ADEBAYO BLESSING OMOLOLA

17/MHS01/013

MEDICINE AND SURGERY

300 LEVEL

RENAL PHYSIOLOGY

1. Discus the pathophysiological process involved in renal failure
2. With the aid of suitable diagrams discuss the types of dialysis you know.

ANSWERS

1. **PATHOPHYSIOLOGICAL PROCESS INVOLVED IN RENAL FALURE**

   Kidneys excrete the unwanted waste products, which are formed during metabolic activities. 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. In the normal process of urine formation 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 is called tubular reabsorption. And, some unwanted substances are secreted into the tubule from peritubular blood vessels. This process is called tubular secretion or excretion

   THE PATHOPHYSIOLOGY:

   Renal failure refers to failure of excretory functions of kidney. It is usually, characterized by decrease in glomerular filtration rate

(GFR). Severe renal failure can be divided into two main categories:

- **Acute renal failure**, in which the kidneys abruptly stop working entirely or almost entirely but may eventually recover nearly normal function, and
- **Chronic renal failure**, in which there is progressive loss of function of more and more nephrons that gradually decreases overall kidney function.

The causes of acute renal failure can be divided into three main categories:

i. Acute renal failure resulting from decreased blood supply to the kidneys; this condition is often referred to as prerenal acute renal failure to reflect the fact that the abnormality occurs in a system before the kidneys. This can be a consequence of heart failure with reduced cardiac output and low blood pressure or conditions associated with diminished blood volume and low blood pressure, such as severe haemorrhage.

ii. Intrarenal acute renal failure resulting from abnormalities within the kidney itself, including those that affect the blood vessels, glomeruli, or tubules.

iii. Postrenal acute renal failure, resulting from obstruction of the urinary collecting system anywhere from the calyces to the outflow from the bladder.The most common causes of obstruction of the urinary tract outside the kidney are kidney stones, caused by precipitation of calcium, urate, or cysteine.

Major physiologic effect of renal failure is retention in the blood and extracellular fluid of water, waste products of metabolism, and electrolytes. This can lead to water and salt overload, which in turn can lead to Edema and hypertension. Excessive retention of potassium, however, is often a more serious threat to patients with acute renal failure, because increases in plasma potassium

concentration (hyperkalemia) to more than about 8 mEq/L (only twice normal) can be fatal. Because the kidneys are also unable to excrete sufficient hydrogen ions, patients with acute renal failure develop metabolic acidosis, which in itself can be lethal or can aggravate the hyperkalemia. In the most severe cases of acute renal failure, complete anuria occurs. The patient will die in 8 to 14 days unless kidney function is restored or unless an artificial kidney is used to rid the body of the excessive retained water, electrolytes, and waste products of metabolism.

Other effects are:

Anemia: Since erythropoietin is not secreted in the kidney during renal failure, the production of RBC decreases resulting in normocytic normochromic anemia.

Hyperparathyroidism: Secondary hyperparathyroidism is developed due to the deficiency of calcitriol (1,25-dihydroxycholecalciferol). It increases the removal of calcium from bones resulting in osteomalacia.

2. **DIALYSIS** is the procedure to remove waste materials and toxic substances and to restore normal volume and composition of body fluid in severe renal failure.

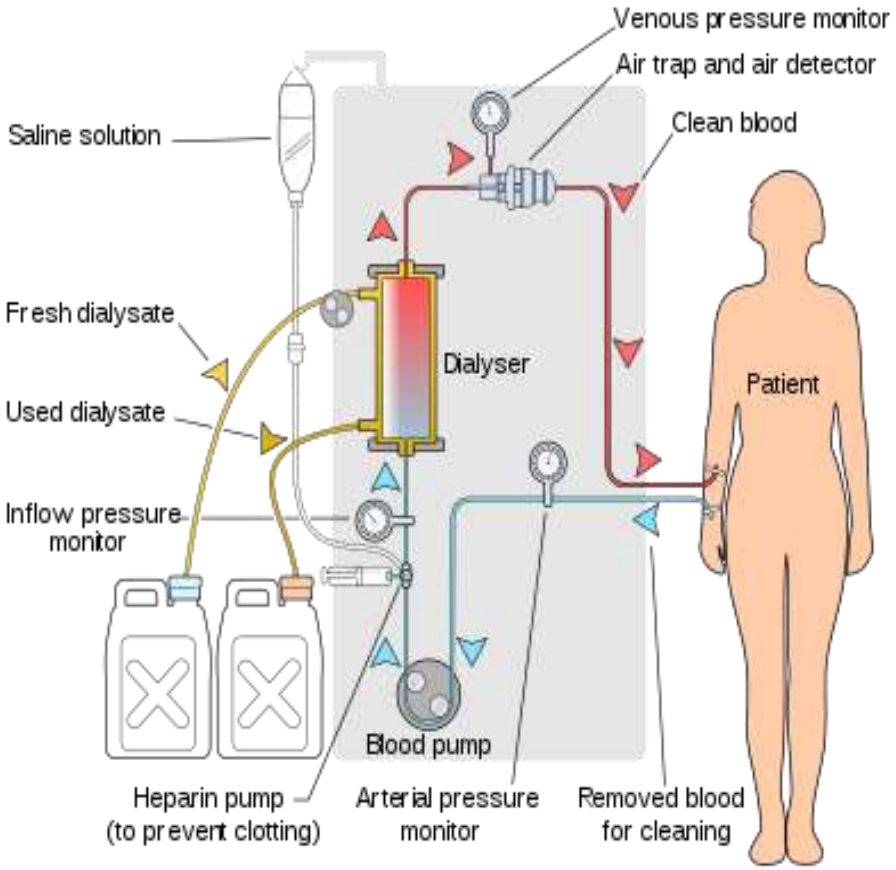
   Artificial kidney is the machine that is used to carry out dialysis during renal failure. It is used to treat the patients suffering from acute renal failure and Chronic or permanent renal failure.

