Urinary System: ureter, urinary bladder, and male and female urethra

General Histology

Second year

URETERS

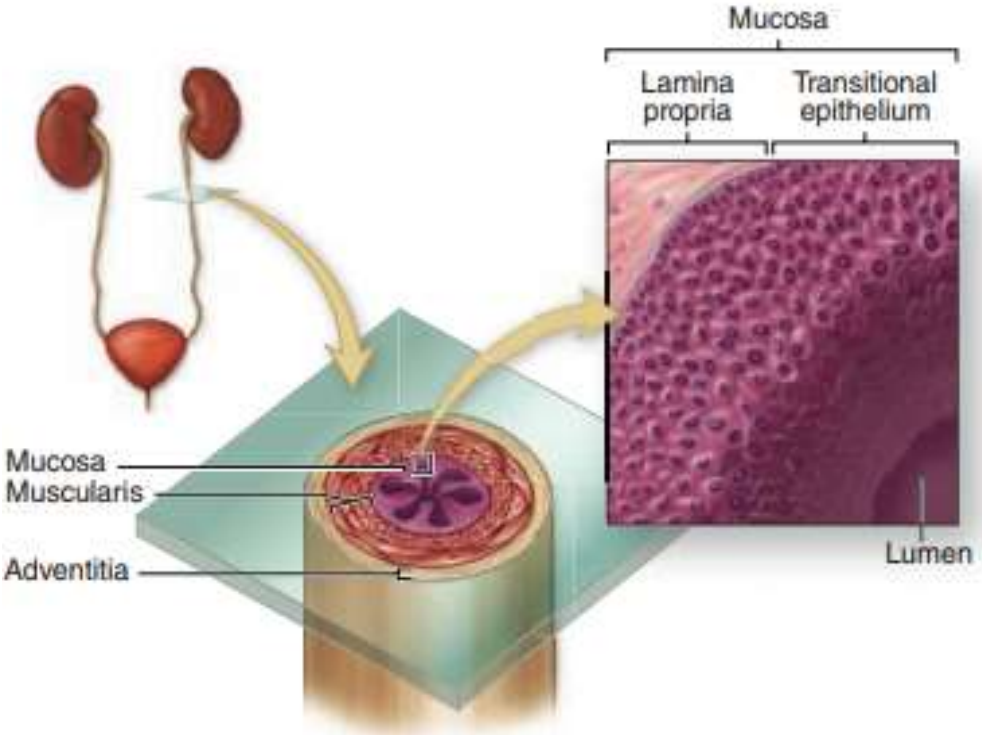
Urine is transported by the ureters from the renal pelvis to the urinary bladder where it is stored until emptying by **micturition** via the **urethra**. The walls of the ureters are similar to that of the calyces and renal pelvis, with **mucosal**, **muscular**, and **adventitial layers** and becoming gradually thicker closer to the bladder. The mucosa of these organs is lined by the uniquely **stratified urothelium** or **transitional epithelium**.

Cells of this epithelium are organized as three layers:

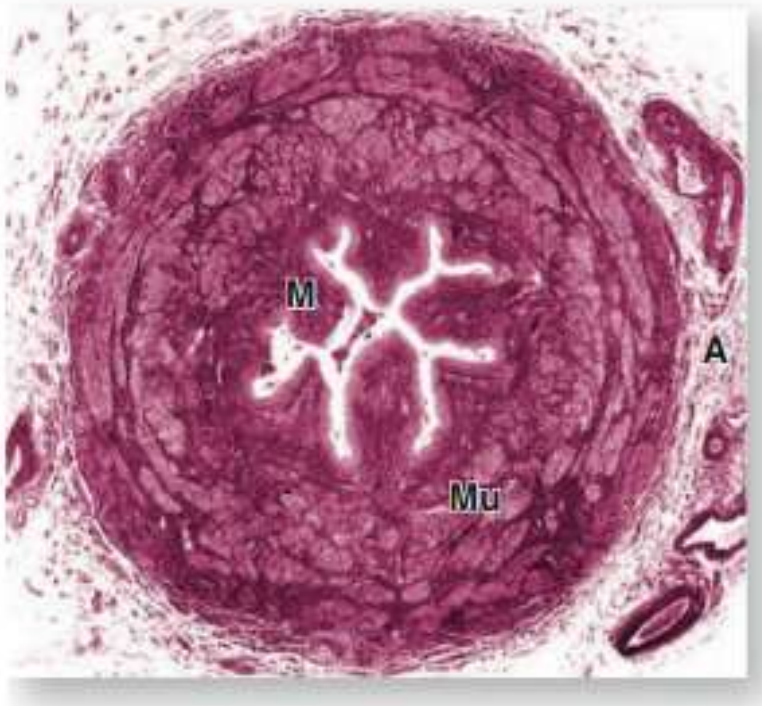
1. A single layer of small **basal cells** resting on a very thin basement membrane;
2. An intermediate region containing from one to several layers of **cuboidal** or low **columnar cells**; and
3. A superficial layer of large bulbous or elliptical **umbrella cells**, sometimes binucleated, which are highly differentiated to protect the underlying cells against the potentially **cytotoxic effects of hypertonic urine.**

The thick muscularis of the ureters moves urine toward the bladder by **peristaltic contractions** and produces prominent mucosal folds when the lumen is empty (Figure 19–16).

