CHAPTER-1
Reproduction

It is sequence of biological events leading to multiplication or production of offspring to ensure the continuation of species.

Sequence of biological events:

1. Differentiation.
2. Birth.
3. Growth.
4. Show the sign of puberty at proper interval.
5. Cyclicity.
6. Copulation.
7. Fertilization.
8. Embryogenesis.
9. Implantation.
10. Parturition.
11. Young ones are born.
12. Post parturient recovery.

Structure and function of reproductive organs in female in different species:

Ovary > Oviduct > uterus > cervix > vagina.

- In non-mammal vertebrates, such as most birds and reptiles, there is a common body opening, called a **cloaca** which functions in the digestive, excretory and reproductive systems. Mating between birds usually involves positioning the cloaca openings opposite each other for transfer of sperm from male to female (ducks are rare among birds in that males have a penis).

Function of ovary:

a) To produce gametes (ova or ovum).
b) To produce female sex hormone-> (estrogen E2, progesterone P4).

SHAPE AND SIZE OF OVARY IN DIFFERENT SPECIES		
ANIMAL	**SHAPE**	**SIZE (mm)**
Cow And Buffalo	Almond	35x25x15
Ewe/Doe	Almond	18x13x8
Mare	--------	70x50x30
Sow	Mulberry/cluster of grapes	No specific

- 75000 ova are present after some time of birth of the individual.
- 2500 are left in the old age of individual.
- **Egg nest -** group of ova and germ cells.

- **Medulla -** it contains connective tissue, blood vessels, nerves and lymphatic system.

Shape of ova/ovum at different stages

In primary and secondary there is different of only one layer but in tertiary oocyte a cavity formed which takes the cells one side make round structures around the ovum known as antrum.

Structure of a mature follicle:

A mature follicle is also known as graffian follicle because of *D. Graaf* given the structure of mature follicle.

Liquor folliculi - Rich in hormone Estrogen (E2).

- **Corpus luteum is yellow in cows and mares.**
- **Corpus luteum is greenish white in sow and ewes.**
- **Luteolysis -** destruction of corpus luteum.
- **Corpus albicans –** it is a white scar appear on ovary when animal is not pregnant
- Blood cells are only upto Theca interna, they produce hormone testosterone **T4.**
- Testosterone change into estrogen hormone by granulosa cells/Estradiol.
- The liquor folliculi is rich in female hormone estrogen.

Corpus Luteum

After ovulation, the ruptured follicle collapses and a small hemorrhage occurs. This blood-clotted area is called a corpus haemorrhagicum and only lasts two to three days. This area begins to be filled by a yellow mass of cells. This yellow body is called the corpus luteum. Its cells have the primary purpose of producing the female sex hormone, progesterone. Production of progesterone prepares the female reproductive anatomy for pregnancy and lasts approximately twelve days unless the ovum is fertilized (in which case the corpus luteum remains untill parturition). A degenerating corpus luteum becomes covered by connective tissue and is called a corpus albicans. The function of the corpus albicans is to remove the yellow cells of the corpus luteum and return the ovary to its normal shape and function.

CHAPTER — 2

Female reproductive physiology and duct system

a) OVIDUCT- it is the tubular part of starting from ovary till uterus. It consists of three parts: infundibulum, ampulla and isthmus.

a. **Infundibulum:** it is in the form of funnel shape outermost part of the infundibulum there are finger like structure known as *fimbriae.* Ovary release ovum is taken by infundibulum.

b. **Ampulla:** it is convoluted tube upto 10-15 cm in length and 3-5 num in diameter. **Note:** the junction between ampulla and isthmus is known as Ampullary-isthmus junction. Reproduction takes place at this junction.

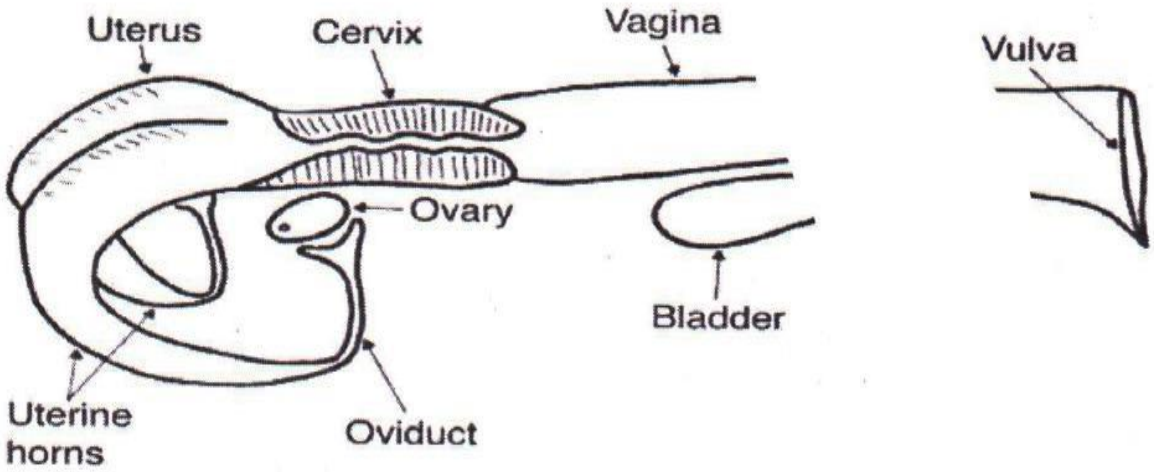
c. **Isthmus:** it is a tube which connects the ampulla through itself to uterus (horns) and the junction between isthmus and uterus is known as uterotubal junction.

- During heat period estrogen level increase and progesterone level decrease.
- During pregnancy estrogen level decrease and progesterone level increase.

b) Uterus: this starts from uterotubal junction to the cervix. It consists of two parts: *Uterine horn and uterine body.*

Normally in non-pregnant case its size is 35-50cm in length.

- In case of cow, buffalo, sheep or goat bicornuate type of uterus is found. In bicornuate type of uterus 80-90% is uterine horn and 10-20% uterus body.
- In case of mare dimension of uterus are 50% uterine horns 50% uterine bodies. This type of uterus is known as bipartite.



- In case of rat, rabbit and guinea pigs duplex uterus is found. Every part/both parts contain foetus or fertilization takes place in both parts.
- In some animals only uterus body is present and uterus horns are absent. This is known as simple uterus. Ex Monkey, woman.
- Endometrium contains glands that secrets nutritional substance for nourishment of foetus and release uterine milk.
- In case of cow, buffalo and ewe the endometrial part show pr*ction they fuse with foetus.

Nature of uterus:

- **Tonned nature:** tight and erect uterus when **E2** increase.
- **Flaccid nature:** loosely packed when P4 increase.

Placenta:

Classification Based on Placental Shape and Contact Points

- **Cotyledonary placenta:** it is present in Cows and *Buffalo.* 70-90 placental layers are present in the last stage of pregnancy. There are 70 to 120 such cotyledonary attachments in a pregnant cow in late pregnancy. There are 88 to 96 in ewes and does,and these are smaller than in cows.
- **Diffused placenta: it** is present in Sow and *Mare,* **In** this placenta extra embryonic membrane is attached with endometrium loosely.
- **Zonary placenta:** it is present in case of *Bitch.* Extra embryonic membrane is attached with in a special zone so it is called zonary type placenta.
- **Discoid:** A single placenta is formed and is discod in shape. Seen in primates and rodents.

Classification Based on Layers Between Fetal and Maternal Blood

There are also three layers or, the maternal side, but the number of these layers which are retained - that is, not destroyed in the process of placentation - varies greatly among species. The three potential maternal layers in a placenta are:

1. Endothelium lining endometrial blood vessels
2. Connective tissue of the endometrium
3. Endometrial epithelial cells

One classification scheme for placentas is based on which maternal layers are retained in the placenta, which of course is the same as stating which maternal tissue is in contact with chorionic epithelium of the fetus.

Types of Placenta	**Maternal Layers Retained**			Examples
	Endometrial Epithelium	Connective Tissue	Uterine Endothelium	
Epitheliochorial	+	+	+	Horses, Swine, Ruminants
Endotheliochorial	-	-	+	Dogs, Cats
Hemochorial	-	-	-	Humans, Rodents

c) Cervix: it is present from end part of uterus to start of vagina. It is a thick walled inelastic structure and about 2-5 cm in diameter and 5-10 cm in length. Inside hole is smaller. On the inner side there are transverse interlocking ridges in the form of angular rings. It secretes the thick mucus type of gel during pregnancy which tightly closed the cervix. It is tighter in advanced stage of pregnancy. It dilates during heat period, estrogen level increase and there is copulation take place.

It is more dilated in case of parturition E2 and relaxin hormone. It is site of deposition of sperm in sow and mare. But in another animal semen is deposited in vagina.
If we collect mucus and spread it on a slide when observe it under microscope, there is high level of E2 and plant like pattern is seen. **It** indicates heat in animals.

d) **Vagina:** thin walled elastic structure. It is the female organ of copulation. In case of cow/buffalo/mare the length of vagina is 20-30 cm and in case of doe/ewe/sow it is 10-15 cm in length.

- During heat period inner cells of vagina becomes confined that loose their nucleus.
- After heat period estrogen increase, epithelium regenerate and helps to making vagina lubricate and protective medium to protect the male reproductive organ from any injury during copulation. This change is more significant in small animal as compare to domestic animals such as cow/buffalo/mare etc.

e) **Vulva:** it consists of two parts: 1. Vestibule 2. Labia
Tubular part is vestibule it is 10-12 cm in length in cattle/buffalo/mare etc. in domestic animal and 4-5 cm in length in small animal such as pig/sheep/goat.

At the junction of vagina and vestibule there is a small thin sheet like structure a bore known as **'hymen'.** Because of small/narrow bore during 1st time copulation there is some bleeding occurred.

Vestibule is the common organ/passage for the urinary and reproductive system or we can say vestibule is the part of female urogenital system.

Outside opening of urethra is known as external urethral orifice. On the external side there is a blind spot known as **'sub-diverticulum'.** About 1cm behind of vulva there is an erectile tissue known as **'clitoris'.** During heat period it is erect.
Generally, it is not visible, but in case of mare it is more erect and dominant.
'winking' can be seen outside.

- **Labia:** outermost part of female genital organ. It is in the form of two pair of folded skin/lips.
  Outer most part of lips is known as **'labia majora'.**
  Inner part of (pair of folded skin) is known as **'labia minora'.**
  Whole part of reproductive system is present in abdominal cavity and whole reproductive organ are supported by a layer known as peritoneum. It helps to support the genital organs in abdominal cavity.
  Supportation of :

Ovary	**Meso – Ovarium**
Ovi – duct	**Meso – Salpinx**
Ulterus	**Meso – metrium**

Rest of part is supported by skin and other layers.

- **Blood supply to reproductive organs.**
  - Blood supply to ovary, ovi duct and half of uterine horns-> utero ovarian artery.
  - Remaining part of uterine body-) median/ middle uterine artery.

