Chapter 10

URINARY SYSTEM

Outline

- **Essentials of Urinary System**
  - o **Kidneys**
    - **Structure of nephron**
  - o **Ureters**
  - o **Urinary bladder**
  - o **Urethra**
    - **Male urethra**
    - **Female urethra**

Urinary system removes wastes from the body.
The urinary system also maintains homeostasis or a constant internal environment within the body

ESSENTIALS OF URINARY SYSTEM
The urinary system consists of two kidneys, two ureters, the urinary bladder and the urethra.

KIDNEYS

SYNONYMS
The kidneys are also called *renes* from which we have the derivative *renal*; and *nephros* from which we have the terms *nephron, nephritis*, etc.

INTRODUCTION
The kidneys are a pair of excretory organs situated in the dorsal part of the abdominal cavity on each side of the aorta and caudal vena cava, just ventral to the first few lumber vertebrae. They lie behind the peritoneum. They remove the waste products of metabolism and excess of water and salts from the blood, and maintains its pH.

LOCATION
The kidneys usually lie ventral to the first three lumbar transverse processes; against the dorsal wall of the abdominal cavity. The kidneys are described as *retroperitoneal*, reflecting their location outside the peritoneal cavity, where they are more closely attached to the abdominal wall by fascia, vessels, and peritoneum than are most other abdominal organs.

RELATIVE POSITION
The right kidney is slightly more cranial than the left. The left kidney tends to be more pendulous, and the forestomach may push the left kidney to the right as far as the median plane or beyond, particularly when the rumen is full.

MORPHOLOGY
The kidneys are bean-shaped and smooth, without any lobulation. They are elliptical in form.

Structure of Nephron

The structures of a nephron include:

GLOMERULUS = cluster of capillaries
BOWMAN'S CAPSULE = cup-shaped structure that contains the glomerulus
PROXIMAL CONVOLUTED TUBULES = hollow tubes involved in reabsorption
LOOP OF HENLE = U-shaped turn that is involved in reabsorption
DISTAL CONVOLUTED TUBULES = hollow tubes involved in secretion

COLLECTING TUBULES = hollow tubes that carry urine from the cortex to the renal pelvis

DESCRIPTION

Each kidney presents:

Two Surfaces
- **i. Dorsal surface**
- **ii. ventral surface**

TWO BORDERS
- **i. Medial border**
- **ii. Lateral border**

TWO EXTREMITIES
- **i. Anterior extremity**
- **ii. Posterior extremity**

…… (See Figure 10 – 1)

GROSS FEATURES OFA KIDNEY

Naked eye examination of a coronal section of the kidney shows two distinguishable zones and other structures;

Cortex: …… It is the peripheral part of the renal parenchyma.
It contains the renal corpuscles and convoluted portion of the tubules.

Medulla: …… It is centrally located dense parenchyma of the kidney.
It gives striated appearance due to presence of numerous collecting ducts in this region.

Cortico-medullary Junction: is formed by the joining part of the cortex and medulla.

Renal capsule: is the outermost strong fibrous covering of the kidney.

Hilus: is present in the middle of the medial border. It passes through the artery, veins and ureters.

Renal Pelvis: is the expanded portion of the ureter within the kidney.

Renal Sinus: is the fat-filled space that contains the vessels and surrounds renal pelvis.

Renal Pyramid: is formed by the medulla portion of the kidney; It is also triangular in outline.

Renal Papilla: is the blunt tip of the renal pyramid which opens into the renal pelvis.

Renal Crest: is formed by the fusion of 12-16 papillae of renal pyramids. Other name; "common papillae"

Arcuate branches: of the renal vessels are apparent at the cortico-medullary junction.

- **Structural anatomy of both the kidneys is almost similar.**

…… (See Figure 10 – 2)

FIXATION OF KIDNEYS

The kidneys are held in position chiefly by:

(i) The pressure of adjacent organs
(ii) The perirenal fat (*capsule adiposa*)

BLOOD SUPPLY

Because of its important role in adjusting the composition of extracellular fluid (including plasma), the blood supply to the kidney is much more extensive than the size of the organ would suggest. The two *renal arteries* may receive as much as one fourth of the total cardiac output.

