Reproductive and Hormonal Functions of the Male-I

Unit XIV

Chapter 81

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Male Reproductive System

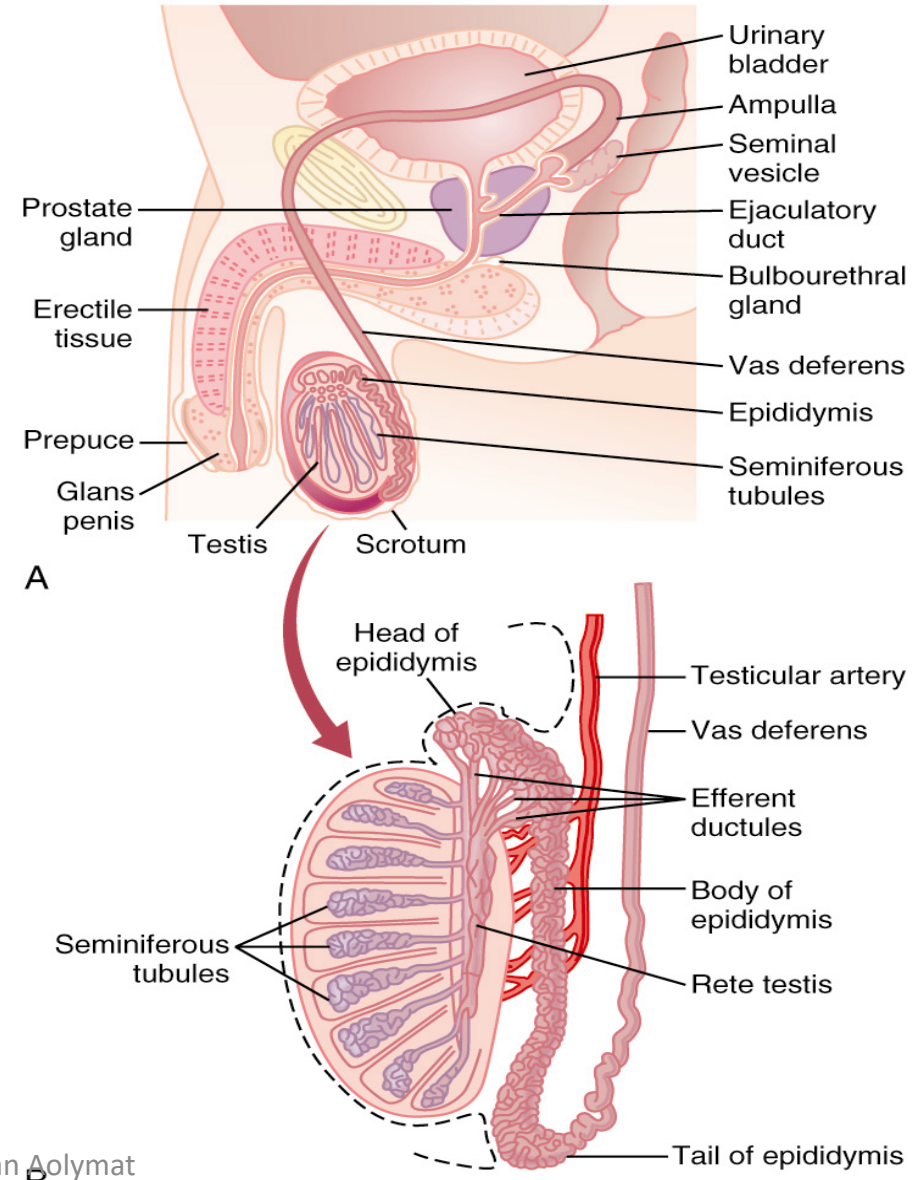
Primary Sex Organs

Testes : composed of up to 900 coiled seminiferous tubules→spermatogenesis

Accessory Sex Organs

Accessory sex organs in males are:

