CHAPTER 5: URINARY SYSTEM

Building a Medical Terminology Foundation 2e by Kimberlee Carter; Marie Rutherford; and Connie Stevens

- 5.1 – Introduction to the Urinary System
- 5.2 – Anatomy (Structures) of the Urinary System
- 5.3 – Physiology (Function) of the Urinary System
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- Vocabulary & Check Your Knowledge
- References

Please visit the web version of *Building a Medical Terminology Foundation 2e* (https://ecampusontario.pressbooks.pub/medicalterminology2/) to access the complete book, interactive activities and ancillary resources.

5.1 - Introduction to the Urinary System

Learning Objectives

- Identify the anatomy and describe the main functions of the urinary system
- Analyze, translate, and define medical terms and common abbreviations of the urinary system
- Practice the spelling and pronunciation of urinary system medical terminology
- Identify the medical specialties associated with the urinary system and explore common diseases, disorders, diagnostic tests and procedures

Urinary System Word Parts

Click on prefixes, combining forms, and suffixes to reveal a list of word parts to memorize for the urinary system.

Urinary System Word Parts
Prefix

- **a-** (absence of, without)
- **an**– (absence of, without)
- **dia-** (through, complete)
- **dys**– (painful, abnormal, difficult, laboured)
- **poly**– (many, much)

Combining Forms

- **albumin/o** (albumin)
- **azot/o** (urea, nitrogen)
- **blast/o** (developing cell, germ cell)
- **cyst/o** (bladder, sac)

- **glomerul/o** (glomerulus)
- **glyc/o** (sugar)
- **glycos/o** (sugar)
- **hydr/o** (water)
- **lith/o** (stone, calculus)
- **meat/o** (meatus)
- **nephr/o** (kidney)
- **noct/i** (night)
- **olig/o** (few, scanty)
- **pyel/o** (renal pelvis)
- **ren/o** (kidney)
- **ureter/o** (ureter)
- **urethr/o** (urethra)
- **urin/o** (urine, urinary tract)
- **ur/o** (urine, urinary tract)
- **vesic/o** (bladder, sac)

Suffix

- –**al** (pertaining to)
- –**ary** (pertaining to)
- –**cele** (hernia, protrusion)
- –**emia** (in the blood)
- –**gram** (the record, radiographic image)
- –**graph** (instrument used to record)
- –**graphy** (process of recording, radiographic imaging)
- –**iasis** (condition)
- –**esis** (condition)
- –**itis** (inflammation)
- –**lith** (stone)
- –**lysis** (loosening, dissolution, separating)
- –**megaly** (enlarged, enlargement)
- –**oma** (tumour, swelling)
- –**osis** (abnormal condition)
- –**ptosis** (drooping, sagging, prolapse)
- –**rrhaphy** (suturing, repairing)
- –**scope** (instrument used for visual examination)
- –**scopic** (pertaining to visual examination)
- –**scopy** (visual examination)
- –**stomy** (creation of an artificial opening)
- –**tomy** (cut into, incision)
- –**tripsy** (surgical crushing)
- –**uria** (urine, urination)

Activity source: Urinary System Word Parts by Kimberlee Carter, from *Building a Medical Terminology Foundation*, licensed under CC BY 4.0./ Text version added.

Introduction to the Urinary System

The urinary system has roles you may be well aware of. Cleansing the blood and ridding the body of wastes probably come to mind. However, there are additional, equally important functions, played by the system. For example, regulation of **pH**, a function shared with the lungs and the buffers in the blood. Additionally, the regulation of blood pressure is a role shared with the heart and blood vessels. What about regulating the concentration of **solutes** in the blood? Did you know that the kidney is important in determining the concentration of red blood cells? Eighty-five percent of the erythropoietin (EPO) produced to stimulate red blood cell production is produced in the kidneys. The kidneys also perform the final synthesis step of vitamin D production, converting calcidiol to calcitriol, the active form of vitamin D. If the kidneys fail, these functions are compromised or lost altogether, with devastating effects on **homeostasis**.

Watch Urinary System, Part 1: Crash Course Anatomy & Physiology #38 (10 min) on YouTube (https://youtu.be/l128tW1H5a8)

Urinary System Medical Terms

Urinary System Medical Terms

1. **albuminuria**
    - albumin/uria
    - albumin in the urine
2. **azotemia**
    - azot/emia
    - urea in the blood
3. **cystectomy**
    - cyst/ectomy

- excision of the bladder

4. **cystolithotomy**
    - cyst/o/lith/o/tomy
    - incision into the bladder to remove stone(s)
5. **cystorrhaphy**
    - cyst/o/rrhaphy
    - suturing the bladder
6. **cystostomy**
    - cyst/o/stomy
    - creation of an artificial opening into the bladder
7. **cystotomy**
    - cyst/o/tomy
    - incision into the bladder
8. **cystogram**
    - cyst/o/gram
    - radiographic image of the bladder
9. **cystography**
    - cyst/o/graphy
    - radiographic imaging of the bladder
10. **cystoscope**
    - cyst/o/scope
    - instrument used for visual examination of the bladder
11. **cystoscopy**
    - cyst/o/scopy
    - visual examination of the bladder
12. **cystitis**
    - cyst/itis
    - inflammation of the bladder
13. **cystocele**
    - cyst/o/cele
    - protrusion of the bladder

14. **cystolith**
    - cyst/o/lith
    - stone(s) in the bladder
15. **glomerulonephritis**
    - glomerul/o/nephr/itis
    - inflammation of the gomeruli of the kidney
16. **glycosuria**
    - glycos/uria
    - sugar (glucose) in the urine
17. **hydronephrosis**
    - hydro/nephr/osis
    - abnormal condition of water in the kidney
18. **lithotripsy**
    - lith/o/tripsy
    - surgical crushing of stone(s)
19. **meatotomy**
    - meat/o/tomy
    - incision into the meatus
20. **meatal**
    - meat/al
    - pertaining to the meatus
21. **nephritis**
    - nephr/itis
    - inflammation of the kidney
22. **nephrolithiasis**
    - nephr/o/lith/iasis
    - condition of stone(s) in the kidney
23. **nephroma**
    - nephr/oma
    - tumour of kidney
24. **nephromegaly**

- nephr/o/megaly
- enlarged kidney

25. **nephroptosis**

    - nephr/o/ptosis
    - drooping kidney

26. **nephrectomy**

    - nephr/ectomy
    - excision of the kidney

27. **nephrolitotomy**

    - nephr/o/lith/o/tomy
    - incision into the kidney to remove stone(s)

28. **nephrolithotripsy**

    - nephr/o/lith/o/tripsy
    - surgical crushing of stone(s) in the kidney

29. **nephrolysis**

    - nephr/o/lysis
    - separating the kidney (from body structures)

30. **nephropexy**

    - nephr/o/pexy
    - surgical fixation of the kidney

31. **nephrostomy**

    - nephr/o/stomy
    - creation of an artificial opening into the kidney

32. **nephrography**

    - nephr/o/graphy
    - radiographic imaging of the kidney

33. **nephroscopy**

    - nephr/o/scopy
    - process of viewing the kidney

34. **nephrosonography**

    - nephr/o/son/o/graphy

- process of recording the kidney using sound

35. **nephrologist**
    - nephr/o/logist
    - specialist who studies and treats disease and disorders of the kidney
36. **nephrology**
    - nephr/o/logy
    - study of the kidney
37. **nocturia**
    - noct/uria
    - night urination
38. **oliguria**
    - olig/uria
    - scanty urine (output)
39. **pyelitis**
    - pyel/itis
    - inflammation of the renal pelvis
40. **pyelonephritis**
    - pyel/o/nephr/itis
    - inflammation of the renal pelvis and the kidney
41. **pyelolithotomy**
    - pyel/o/lith/o/tomy
    - incision into the renal pelvis
42. **pyeloplasty**
    - pyel/o/plasty
    - surgical repair of the renal pelvis
43. **renogram**
    - ren/o/gram
    - radiogrphaic record of the kidney
44. **ureteritis**
    - ureter/itis
    - inflammation of the ureter

45. **ureterectomy**
    - ureter/ectomy
    - excision of the ureter
46. **ureterostomy**
    - ureter/o/stomy
    - creation of an artificial opening into the ureter
47. **ureterocele**
    - ureter/o/cele
    - protrusion of a ureter
48. **ureterolithiasis**
    - ureter/o/lith/iasis
    - condition of stone(s) in the ureter
49. **ureterostenosis**
    - ureter/o/stenosis
    - narrowing of the ureter
50. **ureteroscopy**
    - ureter/o/scopy
    - visual examination of the ureter(s)
51. **urethrocystitis**
    - urethr/o/cyst/itis
    - inflammation of the urethra and the bladder
52. **anuria**
    - an/uria
    - absence of urine
53. **diuresis**
    - di/ur/esis
    - condition of urine passing through (increased excretion of urine)
54. **dysuria**
    - dys/uria
    - difficult or painful urine

55. **urinary**
    - urin/ary
    - pertaining to urine
56. **retrograde urogram**
    - retrograde ur/o/gram
    - radiographic image of the urinary tract
57. **ureteroscopy**
    - ureter/o/scopy
    - visual examination of the ureter(s)
58. **urogram**
    - ur/o/gram
    - radiographic image of the urinary tract
59. **hematuria**
    - hemat/uria
    - blood in the urine
60. **polyuria**
    - poly/uria
    - excessive urine
61. **pyuria**
    - py/uria
    - pus in the urine
62. **urinary**
    - urin/ary
    - pertaining to urine
63. **urologist**
    - ur/o/logist
    - physician who studies and treats diseases of the urinary tract
64. **urology**
    - ur/o/logy
    - study of the urinary tract
65. **vesicotomy**

- vesic/o/tomy
- inciscion into the bladder

Activity Source: Urinary System Medical Terms by Kimberlee Carter, from *Building a Medical Terminology Foundation*, licensed under CC BY 4.0./ Text version added.

