MALE REPRODUCTIVE SYSTEM

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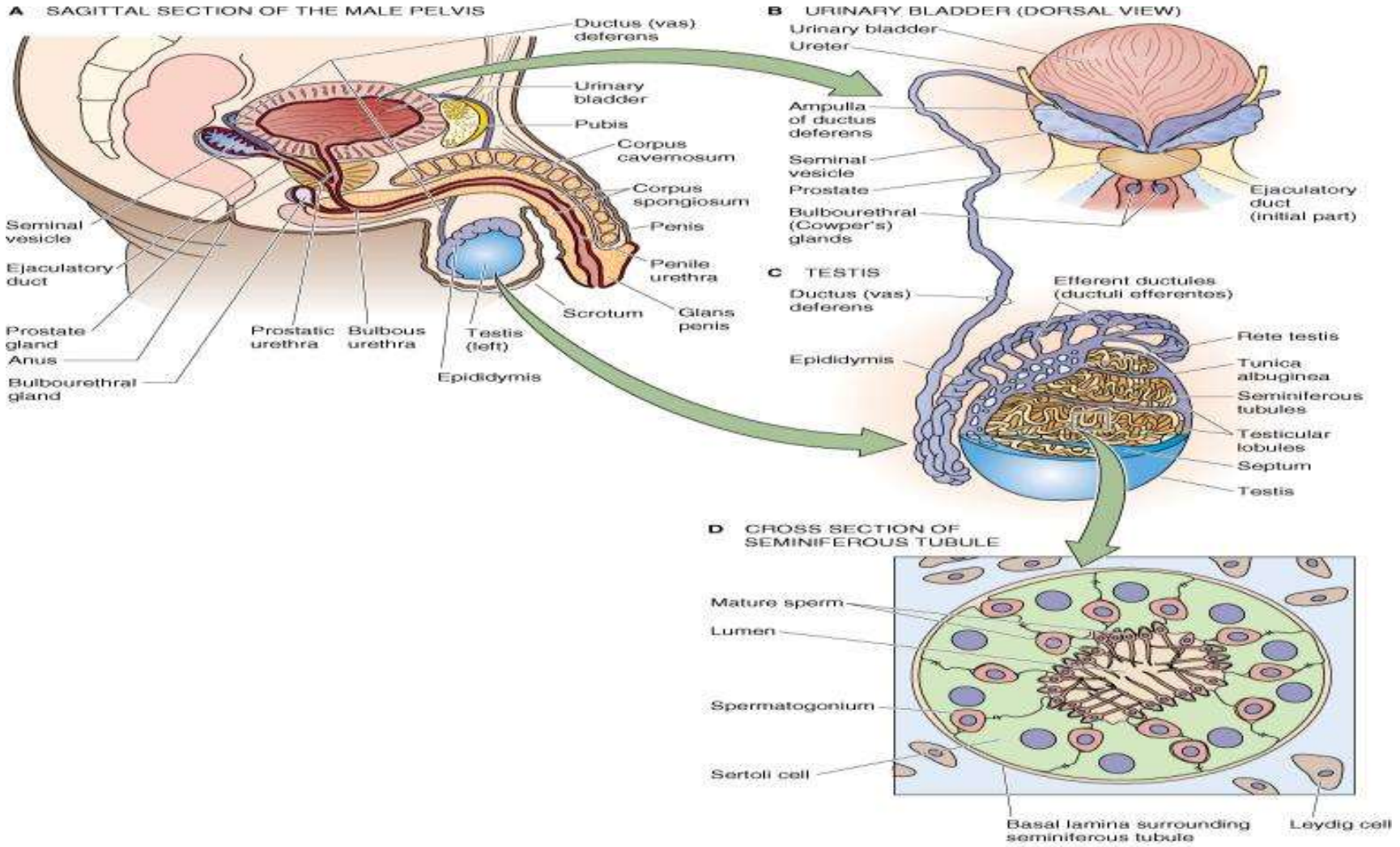
PARTS OF MALE REPRODUCTIVE SYSTEM

A. Gonads – Two ovoid testes present in scrotal sac, out side the abdominal cavity

B. Accessory sex organs - epididymis, vas deferens, seminal vesicles, ejaculatory ducts, prostate gland and bulbo-urethral glands

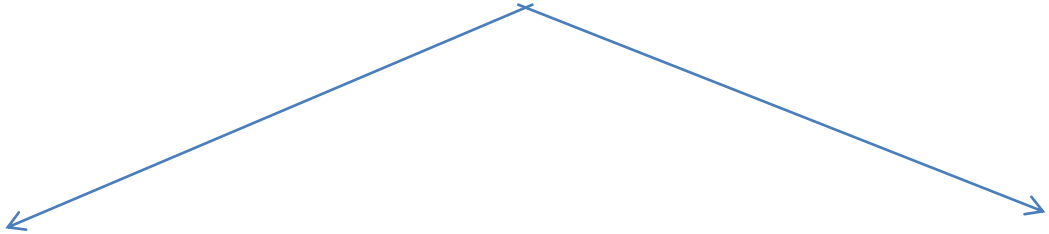
C. External genitalia – penis and scrotum