Cervix, vagina, vulva, vestibule labia- hypogastric artery.

Note: median uterine artery is large artery and its size is more increase during pregnancy for fast blood circulation to give nutrition to foetus. Fast blood circulation causes vibration known as 'Fremitus'.

Utero ovarian artery vein drain the blood to heart and lungs for purification.

Various functions of female reproductive organ:

➢ Ovaries: these are two oval bodies of size 3x2x1 cm and attached to a ligament by a fold of peritoneum.

I. Function:
II. Producing ova.
III. Producing female hormone- estrogen and Progestrone.

➢ Oviduct: these are two narrow tube also known as fallopian tube. It has three parts:

I. infundibulum
II. ampulla.
III. Esthmus.

Function:

I. Fertilization take place here.
II. Transport egg from ovaries to uterus.

Uterus :- it is a thick walled hollow muscular organ situated in abdominal cavity. It has 3 parts.

I. Uterine horns.
II. Uterine body.
III. Cervix.

Function: -

I. Passage way for.sperm during copulation.
II. Incubation and nourishment of embryo during pregnancy.
III. Expulsion of foetus during parturition.

➢ **Cervix:** a' thick walled mass of connective tissue with a small tube like opening. The tip of cervix presents a depression called external os.

Function:

I. It joints the uterus to vagina.
II. It serves as a passage way for semen during copulation.

> **Vagina** :- it is a' muscular tube of length-about 20 cm and has external urethral!brifice.

Function:

I. It serves as receptable for - penis.
II. It serves as birth canal during parturition
III. Acts as passage way for urine

Vulva: the external portion of female reproductive ifadhan tidal most part of birth

canal.

Function:

I. It serves to protect internal system from infection.
II. Initially receive the penis at copulation.
III. Acts as a passage way for urine.

STRUCTURE AND FUNCTION OF THE MALE REPRODUCTIVE SYSTEM IN POULTRY

The male reproductive anatomy of poultry differs when compared to that of other animal species. The poultry anatomy consists of two *testes* (each with an *epididymis* and *vas deferens)* that lead to *papillae* and a rudimentary copulatory organ. The testes are unique in that they are located along the backbone within the abdominal cavity. Exactly how the testes produce viable sperm within such a warm body temperature is still not completely understood. The epididymis is small in relation to the size of the testis but still functions in sperm storage. Both vas deferenses extend from the epididymis to the *cloaca* and are located on each side of the vertebral column. They function in transportation of sperm and as sperm reservoirs. The cloaca is the portion of the lower end of the avian digestive tract that provides a passageway for products of the urinary, digestive, and reproductive tracts.

The copulatory anatomy consists of two papillae and the rudimentary copulatory organ. The papillae are located at the end of the vas deferens and on the floor of the cloaca. They are the organs that emit semen into the cloaca. The rudimentary copulatory organ is only used for sex identification of young chicks, but it is erectile in ducks and geese. During copulation, the sperm is passed from the papillae into the oviduct opening or cloacal wall of the female. Androgen is the male sex hormone produced by the testes. It not only directs sexual activity and the production of sperm, but it also controls secondary sexual characteristics of the male. These characteristics include comb growth, crowing or gobbling, and strutting. Social rank or "peck order" is also influenced by the rate of androgen secretion.

FEMALE REPRODUCTIVE SYSTEM IN POULTRY

The female reproductive system in the domestic fowl consists of the ovary and the accompanying oviduct. While the female embryo in chicken has two sets of reproductive organs, only one of these, the left survives and reaches maturity to produce eggs. The single surviving ovary is located in the laying hen just rr front of the kidneys in the abdominal cavity and is firmly attached to the wall of the cavity. The ovary is well endowed with blood vessels to ensure there is no hindrance to the transport of nutrients to the developing yolk.

Ovary

The ovary consists of a mass of yellowish, rounded objects called follicles, each containing an ovum or yolk. There are many such follicles but only a smar number in comparison, will ever reach maturity to produce an egg. When the hen is in lay the ovary will be active. The size of the follicles will vary from very small to those

approaching the normal yolk size in the egg which can be up to 40 millimetres in diameter, and will contain a fully matured yolk ready for release into the oviduct.

It is possible to find five stages of development in the active ovary:

1. Primary follicles — follicles that have not yet commenced to grow
2. Growing follicles
3. Mature follicles — follicles ready or nearly so for release
4. Discharged follicles — where the yolk has just been released
5. Atretic follicles — those from which the yolk has been released some time ago

Yolk

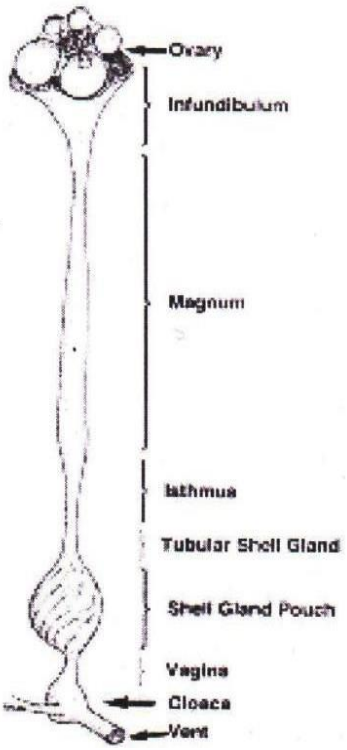
It takes approximately 10 days for a yolk to develop from the very small to the normal size

found in eggs and during this time it is contained in the foldcle. The follicle acts as a sack

during this period of development supplying it with the nutrients required for its growth. When a mature follicle is examined an elongated area virtually free of blood vessels will be found on the distal surface of it. This area, called the stigma, is where the follicle normally splits to release the yolk into the oviduct. If, for some reason, the follicle splits at other than the stigma, the numerous blood vessels that rupture will result in free blood being found in the egg i.e. a blood spot will form.

Oviduct

The function of the oviduct is to produce the albumen, shell membranes and the shell around the yolk to complete



the egg. It is a long tube well supplied with blood via numerous blood vessels. There are many glands found in its walls that produce the albumen, the shell membranes and the shell. In the non-layer the oviduct is quite short and small in diameter. However, once the reproductive system becomes active, it grows to a length of 70-80 centimetres with a variable diameter depending on the function of the section being examined.

The oviduct consists of five distinct parts or sections, each having different functions:

1. **Infundibulum (or funnel):** located adjacent to the ovary and with long segments enclosing the ovary, the infundibulum collects the yolk after its release from the follicle as a funnel and directs it into the oviduct. This section has very thin walls and is 6-9 centimetres long. Fertilisation of the ovum by the male sperm.occurs here.
2. **Ampulla or magnum:** at approximately 40 centimetres long fit secretes more than 40% of the albumen.
3. **Isthmus:** at about 12 centimetres in length, it secretes some albumen and the shell membranes.
4. **Uterus or shell gland:** at approximately 12 centimetres in length it secretes about 40% of the albumen and the egg's shell.
5. **Vagina:** at approximately 12 centimetres in length, it secretes the egg's outer cuticle and possibly the shell pigment.

CHAPTER – 3
Male reproductive system in domestic animals

1. **Testis :** primary sex organ of male. It is covered with pouch of skin, protective muscular fibrous tissue known as scrotum. It is attached with inguinal region with spermatic cord.
2. **Accessory sex glands :**

1. Testis : primary male reproductive organ, oval and round in shape according to species, size of testis: cow/buffalo, bull and boar:
   10-13cm in length
   5 – 6 cm width
   300 – 400 gram weight
   But size is smaller in ram/buck and stallion.
   Gubernaculum: testis developing in male unborn animal during pregnancy in abdominal cavity and contact with scrotum by gubernaculums. Its size decrease as the maturation of animal.

- Descending occurs in mid pregnancy - cow/buffalo/sheep/goat.
- Descending occurs in late pregnancy - boar.
- Descending occurs around pregnancy - stallion.

Cryptorchid: The animals whose testes/testis are nor descend to scrotum. It is of two types: cryptorchidism.

a. Unilateral cryptorchidism.
b. Bilateral cryptorchidism.

- **Tunica vaginalis:** Outermost covering of testis which is extension of peritoneum.
- **Tunica allbuginea:** Below tunica vaginalis there is a white fibrous layer.
- **Parenchyma:** structural tissue of testicles is divided into compartments. Each compartment contains large no. structure of testis. Seminiferous tubules structures. Seminiferous tubule contains different type of cells; at different stages they develop into N immature sperm.
- **Germ cells/spermatogonia:** small cells and the place 'where sperm develop.
- **Sertoli cells:** these are large cells also known as nourish cells. The hormone FSH (follicle stimulating hormone) act on these Sertoli cells and help them to produce ABP (androgen binding protein) and also another hormone known as 'Inhibin hormone'.

Two hormones are secreted by anterior pituitary gland:

1. FSH

2. LH

1. FSH: FSH stimulates testicular growth and enhances the production of an androgen-binding protein by the Sertoli cells, which are a component of the testicular tubule necessary for sustaining the maturing sperm cell. This androgen-binding protein causes high local concentrations of testosterone near the sperm, an essential factor in the development of normal spermatogenesis,

2. LH: it acts on leydig cells these cells to produce testosterone. Testosterone diffuse into spermatogonia and development of spermatogonia lead to produce immature sperm. LH also helps in breakdown of ova into corpus luteum in female (non pregnant).

Function of testosterone:

a. Production of male gametes/sperms.
b. Helps in developing secondary male sex characters and differ the male from female.

seminiferous tubules join together form the rete-testis and many rete-testes join together and form vasa efferentia and in last they form/join with epididymis. A pouch of thick skin which consists of testis is called scrotum. It contains sweat glands and sebaceous gland (secrete sticky substance). It has fine hair on the surface of scrotum. It also contain a layer of smooth muscle known as tunica dartus. It also divided scrotum two parts for both testes (left testis and right testis) then these testes are attached with scrotum/tunica dartus through tunica vaginalis.

Testes are attached with abdominal through spermatic cord. This cord contains testicular artery, vein, vasa deferens, nerves, cremester muscle they provide supports to testis.

Note: These highly convoluted veins form a plexus known as pampinifor plexus.

Function of scrotum/spermatic cord:

a. They support testis in their proper position.
b. Scrotum protect testis from external injury. This area is minimum exposure to injury.
c. Thermoregulation is done by scrotum/spermatic cord.

Note: Spermatic cord provide proper temperature of blood for sperm production. The blood come from testicular artery is warm and the blood of vein is cold. Testocigar artery and veins are close to each other. The blood warmth of artery is taken by vein and blood reaches to the testis is somewhat cold which is helpful in formation of sperm and vein get blood is somewhere warmer which reaches to the heart.

Testes contract during cold temperature they attach with abdomen. They relaxed during summer and somewhat away from the body. The area of scrotum will be more in summer. Sweat glands present on scrotum secrete sweat. There is evaporation occurs. There is formation of evaporating process/cooling during high temperature.

The temperature of testis is somewhat less then body temperature.