FIGURE 19–16 Ureters.



(a) Ureter cross section



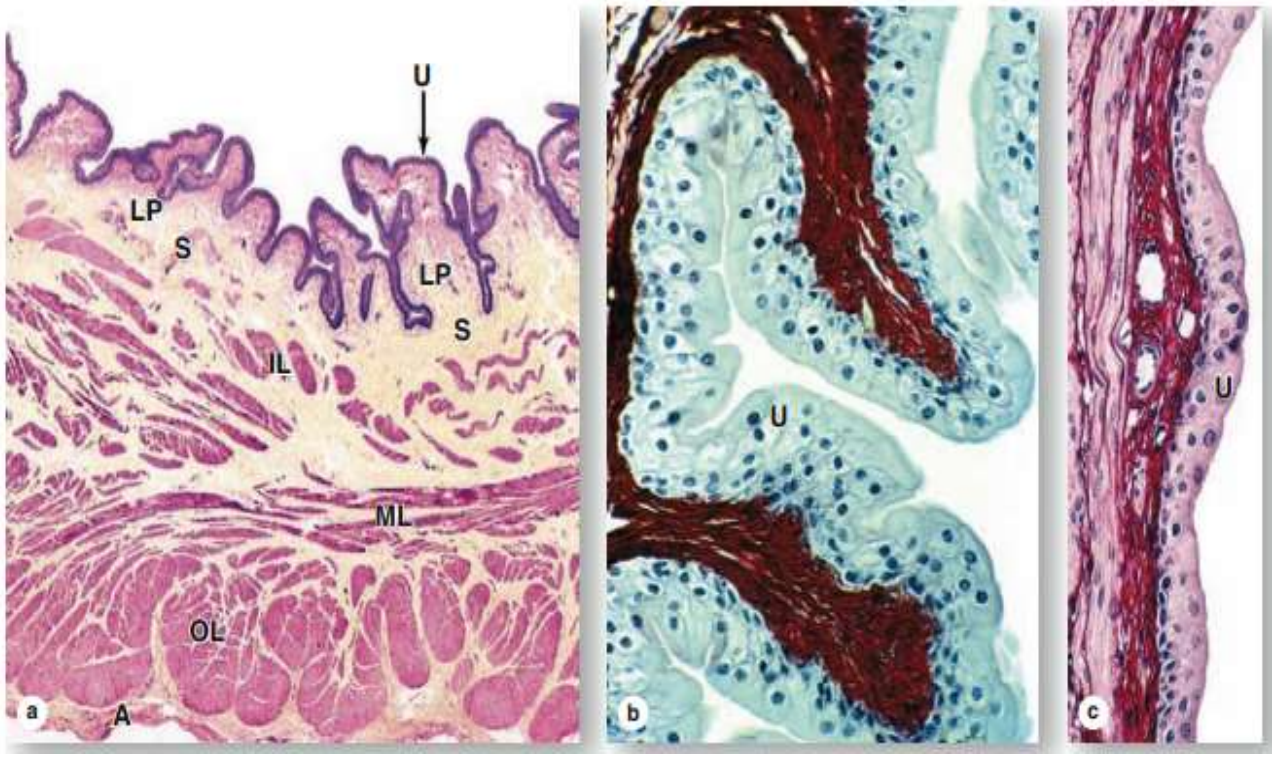
(b)

(a) Diagram of a ureter in cross section shows a characteristic pattern of longitudinally folded mucosa, surrounded by a thick muscularis that moves urine by regular waves of peristalsis. The lamina propria is lined by a unique stratified epithelium called **transitional epithelium** or **urothelium** that is resistant to the potentially deleterious effects of contact with hypertonic urine.

(b) Histologically the muscularis (**Mu**) is much thicker than the mucosa (**M**) and adventitia (**A**). (X18; H&E)

Umbrella cells are especially well developed in the bladder (Figure 19–17) where contact with urine is greatest. **Urothelium** is surrounded by a folded lamina propria and submucosa, followed by a dense sheath of interwoven smooth muscle layers and adventitia (Figures 19–16 and 19–17). **Urine** is moved from the renal pelvises to the bladder by **peristaltic contractions** of the ureters.

