovary

Ovary and surrounding ligaments:

- These are **regions where cysts frequently occur.**

For diagnosis:

- It is important to **know the normal size of a mature follicle.**

However:

- **Histological examination is required for definitive differentiation.**
- **The normal follicle size varies depending on the animal species.**

Ovarian Cysts

Within the ovary:

- Normal atretic follicles
- Follicular cysts
- Cystic Graafian follicle
- Luteinized follicle
- Cystic corpus luteum
- Multiple follicles
- Epithelial (germinal) inclusion cyst
- Cystic rete ovarii

Around the Ovary

- Multiple follicles
- Mesonephric tubule and duct cysts
- Paramesonephric duct cysts
- Tubo-ovarian cyst

Physiological Follicular Atresia

It is a **normal physiological process**.

- It can occur at **any stage of follicular development**.
- It continues **throughout the animal's life**.

During the estrous cycle:

- Many follicles develop.
- However, usually **only one or a few follicles ovulate**.
- The **remaining follicles undergo atresia**.

Pathological Follicular Atresia

- May develop as **part of a disease process**.

Causes:

- Hormonal imbalance
- Pituitary or gonadotropin disorders
- Systemic diseases
- Nutritional deficiencies

Consequences:

- Follicular development **stops and regresses**

More commonly observed in:

- Animals showing **anestrus**
- **Cachectic or poorly nourished animals**

Morphology of Follicular Atresia

Types of atresia:

1. Obliterative atresia
2. Cystic atresia

Obliterative Atresia

- Granulosa cells undergo **atrophy**

Cystic Atresia

- Granulosa cells undergo **hypertrophy**
- The **antrum enlarges**, resulting in a **cystic appearance**

Histological Findings of Follicular Atresia

- **Pyknosis and chromatolysis** in follicular cells
- **Degeneration of granulosa cells**
- **Thickening and hyalinization of the basement membrane**

This appearance is sometimes described as a “**glassy membrane.**”

Ovarium Cysts

- Cystic structures of **follicular origin** that develop as a result of **disorders in ovulation or luteinization**.
- Usually associated with **hormonal imbalances**.
- Most commonly observed in **cattle**, and less frequently in **dogs, sheep, and goats**.

Follicular Cysts

Large **Graafian** follicles that fail to ovulate.

Pathogenesis:

- Insufficient **LH secretion** required for ovulation
- Disorders in the **hypothalamus–pituitary–ovarian axis**
- **Hormonal imbalances**

Outcome:

- The follicle **continues to enlarge without ovulation**
- A **cystic structure** develops.

Causes of Follicular Cyst Formation

- Insufficient **LH** secretion during estrus
- Failure of the **hypothalamus** to respond to increased **estrogen levels**
- **Stress** and high milk production
- Disorders in **LH** synthesis

As a result:

- **Ovulation** does not occur
- The **follicle** becomes **cystic**

Follicular Cysts –

Macroscopical Findings

- Cysts may be **single or multiple**
- May occur **unilaterally or bilaterally**
- Usually **larger than 2 cm in diameter**
- Characterized by **thin cyst walls**
- Located **on the ovarian surface or within the ovary**
- May appear **protruding from the ovarian surface**

Follicular Cysts –

Microscopical Findings

- A **layer of granulosa cells** is present around the cyst wall
- **Granulosa cells may degenerate over time**
- **Partial luteinization** may occasionally occur
- In most cases, **luteinization is not prominent**

Hormonal effects:

- **Prolonged estrogenic stimulation** may be observed in the genital system.

Cystic Graafian Follicle

- Frequently observed especially in **cattle and pigs**
- Associated with **disruption of the estrous cycle after parturition**

Diagnostic criteria:

- Follicles **larger than 2.5 cm in diameter**
- **Ovulation or luteinization does not occur**

Pathogenesis:

- May develop following the use of **progesterone-like substances**
- Due to disturbance of the **estrogen–progesterone balance**.

Luteinized Follicle

- Develops as a result of **insufficient or delayed LH secretion**

Characteristics:

- **Ovulation does not occur**
- The follicle **undergoes luteinization**
- **Ovulation papilla is absent**

Histology:

- **Granulosa cells transform into lutein cells.**

Cystic Corpus Luteum

- Develops as a result of **cavitation** within the **corpus luteum**

Characteristics:

- The **luteal tissue** remains as a thin layer
- A **cystic cavity** is present in the center

Clinical significance:

- Usually does not affect fertility
- May not interfere with the establishment of pregnancy.

Lesion	Ovulation	Luteinization	Clinic
Follicular cyst	No	No	E2
Luteinized Follicle	No	Yes	Pr
Cytic CL	Ovulation before	Yes	Fertility normal

Did Ovulation Occur?

No → Follicular cyst or lutein cyst

Yes → Cystic corpus luteum

Is the Wall Thick or Thin?

Thin wall → Follicular cyst

Thick wall → Lutein cyst

Hormonal Effect

Estrogen → Follicular cyst

Progesterone → Lutein cyst / Cystic corpus luteum

The Other Ovarian Cysts

Multiple Follicles

- May develop following the use of **superovulation drugs**.

Epithelial Inclusion Cysts

- Form as a result of **invagination of the ovarian surface epithelium**.

Rete Tubule Cysts

- Develop due to **dilatation of the rete ovarii tubules**.

Paramesonephric Cysts

- Originate from **embryological remnants**.

Inflammation of the Ovary (Oophoritis, Ovaritis)

- Rarely observed in domestic animals; **most commonly seen in cattle.**
- The ovary is **relatively resistant to hematogenous infections.**
- Therefore, it is **usually not affected during septicemia or toxemia.**
- Inflammation generally develops by **ascending spread from the uterus or uterine tube.**

Purulent Oophoritis

- Most cases are **purulent** in nature.
- Characterized by **abscess** formation.
- In cattle, it usually develops **after postpartum metritis or pyometra**.