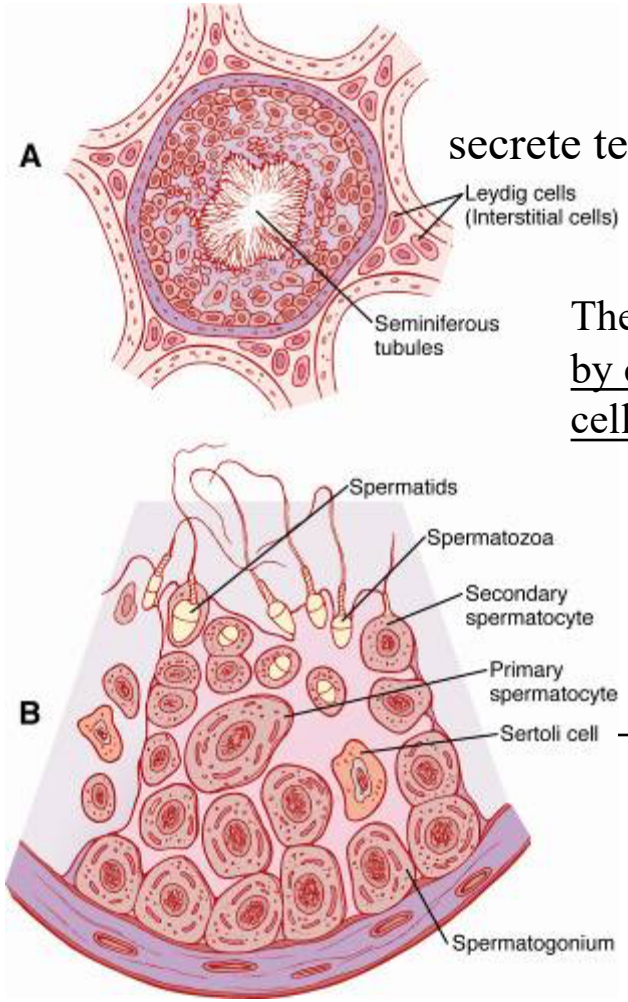
1. Seminal vesicles
2. Prostate gland
3. Urethra
4. Penis



Functions of the male reproductive system

- **Testes**→ produce sperm and male sex hormone **testosterone.**
- **Ducts**→ transport, store, and assist in maturation of sperm.
- **Accessory sex glands**→ secrete most of the **liquid portion** of semen.
- **Penis** → contains the urethra, a passageway for ejaculation of semen and excretion of urine.

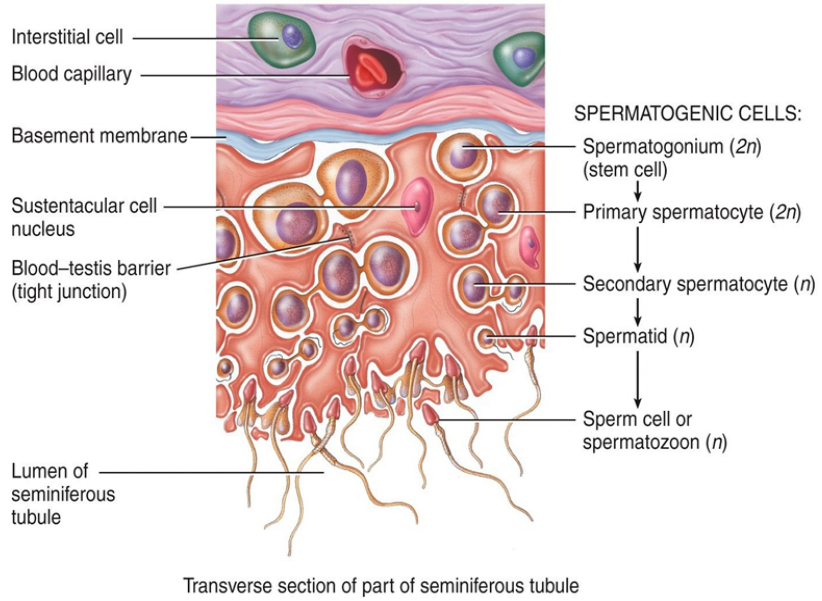
Male reproductive system



occurs in the seminiferous tubules of the testes

secrete testosterone

The germ cell line is completely invested by cytoplasm of surrounding Sertoli cells→Blood Testes Barrier



