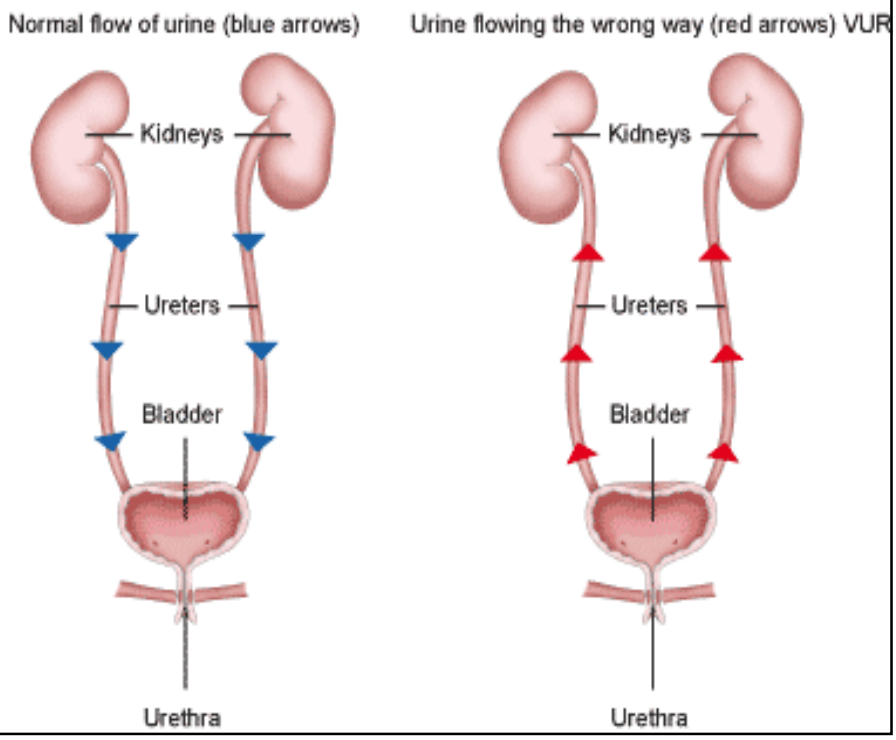
D.HAMMOUDI.MD

Lower Urinary Tract

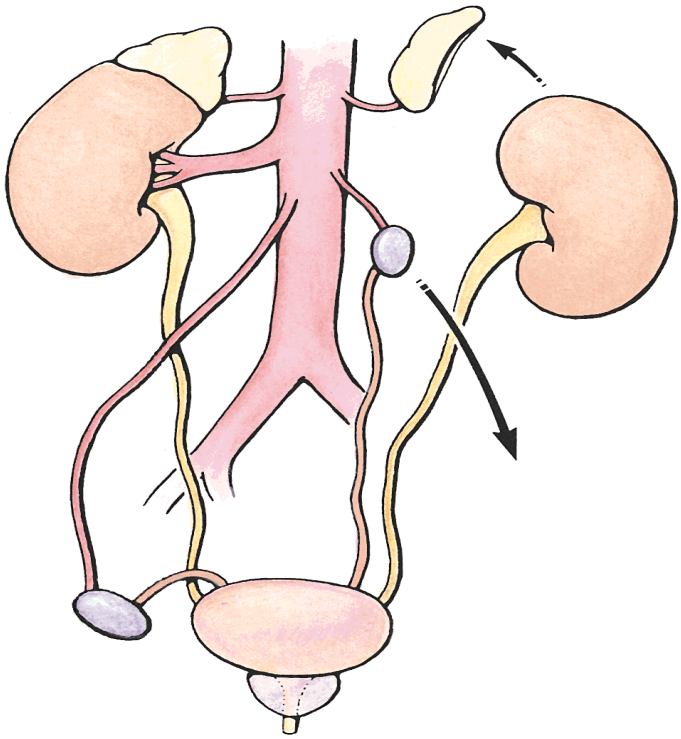
- Series of tubes & reservoirs for urine
- Calyceal collecting ystem
- Renal pelvis
- Ureter
- Urinary bladder
- urethra

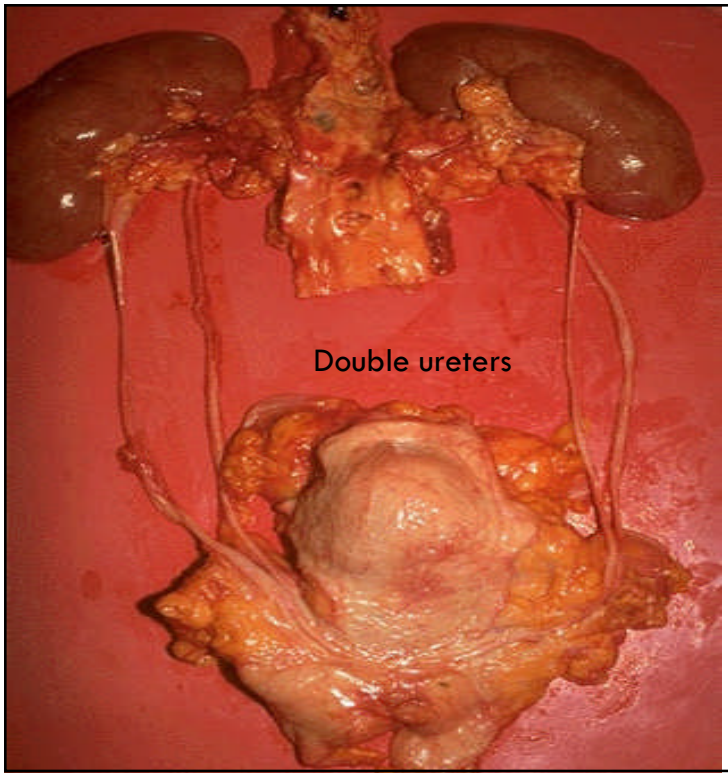
URETERS



URETERS

- Run anterior to psoas and bifurcation of common iliac arteries to enter pelvis.
- Run retroperitoneally along posterolateral wall, anterior to the internal iliac artery.





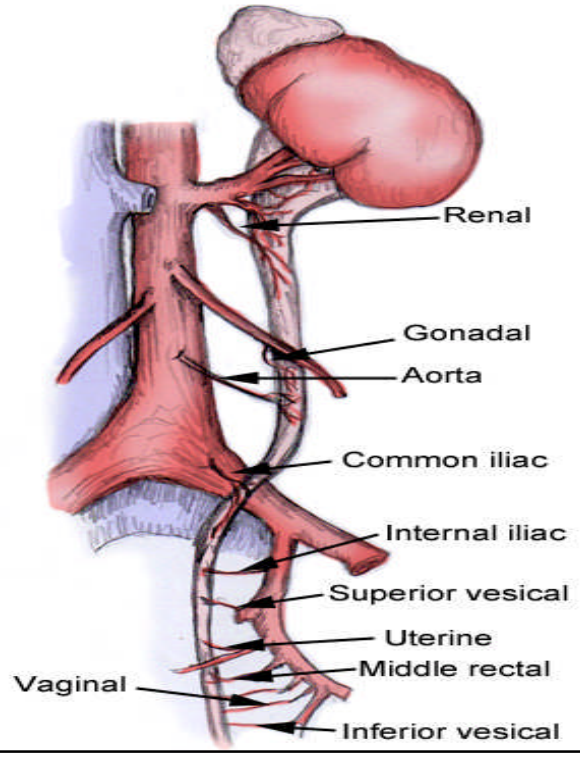
•
Muscular tube that transmit urine via peristaltic waves,.
• from kidney is the most posterior structure that emerges from hilus of kidney
25-30 cm long
enter bladder at anteromedially, superior to levator ani

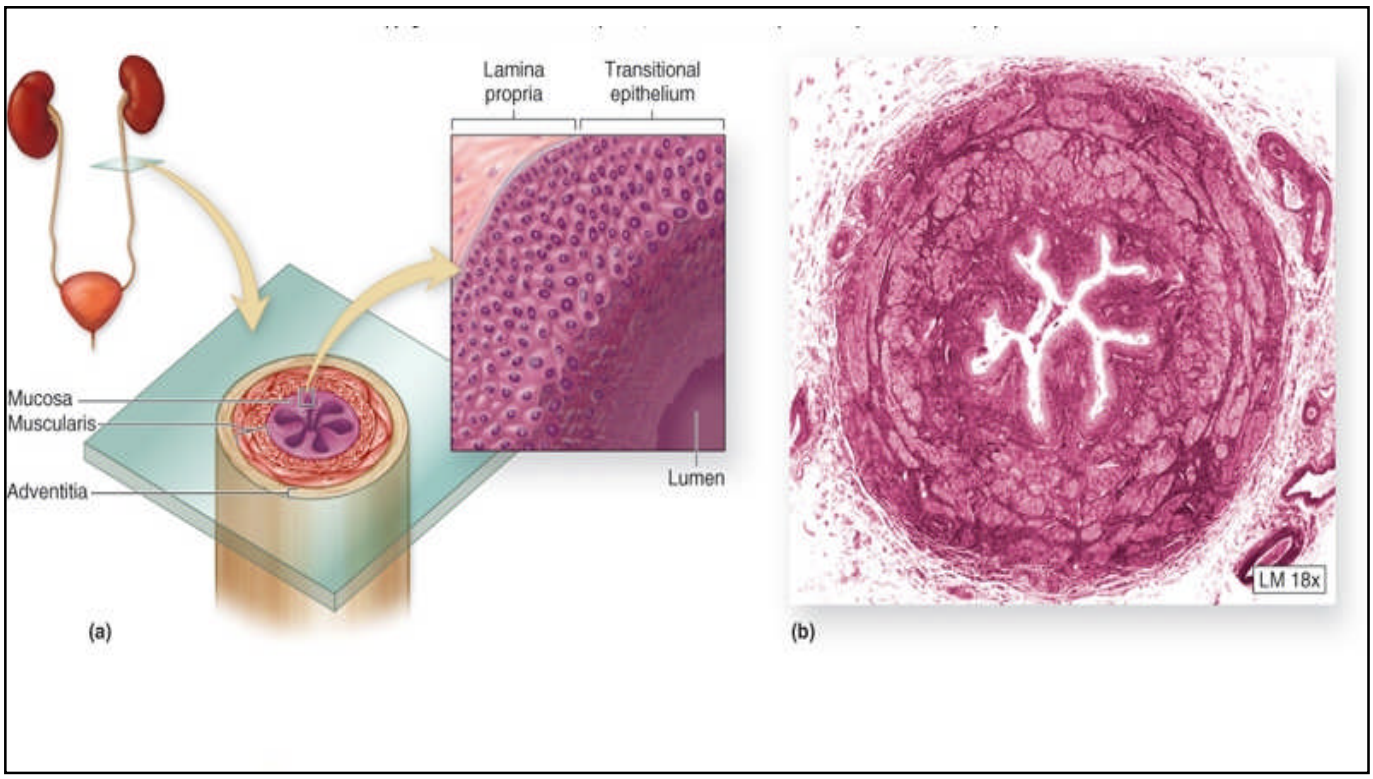
Topography:
•crosses **bifurcation of common iliac a** at pelvic brim
•desc retroperitoneally on lat pelvic wall –> **med to umbilical a & obturator a/v**
•**post to ovary** at post surface of ovarian fossa
•1-2 cm **lateral to uterus,** runs w/ uterine a, which runs above and ant to base of broad lig
•passes **post/inf to ductus deferens** & lies in front of seminal vesicle before entering post/lat bladder (male)

Blood Supply:
from
•aorta,
•renal,
•gonadal,
•common & int iliac,
•umbilical, sup/inf vesicle a, middle rectal a

Vesicle venous plexus –> **int iliac v** (sometimes, prostatic vesicle plexus)

Lymph Drainage: lumbar, common iliac, ext iliac, int iliac l.n




Lamina propria
Transitional epithelium
Mucosa
Muscularis
Adventitia
Lumen
(a)
LM 18x
(b)

Innervation

The ureter has an intrinsic pacemaker that governs peristalsis but also has autonomic inputs.

Thoracolumbar preganglionic inputs synapse with aorticorenal and inferior and superior hypogastric sympathetic plexuses before innervating the ureter.

Parasympathetic inputs derive from the S2-S4 segments.

Mucosal irritation and luminal distention stimulate nociceptors whose afferents travel with sympathetic nerves and confer the visceral-type referred pain that results in the manifestations of ureteral colic.

Pain or hyperesthesia may be sensed from the region of the ipsilateral ribs down to the scrotum or labia.

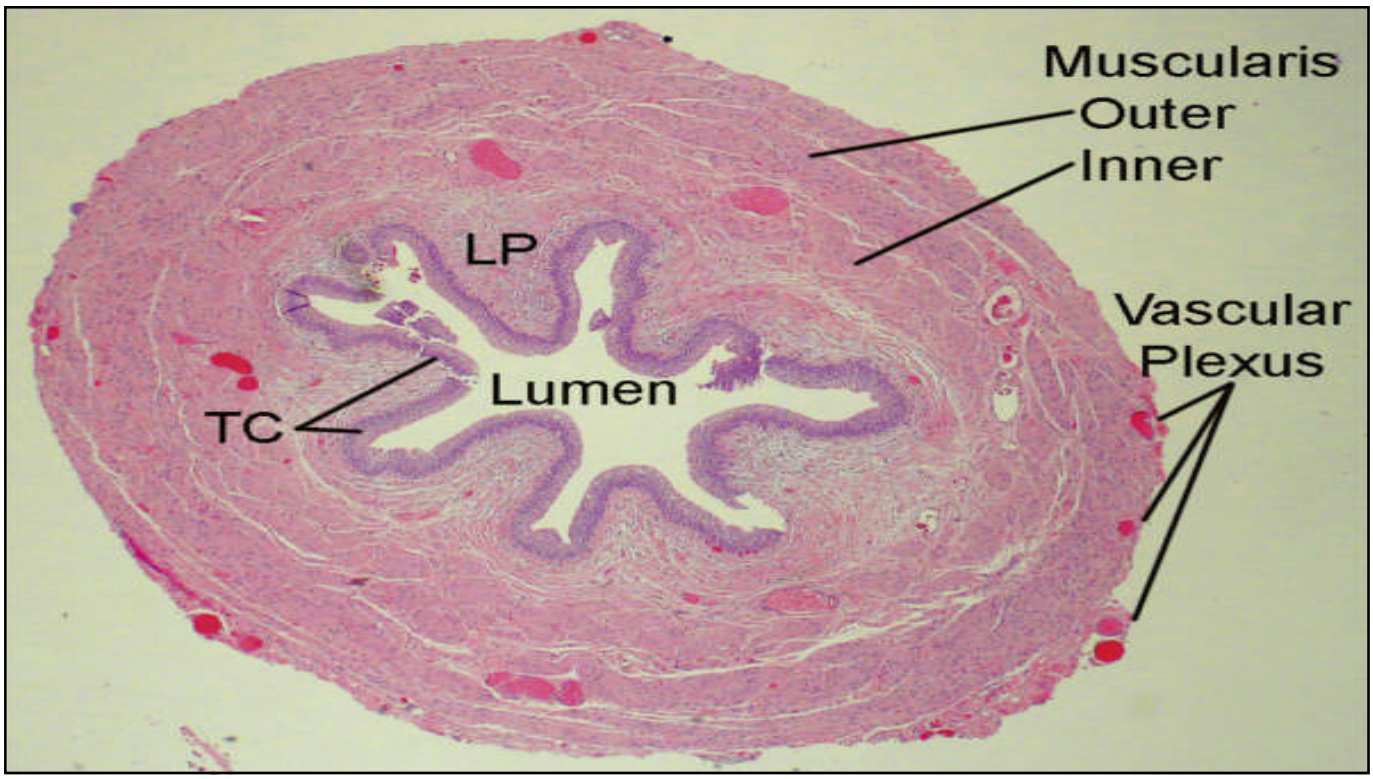
The ureter has 3 physiologic narrowings:

(1)the ureteropelvic junction,

(2) the crossing over the iliac vessels,

(3) the ureterovesical junction.