Attribution

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5.2 - Anatomy (Structures) of the Urinary System

Kidney(s)

The kidneys lie on either side of the spine in the retroperitoneal space between the parietal peritoneum and the posterior abdominal wall, well protected by muscle, fat, and ribs. They are roughly the size of your fist. The male kidney is typically a bit larger than the female kidney. The kidneys are well vascularized, receiving about twenty-five percent of the cardiac output at rest. Figure 5.1 displays the location of the kidneys.

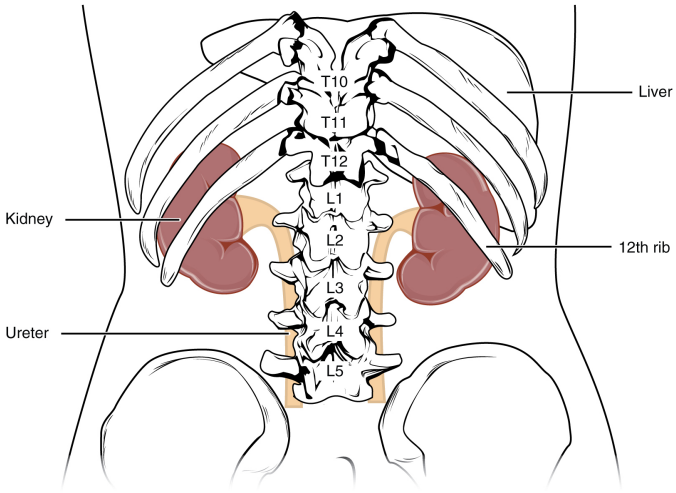


Figure 5.1 Kidneys. The kidneys are slightly protected by the ribs and are surrounded by fat for protection (not shown). From Betts, et al., 2013. Licensed under CC BY 4.0.

Did You Know?

The right kidney is smaller than the left. It also sits slightly lower to make room for the liver located on the right side of your body.

Kidneys' Internal Structure

A frontal section through the kidney reveals an outer region called the renal cortex and an inner region called the **medulla** (see Figure 5.2). The **renal columns** are connective tissue extensions that radiate downward from the cortex through the medulla to separate the most characteristic features of the medulla, the **renal pyramids** and **renal papillae**. The papillae are bundles of collecting ducts that transport urine made by nephrons to the **calyces** of the kidney for **excretion**. The renal columns also serve to divide the kidney into 6–8 lobes and provide a supportive framework for vessels that enter and exit the cortex. The pyramids and renal columns taken together constitute the kidney lobes.

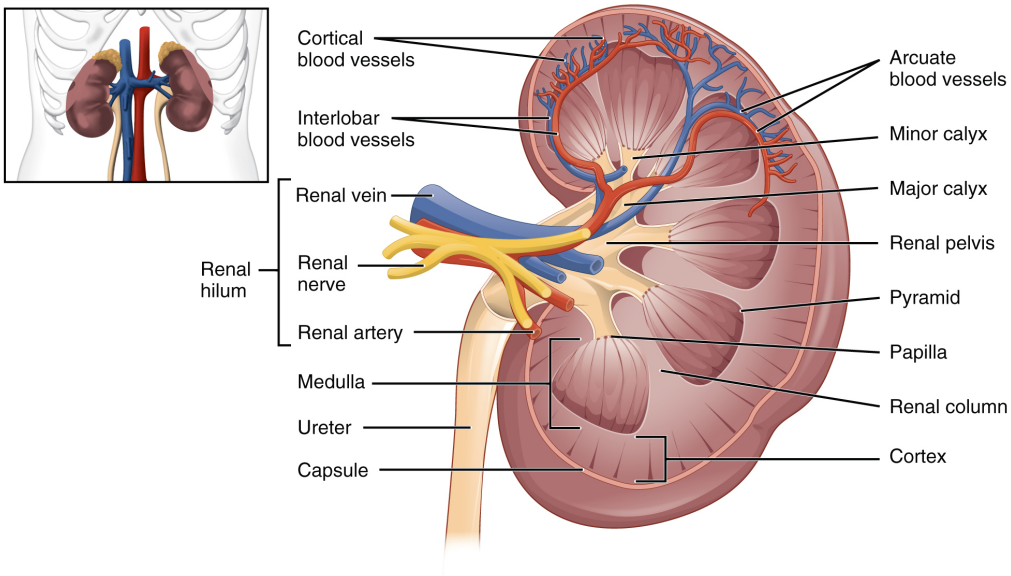


Figure 5.2 Left Kidney. From Betts, et al., 2013. Licensed under CC BY 4.0. [Fig. 5.2 Image description.]

Renal Hilum

The **renal hilum** is the entry and exit site for structures servicing the kidneys: vessels, nerves, lymphatics, and ureters. The medial-facing hila are tucked into the sweeping convex outline of the cortex. Emerging from the hilum is the renal pelvis, which is formed from the major and minor **calyxes** in the kidney. The smooth muscle in the renal pelvis funnels urine via **peristalsis** into the ureter. The renal arteries form directly from the descending aorta, whereas the renal veins return cleansed blood directly to the inferior vena cava. The artery, vein, and renal pelvis are arranged in an anterior-to-posterior order.

Nephrons and Vessels

The renal artery first divides into segmental arteries, followed by further branching to form interlobar arteries that pass through the renal columns to reach the cortex (see Figure 5.3). The **interlobar** arteries branch into

arcuate arteries, cortical **radiate** arteries, and then into afferent arterioles. The afferent arterioles service about 1.3 million nephrons in each kidney.

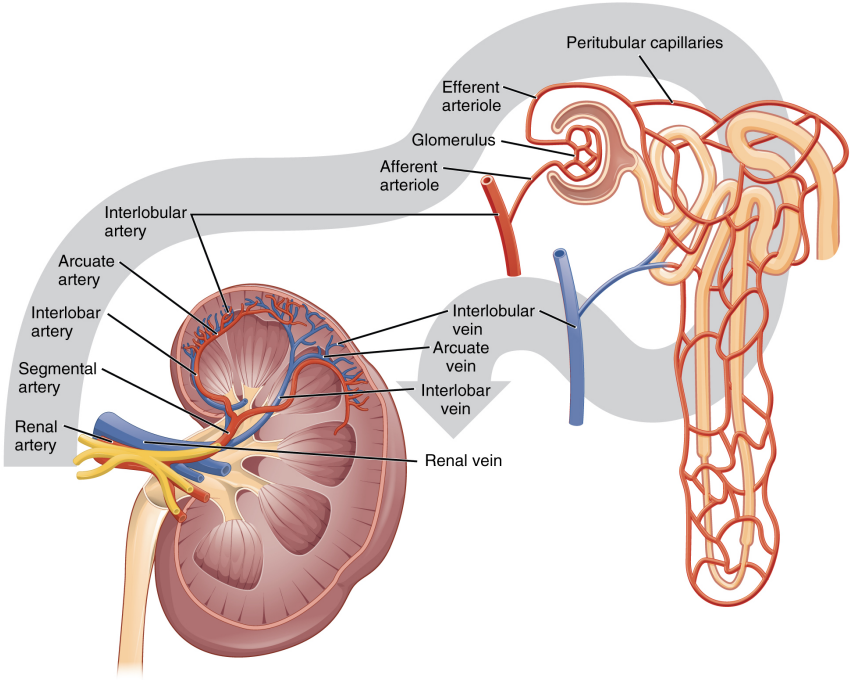


Figure 5.3 Blood Flow in the Kidney. From Betts, et al., 2013. Licensed under CC BY 4.0.
[Fig 5.3 Image Description]

Nephrons are the "functional units" of the kidney; they cleanse the blood and balance the constituents of the circulation. The afferent arterioles form a tuft of high-pressure capillaries about 200 μm in diameter, the **glomerulus**. The rest of the nephron consists of a continuous sophisticated tubule whose proximal end surrounds the glomerulus—this is **Bowman's capsule**. Together, the glomerulus and Bowman's capsule form the **renal corpuscle**. As mentioned earlier, these glomerular capillaries filter the blood based on particle size. After passing through the renal corpuscle, the capillaries form a second arteriole, the **efferent arteriole** (see Figure 5.4). These will next form a capillary network around the more distal portions of the nephron tubule, the **peritubular capillaries** and **vasa recta**, before returning to the venous system. As the glomerular filtrate progresses through the nephron, these capillary networks recover most of the solutes and water, and return them to the circulation. Since a capillary bed (the glomerulus) drains into a vessel that in turn forms a second capillary bed, the definition of a portal system is met. This is the only portal system in which an arteriole is found between the first and second capillary beds. Portal systems also link the hypothalamus to the anterior pituitary, and the blood vessels of the digestive viscera to the liver.

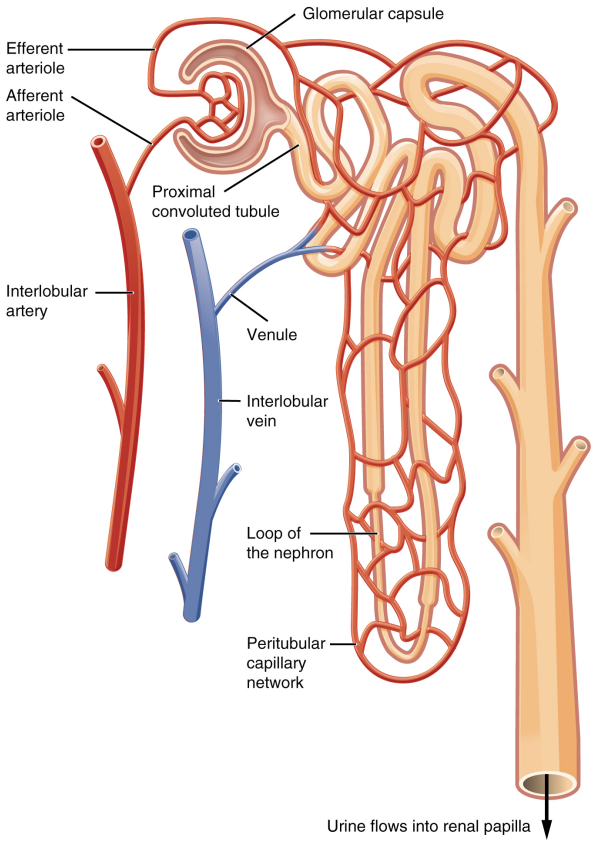


Figure 5.4. Blood Flow in the Nephron. The two capillary beds are clearly shown in this figure. The efferent arteriole is the connecting vessel between the glomerulus and the peritubular capillaries and vasa recta. From Betts, et al., 2013. Licensed under CC BY 4.0.