Transverse section of part of seminiferous tubule

Role of Sertoli Cell in Spermatogenesis

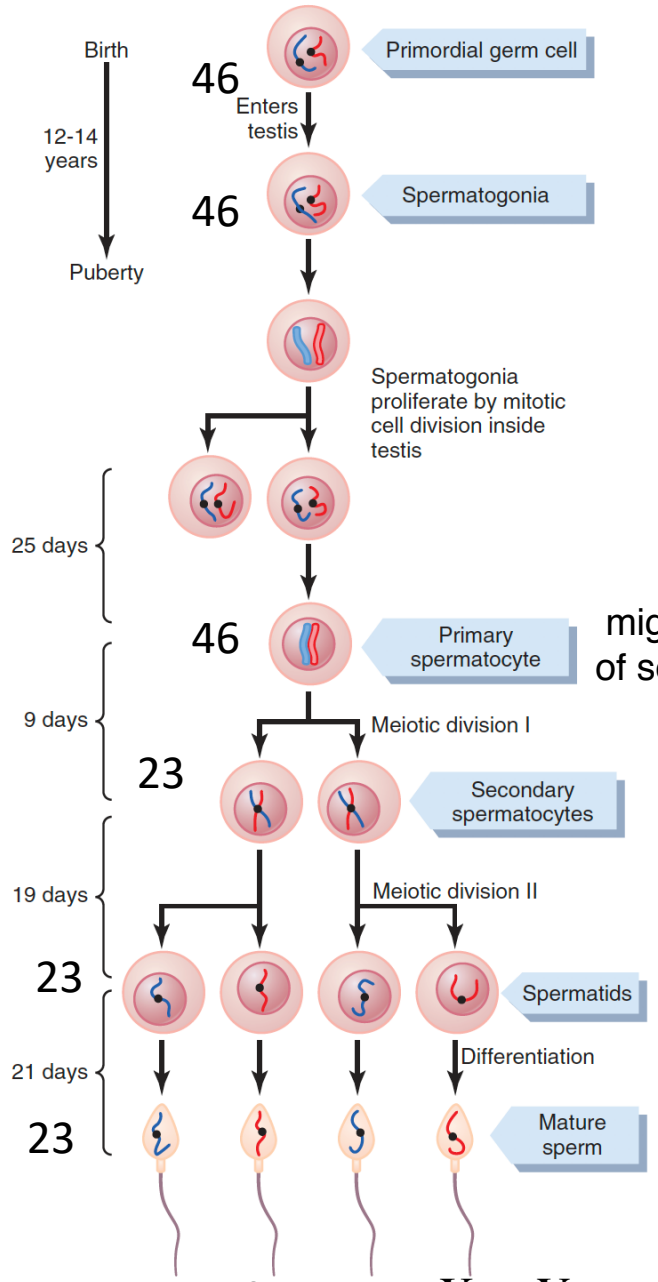
i. Supporting and nourishing the germ cells + Phagocytosis
ii. Providing hormonal substances necessary for spermatogenesis
iii. Secreting androgen-binding protein (ABP)→ binds testosterone and helps maintain a high concentration of testosterone (stimulated by FSH)
iv. Releasing sperms into the lumen of seminiferous tubules (spermination)→sperm are released from their connections to sustentacular cells.
v. Blood Testies Barrier

Functions of Sertoli Cells

- **Synthesze and Secret the following**
- Secretes inhibin: inhibits FSH secretion. (*regulator of spermatogenesis*).
- Secrets Activin: function not clear. (*regulator of spermatogenesis*)
- MIS (Mullerian-inhibiting substance): causes regression of mullerian ducts in males during fetal life.
- Estrogen: role not known, possibly controlling testosterone production.

spermatogenesis

Start at Puberty
74 days



migrate along with Sertoli cells towards lumen of seminiferous tubule

Spermeogenesis
is the process by which spermatids become matured spermatozoa.
Changes e during spermeogenesis:
i. Condensation of nuclear material
ii. Formation of acrosome, mitochondrial spiral filament and tail structures
iii. Removal of extra volume of nonessential cytoplasm.

