بسم الله الرحمن الرحيم

كلية آشور الجامعة – قسم تقنيات المختبرات الطبية Human Physiology 2nd stage

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Urinary physiology:

The urinary system, also known as the renal system, consists of the **two kidneys, two ureters,** the **bladder,** and the **urethra**. Each kidney consists of millions of functional units called nephrons. The kidneys have extensive blood supply via the renal arteries which leave the kidneys via the renal vein. Following filtration of blood and further processing, wastes (urine) exit the kidney via the ureters, tubes made of smooth muscle fibers that propel urine towards the urinary bladder, where it is stored and subsequently expelled from the body by urination. The female and male urinary system is very similar. About 1-2 litres of urine are produced every day in a healthy human, although this amount may vary according to circumstances such as fluid intake.

The main functions of the urinary system:

- Regulate blood volume and composition (e.g. sodium, potassium and calcium)
- Regulate blood pressure.
- Regulate pH of the blood.
- Contributes to production of red blood cells by the kidney.
- Helps synthesize calcitriol (active form of Vitamin D).
- Stores waste product (mainly urea and uric acid) before removed from the body.
- Regulation of acid-base homeostasis of the body.
- Control levels of electrolytes and metabolites.

Urine Definition: a watery, yellowish fluid stored in the bladder and discharged through the urethra. It is one of the body's chief

means of eliminating excess water and salt, and also contains nitrogen compounds such as urea. Urine flows from the kidneys through the ureters to the bladder and expelling through the urethra by urination.

Normal Constitute of Urine:

Urine is an aqueous solution of greater than 95% water, with the remaining constituents: urea 9.3 g/L, chloride 1.87 g/L, sodium 1.17 g/L, potassium 0.750 g/L, creatinine 0.670 g/L and other dissolved ions.

Abnormal constituents of urine:

(a) Proteinurea: Presence of protein in urine.
(b) Hematuria: presence of intact blood cells in urine.
(c) Crystalluria: presence of crystals in urine.
(d) Pyuria: presence of purulent debris in urine.
(e) Hemoglobinuria: presence of hemoglobin in urine.
(f) Myoglobinuria: presence of myoglobin in urine.
(g) Indicanuria: presence of Indican substance in urine.
(h) Creatinuria: breakdown of muscular tissues leads to increase amount of creatinine in urine.

Physical and Chemical property of Urine:

Physical characteristics can be applied to **urine** include color, turbidity, smell (odor), pH (acidity – alkalinity) and density. Color: Typically yellow-amber, but varies according to diet and the concentration of the **urine**. Turbidity urine is unclear and murky urine whereas odor is indicate a high amounts of waste in the urine. The pH of urine may range from 4.5 to 8.

Chemical property of urine is an aqueous solution of greater than 95% **water**. Other constituents include urea, chloride,

sodium, potassium, creatinine and other dissolved ions, and inorganic and organic compounds.

Analysis Approx.	Range Covered	
Urea	38 – 500	mmol / L
Creatinine	1.0 – 22	mmol / L
Calcium	0.5 - 7.0	mmol / L
Phosphate	6 – 35	mmol / L
Protein	0 – 2	g /L
Albumin	0 – 2000	mg / L
Glucose	0 – 40	mmol / L

Role of Kidney in Urine Formation:

The kidneys filter unwanted substances from the blood and produce urine to excrete them. Urine is one of the body's waste products. It is primarily composed of water and urea. **Urea** is a special nitrogenous waste compound that the body must routinely remove. Urine formation occurs in the kidney in three stages: **filtration**, **reabsorption**, and **secretion**.

Stage 1: **filtration.** The **kidney** is the body's blood filtering system. Each kidney contains over 1 million tiny structures called **nephrons**. Each nephron has a **glomerulus**, the site of blood filtration. The glomerulus is a network of capillaries surrounded by a cuplike structure called the **Bowman's capsule**. This is where filtration occurs. Blood is pushed through the tiny capillaries; the high-pressure forces some things to pass through the capillary walls. Water, sugar, salts, amino acids, nitrogenous

wastes, and other tiny things. Cells and large blood proteins that cannot fit through remain in the blood vessels.