Ureter(s)

The kidneys and ureters are completely **retroperitoneal**, and the bladder has a **peritoneal** covering only over the dome. As urine is formed, it drains into the **calyces** of the kidney, which merge to form the funnel-shaped renal pelvis in the hilum of each kidney. The hilum narrows to become the **ureter** of each kidney. As urine passes through the ureter, it does not passively drain into the bladder but rather is propelled by waves of **peristalsis**. The ureters are approximately 30 cm long. The inner mucosa is lined with transitional epithelium and scattered **goblet** cells that secrete protective mucus. The muscular layer of the ureter consists of longitudinal and circular smooth muscles that create the peristaltic contractions to move the urine into the bladder without the aid of gravity. Finally, a loose **adventitial** layer composed of **collagen** and fat anchors the ureters between the parietal peritoneum and the posterior abdominal wall.

Bladder

The urinary bladder collects urine from both ureters (see Figure 5.5). The bladder lies anterior to the uterus in females, posterior to the pubic bone and anterior to the rectum. During late pregnancy, its capacity is reduced due to compression by the enlarging uterus, resulting in increased frequency of urination. In males, the anatomy is similar, minus the uterus, and with the addition of the prostate inferior to the bladder. The bladder is partially retroperitoneal (outside the peritoneal cavity) with its peritoneal-covered "dome" projecting into the abdomen when the bladder is distended with urine.

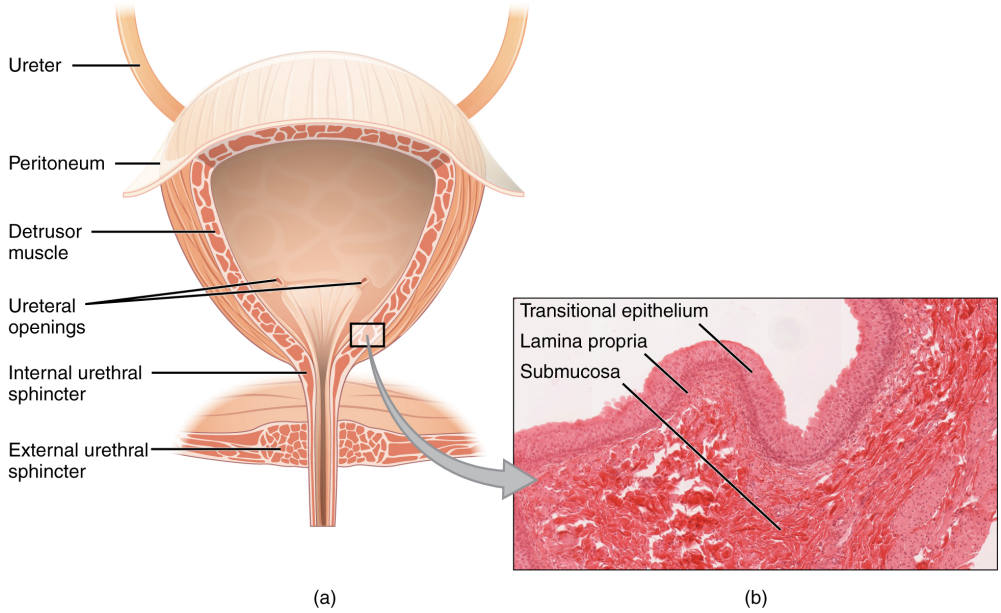


Figure 5.5 Bladder. (a) Anterior cross section of the bladder. (b) The detrusor muscle of the bladder (source: monkey tissue) LM × 448. (Micrograph provided by the Regents of the University of Michigan Medical School © 2012). From Betts, et al., 2013. Licensed under CC BY 4.0.

Urethra

The urethra transports urine from the bladder to the outside of the body for disposal. The urethra is the only urologic organ that shows any significant anatomic difference between males and females; all other urine transport structures are identical (see Figure 5.6).

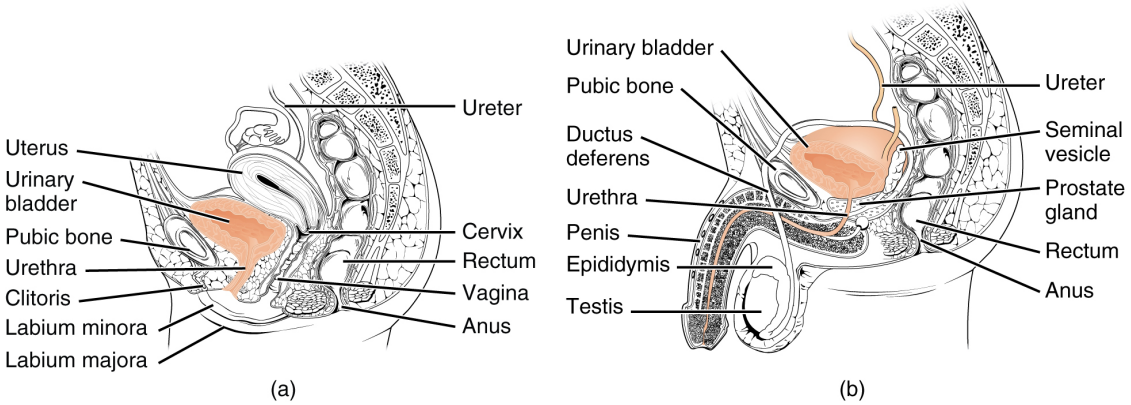


Figure 5.6. Female and Male Urethras. The urethra transports urine from the bladder to the outside of the body. This image shows (a) a female urethra and (b) a male urethra. From Betts, et al., 2013. Licensed under CC BY 4.0.

The urethra in both males and females begins inferior and central to the two ureteral openings forming the three points of a triangular-shaped area at the base of the bladder called the trigone (Greek tri- = "triangle" and the root of the word "trigonometry"). The urethra tracks posterior and inferior to the pubic symphysis (see Figure 5.6). In both males and females, the proximal urethra is lined by transitional epithelium, whereas the terminal portion is a nonkeratinized, stratified squamous epithelium. In the male, **pseudostratified** columnar epithelium lines the urethra between these two cell types. **Voiding** is regulated by an involuntary **autonomic** nervous system-controlled internal urinary sphincter, consisting of smooth muscle and voluntary skeletal muscle that forms the external urinary sphincter below it.

Micturition Reflex

Micturition is a less-often used, but proper term for **urination** or **voiding**. It results from an interplay of involuntary and voluntary actions by the internal and external urethral sphincters. When bladder volume reaches about 150 mL, an urge to void is sensed but is easily overridden. Voluntary control of urination relies on consciously preventing relaxation of the external urethral sphincter to maintain urinary continence. As the bladder fills, subsequent urges become harder to ignore. Ultimately, voluntary constraint fails with resulting incontinence, which will occur as bladder volume approaches 300 to 400 ml.

- Normal micturition is a result of stretch **receptors** in the bladder wall that transmit nerve impulses to the sacral region of the spinal cord to generate a spinal reflex. The resulting parasympathetic neural outflow causes contraction of the **detrusor** muscle and relaxation of the involuntary internal urethral sphincter.
- At the same time, the spinal cord inhibits somatic motor neurons, resulting in the relaxation of the skeletal muscle of the external urethral **sphincter**.
- The micturition reflex is active in infants but with maturity, children learn to override the reflex by asserting external sphincter control, thereby delaying voiding (potty training). This reflex may be preserved even in the face of spinal cord injury that results in paraplegia or quadriplegia. However, relaxation of the external sphincter may not be possible in all cases, and therefore, periodic catheterization may be necessary for bladder emptying.

Nerves involved in the control of urination include the hypogastric, pelvic, and pudendal. Voluntary micturition requires an intact spinal cord and functional pudendal nerve arising from the sacral micturition center. Since the external urinary sphincter is voluntary skeletal muscle, actions by cholinergic neurons maintain contraction (and thereby continence) during filling of the bladder. At the same time, sympathetic nervous activity via the hypogastric nerves suppresses contraction of the detrusor muscle. With further bladder stretch, afferent signals traveling over sacral pelvic nerves activate parasympathetic neurons. This activates efferent neurons to release acetylcholine at the neuromuscular junctions, producing detrusor contraction and bladder emptying.

Did You Know?

A healthy adult bladder can store up to 455 millilitres of urine for between two to five hours.

