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17/MHS01/297

MEDICINDE AND SURGERY

300 LEVEL

1. ROLE OF KIDNEYS IN GLUCOSE HOMEOSTASIS

The kidneys’ contributions to maintaining glucose homeostasis are significant and include such functions as release of glucose into the circulation via gluconeogenesis, uptake of glucose from the circulation to satisfy their energy needs, and reabsorption of glucose at the level of the proximal tubule. Renal release of glucose into the circulation is the result of glycogenolysis and gluconeogenesis, respectively involving the breaking down and formation of glucose-6-phosphate from precursors (e.g., lactate, glycerol, amino acids). With regard to renal reabsorption of glucose, the kidneys normally retrieve as much glucose as possible, rendering the urine virtually glucose free. The glomeruli filter from plasma approximately 180 grams of D-glucose per day, all of which is reabsorbed through glucose transporter proteins that are present in cell membranes within the proximal tubules. If the capacity of these transporters is exceeded, glucose appears in the urine. The process of renal glucose reabsorption is mediated by active (sodium-coupled glucose cotransporters) and passive (glucose transporters) transporters. In hyperglycemia, the kidneys may play an exacerbating role by reabsorbing excess glucose, ultimately contributing to chronic hyperglycemia, which in turn contributes to chronic glycemic burden and the risk of microvascular consequences.

1. PROCESS OF MICTURITION

Micturition is the process of discharging urine from the urinary bladder.  It is brought about by reflex contraction of a special muscle called the detrusor muscle after voluntary relaxation of the sphincter muscle. The [human excretory system](https://byjus.com/biology/human-excretory-system/) consists of a pair of kidneys and ureters, a urinary bladder, and a urethra. The kidneys play a major role in the process of urine formation and its excretion. The urine formed is stored in the urinary bladder.

Micturition is also known as voiding phase of bladder control and lasts for a short time. As the bladder becomes full, the stretch receptors increase their firing rate. This increases the urge to urinate and causes micturition reflex. It sometimes even causes involuntary urination.

Micturition process consists of two phases:

* Storage phase
* Voiding phase

Storage Phase

The urinary bladder is a balloon-shaped, hollow, muscular, organ that acts as the storage organ for urine. The urinary bladder in a healthy urinary system can store up to 16 ounces of urine for 2 to 5 hours easily. The circular sphincter muscles prevent leakage of urine. They close tightly around the opening of the bladder into the tube (urethra) that allows the passage of urine outside the body.

Voiding Phase

When the bladder is filled with urine, the nerves in it are triggered, which in turn stimulates the need to urinate. The brain signals urinary bladder to contract. The receptors of the urinary bladder send a signal to the [central nervous system](https://byjus.com/biology/central-nervous-system/), in response to which the nervous system sends a signal that incites the contraction of the urinary bladder.  Through the urinary opening at the urethra, the urine is eliminated, and the process is called micturition. The neural mechanism involved is called the micturition reflex.

1. JUXTAGLOMERULAR APPARATUS

The juxtaglomerular apparatus (JGA) is a composite assembly of specialized structures at the vascular pole of the [glomerulus](https://www.sciencedirect.com/topics/engineering/glomerulus) (Figures 20.28 and 20.29). The juxtaglomerular apparatus lies between the glomerulus and the distal convoluted tubule of the same nephron. The thick ascending limb of [Henle's loop](https://www.sciencedirect.com/topics/medicine-and-dentistry/henle-loop) (TAL) returns to its parent glomerulus and extends through the angle between afferent and efferent [arterioles](https://www.sciencedirect.com/topics/medicine-and-dentistry/arteriole), where it is firmly attached to the extraglomerular [mesangium](https://www.sciencedirect.com/topics/medicine-and-dentistry/mesangium) (Figure 20.66a). At the attachment point, the TAL changes its character: a plaque of specialized cells, known as the [macula densa](https://www.sciencedirect.com/topics/medicine-and-dentistry/macula-densa) (MD), represents the contact site of the tubule. Around this attachment, other specialized structures are developed which, together with the macula densa, comprise the JGA. These are: the terminal portion of the afferent [arteriole](https://www.sciencedirect.com/topics/medicine-and-dentistry/arteriole) housing the [renin](https://www.sciencedirect.com/topics/medicine-and-dentistry/renin) producing [granular cells](https://www.sciencedirect.com/topics/medicine-and-dentistry/granular-cell); the initial portion of the efferent arteriole; and the extraglomerular mesangium (EGM). The latter is in continuity with the intraglomerular mesangium, and has intimate relationships with the parietal epithelium of [Bowman's capsule](https://www.sciencedirect.com/topics/medicine-and-dentistry/bowman-capsule).20 The JGA, more precisely the granular cells and the [smooth muscle cells](https://www.sciencedirect.com/topics/medicine-and-dentistry/smooth-muscle-cell) of afferent and efferent arterioles, are richly innervated by sympathetic nerves. The juxtaglomerular apparatus can be considered as an anatomical unit important in tubuloglomerular feedback control of renal blood flow, [glomerular filtration](https://www.sciencedirect.com/topics/medicine-and-dentistry/glomerulus-filtration) rate and possibly also tubular control of [renin](https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/renin) secretion.



4. ROLE OF KIDNEYS IN BLOOD PRESSURE REGULATION

The renin-angiotensin system or RAS regulates blood pressure and fluid balance in the body. When blood volume or sodium levels in the body are low, or blood potassium is high, cells in the kidney release the enzyme, renin. Renin converts angiotensinogen, which is produced in the liver, to the hormone angiotensin I. An enzyme known as ACE or angiotensin-converting enzyme found in the lungs metabolizes angiotensin I into angiotensin II. Angiotensin II causes blood vessels to constrict and blood pressure to increase. Angiotensin II stimulates the release of the hormone aldosterone in the adrenal glands, which causes the renal tubules to retain sodium and water and excrete potassium. Together, angiotensin II and aldosterone work to raise blood volume, blood pressure and sodium levels in the blood to restore the balance of sodium, potassium, and fluids. If the renin-angiotensin system becomes overactive, consistently high blood pressure results.

5. ROLE OF KIDNEY IN CALCIUM HOMEOSTASIS

The **kidney** is critically important in calcium homeostasis. Under normal blood calcium concentrations, almost all of the calcium that enters glomerular filtrate is reabsorbed from the tubular system back into blood, which preserves blood calcium levels. If tubular reabsorption of calcium decreases, calcium is lost by excretion into urine.