CHAPTER-9

# Anatomy of Male and Female Reproductive System

## Objective

To learn the anatomy of male and female reproductive system

## Introduction

Production of dairy animals largely depends upon reproduction. For successful reproduction, the animal should attain puberty and sexual maturity at right time, insemination or naturally mating at proper time, conceive, carry the fetus for full gestation, calve normally, start cycling and conceive again at right time: Approximately 6 – 8 such cycles can happen in life time of a cow. If there is any break in this cycle, then the reproduction efficiency of the animal and the farm goes down. For efficient reproduction management, proper knowledge about the reproductive organs is necessary. This chapter explains different parts of male and female reproductive system using bull and cow as model.

### Male reproductive system

The basic components of male reproductive system are testis, excurrent duct system, accessory sex glands and supporting structures. Male reproductive system is supported by the pelvis, and is housed internally in the abdomen and outside the abdominal cavity in the region of the groin.

### Testis

Testis (plural, testes) is like a factory that produces spermatozoa. Male hormone (testosterone) is also produced by the testis. The testes are oval shaped and in most of the mammals they descend outside the body into the scrotum. The testis consists of testicular capsule, parenchyma, mediastinum and rete tubules. The testicular capsule covers the testicular parenchyma. The testicular parenchyma can be divided into the tubular compartment comprising of the semeniferous tubules and the interstitial compartment consisting of blood vessels, connective tissue, nerves, lympatics, leydig cells, etc. Several seminiferous tubules are present in parenchyma. Interstitial cells are found in the connective tissue septa surrounding the seminiferous tubules. Sperm production occurs along the entire length of these highly convoluted and densely packed seminiferous tubules within the testes. All of the separate sperm producing tubes however, eventually converge into a single collection tube in the center of the testicle. The interstitial tissue of the testis consists of loose

areolar connective tissue containing numerous reticular fibers, which serves to support the seminiferous tubules. The interstitial cells (Leydig cells), located in this connective tissue, are responsible for the synthesis and secretion of the steroid hormone testosterone.

### Excurrent duct system

The excurrent duct system helps in storage, maturation and conveying the sperm cells out of the testis and eventually out of the body. They include vas efferentia (ductuli efferentes), epididymis, vas deferens and urethra. The epididymis is a large tortuous duct outside the testis through which sperm migrate slowly across the head (Caput), body (Corpus) and tail (Cauda) of the epididymis; the tail portion is the chief site of sperm storage. The epididymis is tightly adhered to the outside of the testicle. The function of the epididymis is to provide environment for final maturation of spermatozoa so that the sperm acquires capacity to fertilize the ovum. The epididymis also serves as a storage reservoir and exit control for spermatozoa. The ductus epididymis continues as the ductus deferens. The vas deferens or ductus deferens is a slender tube connecting the epididymis with the urethra and which enlarges into an ampulla just before joining the urethra. The vas deferens leaves the testicle to become part of the spermatic cord and pass thorough the inguinal canal and enter into the abdomen. Urethra is the tube in the penis through which semen is discharged at the time of copulation and through which urine is excreted. Urine enters the urethra by relaxation of a muscle under voluntary control. Fluids are added to sperm in the pelvic urethra during the process of ejaculation. The male urethra consists of two portions; the pelvic urethra and the penile urethra.

### Penis

Penis is the organ of copulation. The penis provides an outlet for both urine and the copulatory ejaculate (spermatozoa and semen). In general, the penis is composed of three parts viz base (root), body (shaft) and glans. The body of the penis consists of the urethra, erectile tissue, smooth and skeletal muscle, touch and pressure receptors and a dense connective tissue capsule. When a bull is not sexually stimulated, a major length of the penis is flexed inside the body cavity by a paired “retractor penis muscle” called as “Symoid flexure.” Once the male is excited, the neurohormonal mechanism favours relaxation of retractor penis muscle and thus erection, elongation and protrusion the penis outside the prepuce occur.