Check Your Knowledge of Urinary Systems

Concept Check

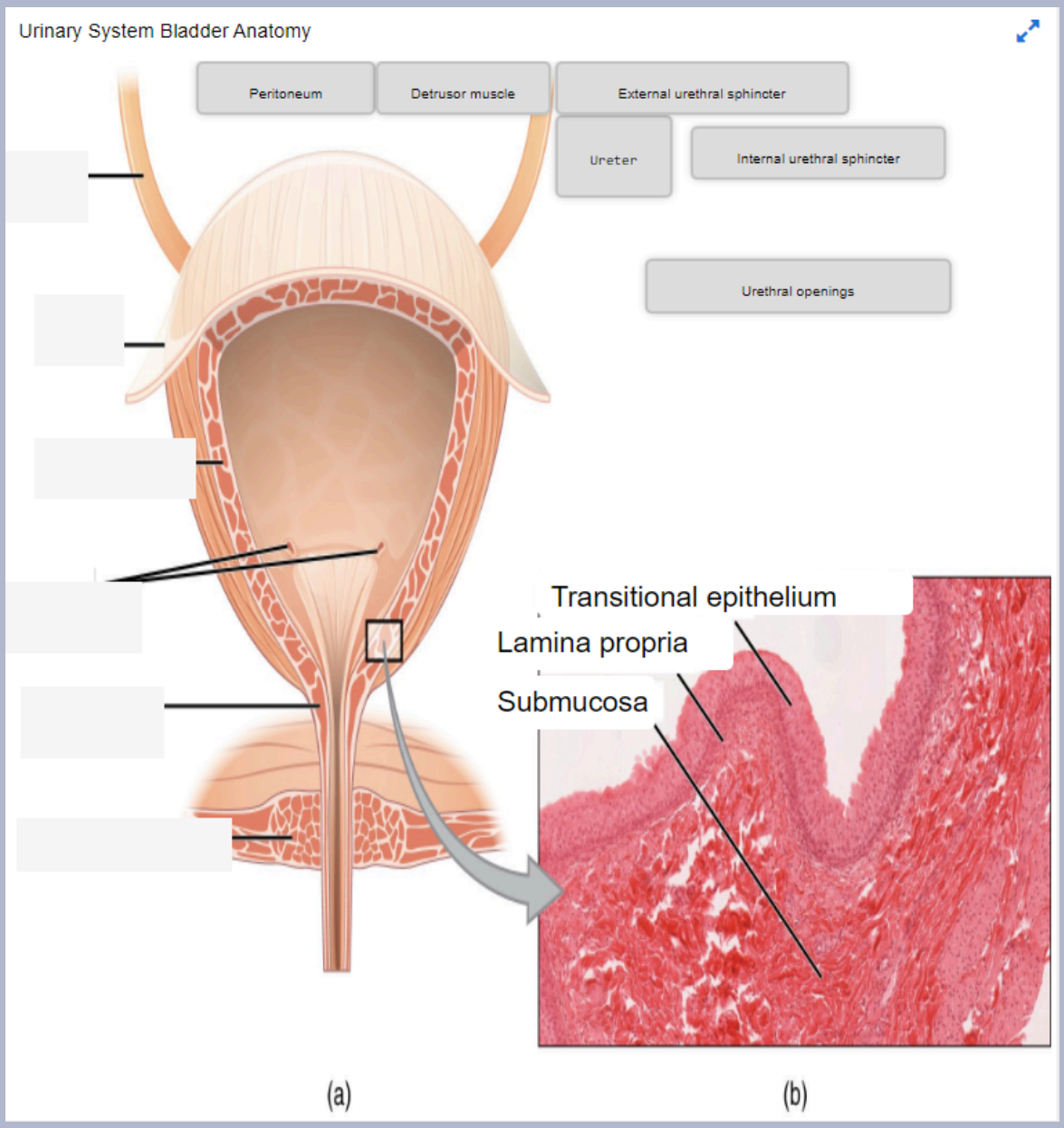
- Describe **two** organs or **structures** essential to the urinary system.
- Identify the **structure** within the kidneys which filters blood.
- Name a commonly used term for the **micturition reflex.**

Anatomy Labeling Activity

Urinary System Bladder Anatomy (Text Version)

Label the diagram correctly with the following words:

1. Peritoneum
2. Detrusor muscle
3. External urethral sphincter
4. Ureter
5. Internal urethral sphincter
6. Ureteral opening



Urinary System Bladder Anatomy Diagram (Text Version)

This figure shows the cross section of the bladder, and the major parts are identified from top to bottom. The tube leading to the bladder is known as the _____[Blank 1]. Surrounding the bladder is a membranous cover called the _____[Blank 2]. The walls of the bladder are formed by _____[Blank 3], which allows the bladder to contract to excrete urine or relax to hold urine The right panel shows a micrograph of the bladder. The _____[Blank 4] are found inside the bladder wall allowing for the ureters to enter and deposit urine formed from the kidneys. In the lower portion of the bladder is two sphincter muscles the internal one is the _____[Blank 5] and the _____[Blank 6]. These sphincter muscles open and close controlling the flow of urine out of the bladder and into the urethra to be carried to the outside of the body.

Check your answers: [1]

Activity source: Urinary System Bladder Anatomy by Kimberlee Carter, from *Building a Medical Terminology Foundation*, illustration from *Anatomy and Physiology (OpenStax)*, licensed under CC BY 4.0./ Text version added.

Image Descriptions

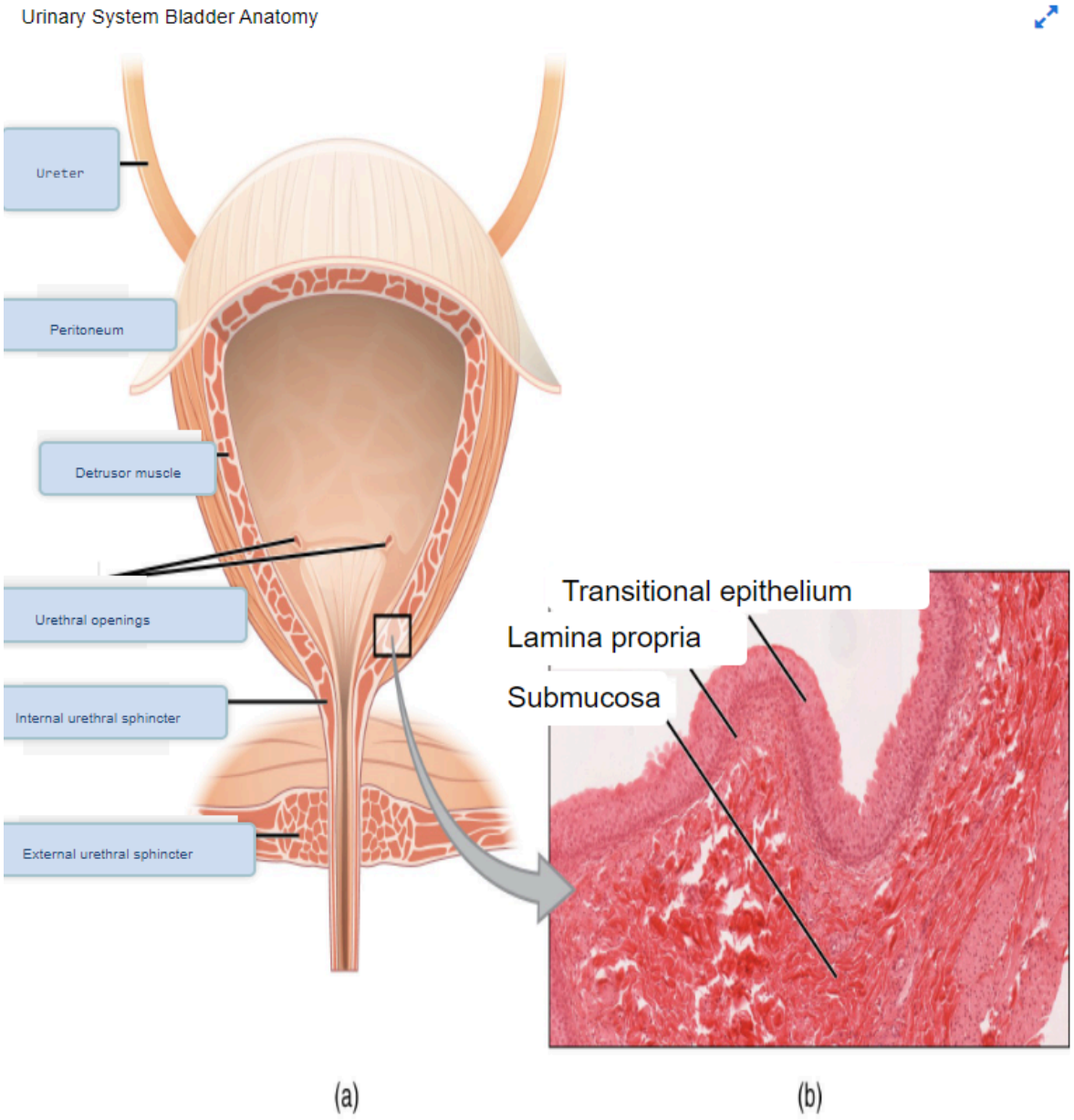
Figure 5.1 image description: This illustration shows an anterior view of the abdominal area. The liver is prominently positioned in the upper right quadrant, partially overlapping the right kidney. The 12th rib is visible, arching above the upper portion of the kidneys. The ureters are shown descending from the kidneys, running vertically down towards the bladder [Return to image 5.1]

Figure 5.2 image description: This illustration shows a frontal section through a kidney. Working clockwise from the top of the image is the arcuate blood vessels. The minor and major calyx is shown followed by the renal pelvis, pyramid, and papilla. The renal column is connective tissue radiating downward towards the renal cortex. The capsule is a tough outer layer surrounding the kidney. The ureter extends from the kidney towards the bladder. The medulla is the inner component of the kidney. The hilum is a small opening structure, allowing for the renal artery, renal nerve and renal artery to enter and exit the kidney. Above the renal vein is the interlobar blood vessels followed by the cortical blood vessels [Return to Figure 5.2].

Figure 5.3 image description: The illustration is an anatomical view of the human kidney and its blood supply system. Displayed is the internal structure of the kidney, including the renal artery, interlobar artery, arcuate artery, interlobular artery, and afferent arterioles leading to the glomerulus. The glomerulus is connected to efferent arterioles, which lead to peritubular capillaries. The illustration also depicts the flow of blood from these vessels into the renal vein.[Return to Figure 5.3].