FIGURE **19–17** Bladder wall and urothelium.



(a) In the neck of the bladder, near the urethra, the wall shows four layers: the mucosa with urothelium (**U**) and lamina propria (**LP**); the thin submucosa (**S**); inner, middle, and outer layers of smooth muscle (**IL**, **ML**, and **OL**); and the adventitia (**A**). (X15; H&E

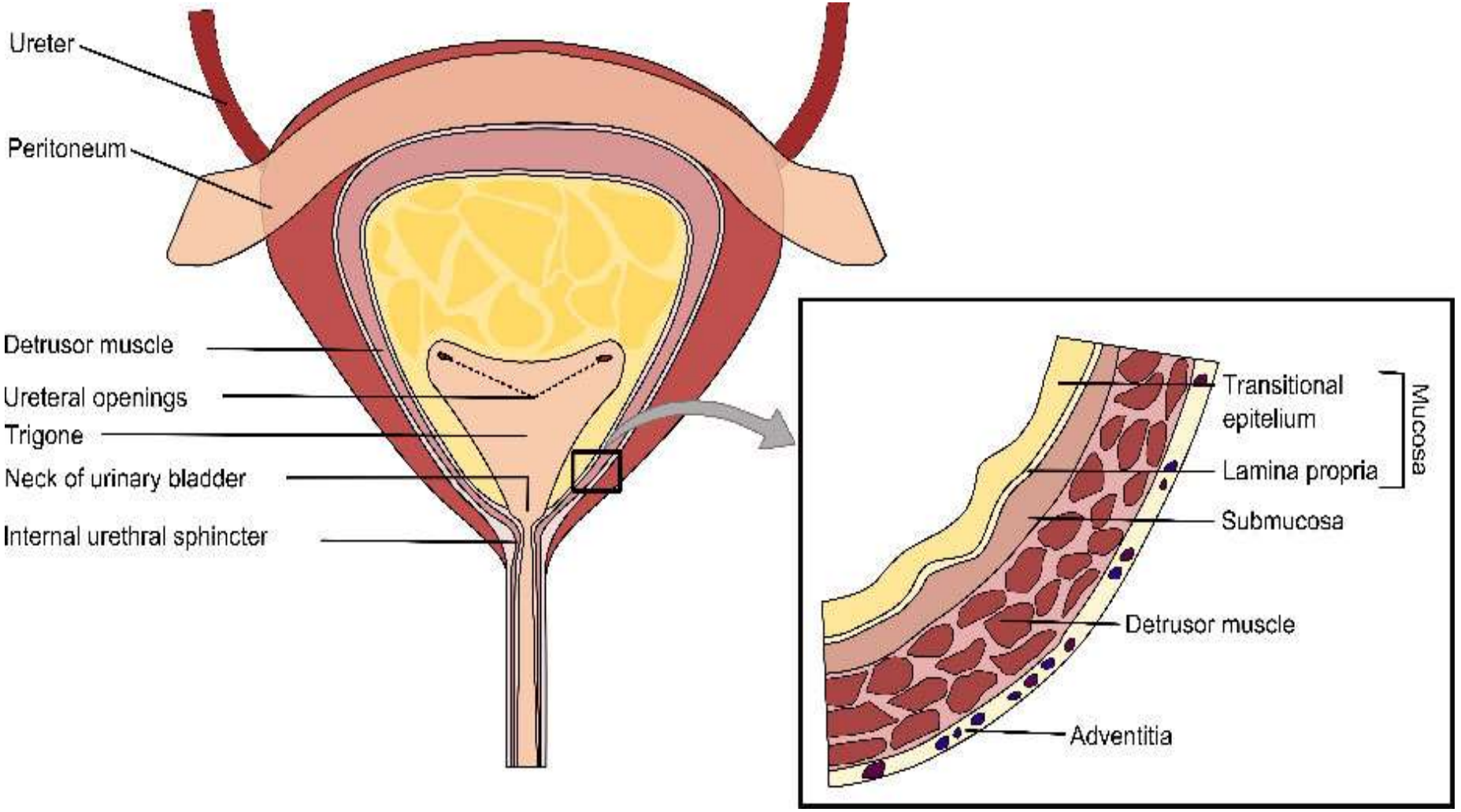
(b) When the bladder is empty, the mucosa is highly folded and the urothelium (**U**) has bulbous umbrella cells. (X250; PSH)

(c) When the bladder is full, the mucosa is pulled smooth, the urothelium (**U**) is thinner, and the umbrella cells are flatter. (X250; H&E)