### Accessory sex glands

Accessory glands include the ampullary glands, vesicular glands (seminal vesicles), prostate gland, bulbourethral gland (cowper’s gland) and urethral gland. The accessory glands are important for adding seminal plasma to the sperm cells. The products of these glands

serve to increase the volume, to nourish and activate the spermatozoa, to clear the urethral tract prior to ejaculation and serve as the vehicle of transport of the spermatozoa in the female tract. Vesicular glands produce most of the volume, energy sources, buffers and ions. The prostate glands lie in close proximity to the pelvic urethera. The bulbourethral glands are paired glands located on either side of the pelvic urethra.

### *Supporting structures*

The supporting structures of male reproductive system comprised mainly spermatic cord, scrotum, tunica dartos and cremaster muscles. The testes are connected to the internal components of the male reproductive system by a cord-like attachment. This connection is called the spermatic cord and passes through a small opening of the abdominal wall called the inguinal canal. The spermatic cord serves as a passageway for blood vessels and nerves, which allows entry and exit for substances necessary to sustain cell life and supply hormones for reproductive regulation. The scrotum encloses the testis and is located between thighs in most of the farm animals with an exception of boar, where it is located caudal to the thighs. The outer layer of the scrotum is skin that is relatively free of hair.

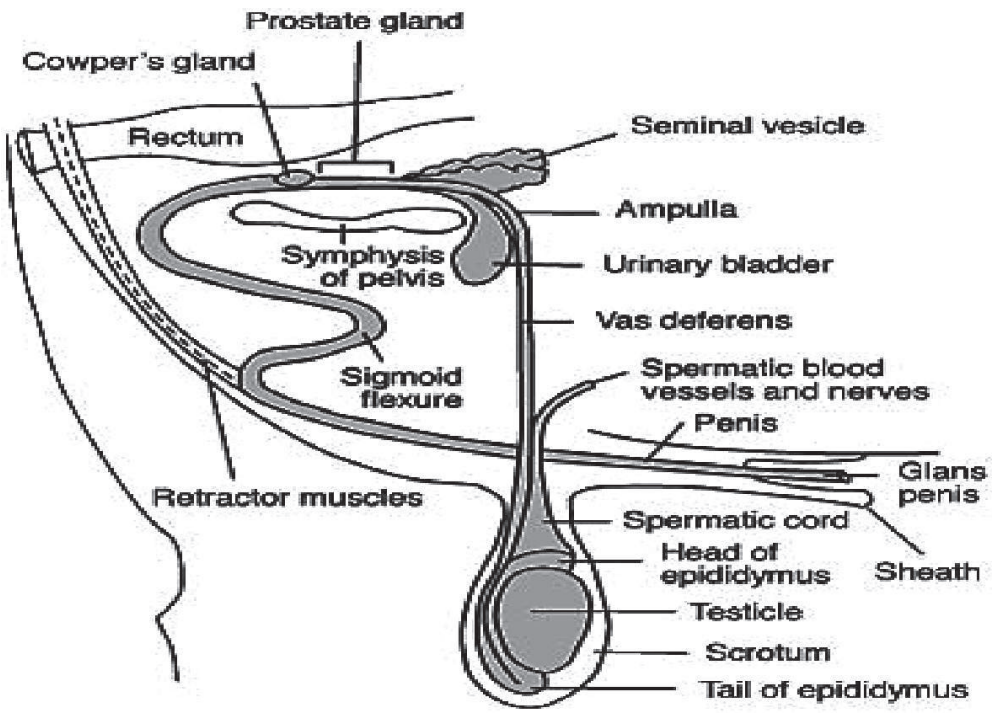



**Figure 1: Parts of male reproduction system**

## Female reproductive system

A thorough understanding of functional anatomy of female genital organs is essential to obtain high conception rates in artificial insemination.

