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NURSING SCIENCE

17/MHS02/037

URINE FORMATION AND CONCERNTRATION

Urine is formed in the kidneys through a filtration of blood . urine is pass through the ureters to the bladder . During urination the urine is passed from the bladder through the urethra to the outside of the body.

The kidneys filter unwanted substances from the blood and produce urine to excrete them

The processes involved in urine formation

There are three main steps of urine formation:

- Glomerula filtration
- Tubular reabsorption
- Tubular secretion

These processes ensure that only waste and excess water are removed from the body.

Glomerula Filtration

The kidney is the body's blood filtering system. Blood vessels visit the kidney and enter a special ball of capillaries called the glomerulus. The glomerulus is nestled within a region of the kidney called the Bowman's Capsule. This is where filtration occurs. As blood is pushed through the tiny capillaries, the high-pressure forces some things to pass through the capillary walls. The walls act as a sieve or a filter. Hence, it is called filtration.Water, sugar, salts, amino acids, nitrogenous wastes, and other tiny things enter the kidney as a substance called the filtrate. Cells and large blood proteins that cannot fit through remain in the blood vessels. The filtrate entering the kidney is like pre-pre-urine.

Tubular Reabsorption

The filtrate enters the kidney in the proximal tubule. This region of the kidney is special because many things can be removed from the filtrate. These valuable things are recollected, or reabsorbed, by the body.

Glucose, certain salts, vitamins, hormones, and amino acids are restored to the body and will not be included in urine. Sometimes, if the body has too much of something then the extra sugar or salt will stay in the filtrate. For example, diabetics with high levels of blood glucose

may have glucose in their urine since it cannot all be reabsorbed. The filtrate after reabsorption is like pre-urine

Tubular Secretion

The filtrate then passes through a really neat structure called the Loop of Henle where it gains and loses water and salt. As it leaves the Loop of Henle, it enters the distal tubule, where secretion occurs.

osmosis, and small proteins are reabsorbed by pinocytosis.

Secretion takes place from the blood in the peritubular capillaries to the filtrate in the renal tubules and can ensure that wastes such as creatinine or excess H+ or excess K+ ions are actively secreted into the filtrate to be excreted.

Excess K+ ion is secreted in the tubules and in exchange Na+ ion is reabsorbed otherwise it causes a clinical condition called Hyperkalemia.

Tubular secretion of hydrogen ions (H+) is very important in maintaining normal blood pH.

Substances such as , e.g. drugs including penicillin and aspirin, may not be entirely filtered out of the blood because of the short time it remains in the glomerulus. Such substances are cleared by secretion from the peritubular capillaries into the filtrate within the convoluted tubules.

The tubular filtrate is finally known as urine. Human urine is usually hypertonic.

Composition of human urine

Water – 96%

Urea – 2%

Uric acids, creatinine, pigments- 0.3%

Inorganic salts – 2%

Bad smell is due to Urinoid

Pale yellow color due to urochrome or urobillin (which is a breakdown product of haemoglobin)

URINE CONCERTRATION

ADH

It is a hormones that influences selective reabsorption by increasing the permeability of the convoluted tubule and collecting tubules which als o increases water reabsorption.

Antidiuretic hormone (ADH) causes the kidneys to release less water, decreasing the amount of urine produced. A high ADH level causes the body to produce less urine. A low level results in greater urine production.

- ADH controls urine concentration

Glomerular filtration, starting with the anatomy of the nephron

*In the presence of ADH, the medullary collecting ducts become freely permeable to solute and water. As a consequence, the fluid entering the ducts (en route to the renal pelvis and subsequent elimination) acquires the concentration of the interstitial fluid of the medulla; i.e., the urine becomes concentrated.

- The laboratory will test how concentrated your urine is. More concentrated urine means that there are more solutes and less water in the sample. Solutes are dissolved particles, such as sugars, salts, and proteins. Normal values may vary based on the laboratory used.

PROPERTIES/CHARACTERISTICS

Amber color ,ph 4.5 to 8.0, specific gravity is 1.003-1.032

urine include color, turbidity (transparency), smell (odor), pH (acidity – alkalinity) and density.

Since the ph, specific gravity, volume and others varies within a physiological range it means that concentration of urine varies and there could be diluted or concentrated urine.

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Glomerular filtration, starting with the anatomy of the nephron

WHAT MOLECULES OF BLOOD ARE FILTERED

*Filtered molecules involve small molecules such as

-water,

-electrolytes,

- glucose and

-small proteins.

Large molecules include: cells and large proteins. So large molecules like Red water, electrolytes, glucose and small proteins. Large

*Non-filtered molecules include:

cells and large proteins.

Glomerular filtration rate (GFR)

Glomerular filtration rate (GFR) is a test used to check how well the kidneys are working. Specifically, it estimates how much blood passes through the glomeruli each minute. Glomeruli are the tiny filters in the kidneys that filter waste from the blood

Mathematicaly GFR is calculated as

Glomerular filtration rate (GFR), is determined by the equation GFR = Kf × net filtration pressure,where Kf is the filtration coefficient. ... An increase in renal arterial pressure (or renal blood flow) causes an increase in GFR.

Glomerular filtration rate (GFR) is the amounts of fluid filtered through the glomerular capillaries. It is about 180 liters each day and *125ml/min

N/B

Nephron is composed of glomerulus, bowman capsule and tubule

SEGMENT OF THE TUBULES ARE

1.Proximal tubule

2.Loop of Henle

3.Distal convoluted tubule.

4.Collecting duct.

removed from the plasma by the kidney and excreted in urine.

1. Potassium is secreted actively by sodium potassium pump in proximal and distal convoluted tubules and collecting ducts

2. Ammonia is secreted in the proximal convoluted tubule

3. Hydrogen ions are secreted in the proximal and

distal convoluted tubules. Maximum hydrogen ion

secretion occurs in proximal tubule

4. Urea is secreted in loop of Henle

- Filtration occurs in the GLOMERULUS

GLOMERULAR FILTRATION

ANATOMY OF NEPHRON

The nephron is the microscopic structural and functional unit of the kidney. It is composed of a renal corpuscle and a renal tubule. The renal corpuscle consists of a tuft of capillaries called a glomerulus and an encompassing Bowman's capsule. The renal tubule extends from the capsule.

HOW IS URINE PASSED OUT OF THE BODY

- At the end of the process, Urine excreted/passed out of the bladder and the body through the urethra. The kidneys, ureters, bladder, and urethra make up the urinary tract,the pathway through which urine flows and is eliminated from the body.
- Accumulation of urine in the bladder wall generating sensory (afferent) impulses that are transmitted to the spinal cord, where a spinal reflex is initiated. This stimulates involuntary contraction of the detrusor muscle and relaxation of the internal urethral sphincter and expels urine from the bladder. This is known as Micturition or voiding of urine.

  ### RENAL CLEARANCE

  Renal clearance of a substance refers to the how quickly a particular substance is removed from the plasma by the kidney and excreted in urine.