Attribution

Notes



1. **Check your Answer: Urinary System Bladder Anatomy Diagram (Text Version)**This figure shows the cross section of the bladder, and the major parts are identified from top to bottom. The tube leading to the bladder is known as the **ureter.** Surrounding the bladder is a membranous cover called the **peritoneum**. The walls of the bladder are formed by **detrusor muscle**, which allows the bladder to contract to excrete urine or relax to hold urine The right panel shows a micrograph of the bladder. The **ureteral openings** are found inside the bladder wall allowing for the ureters to enter and deposit urine formed from the kidneys. In the lower portion of the bladder is two sphincter muscles the internal one is the **internal urethral sphincter** and the **external urethral sphincter**. These sphincter muscles open and close controlling the flow of urine out of the bladder and into the urethra to be carried to the outside of the body.

5.3 - Physiology (Function) of the Urinary System

- Remove waste products and medicines from the body.
- Balance the body's fluids.
- Balance a variety of electrolytes.
- Release hormones to control blood pressure.
- Release a hormone to control red blood cell production.
- Help with bone health by controlling calcium and phosphorus.

Having reviewed the anatomy of the urinary system, now is the time to focus on physiology. You will discover that different parts of the **nephron** utilize specific processes to produce urine: **filtration**, **reabsorption**, and **secretion**. You will learn how each of these processes works and where they occur along the nephron and collecting ducts. The physiologic goal is to modify the composition of the plasma and, in doing so, produce the waste product: urine.

Nephrons: The Functional Unit

Nephrons take a simple filtrate of the blood and modify it into urine. Many changes take place in the different parts of the nephron before urine is created for disposal. The term "forming urine" will be used hereafter to describe the **filtrate** as it is modified into true urine. The principal task of the nephron population is to balance the **plasma** to homeostatic set points and excrete potential toxins in the urine. They do this by accomplishing three principle functions—filtration, reabsorption, and secretion. They also have additional secondary functions that exert control in three areas: blood pressure (via the production of renin), red blood cell production (via the hormone EPO), and calcium absorption (via the conversion of calcidiol into calcitriol, the active form of vitamin D).

Loop of Henle

The descending and ascending portions of the loop of Henle (sometimes referred to as the **nephron** loop) are, of course, just continuations of the same tubule. They run adjacent and parallel to each other after having made a hairpin turn at the deepest point of their descent. The descending loop of Henle consists of an initial short, thick portion and long, thin portion, whereas the ascending loop consists of an initial short, thin portion followed by a long, thick portion. The descending and ascending thin portions consist of simple squamous epithelium. Different portions of the loop have different **permeabilities** for solutes and water.

Collecting Ducts

The collecting ducts are continuous with the nephron but are not technically part of it. In fact, each duct collects

filtrate from several nephrons for final modification. Collecting ducts merge as they descend deeper in the medulla to form about 30 terminal ducts, which empty at a papilla.

Glomerular Filtration Rate (GFR)

The volume of filtrate formed by both kidneys per minute is termed the **glomerular filtration rate** (GFR). The heart pumps about 5 L of blood per minute under resting conditions. Approximately 20 percent or one litre enters the kidneys to be filtered. On average, this litre results in the production of about 125 mL/minute filtrate produced in men (range of 90 to 140 mL/minute) and 105 mL/minute filtrate produced in women (range of 80 to 125 mL/minute). This amount equates to a volume of about 180 L/day in men and 150 L/day in women. Ninety-nine percent of this filtrate is returned to the circulation by reabsorption so that only about 1–2 litres of urine are produced per day.

GFR is influenced by the hydrostatic pressure and colloid osmotic pressure on either side of the capillary membrane of the glomerulus. Recall that filtration occurs as pressure forces fluid and solutes through a **semipermeable** barrier with the solute movement constrained by particle size. **Hydrostatic** pressure is the pressure produced by a fluid against a surface. If you have fluid on both sides of a barrier, both fluids exert pressure in opposing directions. The net fluid movement will be in the direction of the lower pressure. **Osmosis** is the movement of solvent (water) across a membrane that is **impermeable** to a solute in the solution. This creates osmotic pressure which will exist until the solute concentration is the same on both sides of a semipermeable membrane. As long as the concentration differs, water will move. Glomerular filtration occurs when glomerular hydrostatic pressure exceeds the luminal **hydrostatic** pressure of Bowman's capsule. There is also an opposing force, the osmotic pressure, which is typically higher in the glomerular capillary. To understand why this is so, look more closely at the microenvironment on either side of the filtration membrane.

You will find osmotic pressure exerted by the solutes inside the lumen of the capillary as well as inside of Bowman's capsule. Since the filtration membrane limits the size of particles crossing the membrane, the osmotic pressure inside the glomerular **capillary** is higher than the osmotic pressure in Bowman's capsule. Recall that cells and the medium-to-large proteins cannot pass between the podocyte processes or through the fenestrations of the capillary endothelial cells. This means that red and white blood cells, platelets, **albumins**, and other proteins too large to pass through the filter remain in the capillary, creating an average **colloid** osmotic pressure of 30 mm Hg within the capillary. The absence of proteins in Bowman's space (the lumen within Bowman's capsule) results in an osmotic pressure near zero. Thus, the only pressure moving fluid across the capillary wall into the lumen of Bowman's space is hydrostatic pressure. Hydrostatic (fluid) pressure is sufficient to push water through the membrane despite the osmotic pressure working against it. The sum of all of the influences, both osmotic and hydrostatic, results in a net filtration pressure (NFP) of about 10 mm Hg (see Figure 5.7).

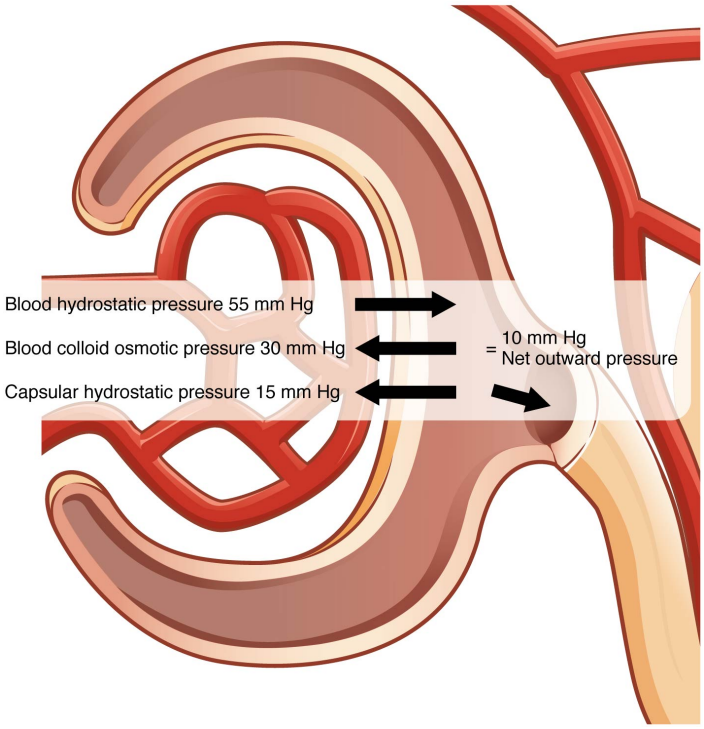


Figure 5.7 Net Filtration Pressure. The NFP is the sum of osmotic and hydrostatic pressures. From Betts, et al., 2013. Licensed under CC BY 4.0. [Fig. 5.7 Image description.]

A proper concentration of solutes in the blood is important in maintaining osmotic pressure both in the glomerulus and systemically. There are disorders in which too much protein passes through the filtration slits into the kidney filtrate. This excess protein in the filtrate leads to a deficiency of circulating **plasma** proteins. In turn, the presence of protein in the urine increases its osmolarity; this holds more water in the filtrate and results in an increase in urine volume. Because there is less circulating protein, principally albumin, the osmotic pressure of the blood falls. Less osmotic pressure pulling water into the capillaries tips the balance towards hydrostatic pressure, which tends to push it out of the capillaries. The net effect is that water is lost from the circulation to interstitial tissues and cells. This "plumps up" the tissues and cells, a condition termed systemic edema.

Reabsorption and Secretion

The renal corpuscle filters the blood to create a filtrate that differs from blood mainly in the absence of cells and large proteins. From this point to the ends of the collecting ducts, the filtrate or forming urine is undergoing modification through **secretion** and **reabsorption** before true urine is produced. Here, some substances are reabsorbed, whereas others are secreted. Note the use of the term "reabsorbed." All of these substances were "absorbed" in the digestive tract—99 percent of the water and most of the solutes filtered by the nephron must be reabsorbed. Water and substances that are reabsorbed are returned to the circulation by the peritubular and vasa recta capillaries.

It is vital that the flow of blood through the kidney is at a suitable rate to allow for filtration. This rate determines how much solute is retained or discarded, how much water is retained or discarded, and ultimately, the **osmolarity** of blood and the blood pressure of the body.

Urinalysis

Urinalysis (urine analysis) often provides clues to renal disease. Normally, only traces of protein are found in urine, and when higher amounts are found, damage to the glomeruli is the likely basis. Unusually large quantities of urine may point to diseases like diabetes mellitus or **hypothalamic** tumors that cause diabetes insipidus. The color of urine is determined mostly by the breakdown products of red blood cell destruction (see Figure 5.8). The "heme" of **hemoglobin** is converted by the liver into water-soluble forms that can be excreted into the **bile** and indirectly into the urine. This yellow pigment is urochrome. Urine color may also be affected by certain foods like beets, berries, and fava beans. A kidney stone or a cancer of the urinary system may produce sufficient bleeding to manifest as pink or even bright red urine. Diseases of the liver or obstructions of bile drainage from the liver impart a dark "tea" or "cola" hue to the urine. **Dehydration** produces darker, concentrated urine that may also possess the slight odour of **ammonia**. Most of the ammonia produced from protein breakdown is converted into **urea** by the liver, so ammonia is rarely detected in fresh urine. The strong ammonia odour you may detect in bathrooms or alleys is due to the breakdown of urea into ammonia by bacteria in the environment. About one in five people detect a distinctive odour in their urine after consuming asparagus; other foods such as onions, garlic, and fish can impart their own aromas. These food-caused odours are harmless.