Epididvmus: it is pipe occupy the 60% space of testis. **It** consists of three parts:

a. **Head** - Caput epididymis.
b. **Body -** corpus epididymis.
c. **Tail** - cauda epididymis.

a. Head: it is attached with vasa-efferentia and takes sperm from testes.
b. **Body:** coiled folded structure around testis os known as body of epididymis.
c. **Tail:** it is attached with vasa deferens. It transfers the sperm to vasa deferens through caudal epididymis.

Function of epididymis:

a. Transport of spermatozoa. It takes 9-15 days from transport to storage.
b. It consists of smooth muscle, the smooth muscle contract.
c. Concentration of spermatozoa. Head and body absorb fluid and increase concentration.
d. Storage of spermatozoa. It takes place in tail part.
e. **Maturation:** before storage, spermatozoa are non-motile and non-fertile, During/after storage there occurs a change and it helps in maturation of spermatozoa,

Vas deferens/ ductus deferens: it starts from tail of epididymis to urethra. It becomes dilated at one site known as ampulla. They contact with urethra. They transport sperm. It also has smooth muscle. These muscles contract and help in transportation of sperm,

Urethra: it is a tubular part of urogenital system from ampulla to external part of ponls,

There is secretion from accessory sex glands. It is mixed with secretion of accessory sex gland known as seminal plasma.

Sperms mixed with seminal plasma are known as semen.

- **Accessory sex glands: The** four major accessory sex glands are the ampulla, the vesicular glands (seminal vesicles) and the bulbourethral glands.
- **Ampulla —** This gland is an enlargement of the terminal portion of the ductus deferens and consists of branched tubular or tubuloalveolar glands without a specialized excretory duct. The ampulla is fully developed in ruminants, and horses where the glandular structures are located in the lamina propria. These glands are absent in dogs, cats and swine.
- **Vesicular glands (seminal vesicles) —** These glands are typically paired and are composed of simple columnar glandular epithelium which is arranged in lobutes. The excretory ducts are lined by stratified columnar epithelium. Vesicular glands are absent in carnivores but present in horses, swine and ruminants.
- **Prostate glands —** The prostate glands consists of the main body and a disseminate portion. The body is surrounded by a thick collagenous capsule whOle the disseminate portion is embedded in loose collagenous matrix extending along the dorsal aspect of the urethra and eventually extends laterally and ventrally to join the body. The gland is histologically composed of tubuloalveolar structures composed of low columnar to

cuboidal cells, have apocrine gland type secretory activity and have acidophilic granules and lipid droplets in the epithelial cytoplasm. The body is well developed in carnivores and horses while the disseminate portion is better developed in cattle and swine. Rams do not have a well-developed prostate.

- **Bulbourethral glands —** These are paired structures located dorsolateraily to the pelvic urethra and are composed of paired tubuloalveolar glands with columnar epithelium. The ducts of this gland are lined by columnar, pseudostratified or transitional epithelium. All domestic animals except for dogs have bulbourethral glands. The mucus production from this gland has lubricating function and clears the urethra of urine.
- Cowper's gland is much larger in 'boar' as compare to another species.
- Secrete little amount of fluid than other glands.
- Helps to flush the urine from urethra to protect the semen/sperm from harmful effects of urine.

Just from ejaculation/copulation droplets/ dropping is seen which the secretion of Cowper's gland.

Penis: organ of compulation in male reproductive system. It is a cartilageal muscular structure. In cow and buffalo bull, boar and ram there is a sigmoid flexure (S-shape)during non-exited stage or condition. Structure is present which old penis (during non-excitement and a retractor muscle is attached to this flexure to retract the penis in the pelvic cavity during non-excitement stage.

Two erectile tissues are present in penis. These are

- **Corpus spongiosum penis.**
- **Corpus cavernosum penis.**

They cause:

a. More accumulation of blood.
b. Stiffness and eniargement of penis.
c. Ejaculation of semen during excitement stage.

Tip of penis i.e. (glans penis) highly sensitive much larger in equine.

Different in different species.

Prepuce/sheath: Inviginated skin which encloses the free end of penis and protect it. At the opening of prepuce, there are long touch airs are found known as preputial hair to keep this clean.

- Prepuce is same embryonic origin as compare to ‘labia minora’.
- Scrotum is same embryonic origin as compare to ‘labia majora’.
- Glans penis is penis is same embryonic origin as compare to ‘clitoris’.

Blood sypply to the organs of male reproductive system

- Scrotum gets blood supply from ‘external pudendal artery’.

- Testis gets blood supply from 'internal spermatic artery'.
- Penis and accessory sex glands get blood supply from 'internal pudental artery'.

FUNCTION OF MALE REPRODUCTIVE ORGANS:

➢ **Testis:** The testes are located outside the body cavity in scrotum.

Function:

I. To produce male gamete i.e. spermatozoa/sperm.

II. To produce male hormone i.e. androgen/testosterone.

➢ **Epididymis:** It is a compact flat elongated structure and has a body, ahead and a tail.

Function:

I. Transport of sperm from testicles to Vas deferens.

II. Concentration of sperm by absorption of surplus fluid.

III. Maturation of sperm.

IV. Storage of viable sperm.

➢ **Spermatic cord:** It is a tube from head of epididymis to the inside of body cavity.

Fuction:

➢ Spermatic blood vessels and nerves which give nutrition fr the formation of sperm cells.

➢ It connects epididymis to vas deferens.

➢ Support the testis.

➢ **Vas-deferens:** It starts from tail of epididymis and passes as part of spermatic cord through the inguinal ring into body cavity.

Function:

I. It transports the sperm from epididymis to urethra.

➢ **Accessory sex gland:**

i. Seminal vesicle:

a. Contribute seminal plasma.

b. Provide energy and buffer action to sperms to protect them.

ii. Prostate glands:

Add inorganic salt i.e. Na, K, Cl, Ca, Mg to seminal plasma.

iii. Cowper's gland/ Bulbourethral gland:

a. Flush the urethra to protect the spermatozoa from harmful effects of urine.

Function:

i. Make up most of the liquid portion of semen.

ii. Become the sperm more molile.

iii. It flushes cleans the urethra.

➢ **Urethra:** the two vas-deferens eventually unit into a single tube, the urethra, which is a chain passing through the penis.

Function:

i. It serves as a common passage for semen and urine.
ii. All glands are secreted here.

- **Penis:** It is a cylindrical structure and organ of copulation. It consists of three part- roots, body and glans penis. The outer sheath is called prepuce.

Function:

I. It is an organ of copulation.
II. It is a passage of secreting urine and sperm.

Scrotum: It is a cutaneous sac and situated in front of inguinal region. It consists the both testes.

Function:

I. It consists and protects testicles.
II. It controls the temperature of whole body.
III. Thermo regulation of testis through tunica dartus.

- **Glans Penis:**

I. Same as penis and help in stimulation of penis by erectile tissues.

- **Prepuce:**

I. Encloses penis.
II. Protect the glans penis from unwanted contamination.

CHAPTER – 4

ESTROUS CYCLE OF DOMESTIC ANIMALS

Puberty: The condition of being or the period of becoming first capable of reproducing sexually that is brought on brought on by the production of sex hormones and the maturing of the reproductive organs (such as the testes and ovaries), development of secondary sex characteristics.

- After birth of animal, they are not mature at that time. They take proper age, weight and time to be prepared for reproduction.
- It is the 1st appearance of sexual activity in male and female.
- 1st appearance of heat in female is known as puberty of female.
- Ejaculation and tightening of penis ins known as puberty of male

The animal should be mentally prepared for reproduction. GnRH hormone is released through pituitary gland at the age of puberty.

Puberty age in domestic animal in months			
Breed	**Female**	**Male**	**Weight(in kg).**
Cow (cross bred)	11-13	11-14	200-225
Cow	17-24	18-30	350
Buffalo	24-30	24-30	300
Goat	6-7	6-8	30-35
Sheep	7-10	7-11	30-35
Pig	6-7	6-8	70-90
Horse	20-24	20-24	300-350
Dog	9-20	9-12	10-50

Puberty age delayed due to factors:

- Depending upon the species.
- Depending upon season.
- Poor health (chronic disease).
- Poor nutrition.

ESTRUS CYCLE:

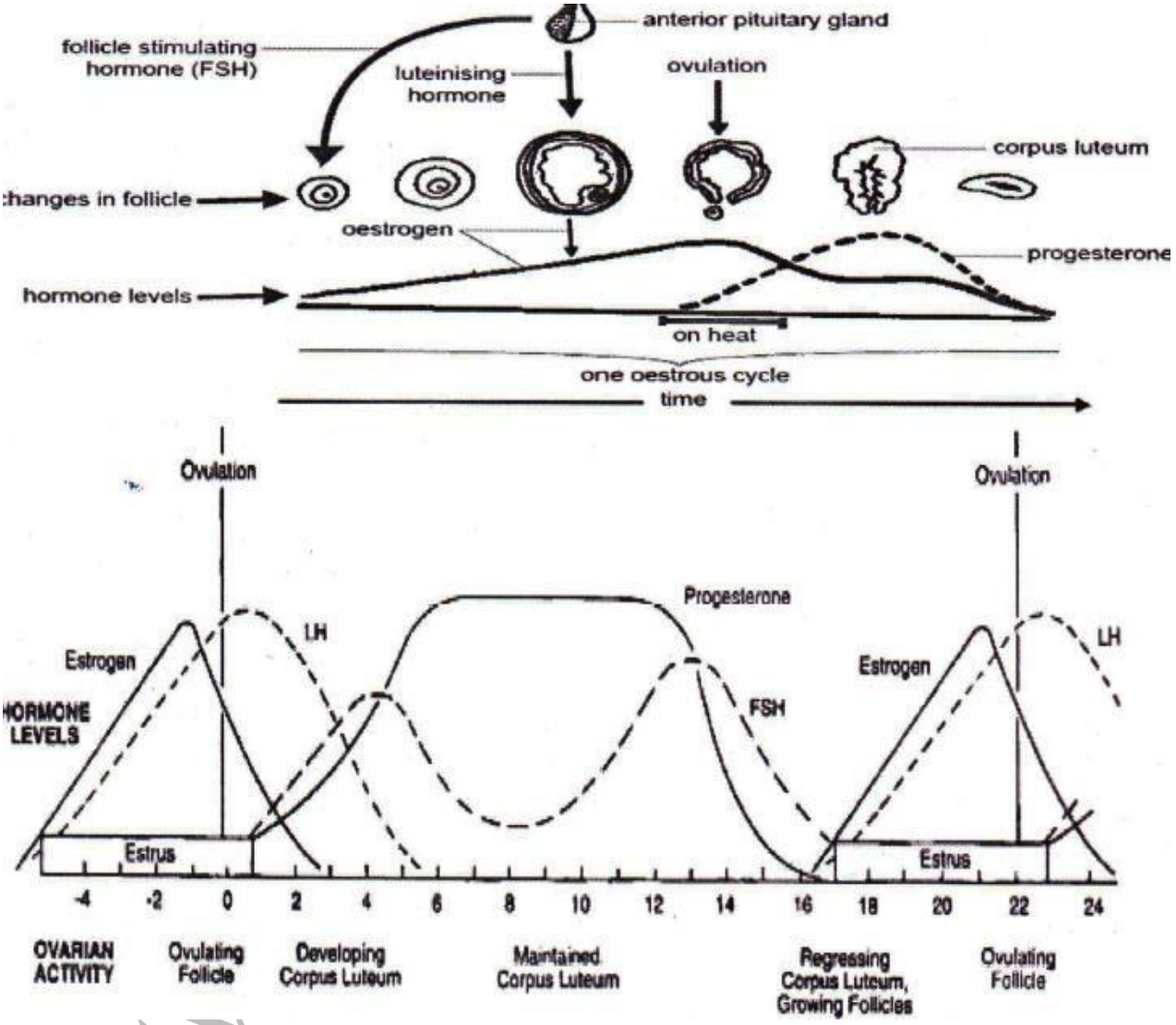
It is the series of physiological sexual activity attain animal between these two successive estruses and between two heat periods.