➢**four spermatids**

X or Y

Hormonal Factors Stimulates Spermatogenesis

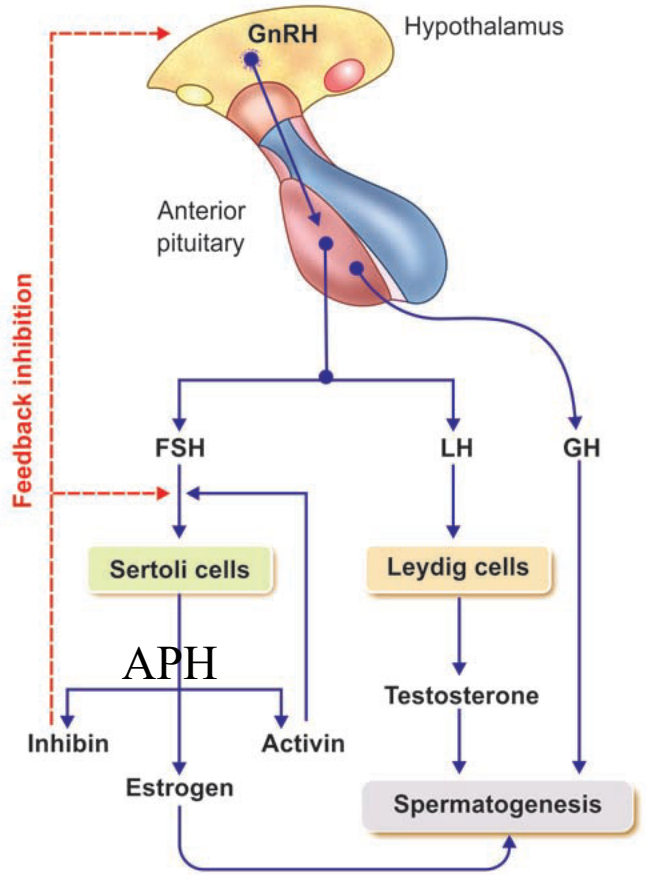
1. Testosterone --> secreted by Leydig cells→ growth and division of the testicular germinal cells

2. Luteinizing hormone (LH)→ stimulates the Leydig cells to secrete **testosterone**.
3. Follicle-stimulating hormone (FSH--> stimulates the process of spermiogenesis
GnRH→ stimulates anterior pituitary gland to produce luteinizing hormone (LH) and follicle stimulating hormone (FSH)

4. Estrogens→ formed from **testosterone** by the Sertoli cells when stimulated by FSH→probably also essential for spermiogenesis.

5. Growth hormone (as well as most of the other body hormones) → controlling metabolic functions of the testes.
Growth hormone→promotes early division of the spermatogonia

Dwarfs→ spermatogenesis is severely deficient or absent, thus causing infertility.