This is crucial in the manifestations of calculus disease



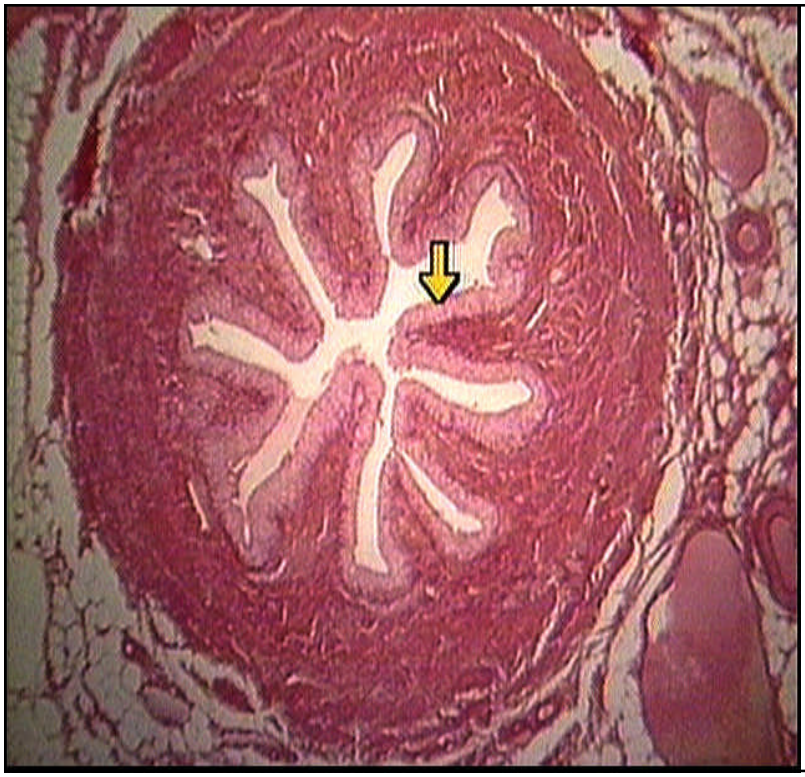
Like the renal pelvis, bladder, and proximal urethra, the ureter is lined with **transitional cell epithelium**,
which consists of a short basal layer, one or more layers of columnar cells, and, most apically, **umbrella cells.**

The umbrella cells are specialized to survive bathing in hypertonic urine and to stretch with distention of the lumen.

Deep to the epithelial layer is the lamina propria, an elastic connective tissue matrix.

The **thickest layer of the ureter is the muscularis**, which is composed of smooth muscles oriented in an inner longitudinal and outer circular arrangement.

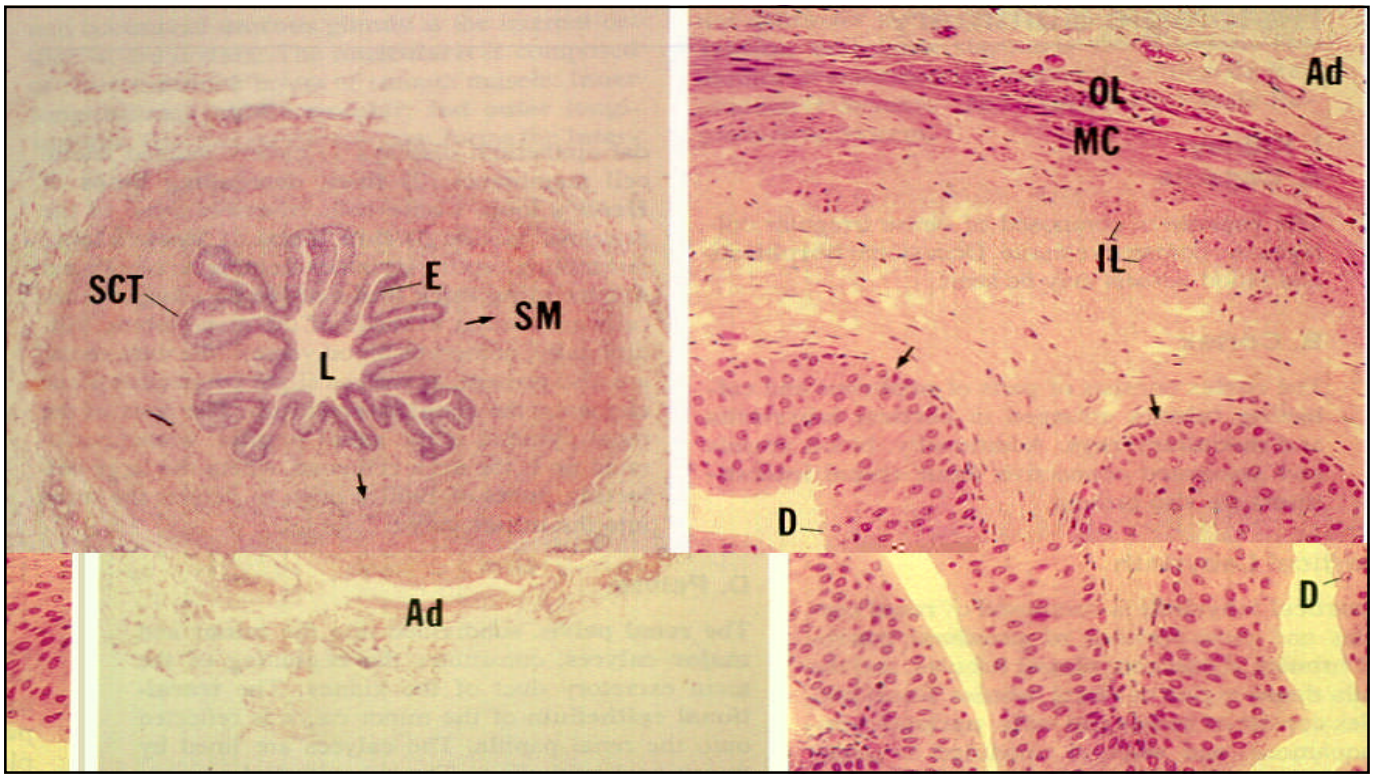
Finally, the outer portion of the ureter is the adventitia, a fibrous layer that harbors the vascular supply

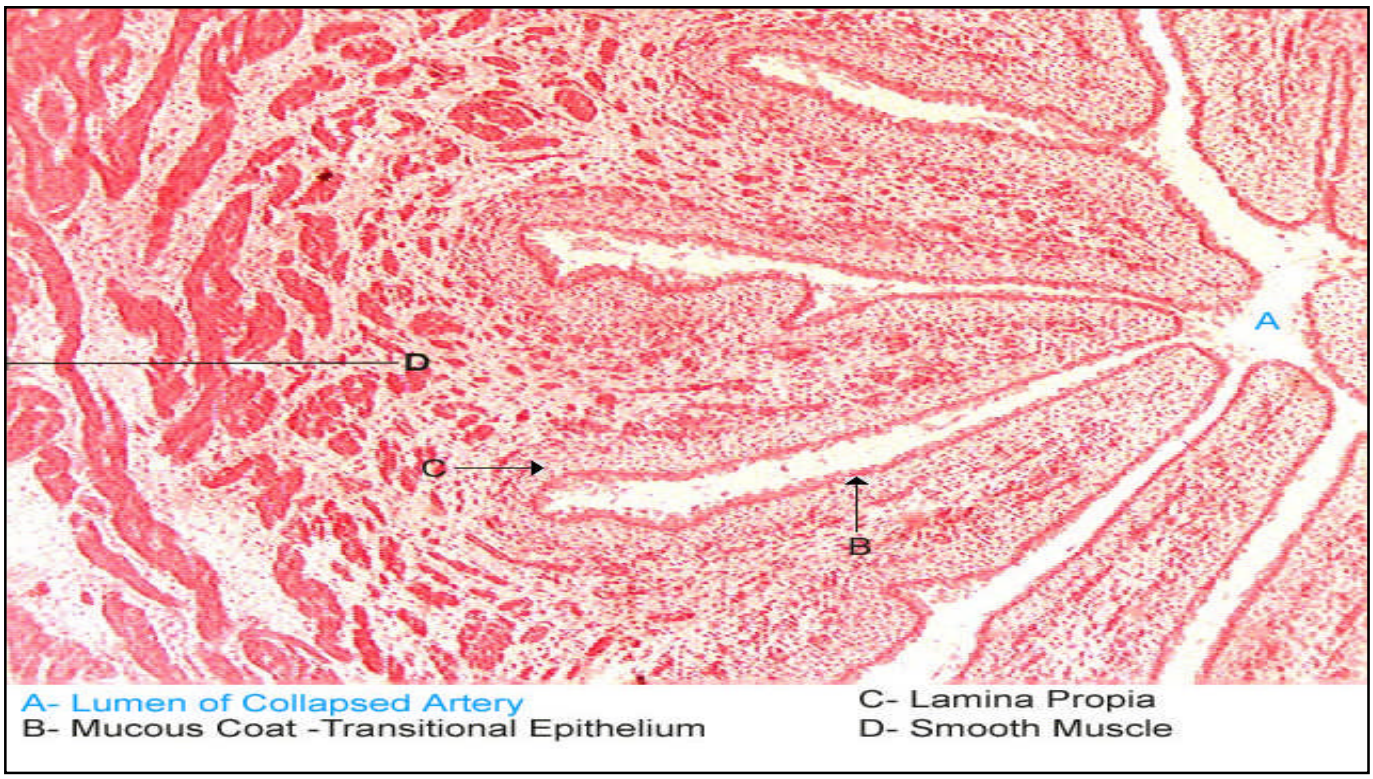


The ureters are muscular tubes which conduct urine from the kidneys to the bladder.
The wall of the ureter contains two layers of smooth muscle arranged in an irregular spiral arrangement.

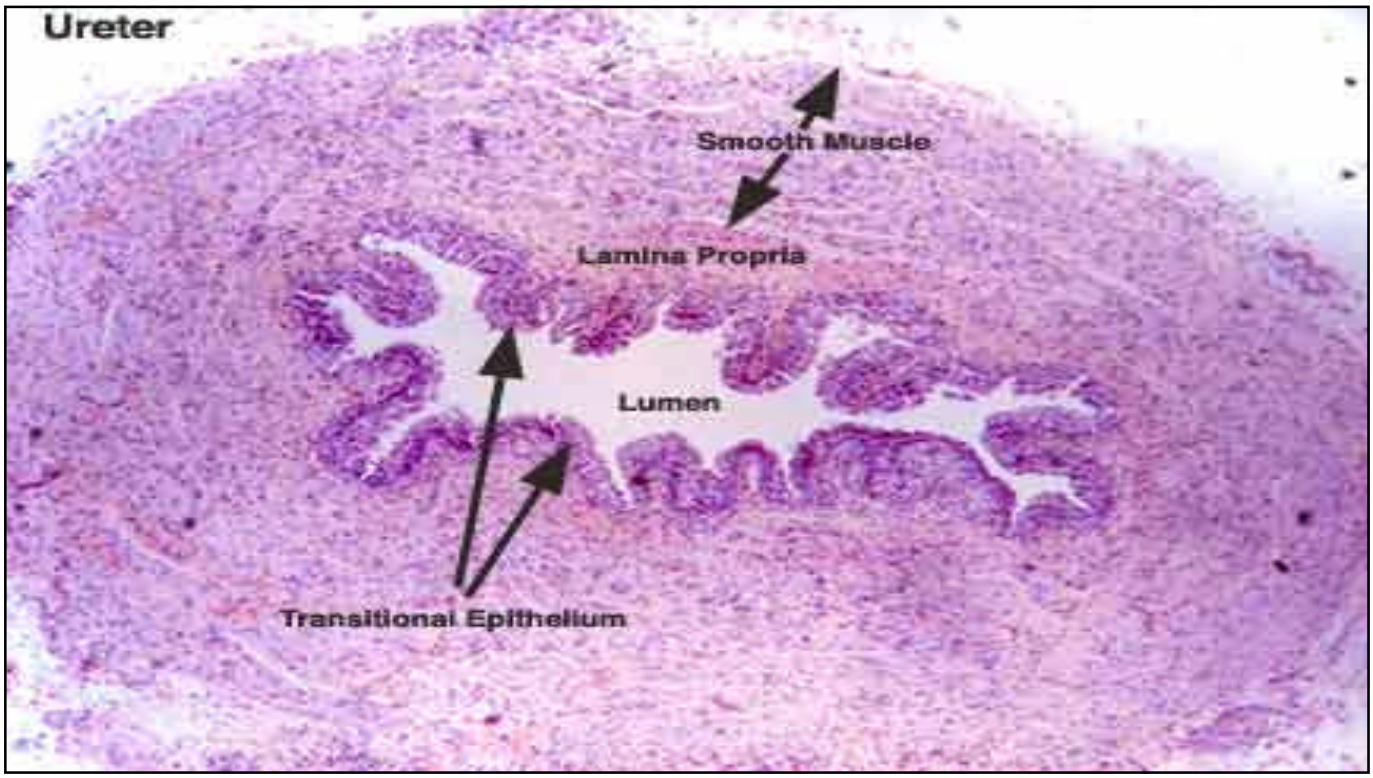
The lumen of the ureter is lined by transitional epithelium which is thrown up into folds in the relaxed state (arrow).

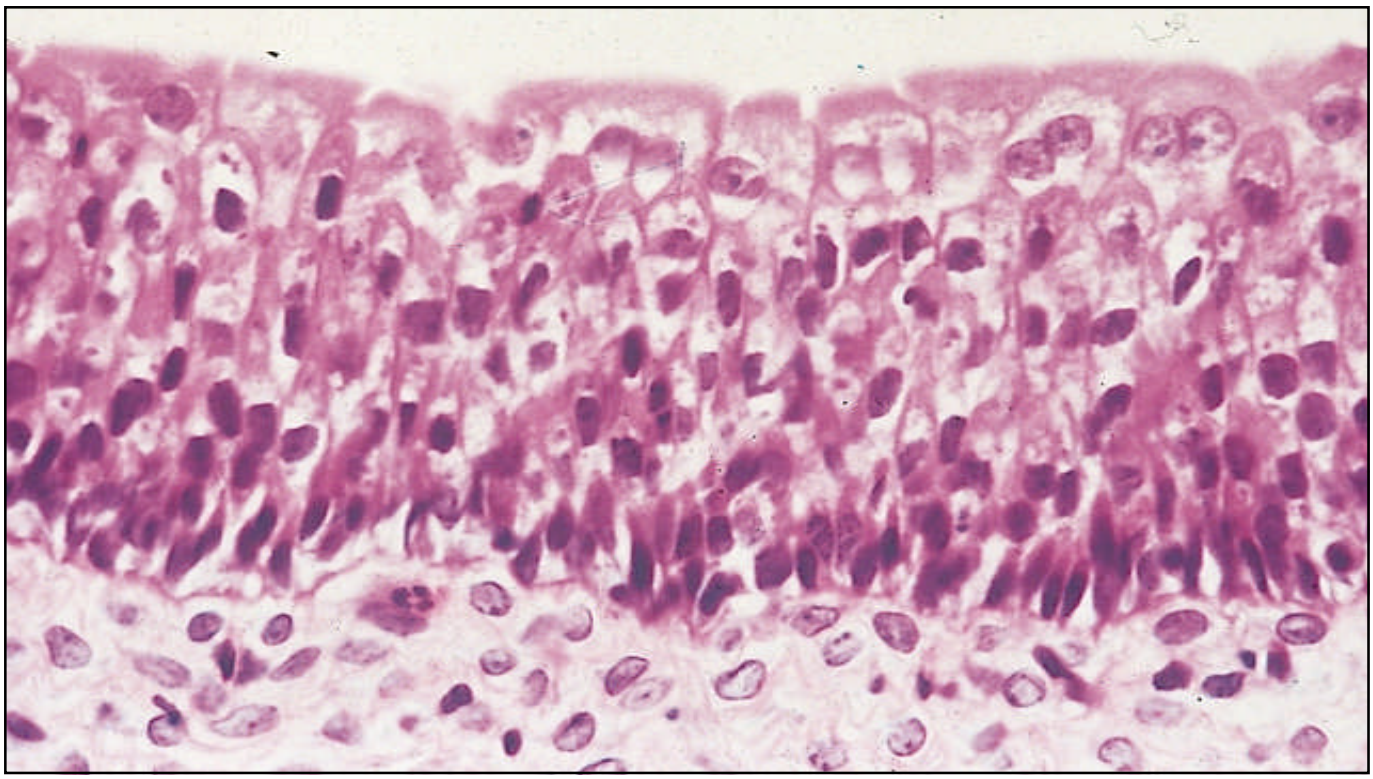
Surrounding the muscular wall is a loose connective tissue adventitia containing blood vessels, lymphatics and nerves.