Each renal artery enters the hilus of the kidney and divides into a number of relatively large branches, the *interlobar arteries*. These pass peripherally between pyramids almost to cortex, where they bend abruptly and become *arcuate arteries*, which derived their name from the arched manner by which they pass along the junction between cortex and medulla.

The *arcuate veins* drain blood from both the cortex and medulla, pass through the medulla as interlobar veins, and enter the renal veins, which emerge from the renal hilus to empty into the caudal vena cava.

NERVE SUPPLY

Sympathetic nerves are the primary innervation of the kidneys. These derive from the celiacomesen-teric plexus and innervate blood vessels and renal tubules.

DIFFERENTIAL FEATURES BETWEEN RIGHT AND LEFT KIDNEYS

RIGHT KIDNEY	LEFT KIDNEY
It is usually a little further cranial.	It is more cauded than the right kidney.
It is quite fixed in position/immovable	It shows slight movement which is caused by the filling of the rumen. / movable
It is extensively related to liver than any other organ.	Its cranial extremity is related to the spleen and dorsal sac of the rumen.
It is related ventrally to the duodenum, right lobe of pancreas, the caecum and descending colon.	It is ventrally related to the descending colon, and the small intestine.
The medial border is related to caudal vena cava.	The medial border is close to the abdominal aorta.

URETERS

The ureters are a pair of narrow, thick walled muscular tubes which convey urine from the kidneys to the urinary bladder. The ureter begins at the renal pelvis and terminates at the urinary bladder.
There are two ureters; one for each kidney, named as right and left ureters.

STRUCTURE
The smooth muscle of the ureter undergoes peristaltic waves of contraction that encourage the flow of urine to the urinary bladder.

DIVISIONS
A ureter may be dividable into two parts;
- **(i) Abdominal part of ureter**
- **(ii) Pelvic part of ureter**

URINARY BLADDER

The urinary bladder is the temporary store house and muscular reservoir of urine which gets emptied through the urethra. The *detrusor muscle* of urinary bladder is arranged in whorls and spirals and is adapted for mass con-traction rather than peristalsis.

SHAPE
The urinary bladder is a long, narrow pisiform mass.

PARTS
It may present three main parts;
- **(i) Vertex: …… It is the anterior blind part.**
- **(ii) Body: …… It is the middle rounded part of the bladder.**
- **(iii) Neck : …… It is the posterior narrower extremity that joins the urethra.**

LIGAMENTS
The urinary bladder is fixed in position by the two types of ligaments.
- **(i) Lateral ligament; two in numbers**
- **(ii) Medial ligaments**

URETHRA

The urethra is the long mucus tube which extends from the bladder to the glans penis.
The urethra is a tube extending from the urinary bladder to the outside of the body.

MALE URETHRA
The male urethra subserving the functions of urination and ejaculation i.e. expulsion of semen
FEMALE URETHRA
The female urethra is for urination only.

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Chapter 11

MALE REPRODUCTIVE SYSTEM

Outline

- **Essentials of Male Reproductive System**
  - Two testicles
    - **Epididymis**
  - Ductus deferens
  - Accessory sex glands
    - **Seminal vesicles**
    - **Prostate gland**
    - **Bulbo-urethral**
  - Penis
    - **Muscles of penis**
  - Prepuce
  - Urethra
- **Other Relevant structures**
  - Scrotum
  - Spermatic cord
  - Inguinal canal
  - Descent of the testis
  - Castration

The organs and glands of the male reproductive tract manufacture the male gamete (*spermatozoon* or sperm) and deliver it to the female reproductive tract.

ESSENTIALS OF MALE REPRODUCTIVE SYSTEM

The male reproductive system consists of two testes (testicles), ductus deferens, accessory sex glands, the urethra and the penis. ……(See Figure 11 – 1 & Figure 11 – 4)

SCROTUM

The scrotum is a cutaneous sac that conforms in size and shape to the testes it contains. It is the diverticulum of the abdomen in which the testes rest. It is ovoid, compressed cranio-caudally, long and pendulous.