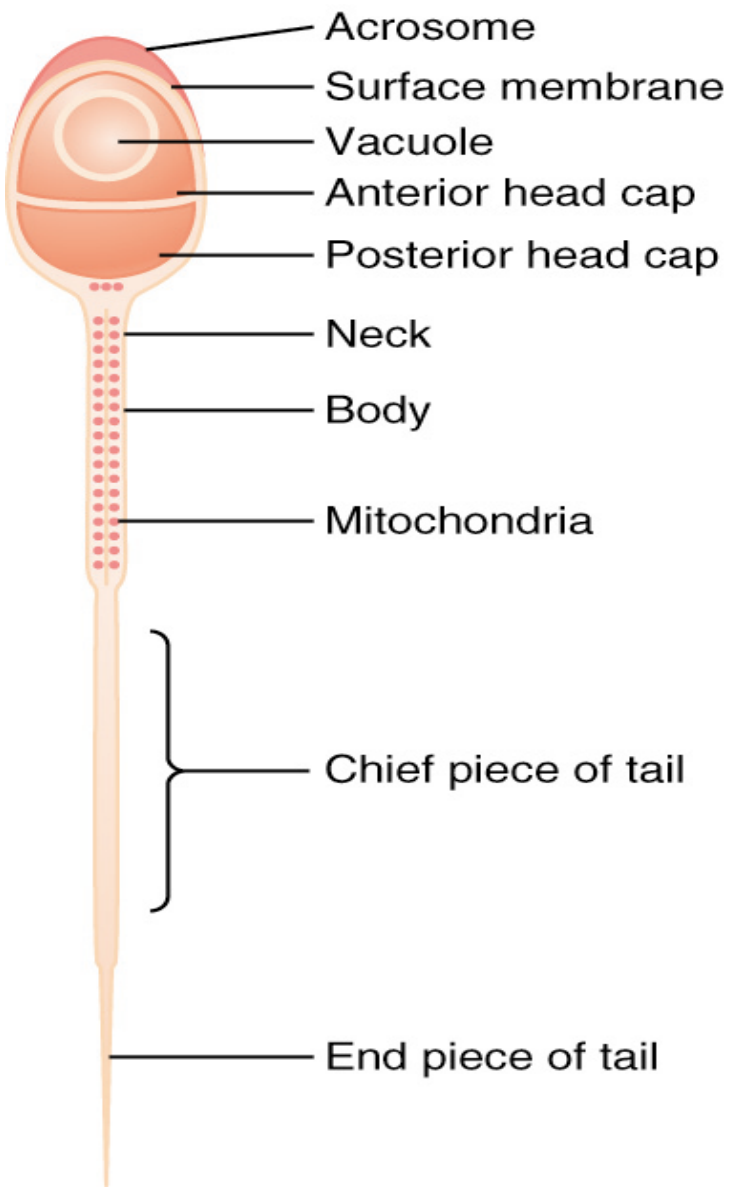
Structure of the Human Spermatozoon

Sperm: designed to reach and penetrate the secondary oocyte in order to achieve **fertilization** and create a zygote.

head →contains condensed nucleus with 23 chromosomes+ thin cytoplasm.

Acrosome→ covers the head and contains enzymes (hyauronidases & proteolytic enzymes) to help with penetration.

Tail= flagellum →3 parts
(1) central → microtubules = axoneme
(2) thin cell membrane covering the axoneme
(3) mitochondria→ATP for locomotion
The principal piece and end piece make up the tail used for movement (velocity 1-4 mm/min)



Maturation of Sperms

- Seminiferous tubules → tubule of the epididymis
- Sperms at early portions of epididymis→ nonmotile & cannot fertilize an ovum.
- After 18- 24 hours presence in epididymis→ sperms develop capability of motility, even though **several inhibitory proteins** in the epididymal fluid still prevent final motility until after ejaculation.

The Sertoli cells and the epithelium of the epididymis→secrete a special nutrient fluid that is ejaculated along with the sperm.

fluid contains:

hormones (testosterone and estrogens),
enzymes
other nutrients that are essential for sperm maturation.

Stored at epididymis (mainly) & vas deferens for 1 month in depressed state)
Frequent ejaculation →few days storage

After ejaculation→ maturation of sperm→ become motile and capable of fertilizing the ovum

Maturation of Sperms

Capacitation: A process to render the sperms competent to fertilize the ovum/ hypermotile.

- Occurs when sperm is expelled coming in contact with the fluids of the female genital
- Normally requires from 1 to 10 hours.

Changes leading Capacitation of Spermatozoa

- various inhibitory factors that suppress sperm activity → washed by uterine and fallopian tube fluids
- Loss of cholesterol vesicles (tough & prevent enzymatic release) at acrosome of sperm
- Increase permeability of flagella to Ca ions cause increase in motility
- Ca ions enhances the release of enzymes by the acrosome enhancing the penetration of ovum

Seminal Vesicles

60% of total semen.

Functions of seminal fluid-

Nutrition to sperms →Fructose
Other subestances: citric acid, PG

Clotting of semen
Immediately after ejaculation→ clotting of semen → conversion of fibrinogen into fibrin.

Fertilization
Prostaglandin →enhances fertilization of ovum by:
1. Increasing the **receptive capacity** of cervical mucosa for sperms
2. Initiating reverse **peristaltic movement** of uterus and fallopian tubes→increasing rate of semen transport **(oxytocin is also responsible for this process).**

Prostate Gland

- 30% of total semen.

Functions of prostatic fluid-Ca, citrate, phosphate

Maintenance of sperm motility

pH<6 →NON-MOTILE SPERM
Vas deference & female genital tract are acidic.
Prostatic fluid provides optimum pH for the motility of sperms.

Clotting of semen
clotting enzymes present in prostatic fluid→ convert fibrinogen (from seminal vesicles) into **coagulum**--> holding the sperms in uterine cervix.

Lysis of coagulum
The coagulum is dissolved by **fibrinolysin** of prostatic fluid (15-30 min after ejaculation), so that the sperms **become motile**.

prostate-specific antigen (PSA)→ hydrolyse sperm motility inhibitors.