   TYPE OF DIALYSIS:

i. Hemodialysis
ii. Peritoneal dialysis
iii. Hemofiltration

HEMODIALYSIS: Hemodialysis utilizes counter current flow, where the dialysate is flowing in the opposite direction to blood flow in the extracorporeal circuit. Counter-current flow maintains the concentration gradient across the membrane at a maximum and

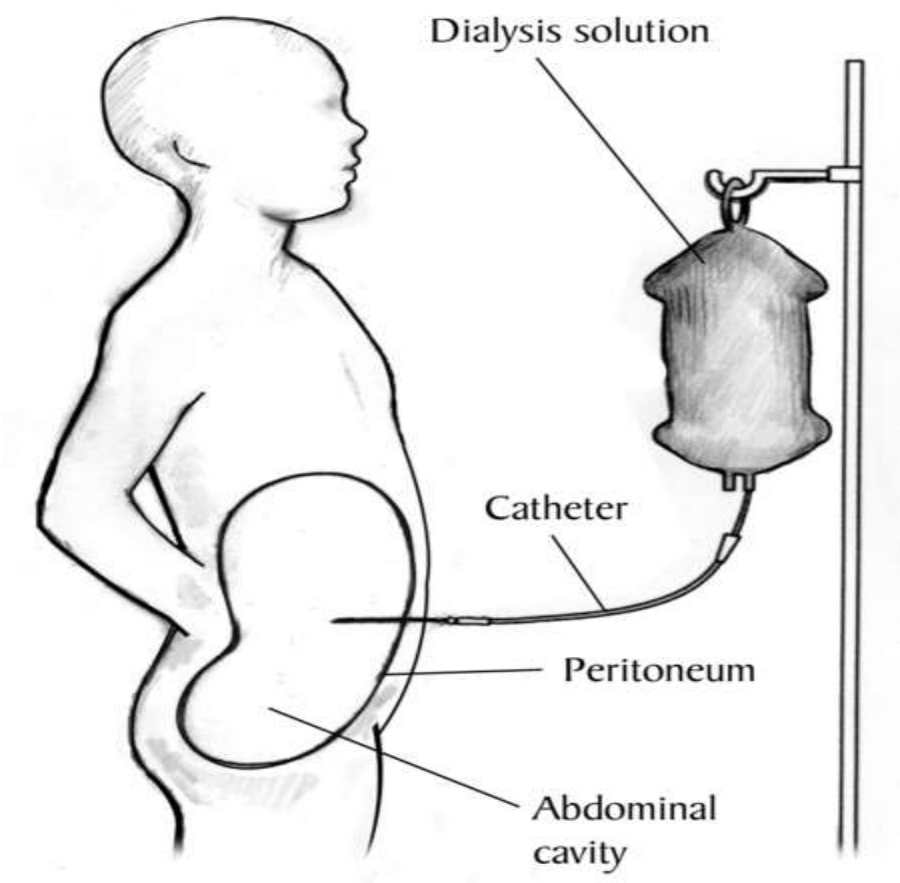
increases the efficiency of the dialysis. In hemodialysis, the patient's blood is pumped through the blood compartment of a dialyzer, exposing it to a partially permeable membrane. The dialyzer is composed of thousands of tiny hollow synthetic fibers. The fiber wall acts as the semipermeable membrane. Blood flows through the fibers, dialysis solution flows around the outside of the fibers, and water and wastes move between these two solutions. The cleansed blood is then returned via the circuit back to the body. Ultrafiltration occurs by increasing the hydrostatic pressure across the dialyzer membrane. This usually is done by applying a negative pressure to the dialysate compartment of the dialyzer. This pressure gradient causes water and dissolved solutes to move from blood to dialysate and allows the removal of several litres of excess fluid during a typical 4-hour treatment.