LAYERS

The scrotum consists of four layers. (outward to inward)

i) Skin: It is thin, elastic and hairy.
ii) Tunica dartos: It is reddish in color and closely adherent to skin.
iii) Scrotal fascia
iv) Parietal layer of Tunica vaginalis.

CONTENTS

The scrotum contains the following structures:

1. **Right and left testes.**
2. **the epididymis**
3. **lower parts of spermatic cord**

TESTES

The testes (testicles) are the male gonads. They are homologue with the ovary of the female. The spermatic cord (discussed below) suspends each individual testis within the scrotum.

SITUATION

The testicles are held near to the sigmoid (S-shaped) flexure of the penis.

DIMENSION

Each testis weigh about 250-300 gm and its length is about 10 cm.
Each testis is elongated and oval in outline and its long axis is nearly vertical.

DESCRIPTION

Each testis presents for its description;

Two Surfaces

i) Medial surface
ii) Lateral surface
Both the surfaces are smooth & convex.

Two Borders

i) Free border: It is cranial in position.
ii) Attached or Epididymal border: It is caudal in position.

Two Extremities

i) Anterior extremity (head)
ii) Posterior extremity (tail)
Both extremities are rounded.

STRUCTURE

Each testis consists of a mass of coiled *seminiferous tubules* surrounded by a heavy fibrous capsule called the tunica albuginea. A number of fibrous septa, also called *trabeculae*, pass inward from the tunica albuginea, dividing the testis into lobules and providing a framework for support of the seminiferous tubules and the interstitial tissue that produces testosterone. The seminiferous tubules are the site of *spermato-genesis*, the formation of spermatozoa.

The connective tissue between the seminiferous tubules contains the *interstitial cells* (Leydig cells). The interstitial cells secrete the male hormone testosterone when stimulated by the pituitary gonadotropin LH.

***Sustenticular cells* (Sertoli cells) within the seminiferous tubules envelop developing spermatozoa and their precursors. These cells nourish the developing sperms.**

Epididymis

The epididymis is the tube at the upper part of each testis that secretes part of the semen, stores semen before ejaculation, and provides a passageway for sperms. It is closely attached to the caudal border of the testicle…… (See Figure 11 – 2)

The epididymis is composed of a long, convoluted tube that connects the efferent ductules of the testis with the ductus deferens.

PARTS OF EPIDIDYMIS

The epididymis is arbitrarily divided into three parts;

i) Head: into which the efferent ductules empty.
ii) Body: Lying on the long axis of the testis.
iii) Tail: that is attached by ligaments directly to the testis and to the adjacent tunica vaginalis.

LIGAMENTS OF THE TESTIS AND EPIDIDYMIS

There are two ligaments in this aspect, viz;

a) **Ligament of the testis.**
b) Ligament of the tail of the epididymis.

DUCTUS DEFERENS

The ductus deferens, commonly termed the vas deferens. …… (See Figure 11 – 2)
The ductus deferens is a muscular tube that undergoes peristaltic contraction during ejaculation, propelling the spermatozoa from the epididymis to the urethra. It extends from the tail of the epididymis to the pelvic part of the urethra.
The tail of the epididymis is continued as ductus deferens. The ductus deferens leaves the tail of the epididymis, passes through the inguinal canal as a part of the spermatic cord.

SPERMATIC CORD

The spermatic cord begins at the deep inguinal ring, where its constituent parts come together, extends obliquely downward through inguinal canal.

CONSTITUENTS OF SPERMATIC CORD

The spermatic cord consists of the following seven structures.

1) **Spermatic artery**
2) **Spermatic veins**
3) **Lymphatics**
4) **Sympathetic nerves**
5) **Ductus deferens**
6) **Internal cremaster muscle**
7) **Visceral layer of tunica vaginalis**

The first four constituents of spermatic cord are gathered into a rounded mass by mean of connective tissue.

TUNICA VAGINALIS

It is a fold of peritoneum which extends from the inguinal canal to bottom of the scrotum.
It consists of two layers.

