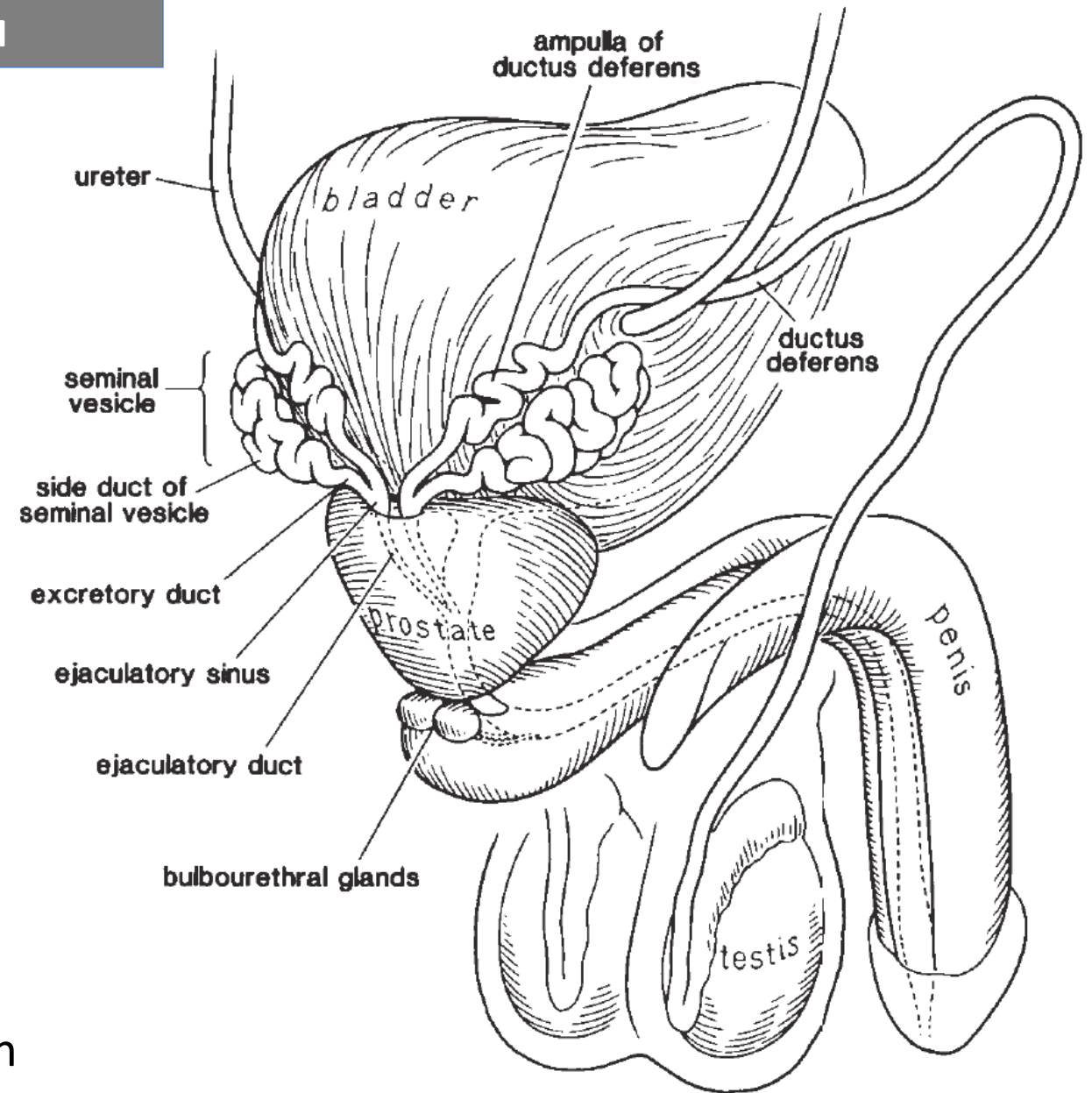


Histology of accessory male genital glands and penis

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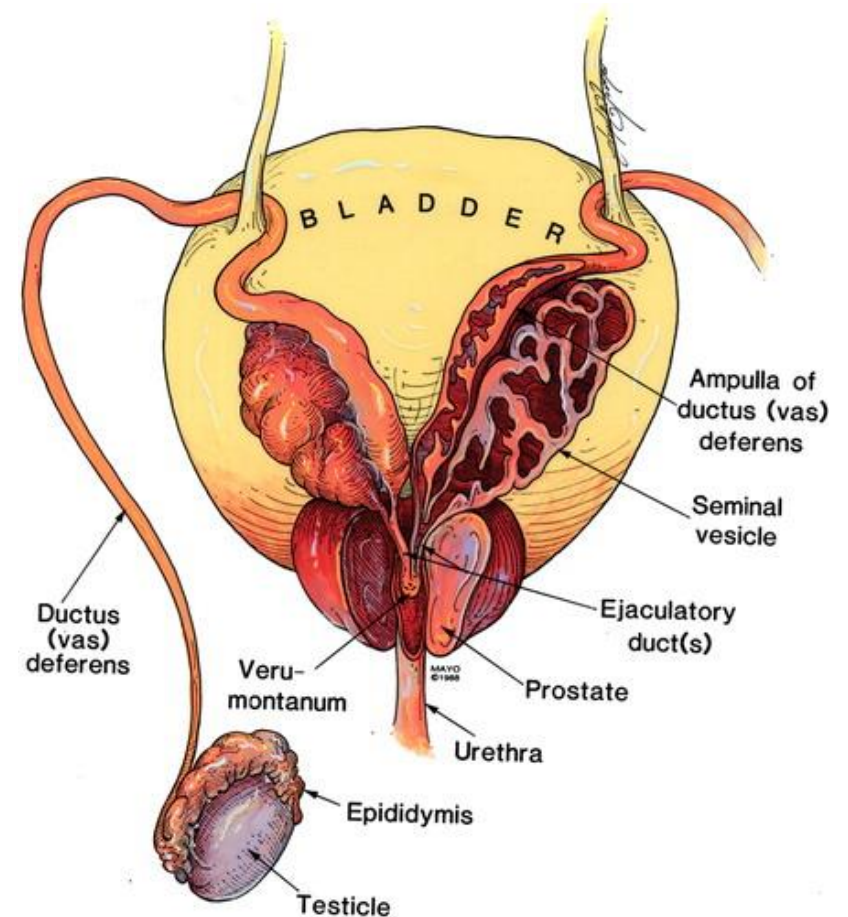


Learning objectives

- The histology and function of the...
 - Seminal vesicles (Vesicula seminalis)
 - Prostate Gland
 - Bulbourethral glands
 - Urethra
 - Penis
- The main aspects of the ejaculate

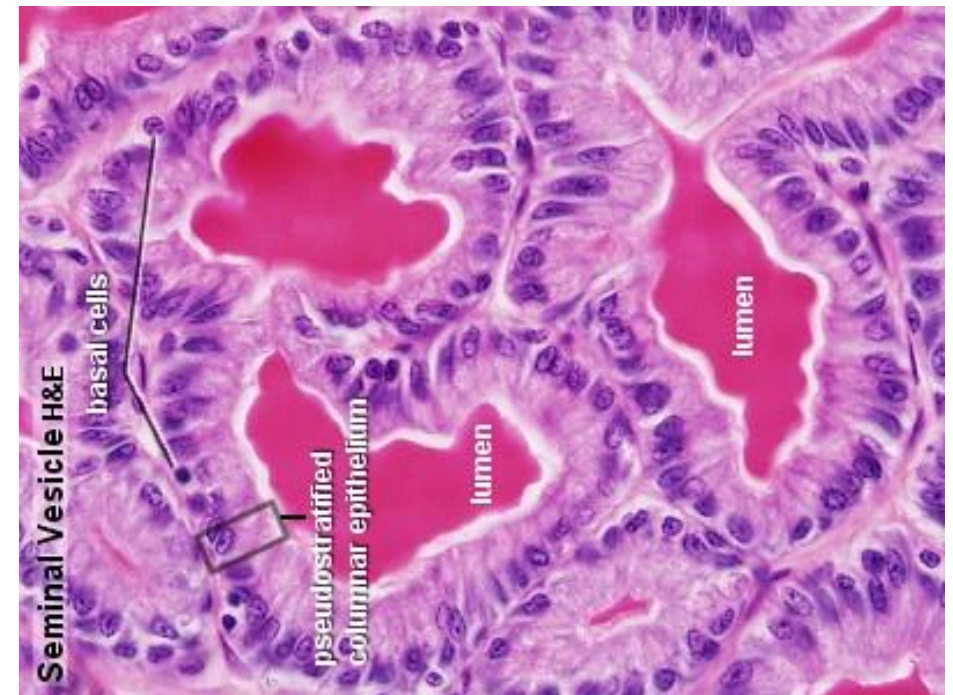
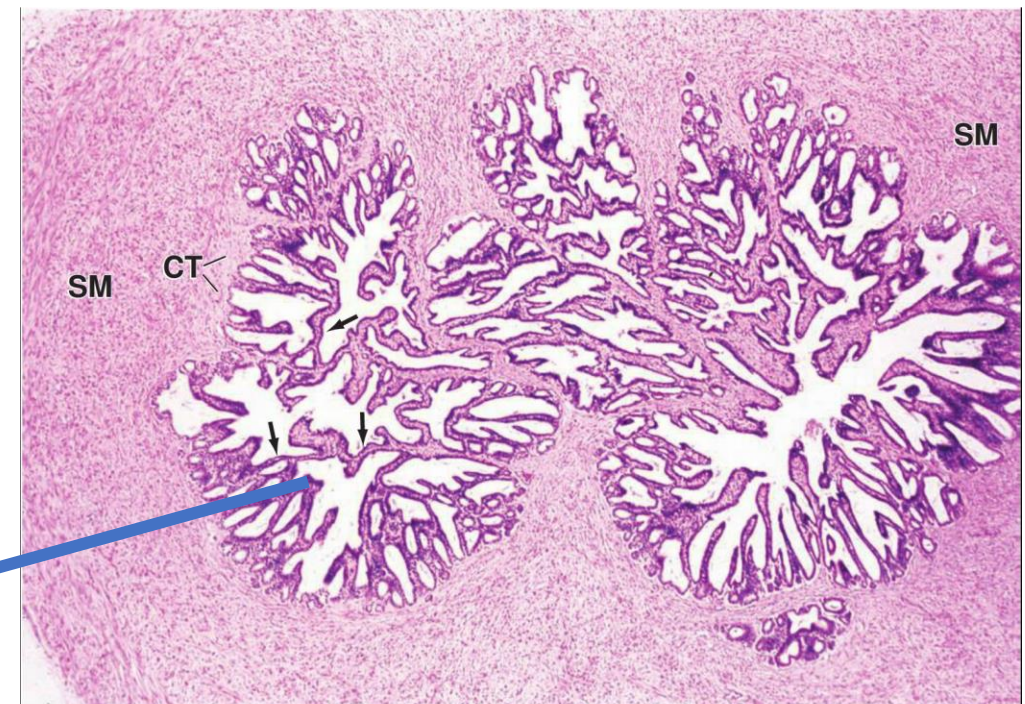
Seminal vesicles (Vesicula seminalis)

- The seminal vesicles are **paired**, elongate, and highly folded **tubular glands** located on the posterior wall of the urinary bladder, parallel to the ampulla of the ductus deferens.
- The short excretory duct from each seminal vesicle combines with the ampulla of the ductus deferens to form **the ejaculatory duct**.



Seminal vesicles (Vesicula seminalis)

- The wall of the seminal vesicles contains a **mucosa**, a **layer of smooth muscle** (thin external longitudinal and a thicker internal circular muscle layer), and a **fibrous coat**
- The mucosa is thrown into numerous primary, secondary, and tertiary folds that increase the secretory surface area. Actually there is a single lumen.
- The **pseudostratified columnar epithelium** contains tall, **nonciliated columnar cells** and **short, round cells** that rest on the basal lamina.
- The short cells appear identical to those of the rest of the excurrent duct system. They are the stem cells from which the columnar cells are derived.
- The columnar cells have the morphology of **protein-secreting cells**, with a well-developed rER and large secretory vacuoles in the apical cytoplasm. They may have short microvilli and stored lipofuscin pigment.

