

REPRODUCTIVE SYSTEM

To continue its own race, an organism by the process of reproduction, produces offsprings like its own. In sexual reproduction the organisms produce male and female gametes which on combining, develop into a new individual. The formation of gametes takes place in reproductive organs.

Primary sex organ:

Essential organs which form the gametes. In males, the gamete forming organs are the testes. In females, the corresponding organs are ovaries.

The male gamete is the spermatozoon.

The female gamete is the ovum.

Secondary sex organ:

These form the passage for the gametes to help the union of male & female gametes.

In male this includes epididymis, vas deferens, seminal vesicles, prostate, bulbourethral glands & penis,

While in female- Fallopian tube, uterus & vagina. (Breast is an accessory sex organ)

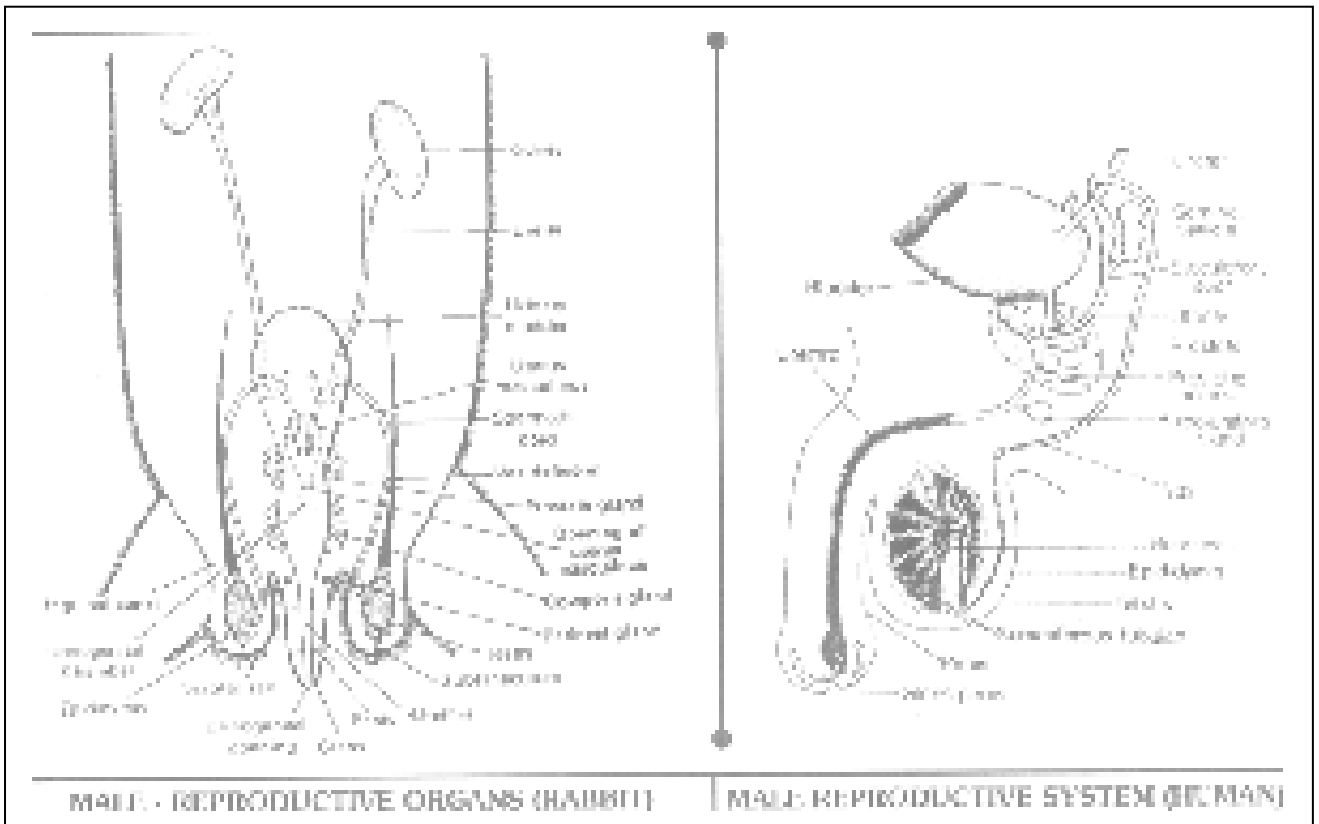
Development of Sex organ:

During intra uterine life (IUL) testis & ovary develop from mesoderm. They develop in abdominal cavity in IUL, at the time of birth, testes descend down into scrotal sac but ovaries remain in abdominal cavity.

MALE REPRODUCTIVE SYSTEM

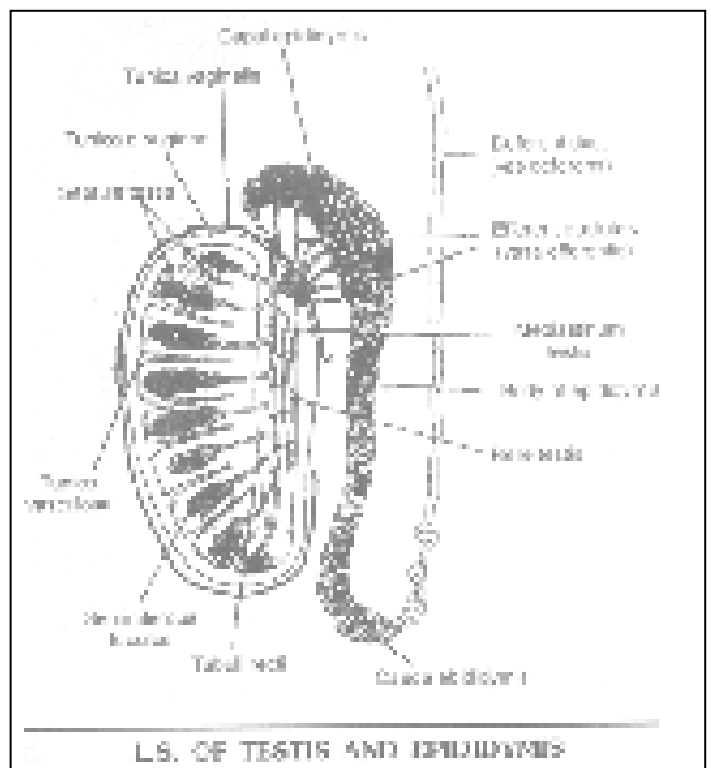
- ☛ In man, one pair testes are the main or primary reproductive organ. Size 4-5 cm × 2-3cm
- ☛ Both testes are located in a small bag like structure situated below & outside the abdominal cavity called as scrotum or scrotal sac. The temperature of scrotum is 2 to 3°C lesser than body temperature.
- ☛ Internally scrotum is lined by dartos muscle & spermatic fascia.
Dartos muscle helps in regulation of the temperature within the scrotum during cold season, It becomes contracted in cold & during warm season, It becomes relaxed.
Cremaster muscles line inside the wall of scrotal & inguinal canal region and help in elevation of testes.
- ☛ Each testis is attached to the wall of the scrotal-sac through flexible, elastic fibres, This called Gubernaculum of Mesorchium.
- ☛ Each testis is attached to the dorsal body wall of the abdominal-cavity through a cord termed as the Spermatic-cord. This cord is made up of elastin fibres & spermatic fascia. The contents of cord are vas deferens, gonadal veins, gonadal arteries, nerves and lymphatics.
During embryonic stage, testes develop in abdominal cavity & they descend to reach the scrotum at the time of birth. When the testes do not descend to reach the scrotum but remain in abdominal cavity at the time of birth this condition is called undescended testes or cryptorchidism. Such testis can not develop and function properly and may develop malignancy.
Orchiopexy: When the undescended testes are brought into scrotal sac by surgical process during childhood this process called as orchiopexy.
Castration: Crushing of testes in bulls to convert them to bullocks. (This makes them more obedient due to fall in the level of testosterone)
- ☛ In some animals the testes descend into the scrotum only in the breeding-season. E.g. Order Chiroptera
Order Rodentia
- ☛ Testes of some animals are permanently placed in the abdominal-cavity. Their scrotum is vestigial-organ. E.g. prototherians, animals of the order Edentata (Armadillo, Pangolin, Sloth)
Order Proboscidea (Elephant)
Order Sirenia and order Cetacea

- Each scrotum is connected to the abdominal cavity through a passage termed as inguinal-canal. Through this canal the testis descend down into the scrotal-sacs at the time of birth. Spermatic cord in males passes through the inguinal canal. Sometimes the inguinal canal may tear leading to abnormal protrusion of abdominal content like loops of intestine into the inguinal canal. This condition is called as inguinal hernia.



