NAME: FAKROGHA LATRICIA OYINTARE

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LEVEL:300L

1. PATHOPHYSIOLOGICAL PROCESS OF RENAL FAILURE

Renal failure has to do with the failure of the excretory functions of the kidney. However, it is often described as a decrease in the **GLOMERULAR FILTRATION RATE(GFR)**. It is regarded as the best index used to determine renal failure. **The normal value for the GFR=125ml/min/7.3m^2**. During initial stages of renal failure, the GFR is not affected that much, that is, if 50% of the nephrons are affected initially, there would only be a 20-30% decrease in the GFR index. This is due to the compensatory efforts of the unaffected nephrons.

Thus, renal failure could be:

a. Acute and
b. Chronic

A. **ACUTE RENAL FAILURE**: ACUTE means a sudden occurrence. Therefore, an acute renal failure is an abrupt or sudden stoppage of renal functions. It can lead to sudden life-threatening reactions in the body that will require urgent treatment. This form of renal failure can be ***reversed*** within few days to weeks. Some identified causes are:

1. Acute nephritis: Inflammation of the kidneys as a result of immune reactions within the body
2. Damage to the renal tissues by toxic poisons like lead, mercury and $CaCl_4$
3. Renal ischemia, as a result of circulatory shock
4. Acute Tubular Necrosis: This necrosis of tubular cells in the kidney can be caused by burns, hemorrhage, snake bite, toxins (heavy metals, etc), and drugs (diuretics, etc)
5. Severe transfusion reactions
6. Sudden fall in blood pressure due to hemorrhage, diarrhea, severe burns etc.
7. Formation of calculi (kidney stones) or tumors in the ureter leading to blockage

CHARACTERISTICS OF ACUTE RENAL FAILURE

1. OLIGURIA: Decreased renal output
2. Anuria: Stoppage of urine formation in severe cases

3. Proteinuria: Presence of proteins in the urine. Can also include albuminuria.
4. Hematuria
5. Edema: Caused by the increase in the volume of the extracellular fluid due to retention of sodium and water.
6. Hypertension: Occurs within a few days of the increased extracellular fluid volume.
7. Acidosis; due to retention of the metabolic end products.
8. Glycosuria: Presence of glucose in the urine due to increase in the threshold of glucose by the kidney.

B. **CHRONIC RENAL FAILURE**: This is also called **END-STAGE RENAL DISEASE**. It is a progressive, ***irreversible*** deterioration in renal function in which the body's ability to maintain metabolic and fluid and electrolyte balance fails, resulting in uremia or azotemia (retention of urea and other nitrogenous wastes in the blood). There are still compensatory efforts made by the unaffected nephrons here but as **more nephrons start losing their function over time**, the compensatory provisions fail and chronic renal failure ensues.

CAUSES OF END STAGE RENAL DISEASE

1. Diabetes Mellitus (LEADING CASUE)
2. Hypertension
3. Obstruction of the urinary tract (kidney stones)
4. Chronic glomerulonephritis
5. Pyelonephritis
6. Comorbid conditions that develop during chronic renal insufficiency contribute to the high morbidity and mortality among patients with ESRD.
7. Polycystic kidney disease
8. Toxic agents (chromium, mercury, lead)

PATHOPHYSIOLOGY

As renal function declines, the end products of protein metabolism (which are normally excreted in urine) accumulate in the blood. Uremia develops and adversely affects every system in the body. The greater the buildup of waste products, the more severe the signs and symptoms. The rate of decline in renal function and progression of chronic renal failure is related to the **underlying disorder, the urinary excretion of protein, and the presence of hypertension**. The disease tends to progress more rapidly in patients who excrete significant amounts of protein or have elevated blood pressure than in those without these conditions.

CHARACTERISTICS OF ESRD

1. Uremia: Characterized by the excess accumulation of end products of protein metabolism urea, nitrogen and creatinine in the blood due to the failure of the

kidney to excrete these substances, therefore to the detriment to the normal functioning the body system. Some of the symptoms are anorexia, lethargy etc.

2. Acidosis
3. Edema; failure of the kidney to excrete sodium and other electrolytes will cause increase in extracellular fluid.
4. Anemia: Erythropoietin production by the kidney ceases during renal failure therefore resulting in normocytic normochromic anemia.
5. Hyperparathyroidism: This develops after the renal failure due to the deficiency of **calcitriol** which is normally produced by a normal kidney. It leads to the increased removal of calcium from bones resulting **osteomalacia**.