Main etiologic agent:

- *Arcanobacterium pyogenes* (*Trueperella pyogenes*)

Ovarian Abscess

Abscesses may develop in the following situations:

- **Spread of bacteria from a pyometra-affected uterus into the oviduct**
- **Colonization of bacteria in the crater-like cavity formed after manual removal of the corpus luteum**

Gross Findings

In the **ovary**:

- **Swelling and hyperemia**
- **Yellow purulent exudate on the cut surface**
- **Small or large abscesses in the follicular region**

Oophoritis apostematosa

Chronic Oophoritis

In chronic cases:

- **Increase in connective tissue**
- **The ovary becomes firm and smaller**

Sclerosis ovarii

Infectious Diseases

Lesions of the following diseases are **rarely observed in the ovary:**

- **Tuberculosis**
- **Brucellosis**

Routes of spread:

- **Hematogenous**
- **Ascending**
- **Direct contact**

Oviduct-Uterus

Hydrosalpinx

- Hydrosalpinx is the **dilatation of the oviduct with clear fluid** as a result of **mechanical or functional obstruction**.

Pathogenesis

- The **obstruction** may occur at any part of the lumen.
- Dilatation may be **uniform or irregular**.

Hydrosalpinx

Gross Features

- The wall is thin.
- The length and tortuosity of the duct increase.
- Diffuse multilocular cysts may develop in the mucosa.

Congenital Cases

- May occur in segmental aplasia.
- Particularly observed in freemartins.
- Seen in segmental aplasia of the uterine horns.

Salpingitis

- In most cases, it **develops following uterine inflammation**.
- It is **usually bilateral** and **difficult to recognize macroscopically**.

Gross findings:

- **Mild hyperemia**
- **Thickening of the mucosa**
- **Mild exudate in the lumen**

Microscopy:

- **Acute or chronic inflammation** may be observed.
- Even **mild lesions may affect fertility**.

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Pyosalpingitis

Main etiologic agents:

- *Escherichia coli*
- *Trueperella (Actinomyces) pyogenes*
- *Streptococcus* spp.
- *Staphylococcus* spp.

Characteristics:

- As a result of **inflammation or obstruction**, the **lumen becomes filled with pus**.
- **Numerous neutrophils and other inflammatory cells** are observed microscopically.
- **Inflammatory cells may be present in the mucosa or within cysts**.
- **Squamous metaplasia** may develop in some areas.

Tumors of the Uterine Tube (Tuba Uterina)

- **Very rare in domestic animals.**
- **Most commonly described in dogs.**

Tumor types:

- **Adenoma**
- **Adenocarcinoma**

Origin:

- **From fimbrial or infundibular epithelial cells**

Additional finding:

- **In older dogs, a lipoma may occur in the mesosalpinx.**

Uterine Anomalies

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graph TD; UA[Uterine Anomalies] --> DA[Developmental anomalies]; UA --> PA[Positional anomalies]; DA --> A[Aplasia]; DA --> SA[Segmental aplasia]; DA --> UU[Unicornuate uterus]; DA --> UD[Uterus didelphys]; PA --> T[Torsion]; PA --> P[Prolapse]; PA --> H[Hernia];
```

Developmental anomalies

Aplasia

Segmental aplasia

Unicornuate uterus

Uterus didelphys

Positional anomalies

Torsion

Prolapse

Hernia

Uterus – Congenital Developmental Anomalies

- Major congenital anomalies are **rare in domestic animals.**
- They are **most commonly observed in pigs and cattle.**
- They occur **more frequently in freemartins and hermaphrodites.**

Segmental Aplasia

- *Absence of a portion of the uterine horns or the uterine body.*
- Occurs as a result of a **developmental defect of the paramesonephric (Müllerian) ducts.**

Unicornuate Uterus (Hemiuterus)

- **Absence of one uterine horn.**
- **Occurs as a result of a unilateral developmental defect of the Müllerian duct.**

Characteristic:

- **The remaining horn is usually small and may contain cystic structures.**

Uterus Didelphys

- **Formation of a double uterus.**
- **Each uterine horn is connected to a separate uterine body and cervix.**

Cause:

- **Failure of fusion of the Müllerian ducts.**
- **The cranial part of the vagina may be septated.**

Agenesis of Uterine Glands

- Caruncles and surface epithelium are present, but uterine glands are absent.
- Most commonly observed in cattle.
- Estrus and ovulation occur.
- The corpus luteum persists.

Positional Changes

Hernia

- In dogs, the **uterus may enter the inguinal canal.**

Torsion

- **Most commonly observed in cows.**
- May occur as a result of **pregnancy, pyometra, or mucometra.**

Uterine Torsion – Findings

- **Fetal death**
- **Hemorrhage and necrosis**
- **Venous hyperemia and edema**
- **The fetus may become mummified or putrefied.**

Uterine Rupture

- The **uterine wall** may **tear**.
- The rupture may be **limited to the mucosa** or **may be complete**.

Causes:

- **Dystocia (difficult birth)**
- **Infection**
- **Excessive infusion**

Uterine Prolapse

Most common in:

- Cattle, sheep, and pigs
- Postpartum period

Main causes:

- Dystocia (difficult birth)
- Uterine atony
- Persistence of cervical dilation
- Hypocalcemia
- Estrogenic plants

Consequences:

- Vascular disturbances
- Shock, trauma, and sepsis

Uterine Bending

Versio and Flexio Uteri

- **Bending of the uterus toward the ventral, dorsal, or lateral direction.**

Postpartum Developmental Anomalies

Endometrial Atrophy

- Characterized by **thinning of the endometrium**.

Causes:

- **Hypopituitarism**
- **Old age or prolonged anestrus → loss of ovarian function** (especially in mares)
- **Chromosomal anomalies**
- **Cases of unknown etiology**

Endometrial Hyperplasia

- Particularly important **in sheep and dogs**.
- It may also occur in cattle, cats, and pigs, but is rare in mares.

Main cause:

- Prolonged **hyperestrogenism**

Examples:

- Estrogenic pastures (sheep)
- Follicular cyst
- Granulosa cell tumor
- Phytoestrogens (cattle)
- Zearalenone mycotoxin (pigs)

Findings

Histopathological findings:

- Increase in the number and size of glands
- Mucosa is thickened and edematous

In cystic lesions:

- Glands become filled with fluid
- Epithelium may become flattened

Consequences:

- Reduced **fertility**
- **Dystocia and uterine hypotonia** may develop
- **Endometritis and pyometra** may occur in dogs and cats

*It is not considered a **precancerous** condition in animals!

Adenomyosis and Endometriosis

- **Adenomyosis** is the presence of **endometrial tissue within the myometrium**.
- It is an **important lesion in primates**. However, adenomyosis may **rarely occur in domestic animals such as cats, cattle, and dogs**, and is thought to develop after **prolonged estrogenic stimulation**.
- Its effect may be **clinically insignificant**, or it may cause **diffuse, symmetric, or focal enlargement of the uterus**, sometimes leading to **asymmetric uterine enlargement**.
- In some cases, it may **develop as a malformation**.

Endometriosis

- Presence of endometrial tissue outside the uterus.

Common locations:

- Ovary
- Mesometrium
- Peritoneum
- Surgical scars

Possible mechanisms:

- Coelomic epithelial metaplasia
- Transformation of embryonic tissue remnants
- Lymphatic or vascular dissemination

Inflammatory Lesions of the Uterus

Inflammation of the Non-Pregnant Uterus

In domestic animals, uterine inflammations are common.

Most of these inflammatory conditions develop as a result of the introduction of infectious agents into the uterus:

via semen, or

during **pregnancy, parturition**, and the **postpartum period**.

Classification of Inflammation

- **Endometritis** → Inflammation of the uterine mucosa.
- **Metritis** → Inflammation of all layers of the uterus.
- **Perimetritis** → Inflammation of the serosal layer of the uterus.
- **Parametritis** → Inflammation of the surrounding tissues of the uterus (e.g., lig latum uteri).

Non-Specific Infections of the Uterus

- Non-specific endometritis is caused by bacterial agents.
- These bacteria are not specific to the female genital system.

Pathogenesis

- Under suitable conditions, bacteria colonize the endometrium.
- As a result, transient inflammation and temporary infertility develop.

Occurrence

- It is most commonly observed in heifers mated with frequently used (overused) bulls.

Source of Infection

- The **vaginal flora** of the heifer
- The **penile and preputial flora** of the bull
- These bacteria enter the uterine lumen and cause **endometritis**.

Course

- In recurrent infections, the animal may develop resistance to these bacteria.
- It can also be observed in **artificial insemination** performed with semen that does not contain antibiotics.

It usually occurs after parturition.

Predisposing Conditions

- Abortion
- Retained placenta
- Dystocia (difficult birth)
- Twin birth
- Trauma to the genital tract

Factors facilitating infection:

- Delayed uterine involution