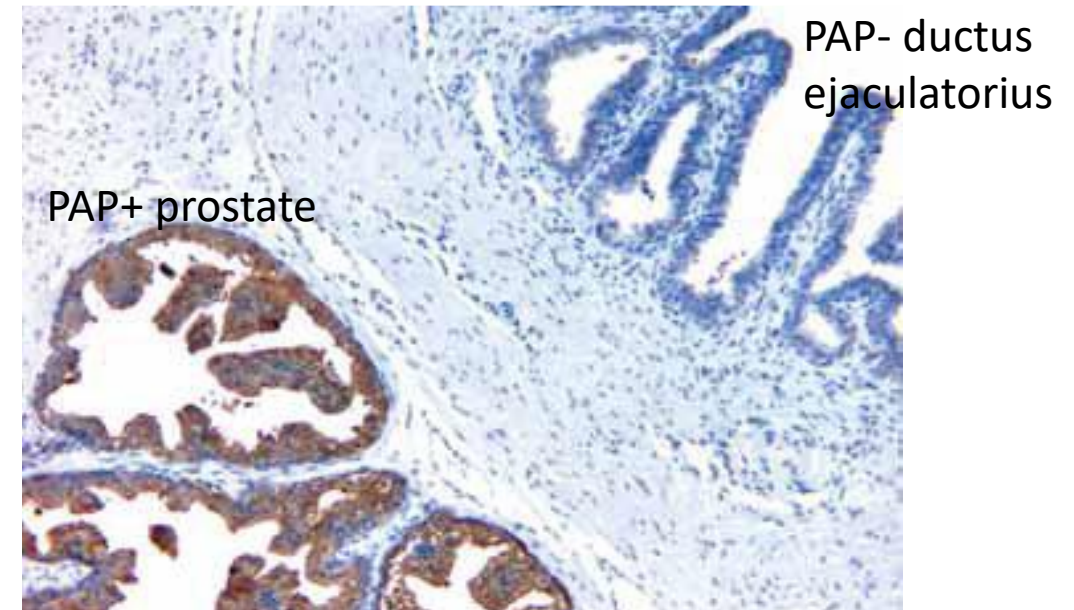
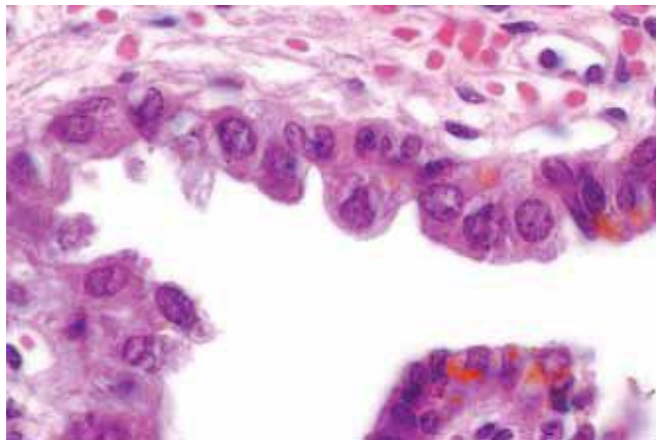
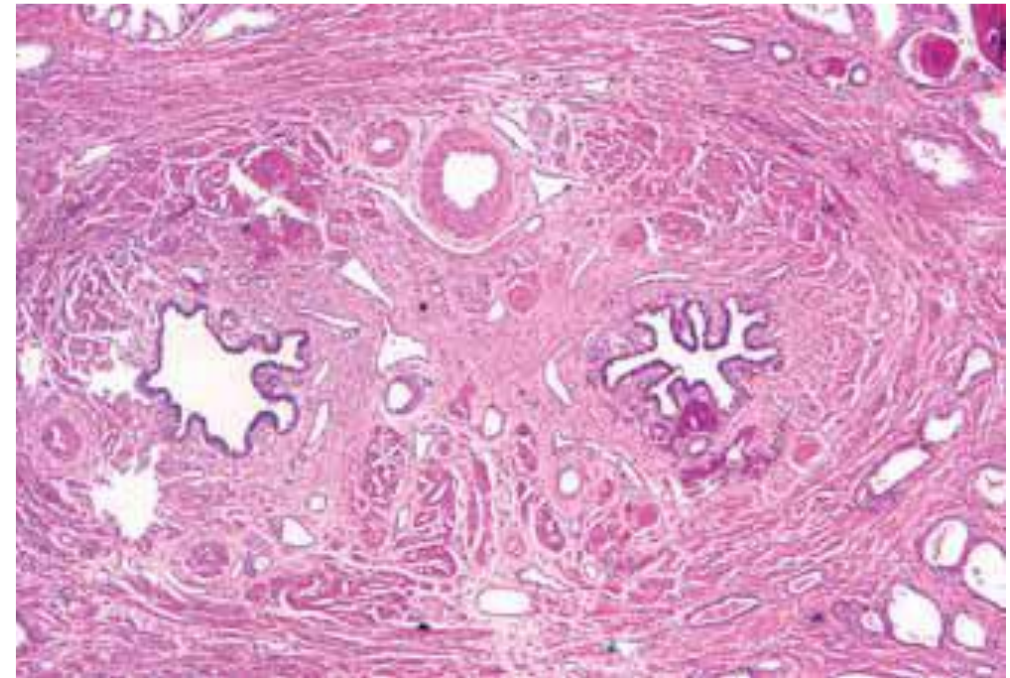


Seminal vesicles (Vesicula seminalis)

- The secretion of the seminal vesicles is a whitish yellow, viscous material. It contains **fructose**, which is the principal metabolic substrate for sperm, along with other simple sugars, amino acids, ascorbic acid, and prostaglandins.
- Contraction of the smooth muscle coat of the seminal vesicles during ejaculation discharges their secretion into the ejaculatory ducts and helps to flush sperm out of the urethra. **It contributes about %70-85 of human ejaculate.**
- The secretory function and morphology of the seminal vesicles are under the control of **testosterone**.
- Spermatozoa, refluxed from the ejaculatory duct, occasionally may be present in lumen, although they are not normally stored within the seminal vesicles.

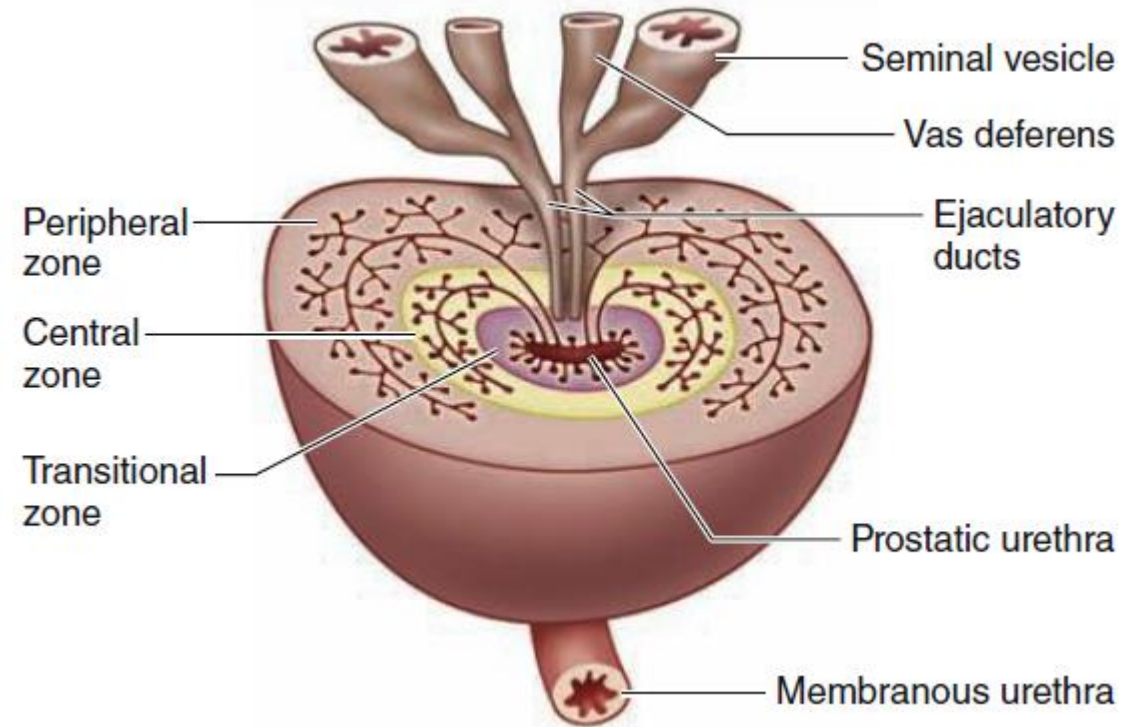
Ductus ejaculatorius

- The ejaculatory ducts are short (1.5 cm) paired ducts, arising from the confluence of the excretory duct of the seminal vesicle and the ampulla of the vas, that quickly converge and enter the prostate.
- They run through the central zone of the prostate parenchyma and enter the posterior aspect of the distal prostate urethra at the veru montanum
- The epithelium of the ejaculatory ducts resembles that of the seminal vesicle and ampulla of the vas.



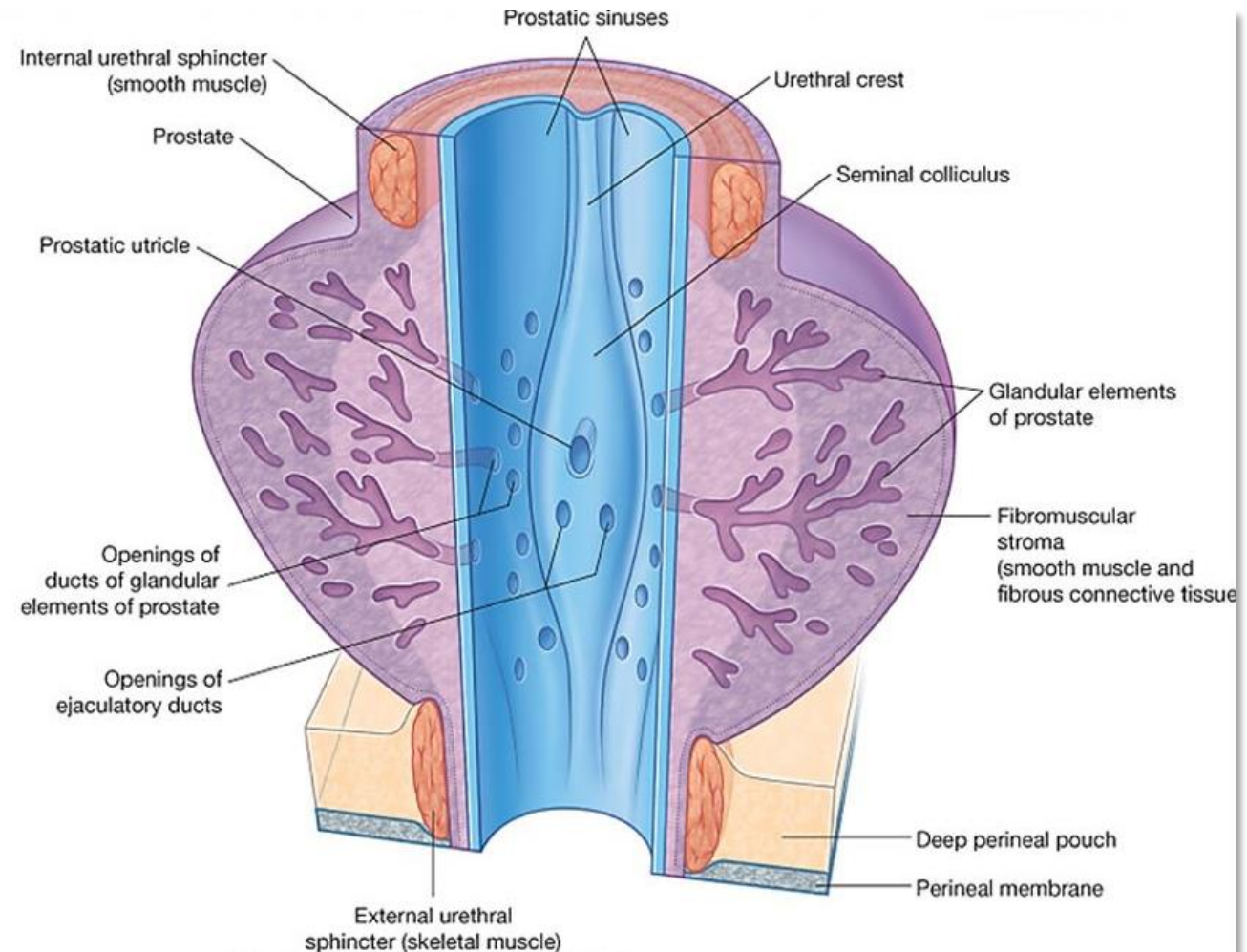
Prostate

- The prostate is the largest accessory sex gland of the male reproductive system.
- Its size and shape are commonly compared to those of a walnut, approximately 2 cm × 3 cm × 4 cm in size and weighs about 20 g.
- The main function of the prostate gland is to secrete a clear, slightly alkaline (pH 7.29) fluid that contributes to the formation of seminal fluid.
- The gland is located in the pelvis, inferior to the bladder, where it surrounds the prostatic part of the urethra.



Prostatic glands

- **It consists of 30 to 50 tubuloalveolar glands** arranged in three concentric layers:
- an inner mucosal layer, an intermediate submucosal layer, and a peripheral layer containing the main prostatic glands.
- The glands of the mucosal layer secrete directly into the urethra; the other two layers have ducts that open into the prostatic sinuses located on either side of the urethral crest on the posterior wall of the urethra.