ANATOMY OF MALE INTERNAL GENITALIA AND ACCESSORY SEX ORGANS



SEMINIFEROUS TUBULE

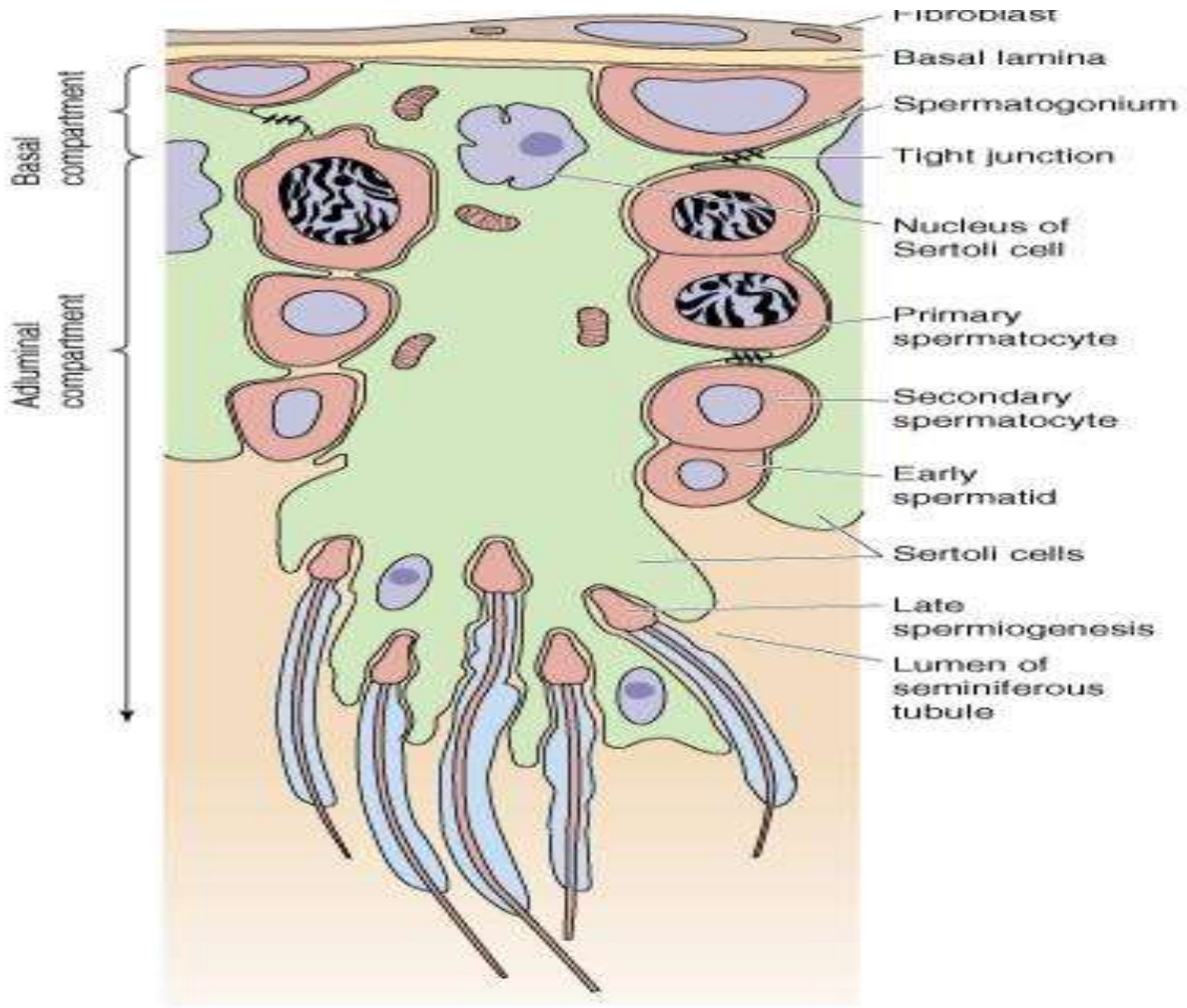
Two principal cell types in seminiferous tubule



Sertoli cell

Germ cell

INTERACTION BETWEEN SERTOLI CELLS AND SPERM



BLOOD- TESTIS BARRIER

- **Blood – testis barrier protects germ cells in seminiferous tubules from harmful elements in blood.**
- **The blood- testis barrier prevents entry of antigenic substances from the developing germ cells into circulation.**
- **High local concentration of androgen, inositol, glutamic acid, aspartic acid can be maintained in the lumen of seminiferous tubule without difficulty.**
- **Blood- testis barrier maintains higher osmolality of luminal content of seminiferous tubules.**

FUNCTIONS OF SERTOLI CELLS

1. Germ cell development

2. Phagocytosis

3. Nourishment and growth of spermatids

4. Formation of tubular fluid

5. Support spermiation
6. FSH and testosterone sensitivity
7. Endocrine functions of sertoli cells
    i) Inhibin
    ii) Activin
    iii) Follistatin
    iv) MIS
    v) Estrogen

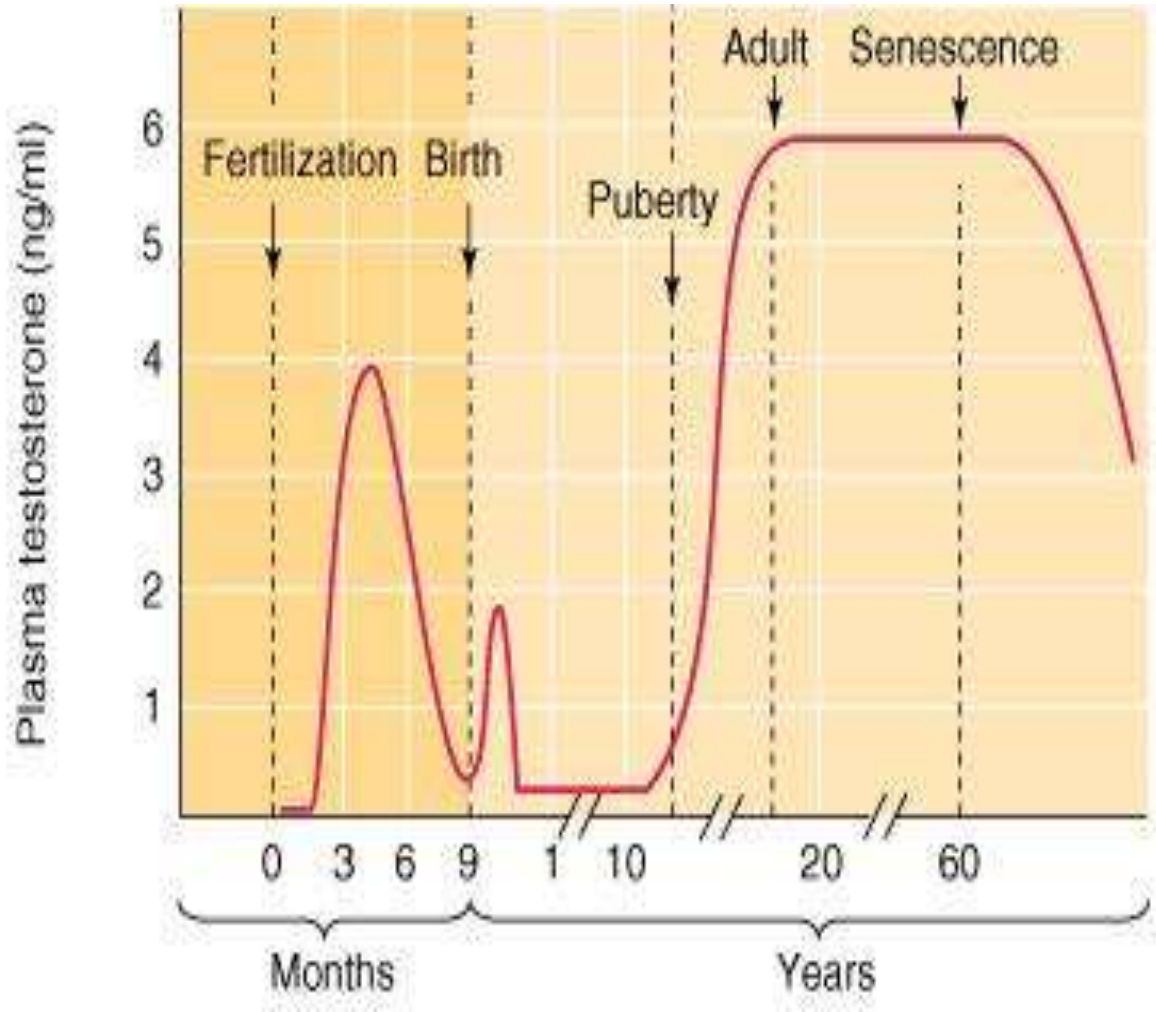
8. Sertoli cell secretes ‘Androgen binding protein’(ABP) and H-Y antigen.