- Necrotic placental and endometrial remnants
- Prolonged opening of the cervix

Result:

- Bacteria multiply within the uterus
- **Endometritis develops**

- **The following bacteria have been isolated from non-specific endometritis in domestic animals:**
- *E. coli* (coliform bacteria)
- *Proteus* spp.
- *Trueperella* (*Actinomyces/Corynebacterium*) *pyogenes*
- β -hemolytic streptococci
- *Klebsiella* spp.
- *Clostridium* spp. (Gram-positive anaerobes)
- *Fusobacterium* and *Bacteroides* spp. (Gram-negative anaerobes)

Nonspecific endometritis – Findings

Macroscopic Findings

- In mild acute cases, no gross lesions may be observed.
- In severe acute cases:
 - The endometrium is swollen and hyperemic.
 - Fibrin strands are present on the mucosal surface.
 - Necrotic areas may be observed.
 - Purulent exudate is present in the uterine lumen.
- The color of the exudate ranges from **gray-yellow to reddish-brown**.

Postpartum:

- Necrotic fetal and maternal placental remnants may be present.

Nonspecific endometritis – Findings

Microscopic Findings

- In mild cases, **neutrophil infiltration** is observed in the endometrial stroma and glands.
- In the surface epithelium, lesions may range from mild desquamation to extensive necrosis.
- As inflammation progresses, neutrophils migrate through the glands and surface epithelium and **accumulate in the uterine lumen**.

Progression of Inflammation

- In the endometrial stroma, the following cells are also observed, especially around blood vessels and glands:
 - **Lymphocytes**
 - **Macrophages**
 - **Plasma cells**
- **This finding indicates the development of a chronic inflammatory component.**

Severe Acute Endometritis

- In most species, it gradually progresses to chronic inflammation.
- The necrotic endometrium is replaced by:
 - granulation tissue
 - fibrous tissue
- Changes observed in advanced stages include:
 - metaplastic keratinization
 - atrophy of uterine glands
 - dystrophic calcification
- At this stage, the number of uterine glands decreases.

Chronic Endometritis

Endometritis chronica hypertrophicans

The endometrial mucosa is thickened.

Endometritis chronica polyposa

Polypoid proliferations are observed in the ducts of the uterine glands.

Endometritis chronica atrophicans

The uterine wall is thinned.

Specific Infectious Agents That Cause Endometritis

- Many specific infectious agents can cause **abortion or stillbirth** in the pregnant uterus.

A large proportion of these agents are transmitted via the *venereal route*.

Bovine Venereal Campylobacteriosis

Etiologic agent:

Campylobacter fetus subsp.
venerealis

Transmission:

Infection occurs through
mating with infected bulls
(coitus) or via **artificial
insemination** using
contaminated semen.

- **Pathogenesis:**

The organism initially multiplies **in the vagina** and, after approximately one week, ascends **to the endometrium**.

In the endometrium, it induces a diffuse acute to subacute inflammation.

The resulting endometritis typically persists for 6–12 weeks.

Course of Infection:

Some cows carry the organism in the vagina as a latent infection.

These animals can serve as a reservoir and source of infection for bulls.

In some infected cows, immunity may develop over time.

Macroscopic Findings:

Gross changes are usually minimal. In mild cases, there may be hyperemia and a dull, mucoid layer covering the endometrium.

Microscopic Findings:

The endometrium shows inflammatory infiltration composed of **neutrophils and plasma cells**.

The inflamed endometrium **is unsuitable for blastocyst implantation**, leading to infertility.

Functional Consequences:

An inflamed endometrium is not suitable for **blastocyst implantation**, resulting in infertility.

Affected animals show repeated estrous cycles due to the effect of infection on **PGF₂α (prostaglandin F₂α)** synthesis and secretion.

- **Pregnancy Outcome:**

If pregnancy occurs, abortion may develop.

- **Herd-Level Impact:**

Because many animals become infected, the condition is referred to as enzootic infertility.

- **Carrier State and Immunity:**

Some cows shed the organism during latent vaginal infection and act as a reservoir for bulls.

A proportion of infected cows may develop immunity over time.

Brucellosis

Etiologic agent:

In cattle: *Brucella abortus*

In pigs: *Brucella suis*

Transmission and effects in cattle:

Brucella abortus is a primary pathogen of the pregnant uterus, and its most important consequence is abortion.

Transmission occurs via the alimentary route or through contaminated semen.

In the non-pregnant uterus, it may cause transient purulent endometritis.

Brucellosis in pigs:

The causative agent is *Brucella suis*.

Transmission occurs via coitus (venereal route) and the alimentary route.

- **Macroscopic Findings:**

Characteristic uterine lesions may be observed in both pregnant and non-pregnant animals.

In non-pregnant animals, the endometrium may **contain 2–3 mm, white-yellow, raised granulomas.**

- **Microscopic Findings:**

Granulomatous inflammation is present.

The granulomas typically consist **of central caseous necrosis** surrounded by histiocytes and epithelioid cells, along with mononuclear cell infiltration.

A small number of neutrophils may also be present.

- **Clinical Outcome:**

These lesions may lead to infertility and, in pregnant animals, may result *in abortion or stillbirth.*

Bovine Venereal Trichomoniasis

Etiologic agent and transmission:

The causative agent is *Trichomonas foetus*, a flagellated protozoan.

Transmission occurs through mating with subclinically infected bulls (**venereal transmission**). The organism colonizes the **vagina, uterus, and uterine tubes**.

Macroscopic Findings:

Early embryonic death or **failure of implantation** may occur.

Infected animals may remain **infertile** for a period but can later **regain fertility**.

Partial resistance to reinfection may develop.

Mucopurulent vaginal discharge may be observed, especially in heifers.

Microscopic Findings:

Purulent endometritis and salpingitis are present.

Numerous *Trichomonas foetus* organisms may be detected in vaginal or uterine discharge.