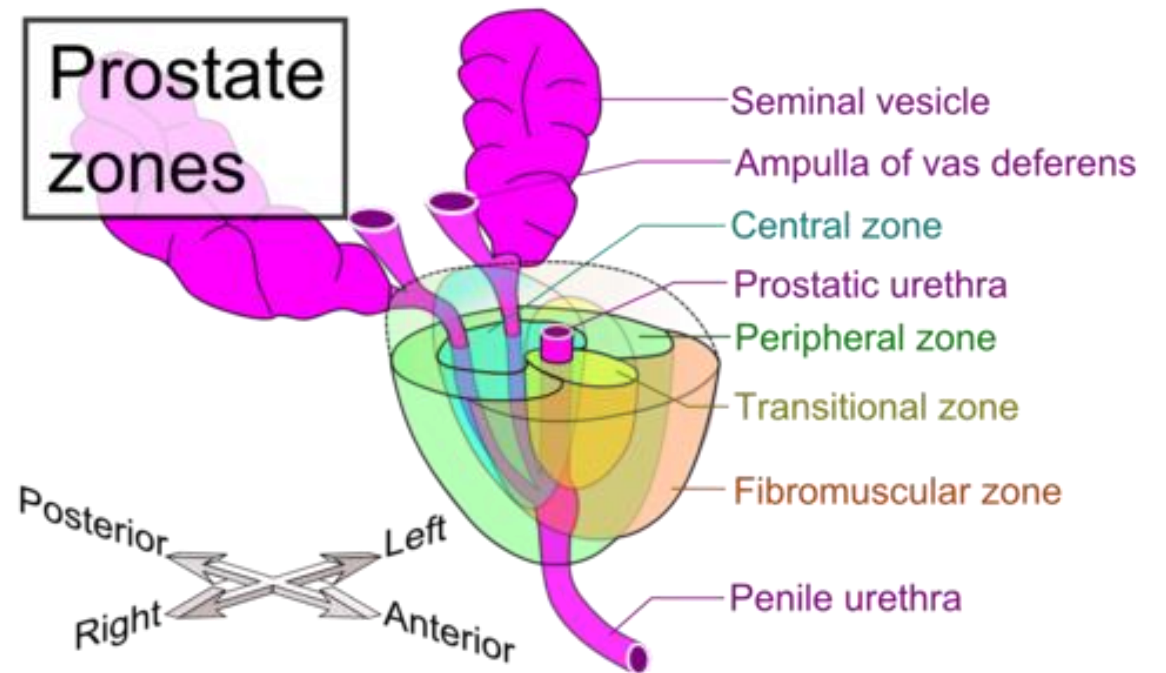


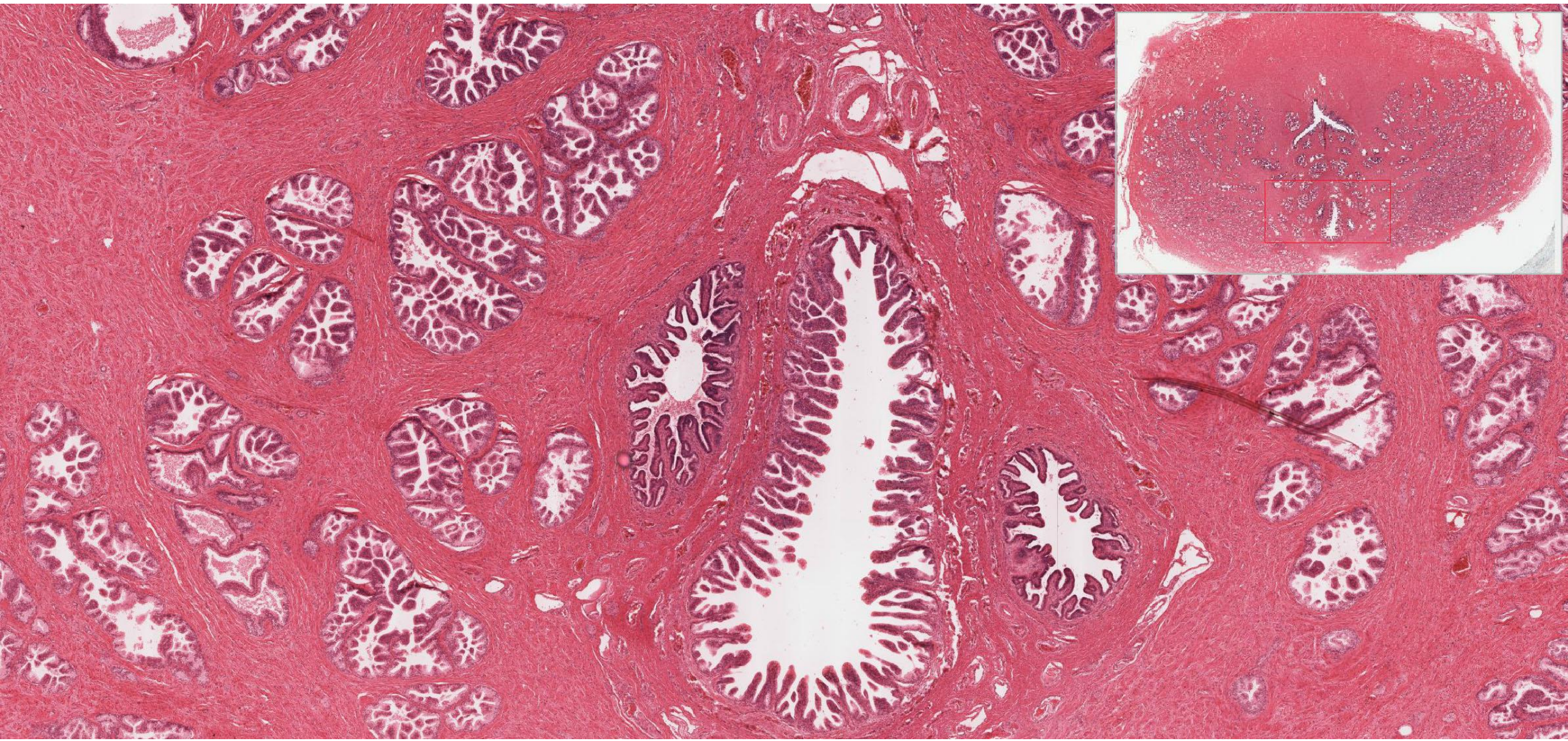
Drake: Gray's Anatomy for Students, 2nd Edition.

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The adult prostatic parenchyma is divided into three anatomically and clinically distinct zones:

- **the peripheral, central, and transition zones**
- The **central zone** surrounds ejaculatory ducts as they pierce the prostate gland. It contains about 25% of the glandular tissue and is **resistant to both carcinoma and inflammation**.
- In comparison to the other zones, cells in the central zone have distinctive morphologic features (a more prominent and slightly basophilic cytoplasm and a larger nuclei displaced at different levels in adjacent cells).
- Recent findings suggest that this zone originates embryologically from the inclusion of mesonephric duct cells into the developing prostate.

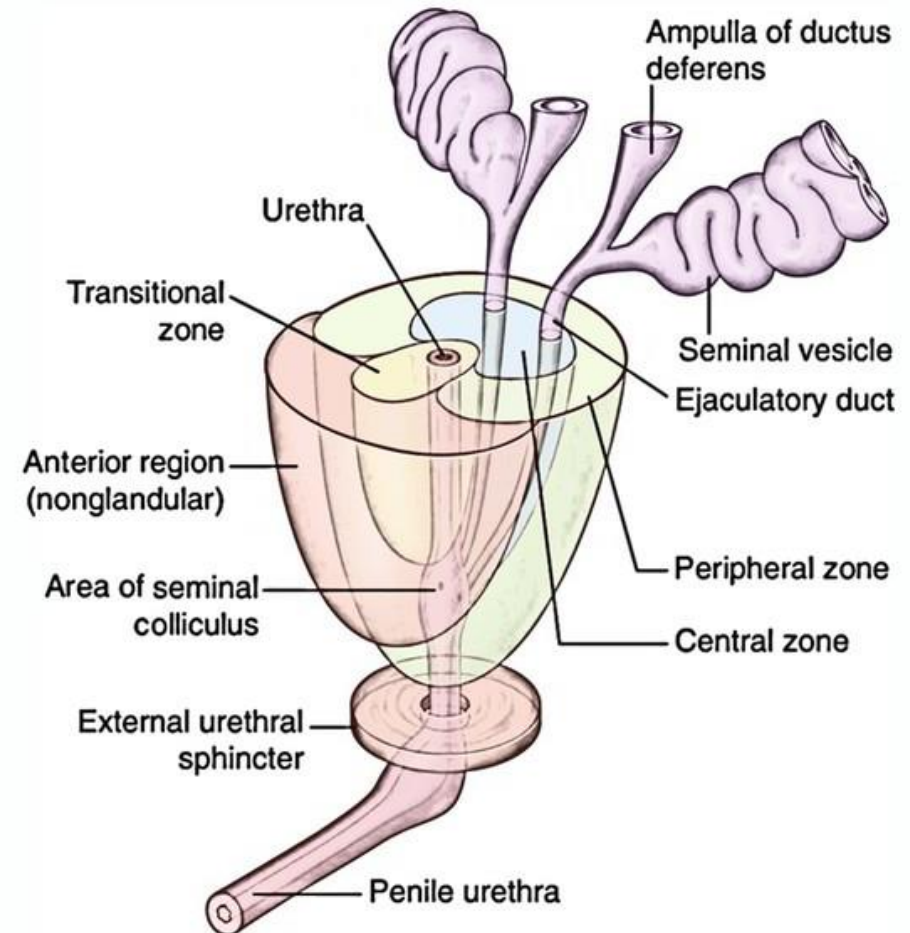


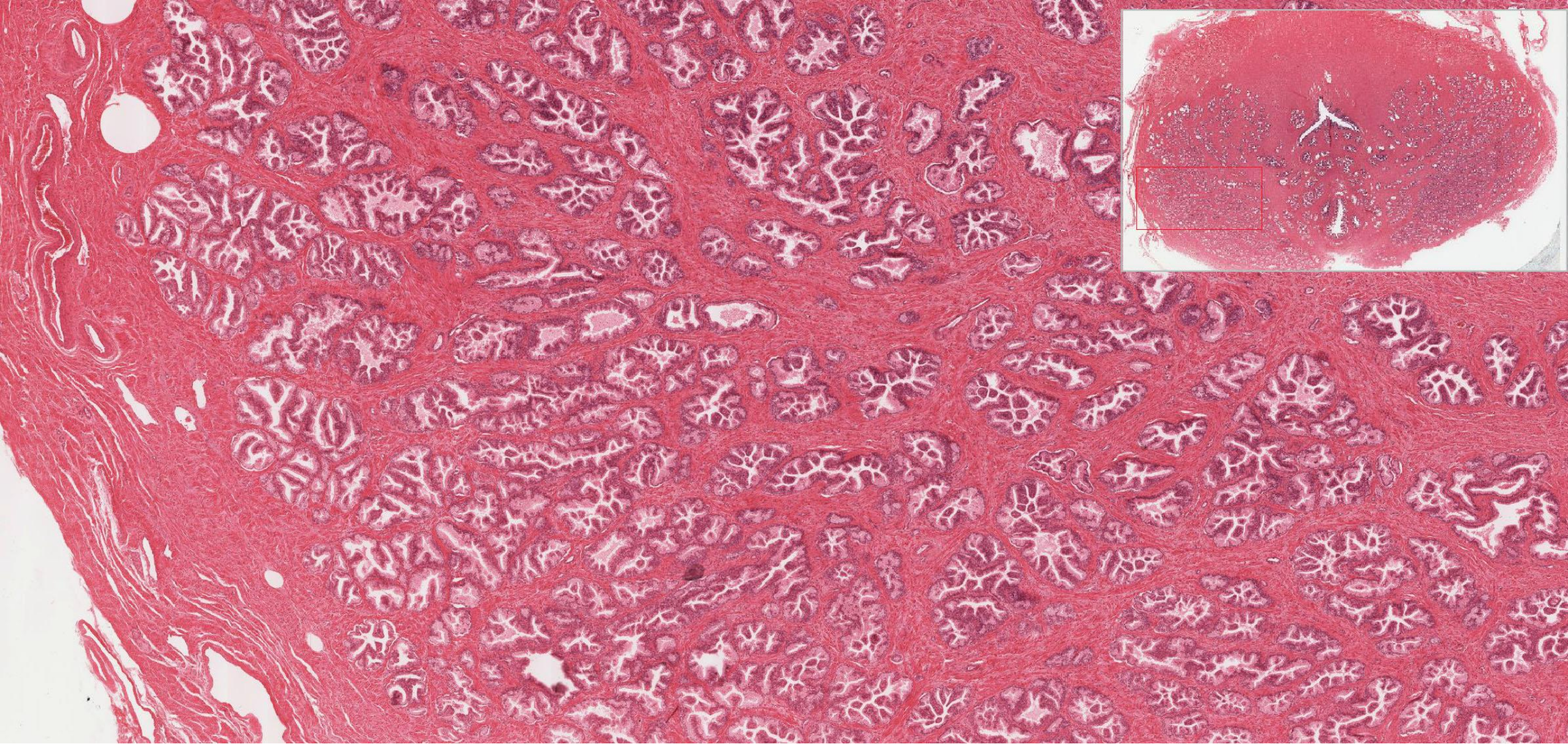


The **central zone** is the region surrounding the urethra and ejaculatory ducts. Interestingly, this zone is relatively resistant to inflammation and hyperplasia.

Peripheral zone

- The **peripheral zone** comprises 70% of the glandular tissue of the prostate. It surrounds the central zone and occupies posterior and lateral parts of the gland.
- Most **prostatic carcinomas** arise from the **peripheral zone** of the prostate gland. The peripheral zone is palpable during digital examination of the rectum. This zone is also the most susceptible to inflammation.