Internal Structure of Testis:

Testis is covered by three coats. Outer most is tunica vaginalis. Middle coat is tunica albuginea & inner most is tunica vasculosa. Tunica vaginalis has parietal & visceral layer. It covers the whole testis except it's posterior border from where the testicular vessels & nerves enter the testis. The Tunica albuginea is a dense, white fibrous coat covering the testis all around. The posterior border tunica albuginea is thickened to form vertical septum called the Mediastinum testis. Tunica vasculosa is the inner most vascular coat of the testis lining testicular lobules. Each lobules has 2 to 3 seminiferous tubules, which join together at the apices of the lobules to form straight



tubules or tubulirecti which enter the mediastinum. Here they form a network of tubules called as rete

Testis. Rete testis fuse to form 10 to 20 efferent ductules called as vasa efferentia or ductuli efferentes. These ductules come out from upper dorsal surface of testis & open into common tubules, which get highly coiled to form epididymis or ductus epididymis. This epididymis is responsible for functional maturation of sperm.

☞ Total number of seminiferous tubules in each testis is about 750 to 1000.

☞ In rabbit, epididymis is 3m long and in man it is 6m in length.

Epididymis has 3 parts:

(i) Upper, highly coiled part- Caput epididymis or Globus-major

(ii) Middle part- Corpus epididymis

(iii) Basal, least coiled part- Cauda epididymis or Globus minor

Cauda-epididymis enters inside the abdominal-cavity from the scrotal-sac in the form of Vas deferens or ductus deferens. Terminal dilated part of vas deferens are called ampulla. Vas deferens and Epididymis both develop from the wolffian-duct of mesonephros. Epididymis can temporarily stores the sperms for as long as one month and here the functional maturation of sperms takes place. 18 to 24 hr. after functional maturation of sperm, sperms proceed further to store in vas deferens, specially in its ampulla part. The wall of epididymis is made up of 2 layers-outer circular muscle layer and inner epithelium. Wall of Vasdeferens is also made up of 2 layers-outer circular muscle layer and epithelium. The sperms reach the abdominal cavity due to the pulsation of the vas-deferens.

Cutting of the vasa-deferens & tying it by a thread is termed as vasectomy. Cutting & tying of the oviducts is termed as the tubectomy.

Vas deferens runs upward & enter into abdominal cavity. Both vas deferens coil around the ureter of their respective sides and then dilate to form ampulla. Ampulla of each side receives the seminal vesicle of that side. The vas deferens now forms ejaculatory duct and opens into prostatic urethra.

In rabbit 1 seminal vesicle is found on dorsal side of urinary bladder & it opens at the junction of both vas deferens, while in human 1 pair of seminal vesicles are situated on dorsolateral side of urinary bladder which open separately before the terminal ends of vas deferens. So terminal ends of vas deferens meet to form a single ejaculatory duct.

Accessory Reproductive Glands

The substances secreted by the accessory reproductive glands help in reproduction, these are-

1. Seminal vesicle

It is also called Uterus-masculinus. It forms from the Mullerian-duct of embryo. In females, these ducts form the oviducts. Internally, it is lined by glandular epithelium which secretes seminal fluid, which is lubricating, transparent & jelly like substance, which makes 60-70% part of semen. It is slightly alkaline (pH 7.3). Fructose is found in seminal fluid, it act as fuel to sperm. Fibrinogen, prostaglandin, citrate, inositol and several proteins are also present in semen.

2. Prostate gland

This gland is located below the urinary bladder. It is unpaired & made up of 5 lobes in man. In rabbit 3 or 4 lobe are found. Each lobe opens into prostatic urethra through many fine apertures. It secretes slightly alkaline prostatic fluid which is milky, thick, sticky or jelly like. It makes about 30% part of semen and helps in sperm activation. In the secretion of prostate – gland citric acid, Calcium and phosphate, clotting enzyme and profibrinolysin are present. The secretion of the prostate gland combines with the secretion of seminal vesicle and so the semen gets coagulated. In the coagulated semen, the mobility of sperms is reduced and so their energy is conserved. After some time due to fibrinolysins, semen again liquefies and in this semen now the sperms can move.

3. Cowper's glands

It is a pair of glands found on lateral side of urethra. It is also called as bulbourethral gland. It is situated in membranous part of urethra & opens into penile urethra. It secretes transparent, slimy, jelly like fluid. It is slightly alkaline (pH is 7.2) This destroys the acidity of the urethra and cleans it for the movement of sperms.

4. Perineal or Rectal glands

These are found both in male and female rabbits. Perineal gland is found around external genital organ & perineal region, while rectal glands are found around external genital organs & anus. During the breeding season, these glands secrete odoriferous liquid which has pheromones or Ectohormones in it. The pheromone develops sexual attraction between opposite sexes. & also develops desire for copulation.

Note:- In ma, perineal or Rectal glands are absent.

Semen- Semen = Sperm+ Accessary reproductive gland fluid

volume= 3 to 4 ml.

Normal sperm count 20 to 120 million/ml.

Oligospermia < 20 million/ml.

Azospemia- either absence or near absence of sperms.

Penis

Urethra continues in a muscular & tubular organ called as penis. Terminal part of shaft of penis is bulging, it is called as glans penis. This glans penis is covered by a movable skin called as prepuce or foreskin.

A special type of sebaceous gland is found on the prepuce called preputial gland which secretes smegma. Removal of prepuce by surgery is called as circumcision.

Prepuce is attached to the base of glans with the help of an elastic cord like membrane called Frenulum prepuce.

In penis of some animals a bone is present called Baculum and such a penis is called Os-penis e.g. Whale, Bat, Rat etc. The penis of opossum, Bendicoot etc. is double branched (Bifurcated).

Penis is an erectile copulatory intromittent organ. Root of the penis containing muscles is called crura.

Penis consists of a long shaft that enlarges to form an expanded tip called as the glans penis.

Body of penis:

It is composed of three longitudinal cylindrical masses of erectile tissue. These masses are, the right & left corpora cavernosa & a median corpus spongiosum.

The two corpora cavernosa do not reach the end of the penis. Each of them terminates under cover of the glans penis.

The corpus spongiosum continues further, its terminal part is expanded to form a conical enlargement called the glans penis. Through out its whole length it is transversed by the urethra.

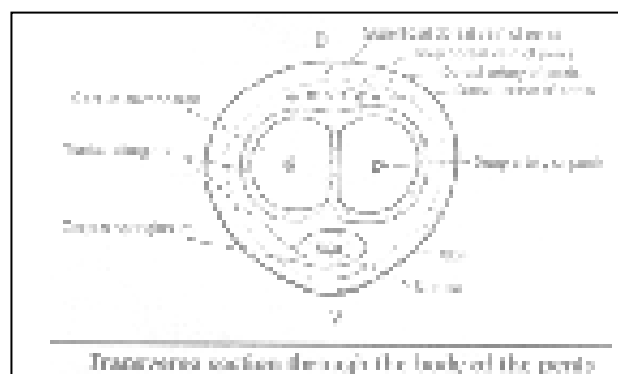
The base of the glans penis has projecting margin the corona glandis.

External opening of penis is called penile/urethral meatus.

Erection of Penis:

Erection of penis is purely vascular phenomenon and is controlled and is controlled by A.N.S.

It occurs due to increase of blood supply, due to dilation of penile arteries causing enlargement and hardening of penis. During this time the muscles of crura are relaxed.