2. **TYPES OF DIALYSIS**

DAILYSIS is the procedure done to remove waste materials and toxic substances and to restore normal volume and composition of body fluid in severe renal failure. The frequency and duration of the dialysis depends on the severity of the renal dysfunction.

PRINCIPLE

DAILYSIS is a term that refers to the diffusion of solutes from an area of higher concentration to the area of lower concentration through a semipermeable membrane. An artificial kidney(DIALYSER) is used to carry out the dialysis during renal failure both chronic and acute.

TYPES OF DIALYSIS

1. Hemodialysis
2. Peritoneal dialysis
3. Continuous replacement therapy

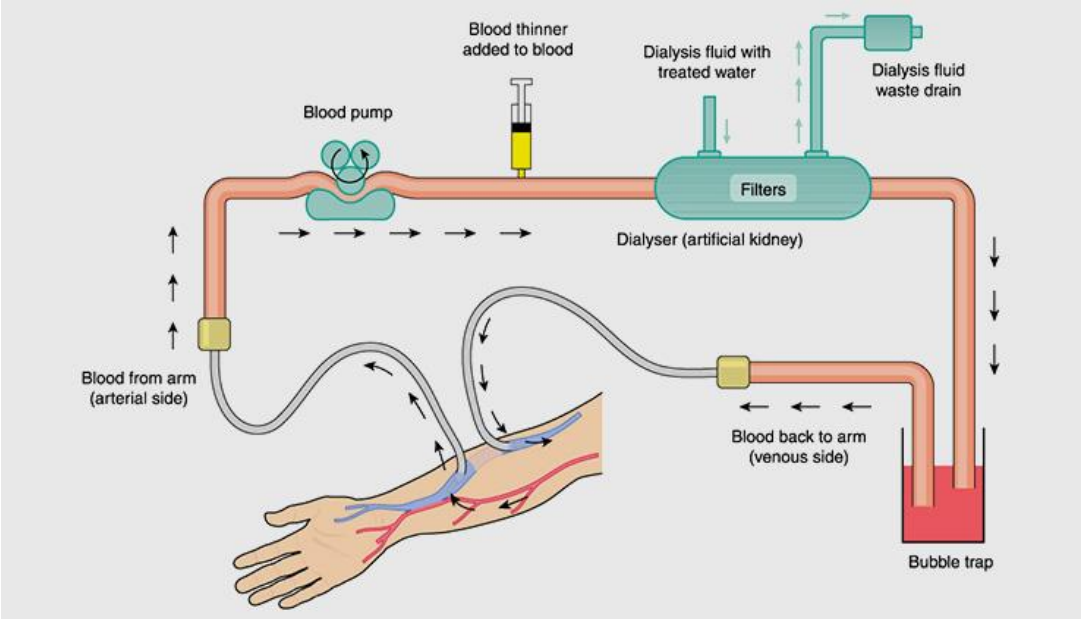
1. **HEMODIALYSIS**:
   Hemodialysis is a procedure where a dialysis machine and a special filter called an artificial kidney, or a dialyzer, are used to clean the blood and returned back to the body.

   EQUIPMENT

- Artificial (dialyzer)
- Dialysis solution (dialysate)
- Tubing for transport of blood and dialysis solution(Atriovenous(AV) Fistula, AV Graft or Central venous graft)
- Heparin

PROCEDURE

An AV fistula is a vascular access created to get the blood from the body to the dialyzer and back to the body. The vascular access has two needles for the aforementioned purpose. They connect to the dialyzer bringing blood from the body and taking cleansed blood away from the dialyzer. The dialysis machine acts a pump and computer. It keeps track of blood flow, blood pressure, how much fluid is removed and other vital information. It mixes the dialysate, or dialysis solution, which is the fluid bath that goes into the dialyzer. This fluid helps pull toxins from the blood through diffusion, and then the bath goes down the drain. The electrolytes in the dialysis solution are also used to balance the electrolytes in the patient's blood. The extra fluid is removed through a process called filtration. The dialysis machine has a blood pump that keeps the blood flowing by creating a pumping action on the blood tubes that carry the blood from the body to the dialyzer and back to the body.



