

Anatomy and Physiology

8. The Urinary System



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The Urinary System

Tour of the System

The urinary system removes waste by-products of metabolism. It is a very complicated system and works closely with the endocrine and cardiovascular system.

Waste products such as urea and ammonia seep from cells and tissues into the blood stream.

If these waste molecules remain in the bloodstream, they can accumulate to toxic levels in a very short time.

This liquid waste enters the kidneys through the renal arteries, from the abdominal aorta.

Around 1200 ml of blood can enter the kidneys per minute.

The renal artery entering each kidney branches into segmental arteries.

These branch into interlobar arteries.

Eventually the blood vessels become arterioles that supply the glomeruli.

The glomerulus is a ball-shaped tangled network of capillaries and is part of a nephron - the main structural and functional unit of the kidney.

Below the glomeruli is space, called the interstitium. Any fluid for re-absorption recovered from urine passes into here.

There are two main sections in the kidney, the renal cortex and renal medulla.

In the diagram below, the renal cortex is where the blood vessels are around the kidney and the renal medulla is the area between the renal pyramids.

Nephrons are located throughout the kidney and the first part of the nephron is located in the cortex. This part of the nephron, the renal corpuscle filters urine.

Nephrons have a thin wall that allows fluid to pass from the glomeruli into them.

Blood eventually drains out of nephrons into peritubular capillaries.

These then become venules and veins until filtered blood leaves the kidney through the renal vein.

Urine filtered from the blood through the nephrons passes through the renal tubule and through various tubes and processes.

It eventually reaches minor calyces and then major calyces.

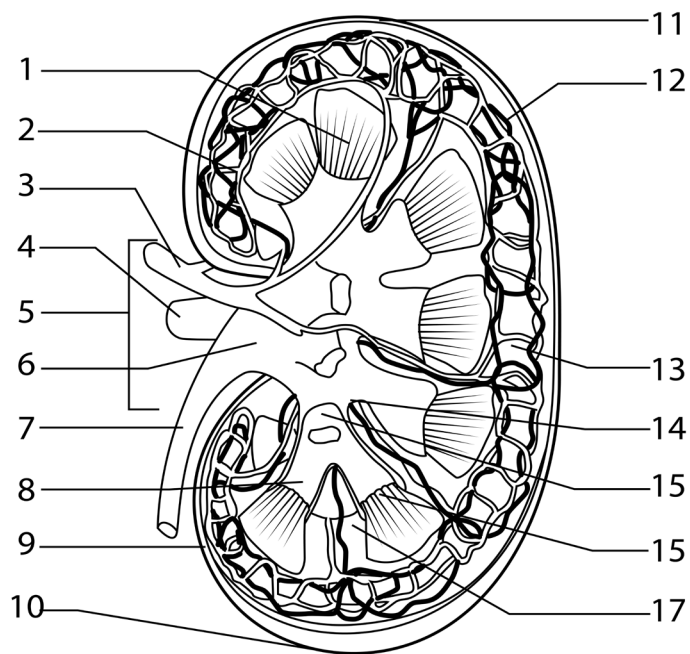
The urine then enters the renal pelvis that becomes the ureter.

The ureter passes urine to the bladder.

The body makes about a liter of urine a day and this is stored in the bladder until emptying.

Urine exits the body through the urethra.

Because about one fifth of the body's supply of blood passes through the kidneys at any given time, they are terribly vulnerable to damage by toxins.



1. Renal pyramid 2. Interlobular artery 3. Renal artery 4. Renal vein 5. Renal hilum 6. Renal pelvis 7. Ureter 8. Minor calyx 9. Renal capsule 10. Inferior renal capsule 11. Superior renal capsule 12. Interlobular vein 13. Nephron 14. Minor calyx 15. Major calyx 16. Renal papilla 17. Renal column

Functions

The functions of the urinary system are to help maintain **homeostasis** by:

- Producing urine
- Storing urine
- Eliminating urine

Components

Kidneys

These are about 10-12 cm wide. As well as helping with the urinary system, kidneys also have other important functions.

They help maintain homeostasis in the body, by helping to control the composition, the volume and the pressure of blood.

Kidneys also help to control blood pH and contribute to metabolic processes such as helping the body to produce vitamin D. They also play an important role in hormone secretion.