1) Parietal layer of Tunica vaginalis: …… It lines the scrotum below.
2) Visceral layer of Tunica vaginalis: ……It covers spermatic cord, testicle and epididymis.

TUNICA ALBOGINEA

It is a strong capsule composed of dense white fibrous tissue & unstriped muscle fibers.

INGUINAL CANAL

The inguinal canal is a passage from the abdominal cavity to the exterior of the body that extends from the deep inguinal ring to the superficial inguinal ring. The deep (internal) inguinal ring is a space or potential space between the caudal border of the internal abdominal oblique muscle and the deep face of the aponeurosis (flat tendon) of the external abdominal oblique muscle.

The superficial inguinal ring is merely a slit in the aponeurosis of the external abdominal oblique muscle.
In addition to the spermatic cord, the canal allows passage of the external pudendal artery and a sensory nerve that serves the inguinal region of the abdominal wall.

DESCENT OF THE TESTES

In both male and female fetuses, the gonads develop in the sublumbar region immediately caudal to the kidneys. In the female animal, the ovaries remain in the abdominal cavity near their origin; but in the male animal, the testes travel (descend) a considerable distance from their point of origin to the scrotum.

The environment of the scrotum features a temperature a few degree lower than that of the normal body temperature; this lowers temperature is favorable to spermatogenesis.

The descent of the testis normally is complete by birth or soon after. It is guided on its journey by the fibrous gubernaculum, a cord like structure that initially extends from the testis through the inguinal canal to the skin in the region that will become the scrotum. As the fetus grows, the gubernaculum draws the testis from the abdominal cavity into the scrotum.

CRYPTORCHISM

It is the condition which is characterized by the indefinite retention of one testicle or both in the abdominal cavity.

CASTRATION

Castration is a term usually applied to removal of the testis of the male animal, although technically it can apply to ovariectomy (removal of the ovaries) of the female animal as well. Early castration also improves the quality of meat animal by inhibiting undesirable secondary sex characteristics (notably the failure to develop marbling of muscle). Table 24-1 lists the common terms for intact and castrated male animals.

Species	Intact Adult Male	Castrated Male
Horse	Stallion	Gelding
Ox	Bull	Steer
Pig	Boar	Barrow
Sheep	Ram	Wether
Goat	Buck	Wether
Chicken	Rooster	Capon

MALE ACCESSORY SEX GLANDS

The male accessory sex glands produce the bulk of the ejaculate, or semen, the medium for transport of sperm. Semen provides favorable conditions for nutrition of sperm and act as a buffer against the natural acidity of the female genital tract.

The accessory sex glands include the seminal vesicles, the prostate gland and the bulbourethral glands.

Male Accessory Sex Glands

Species	Prostate	Seminal Vesicles	Bulbourethral
Horse	+	+	+
Ruminants	+	+	+
Pig	+	+	+
Dog	+	-	-
Cat	+	-	+

+ = Present, - = Absent

Prostate Gland

The prostate gland is an unpaired gland that more or less completely surrounds the pelvic urethra.

The prostate gland comprises various combinations of diffuse and compact parts extending along the pelvic urethra under cover of the urethral muscle. The prostate produces an alkaline secretion that gives semen its characteristic odor. In older intact male animals, the prostate may become enlarged and interfere with urination.

Seminal Vesicles

The seminal vesicles (formerly called *vesicular glands*) are paired glands associated with the genital fold. They are lobulated glands of considerable size. Each vesicular gland merges with the ipsilateral ductus deferens, creating the short ejaculatory duct, which empties in to the pelvic urethra.

Bulbourethral Glands

The Bulbourethral (formerly Cowper's) glands are paired glands on either side of the pelvic urethra just cranial to the ischial arch but caudal to the other accessory glands.

PENIS

The penis is the male organ of copulation which is composed essentially of erectile tissue. It is long, cylindrical with a very much smaller in diameter.

SIGMOID FLEXURE

Just behind the scrotum, it forms an S-shaped curve, called Sigmoid flexure. The position of the flexure affected during erection.