The estrous cycle or oestrus cycle comprise the recurring physiological changes that are induced by reproductive hormones in most mammalian there in females. Estrous cycles start after sexual maturity in females and are interrupted by anestrous phases or by pregnancies. Typically, estrous cycles continue until death. Some animals may display bloody vaginal discharge.

The five phases of oestrus:

1. Proestrus.

2. Oestrus.
3. Metestrus.
4. Diestrus.
5. Anestrous.



Phases of the estrous cycle:

The basic pattern of the estrous cycle is the same in all domestic animals, but some specific differences are found in specific parts of the cycle. The estrous cycle may be divided into several phases based on behavior changes or structural changes in internal and external genitalia.

Stages: The estrous cycle can be divided into four stages: proestrus, estrus, met estrus, and diestrus. **During Proestrus** the CL regreses progesterone declines) and a preovulatory follicle undergoes its final growth phase (Estradiol increases). Ovulation usually occurs during estrus (cows ovulate during **met estrus). Proestrus and estrus** comprise the follicular phase. Corpora luteum develop during met estrus and function at optimum during **diestrus. Metestrus** diestrus make up the luteal phase.

- **Estrus/ heat phase:** It is considered as the day one of the estrous cycle. During this period female animal is receptive to male and this period lasts for about 12-18 hours. In this animal show different symptoms.

a. It stands to be mounted or attempt to mount other animal. i.e. Homosexual behavior.
b. There is appearance of stringy copious mucus hanging/ out of vagina.

Signs of Heat in cattle and buffalo:

1. **Restlessness and Isolation:** The animal becomes restless and she isolates from other animals.
2. **Excitement:** The animal shows sign of sexual excitement.
3. **Reduced or loss of appetite: The reaction of the animal to feed is reduced or totally lost.**
4. **Increased body temperature.** The animal develops unusual high body temperature.
5. **Vaginal discharge:** There would be mucus discharge from the animal vagina/vulva.
6. **Mounting:** An animal on heat will always mount or ride other animals as shown on the sketched diagram above.
7. **Frequent urination:** The animal starts urinate frequently.
8. **Swollen vulva:** The vulva of animal which is in heat found to be swollen.
9. **Bellowing:** Animal do bellowing in heat.
10. Lordosis type of posture is seen in pigs and cat.

Signs of heat in mare:

Some signs are general:

1. Including restlessness, hyperactivity, less time devoted to eating and resting, and more time “running the fences.”
2. Other signs more descriptive of estrus are frequent urination, straddling (squatting) posture, and **clitoral “winking”**
3. Mares exhibiting strong heat will actually lay against a fence or teasing partition when exposed to the teaser, a stallion used to make mares exhibit estrus.

Estrous signs of sheep and goat:

1. Redness of the vulva and discharge from vulva.
2. Tail waging.
3. Mounting other animal.
4. Seeking male.
5. Frequent bleating.
6. Push her back.
7. Standing for mating (standing reflex).

Signs of heat in bitch:

1. She will urinate and the smell of this will excite the male.
2. She may stand and then race around and play and tease the dog.
3. It the male is slow to mount the bitch may mount him.
4. Other females may mount the bitchin heat.
5. Standing heat, the bitch stands with her back curved and tail held to the side.
6. The vulva of the bitch will become red and swollen and thick mucus and blood may be seen.

Wallowing: It is the behavior of buffalo/cattle in pond and in sand.

Integral sign of heat:

a. Increase in blood circulation to vagina, the vagina may be reddish or swollen.
b. There is increase blood circulation in uterus, turgidity/ tightening of uterus and horn.
c. Increase in size of ovary due to development of graafian follicle on the ovary.
d. Cervix may be soft and open.

Ovulation occurs after 10-12 hours of heat and the sperm is ready for reproduction at that time after AI.

- **Metestrus:** This starts after end of heat period and lasts for about 3 days. In early period, there is ovulation, the blood capillaries shrink and during shrinking, there is rupturing of R.B.C. and blood comes out through vagina. This is known as Metestrus bleeding.

  There may be decrease in mucus secretion due to decrease in E_2 hormone, decrease tone of uterus and follicle will start to change in corpus luteum which secrete P_4 hormone. Follicle cells start converting into luteal cells.

- **Diestrus phase:** In this, follicle completely develops into corpus luteum, there will increase in P_4 hormone, decrease in E_2 level.

  The uterus becomes soft, placid and ready to receive the embryo and prepare the uterus for pregnancy to occur. If animal is not pregnant then uterus secrete (PGF_2) hormone, this will reach ovary and destroy the corpus luteum by travelling through blood. It causes luteolysis, P_4 decrease and increasing FSH rising again and there is forming of follicle.

Proestrus: It is in between 17-21 days.

Period before estrous and after diestrus in known as proestrus. During this, there is complete lysis of corpus on ovary, there is initiation of development of follicle and E_2 level start rising.

Follicle start rising and E_2 level continuously increase and the animal again show the eymptoms of estrous.

- **Anestrous:** None occurrence of heat.

  Gestational anestrus (pregnant animal)

  Pathological anestrus (due to formation of pus in genital organs)

Estrous cycle is broadly classified in two phases:

Follicular phase:

The follicular phase is the phase of the estrous cycle, during which follicles in the ovary mature. It ends with ovulation. The main hormone controlling this stage is estradiol (E2). There are several steps in the process of follicular development that occur in the follicular phase: Initiation, Recruitment and progression, Pre-ovulatory maturation and Ovulation

Luteal phase:

The luteal phase is the later phase of the cycle of the earlier phase of the estrous cycle. It begins with the formation of the corpus luteum and ends in either pregnancy or luteolysis. The main hormone associated with this stage is progesterone, which is significantly higher during the luteal phase than other phases of the cycle. The opposite of the luteal phase, the rest of the two weeks, is called the follicular phase.

Note: longest phase is **diestrus** and smallest phase is **estrus.**

Hormonal/Endocrine regulation of estrous cycle:

Hormones regulate the estrous cycle. Hypothalamus secrete many releasing factors. These releasing factors act on pituitary gland and excite the pituitary gland to provide GnRH and other hormone.

GnRH stimulates the gonads also GnRH acts on anterior pituitary glands help in secretion of FSH and LH.

Note: In hypothalamus, there are 2 centers to produce GnRH.

1. Tonic centre.
2. Surge center (high level).

   FSH and LH act on hypothalamus and secrete gonadotrophin. FSH help in development of follicle on ovary the follicle grows and also help in developing different cells i.e. theca interna and theca externa.

Receptor cells for	FSH	Granulosa cells
	LH	Theca interna

LH binds a theca interna and produces the testosterone T_4 hormone from cholesterol.

Then testosterone diffuses to granulosa cells and under the influence of FSH hormone, T_4 is converted into E_2 in granulosa cells.

At the time of heat, maximum growth of granulosa cells crosses the threshold level.

- Maximum peak level of E_2 hormone.
- More secretion of LH hormone by stimulation of surge center., then LH hormone act on developing follicle and ovulation occurs. Also help in brusting of luteum due to which bleeding occurs known as corpus haemorrhagicum.
- During Matestrus: theca interna and follicle convert into luteal cells and increase the level of P_4 hormone.
- During diestrus P_4 cause decrease in GnRH and low level of E_2 and high level of P4 due to inhibitory effect. So no developing follicle.
- Corpus luteum produce oxytocin in some amount during diestrus not by pituitary gland) and help in contraction of uterus during parturition. Small amount of E_2 during diestrus. Wall of uterus acts as receptors for oxytocin and provided environment for implantation.

When animal is not pregnant: oxytocin binds with uterus so producing hormone PGF_2^*

PGF_2^* helps decrease in blood circulation and destruction of CL in ovary destroy the luteal cells P_4 level decreases negative feed balance is removed next cycle start.

If animal is pregnant: no PGF_2^*. So continuous increase in P_4 level.

Certain animals secrete exocrine origin substance (direct secrete their secretion into the blood).

Pheromones: These are some substances secrete by some individual but effect the other individual odorous substance secreted by some exocrine origin and these are derived from fatly acids.

For example: In bitch, the perineal area secretes some substance known as pheromones, smelled by a day from a distance and can move for copulation.

Pheromones secreted by boar and smelled by sow shows 'Lordosis positions stand'.

Cow perineal area secretes pheromones Bull comes there and recognize by VNO Vomaro Nasal Origin (Excessory olfactory origin) found in nasal cavity but ducts open in palate

Flehmen reaction. Sexual behavior of bull.

Based on estrous cycle Animal is classified into 3 categories:

MONOESTRUS ANIMALS:

Dogs, wolves, foxes and bears are animals that are characterized as having a single estrous cycle per year. Domestic canids typically have three estrous cycles every two years but they are generally classified as monoestrus.

POLYESTROUS ANIMALS:

Estrous cycles throughout the year (cattle, pigs, mice, rats).

SEASONALLY POLYESTROUS ANIMALS:

Animals that hve multiple estrous cycles only during certain periods of the year (horses, sheep, goats, deer, cats).

Sheep(short day breeder).

Mare(long day breeder)- Longer duration of sunshine.

Note: Buffalo is a poly estrous animal another type of estrous cycle i.e. menstrual/menstruation cycle is found in monkey and primates (human being).

Estrus cycle in different species:

Sr. No	Species	Estrous Cycle	Estrus	Metestrus	Diestrus	Proestrus	Time of Ovulation
1.	Cow	21 days	12-18 hours	3-4 days	10-14 days	3-4 days	10-12 hours after end of estrus
2.	Buffalo	21 days	10-16 hours	3-4 days	11-15 days	3-4 days	10-12 hours after end of estrus
3.	Ewe	17 days	24-36 hours	2-3 days	10-12 days	2-3 days	Late estrus
4.	Doe	20 days	34-38 hours	2-3 days	10-15 days	2-3 days	Late estrus
5.	Sow	20 days	48-72 hours	2-3 days	11-13 days	3-4 days	Mid estrus
6.	Mare	22 days	4-8 day	2-3 days	10-12 days	2-3 days	1-2
7.	Camel	20 days	1-7 day	2-3 days	8-10 days	2-3 days	During estrus
8.	Bitch	16-56 Weeks	7-8 days	------	-------	------	1-3
9.	Rat	5 days	12 hours	10-14 hours	60-70 hours	12 hours	During estrus

CHAPTER – 5
GESTATION PERIOD OF DOMESTIC ANIMALS

Pregnancy/ gestation:

The time interval between fertilization and parturition.