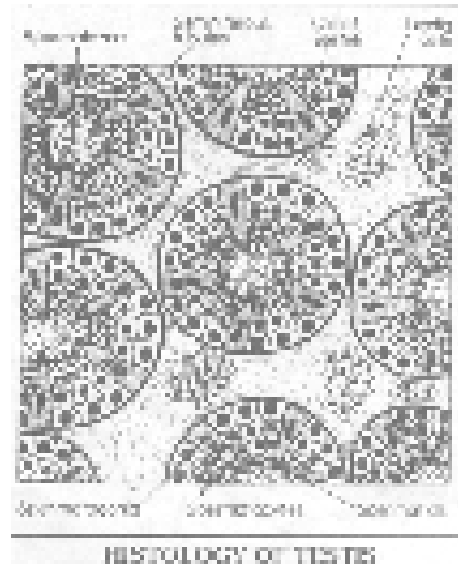
Histology of seminiferous Tubules:

Outer surface of seminiferous tubules is composed of white fibrous connective tissues called as tunica propria. While inner surface is of cuboidal germinal epithelium. This epithelium is made of spermatogenic cells which forms sperm by spermatogenesis. Some columnar cells are found in the layer of germinal epithelium called as Sertoli cells. These provide nutrition to sperm, so they are also called as subtentacular or sustentacular or nurse cells (these occur in mammals).

Other function Sertoli cells-

- (1) They phagocyte the injured or dead sperm cells
- (2) They are the basis of blood testis barrier
- (3) Sertoli cells produce inhibin.
- (4) Sertoli cells can synthesize estrogen from testosterone.

Some endocrine cells are found between seminiferous tubules in intertubular space, these are called as interstitial or Leydig cells. These cells secrete testosterone. The testosterone from Leydig's cells enter the seminiferous tubules by diffusion under the effect of ABP & promotes spermatogenesis.



Male Reproductive Hormones

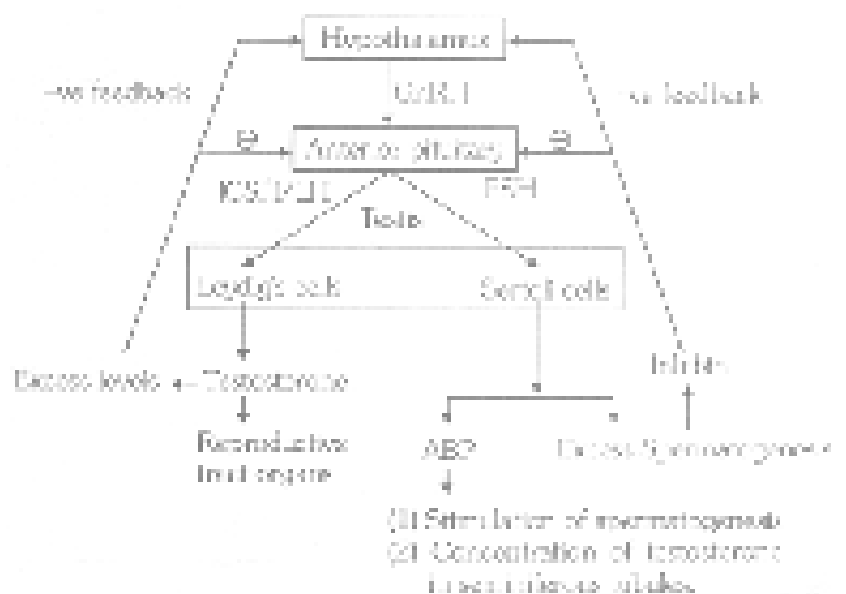
FSH: Binds with FSH receptors attached to the sertoli cells in seminiferous tubules. This causes these cells to grow and secrete various spermatogenic substances and androgen binding proteins (ABP)

ABP: Concentrates the testosterone inside seminiferous tubules.

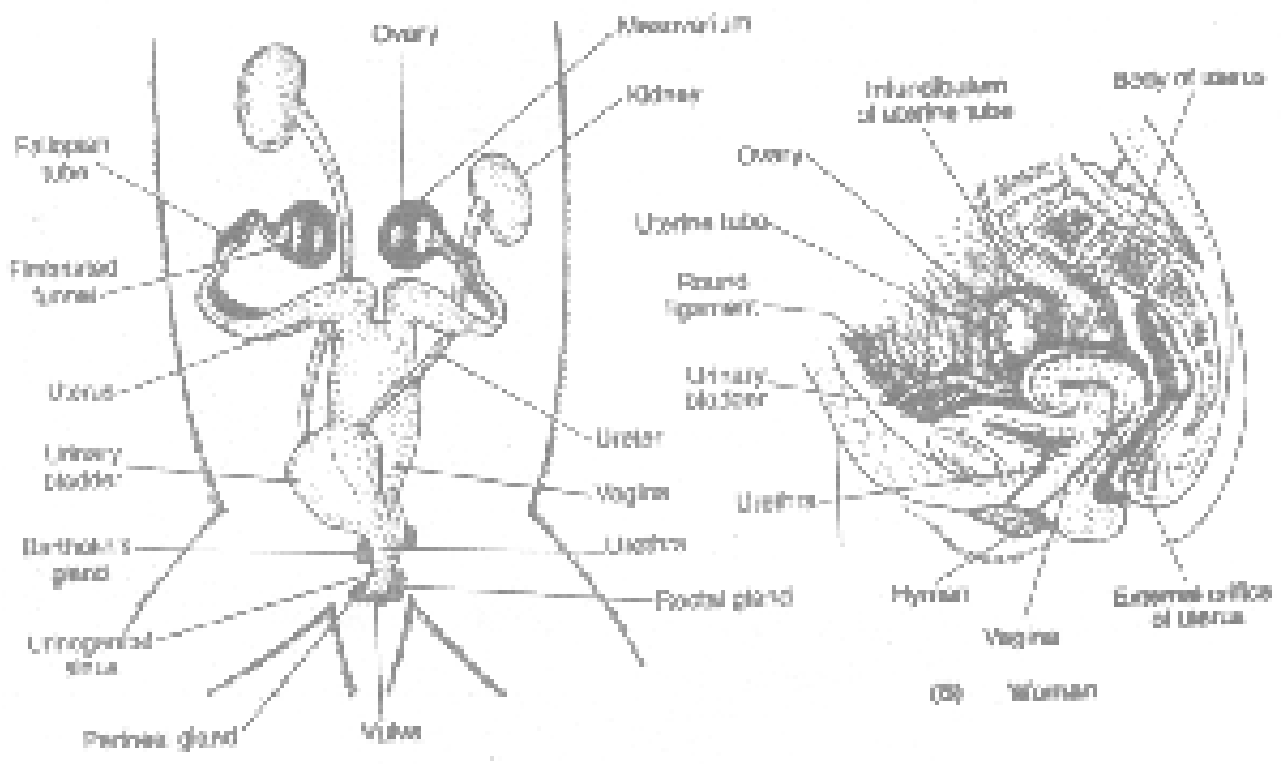
LH/ICSH: It stimulates the Leydig cells to secrete testosterone. Leydig's cells mature at 10 yrs. Of age.

Inhibin : It is secreted by Sertoli cells in response to excess spermatogenesis. The inhibin gives a negative feedback to the hypothalamus and anterior pituitary, this results is suppression of synthesis and release of FSH (Spermatogenesis decreases).

Testosterone: Secreted by Leydig cells. It is essential for (1) Sperm production (2) development of secondary sexual characters (3) ABP secretion (4) It also gives -ve feedback to hypothalamus and anterior pituitary in its excess concentration to suppress GnRH, FSH & LH release. (5) It is secreted in foetal stage in as low as 30 ng/ml plasma concentration to cause descent of testis in last trimester of intrauterine life.