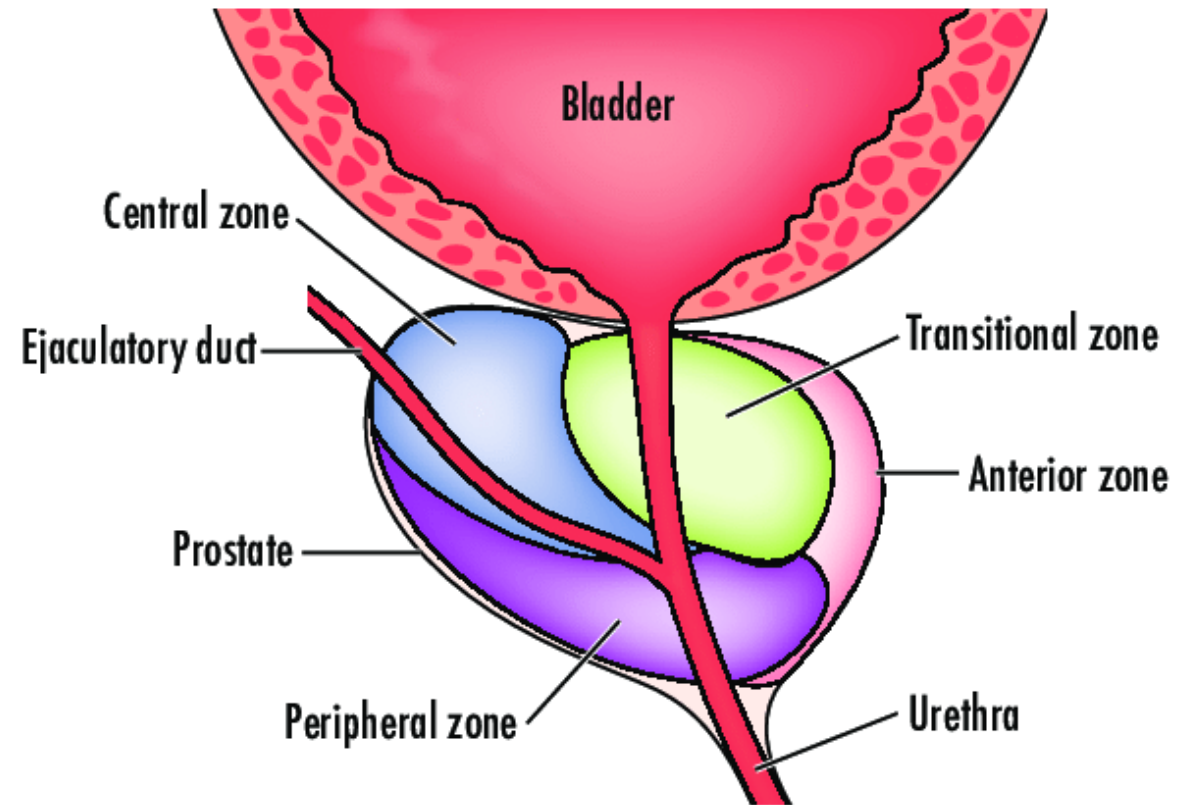


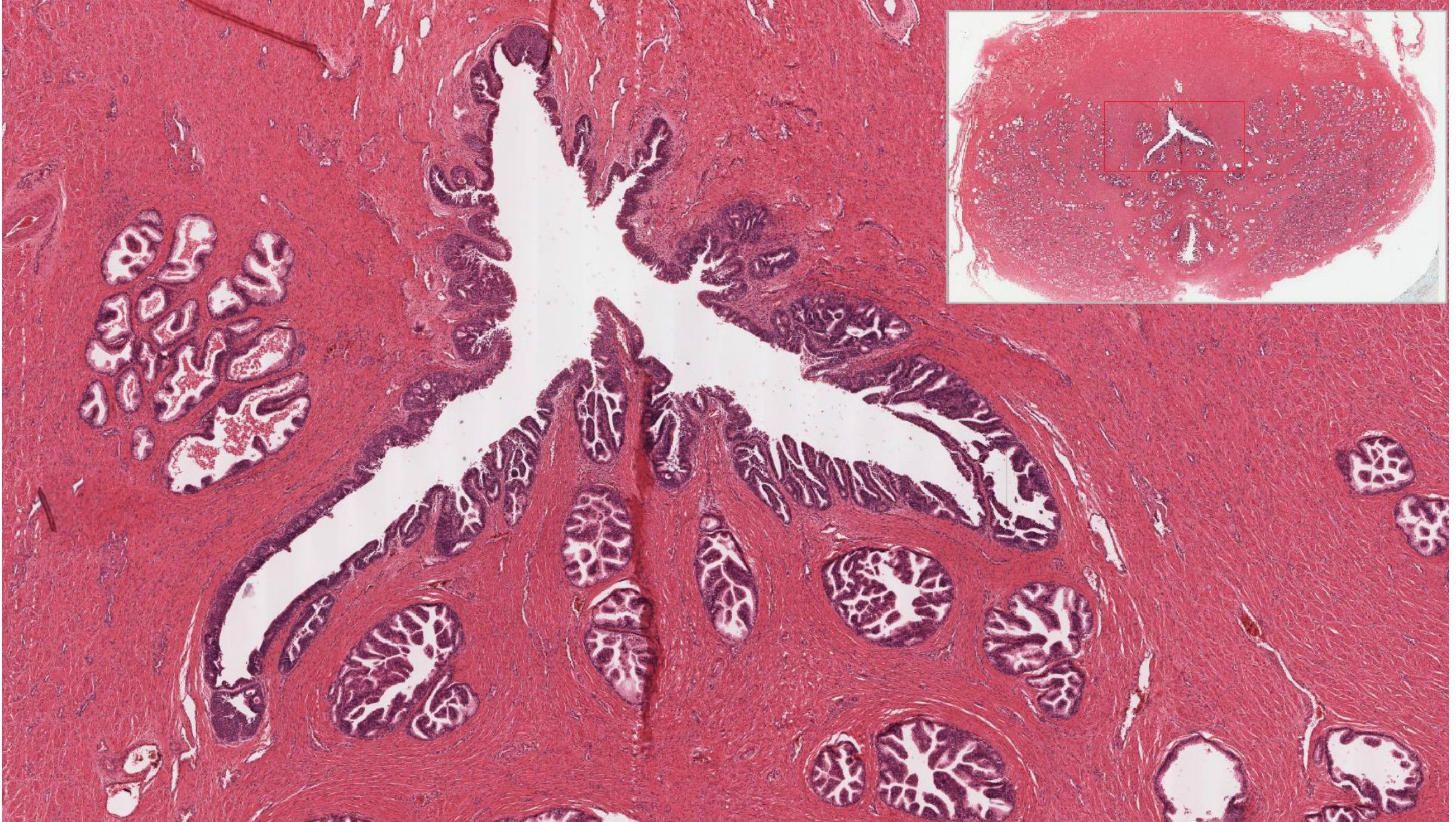


The **peripheral zone** contains the main glands located posterio-laterally in the outer parenchyma of the gland and is the site most susceptible to inflammation (prostatitis) and malignant neoplasia (prostatic carcinoma).

Transitional zone

- The **transitional zone** surrounds the prostatic urethra
- It comprises about 5% of the prostatic glandular tissue and contains the mucosal glands.
- In older individuals, the parenchymal cells of this zone frequently undergo extensive division (hyperplasia) and form nodular masses of epithelial cells (benign prostatic hyperplasia -BPH)



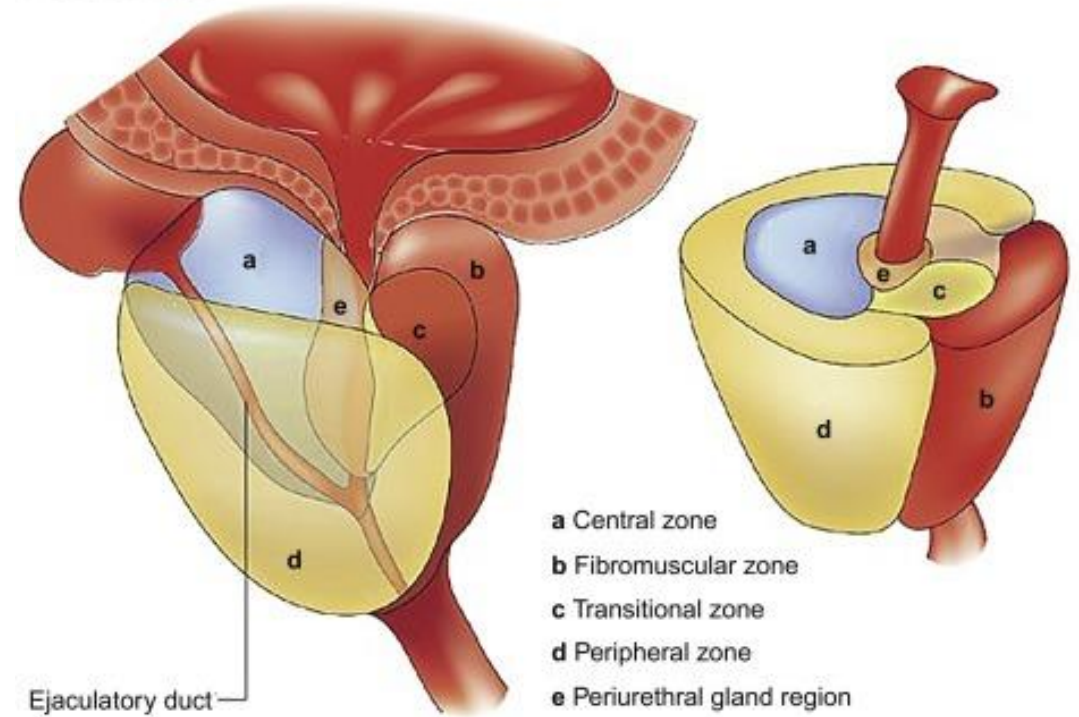


The transitional and periurethral zones surrounds the prostatic urethra and contains submucosal and mucosal glands that undergo non-cancerous proliferation, leading to benign prostatic hypertrophy (BPH)

Additional zones

- The **periurethral zone** contains mucosal and submucosal glands.
- **Fibromuscular stroma** occupies the anterior surface of the prostate gland anterior to the urethra and is composed of dense irregular connective tissue with a large amount of smooth muscle fibers.

Prostate zones



a Central zone
b Fibromuscular zone
c Transitional zone
d Peripheral zone
e Periurethral gland region

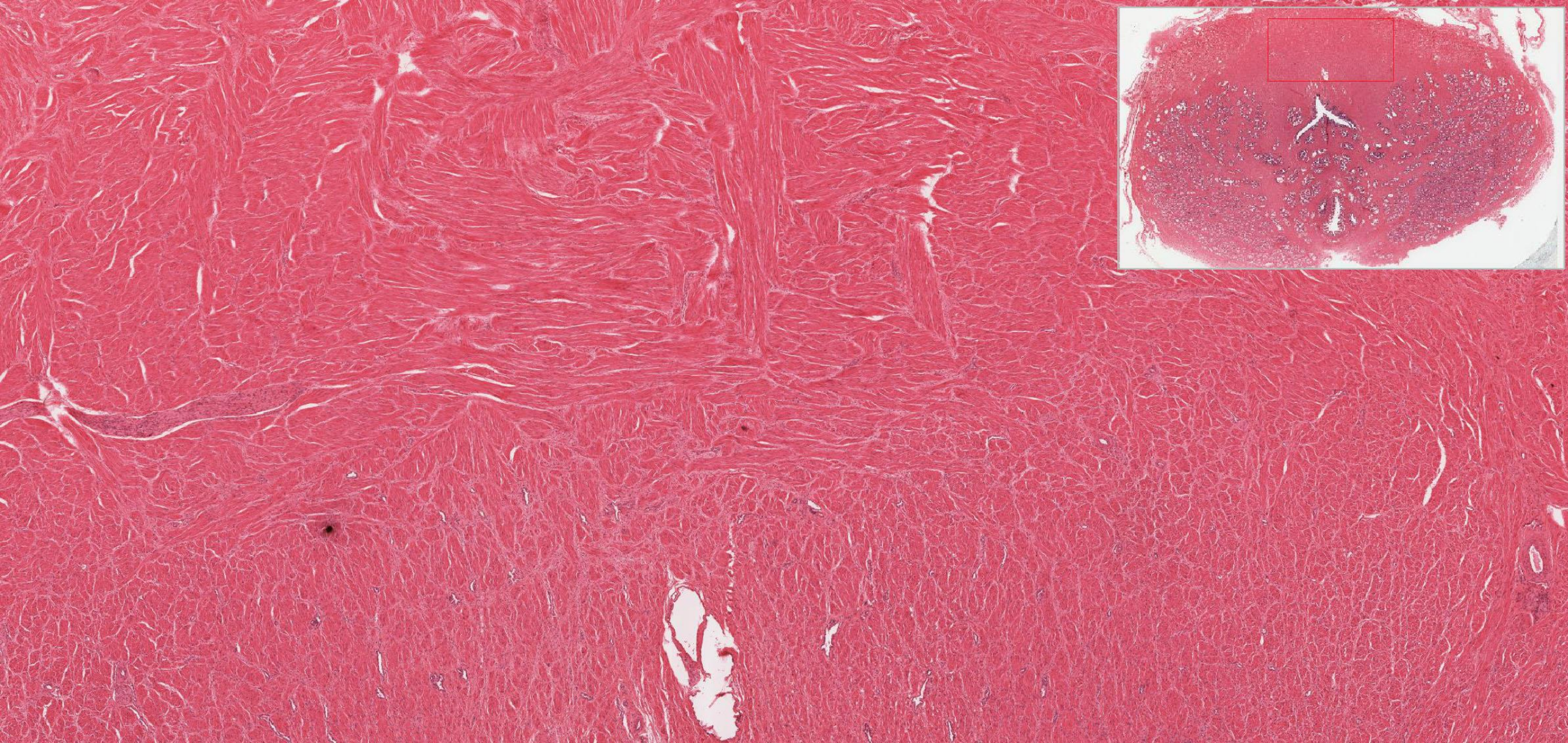
	Prostate zone		
	Peripheral	Transition	Central
Focal atrophy	High prevalence	Medium-high prevalence	Low prevalence
Acute inflammation	None	None	None
Chronic inflammation	Medium-high prevalence	Medium-high prevalence	Low prevalence
Benign prostatic hyperplasia	None	High prevalence	Low prevalence
High-grade PIN	Medium-high prevalence	Low prevalence	Low prevalence
Carcinoma	Medium-high prevalence	Low prevalence	None

High prevalence

Medium-high prevalence

Low prevalence

None

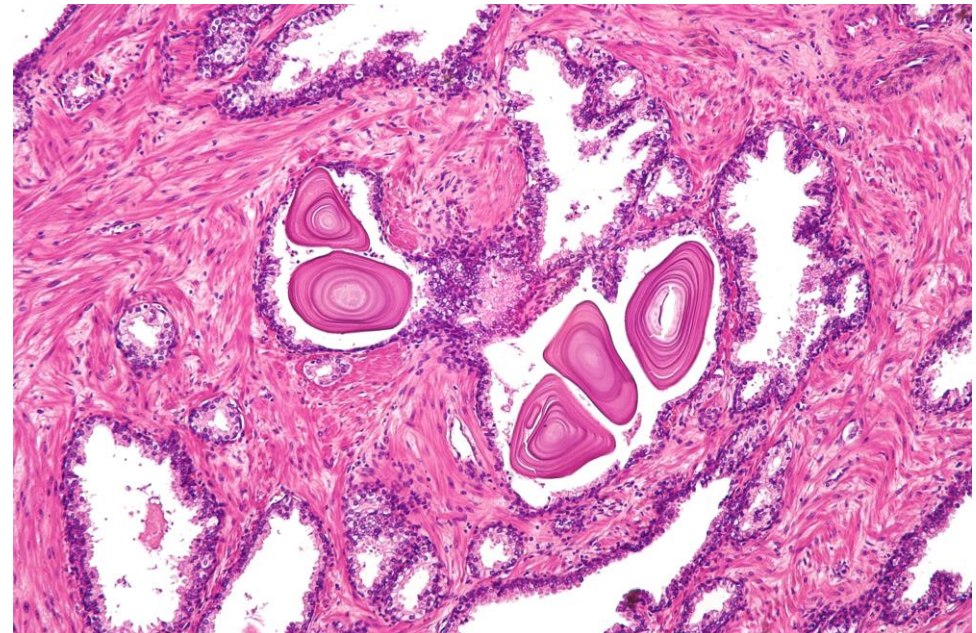


The anterior fibromuscular stroma is located anteriorly and contains no glandular tissue so it typically does not become hyperplastic.