The time interval from fertilization till the young ones are delivered by organism is termed as Gestation/ Gestation period.

Sr.no	Species	Time Interval	
		In days	In Months
1.	Cow	280±5 days	9m±9D
2.	Buffalo	315±5 days	10M±10D
3.	Mare	340±5 days	11M±11D
4.	Sheep And Goat	150±5 days	5M±5D
5.	Pig	113±3 days	3M 3W ± 3D
6.	Camel	405 ± days	13M ±13D
7.	Bitch	60 + 2 days	2M ±2D
8.	Rat and Mice	21±1 days	---------
9.	Monkey	160 ± 5 days	5M ± 5D
10.	Elephant	660 ± 10 days	22M ± 22D
11.	Ass	365 ± 10 days	12M± 12D
12.	Rabbit	31 ± 1 days	1M ± 1D

Ampullary Isthmus junctions the junction where the fertilization takes place in female reproductive tract.

Capacitation: change in sperm in female reproductive tract.

When ovum fuses with sperm at Ampullary isthmus junction and form a cell known as zygote. P_4 help in formation of uterine mild during diestrus after some time, the zygote gets attached to uterus and implantation occurs, then known as embry. It attached with uterine endometrium.

For cow/buffalo:

0-15 days	**Zygote**
15-45 days	**Embryo**
45-270 days	**Foetus**

Young ones are after parturition

Implantation occurs in:

Sr. no	Days	Animal species
1.	**12-20 days**	**Sow**
2.	**18-20 days**	**Sheep/Goat**
3.	**30-35 days**	**Cow/Buffalo**
4.	**50-60 days**	**Mare**

16-32 cells stage in embryo is termed as ‘morulla’.

There will be hatching of embryo termed as 'Gastrulla' at the time of formation of organs from these tissues/ cells.

Differentiation stages are:

- Ectoderm.
- Mesoderm.
- Endoderm.
- Primitive Gut.

➢ For determination of sex in foetus two duct system are responsible:

- Mullerian duct (mesonephric duct).
- Wolfian duct (mesonephric duct).

In the embryonic stage testis develop earlier than the ovary and other female reproductive parts. If embryo having XY chromosome, there is secretion of testis determining factor TDF, this will causes secretion of antimullerian hormone and causes regretion of Mullerian duct and wolffian duct develops/ start to convert in vasa-efferentia, epididymis, vasa deferens, urethra.

Chromosome are XX but if the foetus is female then Mullerian duct starts to convert into ovary, fallopian tube and other female reproductive organs during this stage, there is no secretion of TDF and antimullerian hormone.

➢ **With passage of time:**

Heart beat starts at	22 days
Forelimb bud starts at	25 days
Hind limbs starts at	28 days
Eye along with lens starts at	30 days
Distinct facial features/ development of leg and hoof starts at	45 days
Calcification starts at	70 days
Tooth development starts at	110 days
Extensive bone formulation starts at	180 days
Full calf developed at	270-275 days

In some abnormal conditions in cows and buffalo two foetus are found in uterus of the dam which can take place due to following reason.

1. **Monozygote twins:** When accidentally zygote breaks into two separate cells or zygote then they results as difference development and the become the fetuses of same sex.
2. **Dizygous twin:** When two ova released at the same time they also results in two foetus but they may be of same sex i.e. male-male and female-female or having opposite sex i.e. male-female and condition of male female Dizygous twin is also known as 'free-martin' in which the female is generally infertile.

1. **Aristole –** He described generation of animals

2. **Fallopious –** He 1st time described the oviduct also known as fallopian tube.
3. **Coiter –** Student of Fallopious. He 1st time describe the Corpus luteum.
4. **Regnier degraaf –** He describe structure of Graffian follicle/Antra/Mature of follicle.
5. **Van Leewanhock (Dutch) –** He describe simple microscope.
6. **Spallanzani –** He 1st time describes that spermatozoa are responsible for fertilization. 1st time has done A. I. in Bitch. He has known as father of AI

CHAPTER – 6
SYMPTOMS OF PARTURITION IN ANIMALS

Symptoms of parturition in cattle and Buffalo:

The belly increase in size, especially on the right flank.

The udder fill up and the teats become stiff.

The vulva becomes red and swollen with the presence of mucous and blood colored fluid.

The animal become restless.

The water bag appears at the vulva.

Symptoms of parturition in Sheep and Goat:

The animal keeps away from others.

The vulva is swollen and the skin is loose.

The animal becomes restless and does not eat well.

A discharge from the vulva will start a few days before parturition.

The sheep will lie down and stretch the neck back to look at the sky (star gazing) and lick it6s lips.

The sheep will strain to push out the lamb.

Symptoms of parturition in pigs:

- Restlessness. The sow or gilt will pace up and down or circle round and round.
- Nesting. The sow or gilt will pull or the bedding material into one area and create a nest.

  They do this by carrying the bedding in their mouths and moving the straw with their feet.
- The size and shape of the stomach will increase before farrowing.
- The size of the mammary glands will increase as they bag up with milk.
- Milk production – Just before farrowing the sow or gilts milk will be released.
- The vulva becomes larger and reddens. The muscles around this area slacken before farrowing takes place.
- Laying down and stretching out the back legs will occur as farrowing begins.
- Heavy breathing – As farrowing begins the gilt or sow will start to blow and puff as she strains.

CHAPTER – 7

ADVANTAGES OF ARTIFICIAL INSEMINATION:

There are several advantages by artificial insemination over natural mating or servicing.

- There is no need of maintenance of breeding bull for a herd; hence the cost of maintenance of breeding bull is saved.
- It prevents the spread of certain diseases and sterility due to genital diseases. Eg; contagious abortion, vibriosis.
- By regular examination of semen after collection and frequent checking on fertility make early detection of interior males and better breeding efficiency is ensured.
- The progeny testing can be done at an early age.
- The semen of a desired size can be used even after the death of that particular sire.
- The semen collected can be taken to the urban areas or rural areas for insemination.
- It makes possible the mating of animals with great differences in size without injury to either of the animal.
- It is helpful to inseminate the animals that are refuse to stands or accept the male at the time of oestrum.
- It helps in maintaining the accurate breeding and cawing records.
- It increase the rate of conception.
- It helps in better record keeping.
- Old, heavy and injured sires can be used.

Disadvantages of A.I:

- Requires well-trained operations and special equipment.
- Requires more time than natural services.
- Necessitates the knowledge of the structure and function reproduction on the part of operator.
- Improper cleaning of instruments and in sanitary conditions may lead to lower fertility.
- If the bull is not properly tested, the spreading of genital diseases will be increased.
- Market for bulls will be reduced, while that for superior bulls increases.

CHAPTER – 8
HORMONAL CONTROL OF MALE AND FEMALE REPRODUCTION

Genadotropin releasing Hormone (GnRH)

GnRH is a neuropeptide that is produced in the hypothalamic surge and tonic centres. In the male and the female, the target tissue is the **anterior pituitary gland,** specifically **Gonadotroph cells.** In males and females, secretion of GnRH results in the release of **Follicle Stimulating Hormone (FSH)** and **Leuteinising Hormone (LH)** from the anterior pituitary gland.

In females when the oestrogen concentration prior to ovulation reaches a certain threshold, large quantities of GnRH are released in theform of a surge. This results in a corresponding peak in LH that stimulates ovulation.

Although the hypothalamus via GnRH stimulates the secretion of LH and FSH. It cannot regulate LH and FSH independently. Therefore, another hormone produced from the developing ovarian follicle in the female and sertoli cells in the male acts as a negative feedback mechanism for FSH. Sex hormones also alter the level of production of GnRH from the hypothalamus via a negative feedback system. High concentrations of progesterone or testosterone will reduce the secretion of GnRH and also therefore the secretion of LH and FSH.

Luteinising Hormone (LH)

LH is a type of glycoprotein that is produced in the anterior pituitary via Gonadotroph cells and serves to regulate the function of the gonads. In males LH stimulates the production and secretion of testosterone from the testes via **leydig cells.** In females LH stimulates the production of oestrogens and progesterone from the ovary.

Follicle Stimulating Hormone (FSH)

FSH is a type of glycoprotein that is produced in the **anterior pituitary** via **Gonadotroph cells.** FSH secretion is regulated by GnRH from the hypothalamus. The target tissue of FSH in males are the **sertoli cells** within the testes and in the female the **granulosa cells** of the ovary. FSH stimulates the maturation of germ cells within the testes and ovaries. In the female it also stimulates follicular development and oestradiol synthesis.

In the male FSH also stimulates the secretion of **inhibin** which has a negative

Prolactin (PRL)

Prolactin is a protein that is produced from by the **anterior pituitary** via **lactotroph cell.** This hormone exerts a stimulatory effect on milk sysnthesis within the mammary glands. It has also ben shown to have some degree of gonadal function in some domestic species and rodents. In birds increased concentrations of prolactin have been

linked with brooding behaviors and associated metabolic changes that birds undergo during brooding.

Prolactin sysnthesis is increased when the mother is sucking via a reflex stimulation of the teats. This stimulation reflex reduces the secretion of dopamine and increases the hormone **prolactin releasing hormone** (PRL-RH)

oxytocin (OT)

OT is a neuropeptide (a octapeptide) which is synthesized in the **hypothalamus** and stored in the posterior pituitary. OT is primarily involved in upregulating the activity of smooth muscle cells in the uterus and the smooth muscles surrounding the alveoli ducts of the mammary glands. At parturition, OT causes strong contraction from the myometrium. OT is also essential for 'milk let-down' in most domestic species. OT facilitates the generation of the driving pressure behind pushing the milk towards the large excretory ducts and the teats.

Estradiol (E_2)

Estradiol (E_2) is a steroid hormone and is part of the oestrogens group of hormones and is the principle oestrogen in females. **Estrone** and **estriol** are chemically similar to estradiol but are found in lower concentrations and have a lower estrogenic activity. Production of oestrogens occurs in the ovary via **granulosa cells,** the placenta and the Zona reticularis of the adrenal cortex. In males in it is produced in sertoli cells found in the testes. Estradiol is synthesized from cholesterol.

Oestrogens have a number of functions related to reproduction and other areas of physiology. In relation to the reproductive role of oestrogens, they stimulate follicular growth and maturation, induce the female to begin displaying oeastrous behavior to facilitate mating, prepare the external genitalia for copulation and create favourable conditions for the development of fertilized egg cells. Oestrogens also contribute to the growth and development of mammary tissue and prepare the uterus for parturition.