9. Sertoli cell contributes formation of blood testis barrier.

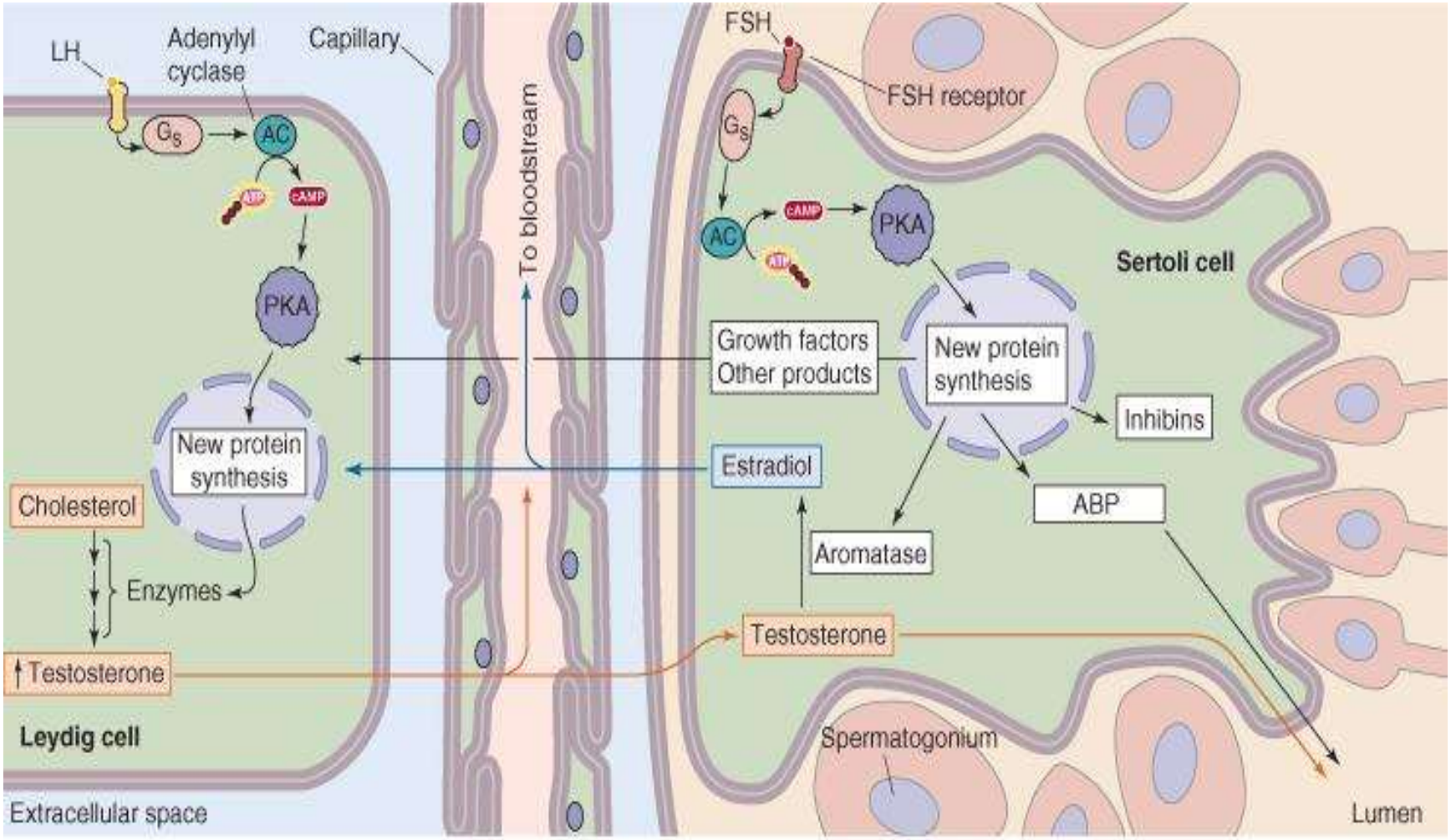
LEYDIG CELL

- **Leydig cells are present near the capillaries in the interstitial space between seminiferous tubules.**
- **They are rich in mitochondria & endoplasmic reticulum.**
- **Leydig cells secrete testosterone,DHEA & Androstenedione.**
- **The activity of leydig cell is different in different phases of life.**

PLASMA TESTOSTERONE LEVEL AS A FUNCTION OF AGE IN HUMAN MALE



LEYDIG AND SERTOLI CELL PHYSIOLOGY



EPIDIDYMIS

Epididymis helps in storage and maturation of spermatozoa-

1.About 99% of testicular fluid is reabsorbed in epididymis and rete testis.

2.In epididymis, the spermatozoa acquire the capacity for progressive forward movement & the ability to attach to zona pellucida of ovum and penetrate into it.