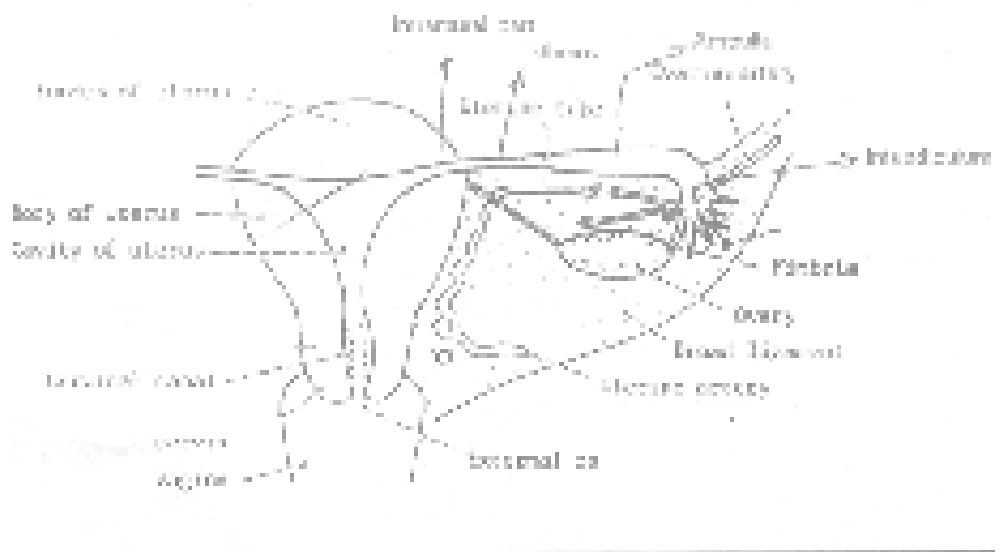


FEMALE REPRODUCTIVE SYSTEM



FEMALE - SEX - ORGANS (RABBIT)

A pair of ovaries is the main or primary sex organ of female reproductive system. Both ovaries are located in abdominal cavity in the ovarian fossa. Each ovary is attached to the posterior layer of broad ligament (Peritoneal ligament) with the help of mesovarium. It is short fold of peritoneum & it is the route of vessels & nerves to ovary.



FEMALE REPRODUCTIVE ORGANS (HUMAN)

A tubule is situated near the ovary. It is also attached with broad ligament, this tubule is called as oviduct. Oviducts develop from the Mullerian-duct of the embryo. In mammals this oviduct is differentiated into two part. It's proximal (towards ovary) narrow & thin part is called as uterine tube or fallopian tube. The lateral end of tube is funnel shaped & called as infundibulum. Its fimbriated & terminal end bears aperture called as abdominal ostium which opens into peritoneal cavity. The part medial to the infundibulum is called ampulla. It is a thin walled dilated part of tube. Fertilization takes place in the ampulla. The part medial to ampulla is called isthmus. The most medial part of this tube situated in the uterus is called intramural or interstitial part of tube. During ovulation, the ova are released in the peritoneal cavity, due to this it is called coelomic. Egg. The distal & dilated part of oviduct forms the uterus.

Types of Uterus

- I. **Duplex:-** These are the simplest type of uteri. Here both the uteri are completely separated and open independently into the vagina through two separate openings. E.g. Rat.
- II. **Bipartiate:-** In these uteri, the lower part of the two uteri are fused and there is a septa in between them, e.g. Carnivorous mammals.
- III. **Bicornuate:-** The lower parts of the 2 uteri are fused with each other but their partition wall is absent. E.g. Rabbit.
- IV. **Simplex:-** When both the uteri are completely fused with each-other to form only one structure. These are the most developed uteri, e.g. human.

☞ It is the most developed form of the uterus which is made from the complete fusion of both uterus.

It piriform (inverted pear) shape, the upper expanded part is called as or fundus while lower cylindrical part is called as cervix.

Upper part of uterus forms the body while lower part forms cervix.

On internal surface of cervix 2 types of constrictions are found which form the Os-cervix.

The body of uterus communicates with the cervix through opening called internal Os.

The cervix communicates with the vagina through an opening called external Os.

The uterus open into a fibromuscular & non glandular tube like organ called vagina (Copulatory organ).

Vulva

Vulva means external genitalia of female. They include mons veneris, labia majora, labia minora. Clitoris, vestibule & related perineum.

Mons veneris (mons pubis):- It is a pad of sub cutaneous connective tissue, lying in front of pubis & is covered by pubic hairs in adult female.

Labia Majora:- Vulva is bounded on each side by the elevation and folds of skin & subcutaneous tissue. Its inner surface is hairless.

Outer surface is covered by sebaceous gland, Sweat gland & hair follicles. It is homologous with the scrotum in the male.

Labia Minora:- they are two thin folds of skin present just within the labia majora. Lower portion of minora fuses across the midline & form a fold of skin called fourchette.

Clitoris:- Small cylindrical & erectile body made by fusion of two labia minora, situated in the most anterior part of vulva. Clitoris is a homologous to the penis in the male. It is also made up of two erectile bodies (corpora cavernosa). The skin which covers the glans of clitoris is called prepuce.

At the terminal part of vagina the urethra opens separately, so they form a common chamber called vaginal vestibule or urogenital sinus. Vagina opens outside through a slit like aperture or triangular space called

Vestibule. The vulva has following openings:-

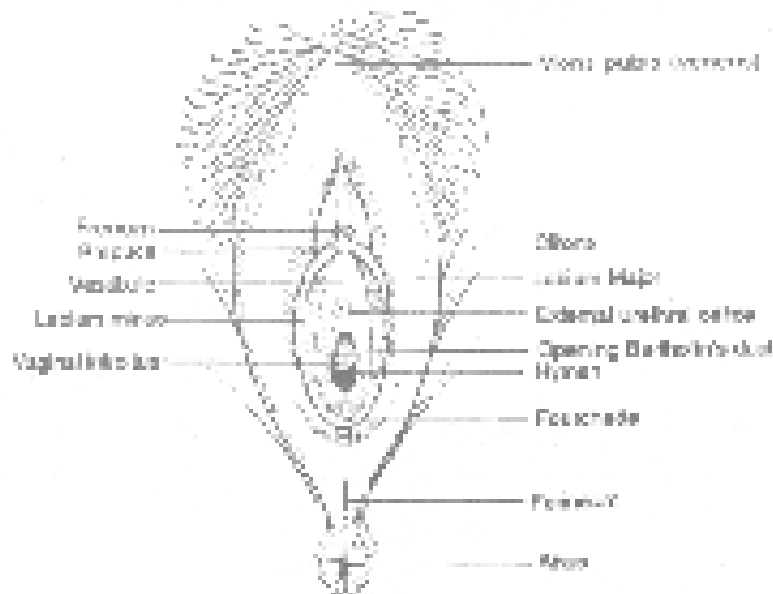
- (a) Urethral opening – Lies on anterior end
- (b) Vaginal orifice- Lies on posterior end.

It is incompletely closed by a septum of mucous membrane called hymen, but it may not be a true sign of virginity.

- (c) Openings of Bartholin's duct on either side

Bartholin Glands:

- ☞ It is homologous to Cowper gland of male
- ☞ In rabbit 1 pair is found on lateral side of vagina. It also opens into vagina.
- ☞ It secretes slimy alkaline. Watery fluid which makes alkaline media in vaginal passage.
- ☞ In human female it is one pair on each side. These are also known as greater and lesser vestibular gland. These glands are situated on lateral side of vagina and on both sides the Bartholin duct opens into vestibule, It secretes alkaline fluid during sexual excitement.



History of Oviduct:

- I. **Serosa or the adventitia:-** It is the outermost layer of visceral- peritoneum (Perimetrium)
- II. **Muscle-layer:-**The middle layer of the oviduct is made up of unstripped-muscle. In uterus, thick smooth muscle bundles are found, these are called as myometrium.
- III. **Mucous membrane:-** It is innermost layer. Mucosa consists of simple columnar epithelium. Epithelium contains both ciliated cells & secretory cells. The secretory cells produce viscous liquid film that provides nutrition & protects the ovum. Mucosa of Uterus is called endometrium, It contains tubular glands, many fibroblasts & blood vessels. In the uterus, the embryo is attached to endometrium. Longest unstripped muscles of the body are found in the walls of uterus. (During pregnancy)

Outer most layer of ovary is called germinal epithelium while the inner layer called T. albuginea is made up of White fibrous connective tissue.