It is also an important cause of pyometra.

Mycotic Endometritis

Etiology and Transmission:

The non-pregnant uterine mucosa is relatively resistant to fungal infections. However, endometrial damage during parturition facilitates fungal colonization.

The most common agents are *Aspergillus* spp. and *Mucor* spp.

Macroscopic Findings:

Granulomatous lesions develop in the endometrium.

Fungal hyphae can be easily demonstrated using special stains.

Clinical Significance:

Mycotic endometritis is generally not an important cause of infertility.

However, in cattle and horses, it may lead to abortion or stillbirth.

Bovine Tuberculosis

Etiology:

The main causative agents of tuberculosis in cattle are:

Mycobacterium bovis (formerly *M. tuberculosis* var. *bovis*)

Mycobacterium tuberculosis

Mycobacterium avium

Infections with human and avian types are rare and usually mild.

Uterine Involvement:

In generalized bovine tuberculosis, uterine involvement **is observed in approximately 20% of cases.**

Routes of Transmission:

Infection most commonly occurs via: **hematogenous spread**

Less frequently, it may occur via: extension from peritoneal tuberculosis ascending infection through the external genital tract

Macroscopic Findings:

In infections caused by the bovine type, lesions range from small, multifocal endometrial tubercles (diffuse miliary tuberculosis) to diffuse caseous necrosis (diffuse caseous endometritis).

Microscopic Findings:

Miliary tubercles form just beneath the epithelium and around uterine glands.

A typical tubercle consists of:

- central caseous necrosis
- a surrounding fibrous capsule
- occasional mineralization

Caseous Necrotic Endometritis:

Caseous endometritis is observed in areas close to the uterine lumen.

Necrotic foci may extend finger-like into the deeper layers of the endometrium.

Spread:

Primary uterine tuberculosis is rare.

Lesions usually develop as a result of hematogenous spread.

Necrobacillary Metritis

Etiology and Transmission:

The causative agent is *Fusobacterium necrophorum*.

It typically occurs postpartum.

It is most commonly seen in cows.

The organism reaches the uterus via **ascending infection from the vagina.**

Most cases develop secondary to parovarian infections.

Macroscopic Findings:

The disease may lead to sepsis and death.

The uterus is:

- enlarged

- horns are tubularly dilated

- walls are firm

The amount of purulent exudate is usually minimal.

The mucosa shows loose and prominent folds.

On cut surface:

- red, streaked demarcation lines

- friable necrotic layers

- are observed.

Microscopic Findings:

Necrosis, leukocytic infiltration, and young granulation tissue are present.

Inflammation and thrombosis are observed in the veins.

It should be differentiated from caseous tuberculous metritis.

Surrounding resorptive tubercles are helpful for differential diagnosis.

Metastatic lesions may be present in the lungs, heart, and liver.

Bovine Herpesvirus (BHV-1)(IBR, pustular vulvovaginitis, balanoposthitis)

Etiology and Transmission:

The causative agent is *Bovine herpesvirus-1* (*BHV-1*).

It is a venereally transmitted viral infection in cattle.

Clinical Findings:

Transient infertility

Abortion

Necrotic and purulent endometritis

Outcome of Metritis and Endometritis

Mild cases usually resolve with recovery and do not affect fertility.

Acute metritis may often result in death.

Possible Complications in Non-resolving Cases:

- ❖ Chronic endometritis
- ❖ Uterine abscesses
- ❖ Parametritis
- ❖ Perimetritis
- ❖ Salpingitis
- ❖ Pyemia
- ❖ Pyometra
- ❖ Rarely, pyelonephritis

Perimetritis and Parametritis

Perimetritis:

Inflammation of the uterine serosa.

Parametritis:

Inflammation of the tissues surrounding the uterus.

These conditions are rare, as the uterine serosa generally prevents the spread of infection.

Uterine Abscesses

Causes:

Severe metritis

Localized trauma of an infected endometrium

Common Location:

Usually observed in the uterine body (corpus uteri) or in one uterine horn

Macroscopic Findings:

Abscesses may reach up to 30 cm in size

They are thickly encapsulated

Contents:

creamy

foul-smelling exudate

Uterine Abscesses

Etiology:

In pure culture:

Trueperella (Actinomyces) pyogenes

In mixed infections:

A. pyogenes

Streptococci

Staphylococci

If the exudate is:

thick, odorless, and pale green

→ *Pseudomonas aeruginosa* is typically isolated

Spread / Associations:

Large abscesses are:

often attached to the omentum

sometimes connected to the abdominal wall

PYOMETRA

Pyometra is a special form of subacute and chronic endometritis,

characterized by the accumulation of a large amount of pus within the uterine lumen.

Cervical Status and Pathogenesis

- The **cervix is generally closed**, which plays a key role in disease development.
- However, this closure is **not always complete**.

Therefore, in some animals, a **small amount of vaginal discharge** may still be observed.

Mechanism of Cervical Closure

Cervical closure can occur in two ways:

Mechanical causes (less common)

Congenital abnormalities

Acquired structural changes (e.g., fibrosis, trauma)

Functional causes (most common)

The main mechanism is **hormonal**

Role of the Corpus Luteum

The **persistence of the corpus luteum (CL)** is the underlying factor. This leads to:

Continuous secretion of **progesterone**

Effect of Progesterone

Under the influence of progesterone:

The **cervix remains functionally closed**

Uterine contractions are reduced

Immune defense is suppressed

Final Outcome

Pus and inflammatory exudate **cannot be expelled**

Material accumulates within the uterus

This results in: **Progression of uterine infection**

Increased severity of the condition

Corpus Luteum Persistence and Species Distribution

- **Persistence of the corpus luteum is a prerequisite for pyometra**

Species distribution:

- Pyometra occurs:
 - Commonly in dogs and cats
 - With variable frequency in cows and mares
 - Rarely in sheep and pigs

In cattle:

- Corpus luteum persistence:
 - Usually develops secondary to uterine pathological processes
- Characteristic finding:
 - No lesions are present outside the genital tract

In dogs and cats:

- Most cases:
 - Develop following cystic endometrial hyperplasia (CEH)
 - Due to secondary bacterial infections
- Additionally:
 - Pseudopregnancy is an important contributing factor

Pyometra in cows

Pathogenesis

- The pathogenesis of pyometra in cattle:
 - Differs from that in dogs
 - Is generally related to corpus luteum activity

Initiating mechanisms

- Coitus
- Early embryonic death
- Retention of the placenta
- Endometrial damage
- Adequate **prostaglandin F2 α (PGF2 α)** production fails
- The **corpus luteum** cannot undergo luteolysis

Result:

- **Persistence of the corpus luteum**

Effects of Progesterone

- Persistent corpus luteum → continuous progesterone secretion
- Myometrial contractions ↓
- Functional **closure of the cervix**
- Endometrial secretions ↑

→ **Intrauterine infection:**

- Persists
- Progresses

Outcome

- The uterus becomes a favorable environment for pathogens

Macroscopic Findings

- In the uterus:
 - Accumulation of pus/exudate reaching several liters
- Exudate characteristics:
 - Thick
 - Muroid (mucinous)
 - Yellow to greenish-gray in color

Etiological Agents

- *Streptococcus* spp.
- *Staphylococcus* spp.
- *Trueperella*
(*Actinomyces/Corynebacterium*) *pyogenes*

Uterine Wall

- Depending on the duration of infection:
 - Firm, thickened, and enlarged
 - Or thin
 - Or fibrotic

Clinical Findings and Outcome

- This condition:
 - Impairs the general health of the animal
 - May ultimately result in sterility

Early Fetal Death

- The fetus:
 - Undergoes partial maceration

Associated Lesions

- In association with pyometra:
 - Perimetritis
 - Pyosalpinx
 - May occur concurrently

Pyometra in Dogs

Etiology

- In dogs, pyometra:
 - Develops **as a result of prolonged progesterone stimulation**
- In this condition:
 - Cystic endometrial hyperplasia (CEH) develops
 - Followed by secondary bacterial infection
- It is referred to as the **Cystic Endometrial Hyperplasia–Pyometra Complex (CEH–Pyometra Complex)**

Etiology

- The causative bacteria are **non-specific**.
- Under normal conditions, these microorganisms are present in the:
 - **Vagina**
 - **Urinary bladder**
 - **Intestinal tract**
- The most commonly isolated pathogens include:
 - *E. coli*
 - *Proteus spp.*
 - *Staphylococci*
 - *Streptococci*

Macroscopic Findings

- In the **uterus**, the uterine horns may be affected:
 - **Both horns**, or occasionally only **one horn**
- Due to the accumulation of **mucopurulent exudate**, the uterine horns show:
 - **Uniform**
 - or **segmental enlargement**

Cervical Status

- The cervix is usually **closed**, and therefore:
 - The **exudate cannot be expelled**
- However, in some cases:
 - A small amount of discharge may be present in the **anterior vagina**

Streptococcal and Staphylococcal Infections

- In these infections, the exudate is:
 - **Scant in amount**
 - **Yellow-greenish** in color
 - **Odorless** (or only slightly odorous)
- The uterus:
 - Shows **ampulla-like enlargement**
 - Has a **thickened wall**

E. coli and Proteus Infections

- In these infections, the exudate is:
 - **Chocolate-brown** in color
 - **Thick and viscous**
 - **Foul-smelling**
- The uterine horns:
 - Become **markedly thinned (membrane-like)**
- The uterine wall:
 - Becomes **paper-thin**

Pyometra in cats

Etiology

- In cats, pyometra:
 - *Differs slightly from that in dogs*
 - This difference is due to variations in the **estrous cycle** between the two species

Estrus and Ovulation Characteristics

- In cats:
 - Ovulation occurs during **mating (induced ovulation)**
- If pregnancy does not occur:
 - **Repeated estrous cycles** are observed

Time of Pyometra Development

- Pyometra in cats generally develops:
 - **2–5 weeks after estrus**
- It may also occur:
 - After **spontaneous ovulation**
 - Most likely following the formation of the **corpus luteum**

Relationship with the Corpus Luteum

- In many cats with pyometra:
 - **A corpus luteum is not detected in the ovaries**

Cystic Endometrial Hyperplasia (CEH)

- In most cats with pyometra:
 - **Cystic endometrial hyperplasia is present**
- However:
 - The relationship between **CEH** and pyometra **has not been fully elucidated**

However, in approximately half of the cases, a corpus luteum is present and shows a significant association with pyometra development

Pyometra in Mares

Etiology

- In mares, pyometra:
 - **Develops following postpartum infections**, similar to cattle
- However, an important difference:
 - The **estrous cycle continues**
- Therefore:
 - The role of a **persistent corpus luteum is negligible**

Etiologic Agents

- The most commonly responsible microorganisms include:

→ ***Streptococcus zooepidemicus***

→ ***Escherichia coli***

→ ***Pseudomonas aeruginosa***

→ ***Citrobacter freundii***

→ ***Klebsiella pneumoniae***

→ ***Pasteurella spp.***

Relationship with the Estrous Cycle

- In severe cases:
 - **Prostaglandin synthesis and secretion are insufficient**
- As a result:
 - **The duration of the estrous cycle is prolonged**

Macroscopic Findings (Uterus)

- In the uterine lumen:
→ **Accumulation of purulent exudate is present**
- Cervix:
→ **Not closed**
- Therefore:
→ During **estrus**, the exudate is **discharged externally**

Exudate Characteristics

- The **color and consistency** of the exudate:
→ **Vary depending on the causative bacteria**

Structural Changes in the Uterus

- Uterus:
→ **Enlarged (distended)**
→ However, the enlargement may be **non-uniform**

The uterine mucosa may exhibit **necrosis, ulceration, hemorrhage, and hyperplasia-associated squamous metaplasia.**

Complications

- **Uterine rupture** may occur:
 - Leading to **fatal peritonitis**

Systemic Effects (Toxin-related)

- Degenerative changes may develop in:
 - **Heart**
 - **Kidneys**
 - **Liver**
 - **Bone marrow**

Histopathological / Systemic Findings

- Liver:
 - **Histiocyte and plasma cell infiltration**
- Bone marrow:
 - **Depression**
 - **Widespread extramedullary hematopoiesis**
- Kidney:
 - **Immune complex glomerulopathy**

Feature	Cow	Dog	Cat	Mare