Glandular epithelium

- Within each prostate zone, the glandular epithelium is generally **simple columnar**, but there may be patches that are **simple cuboidal, squamous, or occasionally pseudostratified**
- The alveoli of the prostatic glands, especially those in older men, often contain prostatic concretions (**corpora amylacea**) of varied shape and size, often upto 2 mm in diameter (precipitation of secretory material around cell fragments)

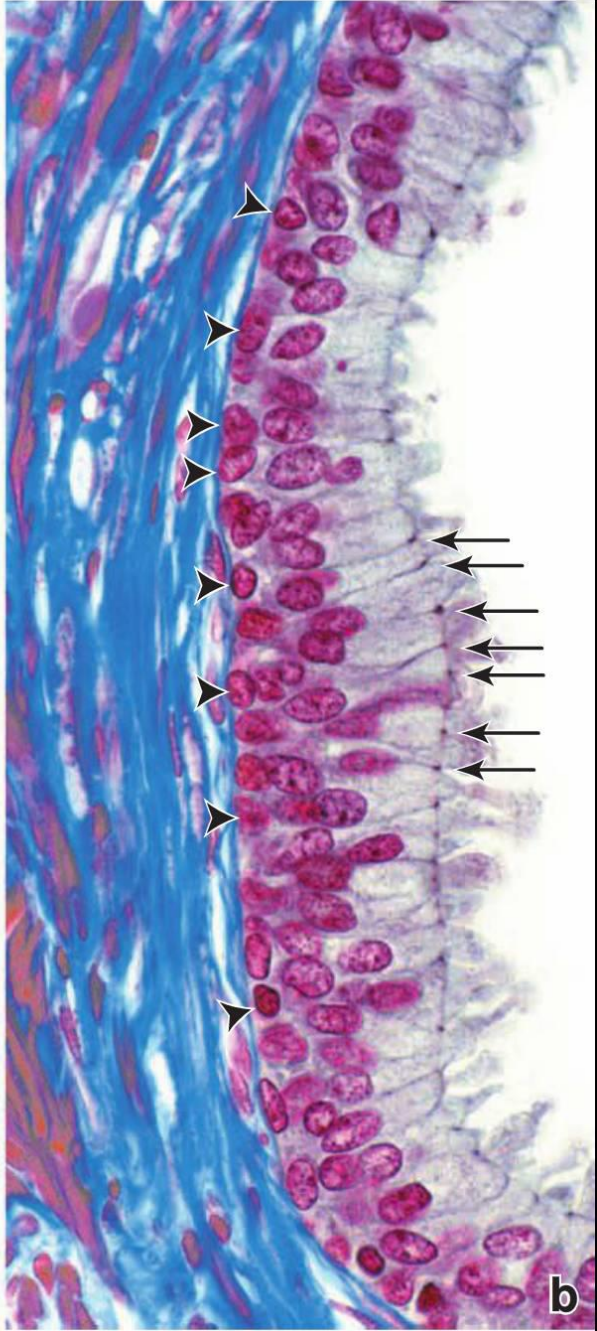
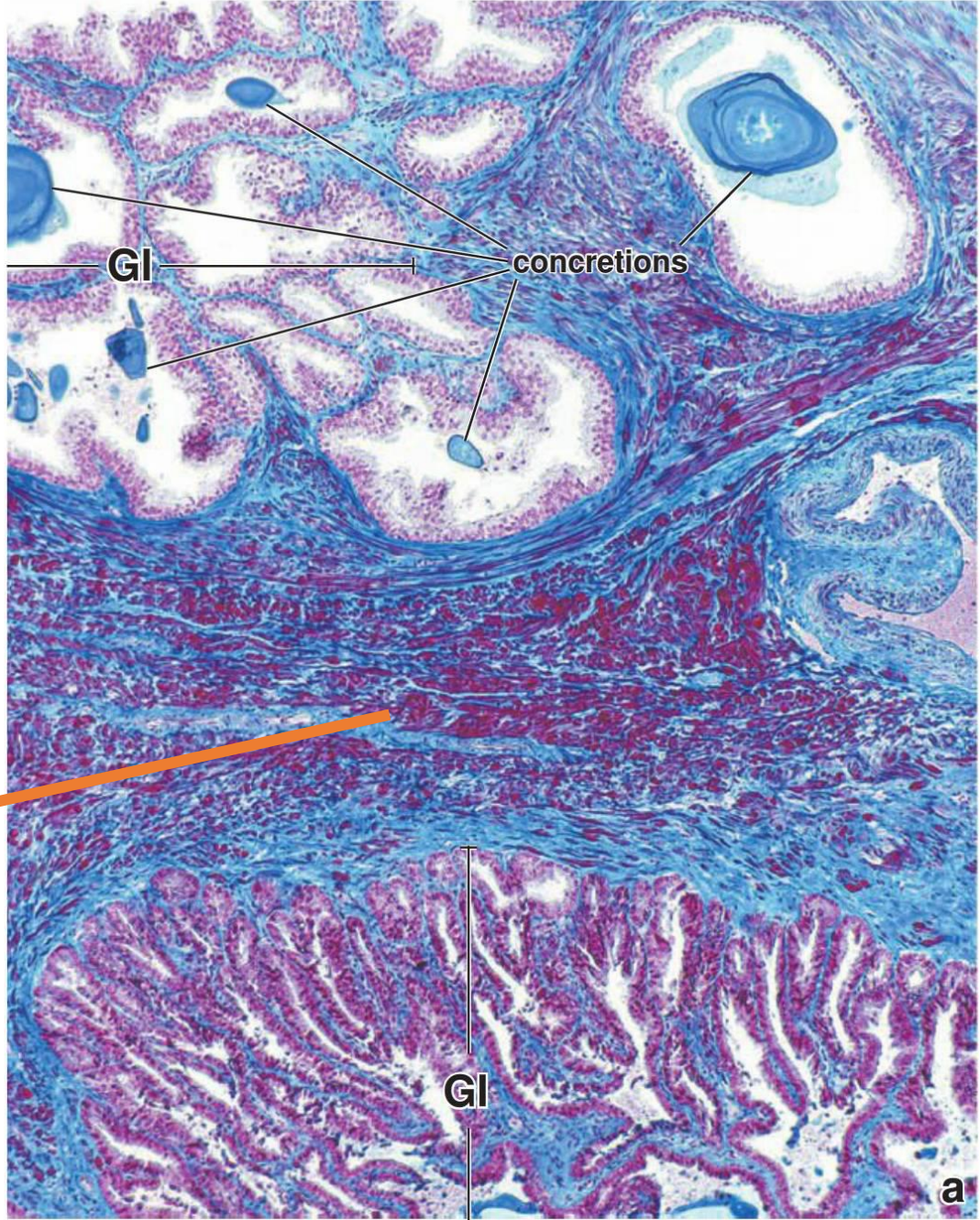
- The glandular epithelium is influenced by sex hormones, such as testosterone and adrenal androgens.
- These hormones enter the secretory cells of glandular epithelium and are converted to **dihydrotestosterone (DHT)** by the enzyme **5 α -reductase**.
- DHT is approximately 30 times more potent than testosterone



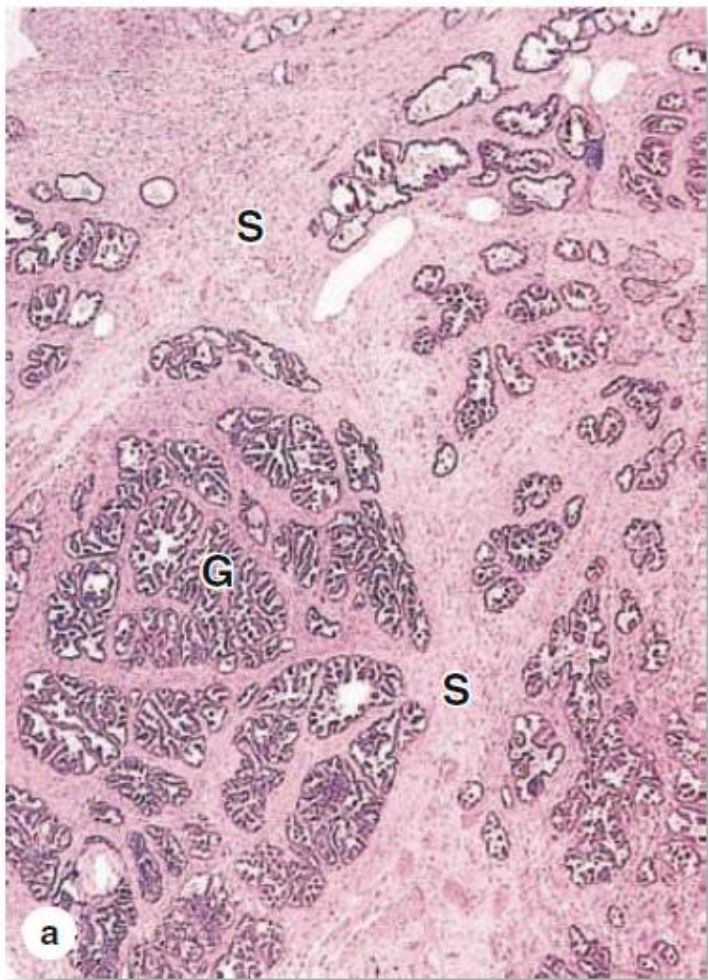
Secretions

- The epithelial cells in prostate gland produce several enzymes, particularly prostate-specific antigen (PSA), prostatic acid phosphatase (PAP), fibrinolysin, and citric acid.
- **Prostatic acid phosphatase (PAP)** (100 kDa) enzyme regulates cell growth and metabolism of prostate glandular epithelium.
- this enzyme is routinely used as an alternate marker to PSA for prostatic tumors.
- **Prostate-specific antigen (PSA)**, a 33 kDa serine protease, is one of the most clinically important tumor markers.
- In normal conditions, PSA is secreted into prostatic gland alveoli and ultimately incorporated into seminal fluid.
- **Fibrinolysin**, secreted from the prostate gland, liquefies semen.

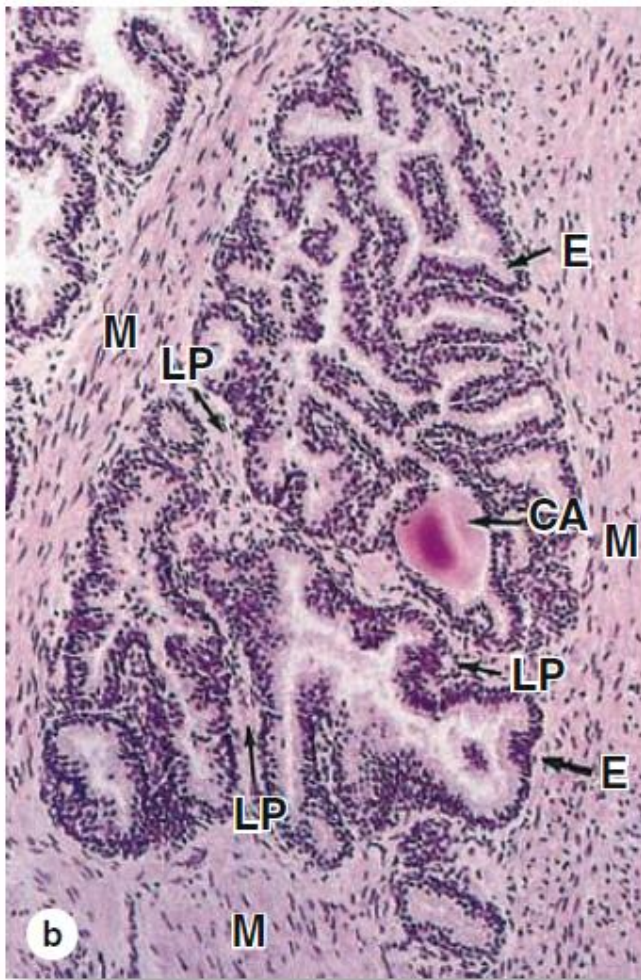
the tubuloalveolar glands (GI) and the fibromuscular tissue that forms the septa between glandular tissues. Within the lumina, various-sized prostatic concretions can be seen.



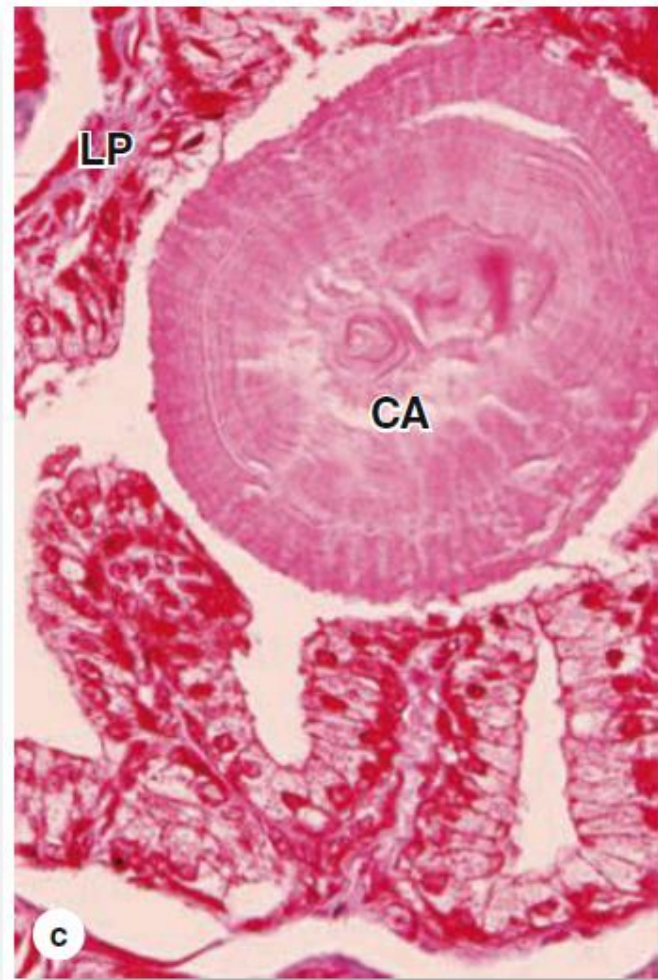
The glandular epithelium is pseudostratified. The round nuclei adjacent to the connective tissue (arrowheads) belong to the basal cells. Those nuclei that are more elongate and further removed from the base of the epithelium belong to the secretory cells.



(a) The prostate has a dense fibromuscular stroma (**S**) in which are embedded a large number of small tubuloalveolar glands (**G**). (X20; H&E)



(b) A micrograph of one prostatic gland, showing a corpus amylaceum (**CA**) concretion and the secretory epithelium (**E**)

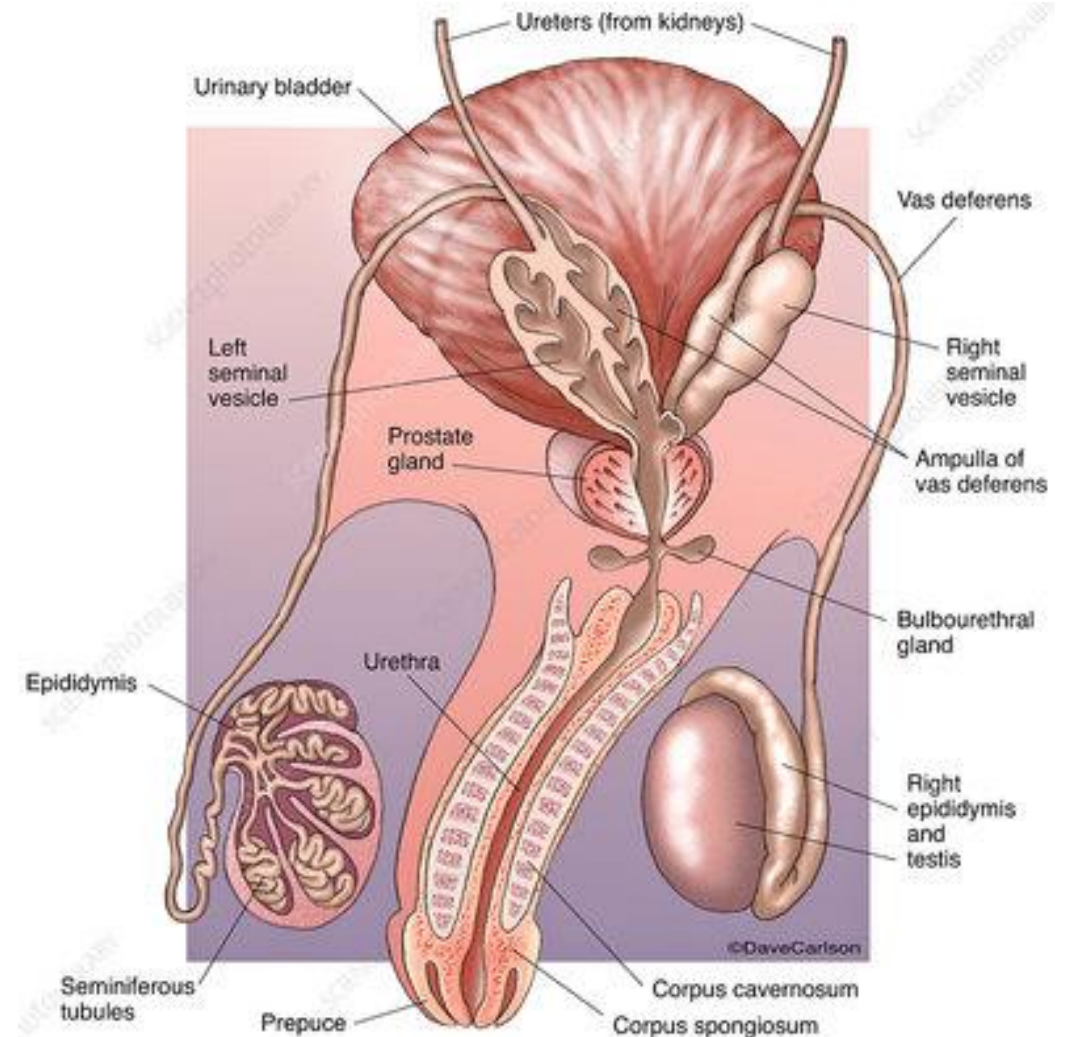


surrounded by a thin lamina propria (**LP**) and thick smooth muscle (**M**). (X122; H&E)