Bulbourethral (Cowper's) glands

secrete an alkaline fluid during sexual arousal that neutralizes acids from urine and mucus for lubrication

Semen:

Contains fluids from seminal vesicles, prostate, vas deference and mucus glands, such as bulbourethral gland
Milky fluid
fructose, vit B, C, E, electrolytes: Na,K, Mg,Ca, Cl, HPO3
LMW polypeptides, proteins

pH = 7.5 final

Each ejaculation contains approximately 2-6 ml,
35-200 sperm, avg 120 m/ml, Avg 400 million/ejaculation
(< 20 million = infertile)
Reach fallopian tube 30-60 min

Factors affecting sperm activity

medium at velocities of 1 to 4 mm/min.

Factors affecting activity of sperm:
1-neutral and slightly alkaline medium→ increase activity
depressed in mildly acidic medium.
strong acidic medium → death

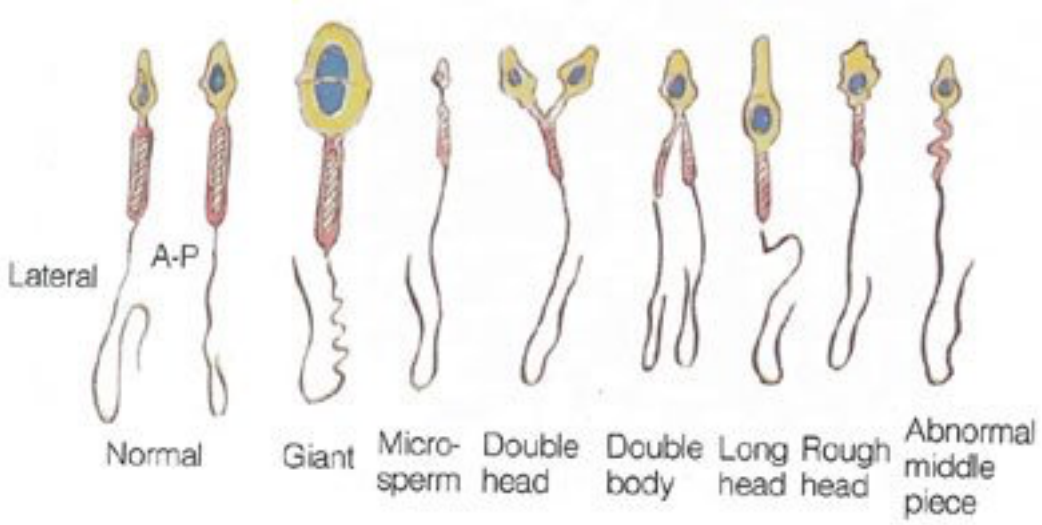
2- temperature →activity increases with increasing T
Optimum 2°C below the internal temperature.
On cold days→scrotal reflexes→ pulling the testes close to the body
Warm days→scrotum descend
excessive temperature -> degeneration of cells of seminiferous tubules

3-rate of metabolism→Proportional

the life expectancy of ejaculated sperm in the female genital tract is only 1 to 2 days.

Qualities of semen required for fertility

	Minimum required
Volume	2 mL
Sperm count	20 million/mL
Number of sperms /ejaculation	40 million
Alive sperms	75%
Motile sperms	50%
normal shape and structure	30%