PARTS

The penis presents three main parts:

a. Root of the penis:
It is attached to the lateral parts of the ischial tuberosity.

b. Body:
It constitutes the bulk of the organ.

c. Glans penis:
It is the terminal part and free end of the organ.

GROSS FEATURES ……. (See Figure 11 – 3)

EXTERNAL URETHRAL ORIFICE: It is small external opening of the urethra.

URETHRAL PROCESS: It is a projection twisted in appearance just beyond the glans penis.

GALAE GLANDIS: It is the most anterior part of the glans penis.

CORONA GLANDIS: The galae glandis is surrounded by a prominent margin called corona glandis.

COLLUM GLANDIS: It is the constricted part behind the corona glandis.

RAPHE GLANDIS: It is a furrow/line at the glans penis region.

MUSCLES OF THE PENIS …… (*See* Figure 11 – 5)

1) **Ischio-cavernosum**
   It is short but strong paired muscle which attaches the root of the penis to the ischial arch.
   ACTION: It pulls the penis against the pelvis.
2) **Corpus cavernosum penis**
   It forms the greater part of the bulk of the penis.
3) **Corpus cavernosum urethra**
   Corpus cavernosum urethra M. is also termed *corpus spongiosum*.
   It forms a tube around the urethra.
   In a cross-section, it may look like dots due to its longitudinal arrangement.
4) **Bulbo-cavernosus**
   This muscle is present in a circular fashion around the proceeding muscle in a cross sectional view.
5) **Retractor penis**
   This muscle comprises of two strips which is the continuation of the suspensary ligament.
   ACTION: To withdraw the penis into the sheath/prepuce after erection.

PREPUCE

The prepuce is an invaginated fold of skin surrounding the free extremity of the penis. The outer surface is fairly typical skin, while the inner mucous membrane consists of a preputial layer lining the prepuce and a penile layer covering the surface of the free extremity of the penis.

PARTS

It presents two main parts; External and Internal.

MALE URETHRA

The male urethra is a long mucous tube which extends from the urinary bladder to the glans penis.

LOCATION
The urethra lies in a groove on the ventral surface of the corpus cavernosum penis muscle.

COURSE
It passes caudally on the floor of the pelvis, turns around the ischial arch, forming a sharp bend, and passes forward as a part of the penis, enclosed in the corpus cavernosum urethrae.

PARTS
It may be divided into two parts;

i) Pelvic part
ii) Extrapelvic part

……
……
……

Chapter 12

FEMALE REPRODUCTIVE SYSTEM

Outline

- **Components of female genital tract**
  - **Ovaries**
  - **Uterine tubes**
  - **Uterus**
    - **Horns**
    - **Body**
    - **Cervix**
  - **Vagina**
  - **Vulva**
    - **Clitoris**
  - **Female Urethra**
- **Ligaments of female genital organs**
- **Mammary glands**

The female reproductive tract produces female gamete(ovum, pl. ova), delivers it to a site where it can be fertilized by the male gamete (sperm), provides an environment for the development and growth of the embryo, and expels the fetus when it is capable of survival outside of the mother's body.

COMPONANTS OF FEMALE REPRODUCTIVE SYSTEM

The female organs of reproduction include: two Ovaries, two uterine tubes (fallopian tubes or oviducts), the uterus, the vagina, the vulva. …… (See Figure 12 – 2)

OVARIES

The ovaries, like the testes in the male, are the primary organs of reproduction in the female. The ovaries are both endocrine and cytogenic (cell-producing), since they produce hormones, which are released directly into the blood stream, and ova, which are released from the surface of the ovary in *ovulation*.

OVARIAN BURSA

Each ovary is pouched by the *ovarian bursa*.

LOCATION

The ovaries are paired glands usually found in the lumber region of the abdominal cavity, a short distance caudal to the kidneys. These are almond-shaped.

LENGTH

The length of each ovary is about 1.5 cm.

DESCRIPTION

Each ovary presents for its description;

Two Surfaces

i) Medial surface

ii) Lateral surface

Both surfaces are rounded & smooth.