PERITONEAL DIALYSIS

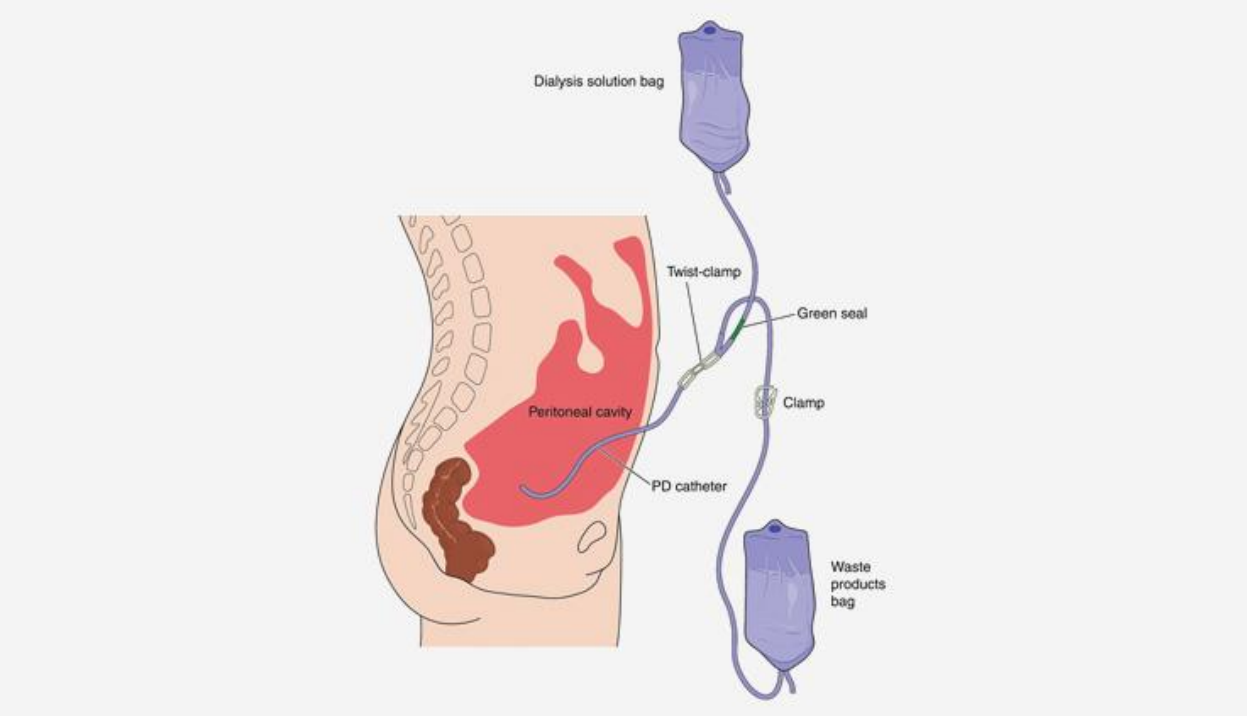
Here, the peritoneal membrane is used as the semipermeable membrane. It is also used in the treatment of the renal failure. The body is being cleaned without being removed from the body. A **DIASYLATE** (salt and sugars) is poured into the abdomen and it absorbs the waste from the blood through he peritoneal membrane which acts as natural filter.

EQUIPMENT

1. Catheter
2. Peritoneal cavity; dialysis takes place here.
3. Peritoneal membrane; acts naturally to filter wastes and fluid from the blood into the dialysates in the peritoneal cavity.

PROCEDURE

A catheter is inserted into the peritoneal cavity through anterior abdominal wall and sutured. The diasylate is passed through this catheter under gravity. The electrolytes in the diasylate pass through the vascular peritoneum into blood vessels of abdominal cavity. Urea, nitrogen and creatinine and other unwanted substances diffuse through the blood vessels into the diasylate for dialysis to take place. Then the diasylate is drained from the peritoneal cavity by gravity to the waste bag.



This can be done at the comfort of your home but it can result in some complications like infections because it is less efficient in removing some toxic substances.

CONTINUOUS REPLACEMENT THERAPY

This therapy is used primarily in the intensive care unit for people with acute kidney failure. It's also known as hemofiltration. A machine passes the blood through tubing. A filter then removes waste products and water. The blood is returned to the body, along with replacement fluid. This procedure is performed 12 to 24 hours a day, generally every day.