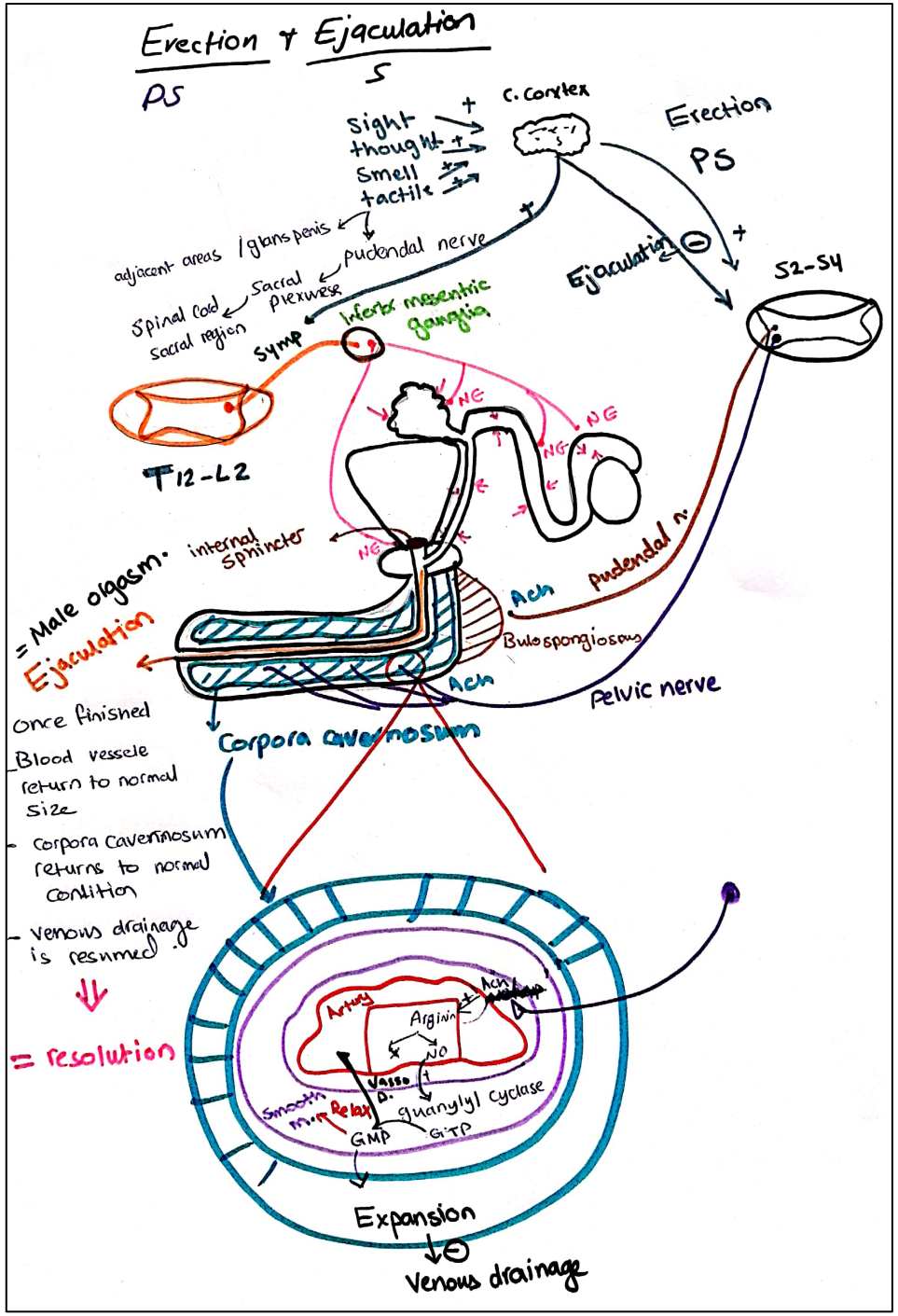
Abnormal Spermatogenesis and Male Fertility