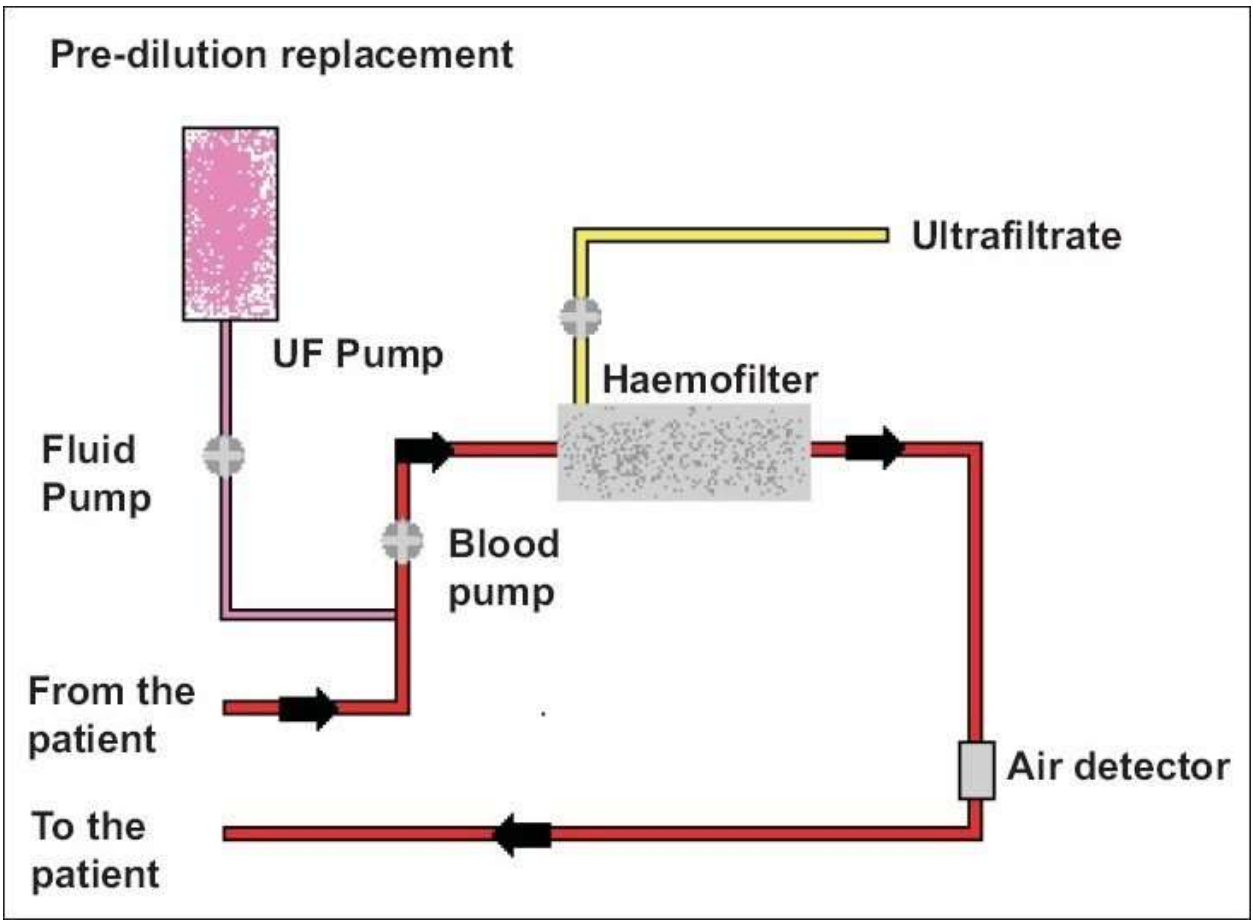
PERITONEAL DIALYSIS: Peritoneal dialysis (PD) is a type of dialysis which uses the peritoneum in a person's abdomen as the membrane through which fluid and dissolved substances are exchanged with the blood. It is used to remove excess fluid, correct electrolyte problems, and remove toxins in those with kidney failure.

In peritoneal dialysis, a sterile solution containing glucose (called dialysate) is run through a tube into the peritoneal cavity, the abdominal body cavity around the intestine, where the peritoneal membrane acts as a partially permeable membrane.

This exchange is repeated 4–5 times per day; automatic systems can run more frequent exchange cycles overnight. Peritoneal dialysis is less efficient than hemodialysis, but because it is carried out for a longer period of time the net effect in terms of removal of waste products and of salt and water are similar to hemodialysis. It has better outcomes than hemodialysis during the first couple of years. Other benefits include greater flexibility and better tolerability in those with significant heart disease.



HEMOFILTRATION: Hemofiltration is a similar treatment to hemodialysis, but it makes use of a different principle. The blood is pumped through a dialyzer as in dialysis, but no dialysate is used. A pressure gradient is applied; as a result, water moves across the very permeable membrane rapidly, "dragging" along with it many dissolved substances, including ones with large molecular weights, which are not cleared as well by hemodialysis. Salts and water lost from the blood during this process are replaced with a "substitution fluid" that is infused into the extracorporeal circuit during the treatment.


Pre-dilution replacement
Ultrafiltrate
UF Pump
Haemofilter
Fluid
Pump
Blood
pump
From the
patient
Air detector
To the
patient