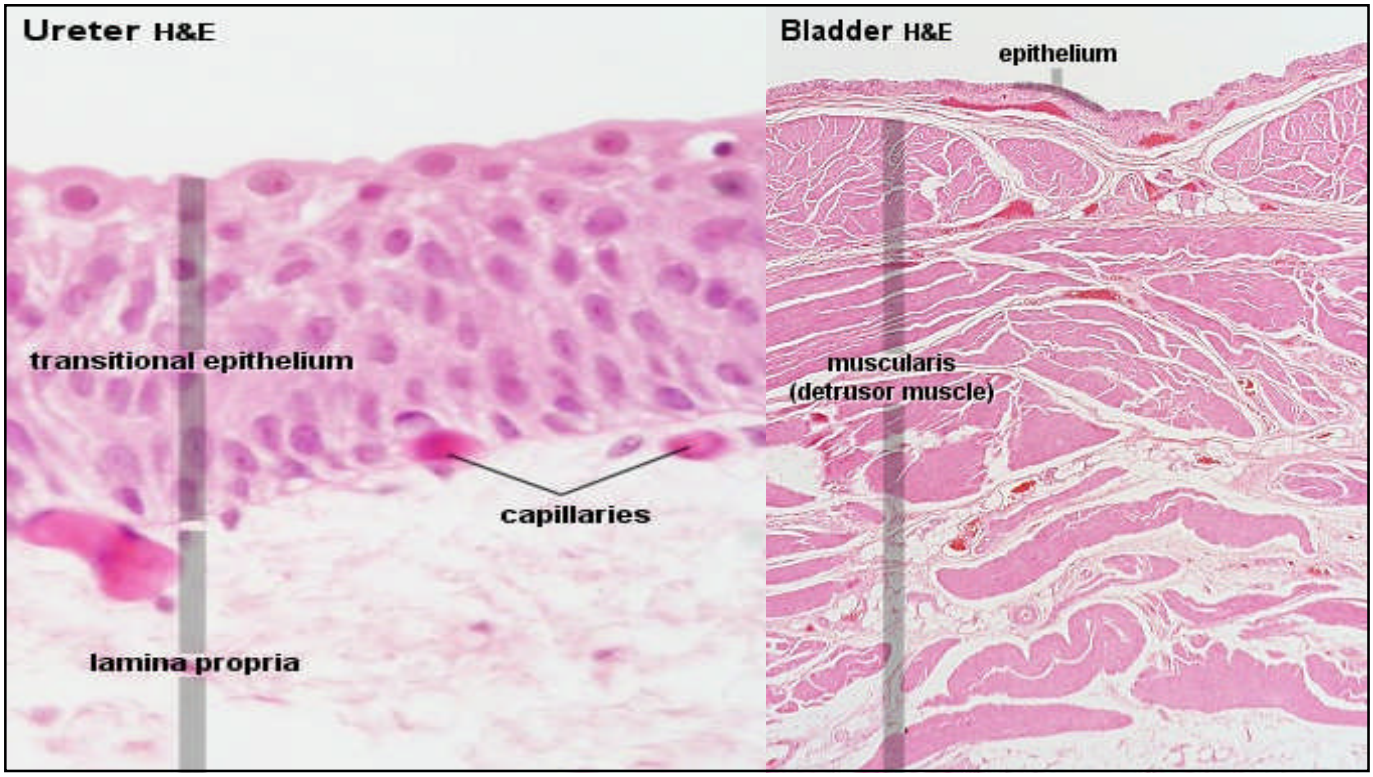


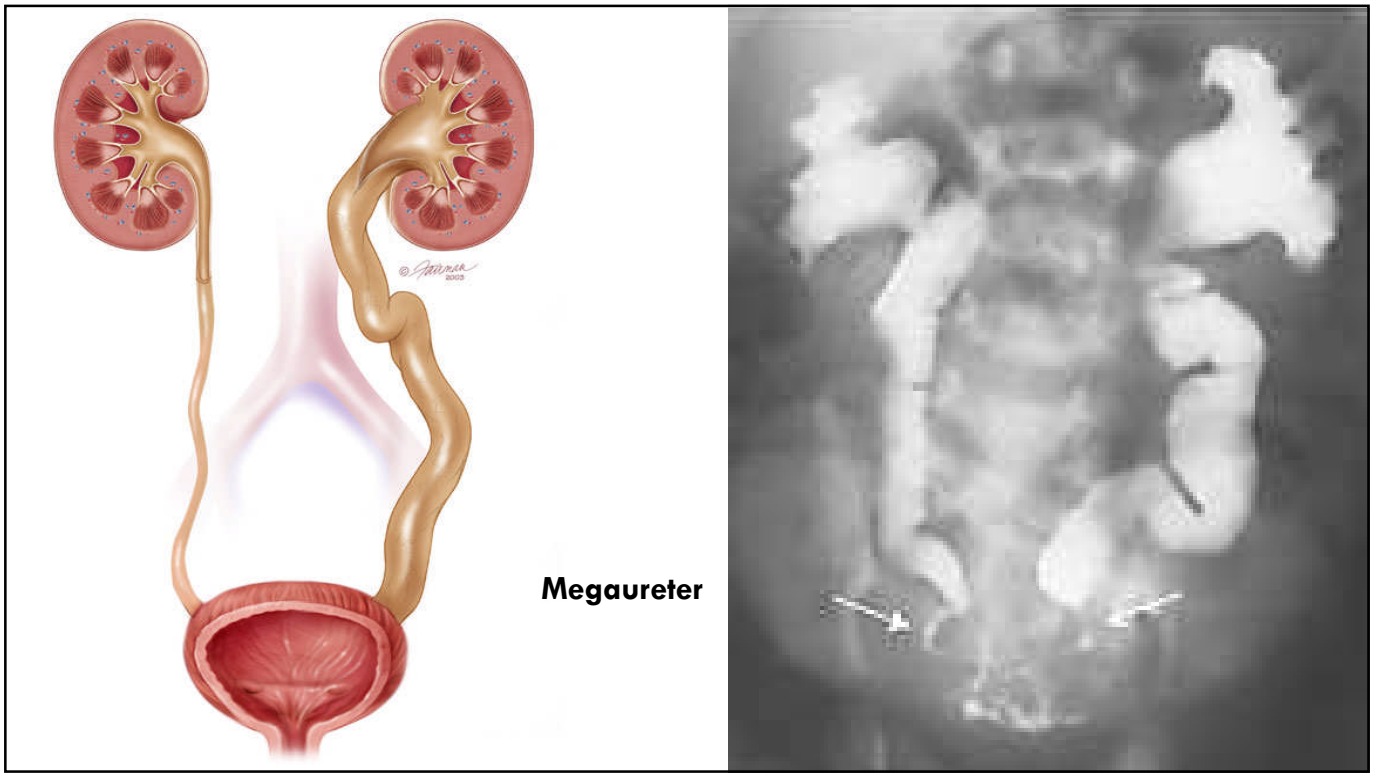
A- Lumen of Collapsed Artery
B- Mucous Coat -Transitional Epithelium
C- Lamina Propia
D- Smooth Muscle



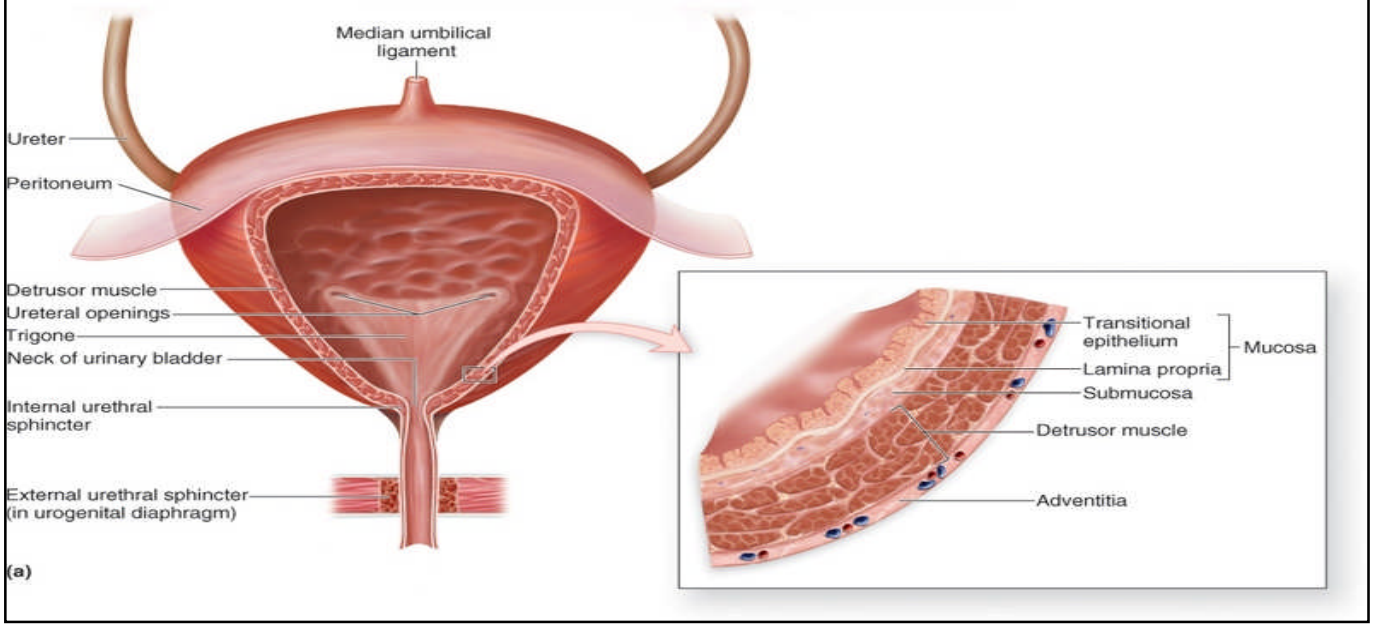


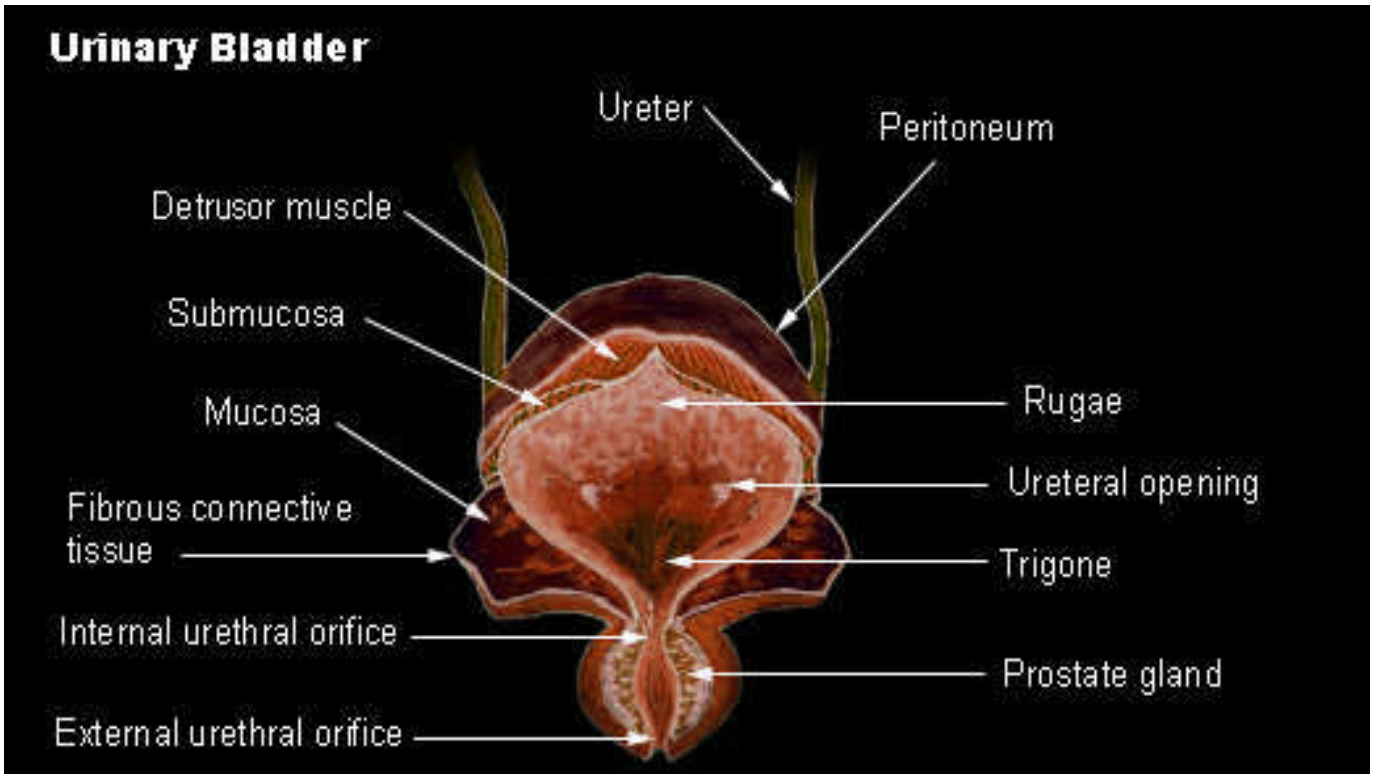
Surface area has deep clefts & vescles thatn may increase
Surface area with distention


Ureter H&E
transitional epithelium
capillaries
lamina propria
Bladder H&E
epithelium
muscularis
(detrusor muscle)


Megaureter

URINARY BLADDER





The **urinary bladder** is the organ that collects urine excreted by the kidneys before disposal by urination.

A hollow muscular, and distensible (or elastic) organ, the bladder sits on the pelvic floor.

Urine enters the bladder via the ureters and exits via the urethra

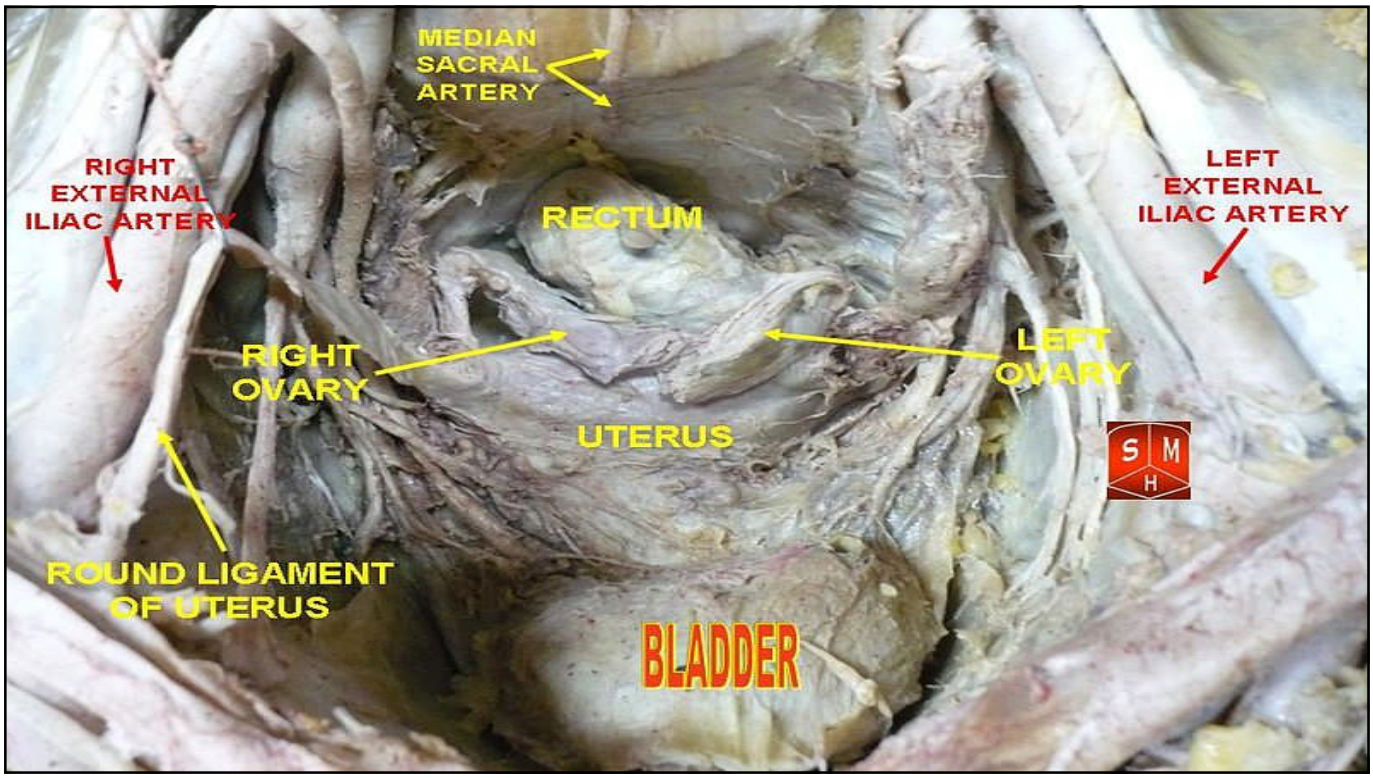
urinary bladder is derived in embryo from the urogenital sinus

Topography:

In males, the base of the bladder lies between the rectum and the pubic symphysis.
It is superior to the prostate, and separated from the rectum by the rectovesical excavation.

In females, the bladder sits inferior to the uterus and anterior to the vagina; thus, its maximum capacity is lower than in males.

It is separated from the uterus by the **vesicouterine excavation**. In infants and young children, the urinary bladder is in the abdomen even when empty



For the urine to exit the bladder, both the must be opened.

- autonomically controlled internal sphincter and
- **the voluntarily controlled external sphincter**

Problems with these muscles can lead to incontinence.

The urinary bladder usually holds **300-350 ml of urine**.