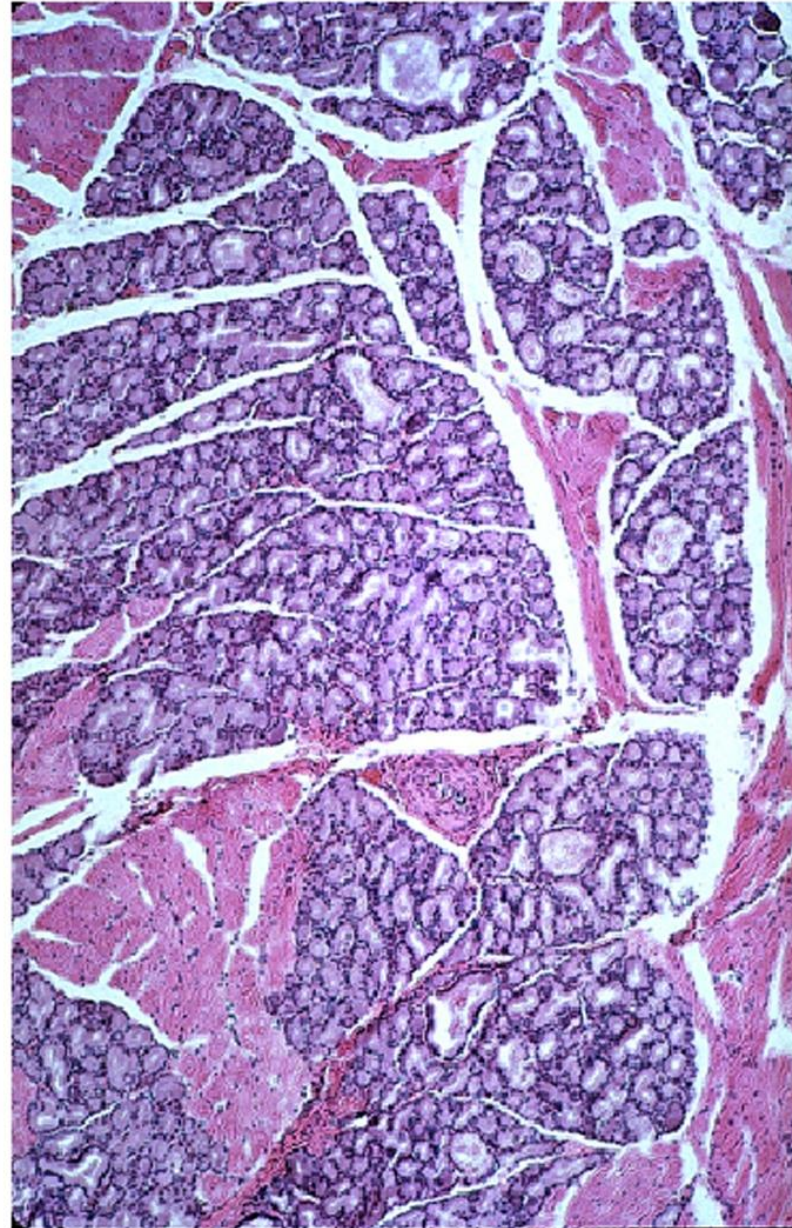
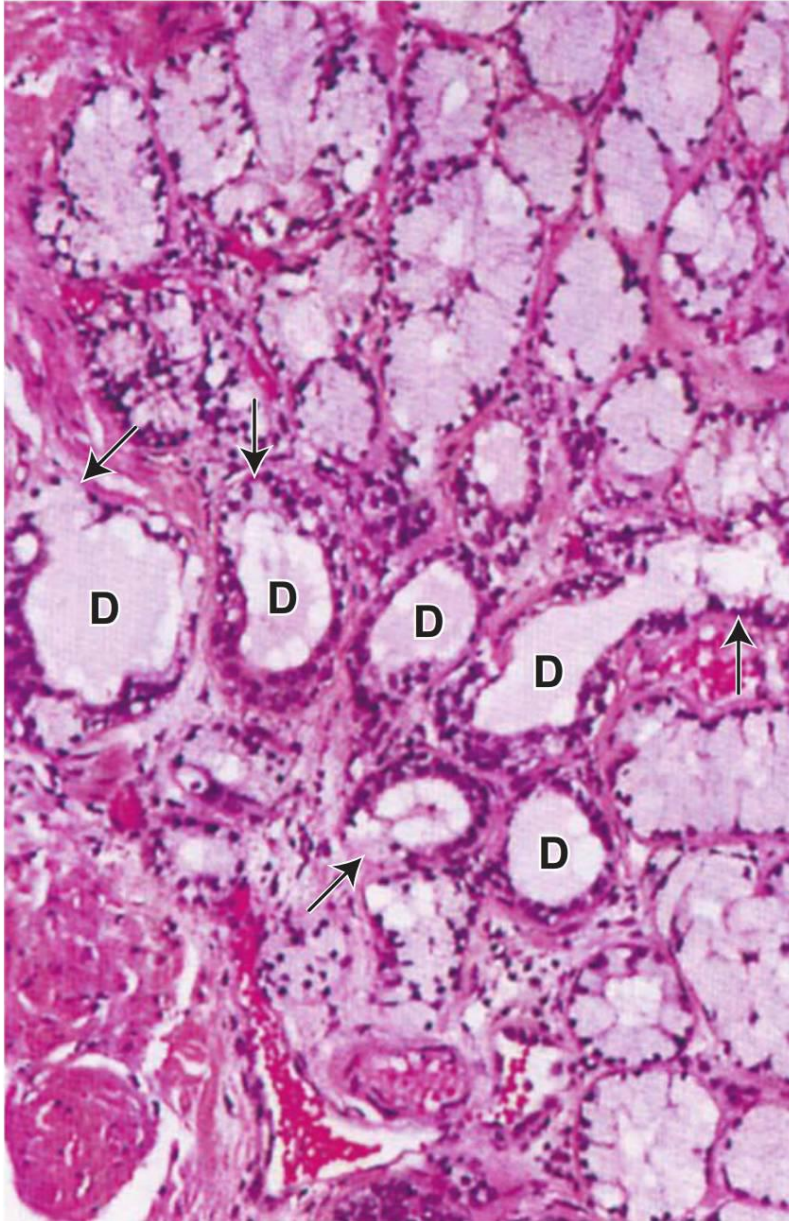
(c) Higher magnification shows the lamellar nature of a corpus amylaceum (**CA**) and the pseudostratified columnar epithelium underlain by lamina propria (**LP**). (X300; Mallory trichrome)

Bulbourethral gland (Cowper's glands)

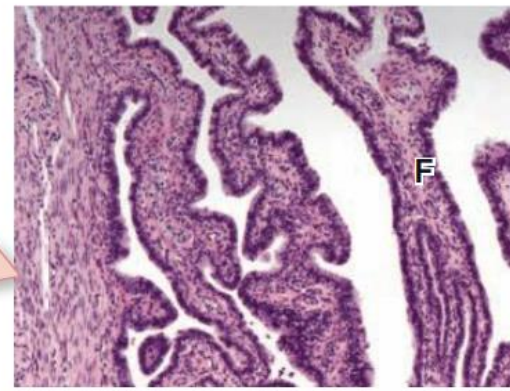
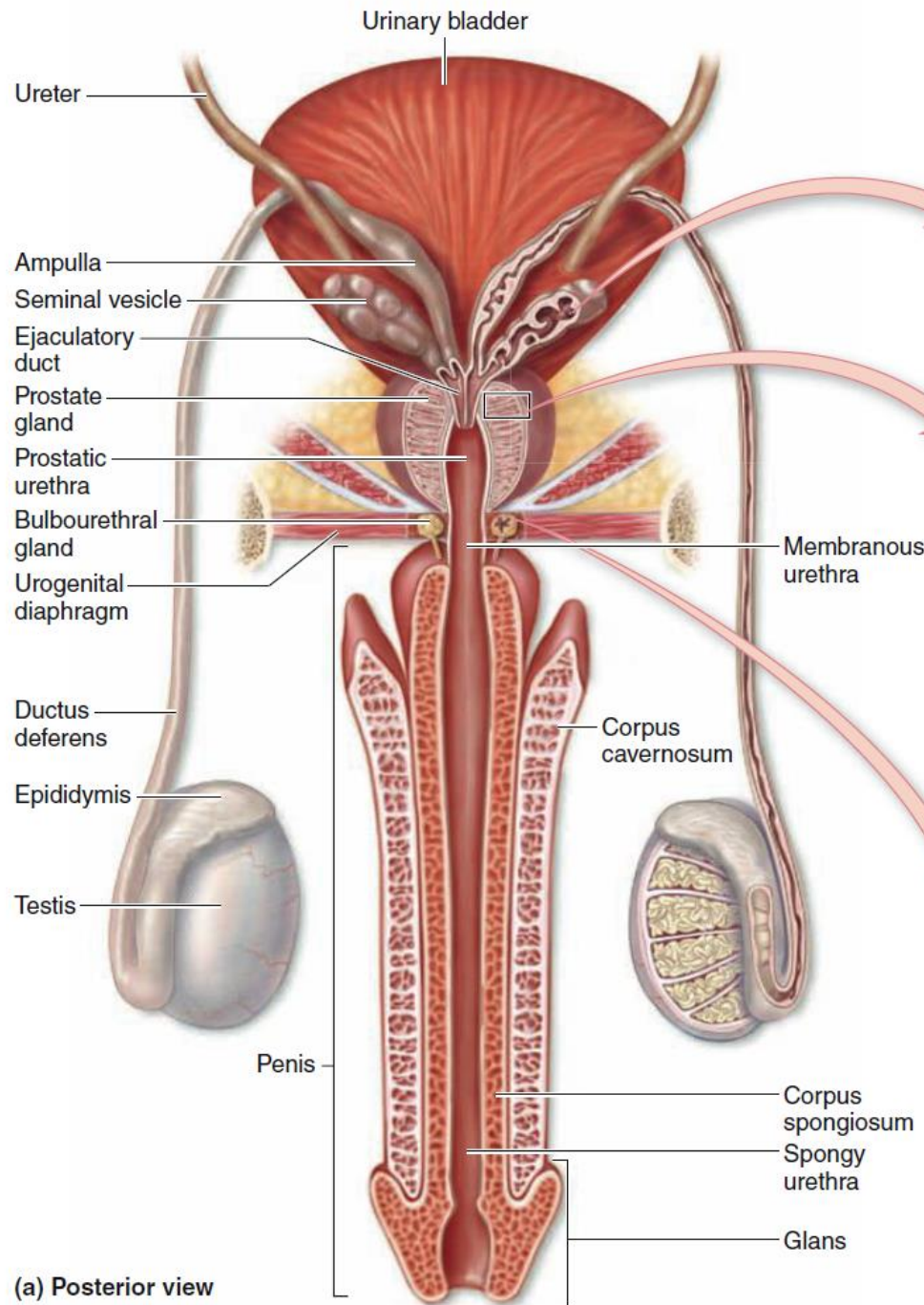
- The paired bulbourethral glands (Cowper's glands) are pea-sized structures located in the urogenital diaphragm. The duct of each gland passes through the inferior fascia of the urogenital diaphragm and joins the initial portion of the penile urethra.
- The glands are **compound tubuloalveolar glands** that structurally resemble mucus secretory glands. The **simple columnar epithelium**, which varies considerably in height depending on the functional state of the gland, is under the control of testosterone.
- The clear, mucus-like glandular secretion contains considerable amounts of galactose and galactosamine, galacturonic acid, sialic acid, and methylpentose.
- Sexual stimulation causes release of this secretion, which constitutes the major portion of the **pre-seminal fluid** and serves to lubricate the penile urethra, neutralizing any traces of acidic urine.



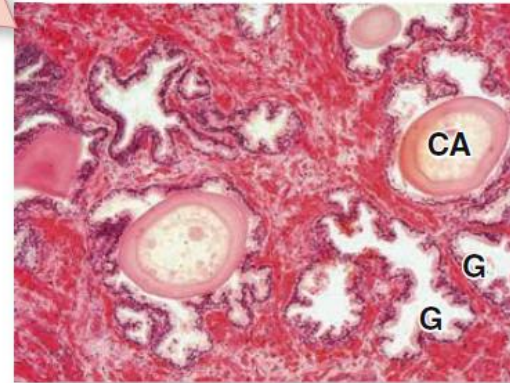
BULBOURETHRAL (COWPER'S) GLANDS



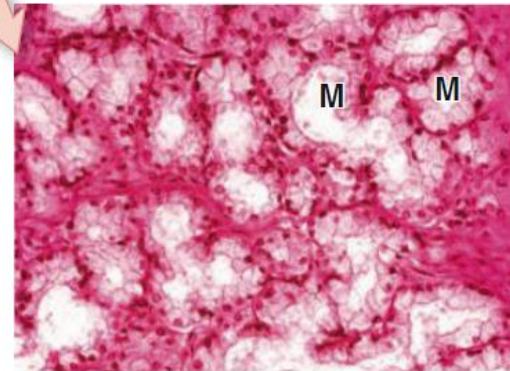
Photomicrograph of human bulbourethral gland. H&E-stained section of the compound tubuloalveolar bulbourethral gland. The epithelium consists of columnar mucus-secreting cells. The nuclei are displaced to the base of the cells by the accumulated secretory material that they contain. The cytoplasm has an appearance similar to typical mucus-secreting cells. The ducts will merge to form a single excretory duct.