ASPECTS OF SPERM MATURATION IN THE EPIDIDYMIS

Progressive increase in forward motility
Increased ability to fertilize
Maturation of acrosome
Molecular reorganization of the plasma membrane: Lipids (stabilization of plasma membrane) Proteins (shedding as well as acquisition of new proteins)
Ability to bind to zona pellucida
Acquisition of receptors for proteins of the zona pellucida
Increased disulfide bonds between cysteine residues in sperm nucleoproteins
Topographic regionalization of glycosidic residues
Accumulation of mannosylated residues on the periacrosomal plasma membrane
Decreased cytoplasm and cell volume

VAS DEFERENCE

- **Proximal part of vas deference stores the sperms.**
- **Vas deference joins with the duct arising from seminal vesicle to form the ejaculatory duct.**
- **The movement of spermatozoa in vas deference is active as they are capable of motility.**
- **Contraction of muscle in the wall of vas deference facilitates the process of sperm movement.**

SEMINAL VESICLE

- **Seminal vesicular fluid contributes to 70% of total volume of the semen.**
- **Rest 20% of the volume is contributed by epididymal fluid & fluid secreted from other accessory sex glands and 10% is contributed by spermatozoa.**
- **The seminal vesicles secrete VitaminC, fructose and prostaglandin.**

PROSTATE GLAND

- **Prostate gland consists of 30-50 branched tubulo- alveolar glands whose secretions empty into prostatic urethra.**

- **The prostatic fluid contains fibrinolysin which prevents sperm heads to clump and large quantity of acid phosphatase.**
- **Prostate gland also releases a factor, which contains sugar, sulfate and vitaminE derivative- that also prevents sperm head to cluster.**

BULBOURETHRAL GLANDS

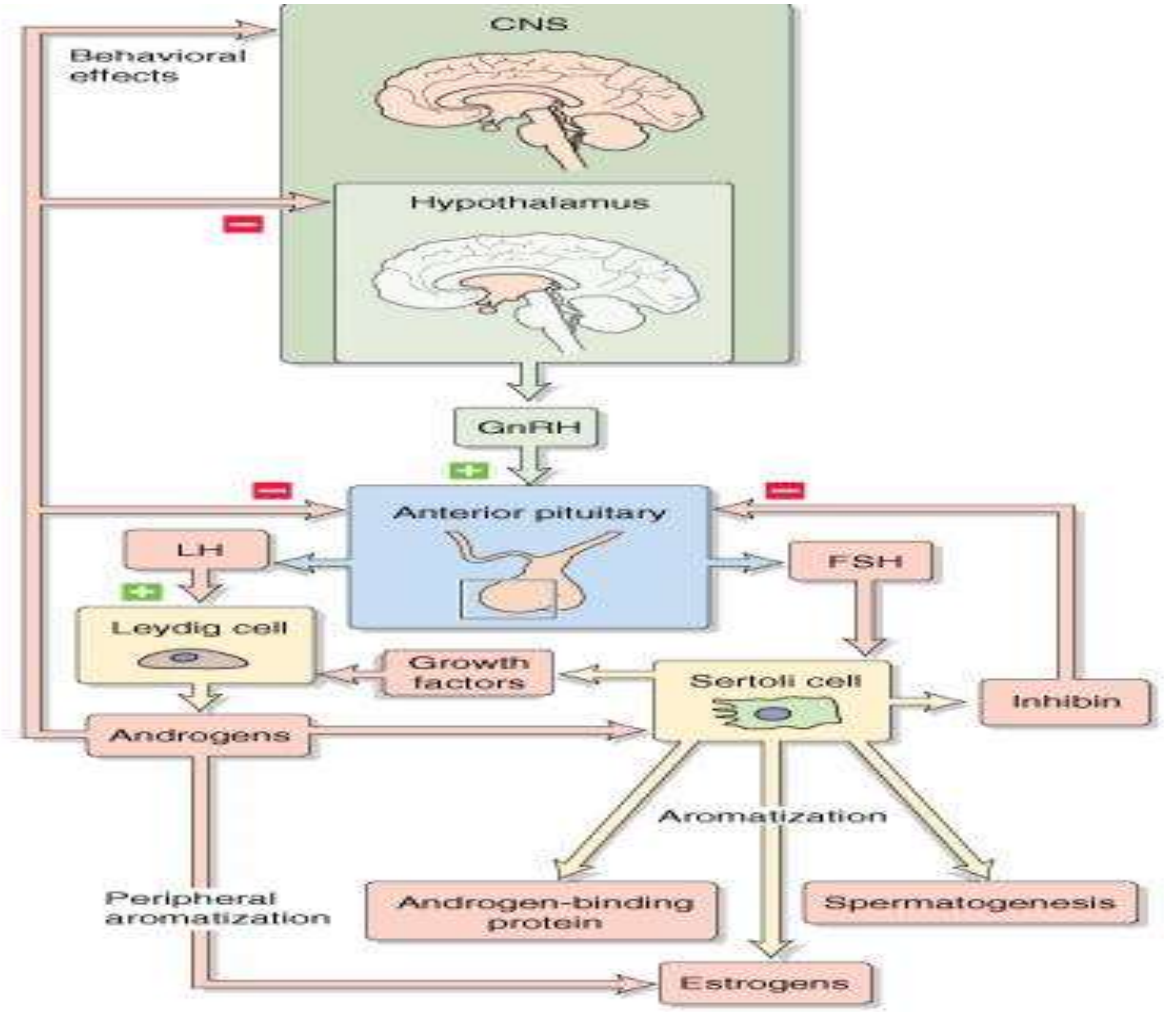
- They secrete mucus and alkaline fluid.

- Seminal fluid contains hyaluronidase, which is not secreted from accessory glands rather it is contained in cytoplasm of sperm cell & released into seminal plasma, facilitates penetration of oocytes by sperms.