As urine accumulates, the **rugae** flatten and the wall of the bladder thins as it stretches, allowing the bladder to store larger amounts of urine without a significant rise in internal pressure

Peristaltic Contractions

- Begin at renal pelvis
- Sweep along ureter
- Force urine toward urinary bladder
- Every 30 seconds

The Urinary Bladder

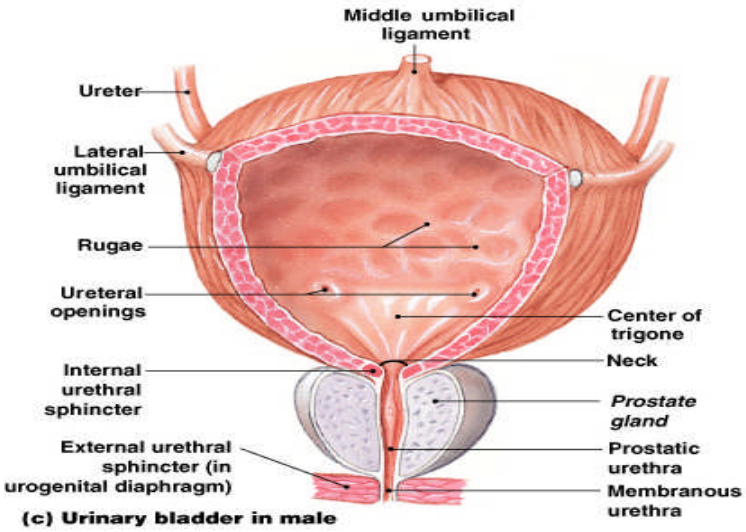
- Is a hollow, muscular organ
- Functions as temporary reservoir urine storage
- Full bladder can contain 1 liter of urine

Bladder Position

-
-
  -
-
  -

Umbilical Ligaments

- Are vestiges of 2 umbilical arteries
- Middle umbilical ligament extends:
  - from anterior, superior border
  - toward umbilicus
- Lateral umbilical ligaments:
  - pass along sides of bladder to umbilicus



(c) Urinary bladder in male

The Mucosa

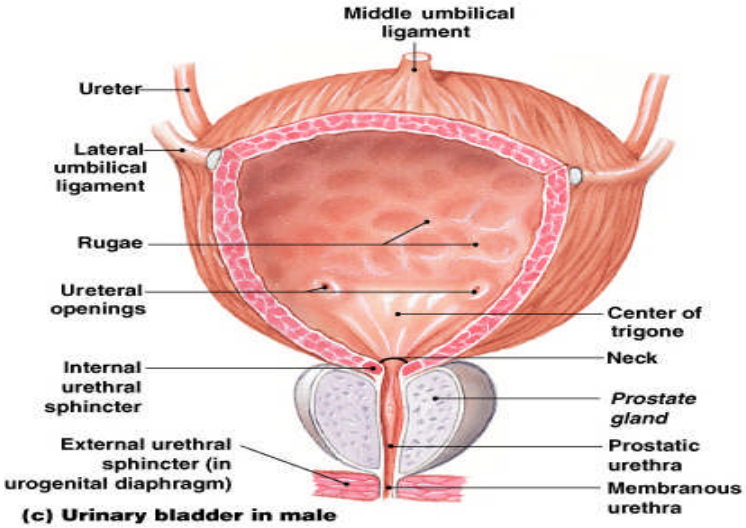
- Lining the urinary bladder has folds (rugae):
  - that disappear as bladder fills

The Trigone of the Urinary Bladder

-
  -
  -
-
  -

The Urethral Entrance

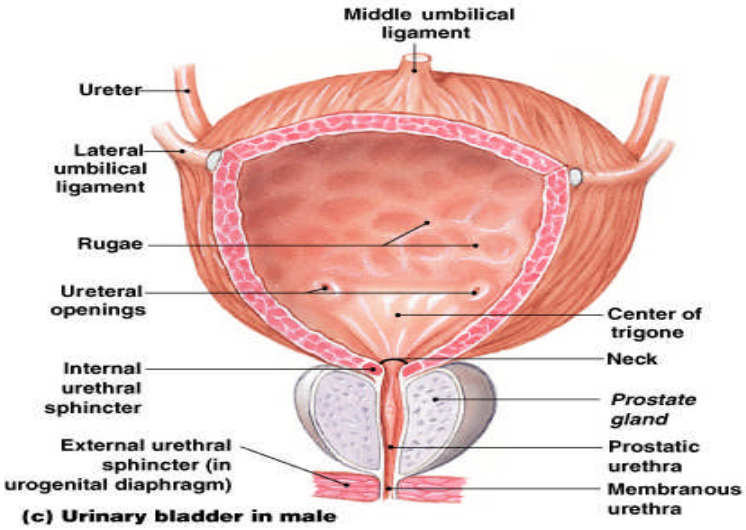
- Lies at apex of trigone:
  - at most inferior point in urinary bladder



(c) Urinary bladder in male

The Neck of the Urinary Bladder

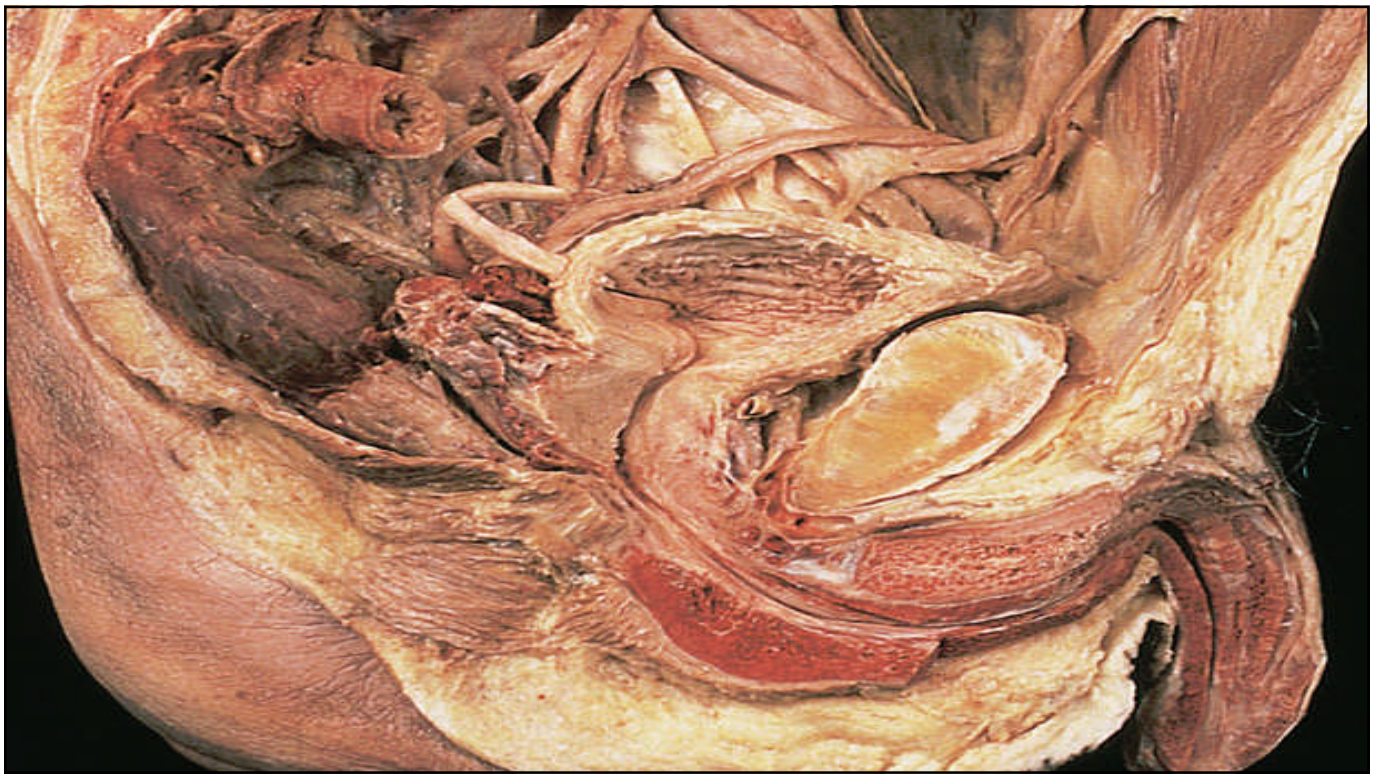
- Is the region surrounding urethral opening
- Contains a muscular internal urethral sphincter (sphincter vesicae- Smooth muscle fibers of sphincter provide involuntary control of urine discharge)

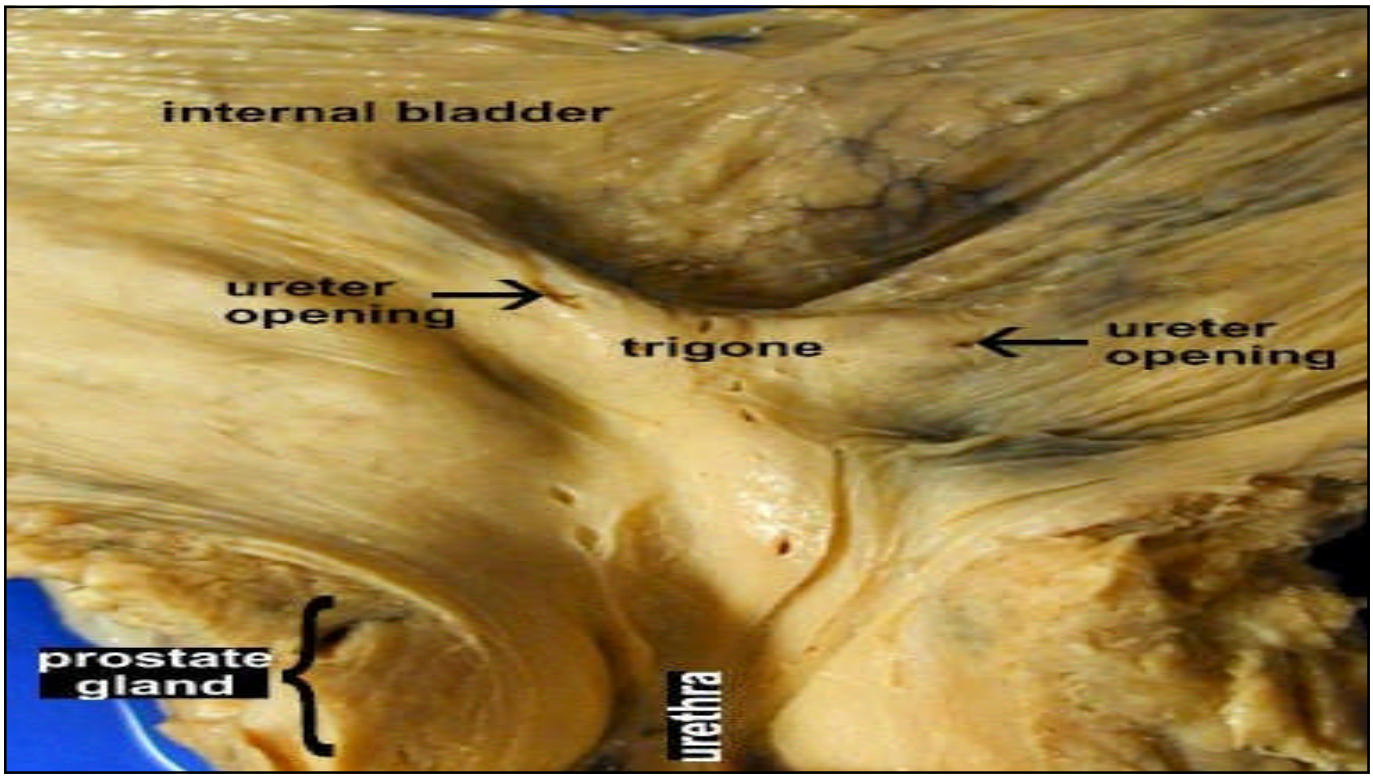


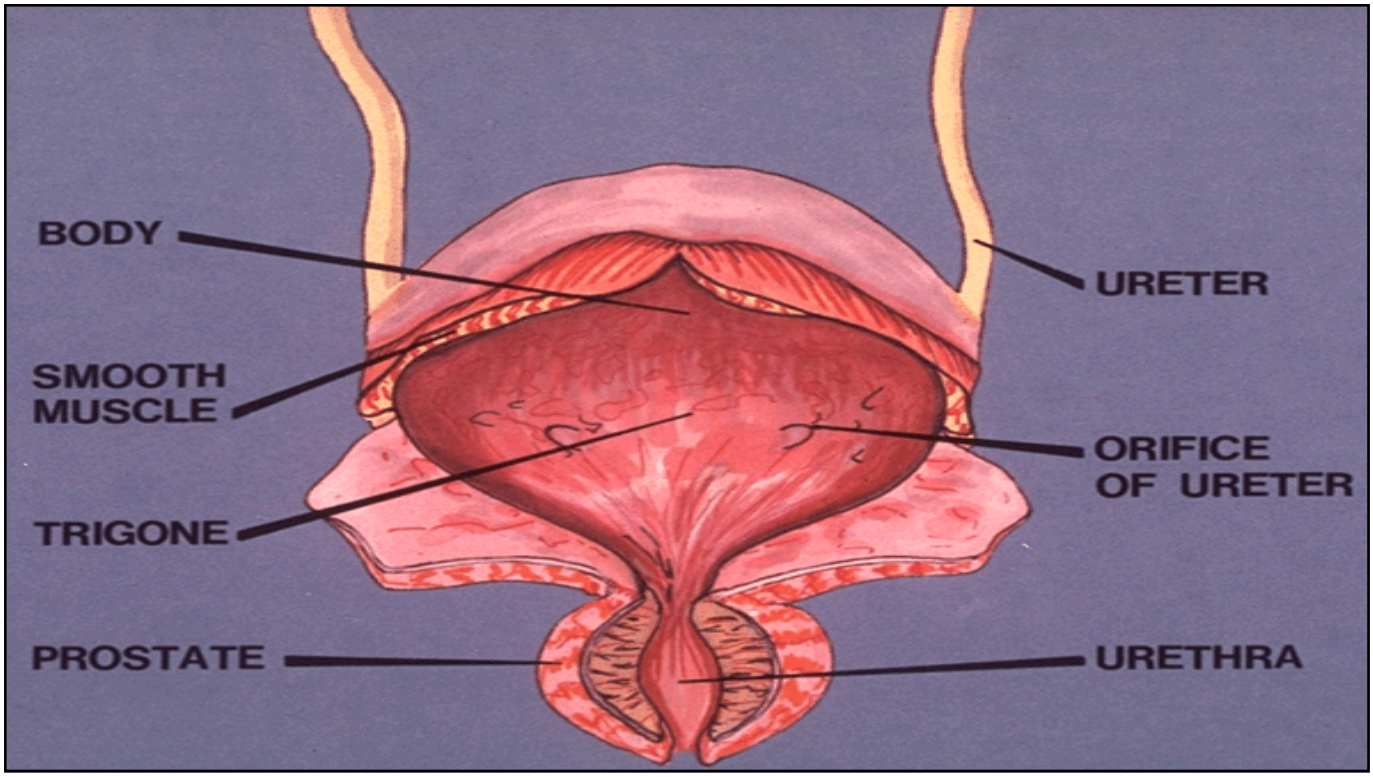
Wall of the Urinary Bladder

- Contains mucosa, submucosa, and muscularis layers:
  - form powerful detrusor muscle of urinary bladder
  - contraction compresses urinary bladder and expels urine

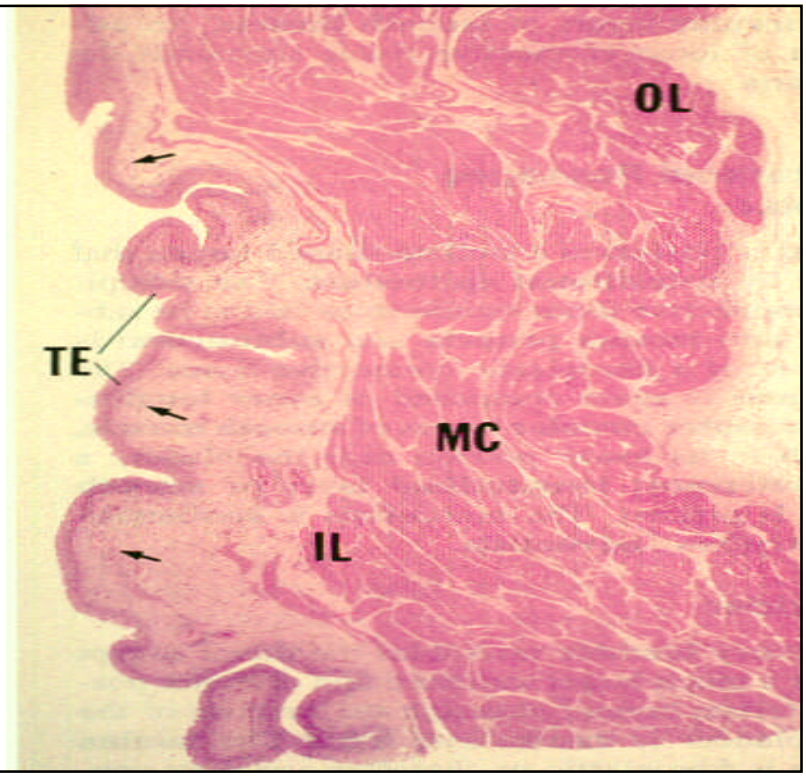
Artery	•Superior vesical artery •Inferior vesical artery •Umbilical artery •vaginal artery
Vein	•Vesical venous plexus
Nerve	•Vesical nervous plexus
Lymph	external iliac lymph nodes, internal iliac lymph nodes