Main mechanism	Secondary to uterine pathology	CEH–Pyometra complex	Similar to dog but different cycle dynamics	Postpartum infection
Corpus luteum (CL)	Persistent CL (essential)	Progesterone effect important	Variable (present in ~50%)	Not important / no major role
Progesterone effect	Present	Key factor	Present but inconsistent	Not prominent
Cervix status	Usually closed	Closed (classical)	Mostly closed	Open
Exudate drainage	Absent or minimal	Usually absent	Usually absent	Drains during estrus
Amount of exudate	Large (can reach liters)	Variable	Variable	Variable
Exudate characteristics	Thick, yellow–green	Varies by pathogen	Similar	Varies by pathogen
Common pathogens	Streptococci, Staphylococci, <i>A. pyogenes</i>	E. coli (most common)	<i>E. coli</i> , <i>Proteus</i> spp. etc.	<i>S. zooepidemicus</i> , <i>E. coli</i> etc.
Main predisposition	Postpartum, embryonic death	Cystic endometrial hyperplasia (CEH)	Repeated estrus cycles	Postpartum infection
Endometrial condition	Infected + secondary changes	CEH + infection	CEH common but unclear relation	Necrosis, ulceration, hemorrhage
Estrous cycle	Suppressed	Progesterone-dominant	Recurrent estrus	Cycle continues
Fertility effect	May lead to sterility	Infertility	Infertility	Infertility
Complications	Fetal maceration, pyosalpinx	Uterine rupture, sepsis	Similar	Rupture → fatal peritonitis
Systemic effects	Present	Marked (toxemia)	Present	Marked (multiorgan effects)

Physometra

- Physometra is defined as:
 - **A form of metritis characterized by gas formation**
- In cattle:
 - Commonly observed in **postpartum gas gangrene**
 - Most often associated with **Clostridium septicum**
- In the uterine lumen:
 - **Hemorrhagic–gelatinous exudate, Gas accumulation**
- Uterine wall:
 - **Undergoes necrosis**

Mucometra

- Mucometra is defined as:
 - **Accumulation of excessive mucus in the uterine lumen**
- It develops when:
 - The **normal outflow of mucus is obstructed**
 - Due to **congenital or acquired blockage**
- Alternatively:
 - It may occur with **increased mucus production**,
 - Especially in cases of **hyperestrogenism**

UTERINE TUMORS

Benign Endometrial Polyps

These are rarely found in cats, rats, and mice. They appear as firm, roughly rounded masses, usually sitting on a broad base and protruding from the surface of the endometrium. In cats, these polyps are made of well-differentiated endometrial glands and fibrous connective tissue.

Adenocarcinoma of the Endometrium

It is a disease of older animals.

It rarely develops in animals other than cattle and rabbits.

Postpartum Involution

Definition

- During the postpartum period:
 - The uterus undergoes **physiological changes**
- These changes result in:
 - Return to the **normal (non-pregnant)**
 - **Anatomical and functional state**
- This process is called:
 - **Postpartum involution**

Duration of Postpartum Involution

- In cattle:

- **Pluriparous cows:** ~40 days

- **Primiparous cows:** ~34 days

- Overall postpartum period:

- Reported as approximately **40–50 days**

- In sheep:

- **20–24 days**

- Rate of involution:

- **Fastest:** 🐮 Mare, 🐷 Sow

- **Slowest:** 🐶 Dog

Complications of Postpartum Involution

Retained Fetal Membranes (Placental Retention)

Definition

- Retention of fetal membranes:
 - **Failure to expel fetal membranes within the normal postpartum period**
- In cattle:
 - Normally expelled within **12 hours after parturition**
- If this period is exceeded:
 - Defined as **retained fetal membranes (RFM)**

Pathogenesis / Etiology (Multifactorial)

- Failure of fetal membrane expulsion:
 - Has a **multifactorial origin**
- Main contributing factors include:
 - **Infectious placental diseases**
 - **Mechanical factors**
 - **Nutritional deficiencies** (especially **minerals**)
 - **Hormonal imbalances**
 - **Circulatory disorders**
 - **Hereditary factors**
 - **Abnormal pregnancy course**

Species Predisposition

- **Retained fetal membranes** are observed **most frequently** in **cattle**.

Clinical and Pathological Consequences

- Following retention:
 - **Fetal membranes undergo decomposition**
 - This creates a **favorable environment for bacterial proliferation**
- As a result, the condition may progress sequentially:
 - Mild transient metritis**
 - Postpartum endometritis**
 - Severe uterine inflammation**
 - Systemic disease**

Normal Separation Mechanism

- **Normal placental separation** occurs with the **initiation of uterine involution.**

- During this process:

- **Uterine blood flow decreases**

- **Maternal caruncles shrink**

- **Degeneration of maternal tissue develops**

- **Chorionic villi undergo autolysis**

These coordinated changes facilitate the detachment of the placenta.

Histopathological Features

- Normal and retained placentomes do not show marked morphological differences.

- However:

→ In normal cows:

The number of multinucleated giant cells decreases within 1
hour postpartum

→ In retention cases:

This decrease does not occur

Persistence of giant cells is considered a key
histopathological finding in retained placenta.

Role of Giant Cells

- These cells:
 - **Mediate the fetomaternal attachment**
- Through:
 - **Necrosis and enzymatic release**
 - **They initiate the breakdown of placental attachments and separation**

Association with Nutrition

- At the herd level:
 - **Retained placenta may be associated with selenium deficiency**

Nutritional status, particularly trace element balance, plays a critical role in normal placental separation.

Subinvolution of Placental Sites (SIPS)

Definition and General Features

- **Subinvolution** is a **rare condition**, particularly observed in **dogs during the postpartum period**.
- Clinically:
 - **Serosanguinous vaginal discharge persists for weeks to months after parturition**
 - In dogs **serosanguinous discharge** for 4–6 weeks postpartum is considered **normal**
- However:
 - **Persistence beyond this period** is considered **pathological**

Pathogenesis

- The exact mechanism is **not fully understood**.
- However:
→ **Estrogen and progesterone levels are typically within normal ranges**

Macroscopic Findings (SIPS)

- **Placental sites:**

- **Approximately twice the normal size**