(b) Seminal vesicle



(c) Prostate gland

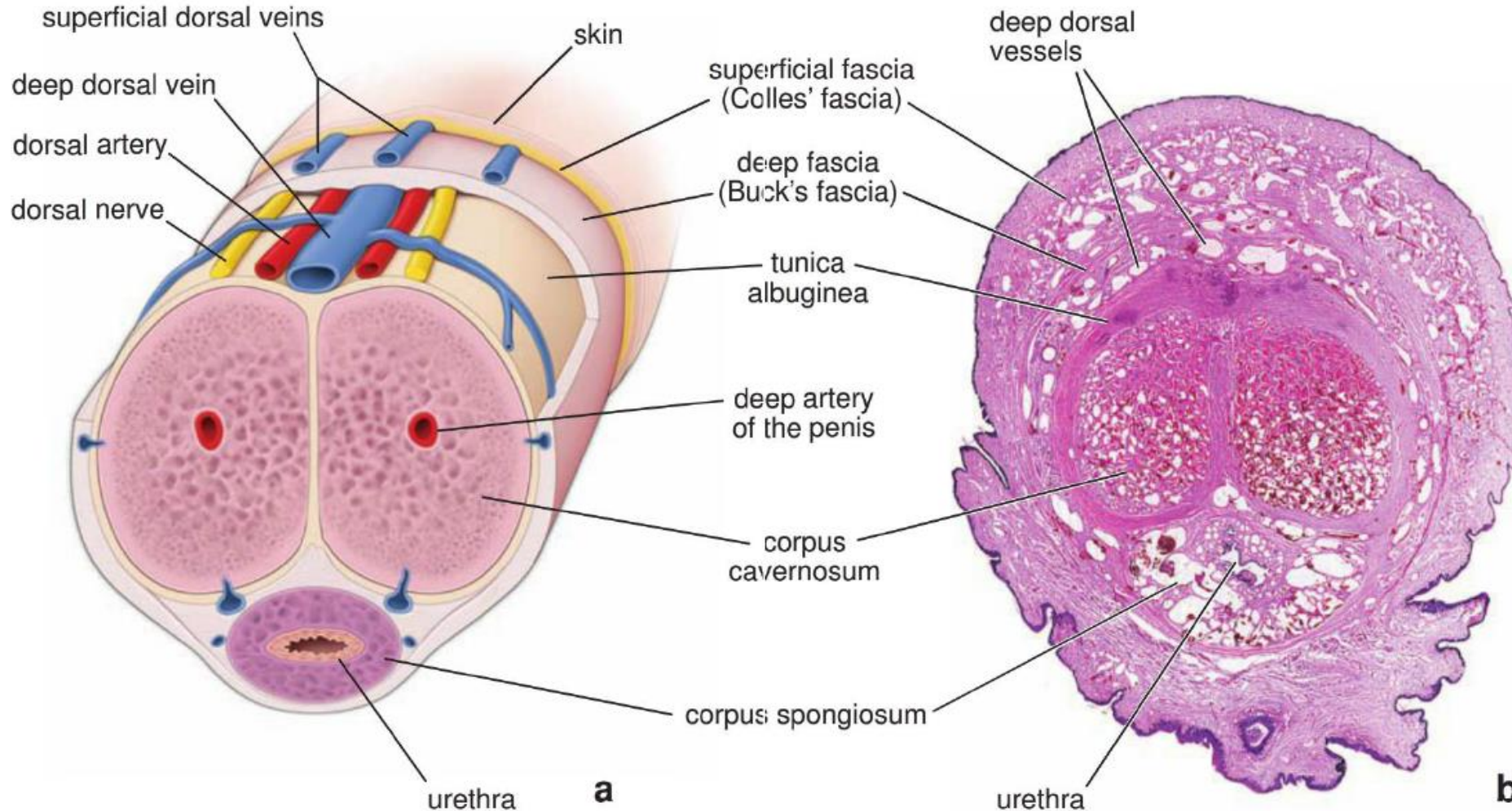


(d) Bulbourethral gland

(a) Posterior view

Penis

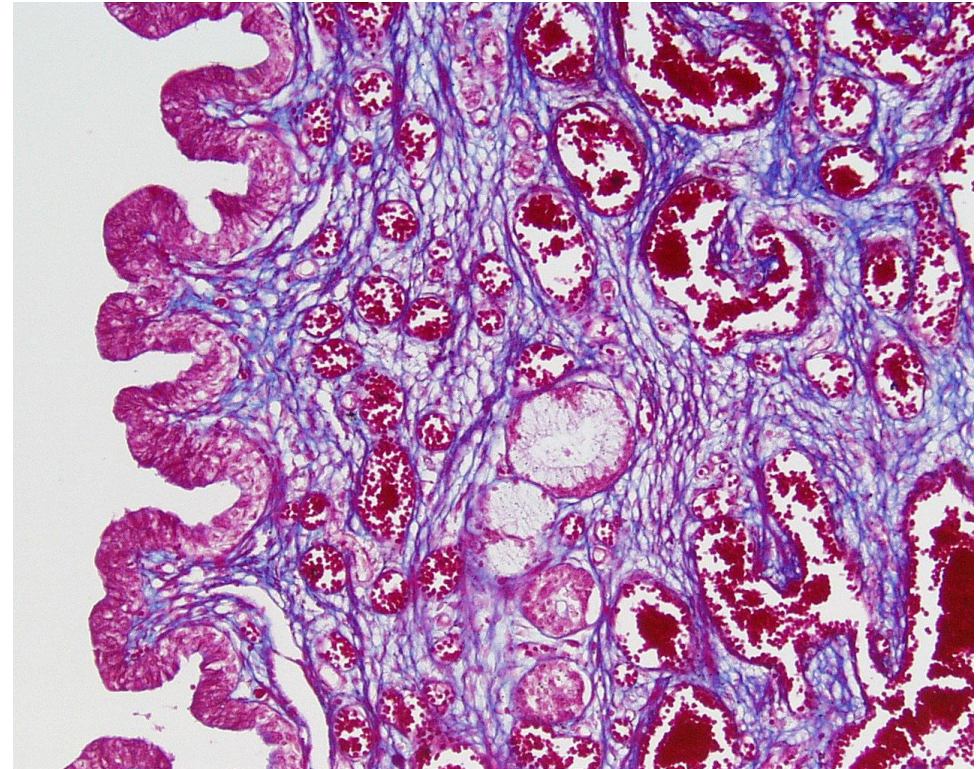
- The penis consists principally of two dorsal masses of erectile tissue, the **corpora cavernosa**, and a ventral mass of erectile tissue, the **corpus spongiosum**, in which the spongy part of the urethra is embedded.

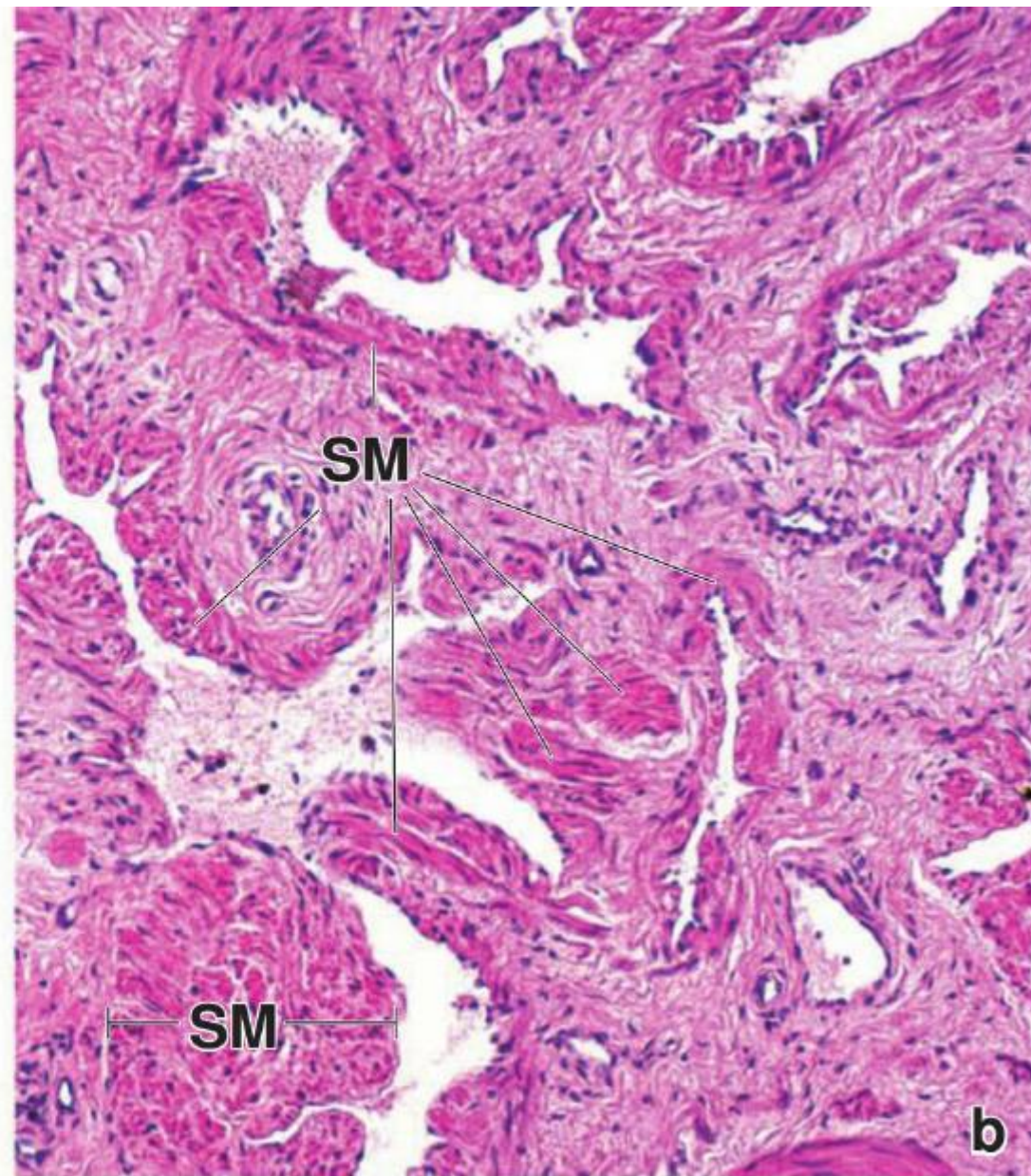


- A dense, fibroelastic layer, the tunica albuginea, binds the three together and forms a capsule around each

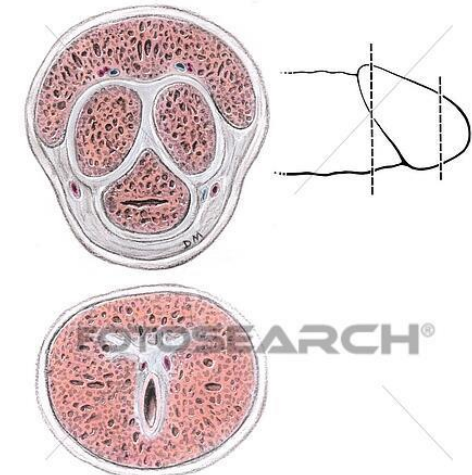
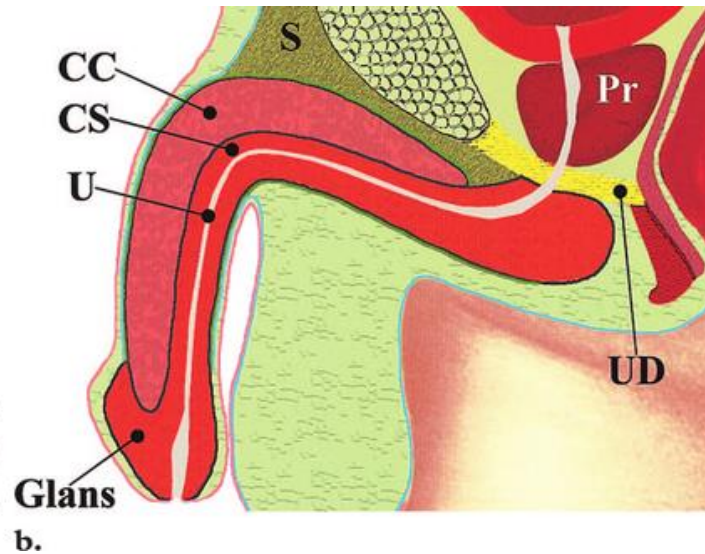
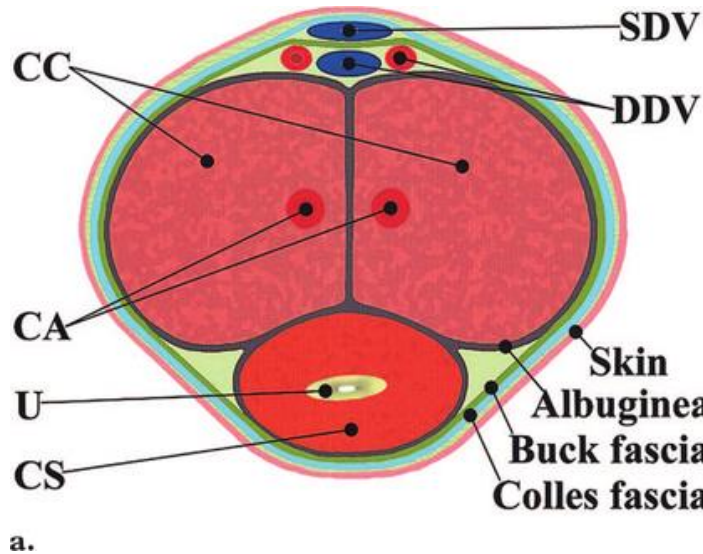
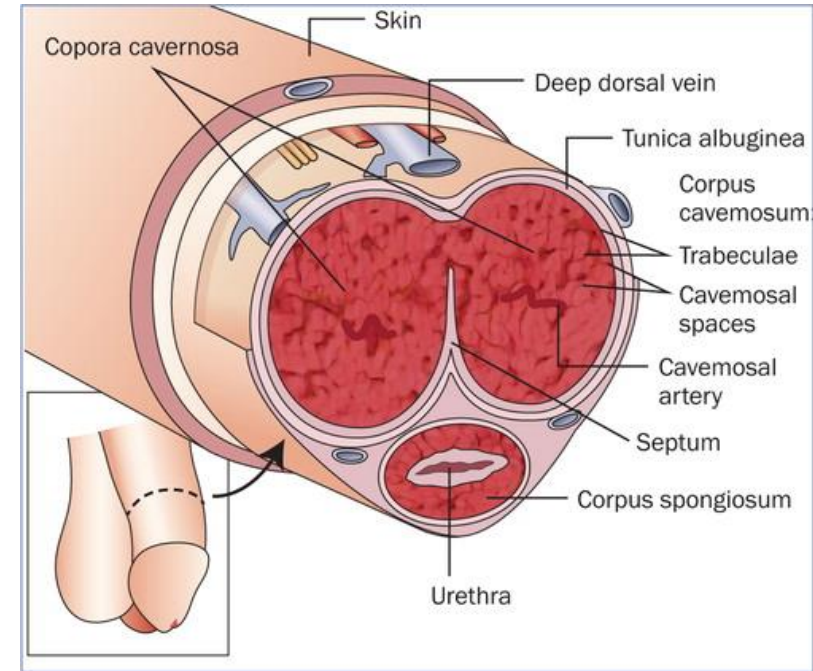
- The corpora cavernosa contain numerous wide, irregularly shaped vascular spaces lined with vascular endothelium. These spaces are surrounded by a thin layer of smooth muscle that forms trabeculae within the tunica albuginea interconnecting and crisscrossing the corpus cavernosum.