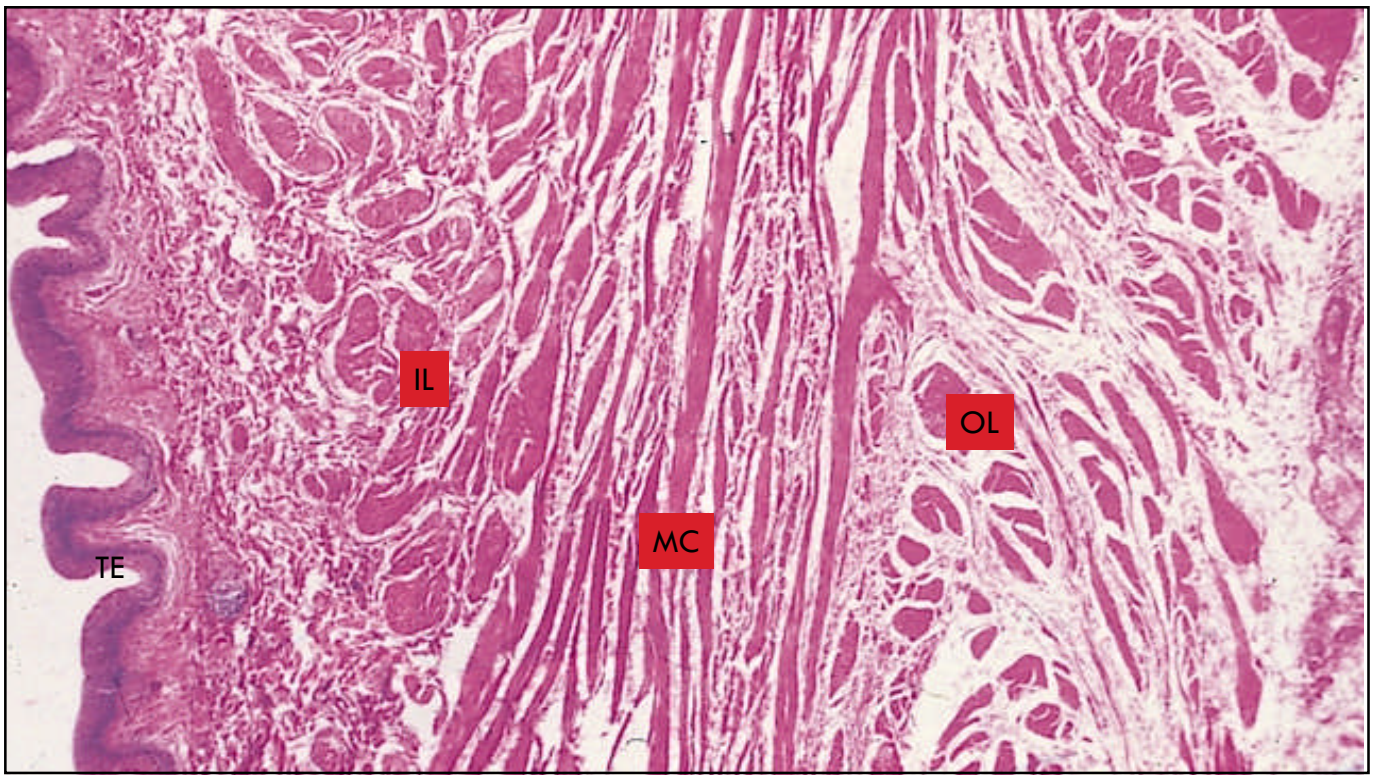


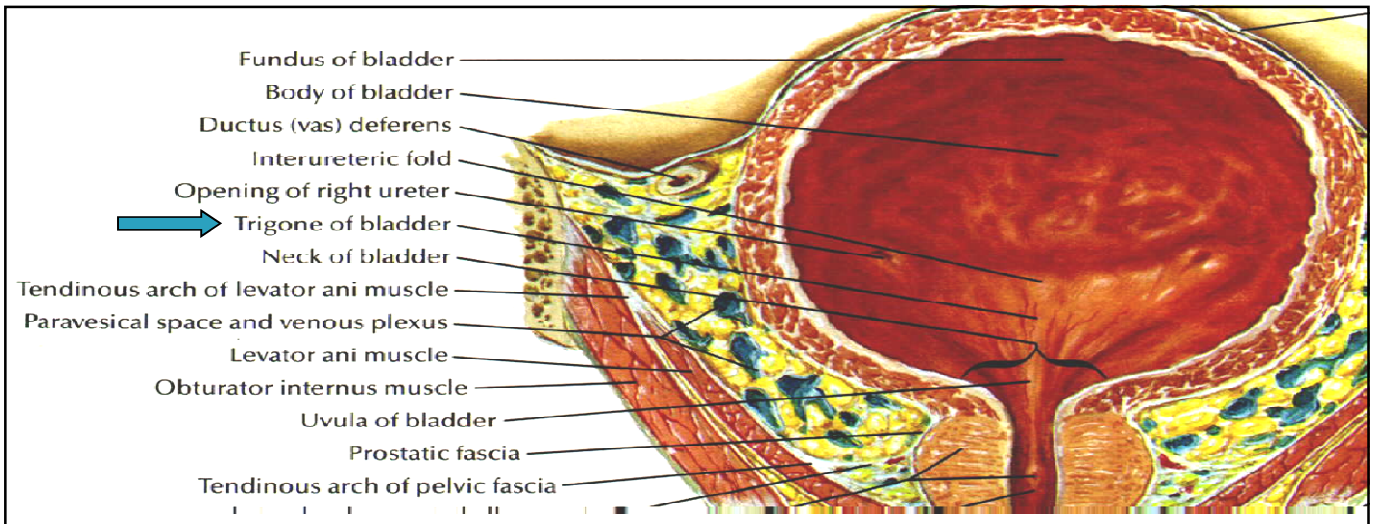

internal bladder
ureter opening
trigone
ureter opening
prostate gland
urethra



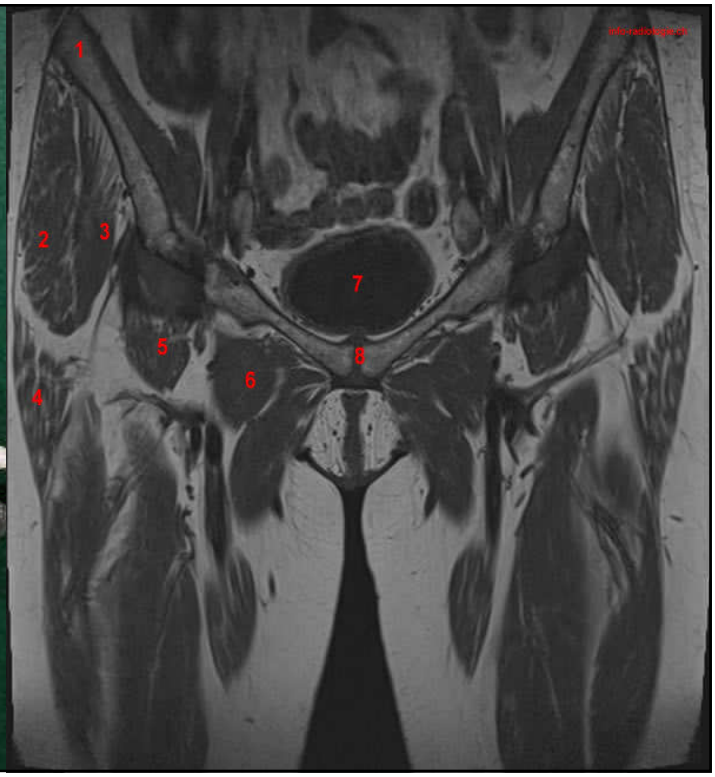
- WALLS ARE LIKE URETER, PELVIS & CALYCES, BUT HAS A THICKER MUSCULARIS EXTERNA







Lined by transitional epithelium over a dense lamina propria.
Walls composed of detrusor muscles.
Inner circular layer forms the internal urethral sphincter.
Also external sphincters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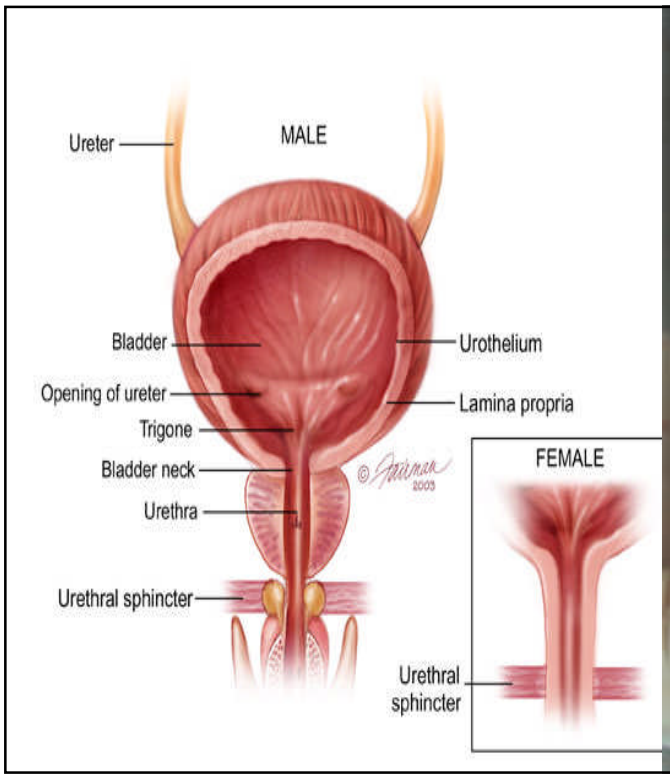
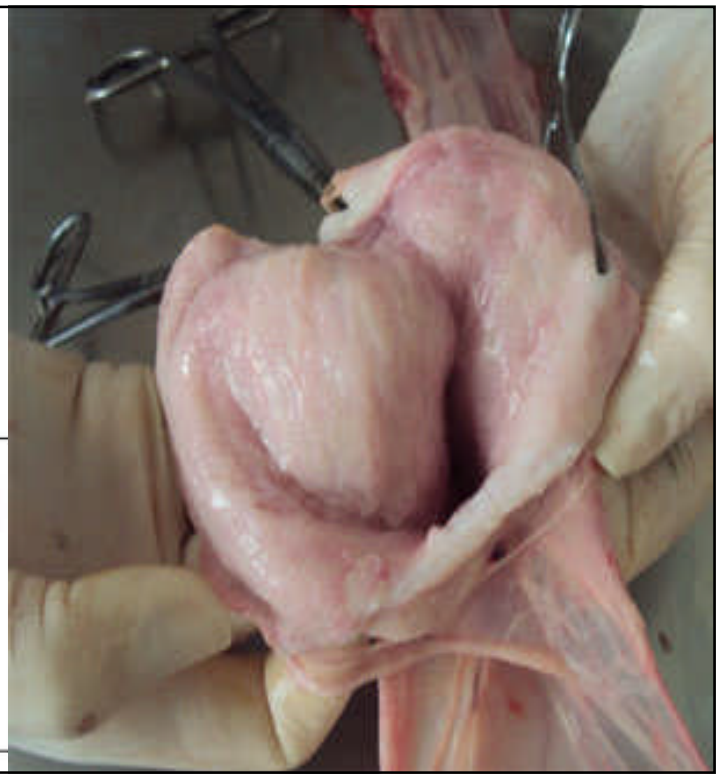
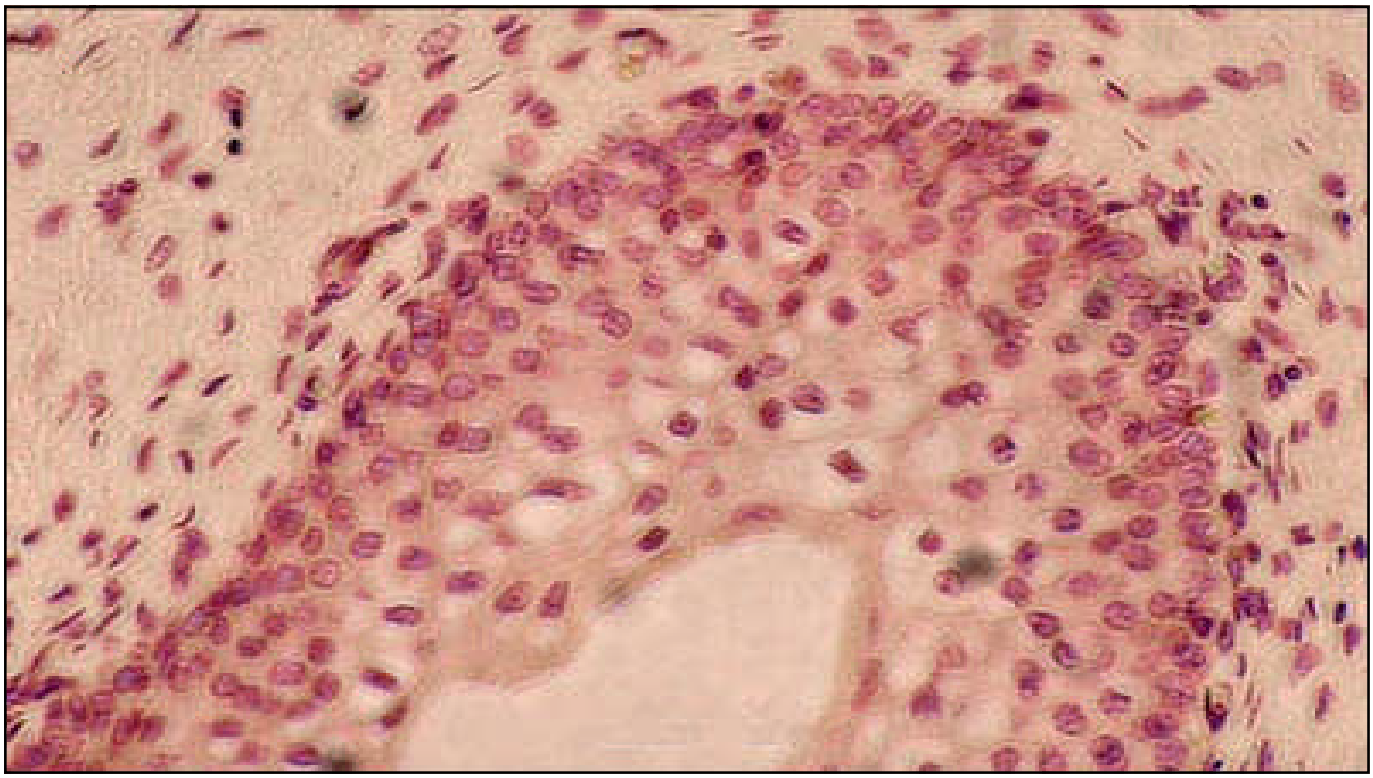
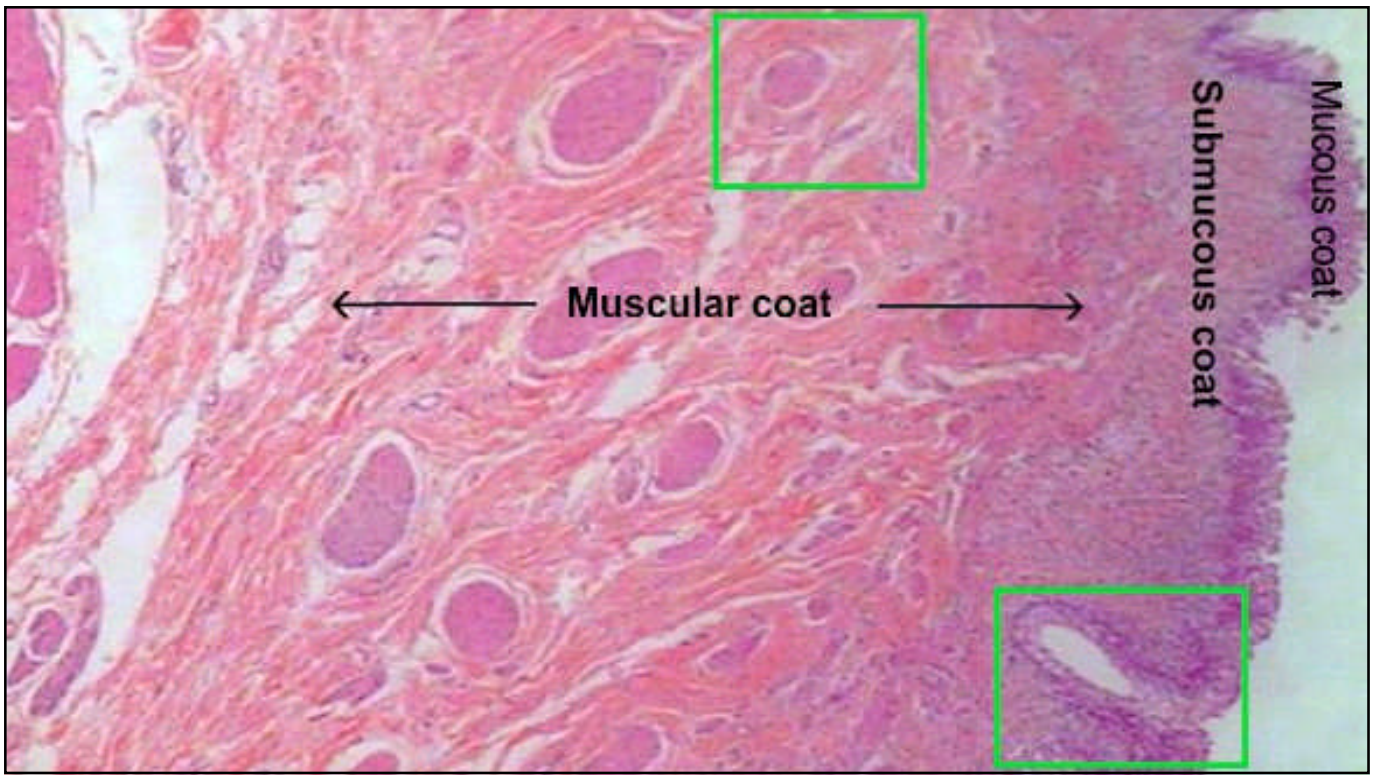
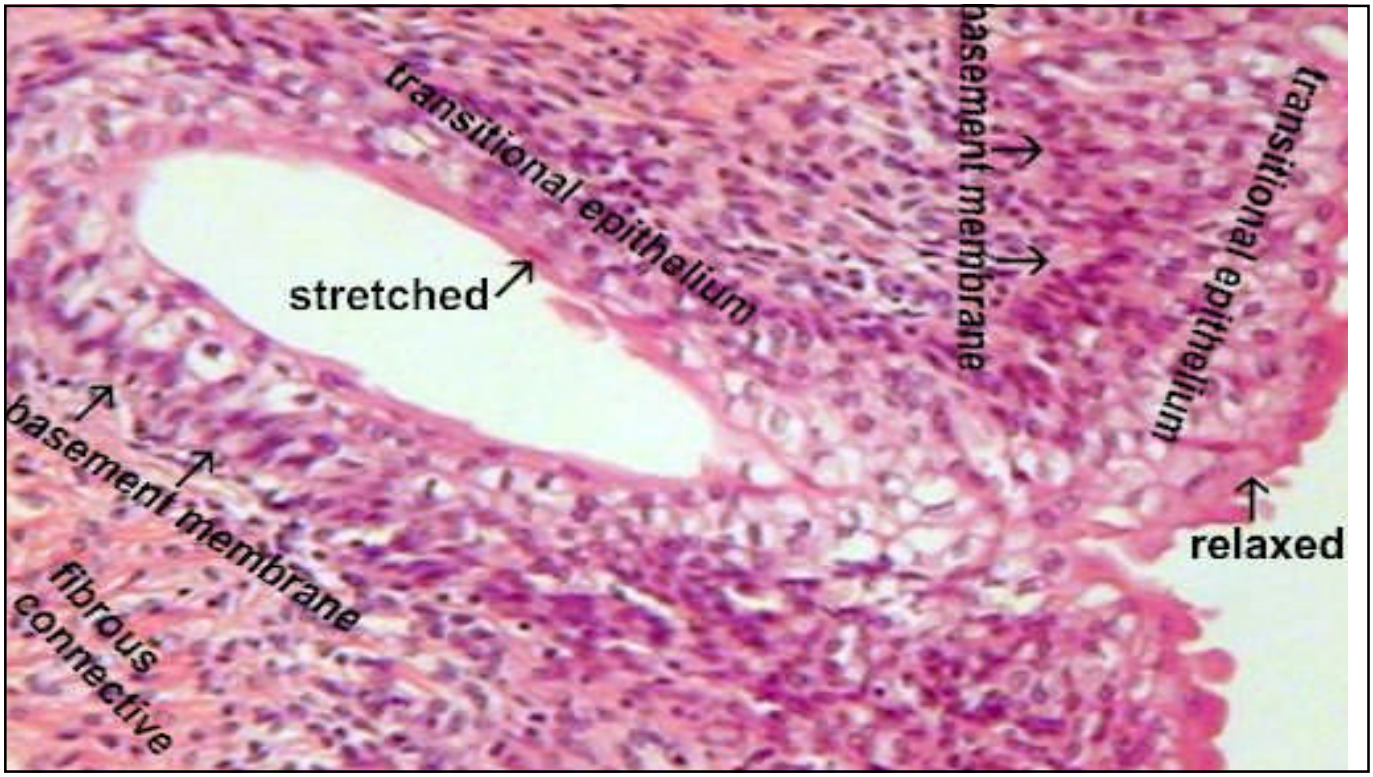