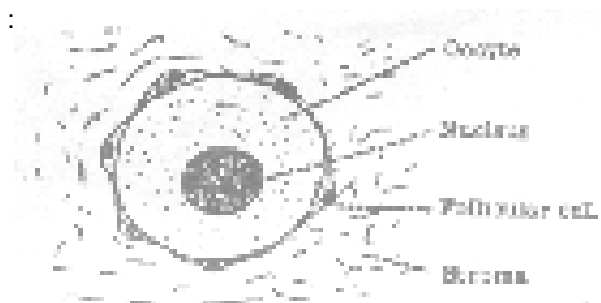
The inner part of ovary is called as stroma. It is differentiated into 2 parts, outer peripheral part is cortex & inner part is called medulla. Stroma consists of follicular cells, connective tissues, blood vessels & lymphatics. Numerous oogonia are found in cortical region in intrauterine life. In early stage of intra uterine life, they proliferate by mitosis, after which meiosis starts in them and proceeds upto prophase stage & halts there itself up to puberty (when the ovulation starts). Now the halted meiosis process restarts at puberty causing primary oocyte to convert into secondary oocyte just before ovulation. With this the 1st meiotic division completes and first polar body is formed. In secondary oocyte immediately begins the second meiotic division but this division stops again at metaphase stage. It proceeds further only when a sperm penetrates the oocyte.

Formation of ovarian or Graafian follicle

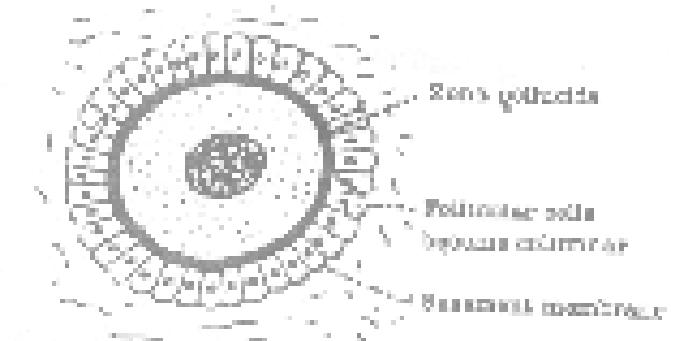
Ova develop from oogonia present in the cortex of the ovary. The oogonia are surrounded by other cells that form a stroma for them. These stromal cells form the ovarian or Graafian follicle that surrounds the ovum and protects it.

The stages of formation of Graafian follicle are as follows :

(1) Firstly some cells of the stroma become flattened and surround a primary oocyte (which develop from oogonia). These flattened cells ultimately called follicular cells.

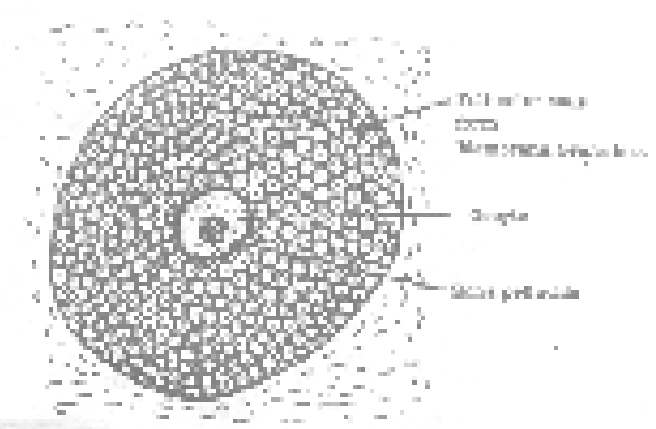


(2) The flattened follicular cells now become columnar. Follicles upto this stage of development are called primordial follicle.

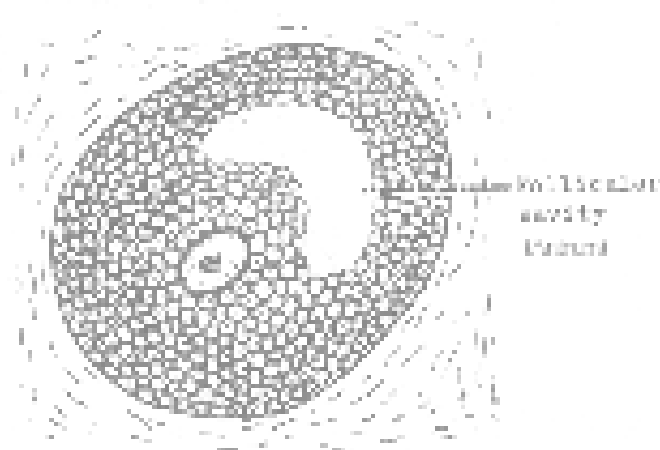


(3) A membrane called the zona pellucida, now appears between the follicular cells and the oocyte.

(4) The follicular cells proliferate now to form several layers of cells to form the membrana granulosa. These cells are now called granulosa cells.



- (5) A cavity appears within the membrana granulosa. It is called the antrum. With the appearance of this cavity, the follicle is formed (follicle means a small sac).



- (6) The cavity of the follicle rapidly increases in size and gets filled with a fluid called liquor folliculi. Due to increase in the size of the cavity the wall of the follicle (formed by granulosa cells) becomes relatively thin. The oocyte now lies eccentrically in the follicle, surrounded by some granulosa cells that are called as cumulus oophorus. The cells that attached it to the wall of the follicle are called as discus proligerus of Germ cell.



- (7) As the follicle expands, the stromal cells surrounding the membrana granulosa become condensed to form a covering called the theca interna. The cells of theca interna (Thecal cells) afterwards secrete a hormone called oestrogen.

- (8) Outside the theca interna some fibrous tissue become condensed to form another covering called the theca externa. The ovarian follicle is now fully formed and is now called the Graafian follicle.

The granulosa cells lying in the close vicinity of the ovum (secondary oocyte) and zona pellucida. Become elongated to form the corona radiata.

After 13 days of menstrual cycle (on 14th day when cycle is ideally for 28 days) Graafian follicle is ruptured & egg is released.

After ovulation the ruptured Graafian follicle is called corpus luteum. Soon after ovulation, the granulosa cells of Graafian follicle proliferate & these cells look yellow due to accumulation of pigment called Lutein. These cells are called lutein cells.

Before ovulation the follicle was avascular but soon after ovulation blood vessels grow & corpus luteum becomes filled with blood. Central part filled with blood is called corpus haemorrhagicum. Lutein cells synthesise the progesterone hormone.

If fertilization occurs in fallopian tube, the corpus luteum then becomes stable for next nine months. If fertilization does not occur then the corpus luteum starts degenerating after about 9 days of its formation. The degeneration is completed by 14 days to form corpus albicans, which gradually disappears.

Progesterone hormone maintains pregnancy and repairs the wall of uterus to make its surface adhesive to help in implantation.

The total number of follicles in the two ovaries of a normal young adult woman is about four lakhs. However most of them undergo regression and disappear due to death and are disposed off by the phagocytes during the reproductive years of the females. This is termed as follicular atresia. This is responsible for limited number of gamete production in females. Generally, only one ovum is liberated in each menstrual cycle, by alternate ovaries. Only about 450 ova are produced by a human female over the entire span of her reproductive life which lasts till about 40-50 years of age.

Although most of the follicular cells and the oocytes undergo degeneration during follicular atresia, some thecal cells, formed from the stroma and located around the follicle, persist and become active. These are called interstitial cells. These cells secrete small amount of androgen.

In Rabbit copulation occurs in breeding season which extends from Feb to June.

Non-specific breeding season is found in human being.

During copulation male ejaculates semen in vagina, this process is called as insemination.

In rabbit ovulation occurs after 12-24 hours of copulation. That means copulation is necessary for ovulation.

Females in which coitus induction is compulsory for ovulation are called as induced or reflex ovulators.

Such a female is called as spontaneous ovulator.