Effects on reproductive organs:

Vagina: slight mucous secretion, hyperaemia, oedema

Cervix: Relaxation, liquification of mucous plug (causing the bull string)

Uterus: stimulates uterine gland development, sensitization of the endometrium to oxytocin, immune activation (Local)< leucocyte infiltration, secretion of PGF_{2a} and PGF_2

Fallopian tube: stimulates mammary duct development

Corpus luteum: Luteolytic (bovine and ovine) but luteotrophic (equine and porcine)

Progesterone (P_4)

Progesterone is a steroid produced by the corpus luteum and the placenta using cholesterol as the base molecule. Progesterone is produced by the corpus luteum as

well as by the fetoplacental unit and in adrenal cortex (to a lesser extent). Progesterone prepares the uterus for reception of fertilized oocytes and is transported via the blood bound to plasma proteins.

Progesterone also prepares the mammary issues for milk production as well as inhibiting female reproductive behaviours associated with oestrous.

Effects on reproductive organs:

Vagina: closure, formation of the mucous plug

Uterus: stimulates uterine gland secretions, sensitization of the endometrium to oxytocin, decreases uterine motility, immunosuppression, inhibition of PGF_{2a} and PGF_2

Fallopian tube: increased secretion, decreased motility

Mammary gland: stimulates lobule-alveolar development

Progesterone During Pregnancy

During pregnancy the plasma concentration of progesterone is maintained at an elevated level. Progesterone also inhibits secretion of GSH and LH (negative feedback at hypothalamic level by inhibiting GnRH) and thus also prevents the ovulation of follicles during the luteal phase and during pregnancy. IN most domestic species the corpus luteum persists for the entire length of gestation. The exception to this rule is the mare in which the progesterone concentration falls during the later stages of pregnancy. This is due to the regression of the corpus luteum around day 180 of the 330-340 days gestation period.

Testosterone(T)

The male sex hormone is called testosterone and this hormone is required for spermatogenesis. Testosterone is a steroid hormone that is produced in the leydig cells within the testes. The primary action of testosterone is anabolic growth, spermatogenesis promotion and promotion of secretion from the accessory sex glands.

Male sex hormones are regulated by negative feedback systems that operate at various levels within the male sex hormone system. The starting point for the production of testosterone (and therefore the production of spermatozoa) is the hypothalamus. The hypothalamus contains neuroendocrine cells that are capable of secreting a substance called Gonadotropin-releasing hormone of GnRH.

Effects of Male Sex Hormones

Testosterone plays a crucial role in the development of male sex organs during fetal growth where increased production of testosterone causes penis growth and development of accessory sex glands during puberty. Testosterone also affects a number of other characteristics of the male, often called the “secondary sex

characteristics". Testosterone has a number of anabolic effects stimulating the development and growth of the skeleton and skeletal muscles. Muscle masses show a general increase and in certain body regions such as the neck of stallions or bulls there is obvious hypertrophy. Testosterone

Also alters behaviour in terms of increasing the degree of sex drive and as a result of the action in several areas of the brain, behaviour can become more aggressive. The larynx of males also enlarges during puberty and the vocal cords lengthen resulting in a deeper and stronger voice.

Prostaglandin F_{20}

The target tissue in the female is the corpus luteum, uterine myometrium and ovulatory follicles. In the female PGF_{2a} remain below a threshold level allowing the corpus luteum to continue to secrete progesterone and thus maintain pregnancy.

Prostaglandin (PGE_2)

PGE_2 is another form of prostaglandin that is produced by the ovary, uterus and embryonic membranes. This form of prostaglandin also has other important roles including vasodilation, smooth muscle relaxation, and inhibition of the release of noradrenaline from sympathetic nerve terminals.

In females it's target tissue is the cervix (it is a potent cervical dilator), corpus luteum and the oviduct where it helps induce ovulation and the secretion of progesterone from the corpus luteum. PGE_2 also plays an important role during labour where it aids the softening of the cervix in animals with the soft-type cervix (equine and human) and aids stimulation of uterine contractions. It can thus be used to prepare the tract for parturition.

CHAPTER – 9
BREEDING SOUNDNESS EXAMIONATION (BSE) OF BULLS

The breeding soundness examination (BSE) is a prediction of a bull's ability to get cows pregnant and is typically performed on bulls that are used for natural service. Animals are usually presented for a breeding soundness exam for four basic reasons.

- The first reason is a prebreeding exam. Bulls are examined, usually a month before breeding, so that one knows for sure that they are normal before they are placed in with females.
- The second reason for a BSE is during the breeding season when an abnormal number of females are returning to estrus.
- A third reason is a pathology consideration in which the bull is suffering from frostbite, testicular swelling, an inability to services, or a systemic disease.
- The final reason for a BSE is a presale exam, thus making sure the animal is a sound potential breeder before the bull is sold in the ring.

Procedure

Examination of the bull should be conducted in a pre-planned manner so that no part of significance is left unexamined. Even though the bull is gentle, it should never be trusted. Bull should be well secured in a stanchion and slowly approached. First approach should be towards the shoulder instead of back of the bull. Sudden moves, loud noise, sudden entry of the strange person etc. should be avoided during examination so that the bull is not excited. The components of breeding soundness examination are as follows:

1 – Identification, history and general clinical examination
2 – Detailed clinical examination of genital tract
3 – Observation of mating behavior and coitus
4 – Collection and evaluation of semen
5 – Other diagnostic tests

1. **Identification, history and general clinical examination identification**

Sire should be positively identified during the examination. The necessity of ide4ntification is clear during generation of health certificate. It is also important when an animal is being examined for infertility. Ear tags help in identifying a bull from a distance.

History

History regarding the Dam's yield, Grand Dam's yield and if possible the yield of progeny should be noted.

Timing of puberty and sexual maturity should be noted. The level of exotic inheritance should be known in cases of crossbred bulls. The records of female bred by the bull should also be

Critically analysed for incidence of abnormal discharge, abortion and delayed return of estrum following service.

History regarding the previous infertility should also be recorded. The records of all vaccination should be collected. Examiner should also determine the presence of recessive genes in thebull whichcan be carried to the next generation and prove lethal, semi lethal or would be undesirable.

General clinical examination

General clinical examination should be conducted in such a way that no organ/part of the body is omitted without investigation. This should take account of the ate, sexualmaturity, body condition, confirmation, intercurrent illness and temperament. This includes assessment of physical condition, integument and body wall, digestive system, urinary system, circulatory system, lymphatic system, respiratory system and locomoter system. All the mentioned body systems should be normal and free from any abnormalities.

2. **Detailed clinical examination of genital tract**

a) **Examination of the external genital organs –** this includes the examination of scrotum with testes, penis and prepuce.

Scrotal and testicular Palpation is done to assess size, texture, tone and evenness of testes. The testes should be freely movable within the scrotum and should be firm and resilient. Testicular tone is normally firm while softness or flabbiness is often associated with testicular dysfunction or degeneration.

Excess hardness or an irregular contour may indicate fibrosis or calcification after degeneration or inflammation. Increased temperature should be noted, as should any asymmetryof the testes. It is generally possible to palpate the head and tall of the epididymis, but the body is often difficult because of its medial position. The tail of epididymis should be assessed for turgidity: a flaccid structure is associated with either a disruption of sperm production or depletionof sperm reserves through overuse. The ductus deferens should be palpated throughout the scrotal neck. The spermatic cord should be palpated up to the level of the inguinal ring for the presence of abdominal contents (scrotal hernia) or abnormalities of spermatic vasculature.

Testis volume is highly correlated with daily sperm aoutput. Hence, measurement of scrotal circumference is a common part of breeding soundness examination of animals with a pendulous scrotum.

The scrotal circumference is measured with the help of a specialized tape at the widest point of the scrotum ensuring that the testes are in scrotum by pulling them down and kept together. Minimal scrotal circumference for yearing 2- year-old and >2 year old should be 32cm, 34cm and 38cm respectively.

Penis and prepuce can be examined at the time of semen collection using AV or by palpation. There should be full penile development. There should no be any abnormally, trauma, inflammation and adhesion in the penis and prepuce.

b) **Examination of internal genital organs**

This includes the per-rectal examination of accessory sex glands. Ampulla, vesicular gland, bulbourethral gland, and prostate are the accessory sex glands present in the bull. Except prostate, all the accessory glands are paired. Ampulla is 10-12 cm long and 1-1.5 cm in diameter. They canbe palpated as the broadened terminalparts of vas deferens lying dorsal to neck of thebladder. Vesicular gland is located on the pelvic floor on each side of the ampulla. It is about 10-15 cm long and 2-4 cm in diameter. Inflammation of this gland is common in the bulls. Normally the gland is flexible cut during inflammationthe flexibility may be lost in varying degree. Bulbourethral glands are located on either side of pelvic urethra near the ischial arch.

3. **Observation of mating behavior and coitus**

Assessment of libido and serving ability is widely used in the examination of bull for breeding soundness. Libido is scored according to the number and vigour of mating attempts. Number of amounts and effective services are recoded in the serving capacity test.

4. **Collection and evaluation of semen**

It is of great diagnostic value in determining the cause, severity and the degree of the pathological conditions of the testes and other genital organs. The quality of semen is also of value in predicting the fertility of male. The different tests for semen evaluation are as follows:

1. **Appearance-** semen should not have any flake or debris.
2. **Colour-** normal colour of bull semen is creamy white having slight yellow colour due to presence of riboflavin secreted by seminal vesicle.
3. **Consistency:** normal consistency of bull semen is thick creamy.
4. **Volume:** average volume of bull semen is 4 ml, but it may range from 1-15ml.
5. **Mass motility:** mass motility of bull semen should be a grade of more than +3.
6. **Individual progressive motility:** individual progressive motility of bull semen should be >70%
7. **pH:** It is around 6.8, but it may range from 6.2-7.5
8. **Concentration of spermatozoa:** bull semen normally have 300-2500 million spermatozoa /ml
9. **Live sperm percentage:** bull semen should have more than 70% live spermatozoa
10. **Sperm abnormalities:** In bull semen, major spermatozoa abnormalities should not be more than 10% or total abnormalities should not be more than 20%.

11. **Other tests includes:** Catalase test, Resistance to cold shock, Millovanov's resistance test, Methylene blue reduction test, Resazurine reduction test, Fructolysis index and oxygen utilization test etc.
5. **Other diagnostic tests-** Testing of bulls for Tuberculosis, John's disease, Brucellosis, Campylobacteriosis, Blue tongue and Trichomoniasis should be done. As per OIE guidelines, the breeding bulls should be free from above mentioned diseases.