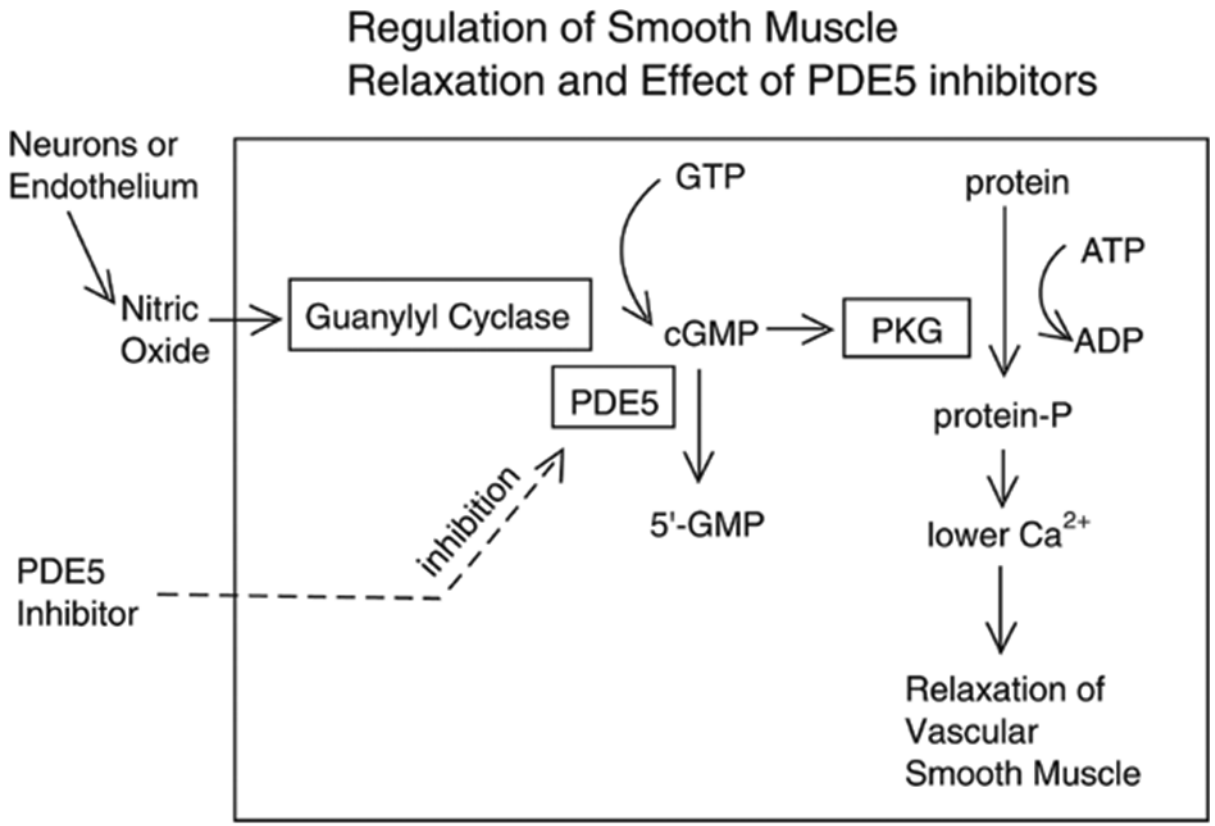
Mumps→bilateral orchitis (inflammation) of the testes resulting from mumps → sterility

Cryptorchidism
congenital disorder ->failure of one or both the testes to descent from abdomen into scrotum.

=undescended testes--> prone for testicular cancer.

Treatment
testosterone or gonadotropic hormones (which stimulate Leydig cells) causes descent of testes,
Surgery


Erection + Ejaculation
PS
S
C. cortex
Sight
thought
Smell
tactile
Erection
PS
adjacent areas / glans penis
Pudendal nerve
Spinal cord
Sacral region
Sacral Plexuses
Ejaculation
S2-S4
Symp
Inferior mesentric ganglia
T12-L2
NE
internal Sphincter
= Male orgasm.
Ejaculation
Ach
Pudendal n.
Bulbospongiosus
Ach
Pelvic nerve
Once finished
Blood vessels return to normal size
- Corpora Cavernosum returns to normal condition
- Venous drainage is resumed
= resolution
Corpora Cavernosum
Artery
Arginine
NO
Vasso D.
Smooth m.
Relax
GMP
Guanylyl Cyclase
GTP
Expansion
Venous drainage


Regulation of Smooth Muscle
Relaxation and Effect of PDE5 inhibitors
Neurons or Endothelium
Nitric Oxide
Guanylyl Cyclase
GTP
cGMP
PKG
protein
ATP
ADP
protein-P
PDE5
5'-GMP
inhibition
PDE5 Inhibitor
lower Ca2+
Relaxation of Vascular Smooth Muscle

Male sexual response

Erection: controlled by parasympathetic nervous system
Incr. Parasympathetic and dec. sympathetic
activity to penile arterioles = vasodilation of the arterioles and erection
Parasympathetic postganglionic fibers release Ach
-- muscarinic receptors on endothelium --
produce NO -- also released by nerve terminals
-- veins are compressed causing reduction in venous return
-- pressure in corpus cavernosum higher than blood pressure
-- NO ⟶ PKG ⟶ dec Ca++ ⟶ relaxation

Male sexual response

Emission: movement of ejaculate into proximal part of urethra under sympathetic control -- causes sequential peristaltic contraction of smooth muscle of vas deferens -- closing of bladder sphincter

Ejaculation: spinal reflex -- triggered by entry of semen into urethra causes nerve impulses to activate perineal muscles -- forcibly expel semen from urethra

Orgasm: culmination of sexual excitation

Detumescence: (flaccidity) NE from sympathetics, endothelin = contraction of smooth muscle and inc venous outflow

The end