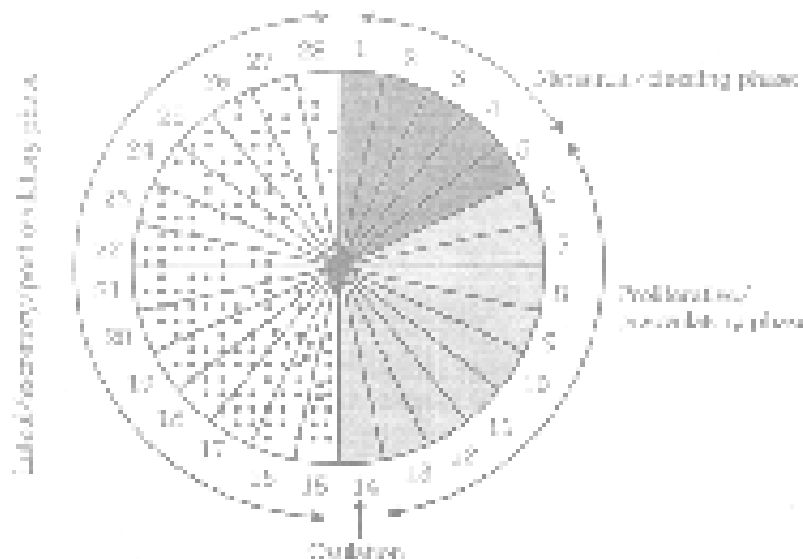
After copulation oxytocin hormone is secreted from pituitary gland. This hormone promotes the peristalsis in the fallopian tube & uterus. Due to this the semen is sucked into fallopian tube.

Due to action of estrogens and progesterone, the endometrium of uterus is prepared for implantation. By the 6th to 7th day, embryo is implanted into endometrium (most commonly at the fundus).

In rabbit implantation occurs on 6th day.

MENSTRUAL CYCLE

Duration -28 days Ideally (Range -22 to 32 days)



This is exhibited by primate group of animals. In this cycle the female body prepares itself for a possible pregnancy. If the pregnancy does not occur then the body aborts all preparation done and restarts the preparation for pregnancy again in a monthly cyclic manner.

Menstrual cycle has three main phases :

- (i) Bleeding phase of menstruation phase.
- (ii) Proliferative/ preovulatory. follicular phase or oestrogenic phase.
- (iii) Secretory/ post ovulatory / luteal phase of progesteronic phase.

(i) Bleeding Phase :

The cycle starts with bleeding phase in its first four to five days. During this bleeding the part of the layer of endometrium gets shed off.

(ii) Preovulatory/ Proliferative phase :

After first four of five days this phase begins. During this phase, Due to release of some GnRH, Pituitary secretes some FSH to stimulate the ovarian follicle. The ovarian follicle now begins to develop. Its theca interna now starts secreting an increasing amount of oestrogen.

The rising level of oestrogen causes the endometrium to proliferate and thicken. It also causes increase in the vascularity and glandularity of the endometrium.

Rising level of oestrogen also provides a positive feed back to the hypothalamus. Due to this, the hypothalamus releases more of GnRH. This GnRH induces the pituitary to release more of FSH. The rising FSH levels now cause:

Further growth and development ovarian follicle to form Graafian follicle

Even further release of oestrogen from the theca interna of this developing follicle.

As the oestrogen level goes on rising, by the end of 10 day the extreme levels of oestrogen (which have by then caused maturation of Graafian follicle and growth of endometrium) now give a negative feed back to the pituitary causing a fall in FSH secretion but also causing a rise in LH secretion. Now the LH secretion from the pituitary goes on rising. This abrupt rise (on 11th to 13th day) in LH concentration in blood is called as LH surge.

This LH now causes the Graafian follicle to rupture after partial completion of II meiotic division in oocyte and thus the secondary oocyte released. The release of egg (secondary oocyte) which occurs around 14 day is called as ovulation

(iii) Post ovulatory/ secretory phase :

After ovulation the ruptured Graafian follicle transforms into corpus luteum. The granulosa and theca cells of the ruptured Graafian follicle (which is now called as corpus luteum) is found only in mammals and contain a yellow lutein or carotene pigment.

In case of absence of pregnancy this corpus luteum will get degenerated after 14 days of its formation. The degenerated corpus luteum is called corpus albicans (white body)

Function of corpus luteum :- Stimulated by the rising levels of LH, the corpus luteum secretes progesterone hormone. The progesterone facilitates the preparation of endometrium for receiving the embryo and its implantation. Progesterone inhibits the contractions of uterus so that the pregnancy could be maintained. Progesterone also inhibits development of next ovarian follicle. If pregnancy occurs then the corpus luteum persists and secretes progesterone. Progesterone is important to maintain the pregnancy and it is thus called as the pregnancy hormone. By the fourth month of pregnancy, the placenta has developed completely. This placenta now takes over the job of further progesterone secretion. Ovary also secretes some amount of relaxin at the time of parturition.

If pregnancy does not occur after ovulation, then as the progesterone level rises, its rising levels inhibit the release of GnRH from hypothalamus. Due to this FSH, LH secretion by pituitary falls and thereby progesterone secretion

by the corpus luteum (which was due to influence of LH) also now falls.

As the progesterone level drops, the corpus luteum begins to degenerate and transform in corpus albicans (which can not secrete progesterone). Due to the lack of progesterone

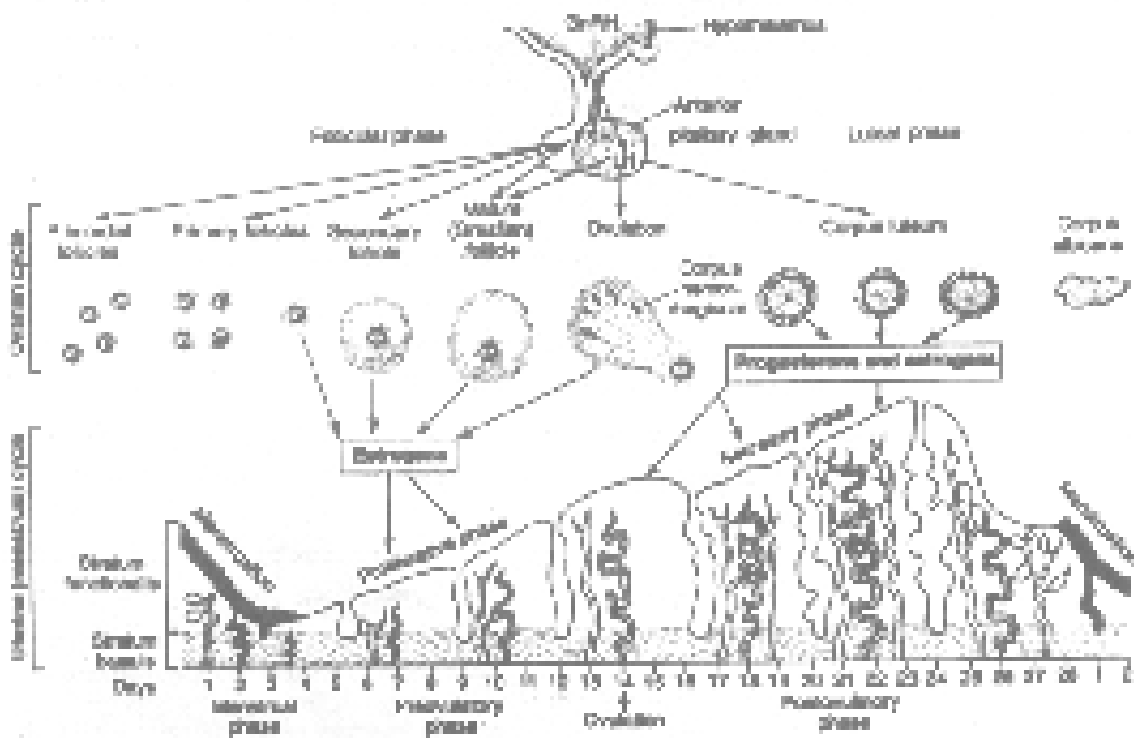
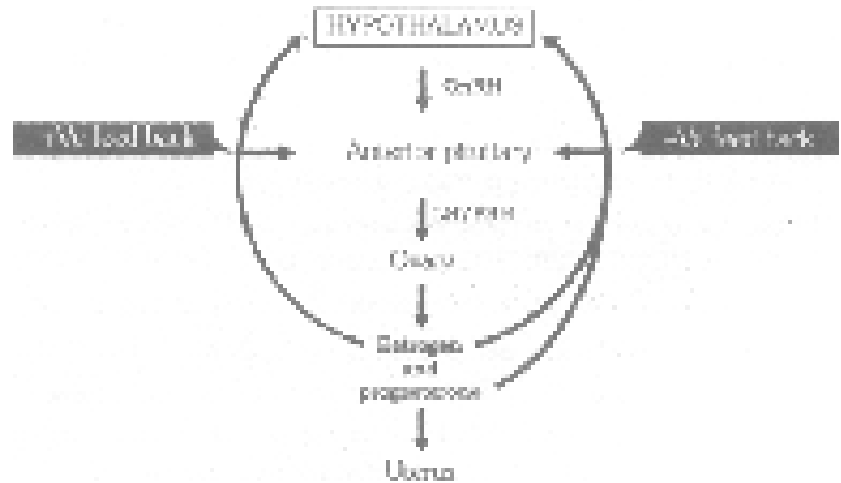
- (i) The overgrown endometrium now begin to break and separate from the inner uterine wall causing bleeding.
- (ii) The uterine contraction (which was till now inhibited due to presence of progesterone) now start.