***Internal genitalia:*** The internal genitalia comprise of ovaries, oviduct, uterus and cervix.

*Ovaries:* The normal, mature cow/ buffalo possess two almond shaped ovaries which are suspended in the abdominal cavity by a ligament (the mesovarium) and are partially surrounded by the infundibulum. Size of the ovaries varies with stage of the reproductive cycle and age of the animal, but generally are 1 to 1-1/2 inches long. The cow is born with the maximum number of immature ova (termed oocytes) that she will ever have (between 60,000 and 80,000).

The primary functions of the ovaries are

- Production of the female gamete (egg or ovum)
- Production of two primary reproductive hormones, estrogen and progesterone.

*Oviducts or Fallopian tubes* are a pair of narrow convoluted tubes extending from the ovary to the uterine horn. Each oviduct is supported by the mesosalphinx, that is derived from broad ligament. The oviduct may be divided into four functional segments; the fringe like 'fimbria'; the funnel shaped abdominal opening near the ovary 'the infundibulum'; the more distal dilated 'ampulla'; and the narrow proximal portion connecting the oviduct with the uterine lumen, 'the isthmus'. The major functions of the oviducts are capturing of ova at the time of ovulation, transport of the egg and spermatozoa in opposite directions almost simultaneously, fertilization, transport of zygote and nourishment of the gametes and embryo.

*Uterus:* The body of the uterus of the cow/ buffalo is short and poorly developed, while the uterine horns are relatively long and well developed. The fertilized embryo moves from the oviduct into the uterine horn, where fetal and maternal membrane development begins. This newly developing fetus grows within a layer of membranes called the placenta, through which nourishment from the dam (mother) diffuses. There is no direct blood connection between the fetus and the dam, but rather a complex system that selectively allows certain molecules to pass from the maternal side of the placenta to the fetal side and vice versa. It also provides nutrients from dam to fetus and carries waste products from the fetus to the dam side. The inner surface of the uterus in the cow also contains 70 to 120 caruncles (Caruncles are oval or round thickenings in the uterine mucosa resulting from proliferation of sub-epithelial connective tissue) through which the fetal placenta (cotyledons) attaches and the fetus receives nourishment during pregnancy. Muscular and secretory activity of the uterus is controlled by ovary hormones and oxytocin from the posterior pituitary. The major functions of the uterus are sperm transport, capacitation of spermatozoa, production of prostaglandins for regulation of corpus luteum, nourishment of sperm, embryo and fetus and maintenance and expulsion of fetus.

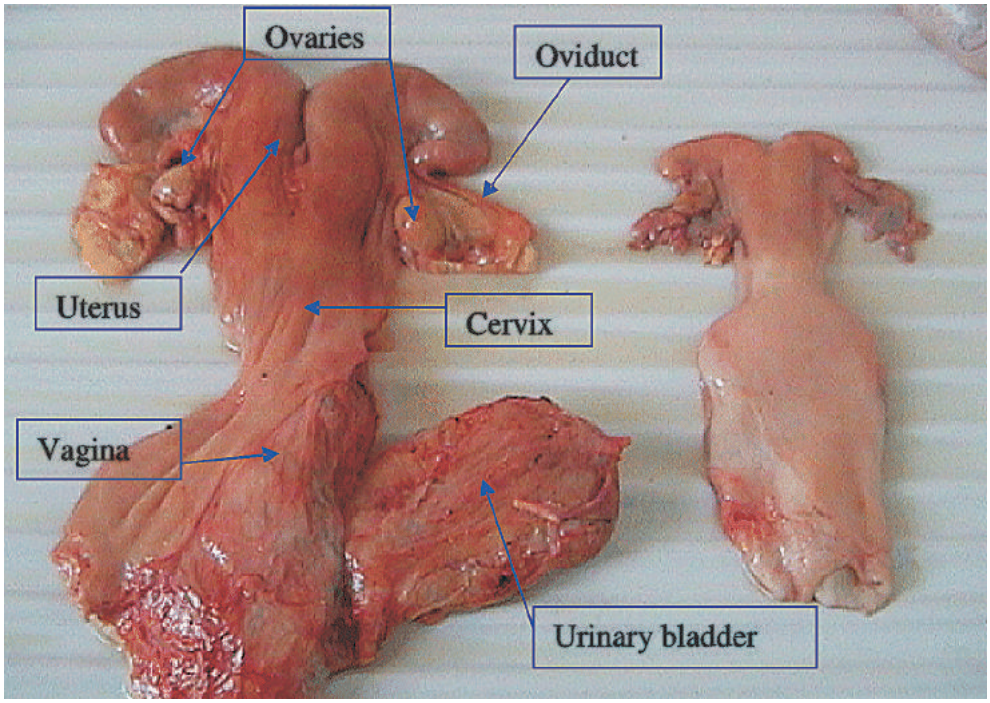
*Cervix:* Neck of the uterus is known as cervix. The primary function of the cervix is to

