Name: Akintunde Dolapo Ayomide.

Matric No:18/mhs02/033.

Level/Department: 200L/Nursing.

Course Code: PHS 212.

QUESTION.

EXPLAIN URINE FORMATION AND CONCENTRATION.

ANSWER.

URINE FORMATION.

Urine formation is a blood cleansing function. Normally, about 1,300 mL of blood (26% of cardiac output) enters the kidneys. Kidneys excrete the unwanted substances along with water from the blood as urine. Normal urinary output is 1L/day to 1.5 L/day.

Processes of Urine Formation:

When blood passes through glomerular capillaries, the plasma is filtered into the Bowman Capsule. This process is called glomerular filtration. Filtrate from Bowman capsule passes through the tubular portion of the nephron. While passing through the tubule, the filtrate undergoes various changes both in quality and in quantity. Many wanted substances like glucose, amino acids, water and electrolytes are reabsorbed from the tubules. This process us called tubular reabsorption. Some unwanted substances are secreted into the tubule from peritubular blood vessels. This process is called tubular secretion or excretion. Thus, the urine formation includes three processes:

1. Glomerular filtration.

2. Tubular reabsorption.

3. Tubular secretion.

Among these three processes filtration is the function of the glomerulus. Reabsorption and secretion are the functions of tubular portion of the nephron.

Glomerular Filtration:

Glomerular filtration is the process by which he blood is filtered while passing through the glomerular capillaries by filtration membrane. It is the first process of urine formation. The structure of filtration membrane is well suited for filtration.

Filtration Membrane

Filtration membrane is formed by three layers:

1. Glomerular capillary membrane.

2. Basement membrane.

3. Visceral layer of Bowman capsule.

TUBULAR REABSORPTION.

Tubular reabsorption is the process by which water and other substances are transported from renal tubules back to the blood. When the glomerular filtrate flows through the tubular portion of nephron, both quantitative and qualitative changes occur. Large quantity of water (more than 98%), electrolytes and other substances are reabsorbed by the tubular epithelial cells. The reabsorbed substances move into the interstitial fluid of renal medulla. And, from here, the substances move into the blood in peritubular capillaries. Since the substances are taken back into the blood from the glomerular filtrate, the entire process is called tubular reabsorption.

METHODS OF COLLECTION OF TUBULAR FLUID.

There are two methods to collect the tubular fluid for analysis.

1. Micropuncture Technique.

2. Stop-flow Method.

TUBULAR SECRETION.

Tubular secretion is the process by which the substances are transported from blood into renal tubules. It is also called tubular excretion. In addition to reabsorption ftom renal tubules, some substances are also secreted into the lumen from the peritubular capillaries through the tubular epithelial cells. DYE PHENOL RED was the first substance found to be secreted in renal tubules in experimental conditions. Later many other substances were found to be secreted. Such substances are;

1. Para-aminohippuric acid (PAH).

2. Diodrast.

3. 5-hydroxyindoleacetic acid (5-HIAA).

4. Amino derivatives.

5. Penicillin.

SUBSTANCES SECRETED IN DIFFERENT SEGMENTS OF RENAL TUBULES.