- **In the uterine horns:**

- **Segmental thickening is present**

- **These changes may be visible even from the serosal surface**

- **Luminal surface:**

- **Coarse and irregular**

- **Gray-brown in color**

- **Exudate:**

- **Serosanguinous**

- **May contain fragments of necrotic placental tissue**

Hemorrhage is the main cause of persistent vaginal discharge

Microscopic Findings

Superficial areas:

- **Necrotic cells**
- **Hematoma formation**
- **Thrombosis**
- **Regenerating endometrium**

Deeper layers:

- **Collagen accumulation (fibrosis)**
- **Hemorrhage**
- **Tissue expansion**
- **Decreased density of endometrial glands**

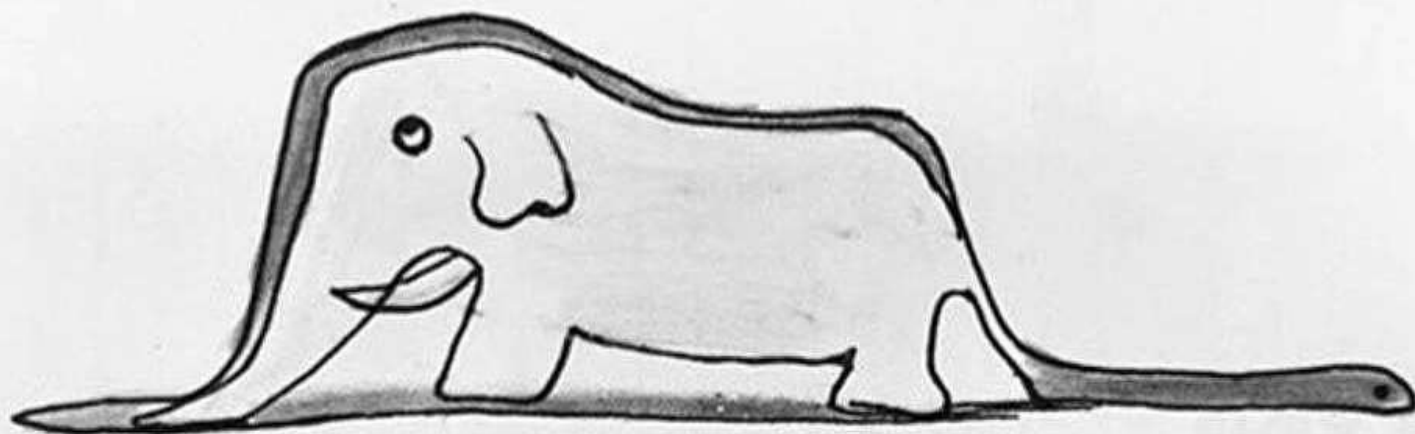
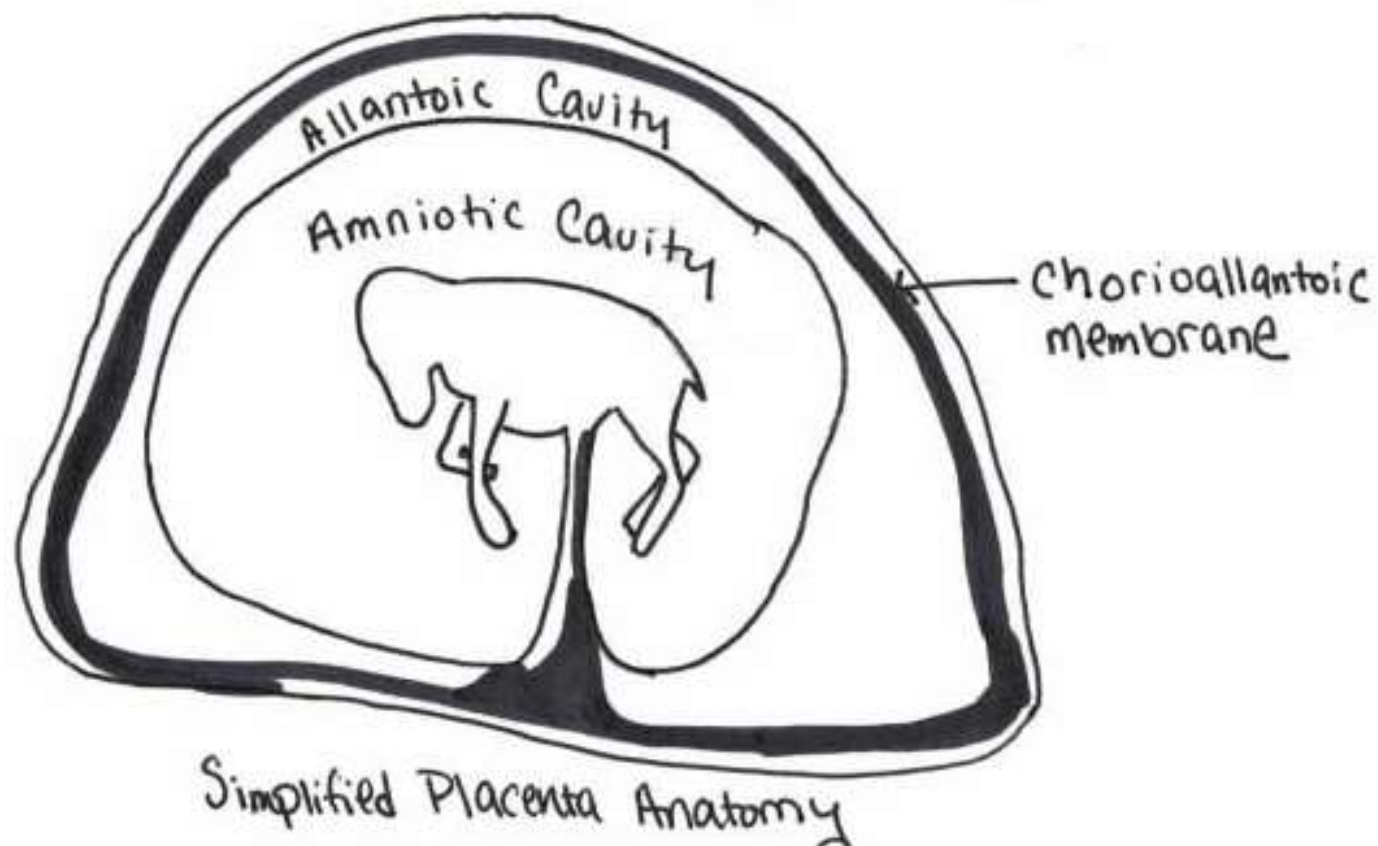
Within collagen-rich areas:

- **Numerous trophoblast-like cells are present**
 - Characteristics of these cells:
 - **Invade into the myometrium**
 - **In some cases:**
 - **May lead to uterine perforation**

Importance of Trophoblastic Cells

- In **subinvolution cases**:
 - **Trophoblastic cells are present in markedly increased numbers**
- Under normal conditions:
 - They are located **around small blood vessels**
- After parturition:
 - **They rapidly undergo degeneration**

Feature	❑ Normal Involution	● Subinvolution (SIPS)
Definition	Physiological return of the uterus to its non-pregnant size and function	Delayed involution of placental sites
Species	All domestic animals	Most typical in dogs
Frequency	Physiological (occurs after every parturition)	Rare, pathological
Vaginal discharge	Normal lochia for 4–6 weeks	Persistent serosanguineous discharge (weeks–months)
Duration of discharge	Gradually decreases and resolves	Prolonged and persistent
Placental sites	Regress and disappear	Enlarged (~2× normal size)
Uterine wall	Uniform involution	Segmental thickening
Surface appearance	Smooth and healed	Rough, irregular, gray-brown plaques
Hemorrhage	Decreases over time	Persistent bleeding
Necrotic tissue	Minimal or absent	Fragments of necrotic placental tissue present
Hormonal status	Normal physiological changes	Estrogen and progesterone levels normal
Pathogenesis	Physiological process	Not fully understood



Hydramnios (Hydrops Amnionii) – Hydrallantois (Hydrops Allantois)

Definition

- These are pregnancy complications characterized by **abnormal accumulation of fluid** in the **amnion and/or allantois sacs**.
- In cattle:
 - They are relatively rare
 - They usually develop separately rather than together
- Normally at parturition:
 - Total fetal fluid volume is approximately 15–20 liters

Physiological Fluids

◆ Amniotic Fluid

- Viscous and mucoid in consistency
- Resembles fetal saliva
- **Originates from fetal secretions**

◆ Allantoic Fluid

- More watery in consistency
- **Originates from fetal urine (via the urachus)**

Hydramnios (Hydrops Amnionii)

Hydramnios (Amniotic Fluid Increase)

Characteristics

- Increase in amniotic fluid volume
- Commonly associated with *fetal anomalies*

Causes

- Musculoskeletal system anomalies
- Especially:
 - Cranial (head) malformations
- Impairment of the fetal swallowing reflex

Hydrallantois (Hydrops Allantois)

Characteristics

- Marked increase in allantoic fluid volume
- More acute and severe clinical course

Causes

- *Placental dysfunction*
- *Adventitial placentation*
- *Twin pregnancy*

Klinik Sonuçlar

Güç doğum (distosi)

Uterus aşırı gerilmesi

Uterus atonisi

Plasenta retensiyonu

Metritis

Fetal Condition

- In the **early stage**:

→ **Abortion is rare**

- In the **advanced stage**:

→ **Fetal death is common**

- In some cases:

→ **Anasarca (generalized edema)**

→ **Ascites (fluid accumulation in the abdominal cavity)**



Yanad Monsef, Kübra Karakaş
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Hazıroğlu. Pathological
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46](https://doi.org/10.33188/vetheder.687446)



Species Distribution

- The condition is **most commonly observed in cattle**, whereas it is **rare in mares**.
- **In mares:**
 - The **allantoic fluid is generally normal in composition**
 - It resembles **maternal and fetal extracellular fluid**
- **Even after expulsion of the fetus:**
 - If **placental retention persists**,
 - **Fluid accumulation may continue**

Fetal Mummification

Fetal mummification is characterized by retention of a dead fetus *in utero*, where it undergoes dehydration without decomposition and becomes a **firm, dry, dark brown to black mass**.

Fetal Maceration and Emphysema

Fetal maceration and emphysema are forms of fetal death associated with *intrauterine infections*, characterized by tissue *disintegration or gas formation* within the fetus

Fetal Maceration

Pathogenesis / Development:

- Intrauterine infection develops first
- This is followed by death of the embryo or fetus
- Fate of the dead fetus:
 - It may undergo maceration
 - It may be resorbed
 - or it may be expelled from the uterus

Etiology (Important):

- The most common causative agents are:
 - *Campylobacter fetus*
 - *Trichomonas foetus*
- These infections are:
 - Especially common in cattle

Pathogenesis (Fetal Maceration)

- **Infection → fetal death**
 - Intrauterine infection leads to **death of the fetus**
- Following fetal death:
 - **Bacterial activity within the uterus increases**
 - This results in **decomposition of soft tissues (maceration)**

Consequences

- Severe endometritis
- Pyometra
- Loss of fertility
-

Fetal Emphysema

- **Definition:**

- A **putrefactive change** characterized by gas formation
- Occurring within the **tissues of a dead fetus**

Mechanism of Development:

- Most commonly associated with:

- **Incomplete abortion**
- **Dystocia (difficult birth)**

- **Pathway:**

- **Gas-producing bacteria** ascend from the vagina into the uterus
- These bacteria act on the **dead fetal tissues**
- Resulting in **gas accumulation (emphysema)**

Fetal Maceration vs Fetal Emphysema

◆ Fetal Maceration:

- **Soft tissues are absent**
- **Bones are free and separated**
- **Uterine content is foul-smelling**

◆ Fetal Emphysema:

- **Fetus is distended (swollen)**
- **Presence of gas within tissues**
- **Crepitation (+) on palpation**
- **Extremely foul odor**