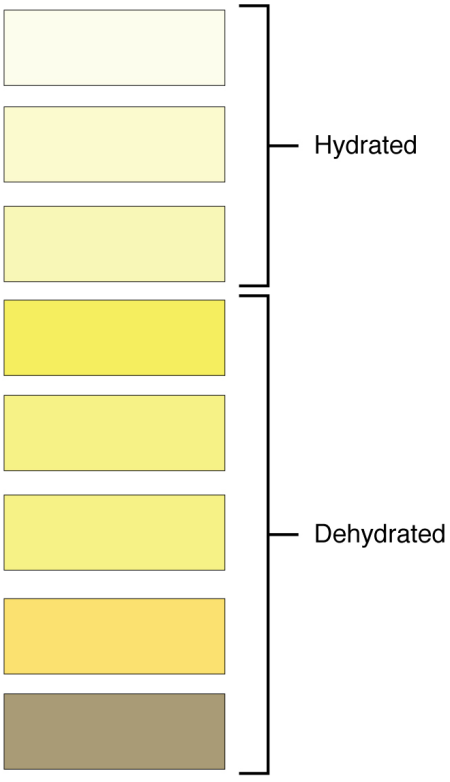


Figure 5.8 Urine Color. From Betts, et al., 2013. Licensed under CC BY 4.0. [Fig. 5.8 Image description.]

The kidneys must produce a minimum urine volume of about 500 mL/day to rid the body of wastes. Output below this level may be caused by severe dehydration or renal disease and is termed **oliguria**. The virtual absence of urine production is termed **anuria**. Excessive urine production is **polyuria**, which may be due to diabetes mellitus or diabetes insipidus. In diabetes mellitus, blood glucose levels exceed the number of available sodium-glucose transporters in the kidney, and glucose appears in the urine. The osmotic nature of glucose attracts water, leading to its loss in the urine. In the case of diabetes insipidus, insufficient pituitary antidiuretic hormone (ADH) release or insufficient numbers of ADH receptors in the collecting ducts means that too few water channels are inserted into the cell membranes that line the collecting ducts of the kidney. Insufficient numbers of water channels (aquaporins) reduce water absorption, resulting in high volumes of very dilute urine.

Concept Check

- Contrast the following terms: **oliguria**, **anuria** and **polyuria**. What are the differences between these terms as they describe urinary output?
- Explain how urine **colour** varies based on food consumed and/or **hydration** levels.

Endocrine Urinary Function

Several hormones have specific, important roles in regulating kidney function. They act to stimulate or inhibit blood flow. Some of these are endocrine, acting from a distance, whereas others are paracrine, acting locally.

Renin–Angiotensin–Aldosterone

Renin is an **enzyme** that is produced by the granular cells of the afferent arteriole. It enzymatically converts angiotensinogen (made by the liver, freely circulating) into angiotensin I. Its release is stimulated by **prostaglandins** to decreased extracellular fluid volume.

Angiotensin II is a potent vasoconstrictor that plays an immediate role in the regulation of blood pressure. It acts systemically to cause vasoconstriction as well as constriction of both the **afferent** and **efferent** arterioles of the glomerulus. In instances of blood loss or dehydration, it reduces both GFR and renal blood flow, thereby limiting fluid loss and preserving blood volume. Its release is usually stimulated by decreases in blood pressure, and so the preservation of adequate blood pressure is its primary role.

Aldosterone, often called the “salt-retaining hormone,” is released from the **adrenal cortex** in response to

angiotensin II or directly in response to increased plasma potassium. It promotes sodium reabsorption by the nephron, promoting the retention of water.

Antidiuretic Hormone (ADH)

Diuretics are drugs that can increase water loss by interfering with the recapture of solutes and water from the forming urine. They are often prescribed to lower blood pressure. ADH, released by the posterior pituitary, works to do the exact opposite. It promotes the recovery of water, decreases urine volume, and maintains plasma osmolarity and blood pressure. It does so by stimulating the movement of **aquaporin** proteins into the **apical** cell membrane of principal cells of the collecting ducts to form water channels, allowing the transcellular movement of water from the lumen of the collecting duct into the interstitial space in the medulla of the kidney by osmosis. From there, it enters the vasa recta capillaries to return to the circulation. Water is attracted by the high osmotic environment of the deep kidney **medulla.**

Parathyroid Hormone

Parathyroid hormone (PTH) is produced by the **parathyroid** glands in response to decreased circulating calcium levels.

Maintaining Homeostasis

Homeostasis requires that volume and **osmolarity** be preserved. Blood volume is important in maintaining sufficient blood pressure, and there are **nonrenal** mechanisms involved in its preservation, including vasoconstriction, which can act within seconds of a drop in pressure. Thirst mechanisms are also activated to promote the consumption of water lost through respiration, evaporation, or urination. Hormonal mechanisms are activated to recover volume while maintaining a normal osmotic environment. These mechanisms act principally on the kidney.

Diuretics and Fluid Volume

A diuretic is a compound that increases urine volume. Three familiar drinks contain diuretic compounds: coffee, tea, and alcohol. The caffeine in coffee and tea works by promoting vasodilation in the nephron, which increases GFR. Alcohol increases GFR by inhibiting ADH release from the posterior pituitary, resulting in less water recovery by the collecting duct. In cases of high blood pressure, diuretics may be prescribed to reduce blood volume and, thereby, reduce blood pressure. The most frequently prescribed anti-hypertensive diuretic is **hydrochlorothiazide.**

Regulation of Nitrogen Wastes

Nitrogen wastes are produced by the breakdown of proteins during normal **metabolism**. Proteins are broken down into amino acids, which in turn are deaminated by having their nitrogen groups removed. **Deamination** converts the amino (NH_2) groups into ammonia (NH_3), ammonium ion (NH_4^+), urea, or uric acid (Figure 5.9). Ammonia is extremely toxic, so most of it is very rapidly converted into urea in the liver. Human urinary wastes typically contain primarily urea with small amounts of ammonium and very little uric acid.

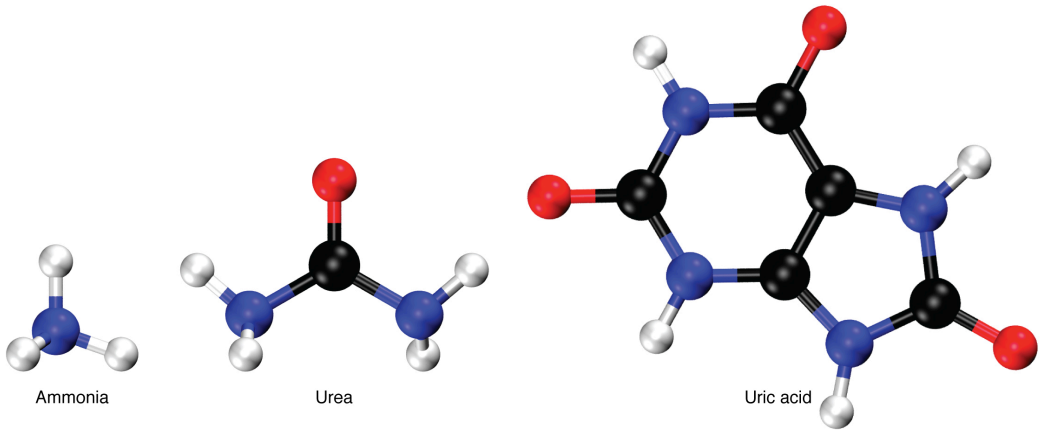


Figure 5.9 Nitrogen Wastes. From Betts, et al., 2013. Licensed under CC BY 4.0.

Elimination of Drugs and Hormones

Water-soluble drugs may be excreted in the urine and are influenced by one or all of the following processes: glomerular filtration, tubular secretion, or tubular reabsorption. Drugs that are structurally small can be filtered by the glomerulus with the filtrate. Large drug molecules such as **heparin** or those that are bound to plasma proteins cannot be filtered and are not readily eliminated. Some drugs can be eliminated by carrier proteins that enable secretion of the drug into the tubule lumen. There are specific carriers that eliminate basic (such as dopamine or histamine) or acidic drugs (such as penicillin or indomethacin). As is the case with other substances, drugs may be both filtered and reabsorbed passively along a concentration gradient.

Watch Urinary System, Part 2: Crash Course Anatomy & Physiology #39 (10 min) on YouTube (https://youtu.be/DlqyyyvTI3k)

Urinary System Medical Terms and Abbreviations

Urinary System Medical Terms Not Easily Broken into Word Parts

Urinary System Medical Terms Not Easily Broken into Word Parts (Text version)

1. **deamination**
    - dē-am-ĭ-NĀ-shŏn
    - The removal of an amino group from a molecule.
2. **distended**
    - dis-TEN-ded (Original Term)
    - stretch out
3. **enuresis**
    - en-ū-RĒ-sĭs (Original Term)
    - involuntary urination
4. **hemodialysis (HD)**
    - hē-mō-dī-ĂL-ĭ-sĭs
    - procedure for removing impurities from the blood due to an inability of the kidney to function
5. **hydrostatic**
    - hī-drō-STAT-ik
    - Relating to the equilibrium of liquids and the pressure exerted by liquid at rest
6. **incontinence**
    - in-KONT-ĭn-ĕns (Original Term)
    - inability to control the bladder and/or bowels
7. **micturate**
    - MĬK-tū-rāt (Original Term)
    - to pass urine
8. **sphincter**
    - SFĬNK-tĕr

- A circular muscle constricting an orifice

9. **stricture**
    - STRIK-chŭr (Original Term)
    - abnormal narrowing
10. **urinal**
    - Ū-rĭn-ăl (Original Term)
    - receptacle for urine
11. **void**
    - VOYD (Original Term)
    - empty or evacuate waste material, urinate

Activity Source: Urinary System Medical Terms not easily broken into word parts from *Medical Terminology.* by Grimm et al., licensed under CC BY 4.0. / Some H5P audio re-recorded by David McCuaig and text version added.