prevent intruders from entering the uterus. The cervix remains tightly closed throughout the gestation except during parturition and estrus/ heat at which the semen passes to uterus after copulation. It has thick walls and a small opening which softens and relaxes to allow a passageway for sperm at mating and expulsion of the fetus at the time of birth. During pregnancy, the cervix is filled with a thick mucus secretion known as the cervical plug, which protects the uterus from infections entering from the vagina. The cervical plug is expelled and the cervical opening begins to dilate in the days prior to calving. Like the rest of the uterus, the activity of the cervix is controlled by ovarian hormones.

*Vagina:* The vagina serves as a receptacle for the male's penis during mating/service. Vagina is a copulatory organ in which semen is deposited and acts as an excretory duct for the secretions of the cervix, endometrium and oviduct. It also serves as a birth canal during parturition. In case of cows and buffaloes, the semen is deposited in the vagina near the cervix during natural mating by the bull. Whereas during artificial insemination catheter (inseminated gun) is inserted through the vagina and cervix and semen is deposited at the uterine side of the cervix. Urine is discharged from the urinary bladder through the urethra, which opens into the base of the vagina. The region behind the urethral opening is called the vestibule and is a common passageway for both the urinary and reproductive systems. The external opening of the vagina is called the vulva.

### *External genitalia*

The vestibule, the labia majora, the labia minora, the clitoris and the vetibular glands comprise the external genitalia. The vestibule is located between the vulva and vagina forming the caudal termination of the genital tract. The urethra opens into the cranial ventral portion of the vestibule. Just posterior to this opening lies a blind sac called sub uretheral diverticulum. The vestibule has several circular or sphincter like muscles that close the genital canal to the outside. Vulva is located below the anus and constitutes the terminal part of the genital tract opening to the exterior through a vertical slit or cleft. The vulva lips meet above and below the opening at an acute angle forming the dorsal and ventral commissure. The vulva and vestibule are the only reproductive organs of female well innervated by sensorly nerve fibers. The labia minora is poorly developed in domestic animals. Clitoris, a homologous organ of penis in male, is embedded in the lower commissure of vestibule and vulva. The clitoris is stimulated naturally by the bull during mating and if stimulated manually during artificial insemination, it can result in increased conception rates (the success rate of artificial insemination or natural mating in domestic animals, usually expressed as a percentage) in mature cows.




### Note:

The words describing anatomical position in animals such as anterior and cranial are synonyms for towards head, posterior and caudal for towards tail. Proximal means towards body and distal means away from body.

### Activity

Obtain male and female genitalia from slaughter houses and study different parts of the reproductive system. Compare the reproductive tract of cow with buffaloes and identify the differences.

## Review Questions

1. Write the importance of reproductive system
2. What are the different parts of internal genitalia in cows?
3. What are the organs involved in sperm production?