Two Borders

i) Attached border
ii) Free border

Two Extremities

i) Anterior extremity
ii) Posterior extremity

INTERNAL STRUCTURE

The ovary is invested in a dense connective tissue capsule, the *tunica albuginea*. The *medulla*, or central portion, of the ovary is the most vascular part, while the *cortex*, or outer portion, consists largely of dense, irregular connective tissue interspersed with follicles (developing ova) and interstitial cells, which have an endocrine function.

UTERINE TUBES

The uterine tubes (also called *oviducts*) are paired, flexuous and convoluted tubes that conduct the ova from each ovary to the respective horn of the uterus and are the usual site of fertilization of ova by the spermatozoa.

PARTS

The uterine tube may be divided into three parts;

i) Infundibulum; funnel-shaped part attached to the ovary.
ii) Ampula
iii) Isthmus: joins the uterine horn.

UTERUS

The *uterus* is a muscular hollow organ which is continuous with the uterine tube, anteriorly and opens into the vagina, posteriorly. It is Y-shaped and lies almost entirely within the abdominal cavity.

PARTS

The uterus consists of three parts;

i) Horns
ii) Body
iii) Neck

Horns

The anterior extremity joins uterine tube & posterior extremity unites with the uterine body. They taper gradually towards their free end.

Body

It is very smaller in size and is about 2 cm long.

Cervix or Neck

The cervix is the constricted posterior part of the uterus which projects caudally into the vagina.

The cervix is a heavy, smooth muscle sphincter that is tightly closed except during estrus and parturition. It presents two prominent features; ..... i) Internal oss ii) External oss

INTERNAL STRUCTURE

The inner surface of the cervix is arranged in a series of circular ridges or rings, sometimes called *annular fold*.

REPRESENTATIVE VALUES FOR THE UTERUS	
Length of uterine horns	10 -12 cm
United parts of uterine horns	2.5 cm or more
Length of the uterine body	2 cm
Length of the cervix	About 4 cm

Uterine Glands

The mucosa lining the uterus, the *endometrium*, is a highly glandular tissue that varies in thickness and vascularity with hormonal changes in the ovary and with pregnancy.

The *uterine glands* are simple branched tubular glands that exhibit considerable coiling. These glands are particularly active during estrus and pregnancy, during which they produce a fluid colloquially known as *uterine milk*.

Caruncles

The *caruncles* are mushroom-like projections from the inner surface of the uteri; they provide a site of attachment for the fetal membranes.

VAGINA

The vagina is the portion of the reproductive tract that lies within the pelvis between the uterus cranially and the vulva caudally. The vagina is the birth canal for delivery of the fetus at parturition and a sheath (vagina is *Latin* for *sheath*) for the penis of the male during copulation.

LOCATION

The vagina lies entirely in the pelvic cavity. It is related dorsally to the rectum, ventrally to the urinary bladder and urethra.

LENGTH

The length of the vagina is about 8 cm.

FEATURES

The anterior part presents *fornix vaginae*, on each side of the cervix.

The posterior part is directly continuous with the vulva without any line of demarcation.

VESTIBULE & VULVA

Vestibule

The *vestibule* is the portion of the reproductive tract between the vagina and the external genitalia. The transition between vagina and vestibule is demarcated by the external urethral orifice, and therefore vestibule is functionally common to both urinary and reproductive tracts.

LENGTH

The vaginal vestibule is about 2.5 to 3.5 cm long.

Vulva

The vulva is the external genitalia of the female. It comprises *right* and *left labia*, which meet on the midline dorsally and ventrally at the *dorsal* and *ventral commissures*, respectively.

This segment of the genital tract is measured from the external urethral orifice to the ventral commissure.

The ventral commissure is usually somewhat pendulous and conceals the clitoris.

Clitoris

The *clitoris* is the homologue of the penis. It is a structure of erectile tissue that has the same embryonic origin as the penis in the male. Like the penis, the clitoris consists of two *crura* or roots, a *body* and a *glans*; only the glans is visible externally.

The clitoris is covered by stratified squamous epithelium and is well supplied with sensory nerve endings.