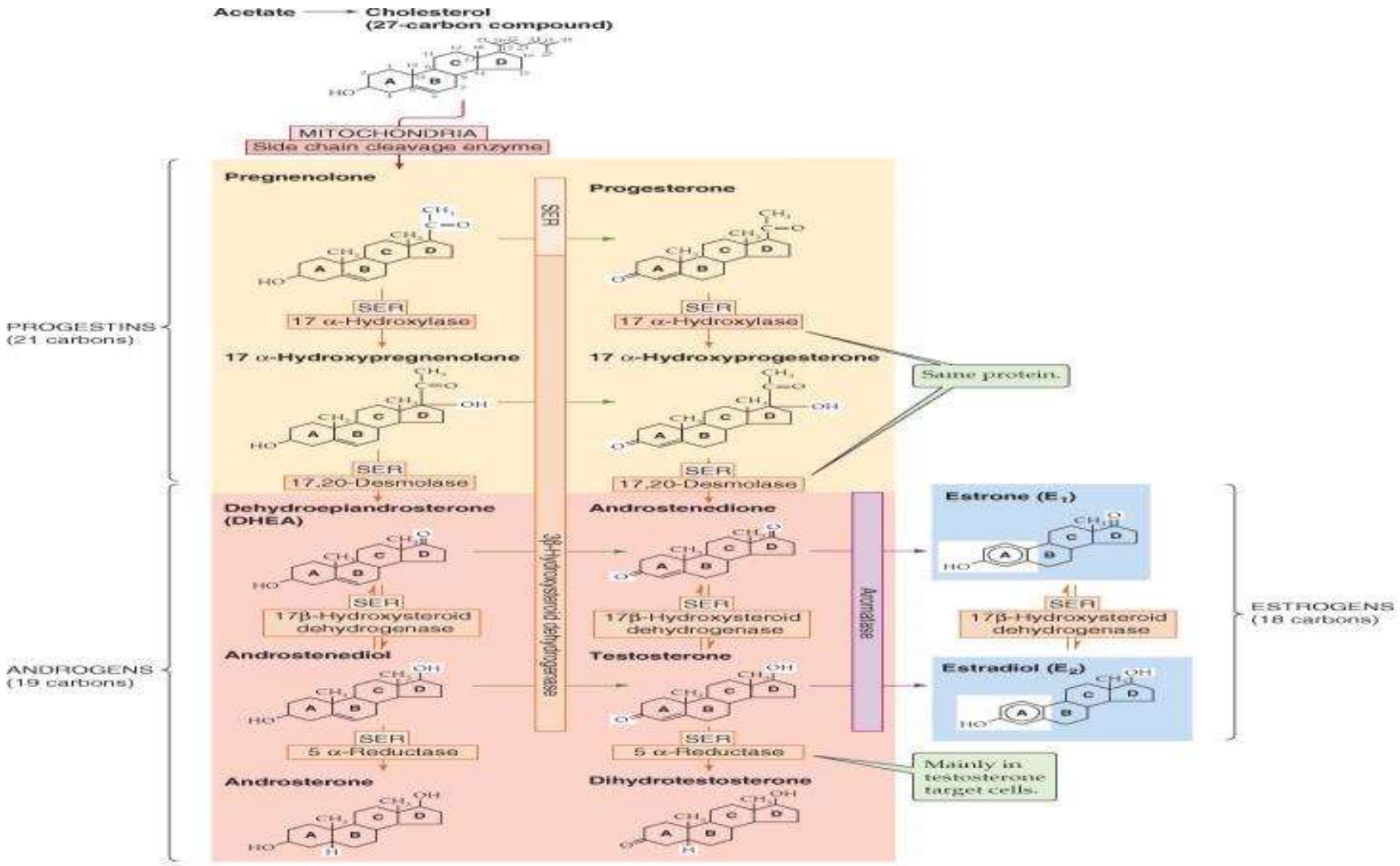
IMPORTANCE OF PRESENCE OF TESTIS IN SCROTUM WHICH IS OUTSIDE THE BODY

- Scrotal temperature of about 32^0C, which is cooler than the normal body temperature, favours spermatogenesis.
- If the testis is kept at body temperature for prolonged period as in experimental condition or in cryptorchidism, spermatogenesis stops with degeneration of seminiferous tubules.
- Pampiniform plexuses of blood vessels serve as counter-current exchanger between the oppositely directed blood flow in arteries and veins, which also helps in keeping the testis at a cooler temperature.

HYPOTHALAMIC-PITUITARY-GONADAL AXIS



BIOSYNTHESIS OF TESTOSTERONE



FUNCTIONS OF TESTOSTERONE

- **Testosterone, together with FSH are necessary for spermatogenesis. It is essential for motility of sperms & their fertilizing power.**
- **Under the influence of testosterone, wollfian duct system differentiates into epididymis, vas deference and seminal vesicles. On the otherhand,DHT promotes differentiation of urogenital sinus & genital tubercle into prostate, penis,urethra and scrotum.**
- **Testosterone is responsible for secondary sexual characters.**

- **Testosterone is responsible for the male sex drive and libido.**
- **Testosterone promotes descent of the testis from the abdomen to scrotal sac during foetal life.**
- **Testosterone also maintains the secretion of prostate and seminal vesicles.**
- **Testosterone stimulates cell division, growth and maturation of tissues.**

- **Testosterone stimulates linear growth, increases muscle bulk & induces epiphyseal fusion of long bones.**

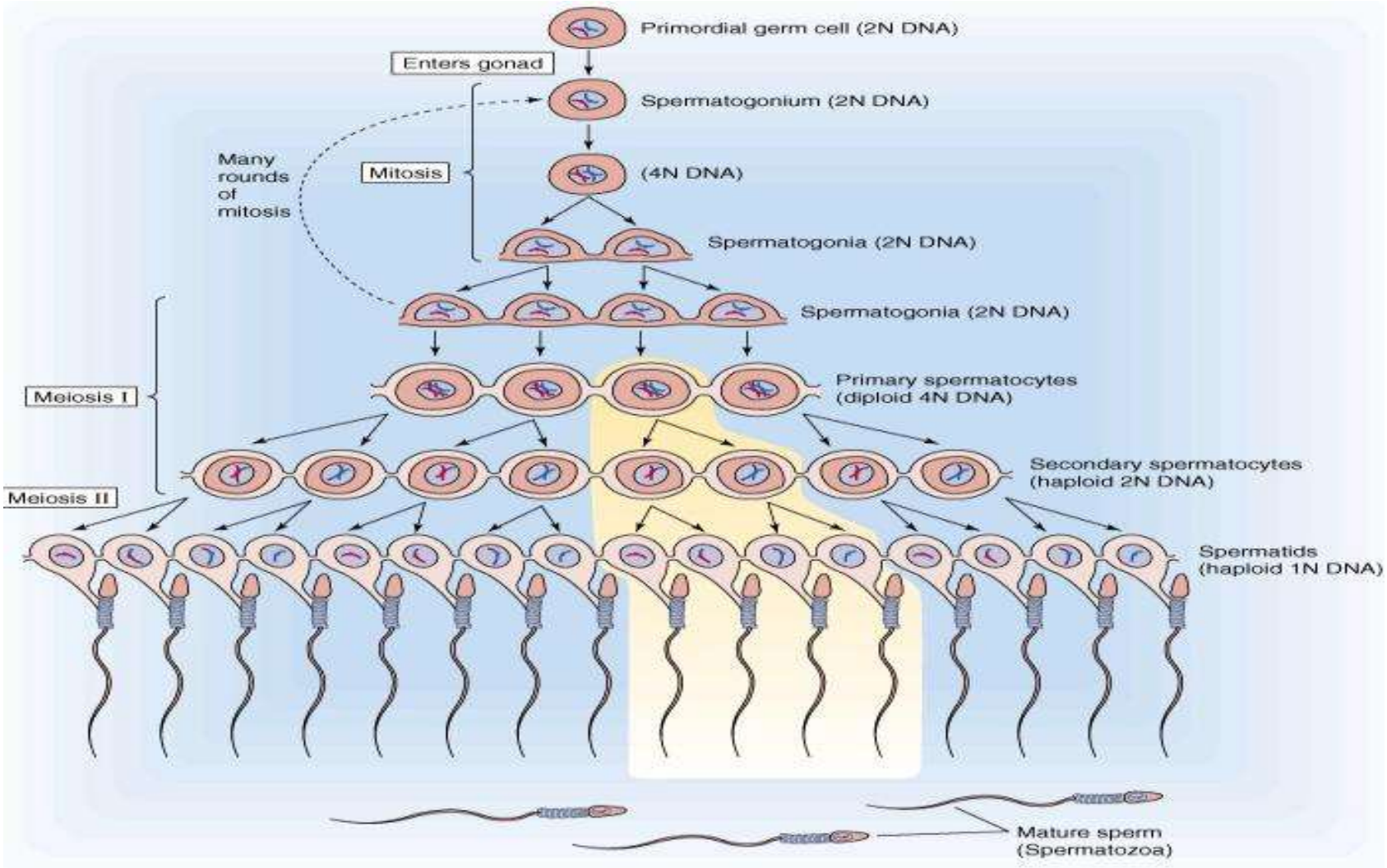
- **Testosterone causes retention of nitrogen, potassium & phosphorous.**