MALE
Ureter
Bladder
Opening of ureter
Trigone
Bladder neck
Urethra
Urethral sphincter
Urothelium
Lamina propria
FEMALE
Urethral sphincter

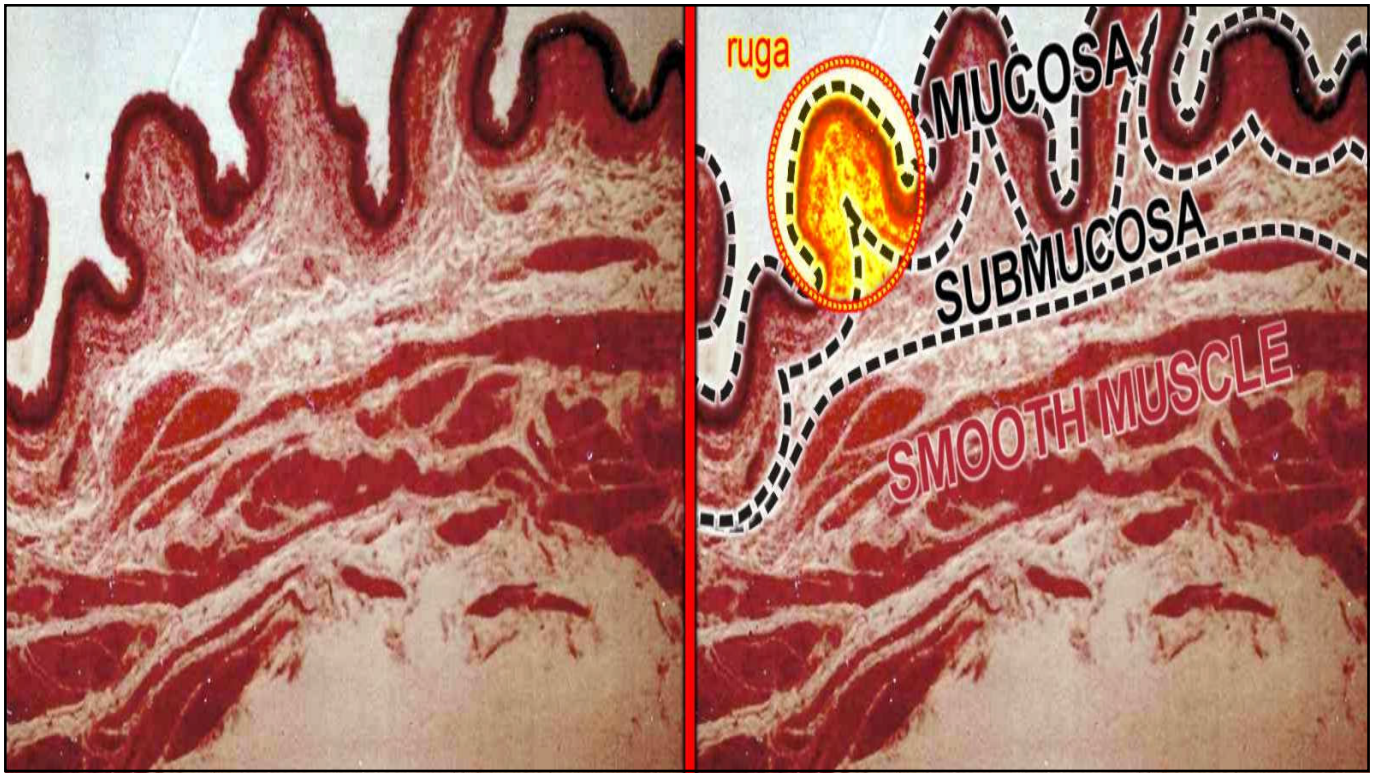


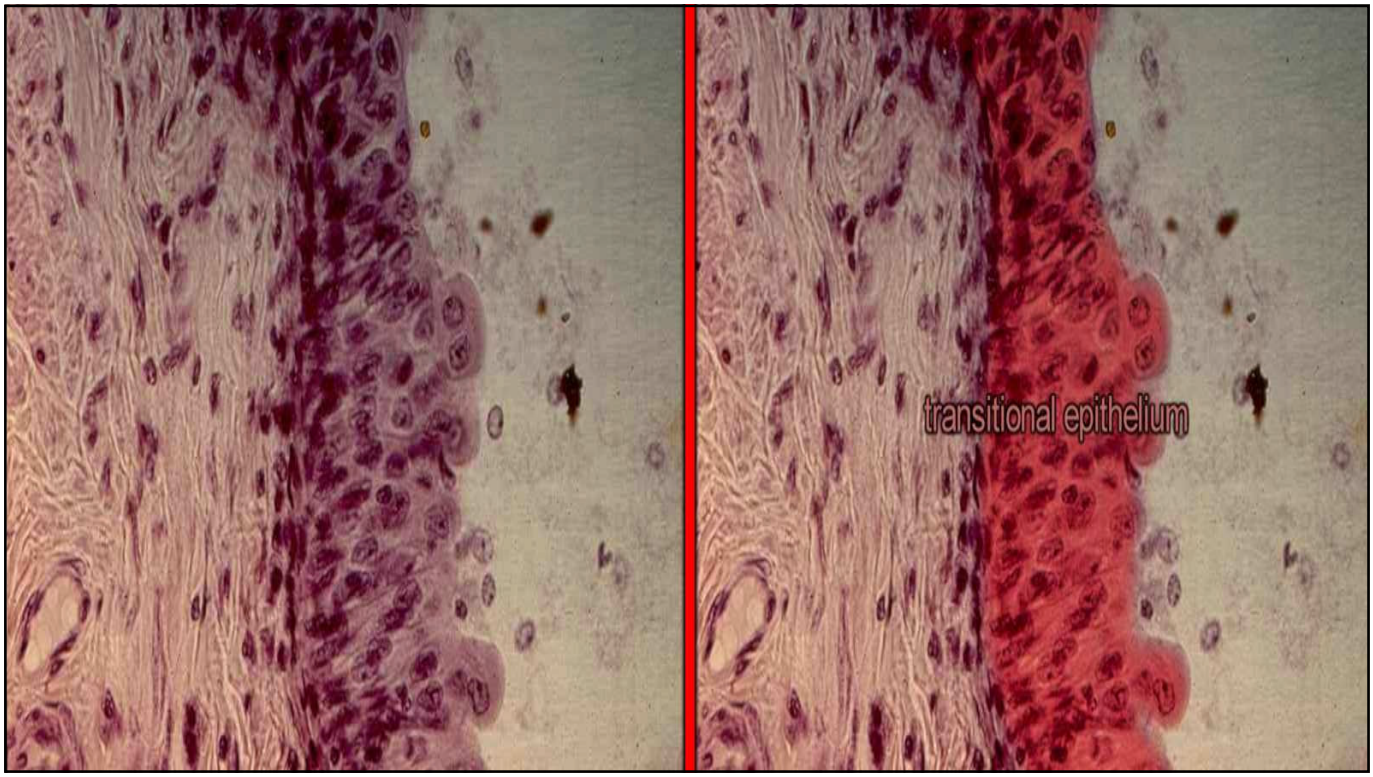

Mucosa
Submucosa
Inner layer of longitudinal muscle
Middle layer of circular muscle
Muscularis
Outer layer of longitudinal muscle




Muscular coat
Submucous coat
Mucous coat


transitional epithelium
stretched
basement membrane
basement membrane
fibrous connective
transitional epithelium
relaxed


ruga
MUCOSA
SUBMUCOSA
SMOOTH MUSCLE


transitional epithelium

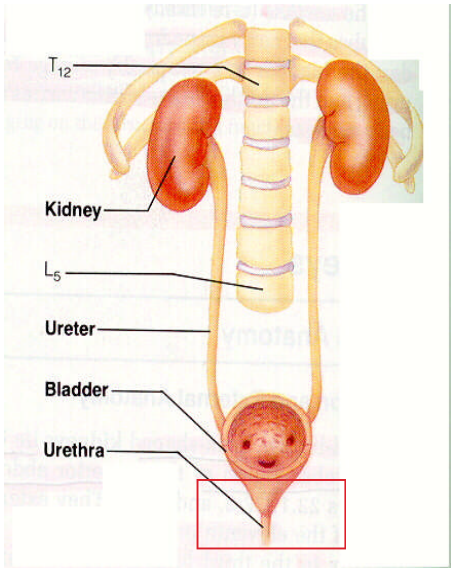
URETHRA

- DIFFERS IN LENGTH, EPITHELIUM, AND FUNCTION IN MALES AND FEMALES...

The epithelium of the urethra starts off as transitional cells as it exits the bladder.
Further along the urethra there are stratified columnar cells, then stratified squamous cells near the external urethral orifice.
There are small mucus-secreting urethral glands, that help protect the epithelium from the corrosive urine.

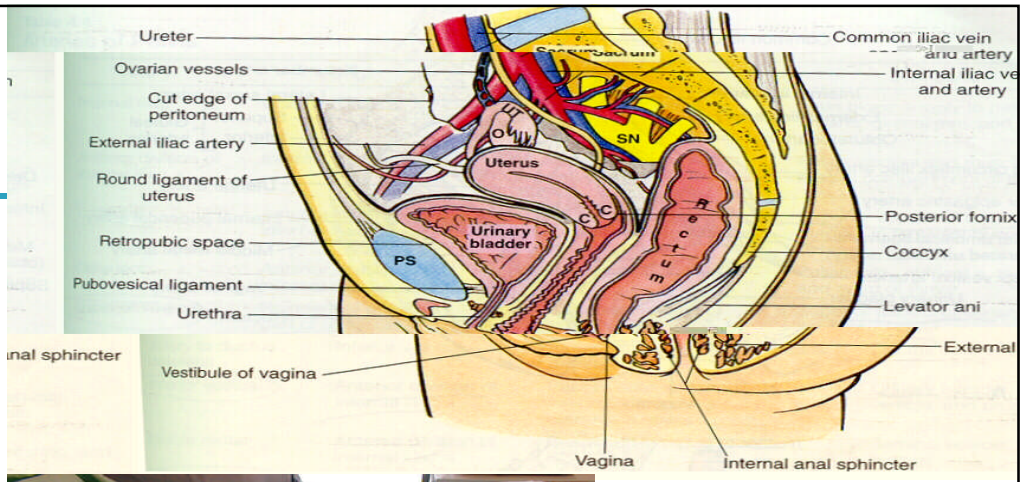
Length of the urethrae
The female urethra is about 4 cm in length.

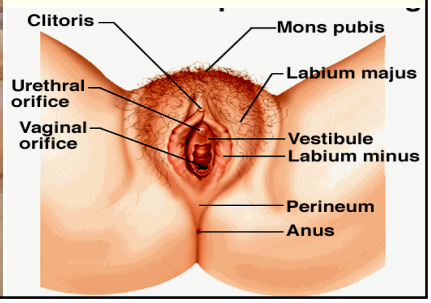
men showed an average length of 22.3 cm (SD = 2.4 cm), ranging from 15 cm to 29 cm.