Thus the separated endometrium along with blood is now being passed out via vaginal route. This is again the beginning of next menstrual or bleeding phase.

Total loss of blood per day is about 20 ml, so an average of 40 to 80 ml bkiid/cycle is lost. This blood can not clot. The period between ovulation and next menstrual bleeding (post ovulatory period) is always constant (I. e. 14 days). However, the ovulation date may vary (causing a change in pre ovulatory period)

After ovulation the ovum is viable only for two days, while sperms introduced into the vagina can survive for a maximum of four days.

On basis of the above data, safe period method for family planning is calculated. Normally it is considered to be day 1 to day 8 and then day 20 to day 28.



Schematic representation of menstrual cycle

ESTRUS CYCLE

Sequential changes of ovary & uterus are combinedly known as estrus or menstrual cycle. Except primatemammals, the estrus cycle is found in all mammals. Menstrual cycle is found in primates

On the basis of estrus cycle these mammals are of 2 types :

(1) Mono estrus animals :

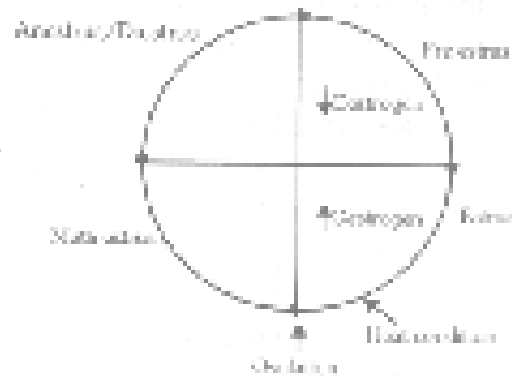
Only 1 cycle is found in reeding season.

(2) Poly- estrus animals :

More than 1 estrus cycles are found in the breeding season.

Estrus cycle completes in 4- stages:-

- (1) Pre-estrus phase
- (2) Estrus phase
- (3) Meta-estrus phase
- (4) Anestrus/Diestrus phase



Pre Estrus:

1st step of estrus cycle. In this stage. oogenesis starts in the ovary. In this stage estrogen level is minimum. in low concentration of estrogen some changes occur in uerus.

- (i) Blood capillaries become more branched
- (ii) Muscles of uterus become more active
- (iii) The stratified glandular epithelial layer of uterus known as stratum Basal is now divides actively to form new stratified epithelial known as sratum functionale.

In this phase no copulation occurs between opposite sexes.

Estrus phase :

In this phase secondary follicle develops in the ovary. Concentration of estrogen is increased. Due to high concentration of estrogen following changes occur in the uterus.

- (i) The diameter of blood vessels increases
- (ii) The cirulation also increases
- (iii) The muscles of uterus divide to cause further thickening of myometrium.
- (iv) Cells of stratum functionale enlarge. New connective tissue& mucus cells are developed.
- (v) Mammary glands also get enlarged.

Due to high concentration of estrogen the sex urge develops in the female. This stage is known as heat condition Copulation occurs only in this phase.

Meta-Estrus Phase:

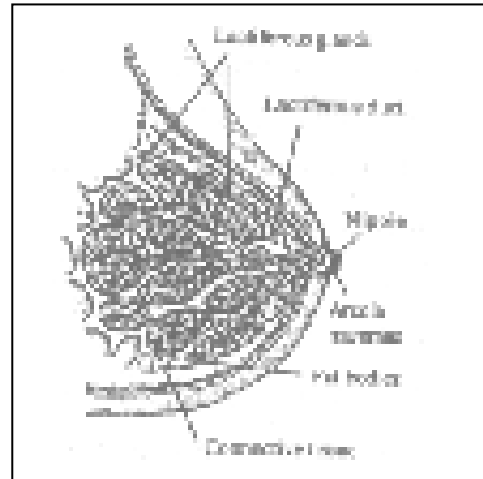
All physiological symptoms which develop in this phase are similar to normal pregnancy even in absence of fertilization, so this phase is known as Pseudo-pregnancy. If fertilization occurs in fallopian tube then this phase extends upto parturition. If fertilization does not occur then this phase becomes short. Keratinization glands are gradually reduced.

Anestrus/Diestrus phase:

Stratum functionale is destroyed by stratum basalis by phgocytosis. Mammary gland, myometrium & blood vessels of uterus become completely normal. So it is the inter phase stage of two estrus cycle & is also known as diestrus phase. In monoestrus animals the anestrus phase is the diestrus phase also.

BREAST

Breast also serves as an accessory reproductive organs in women. Human female possesses a pair of breasts containing mammary glands. These are situated in the front of the thorax on pectoral muscles. Each mammary gland has 15-20 tubulo-alveolar lobules contained in its connective tissue. The space between the lobules is filled with fatty tissue. The lobules contain milk glands in the form of bunches of grapes, which secrete milk. Numerous small ductules arise from each lobule, combine to form a lactiferous duct. Such lactiferous ducts open independently in the nipple.



A nipple is pigmented structure which is a elevated knob like structure at the apical part of mammary glands. The area adjacent to the nipples is also deeply pigmented, which is known as areola mammae. The area surrounding the nipples become much elevated because of the accumulation of fat and by presence of muscles, Nipple is provided with about 15-20 small pores of 0.5 mm size. In men the nipples are vestigial.

Mammary glands produce a nutritive fluid, milk for the nourishment of young ones. Milk protects the young ones. Milk protects the young ones from various infections upto some months after birth.

BRIEF REVIEW

Development of secondary sex organ-

Male	Female
Wolfian duct or Mesonephric duct ———— Epididymis & Vas deferens	Mullarian duct – Fallopian tube, uterus and vagina (Oviduct) Genital tubercle – Clitoris
Regression of Mullarian duct Or Paramesonephric duct ———— Seminal vesicle	
Urogenital sinus – Prostate	
Genital tubercle- Penis	

Puberty –

The age of sexual maturity is called puberty.

- ☞ Accessary sex characters first appear in puberty
- ☞ Puberty occurs in girls at age of 11 to 14 year
Puberty occurs in boys at age of 12 - 15 year
- ☞ At puberty, women starts producing ova.
- ☞ Age of puberty in rabbit = 5-7 months.

Changes in Puberty in boys and girls.

	BOYS	GIRLS
1. Gonadal	Enlargement of the testes, Spermato-genesis begins	Ovarian cycle and ovulation begins
2. Accessory Sexual Organ	Penis, prostate, seminal vesicles and epididymis grow in mass	Uterus, vagina, Fallopian tube. vulve increase in size. Endometrium shows menstrual changes and menstruation occurs.
3. Hairs and voice	Appearance of Beards, moustache, axillary, pubic & hair. Low pitch sound	Typical female distribution of hairs (axilla+ pubis but no hair on chest or abdomen), Breasts grow. Fat deposition leading to feminine contours. High pitch sound
4. Somatic	Skeletal system – grows in length Muscular system- grows in bulk & strength	Pelvic girdle becomes roomy and bigger than pectora (opposite to boys. where pectoral girdle is bigger and pelvic much less roomy).
5. Psychic	Attraction for girls begins.	Attraction for boys.
6. Hormonal	FHS, LH and testosterone secretion – all rise.	FSH, LH, estrogen, progesterone secretion-all rise.

Testis-

- ☞ Testes in mammals are present outside the abdominal cavity because maturation of sperm needs low temperature.
- ☞ Whales and elephants have abdominal testes.
- ☞ Temp. of scrotum is less than body temp. by Approx. 2 or 3°C.