Urinary System Abbreviations

Many terms and phrases related to the urinary system are abbreviated.
Learn these common abbreviations by expanding the list below.
Urinary System Abbreviations

- **ARF** (acute renal failure)
- **BUN** (blood urea nitrogen)
- **cath** (catheter, catheterization)
- **CKD** (chronic kidney disease)
- **ESRD** (end-stage renal disease)
- **ESWL** (extracorporeal shock wave lithotripsy)
- **HD** (hemodialysis)
- **OAB** (overactive bladder)
- **SG** (specific gravity)
- **UA** (urinalysis)
- **UTI** (urinary tract infection)
- **VCUG** (voiding cystourethrogram or void cystourethrogram)

Activity source: Urinary System Abbreviations by Kimberlee Carter from *Building a Medical Terminology Foundation* by Kimberlee Carter and Marie Rutherford, licensed under CC BY 4.0.

Image Descriptions

Figure 5.7 image description: This figure shows the different pressures acting across the glomerulus including blood hydrostatic pressure, blood colloid osmotic pressure, capsular hydrostatic pressure. [Return to Figure 5.7].

Figure 5.8 image description: This color chart shows 8 different shades of yellow and associates each shade with stages of hydration (lightest 3 shades) or dehydration (remaining 5 darker shades). [Return to Figure 5.8].

Attribution

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5.4 - Urinary Diseases, Disorders and Diagnostic Testing

Diabetic Nephropathy

Diabetic nephropathy impacts the kidneys as a result of having diabetes mellitus type 1 or 2. Higher levels of blood sugar can lead to high blood pressure, and this additional pressure exerted on the kidneys causes destruction of the small filtering structures within the kidney (Mayo Clinic Staff, 2019). To learn more about diabetic nephropathy, visit the Mayo Clinic's Diabetic Nephropathy web page [New Tab] (https://www.mayoclinic.org/diseases-conditions/diabetic-nephropathy/symptoms-causes/syc-20354556).

Glomerulonephritis

Glomerulonephritis refers to acute or chronic nephritis that involves inflammation of the capillaries of the renal glomeruli. It has various causes, and is noted especially by blood or protein in the urine and by edema. If untreated, it could lead to kidney failure.

Hydronephrosis

Hydronephrosis is a condition whereby the kidneys begin to swell because of the retention of urine. Several conditions can cause hydronephrosis, such as a kidney stone or blood clot. Treatment will vary, depending on the cause (Cleveland Clinic, 2019). To learn more about hydronephrosis, visit the Cleveland Clinic's web page on hydronephrosis [New Tab] (https://my.clevelandclinic.org/health/diseases/15417-hydronephrosis).

Polycystic Kidney Disease

Polycystic kidney disease (PKD) is a genetic disease where cysts grow inside the kidneys. The kidneys enlarge from the cystic collections, and damage to the filtering structures of the kidneys can occur. As the disease progresses, it may lead to chronic kidney disease (American Kidney Fund, 2020). To learn more, visit the Kidney Fund's PKD web page [New Tab] (https://www.kidneyfund.org/kidney-disease/other-kidney-conditions/polycystic-kidney-disease.html).

Renal Cell Carcinoma

Renal cell carcinoma is a cancer occurring in the kidney tubes where urine is produced or collected. This one of the most common cancers found within the kidneys. Removal of the cancerous lesions is the typical approach from a treatment perspective (Innovation for Patient Care, 2018). To learn more, visit Canadian Cancer Society's page on kidney cancer [New Tab] (https://cancer.ca/en/cancer-information/cancer-types/kidney/what-is-kidney-cancer).

Renal Failure

Renal failure occurs when kidneys suddenly or gradually become unable to filter waste products from blood. When kidneys stop filtering, high level of wastes may build. Two types exist: acute kidney failure and chronic kidney failure (Mayo Clinic Staff, 2019a). To learn more about kidney failure, visit the Mayo Clinic's page on Chronic Kidney Failure [New Tab] (https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521).

Cystitis

Cystitis is inflammation of the urinary bladder, often caused by an infection. A chronic form of this condition is known as interstitial cystitis. Symptoms of cystitis include bladder pressure, voiding frequently, and pain (Mayo Clinic Staff, 2019b). To learn more about cystitis, visit the Mayo Clinic's page on Interstitial Cystitis [New Tab] (https://www.mayoclinic.org/diseases-conditions/interstitial-cystitis/symptoms-causes/syc-20354357).

Urinary Tract Infection

A urinary tract infection (UTI) is an infection caused by bacteria, or sometimes, fungi. The exact type of bacterial growth is determined by conducting urine for culture and sensitivity (C&S) testing. In rare cases, a UTI may be caused by a virus (Lights & Boskey, 2019). For more information, visit Healthline's web page on Urinary Tract Infections [New Tab] (https://www.healthline.com/health/urinary-tract-infection-adults#home-remedies).

Urinary Incontinence

Urinary incontinence is a loss of bladder control. Those afflicted with the condition will experience urine leakage from the bladder. Weak bladder muscles are a risk factor for developing this condition (Kim & O'Connell, 2017). To learn more about this condition, visit Healthline's webpage Urologic Diseases [New Tab] (https://www.healthline.com/health/renal-and-urological-disorders#types).

Urinary Medical Terms in Use

Medical Terms in Context 1

Urinary System Operative Report (Text Version)

Fill in the consultation report with correct words listed below:

- Ureteral
- bladder
- recovery
- draped
- prepped
- fragmented
- lumen
- proximal

URINARY SYSTEM – OPERATIVE REPORT

PATIENT NAME: Cindy WARD

AGE: 48

DOB: September 19

SEX: Female

DATE OF SURGERY: January 8

SURGEON: Steve Foster, MD, Urologist

ASSISTANT: Michelle Stevenson, MD

ANESTHESIOLOGIST: Ryan Haywood, MD

ANESTHESIA: General

PREOPERATIVE DIAGNOSIS: Left proximal ureteral stones.

POSTOPERATIVE DIAGNOSIS: Left proximal ureteral calculi.

INDICATIONS: The patient is a 48-year-old female with a history of kidney stone disease, who has severe left flank pain and was found to have an obstructing large left proximal _____[Blank 1] stone.

OPERATIVE PROCEDURE: After induction of general anesthesia, the patient was placed in the lithotomy position. Patient was _____[Blank 2] and _____[Blank 3] in the usual sterile fashion. A #19-French cystoscope was inserted under camera vision. The urethra was unremarkable. The scope was passed into the bladder. The _____[Blank 4] mucosa was normal throughout. Under fluoroscopic control, a guidewire was placed up the left ureter and bypassed the stone. This was difficult at first, but the guidewire was eventually manipulated around the stone into the _____[Blank 5] collecting system. A rigid ureteroscope was then negotiated up the left ureter alongside the guidewire up to the stone, which was at the junction.

The stone was quite large and occupied the entire _____[Blank 6] of the ureter. Lithotripsy was then performed under camera vision. Using the Holmium laser, the stone was _____[Blank 7] into multiple fragments, all of which were then individually basketed. Some of the stones were sent for analysis.

Further ureteroscopy up to the kidney failed to reveal any significant sized fragments. Therefore, the ureteroscope was removed.

The procedure was tolerated by the patient without complications. The patient was taken to the _____[Blank 8] room in stable condition.

_____
Steve Foster, MD, Urologist

Note: Report samples (H5P and Pressbooks) are to encourage learners to identify correct medical terminology and do not represent the Association for Health Documentation Integrity (AHDI) formatting standards.

Check your answers:[1]

Activity source: Urinary System – Operative Report by Heather Scudder, licensed under CC BY 4.0./Text version added.

Medical Terms in Context 2

Urinary System Consultation Report (Text Version)
Fill in the consultation report with correct words listed below:

- Urine
- shortness
- pain
- leukorrhea
- dysuria
- foul
- urinalysis
- nausea
- UTIs

URINARY SYSTEM – CONSULTATION REPORT

PATIENT NAME: Renee WOODS

AGE: 32

SEX: Female

DOB: June 17

DATE OF CONSULTATION: January 8

CONSULTING PHYSICIAN: Steve Foster, MD, Urology

REASON FOR CONSULTATION: Urinary Tract Infection.

HISTORY: The patient is a 32-year-old female who is complaining of pain on urinating. Patient states it began approximately 3 days ago. The patient describes symptoms of _____[Blank 1] and increased frequency to the washroom. Patient states they usually go to the washroom to urinate 4-5 times a day, but starting 3 days ago, she started going 10-12 times per day. Sometimes no _____[Blank 2] comes out. The urine has a _____[Blank 3] odor and is cloudy. States there has been lower abdomen _____[Blank 4] since yesterday, and says it is worse when she tries to go with no result. Patient has had the same sexual partner for 10 years. She has a history of _____[Blank 5] and feels this is the same.

PHYSICAL EXAMINATION: GENERAL: No weakness, or tiredness. VITALS: Blood pressure 120/80, heart rate 70 and respirations 16. Patient weighs 150 pounds. LUNGS: No cough or _____[Blank 6] of breath. GASTRO: Denies _____[Blank 7], vomiting or change in bowel habits. URINARY/REPRODUCTIVE: Denies hematuria, or any _____[Blank 8].

ASSESSMENT: Did a urinalysis on patient. _____[Blank 9] revealed leukocytes 3+.

PLAN

1. Treat with Ampicillin 400 mg q.i.d.
2. Return to office if no improvement within 48 hours.

_____
Steve Foster, MD, Urology

Note: Report samples (H5P and Pressbooks) are to encourage learners to identify correct medical terminology and do not represent the Association for Health Documentation Integrity (AHDI) formatting standards.