Outcome

The outcome of a breeding soundness examination may be as follows

- **Satisfactory –** The animal is considered satisfactory in all components of the examination.
- **Re-evaluate/Temporarily unsound –** The sire has failed to meet a satisfactory standard in critical areas (or there have been aspects of its performance that could not be satisfactorily evaluated.) A Re-evaluate outcome should be confined to circumstances in which there is a reasonable expectation of improvement with time.
- **Unsatisfactory/unsound –** A sire that is not satisfactory in one or more critical components of the examination is 'unsatisfactory' or 'unsound'. Some of these animals are sterile, but most are considered unlikelytohave acceptable fertility in the circumstances in which they are expected towork.
- **Qualified pass –** Animals that are close to the 'cut point', in critical criteria between being classified as satisfactory or unsatisfactory, may possibly considered as candidates for a qualified pass. In giving such an assessment, it should be made clear that that there are significant reservations about the animal being usable, but that it may be able to manage a reduced work-load or to work under close observation.

CHAPTER – 10

Animal Gametogenesis

The biologicalprocess of production of haploid gametes fromdiploid mother cells is known as **gametogenesis.** Gametes of male and female reproductive systems are known as sperms and oocytes, respectively. The corresponding processes are called as **spermatogenesis** and **oogenesis.**

Spermatogenesis

- The sysnthesis of sperms in the testis of male reproductive system of animals is known as spermatogenesis.
- Hormones involved are testosterone and follicle-stimulating hormone (FSH).
- Estrogen disrupts spermatogenesis and higher level causes infertility.
- Spermatozoas are produced bymeiosis and mitosis in the seminiferous tubules of testis.
- **Spermatagonia,** the diploid stem cells in the tubules, undergo mitotic division to produce diploid **primary spermatocytes;** through a process known as **spermatocytogenesis.**
- During the first meiotic cycle, the primary spermatocytes duplicate their DNA and divide into two **secondary spermatocytes** (haploid). These secondary spermatocytes undergo a further cycle of meiotic division and give rise to four **spermatids** (haploid again), through a process known as **spermatidogenesis.**
- Spermatids differentiate into functional sperm by **spermiogenesis.**

Oogenesis

- **Oogenesis** is the process of synthesis of ova or egg in ovaries of the female reproductive system.
- Hormones involved are FSH, estrogen, luteinizing hormone, and progesterone.
- Similar to sperm production, primordial follicles of ovaries transform into **oogonia** to produce diploid **primary oocytes,** the process known as **oocytogenesis.**
- Primary oocytesenter meiotic division to form ootid (ootidogenesis), which occurs before birth, but gets arrested at prophase I, am cells called as **dictyate.**
- All future egs are at prophase I at the time of birth.
- When the female reaches the adolescent age or menarche, primaryoocytescomlete the first meiotic division to form haploid **secondary oocytes** and a polar body that is discarded at later stage.
- Meiosis II of secondary oocyte begins but a second meiotic arrest happens at metaphase II stage.
- If fertilization occurs at this stage, then the meiotic cycle gets completed to form ootid and a second polar body.

- Maturation of ovum occurs and both polar bodies are discarded, thereby eliminating the extra haploid sets of chromosomes formed because of meiosis

CHAPTER – 11
Basis of Foaling and Foal management

The bith of a foal is a highly anticipated event for may horse owners. Good management pratices are essential to a successful breeding program. A live, healthy foal represents the investment of considerable time, money and effort. Management is especially important prior to the time the foal is weaned. The mare and foal should be on a regular worming, exercise, vaccination schedule along with an adequate nutritional program. Early management can impact future health throughout the foal's life.

The gestation period of the individual mare may change from one year to the nest. The "normal" length of gestation is 340 days; however this is an average, "normal"pregnancies range from 315 to 365 days.

PRE – PARTURATION FOAL PROTECTION

Approximately four to six seeks prior to the anticipated foaling date, the mare should be boosted with vaccines to provide high levels of antibodies in her colostrum (first milk), Consult your veterinarian for recommendations on which vaccines to administer, but as a minimum, the mare should be boosted with tetanus toxoid.

PREPARING THE STALL

The foaling stall should be prepared well in advance. It should be clean, located in a quiet area of the barn and maintained at a comfortable temperature. The stall should be checked over very closely for protruding nails, splintering wood or anything else that could damage the newly born foal. Feed and water containers should be positioned in such a way that they cannot interfare with foaling or inure the newborn foal as it struggles to it's feet and learns to walk. Be sure to have the stall disinfected prior to the mare being introduced.

Before the mare is brought to the foaling stall the floors and walls should be cleaned thoroughly. Remove any bedding and time the floors scrub the walls, feeder, water bucket and manger with soapy water using a wire brush. After the stall has dried it should be disinfected with povidone-iodine, pine oil or some other product recommended by your vet. Leave the stall open to dry for several days, then spread fresh bedding.

If possible the stall should contain foaling rails (boards mounted to the inside of the stall about 10" off the wall and about 10" above the ground for the lowest) to keep the mare off the wall and out of corners. Straw or shredded paper is the bedding of choice

over wood chips or sawdust w1hichca1n adhere to the wet ne1wborn and may irritate the foal's eyes, mucous membranes or interfere with its respiration.
During the last month of pregnancy, the signs observed will help determine when to change feeding practices and when tomove prepare foaling stall.

SIGNS OF APPROACHING FOALING

Mares may exhibit all or none of the following signs:

- Musculature around the tail head becomes soft and flaccid 2 to 4 weeks before foaling.
- Te genitalia relaxes
- The udder begins to fillduring the same period.
- The mare may show signs of uneasiness during thelast two weeks of gestation. Waxing of teats (sticky droplets on the ends of the teats) occurs 24 to 28 hours before parturition.
- Milky fluid mayleak from the teats for hours or days before labor onset.
- Protrusion of "Milk Veins" along the lower side of the abdomen.
- Some mares, especially maiden mares, might not produce milk unitl after foaling.
- Tail or Hindquarters rubbing.

ONE WEEK BEFORE EXPECTED FOALING

Move the mare to a foaling stall and change the feed ration. It is recommended that the grain be reduce and a more bulky ration be fed. A mare should be switched to a ration which includes bran at least 1 week before foaling. One pound of oats and two pounds of bran morning and evening is recommended todecrease the likelihood of constipation before and after foaling. This ration will also discourage heavy milk flow, thereby decreasing the chance of scours in the foal and mastitis in the mare. Afteer foaling, the grain can be increased gradually over a ten-day until a fuyll grain ration is resumed.

FINAL PREPARATIONS

Keep the mare in the foaling stall Wash the mare's the udder and genitalia with a mild soap. Wrap the tail and readjust wrap (remove and reapply) several times each day until foaling is complete.

The Three Stages of Labor

STAGE 1 – During the first stage of labor which will last from 2 to 24 hours, the muscles of the pelvic girdle relac, allowing the bones to spread so the foal can be positioned toward the birth canal. Movement is often noticeable as the foal turns into position. The abdominal wall above the flank and behind the ribs becomes concave, and the tail head becomes more

Prominent. Uterine contractions cause nervousness, erratic eating, sweating, pacing, tail switching and frequent urination. Colic can also cause these signs and it is possible for a mare to bcome colicky from constipation prior to foaling.

STAGE 2 –The second stage of labor can last from a few to 30 minutes and include contractions and delivery. It is important to leave the mare alone at this point if birth is progressing normally. Disturbances may interrupt or prolong the birth process. The mare has very powerful uterine contractions, and when the unborn the birth process. The mare has very powerful uterine contractins, and when the unborn foal is positioned in the birth canal properly, delivery can occur in a relatively short period of time (10 to 15 minutes). Birth usually occurs shortly after the outer water bag ruptures. Most mares position themselves on their sides, with their legs fully extended during the delivery of the foal; however, some insist on standing. If the mare delivers standing, someone should catch the foal and gently lower it to the ground to prevent injuring the newborn foal and to prevent the tearing of the umbilical opening in the abdominal wall and predispose the foal to a hernia. The urachus (tube leading to the urinary bladder) may also tear, causing urine leakage into the foals abdomesn.

The mare will usually rest after the passage of the shoulders and again after the passage of the hips. Do not pull on a foal progressing slowily through the vagina. If birth progress stops for more than ten minutes in one spot, apply gentle traction times with the contractions. If the foal feels “locked in” rotate the body one way, then the other; this might allow the hips to slip through the pelvic opening of the mare.

As the foal emerges, the inner sac usually breaks. If the sac does not break, free the foal from the sac and wipe the nose and moth. Foals not breathing well should be rubbed vigorously with a towel to stimulate breathing. Allow the foal to lie quietly behind the mare for 10 to 25 minutes until the pulsatin’s in the umbilical cord cease. This allows the foal to receive the blood remaining in the placenta still attached to the uterus. Then crush or cut the navel cord and separate it three inches from the body and dip in antiseptic to destroy bacteria, help day up the stump, and prevent infection.

STAGE 3 – The afterbirth is expelled during the finalstage of labor with the aid of uterine contractions. This process usually occurs within three hours, with normal range from 10 minutes to 8 hours. The placenta should be tied in a knot that hangs above the mares hocks to prevent her from stepping on it and tearing it out prematurely. Premature pulling of the placenta can cause irreparable damage to the mare’s reproductive tract and may cause part of the placenta to be retained.

Once the membranes are expelled, thrsecontrtactions continue to decrease the size of the uterus. Colicky symptoms may also appear at this time which are caused by

contractions of the uterine muscles. The placenta is expelled inside out. Membranes which are not expelled

within four hours are considered retained. Do not pug on these retained membranes. Tie them near the mare's vulva to keep the mare from walking on them.

The mare will clean the foal which should be trying to stand. Foals not standing within the first 2 to 4 hours after birth may be weak or abnormal and may require special treatment. The foal also needs first milk (colostrum) before 6 hours pass to help combat disease and to aid in eliminating fecal material which has built up in the intestinal tract.

Soon after parturition examine the mare-and foal for abnormalities such as cleft palate, heart defects, cataracts and musculoskeletal disorders. At this time also vaccinate against tetanus and administer any appropriate antibiotics.

Care of the Newborn Foal

- **Do Not** cut the umbilical cord immediately after birth, because foal receives blood from the placenta after birth. Cutting the cord before this blood transfer may result in circulatory problems in the foal.
- Once the urnblita cord breaks the stump should be dipped in :mild, to 2 percent iodine solutiOn'fThe iodine drys the umbilical stump and prevents bacteria from traveling upthe:stump and entering the foal's body.
- After birth, the foal's nostrils may be covered with part of the pladenta or bedding. These materials need removing if they constrict respiration. If the foal appears to not be breathing, respiratory assistance will be needed to inflate the lungs.
- Urine dripping from the stump Indicates that the fetal urine passage from thetladder to the umbilical (the urachus) has not closed. Normally the urachus closes at birth. If it fails to close, in a condition called "persistent urachus,".
- It is important for the foal to receive colostrum soon after birth because .it contains antibodieS needed for disease protection during the first few months of the fOal's life. These antibodies can be absorbed by the foal's intestinal tract for up tb,36-hours after birth, but -apsorptiVe ability begins dpveasing drastically at 12 hours after birth. Therefore it isimportant that the foal. re-cejvi:ecelostrum before this time has passed.
- To ensure that the mare has high amounts of antibodies in her colostrums, vaccinate her approximately 30 days before foaling. If you miss this vaccination time, make sure the foal is protected against tetanus by giving it a tetanus antitoxin injection at birth. The tetanus antitoxin is less efficient than immunity from colostrums because it protects the foal for only 2 to 3 weeks while its umbilical stump heals.