- **Testosterone is responsible for musculine shape of male body.**

PHASES OF SPERMATOGENESIS

- MITOSIS
- MEIOSIS
- SPERMIOGENESIS

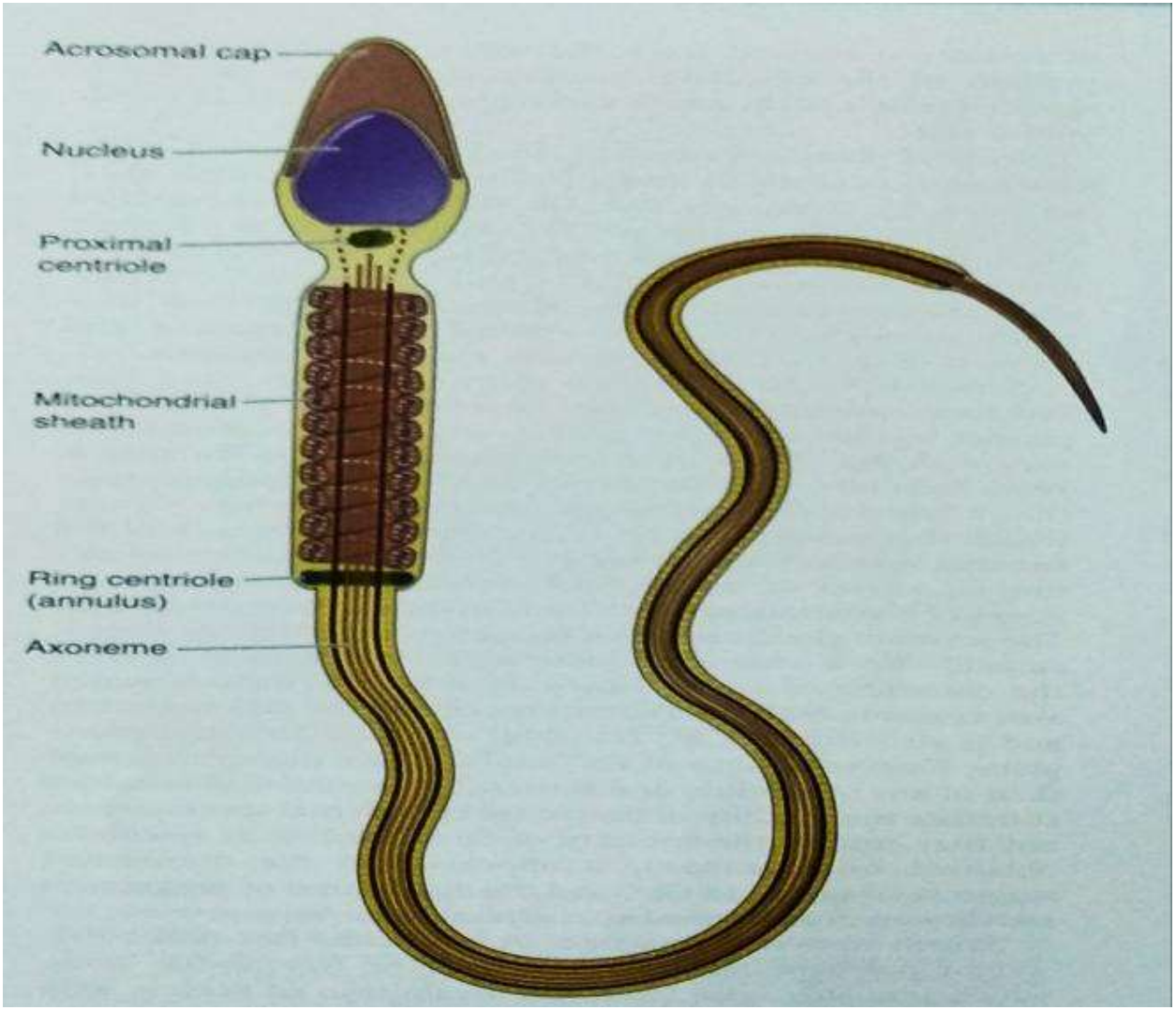
SPERMATOGENESIS



MAJOR CHANGES IN SPERMIOGENESIS

- Massive reduction in cytoplasm
- Elongation of nucleus to become head of spermatozoa
- Acquirement of acrosomal cap
- Formation of middle piece & tail piece with the ability to move effectively and swiftly