GROSS FEATURES

EXTERNAL URETHRAL ORIFICE: is present ant the anterior extremity of the ventral wall of vulva.

VALVULAR CLEFT: The External orifice of the vulva is known as valvular cleft,

LABIA VULVAE: The valvular cleft is margined by two prominent rounded lips labia vulva.

FEMALE URETHRA

The female urethra only serves for urination. It is narrower and much less dilatable.

LENGTH
The female urethra is about 5 to 6 cm in length.
RELATIONS
It is fused dorsally ..... with the wall of vagina, while
Laterally and ventrally ..... is covered by constrictor vestibular Muscle.

LIGAMENTS OF FEMALE GENITAL ORGANS

The ligaments suspend all the Internal Genitalia except the caudal part of the vagina to dorsal flanks.

TYPES OF LIGAMENTS

1) Broad Ligament of the Uterus
It is the extensive peritoneal fold on each side which attaches the genitalia.
It contains the vessels; *uterovarian* artery; (very prominent in this fold) veins and nerves.

PARTS
Each ligament may be divided into three parts.
- **i) Mesovarian: .....Fold of peritoneum attached with the ovary.**
- **ii) Mesosalpinx: .....Fold of peritoneum that is attached with the uterine tube.**
- **iii) Mesometrium: .....Fold of peritoneum attached with horns and body of uterus.**

2) Proper Ligament of the Ovary
Each ovary is attached with cranial end of the uterine horn by proper ligament. It is short in form.
3) Round Ligament
It is the homologue of the embryonic gubernaculums, but is non functional in adult.
4) Inter-cornual Ligament
It is a small ligament which is present between the horns of the uterus.

GENITAL ORGANS WITH THEIR ATTACHED LIGAMENTS

Ovaries	**Mesovarian, Proper ligament of the ovary, Round ligament**
Horns of uterus	**Mesometrium, Intercornual ligament, Proper ligament**
Body of uterus	**Mesometrium**

MAMMARY GLANDS

The mammary glands are modified sudoriferous (sweat) glands that produce milk for the nourishment of offspring. In case of goat, there are two mammary glands which are relatively larger and approximately globular but flattened on septal side.
UDDER: In ruminants, individual glands are associated so closely to one another that they are commonly referred to as a single *udder*.

LOCATION
They are placed on either side of the median plane in the prepubic region.

COMPOSITION

Each gland is composed of a system of ducts connecting masses of secretory epithelium surrounded by connective tissue and fat and supported in a fibroelastic capsule. The proportion of secretory parenchyma to connective tissue is hormonally dictated; during lactation, the mammary gland's secretory tissue increase in volume. After the end of lactation, (when the dam is dry), the secretory tissues regress, and connective tissue constitutes a greater percentage of the gland.

STRUCTURE

The udders of the ewe and the doe differ from that of the cow in that each half of the udder has only one teat, one streak canal, one teat cistern, and one gland cistern. One half of the ovine (sheep) and caprine (goat) udder resembles one quarter of the bovine (cow) udder. The teat is sparsely covered with fine hair.

SUSPENSORY APPARATUS

The udder of lactating animal can weigh profoundly, so the organ is supported by a dense system of fibroelastic ligament called the *suspensory apparatus*. The primary supportive elements of the suspensory apparatus are its two *medial laminae*, which take their origin together from the linea alba of the abdominal wall and the symphysis of the pelvis.

COMPOSITION OF MILK

Milk contains all of the nutrients necessary for survival and initial growth of mammalian neonates. The nutrients in milk include sources of energy (lipids and carbohydrates), proteins to provide amino acids, vitamins, minerals (ash) for electrolytes, and water. The relative amounts of these nutrients in milk vary among species.

Typical Values for Constituents of Milk in Grams per Liter

Species	Lipids	Lactose	Protein	Ash (minerals)	Calcium
Cow	38	48	37	7.0	1.3
Mare	16	50	24	4.5	1.0
Ewe	70	40	60	8.0	1.9
Sow	80	46	58	8.5	2.0
Doe	40	45	35	7.8	1.2

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