- Colostrum has a laxative effect on the foal, which helps it pass the fetal excrement (meconium). Most foals pass the meconium with in 4 hours after birth. If the meconium is not passed, the foal can become constipated. A constipated foal frequently stops moving, squats, and raises its tail trying to defecate. Constipation can be relieved easily by giving the foal a warm, soapy water enema.
- At approximately 10 to 12 weeks of age, the growth rate and nutrient requirement of most foals will exceed the level of nutrients provided in the mare's milk. The best way to compensate for this difference is to supply the foal!I with nutrition in the form of creep feed. High quality grains and forage should be added to the foal's diet. It is essential the ration be properly balanced for vitamins and minerals. Deficits, excesses or imbalances of calcium, phosphorous, copper, zinc, selenium and vitamin E are of particular concern in the growing foal. Improper amounts or ratios can lead to skeletal problems.
- A creep feeder is a specially constructed enclosure that allows the foal to eat a specific diet while preventing the mare access, to 'the feed. Once foals learn to enter the enclosure, they will routinely enter ard, eatthe, grain ,mix. The feeder should be kept clean and fresh feed given daily. The foals should be7pbserved to ensure that overly aggressive foals are not preventing timid ones from eating. Foals that consume creep feed get accustomed to eating without their mothers and usually adjust to weaning much more satisfabtorily.
- Start by feeding ,percent of a foal's body weight per day, tie. 1 pound of feed for each 100 poundsgVody weight), or 1 pound of feed per month of age.
- Foals have Milli stomachs so divide the da1Iy ration into 2-3 feedings...
- Make sure feeds contain the proper balance of vitamins, minerals, energy and protein.
- Use a creep feeder or feed the foal separate from the mare so it can eat its own ration.
- Do not overfeed. Overweight foals are more prone to developmental orthopedic disease (DOD).
- Provide unlimited fresh, clean water.
- Foals are commonly weaned at 5 to 6 months of age. Beginning about the third month, the mare's milk supply gradually declines and a natural weaning process begins.
- To prepare the foal for complete weaning, its ration should be increased over a 2-3 week peribd to make up for the nutrients being lost in the diminishing milk supply.
- Weanlings and yearlings continue totuildWone, muscle and mass at a remarkable rate. From weaning to two years of,agedthe,bots,e may.nearly double its weight again.
- Weanlings and yearlings benefit from a diet -containing 14-16 percent protein. They also require readily aVailable sources: of energy ,tb Meet the demands of growth and activity.

- A good rule of thumb is to provide 60-70 percent of the ration as concentrates and 30-40 percent of the ration as roughage-measured by weight.
- Avoid confining foals for more than 10 hours per day.
- Use longing, round-pen or tread mill work judiciously. Excessive forced exercise can strain joints and limbs.
- Never exercise a foal to the point of fatigue.

CHAPTER —12
ESTROUS SYNCHRONISATION PROTOCOLS IN BOVINES

Advantages of Estrus Synchronization include :

- Earlier and more concentrated calving.
- Uniformity of calves at weaning.
- Use of improved ganetics for producing a value – added product.
- Less time for estrus (heat) detection

Disadvantages of Estrus Synchronization include:

- Drug expense and labor.
- An existing high level of management is required.
- Good handling facilities are required.
- Cows must be cycling and in good body condition.
- We can only synchronize the number cows we can inseminate at one time.

1. GnRH PGF System :

This combination represents the simplest GNRH – Based system and involves the GnRH treatment followed 7 days later by the PGF treatment. A common name that is often used for the GnRH PGF system is Select Sync. Some cows (-8%) will exhibit estrus up to 36 hours before PGF. The early heats are fertile and cows can be inseminated 12 hours after detection.

The PGF treatment is not necessary in early cows that have already exhibited estrts, but will not compromise the pregnancy if given. The peak estrous response will occur 2L3 days after PGF with a range of days - 5. With this system, a minimum of 5 days of estrus detection after PGF and 2 days preceding PGF is required to detect most heats. Essentially all cyclic females will be in estrus during this 7 - day period.

The advantages of this system are:

1. Simple to administer
2. Relatively low drug costs per animal.
3. In animals that display-estrus, fertifity is excellent.
4. High fertility and insemination of only cows in heat results in low semen costs/pregnancy

The disadvantages of this System are:

1. Involves 7 days of heat detection and AI, morning and evening.
2. In herds with a large number of non – responsive anestrous females, submission rates for AI and therefore pregnancy rates can be unacceptably low.

GnRH PGF is most effective if used on cyclic cows, or cows that would be expected to spontaneously resume estrous cycles with in the first couple weeks of the breeding season. Timed AI is not recommended for this protocol.

2. GnRH PGF + GnRH System:

These systems resemble a GnRH PGF system but include a second GnRH injection (+ GnRH) given to all, or some cows either between 48 and 72 hours after PGF (day 2-3), and timed AI on all or a portion of the herd.

GnRH PGF + GnRH is most effective if used on cyclic cows, or anestrous cows that would be expected to spontaneously resume estrous cycles with in the first couple weeks of the breeding session.

A. GnRH PGF + GnRH with Timed AI of All cows : This system involves giving the GnRH treatment on day – 7, PGF on day 0, +GnRH on day 2 (48 hours), and inseminating all cows at the time o the + GnRH injection. No heat detection is performed. A common name for this system is CO Sync.

The advantages of this system are :

1. No heat detection is required.
2. The herd is handled as a group and a miximum of 3 times with reduced labour costs.

The Disadvantages of this system are :

1. All females receive the second GnRH injection, increasing drug costs.

2. In herds with a large number of females that are in heat early, not synchronized, or anestrus.

a. Conception rate/insemination can be very low.

b. Low conception rate, with 100% of cows inseminated, results in high semen, inseminator and drug costs/pregnancy.

c. Pregnancy rates, can be unacceptably low.

A minor modification of this system is to give the +GnRH system on day 2.5 (60 Hours) after PGF and mass inseminate all cows at this time. There is not sufficient evidence at this time to suggest that a large difference in pregnancy rate will occur with timed AI at either 48 or 60 hours after PGF.

A second minor modification to the system is based upon findings that pregnancy rates to this system may be increased by 2-8% if cows are inseminated 8 to 16 hours after the +GnRH treatment. This is an approach commonly used in dairy herds, with a common name of OvSync.

B. GnRH PGF +GnRH with AI of Cows in Estrus Early and Timed AI of Other Cows : This system is identical to the preceding system, with the exception that estrus detection is performed from days -2 to 1 and cows detected being inseminated 12 hours after heat.

The cows inseminated early would not receive the +GnRH treatment and would not be included in the timed AI group.

The Major impact that this alteration has on the previously listed advantages and disadvantages of the GnRH PGF + GnRH program is:

1. Establishes the need for heat detection for 3 days, resulting in increased labor costs and animal handling.
2. Conception rate for cows in estrus and inseminated early would be normal.
3. For the timed AI group. Conception rate would increase due to removal of early females.
4. Pregnancy rate for the herd would be expected to increase.
5. Semen and drug costs would be reduced due to higher conception rates fewer females receiving the +GnRH treatment.

C. GnRH – PGF +GnRH with Heat Detection Until Hour 72, Timed AI at 72 Hours : This approach is actually a hybrid between the GnRH-PGF and the GnRH PGF +GnRH systems. Thus, one common name for this system is Hybrid Sync. This approach is based upon the knowledge that in most herds, a majority of cows that are going to be in heat, will display heat by 60 to 72 hours (Day 2.5 to 3) after PGF. With 5 days of heat detection (Day – 2 to Day 3) cows that will display estrus are detected and inseminated 12 hours after detection of heat. This time interval permits cows that will show estrus in a timely manner to do so, and optimizes conception rates for these animals.

3. PRE – SYNC

Pre – Synch is a modification of Ovsynch in which two PGF2a injections 14 days apart are administered 14 days before initiation of the first GnRH injection of Ovsynch. Pre – Synch improves first service conception rate compared to Ovsynch and is a good stategy for programming cows to receive their first postpartum timed A.I.

4. HEAT – SYNCH :-

Heat – Synch is an alternative to Ovsynch/Pre-Synch in which 1.0mg of estradiol cypionate (ECP) is administered 24 hours after the PGF2a injection of Ovsynch to induce ovulation rather than administering GnRH 48 hours after PGF2a. Overall, Heat – Synch results in similar reproductive performance to Pre – Synch but may not be effective for synchronizing anovulatory cows.

5. CIDR (CONTROLLED INTRAVAGINAL DRUG – RELEASING DEVICE)

- Natural progesterone
- Manually admistered and easily removable.
- Rapid increase in peripheral progesterone concentration following administration. Rapid decline in peripheral progesterone at removal.
- Progesterone release through controlled diffusion within the insert.
- Plasma progesterone level rises to 4ug/ml in one hour.

- PGF2a allows for regression of the CL, follicular maturation, estrus behavior, and ovulation.
- Progesterone induces anestrus animals to cycle.

6. MGA (This product not approved for lactating dairy animals.)

Feed 5mg/head/day of MGA (Melengestrol Acetate) for 14 days. MGA is generally fed in a grain carrier and either top dressed onto other feed or batch mixed with larger quantities. Inject a prostaglandin 31 days following the first MGA feeding.

CHAPTER – 13
METHODS OF ARTIFICIAL INSEMINATION

There-are different methods of insemination in different species of animals i.e. speculum method, vaginal method and recto vaginal method.

Recto Vaginal Method

- In cattle the safe and best method of insemination is "Recto vaginal method of insemination".
- Cow which is in heat is well controlled placing it in a Travis.
- The inseminator will get ready by-wearing a plastic apron, gumboots and gloves.
- The semen straw after thawing (keeping the semen straw in warm water for a minute to convert the freezed semen into liquid and.the sperms become motile) is loaded in a sterilized A.I. gun covered with a plastic sheath.-
  - The inseminator will insert the gloved left hand into the rectum-after applying the soft soap,oLother lubricant on the glove and back racked the animal, and the hand is further'Thiserted and will catch hold the cervix through rectal Wall,
  - The A.I gum loaded with semen straw is passed through the volVa to 'vagina and cervix and observed with the hand in rectum that the A. I gum reaches the cervix, then the semen is deposited by injecting the gun, and after depositing the semen the gun is removed, the empty straw and sheath are disordered.

Speculum Method

- In this method, speculum is placed in the vagina of the cow, which provides passage outside to the site of insemination, then inseminating tube is passed through the speculum and semen is deposited at the cervix.

Vaginal Method

- Hand is passed through the vagina and the inseminating tube is guided by hand to the site of insemination and semen is dePbsited. Here there is a risk of contamination and injury of female genitalia.