Check your answers: [2]

Activity source: Urinary System Consultation Report by Heather Scudder and Sheila Bellefeuille, licensed under CC BY 4.0./Text version added.

Medical Specialties and Procedures Related to the Urinary System

Urology is a specialty that "addresses the medical and surgical treatment of disorders and diseases of the female urinary tract and the male urogenital system" (Canadian Medical Association, 2018). This specialty focuses on diagnosis, treatment, and surgical repair. Common clinical visits involve kidney stones, kidney failure, and bladder dysfunction. To learn more about urology as a specialty, visit the Urology Profile [PDF] (https://www.cma.ca/sites/default/files/2019-01/urology-e.pdf) authored by the Canadian Medical Association.

Urologist

A urologist is a medical specialist involved in the diagnosis and treatment of urinary and male genitourinary system conditions, disorders, and diseases such as prostate disease, renal and bladder dysfunctions, and others (Canadian Medical Association, 2019).

Procedures and Testing

Urinalysis

A urinalysis is a microscopic group of urine testing. This test detects and measures several substances in the urine, such as products of normal and abnormal metabolism and bacteria (Lab Tests Online, 2022). To learn more about urinalysis, visit Lab Tests Online's Urinalysis web page [New Tab] (https://labtestsonline.org/tests/urinalysis).

Urine for C&S

Urine for culture and sensitivity. Urine produced by the kidneys is analyzed by way of a urine culture test that can detect and identify bacteria in the urine, which may be causing a urinary tract infection (UTI). If harmful bacteria is found, a sensitivity report is generated. This report lists antibiotics sensitive in the treatment of the bacteria present (Lab Tests Online, 2020a). To learn more about Urine for C&S, visit Lab Tests Online's Urine Culture web page [New Tab] (https://www.testing.com/tests/urine-culture/).

24 Hour Urine Collection

This is a test whereby all urinary output is collected over a 24-hour period of time. The analysis of urinary output over this extended period of time provides a greater indication of normal or abnormal kidney function (Lab Tests Online, 2017). To learn more, visit Johns Hopkins Medicine's *24-hour Urine Collection* article [New Tab] (https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/24hour-urine-collection).

CT Scan of Kidney

Computed tomography is a diagnostic imaging procedure that uses a combination of x-rays and computer technology to produce a variety of images. It provides detailed images of the kidney looking for disease, cancer, obstructions and other kidney conditions (Johns Hopkins Medicine, n.d.) . To learn more about a CT scan of the kidney, visit Johns Hopkins Medicine's page on Computed Tomography (CT or CAT) Scan of the Kidney [New Tab].

Cystoscopy

A cystoscopy is a procedure allowing a physician to check for bladder or ureteral problems, such as bladder cancer. An endoscope is used, also known as a cystoscope, containing a camera at the end of it (Canadian Cancer Society, 2020). To learn more about cystoscopy, visit the Canadian Cancer Society's Cystoscopy and Ureteroscopy web page [New Page] (https://www.cancer.ca/en/cancer-information/diagnosis-and-treatment/tests-and-procedures/cystoscopy/?region=on).

Dialysis

Dialysis is a treatment that removes waste products from the blood when the kidneys are not fully functioning. This type of therapy is available at home or in a hospital or clinic and there are two main types: peritoneal dialysis and hemodialysis (Kidney Foundation, 2020). To learn more about dialysis, visit the Kidney Foundation's Dialysis web page [New Tab] (https://kidney.ca/Kidney-Health/Living-With-Kidney-Failure/Dialysis).

Intravenous Pyelogram

An intravenous pyelogram (IVP) is a specialized x-ray designed to produce views of the entire urinary tract. A dye is used to secure the enhanced imaging. The x-rays can also show how well the urinary tract is functioning and any identify any blockages (Canadian Cancer Society, 2020a). To learn more about IVP, visit the Canadian Cancer Society's IVP web page [New Tab] (https://www.cancer.ca/en/cancer-information/diagnosis-and-treatment/tests-and-procedures/intravenous-pyelogram/?region=on).

Kidney Scan

A kidney scan is an imaging test which views the kidneys. It is considered a nuclear imaging test, as it uses radioactive tracers to pick up hot or cold spots within the kidney. These variations are considered abnormal.

Kidney Transplant

When kidneys fail or when a person is in end stage chronic kidney disease, a surgical procedure is performed in the form of a kidney transplant. This procedure involves harvesting a donor kidney, which is transplanted into the recipient in need of a functioning kidney to support vital function of the urinary system.

Attribution

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Notes

1. 1. Ureteral, 2. Prepped, 3. Draped, 4. Bladder, 5. Proximal, 6. Lumen, 7. Fragmented, 8. Recovery.
2. 1. Dysuria, 2. Urine, 3. Foul, 4. Pain, 5. UTIs, 6. Shortness, 7. Nausea, 8. Leukorrhea, 9. Urinalysis

Vocabulary & Check Your Knowledge

Urinary System Vocabulary

Adventitial

The outermost layer of the wall of a blood vessel.

Apical

Relating to or denoting an apex.

Autonomic

Involuntary or unconscious.

Calyces

A cuplike cavity or structure.

Deamination

The removal of an amino group from a molecule.

Detrusor

A muscle which forms a layer of the wall of the bladder.

Excretion

Waste is eliminated from an organism. In vertebrates this is primarily carried out by the lungs, kidneys, and skin.

Homeostasis

A biological process that results in stable equilibrium.

Hydrostatic

Relating to the equilibrium of liquids and the pressure exerted by liquid at rest.

Hypothalamic

A region of the forebrain below the thalamus.

Lethargy

Periods of weakness.

Mitochondria

An organelle found in large numbers in most cells.

Osmosis

A process by which molecules of a solvent tend to pass through a membrane from a less concentrated solution into a more concentrated one.

pH

pH is a measure of how acidic or alkaline a substance is, as determined by the number of free hydrogen ions in the substance.

Prostaglandins

Any of a group of compounds with varying hormone-like effects.

Pseudostratified

Consisting of closely packed cells which appear to be arranged in layers.

Solutes

The minor component in a solution.

Voiding

Excrete (waste matter).

Test Yourself

Urinary System Glossary Reinforcement Activity (Text Version)

1. The removal of an amino group from molecule is called the _____[Blank 1].
    a. Voiding
    b. Deamination
    c. Calyces
2. _____[Blank 2] is a measure of how acidic or alkaline a substance is, as determined by the number of free hydrogen ions in the substance.
    a. pH
    b. Apical
    c. Osmosis
3. _____[Blank 3] relates to the equilibrium of liquids and the pressure exerted by liquid at rest.

a. Solutes
b. Hydrostatic
c. Mitochondria

4. The outermost layer of the wall of a blood vessel is called the _____[Blank 4].

    a. Hydrostatic
    b. Pseudostratified
    c. Adventitial

5. Any of a group of compounds with varying hormone-like effects is referred to as _____[Blank 5].

    a. Solutes
    b. Excretion
    c. Prostaglandins

Check your answers: [1]

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Attribution

Notes

1. 1. Deamination, 2.pH, 3. Hydrostatic, 4. Adventitial, 5. Prostaglandins

References

American Kidney Fund. (2020, June 17). *Polycystic kidney disease*. https://www.kidneyfund.org/kidney-disease/other-kidney-conditions/polycystic-kidney-disease.html

Canadian Cancer Society. (2020). *Cystoscopy and ureteroscopy*. Canadian Cancer Society: Cancer Information. https://www.cancer.ca/en/cancer-information/diagnosis-and-treatment/tests-and-procedures/cystoscopy/?region=on

Canadian Cancer Society. (2020). *Intravenous pyelogram*. Canadian Cancer Society: Cancer Information. https://www.cancer.ca/en/cancer-information/diagnosis-and-treatment/tests-and-procedures/intravenous-pyelogram/?region=on

Canadian Cancer Society. (n.d.) *What is kidney cancer?* Canadian Cancer Society: Cancer Information. https://cancer.ca/en/cancer-information/cancer-types/kidney/what-is-kidney-cancer

Canadian Medical Association. (2019. December). *Urology profile*. Canadian Medical Association Specialty Profiles. https://www.cma.ca/sites/default/files/2019-01/urology-e.pdf

Cleveland Clinic. (2019, May 22). *Hydronephrosis*. https://my.clevelandclinic.org/health/diseases/15417-hydronephrosis

CrashCourse. (2015, October 12). *Urinary system, part 1: Crash Course anatomy & physiology #38* [Video]. YouTube. https://www.youtube.com/watch?v=l128tW1H5a8

CrashCourse. (2015, October 19). *Urinary system, part 2: Crash Course anatomy & physiology #39* [Video]. YouTube. https://youtu.be/DlqyyyvTI3k

Johns Hopkins Medicine. (n.d.). *24-hour urine collection*. John Hopkins Medicine: Health. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/24hour-urine-collection

Johns Hopkins Medicine. (n.d.). *Computed tomography (CT or CAT) scan of the kidney*. John Hopkins Medicine: Health. https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/ct-scan-of-the-kidney

Kidney Foundation of Canada. (2020). *Dialysis*. Kidney Foundation. https://kidney.ca/Kidney-Health/Living-With-Kidney-Failure/Dialysis

Lab Tests Online. (2022, September 28). *Urinalysis*. https://labtestsonline.org/tests/urinalysis

Lab Tests Online. (2022, September 29). *Urine culture*. https://www.testing.com/tests/urine-culture/

Lights, V., & Boskey, E. (2023, February 21). *Everything you need to know about urinary tract infection*. Healthline. https://www.healthline.com/health/urinary-tract-infection-adults

Mayo Clinic Staff. (2023, September 6). *Chronic kidney disease*. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521

Mayo Clinic Staff. (2021, September 29). *Interstitial cystitis*. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/interstitial-cystitis/symptoms-causes/syc-20354357

Mayo Clinic Staff. (2023, October 24). *Diabetic nephropathy*. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/diabetic-nephropathy/symptoms-causes/syc-20354556