- The interstitial connective tissue contains many nerve endings and lymphatic vessels. The vascular spaces increase in size and rigidity by filling with blood, principally derived from the deep artery of the penis that divides into branches called the helicine arteries. These arteries dilate during erection to increase the blood flow to the penis.





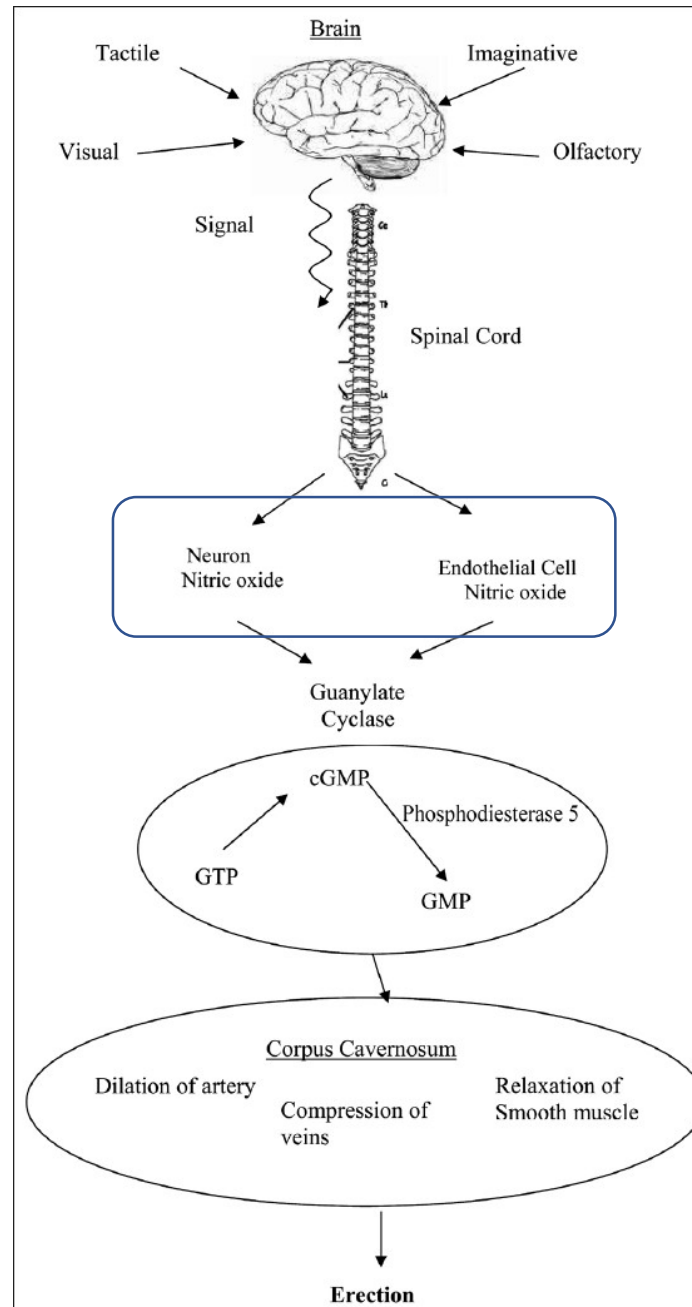
- The skin of the penis is thin and loosely attached to the underlying loose connective tissue except at the glans penis, where it is very thin and tightly attached.
- The skin of the glans is thin and there is no adipose tissue in the subcutaneous tissue. There is, however, a thin layer of smooth muscle that is continuous with the dartos layer of the scrotum.
- In uncircumcised males, the glans is covered with a fold of skin, the prepuce, which resembles a mucous membrane on its inner aspect. Numerous sebaceous glands are present in the skin of the penis just proximal to the glans.



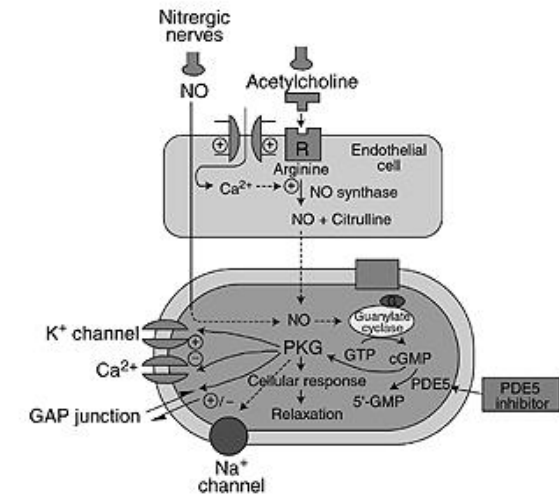
- **Prostatic urethra** extends for 3 to 4 cm from the neck of the bladder through the prostate gland. It is lined with **transitional epithelium (urothelium)**. The ejaculatory ducts of the genital system enter the posterior wall of this segment, and many small prostatic ducts also empty into this segment.
- **Membranous urethra** extends for about 1 cm from the apex of the prostate gland to the bulb of the penis. Transitional epithelium ends in the membranous urethra. This segment is lined with a **stratified or pseudostratified columnar epithelium** that resembles the epithelium of the genital duct system more than it resembles the epithelium of the more proximal portions of the urinary duct system.
- **Penile (spongy) urethra** extends for about 15 cm through the length of the penis and opens on the body surface at the glans penis. The penile urethra is surrounded by the corpus spongiosum as it passes through the length of the penis. It is lined with **pseudostratified columnar epithelium** except at its distal end, where it is lined with **stratified squamous epithelium** continuous with that of the skin of the penis.
- Ducts of the bulbourethral glands (Cowper's glands) and of the mucus-secreting urethral glands (glands of Littré) empty into the penile urethra.

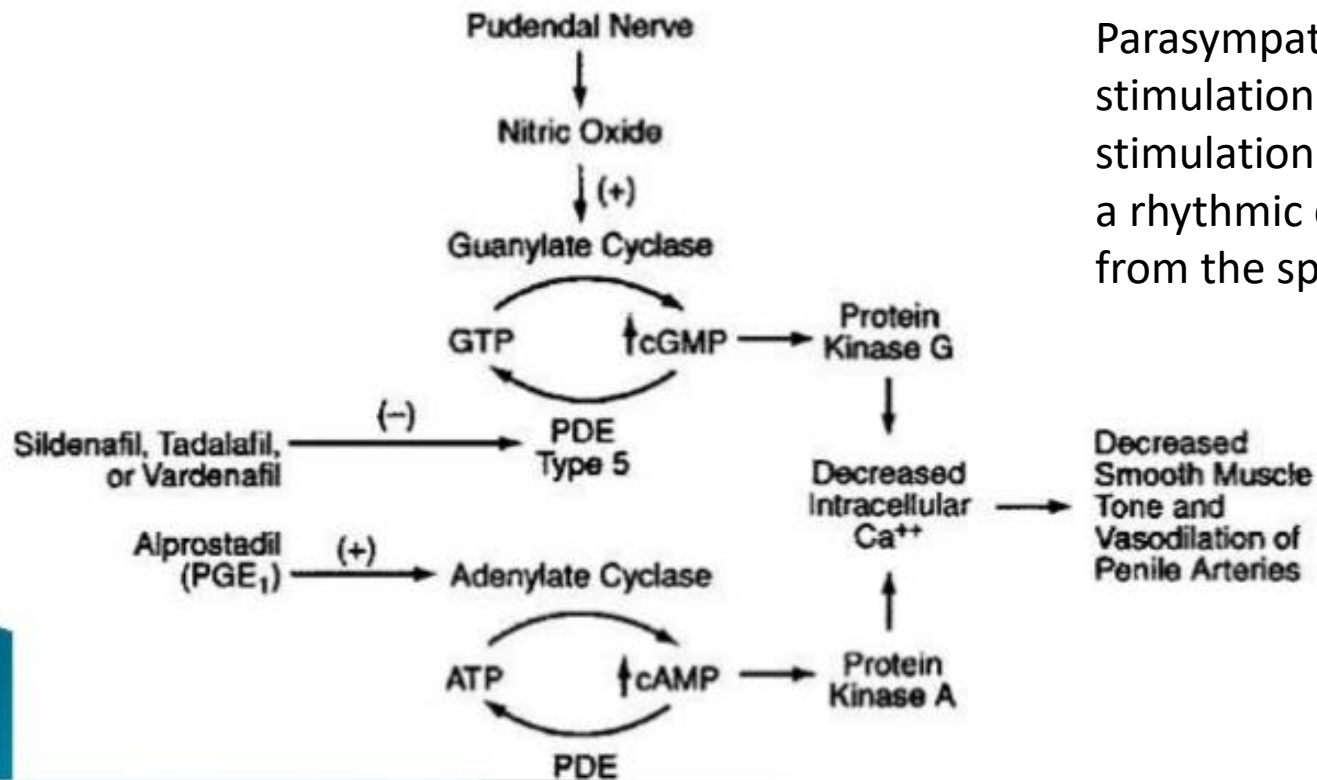
Erection

- Erection is a vascular event
- It is a neurological-vascular process that occurs following CNS-induced stimuli.
- The **helical arteries** expand with the **relaxation** of the trabecular smooth muscle cells as a result of **parasympathetic activation**.
- The corpus cavernosum and spongiosum are enlarged
- With this enlargement, the venous structures are squeezed between the tunica albuginea.
- With the blockage of the venous return, the penis becomes rigid.



- **ACETYL CHOLINE** is secreted from nerve endings with parasympathetic stimulation.
- Endothelial cells in the corpus cavernosum release vasoactive intestinal peptide (VIP) and **NITRIC OXIDE** in response.
- **NO** activates **GUANYLATE CYCLASE** in trabecular muscles and produces **CYCLIC GUANYLATE MONOPHOSPHATE (cGMP)**.
- **cGMP** relaxes smooth muscles.





Parasympathetic stimulation initiates erection, whereas sympathetic stimulation terminates erection and causes ejaculation, a rhythmic contraction of smooth muscle that ejects semen from the spongy urethra

With the sympathetic stimulation, eg ejaculation, arteries re-gain the normal wall tonus therefore erection ends.



Ejaculation

- It has two phases called **emission** and **expulsion**.
- Emission: It is the stage in which retrograde escape is prevented by closing the bladder neck.
- Immediately after this, prostatic secretion containing acid phosphatase, citric acid and zinc (10%) and fluid from the vas deferens (epididymis) and sperm (10%) are mixed in the prostatic urethra.
- At the same time, seminal vesicle fluid that contains fructose and alkalizes semen joins the ejaculate and makes 75-80% of the semen volume.
- Sympathetic nerves are of great importance in this secretory process.
- Expulsion: the peak that involves rhythmic contractions of smooth and striated muscles that result in the discharge of the released secretions from the urethra.

Parameter	Lower reference limit
Semen volume (ml)	1.5 (1.4–1.7)
Total sperm number (10 ⁶ per ejaculate)	39 (33–46)
Sperm concentration (10 ⁶ per ml)	15 (12–16)
Total motility (PR + NP, %)	40 (38–42)
Progressive motility (PR, %)	32 (31–34)
Vitality (live spermatozoa, %)	58 (55–63)
Sperm morphology (normal forms, %)	4 (3.0–4.0)
<i>Other consensus threshold values</i>	
pH	≥7.2
Peroxidase-positive leukocytes (10 ⁶ per ml)	<1.0
MAR test (motile spermatozoa with bound particles, %)	<50
Immunobead test (motile spermatozoa with bound beads, %)	<50
Seminal zinc (μmol/ejaculate)	≥2.4
Seminal fructose (μmol/ejaculate)	≥13
Seminal neutral glucosidase (mU/ejaculate)	≥20

aspermia	no semen (no or retrograde ejaculation)
asthenozoospermia	percentage of progressively motile (PR) spermatozoa below the lower reference limit
asthenoteratozoospermia	percentages of both progressively motile (PR) and morphologically normal spermatozoa below the lower reference limits
azoospermia	no spermatozoa in the ejaculate (given as the limit of quantification for the assessment method employed)
cryptozoospermia	spermatozoa absent from fresh preparations but observed in a centrifuged pellet
haemospermia (haemospermia)	presence of erythrocytes in the ejaculate
leukospermia (leukocytospermia, pyospermia)	presence of leukocytes in the ejaculate above the threshold value
necrozoospermia	low percentage of live, and high percentage of immotile, spermatozoa in the ejaculate
normozoospermia	total number (or concentration, depending on outcome reported)* of spermatozoa, and percentages of progressively motile (PR) and morphologically normal spermatozoa, equal to or above the lower reference limits
oligoasthenozoospermia	total number (or concentration, depending on outcome reported)* of spermatozoa, and percentage of progressively motile (PR) spermatozoa, below the lower reference limits
oligoasthenoteratozoospermia	total number (or concentration, depending on outcome reported)* of spermatozoa, and percentages of both progressively motile (PR) and morphologically normal spermatozoa, below the lower reference limits
oligoteratozoospermia	total number (or concentration, depending on outcome reported)* of spermatozoa, and percentage of morphologically normal spermatozoa, below the lower reference limits
oligozoospermia	total number (or concentration, depending on outcome reported)* of spermatozoa below the lower reference limit
teratozoospermia	percentage of morphologically normal spermatozoa below the lower reference limit

Thank you...

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