ANATOMY OF A SPERMATOZOON



Duration of spermatogenesis

Formation of spermatozoa from spermatogonium takes 65-74 days

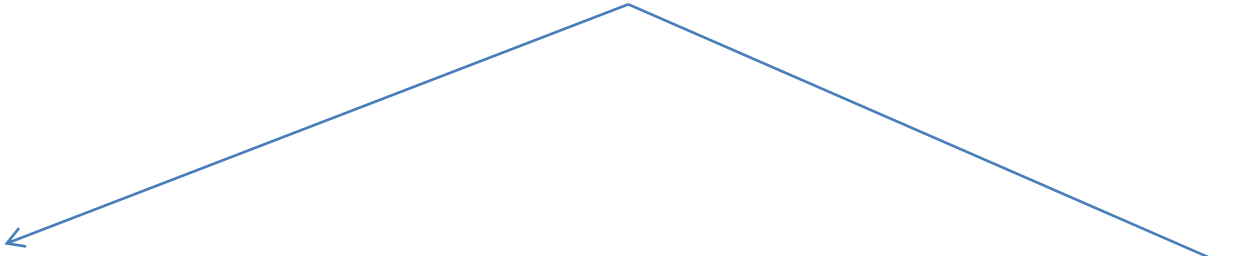
i)Spermatogonium to primary spermatocyte : 16- 20 days

ii)Primary spermatocytes to secondary spermatocytes: 23- 25 days

iii)Secondary spermatocytes to spermatids: 1day

iv)Spermattids to spermatozoa: 25 days

FACTORS INFLUENCING SPERMATOGENESIS



Hormonal Factor

1. Androgen
2. Estrogen
3. LH & FSH

Environmental Factor

1. Temperature Regulation

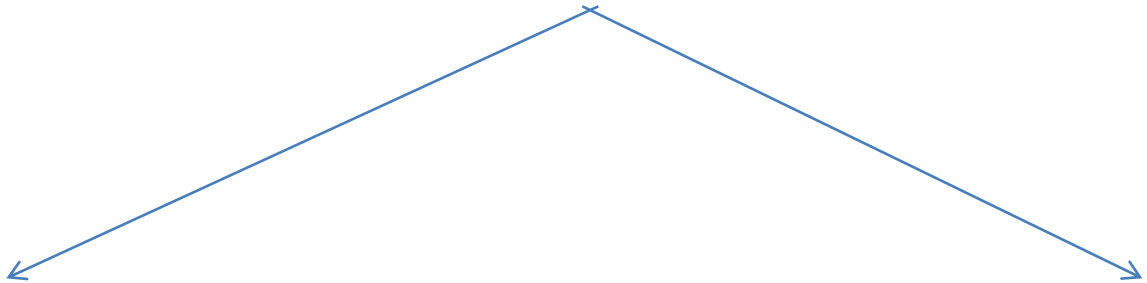
NORMAL PARAMETER VALUES FOR SEMEN

PARAMETER	VALUE
Volume of ejaculate	2–6 mL
Viscosity	Liquefaction in 1 hr
pH	7–8
Count	≥20 million/mL
Motility	≥50%
Morphology	60% normal

DIFFERENCE BETWEEN SPERMATOGENESIS & OOGENESIS

- **In females, mitotic proliferation of germ cells completes before birth whereas in males,spermatogonia start to grow at the time of puberty and then continue to divide throughout life.**
- **In females, the meiotic division of primary oocyte produces only one ovum, whereas in males one primary spermatocyte produces four spermatozoa.**
- **In female, second meiotic division is completed during fertilization, whereas in males, second meiotic division is completed during spermatogenesis.**