Seminiferous tubules-

- ☞ Each testis of man contains about 750 to 1000 convoluted seminiferous tubule.
- ☞ They are separated by interstitial convolute tissue.

Gubernaculum of Mesorchium –

Gubernaculum is the ligamentous connective cord which connects testis to scrotal sacs posteriorly.

- ☞ Gubernaculum represents mesorchium

Ejaculation –

- ☞ Ejaculation is the forceful expulsion of semen during sexual intercourse.
- ☞ At an average ejaculation 3 to 5 ml. of semen containing about 300 million spermatozoa is emitted in man. (In healthy normal adult 20 to 120 million/ ml)

Vagina –

- ☞ The vagina is lined by a stratified squamous epithelium without any glands.
- ☞ During reproductive life the vagina contains lactobacillus acidophilus or dorderlein's bacilli which keeps the vaginal pH between 4 to 5 by producing lactic acid from glycogen.

Gametogenesis –

Formation of gametes for sexual reproduction.

- ☞ Germ cells in vertebrate gonads re produced by both mitosis and meiosis.
- ☞ Clulupain protein is present only in Man & fishes sperm

Menstrual Cycle –

Cycle change in the reproductive tract of primate females

- ☞ In healthy women, menstruation occurs at intervals of about 28 days.
- ☞ **Menarche** – Starting of menstruation in girls at about 13 years.

Menopause –

Menopause is the period of life when menstruation naturally stops.

- ☞ Menopause occurs in females at the age of 45-50 years.
- ☞ Ability to reproduce is lost in the female after menopause.

Estrous Cycle –

- ☞ Occurs in non-primate mammals.
- ☞ There is no menstruation at the end of estrous cycle.
- ☞ The estrous cycle runs only during the breeding season
- ☞ Monoestrous animal = Dog, Fox, Dear, Bat
- ☞ Polyestrous animal = Mouse, Pig, Squarril, Cat

Gestation period –

Duration between fertilization and Partuitation

- (1) Rabbit = 28 – 32 days
- (2) Man = 270 – 290 days
- (3) Rat = 20 – 20 days

Gynaecomastia –

Development of breast in the male.

Amenorrhoea –

DSurgical removal of uterus.

Oophorectomy –

Removal of ovaries

World's oldest mother –

Roshanna Della corte, an italian woman gave birth to a baby boy on july 18, 1994 at the age of 62. She is believed to be the world's oldest mother.

Adolescence –

- ☞ Seminiferous tubules – Rete testis – Vasa efferntia – Epididhymis – Vasa deference – Urinogenital Chamber – Urethra – Vagina.
- ☞ Sterility results if sperms count is $< 20 \times 10^6/ml$ or $> 40\%$ sperm are immotile.
- ☞ Use of antibiotics, smoking marijuana, alcohol, hot bath, high fever can also cause temporary drop in sperm count.

Types of Uterus –

- (1) Bicornuate – Rabbit

(2) Duplex= Rat (Simplest types)

(3) Bipartite = Carnivorous animal

(4) Simplex = Max

☞ in human females 2 million oocytes are present at the time of birth.

☞ Only 400 follicles mature during reproductive period.

Spontaneous ovulator –

Ovulation occurs without any induction.

Ex. Most animals (Human)

Induced ovulator (Reflex ovulator) = ovulation occurs after copulation

Ex. Rabbit.

Rut Cycle or Testicular cycle –

Reproductive cycle of male is known as rut cycle.

Vesectomy –

Cutting and tying vas deferens

Tubectomy (Salpingectomy)

Cutting and ligating fallopian tube.

☞ Labia majora of female in homologous to scrotal sacs.

☞ Clitoris in female is homologous to penis.

☞ Prostatic utricle is homologous to vagina of female

☞ Seminal vesicle is homologous to uterus (oviduct).

☞ Colostrum is the first milk produced after child birth

☞ In contraceptive pills oestrogen and progesterone are present in variable combination.

Human sperm –

60 μ long, of this 55 μ is the length of the tail.

☞ In menstrual cycle proliferative phase is of 10-12 days and it is under the influence of oestrogen hormone.

☞ Luteal or secretory phase of menstrual cycle is of 14 days and it is under influence of progesterone hormone & It is always of fixed duration.

Testicle –

Testis + Epididymis

☞ Epididymis is 3m long in rabbit while 6 to 8 m long in man.

☞ Maximum no. of leydig's cells are in the testis of pig.

☞ Function of epididymis = functional maturity and storage of sperms.

Os- penis or Baculum –

In whale, Bat, Rat, Seal, Monkey etc. Ossification occur in septum present between two corpora cavernosa.

Semen –

☞ Milky, viscous, alkaline fluid.

☞ pH = 7.3

☞ Quantity is 2.5- 4 ml at one ejaculation.

Maximum growth in human embryo occurs in fourth month of pregnancy and minimum in last months.

Pseudopregnancy =Due to hormonal disturbance, false symptoms of pregnancy may appear.

Menarch – Beginning of menstrual cycle in females.

☞ Size of human ovary –	Length	x	Width	x	Thickness
	3 to 3.5cm		2 to 2.5 cm		1 to 1.8 cm

☞ Diameter of Graafian follicle – 1 to 1.5 cm.

☞ Fallopian tube length -10 cm to 12 cm.

Hermaphroditism : Those animals who have both type of sex called Hermaphrodite animals, it is found in tapeworms and earthworms.

Capacitation : Reactivation of sperm called capacitation. It is produced in vagina. After ejaculation of sperm in vagina, cervical mucous secretory fluid dissolves inhibitory substances related to sperm & provide more energy to sperm.

Precautious puberty : Menstruation occurs before the age of 9 years.

Pregnancy is detected with the help of HCG in urine of pregnant lady.

Cryptomenorrhoea : Occurrence of menstrual symptoms without external bleeding.

Dysmenorrhoea : Painful menstruation is called Dysmenorrhoea.

Menorrhagia : A normal menstrual blood loss is 50 – 80 ml, and does not exceed 100 ml, In menorrhagia the menstrual cycle is unaltered but the duration and quantity of the menstrual blood loss are increased.

Polymenorrhoea : In polymenorrhoea or epimenorrhoea, the menstrual cycle is reduced from the normal of twenty – eight days to a cycle of two to three weeks and remains constant at that increased frequency.

Male hormonal contraceptive : Research is on for development of a male contraceptive by administration of progesterone hormone.

Oral contraceptive pill-

It is commonly used method for contraception. It is in the form of oral tablet. If menstrual cycle is to start on 1st day then OCP is taken from 5th day & regularly upto 21st day. Remaining 7 day iron & folic acid tablet is given instead of hormonal preparations.

Mechanism of Action –

- (i) It inhibits Ovulation (main action)
- (ii) It prevents fertilization due to atrophy or hypertrophy of endometrium.
- (iii) Formation of thick cervical mucus plug, so that entry of sperm. Is resisted.

PARTURITION:

Parturition is a hormonal process. Many hormonal changes take place during it

1. The progesterone secretion stops, so the placenta dissolves and the foetus is separated from the walls of the uterus.
2. Pituitary gland secretes Oxytocin in more amount This hormone induces intense contractions in the uterus. Due to these contractions, the foetus starts moving towards the vagina. The labour pain during child birth, is due to this hormone. Oxytocin is the main parturition hormone After parturition. Oxytocin stimulates milk-let down by milk ejection reflex.
3. Relaxin hormone is secreted by the placenta and the ovary. This hormone relaxes the pubic – symphysis i. e. the joint between the pelvis – girdles. So more space is available to the foetus to move out.

GESTATION PERIOD :

The time from fertilization to parturition is termed as gestation- period. Rabbit has gestation- period of 28-30 days. In one time 4-6 young – ones are born in rabbit (Maximum =8). The group of young – ones born at the same time are called Litter. At the time of birth the young ones of rabbit are blind, deaf and uncovered with fur. They become normal in next 4-5 days. The young – ones of Hare are normal at the time of birth. In

humans actual gestation period is 9 months -7 says.

In human expected date of delivery (EDD) = 1st day of last menstrual cycle plus 9 months + 7 days.