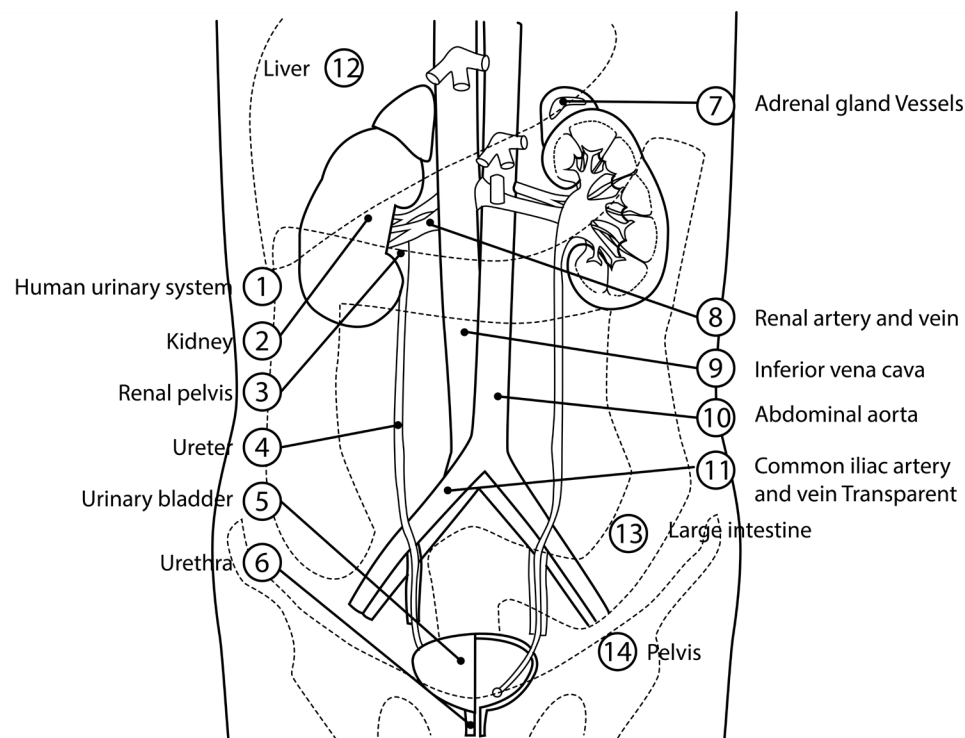
Kidneys contain over one million nephrons and roughly 1700 liters of blood pass through these in a day. From this, 170 liters of filtrate is formed. As the filtrate passes along the nephrons, 169 liters of filtrate is reabsorbed back into the blood stream. The remaining one liter is urine.

Ureters

These two muscular tubes move urine from the kidney to the bladder. These are around 25-30 cm long and 4 mm in diameter.

Bladder

This organ collects urine from the kidneys. It is a muscular organ under both voluntary and involuntary control. As the bladder wall stretches, the nervous system contracts the detrusor muscle. This encourages urine to enter the urethra. Urine can only enter the urethra if the external sphincter, controlled voluntarily, is open.



The urge to urinate usually occurs when around 25% of the bladder is full. If the bladder reaches 100% volume then the bladder will just empty. Micturition is another name for urination.

Urethra

This allows urine to exit the body. In males, the urethra also carries semen.

Testing urine can identify abnormal components that should not be in the urine, such as glucose or erythrocytes.

Common Diseases and Disorders

Acute renal failure (ARF): this is when glomerular filtration either reduces or stops. When this occurs, urine production stops. Causes include circulatory problems or kidney stones.

Chronic renal failure (CRF): This is a progressive and usually irreversible decline in filtration. This is when dialysis and a kidney transplant may be required. Kidney trans-

plants are very successful, with the donor living with one kidney and the recipient maintaining a normal life.

Cystitis: Is a common UTI, especially in women. Cystitis is often called a bladder infection. Symptoms include a constant urge to urinate and burning when urinating.

Diabetes insipidus (DI): Is when there is a very large volume of dilute urine excreted. This is usually associated with kidney disease and is a different disorder to diabetes mellitus.

Incontinence: This usually arises from problems between voluntary and involuntary controlled muscles in the bladder.

Kidney infection: Also called pyelonephritis or pyelitis, this is a UTI that has reached the kidneys. This type of infection can be life threatening.

Kidney stones: Also known as renal calculus, these are a solid mass formed in the kidneys from minerals, such as calcium. Kidney stones can pass through the urinary system without any damage, but if they continue to grow, the ureter becomes blocked causing immense pain.

UTI or Urinary tract infection: This is any bacterial infection affecting any part of the urinary system.

Medical Terminology

Diuresis: Increased urine excretion, diuresis can be induced with diuretics, used frequently in medicine.

Homeostasis: This is the ability of the human body to maintain a stable internal environment, when dealing with both internal and external environmental changes.

Nephrology: Specialized branch of medicine dealing with the kidneys.

Polyuria: Excessive formation of urine.

Urology: Branch of medicine dealing with the urinary system

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