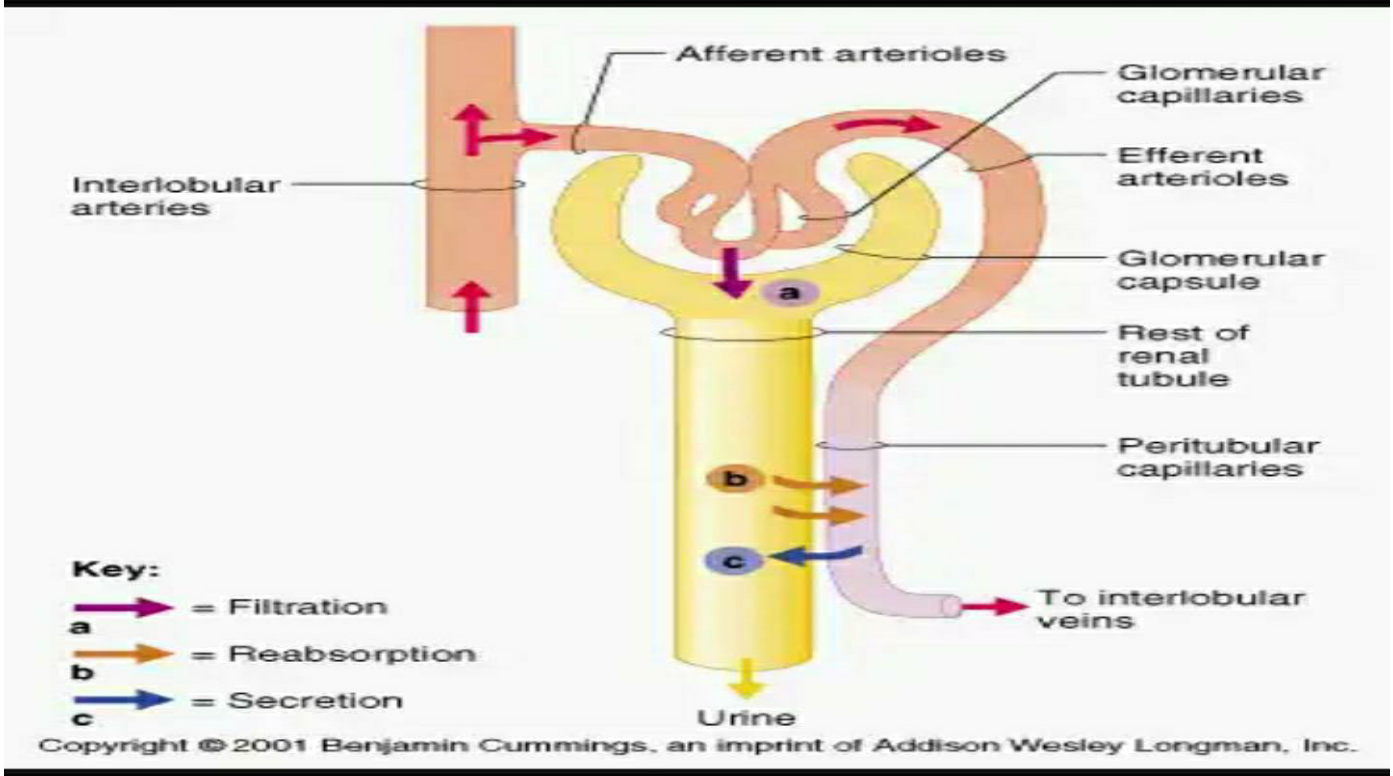
1. Potassium is secreted actively by sodium-potassium pump in proximal and distal convoluted tubules and collecting ducts.

2. Ammonia is secreted in the proximal convoluted tub.

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.

Thus, urine is formed in nephron by the processes of glomerular filtration, selective reabsorption and tubular secretion.



URINE CONCENTRATION.

When the glomerular filtrate passes through renal tubule, it's osmolarity is altered in different segments.

1. BOWMAN CAPSULE;

Glomerular filtrate collected at the Bowman capsule is isotonic to plasma. This is because it contains all the substances of plasma except proteins. Osmolarity of the filtrate at Bowman capsule is 300 mOsm/L.

2. PROXIMAL CONVOLUTED TUBULE;

When the filtrate flows through proximal convoluted tubule, there is active reabsorption of sodium and chloride followed by obligatory reabsorption of water. So, the osmolarity of fluid remains the same as in the case of Bowman capsule, i.e. 300 mOsm/L. Thus, in proximal convoluted tubules, the fluid is isotonic to plasma.

3. THICK DESCENDING SEGMENT;

When the fluid passes from proximal convoluted tubule into the thick descending segment, water is reabsorbed from tubule into outer medullary interstitium by means of osmosis. It is due to the increased osmolarity in the medullary interstitium, i.e. outside the thick descending tubule. The osmolarity of the fluid inside the segment is between 450 and 600 mOsm/L. That means the fluid is slightly hypertonic to plasma.

4. THIN DESCENDING SEGMENT OF HENLE LOOP;

As the thin descending segment of Henle loop passes through the inner medullary interstitium (which is increasingly hypertonic) more water is reabsorbed. This segment is highly permeable to water and so the osmolarity of tubular fluid becomes equal to that of the surrounding medullary interstitium. In the short loops of cortical nephrons, the osmolarity of fluid at the hairpin bend of loop becomes 600 mOsm/L. Thus in this segment the fluid is hypertonic to plasma.

5. THIN ASCENDING SEGMENT OF HENLE LOOP;

When the thin ascending segment of the loop ascends upwards through the medullary region, osmolarity decreases gradually. Due to concentration gradient, sodium chloride diffuses out of tubular fluid and osmolarity decreases to 400 mOsm/L. The fluid in this segment is slightly hypertonic to plasma.

6. THICK ASCENDING SEGMENT;

This segment is impermeable to water. But there is active reabsorption of sodium and chloride from this. Reabsorption of sodium decreases the osmolarity of tubular fluid to a greater extent. The osmolarity is between 150 and 200mOsm/L. The fluid inside becomes hypotonic to plasma.

7. DISTAL CONVOLUTED TUBULE AND COLLECTING DUCT.

In the presence of ADH, distal convoluted tubule and collecting duct become permeable to water resulting in water reabsorption and final concentration of urine. It is found that in the collecting duct, principal (P) cells are responsible for ADH induced water reabsorption. Reabsorption of large quantity of water increases the osmolarity to 1,200 mOsm/L. The urine becomes hypertonic to plasma.