STAGES OF MALE SEX ACT



Erection

Ejaculation

i) Emission

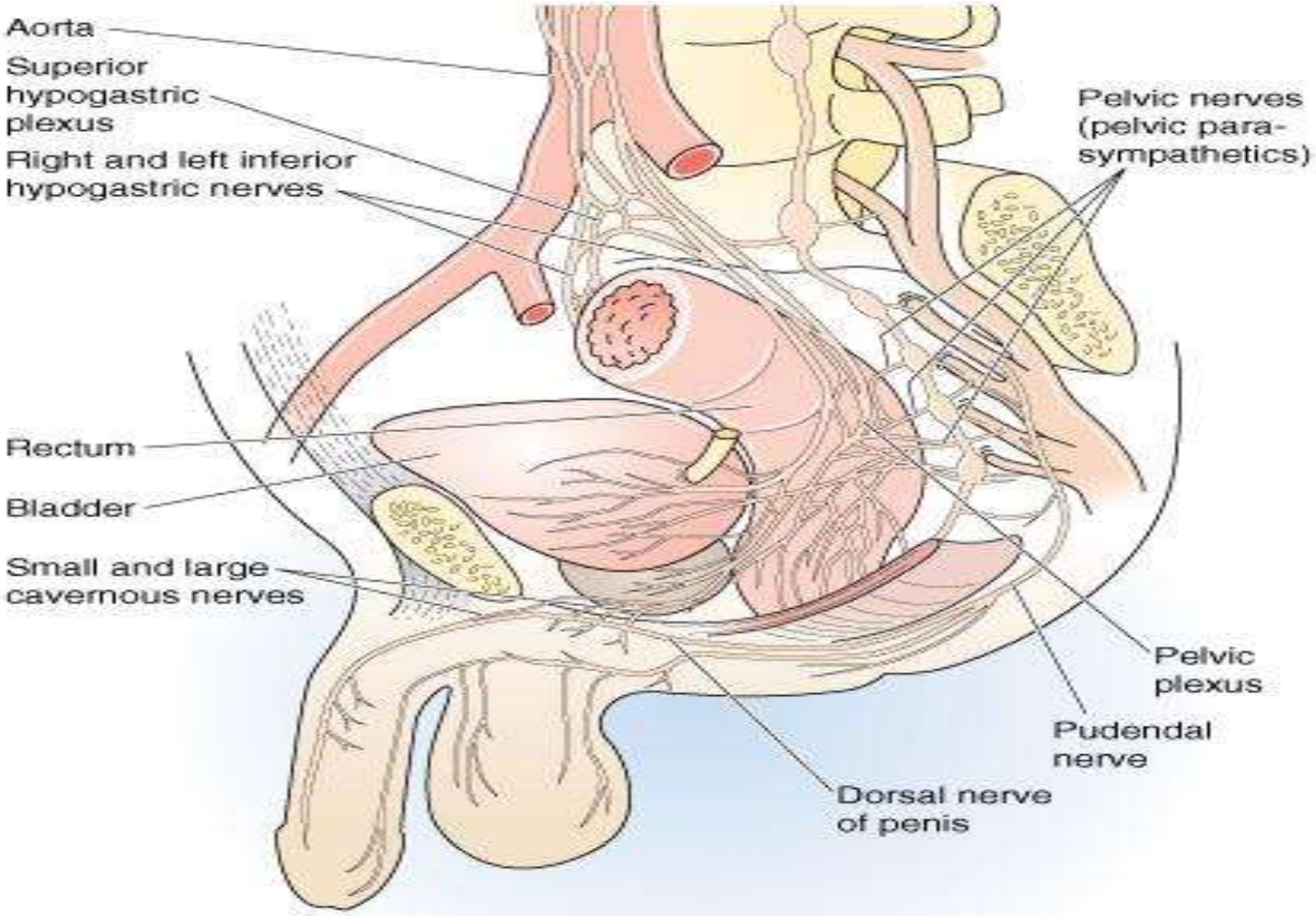
ii)Ejaculation proper

INNERVATION OF MALE GENITAL SYSTEM

- **Sympathetic innervation of male genital system involves a series of prevertebral nerve plexuses & ganglia.**
- **Parasympathetic innervation: Preganglionic PS fibers arise from sacral spinal cord and from pelvic nerve & they synapse in a pelvic plexus. The postganglionic PS follow the cavernous nerve to penile corpora and vasculature.**

- **Sympathetic innervation: Preganglionic sympathetic fibers exit the thoraco-lumbar cord & synapse in one of several prevertebral ganglia.Postganglionic fibers reach the genitalia via hypogastric nerve, the pelvic plexus & the cavernous nerves.**
- **Somatic innervation: somatic motor fibers originate in sacral spinal cord, forming the motor branch of the pudendal nerve. These fibers innervate the striated penile muscles.**
- **The dorsal nerve of the penis is the main terminus of sensory pudendal nerve & is the sole identifiable root for tactile sensory information of penis.**

SAGITTAL SECTION SHOWING INNEVATION OF MALE GENITAL SYSTEM



APPLIED PHYSIOLOGY

1. MALE HYPOGONADISM

A. HYPERGONADOTROPIC HYPOGONADISIM

- **Due to testicular dysfunction**

- **Plasma level of gonadotropin is increased.**

B.HYPOGONADOTROPIC HYPOGONADISM

- **This occurs mainly due to tumor of hypothalamus or pituitary gland.**

- **Plasma gonadotropin level is decreased.**

i) If hypogonadism occurs after puberty, the secondary sexual characteristics regress slowly because it takes very little androgen to maintain them once they are established & the voice remains deep.

ii) When the Leydig cell deficiency occurs from childhood, eunuchoidism results.

a)Eunuchoid individuals are usually tall with narrow shoulders & less muscular development.

b)The genitalia are small and voice is high pitched.

c)Pubic hair is sparse and exhibits female pattern.

2.CRYPTORCHIDISM(UNDESCENDED TESTES)

- **Testicular descent to inguinal region depends on MIS and descent from inguinal region to scrotum depends on some other factors.**
- **The proportion of boys with undescended testis falls to 2% at age of 1 year and 0.3% after puberty.**
- **The incidence of malignant tumors is higher in undescended testes than in scrotal testes.**
- **Treatment with gonadotropic hormones speeds descent in some cases or surgical treatment is recommended.**

3.ANDROGEN SECRETING TUMOR

- **Androgen secreting Leydig cell tumors are rare.**

- **Precocious pseudopuberty develops in prepuberty.**

4.PROTATE SPECIFIC ANTIGEN(PSA)

- **PSA is a 30 kDa serine protease.**
- **The gene for PSA has two androgen response elements.**
- **PSA hydrolyses semenogelin(sperm motility inhibitor in semen).**
- **Though PSA is elevated in BHP and prostatitis, it is markedly increased in malignancy of prostate.**
- **However, the effectiveness of PSA screening as a sole tool in diagnosis of prostatic cancer has been called into question.**

5.TESTOSTERONE & AGING MEN

- **Men do experience a gradual decline in serum testosterone level in comparison to abrupt hormonal alteration that signals the dramatic changes of female menopause.**

- **The decline in serum testosterone level leads to decrease in bone formation, muscle mass, growth of facial hair, appetite , libido & decrease in blood haematocrit.**

- **Testosterone replacement can reverse many of these changes by restoring muscle & bone mass and correcting anaemia.**
- **Although the level of both free & total testosterone decline with age, level of LH is not frequently elevated probably due to some degree of hypothalamic-pituitary dysfunction associated with aging.**

6.ERECTILE DYSFUNCTION(ED)

- **Sildenafil, Vardenafil & Tadalfil are commonly used in men with erectile dysfunction can improve in rigidity and duration of erection.**
- **These drugs are highly selective high affinity inhibitors of cGMP specific phosphodiesterase type 5 and thereby raise[cGMP] in smooth muscle of corpora cavernosa of penis.**
- **One of the side effects of Sildenafil is blue vision, a consequence of the effect of inhibiting cGMP specific phosphodiesterase in retina.**
- **In individuals taking other vasodilatation, Sildenafil can lead to sudden death.**
- **Sildenafil may improve sexual function by increasing blood flow to accessory sex organs.**

7.RETROGRADE EJACULATION

- **Semen enters into the urinary bladder rather than passing down the urethra as a result of failure of constriction of internal urethral sphincter.**
- **Aetiology :**
    1. **Diabetic peripheral neuropathy**
    2. **Multiple sclerosis**
    3. **Certain drugs**
    4. **Bladder neck surgery**
    5. **Trans urethral resection of prostate(TURP)**
    6. **Colorectal surgery**
    7. **Retroperitoneal lymphnode dissection**

- **Presence of more than 15 sperms/hpf in urine specimen after ejaculation confirms the occurrence of retrograde ejaculation.**
- **T/t: by increasing the tone of vas deference to propel the semen forward & by increasing the tone of internal urethral sphincter by**

    1.Phentolamine(α- adrenergic agonist)

    2.Ephidrine(which enhances epinephrine release)

    3.Imipramine(Norepinephrine reuptake inhibitor)

8.SERTOLI CELL- ONLY SYNDROME

- **Aetiology-**
  - **i)Genetical defect**
  - **ii)Orchitis**
  - **iii)Alcoholism**
  - **iv)Toxic agents**
- **The seminiferous tubules are lined by only sertoli cell but show a complete absence of germ cell.**
- **Plasma testostosterone and LH levels are normal but FSH level is elevated.**
- **However, these individuals generally have functional spermatogenesis in other seminiferous tubules.**

THANK YOU