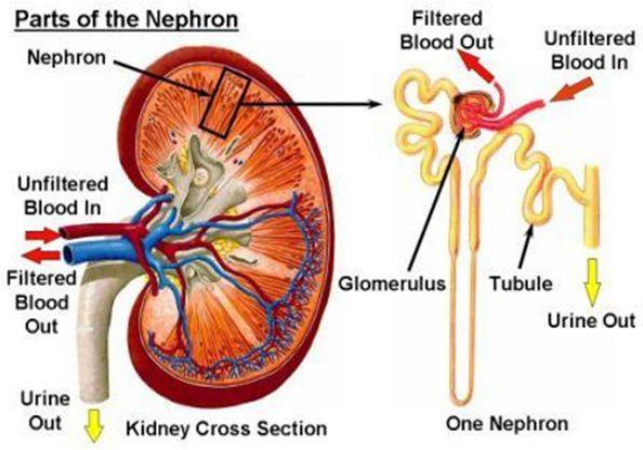
Stage 2: **Reabsorption**. The glomerulus filters water and small solutes out of the bloodstream. The resulting filtrate contains waste, but also other substances the body needs: essential ions, glucose, amino acids, certain salts, vitamins, hormones and smaller proteins. These valuable things are reabsorbed, by the body For example, diabetics with high levels of blood glucose may have glucose in their urine since it cannot all be reabsorbed.

Stage 3: **secretion**. The filtrate then passes through a neat structure called the **Loop of Henle** where it gains and losses water and salt. When it leaves the Loop of Henle, it enters the **distal tubule**, where secretion occurs. The body sometimes needs to send things on the express route to excretion.

Steps in forming urine

Three steps to forming urine:

1) Filtration
2) Reabsorption
3) Secretion



For example, toxins are do not go through filtration and reabsorption, they are secreted directly from the blood vessel

into the fully formed urine in the distal tubule. The secreted ions combine with the remaining filtrate and become urine. It passes out of the kidney through the renal pelvis, into the ureter, and down to the bladder.

Maintenance of body Fluids:

The excretion of water by the kidney is regulated to maintain a constant composition and concentration of extracellular **fluids** and in particular a constant plasma osmolarity. This is based on the anti-diuretic hormone (ADH) or vasopressin.

Sodium is one of the electrolytes found in the **body's fluids**. Electrolytes help with many things, like transmitting nerve impulses and **maintaining** proper muscle actions.

Fluid balance: is an aspect of the homeostasis of organisms, which the amount of water in the organism needs to be controlled. The core principle of fluid balance is that the amount of water lost from the body must equal the amount of water taken in; for example, in humans, the output (via respiration, perspiration, urination, defecation, and expectoration) must equal the input (via eating and drinking, or by parenteral intake). **Euvolemia** is the state of normal body fluid volume, including blood volume, interstitial fluid volume, and intracellular fluid volume; hypovolemia and hypervolemia. Water is necessary for all life on Earth. Humans can survive for 4 to 6 weeks without food but only for a few days without water.

Profuse sweating can increase the need for electrolyte. Water-electrolyte imbalance produces headache and fatigue if mild; illness if moderate, and sometimes even death if severe. Diarrhea is a threat to both body water volume and electrolyte levels, which is why diseases that cause diarrhea are great threats to fluid balance.

Body fluids and the role in acid-bace balance:

Everyday processes like walking, the digestion of food, and the overall metabolism in the body produce a lot of acid as a byproduct. The kidneys were help to regulate the body's pH through something we call acid-base balance. This is a process whereby receptors are able to determine the pH of the body and blood and do something about it if it's too acidic or too basic.

Blood needs the right balance of acidic and basic to function properly. This is called the acid-base balance. Kidneys and lungs work to maintain the acid-base balance. The kidneys have two very important roles in maintaining the acid–base balance: They reabsorb bicarbonate from urine. They excrete hydrogen ions into urine.

A key task of the body is to regulate acid-base balance. Perturbations in acid-base balance are among the most important problems confronting clinicians in a hospital. The kidneys work in partnership with the respiratory system to keep plasma acid-base status within normal limits.