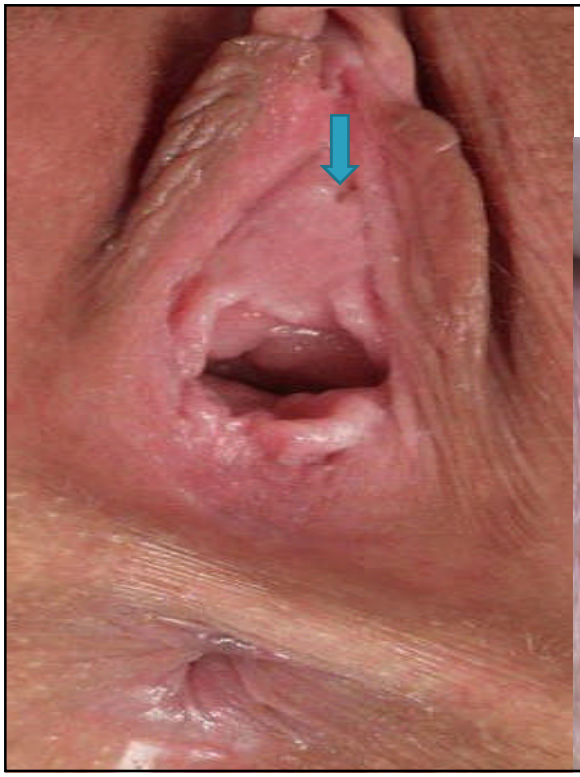
FEMALE URETHRA

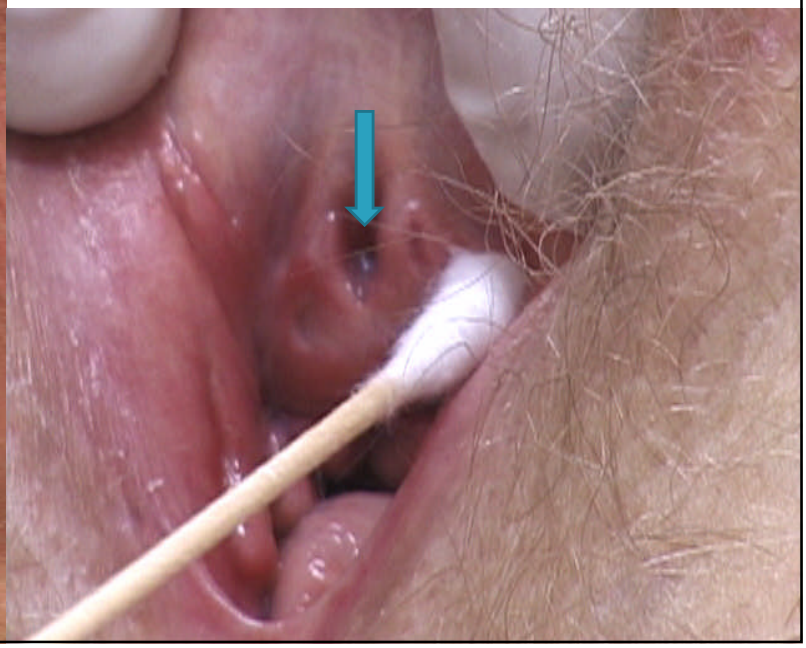
- 4-5 CM
- STRATIFIED SQUAMOUS (AREAS OF PSEUDO-STRATIFIED COLUMNAR)

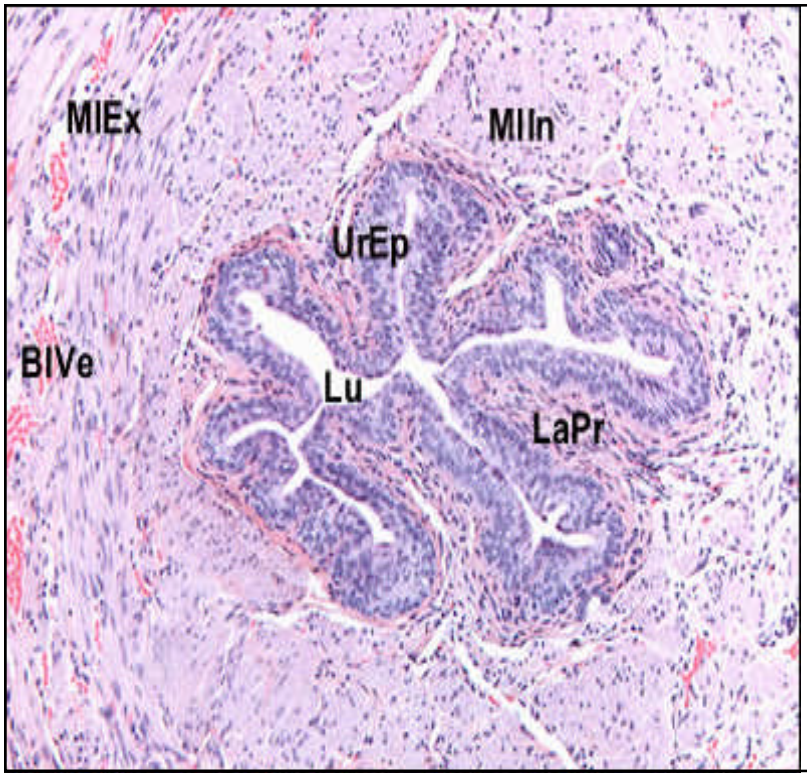




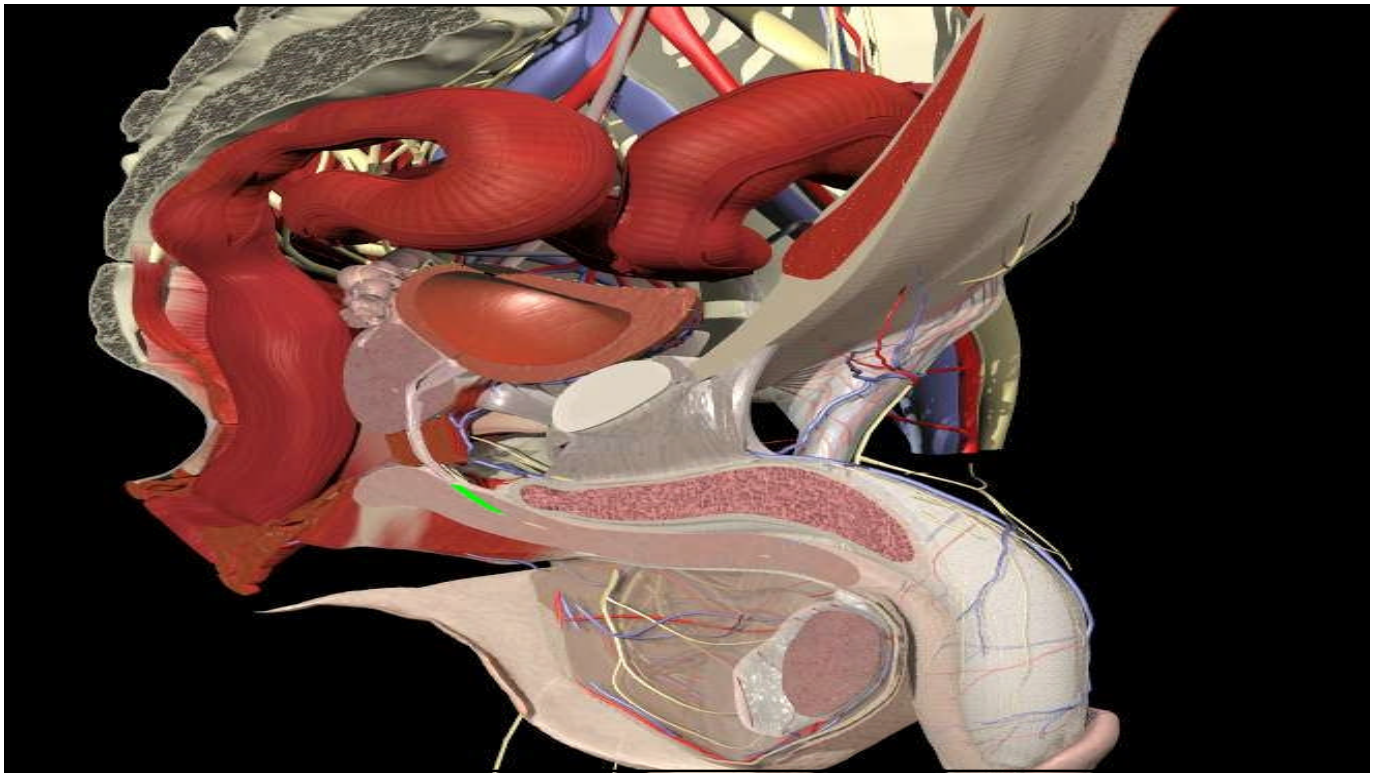
Female urethra

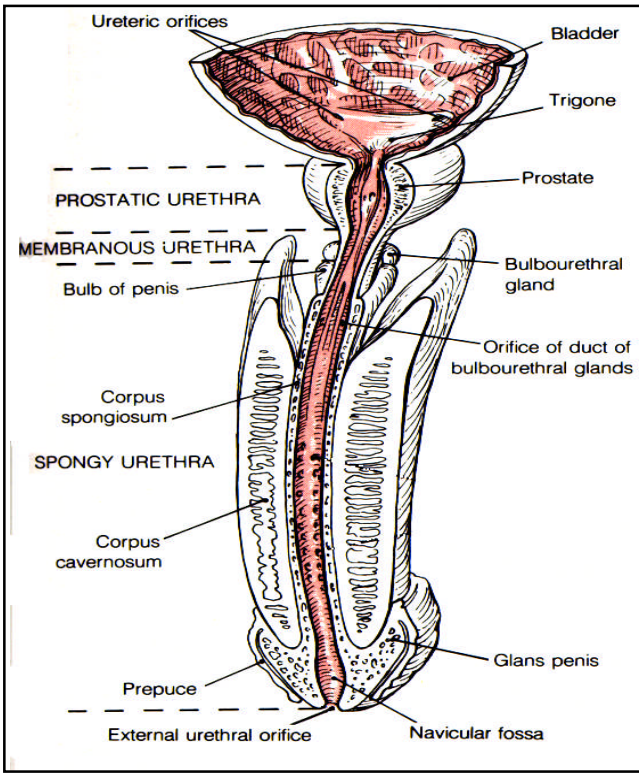






BlVe Blood vessel
LaPr Lamina propria
Lu Lumen
MlEx Muscularis externa
MlIn Muscularis interna
UrEp Urinary epithelium

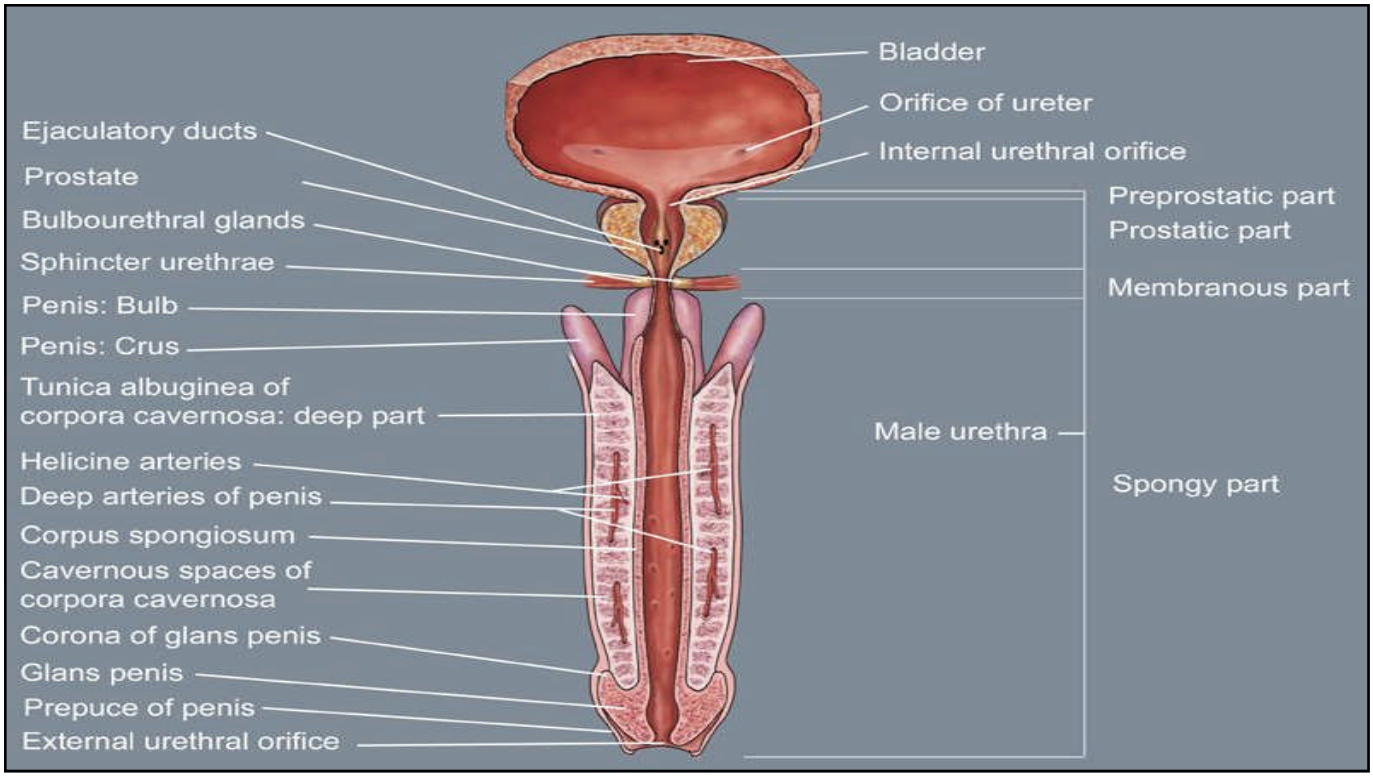




Male urethra conducts both urine and seminal fluid and consists of three parts:

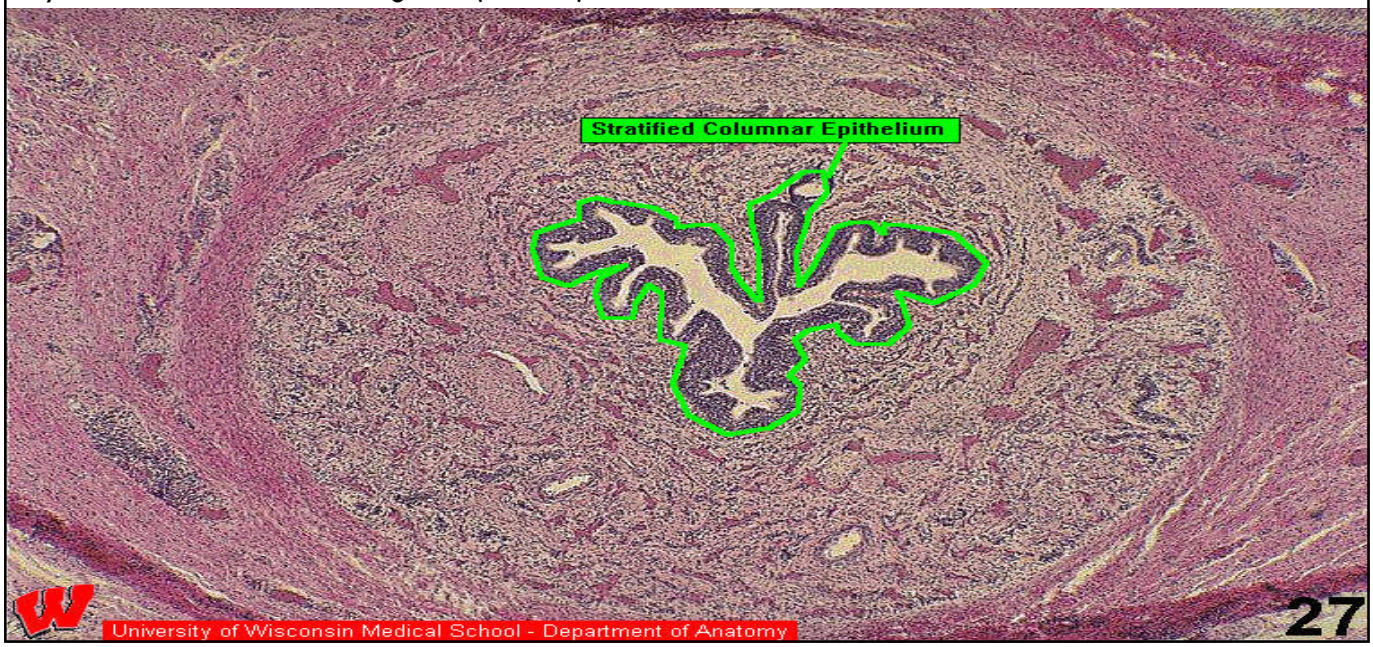
1. **Prostatic**
2. **Membranous**
3. **Spongy (penile, cavernous)**

The external urethral sphincter is a striated muscle that allows voluntary control over urination.