Urinary Bladder

The bladder's lamina propria and dense irregular connective tissue of the **submucosa** are highly vascularized. The bladder in an average adult can hold 400-600 mL of urine, with the urge to empty appearing at about 150-200 mL. **The muscularis** consists of three poorly delineated layers, collectively called the detrusor muscle, which contract to empty the bladder (Figure 19–17). **Three muscular layers** are seen most distinctly at the neck of the bladder near the urethra (Figure 19–17). The ureters pass through the wall of the bladder obliquely, forming a **valve** that **prevents the backflow of urine into the ureters as the bladder fills**. All the urinary passages are covered externally by **an adventitial layer**, except for the upper part of the bladder that is covered by **serous peritoneum.**

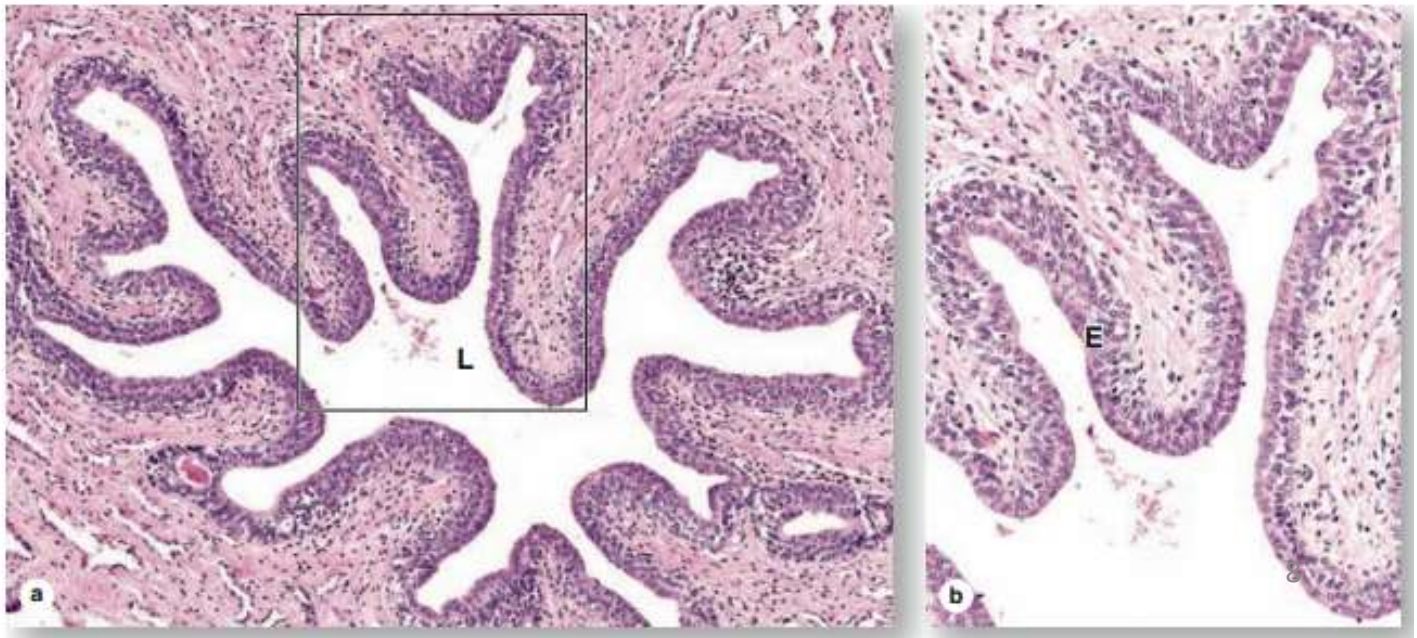
Urinary Bladder



The urethra

The urethra is a tube that carries the urine from the bladder to the exterior (Figure 19–18). **The urethral mucosa** has prominent longitudinal folds, giving it a distinctive appearance in cross section. In men, the two ducts for sperm transport during ejaculation join the urethra at the **prostate gland**.

FIGURE **19–18** Urethra.



The male urethra is longer and consists of three segments:

1. **The prostatic urethra**, 3-4 cm long, extends through the prostate gland and is lined by **urothelium**.
2. **The membranous urethra**, a short segment, passes through an external sphincter of striated muscle and is lined by **stratified columnar** and **pseudostratified columnar epithelium**.
3. **The spongy urethra**, about 15 cm in length, is enclosed within erectile tissue of the penis and is lined by **stratified columnar** and **pseudostratified columnar epithelium** (Figure 19–18), with **stratified squamous epithelium distally**.

- **In women**, the urethra is exclusively a urinary organ. The female urethra is a 3- to 5-cm-long tube, lined initially with **transitional epithelium** which then transitions to **nonkeratinized stratified squamous epithelium**. The middle part of the urethra in both sexes is surrounded by the external striated muscle sphincter.