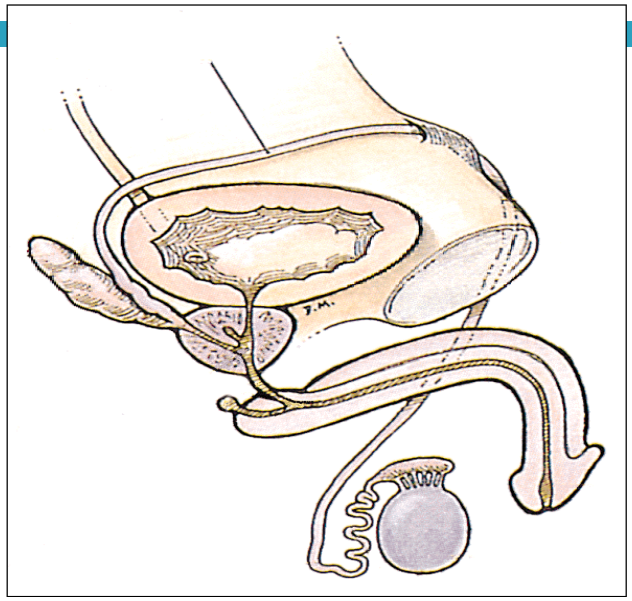
Region	Description	Epithelium
pre-prostatic urethra	This is the intramural part of the urethra and varies between 0.5 and 1.5 cm in length depending on the fullness of the bladder.	Transitional
prostatic urethra	Crosses through the prostate gland. There are several openings: (1) the ejaculatory duct receives sperm from the vas deferens and ejaculate fluid from the seminal vesicle, (2) several prostatic ducts where fluid from the prostate enters and contributes to the ejaculate, (3) the prostatic utricle, which is merely an indentation. These openings are collectively called the verumontanum.	Transitional
membranous urethra	A small (1 or 2 cm) portion passing through the external urethral sphincter. This is the narrowest part of the urethra. It is located in the deep perineal pouch. The bulbourethral glands (Cowper's gland) are found posterior to this region but open in the spongy urethra.	Pseudostratified columnar
spongy urethra (or *penile urethra*)	Runs along the length of the penis on its ventral (underneath) surface. It is about 15–16 cm in length, and travels through the corpus spongiosum. The ducts from the urethral gland (gland of Littre) enter here. The openings of the bulbourethral glands are also found here.Some textbooks will subdivide the spongy urethra into two parts, the bulbous and pendulous urethra.	Pseudostratified columnar – proximally, Stratified squamous – distally

The penile urethra is the Y-shaped structure in the center of the micrograph .It is surrounded by a rich venous plexus called the corpus spongiosum. Outside this layer of blood vessels is a dense CT layer called the tunica albuginea (arrows).



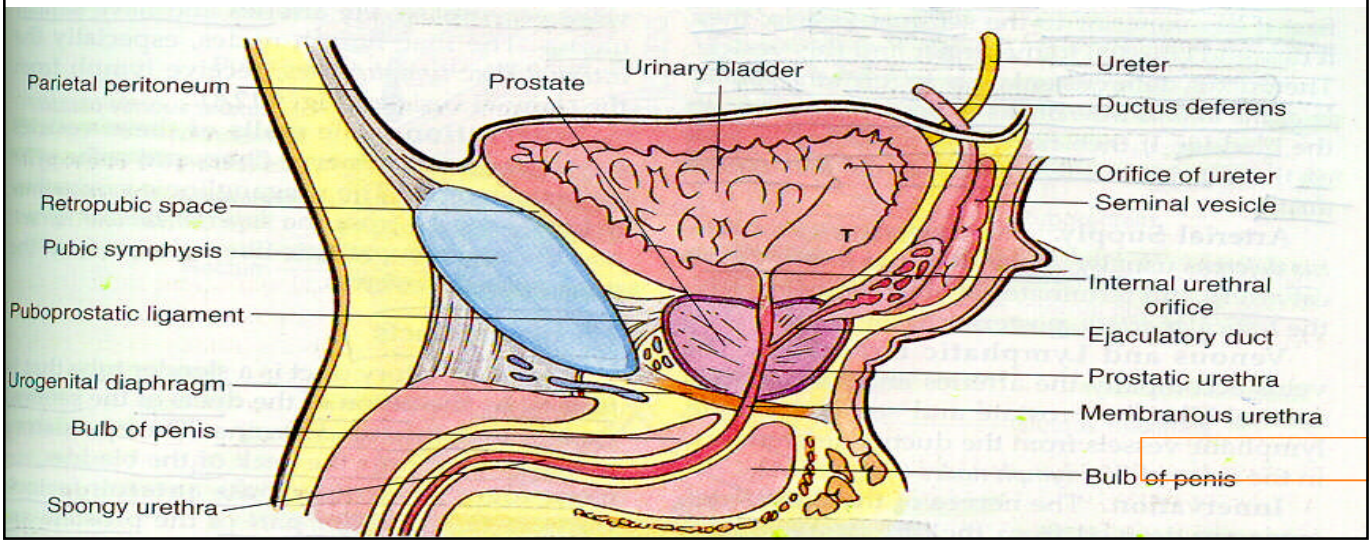
MALE URETHRA: PROSTATIC

- SURROUNDED BY PROSTATE GLAND
- LINED BY TRANSITIONAL EPITHELIUM



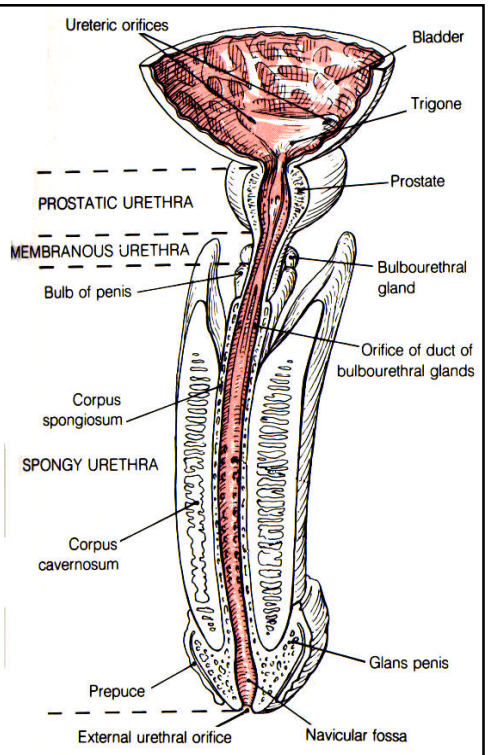
MALE URETHRA: MEMBRANOUS

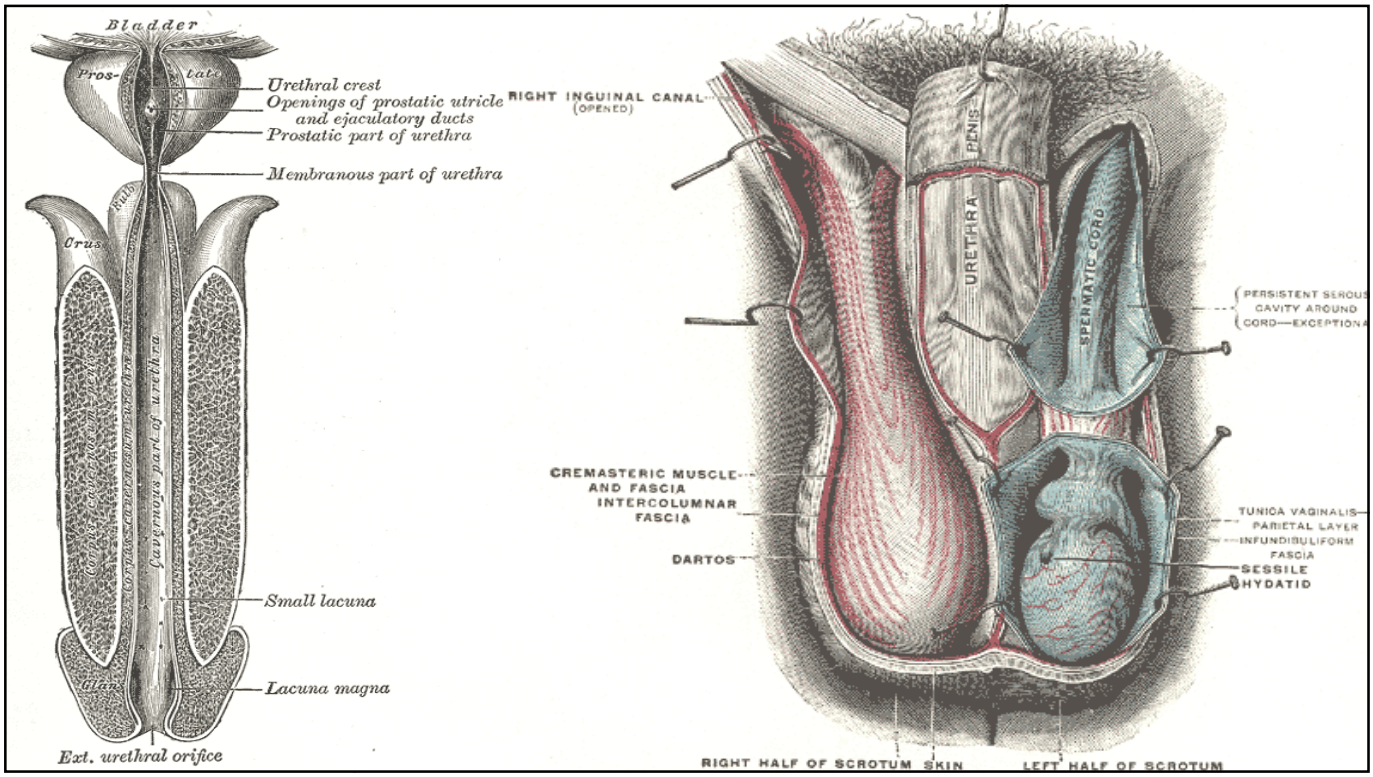
- MEMBRANOUS PART IS SHORTEST SEGMENT
- LINED BY PSEUDOSTRATIFIED COLUMNAR EPITHELIUM

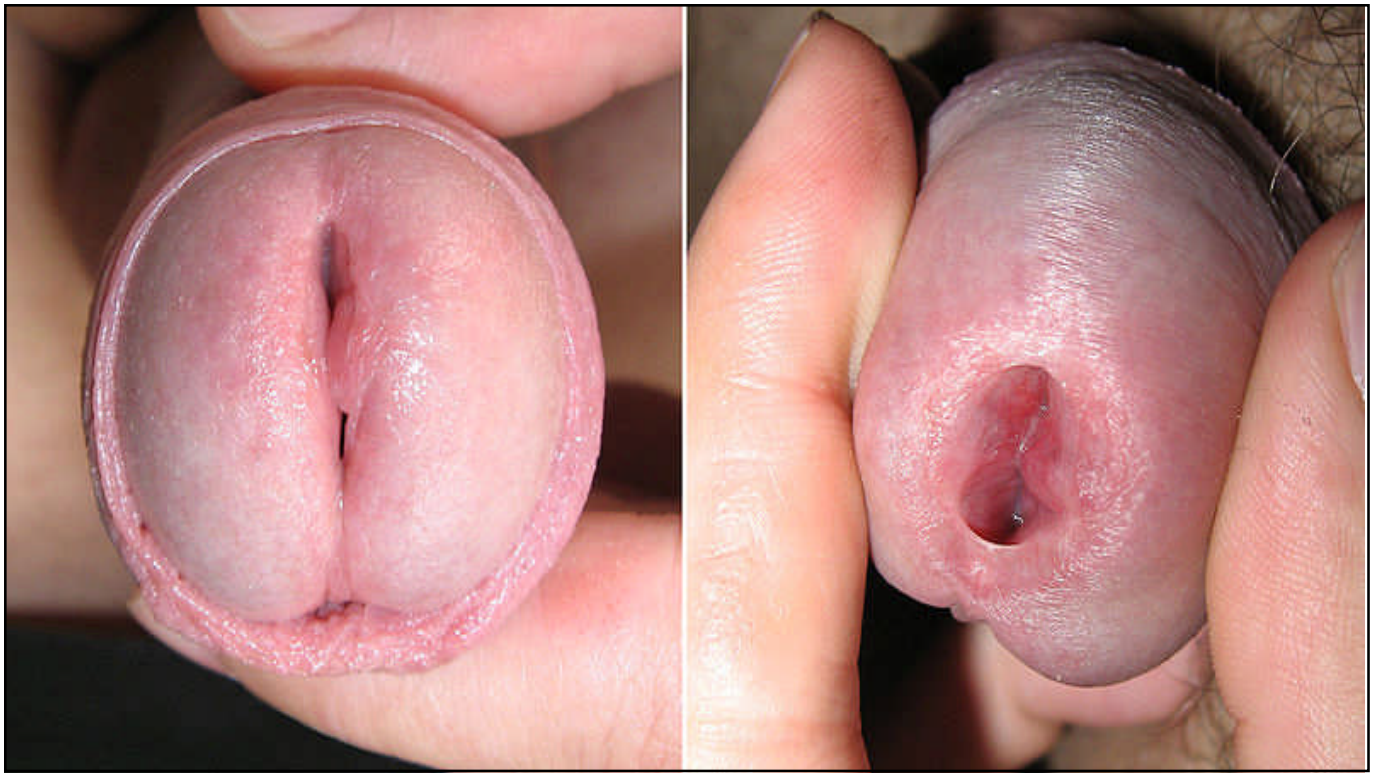


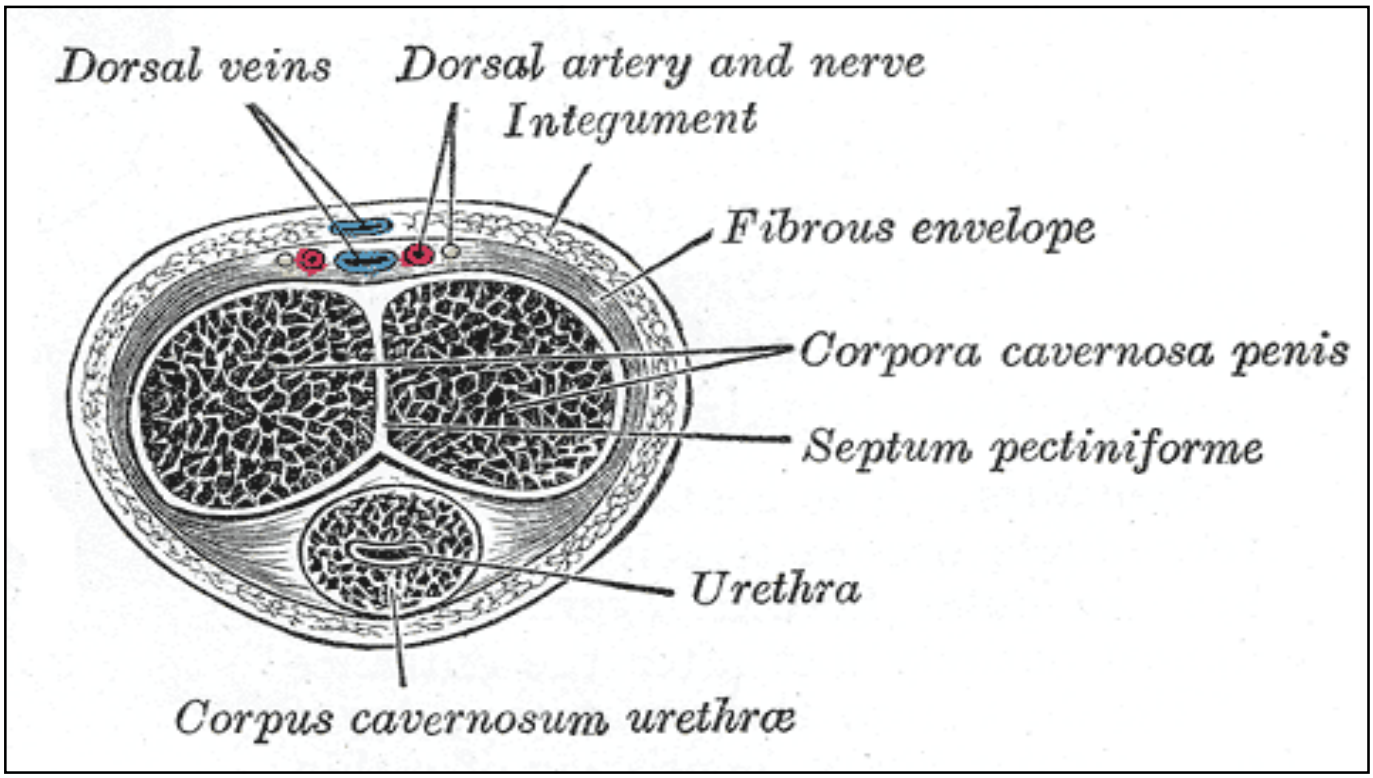
MALE URETHRA: Spongy

- EPITHELIAL LINING CHANGES IN THE GLANS FROM PSEUDOSTRATIFIED COLUMNAR TO STRATIFIED SQUAMOUS
- MUCOUS GLANDS OF LITTRE IN CAVERNOUS PORTION








Dorsal veins
Dorsal artery and nerve
Integument
Fibrous envelope
Corpora cavernosa penis
Septum pectiniforme
Urethra
Corpus cavernosum urethræ

The External Urethral Sphincter

- In both sexes:
  - is a circular band of skeletal muscle
  - where urethra passes through urogenital diaphragm
- Acts as a valve
- Is under voluntary control:
  - via perineal branch of pudendal nerve
- Has resting muscle tone
- Voluntarily relaxation permits micturition

How is urination regulated voluntarily and involuntarily and what is the micturition reflex?

The Micturition Reflex

- Coordinates the process of urination
-
  -
    -
  -
    -
  -
    -
  -

Infants

- Lack voluntary control over urination
- Corticospinal connections are not established

Age-Related Changes in Urinary System

- Decline in number of functional nephrons
- Reduced sensitivity to ADH
- Problems with micturition reflex

3 Micturition Reflex Problems

1. Sphincter muscles lose tone:
   - leading to incontinence
2.
   -
   -
   -
3. urinary retention