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QUESTION 1

Discuss the pathophysiological process involved in renal failure.

ANSWER

Renal failure is defined as a significant loss of renal function in both kidneys to the point where less than 10% to 20% of normal glomerular filtrate rate remains. It refers to the deterioration of renal functions resulting in a declination in glomerular filtrate rate and rise in urea and non-nitrogenous substances in the blood

PATHOPHYSIOLOGY OF RENAL FAILURE

In renal failure there is either glomerular or tubular dysfunction. For instance glomerulonephritis which is the primary cause of glomerular damage and aminoglycoside nephrotoxicity mainly in tubular damage

- **Glomerular Dysfunction**: The main function of the glomeruli is filtration and when there is a damage to it there would be a fall in glomerular filtrate with retention of those substances usually cleared by filtration including water
- **Tubular Dysfunction**: The main function of the tubules is reabsorption; tubular damage will result in voiding of large volumes of dilute urine of low specific, along with electrolytes and nutrients.

There are two types of renal failure and they are:

1. Acute Renal Failure
2. Chronic Renal Failure

ACUTE RENAL FAILURE

This refers to a sudden decline in glomerular filtrate rate over a period of time associated with rapid rise in blood urea. It has an abrupt onset and is potentially reversible. It is characterized by rapid onset of renal dysfunction, chiefly anuria, oliguria and sudden increase in metabolic waste products in the blood with consequent development of uraemia.

CAUSES

Some common disorders that would lead to acute renal failure are: Myocardial infarction, rhabdomylosis, decreased blood flow, obstruction, haemolytic uremic syndrome, and glomerulonephritis.

However it can be classified into three types based on its causes, and they are Pre-renal, intra renal and post renal failure.

- **Pre-renal failure**: Pre renal failure results from impaired or reduced blood flow to the kidney which cause sudden decrease in blood flow to the nephron. Possible causes are shock, hypertension, anaphylaxis, ischemic formation. Renal ischemia ultimately results in functional disorders of depression of glomerular filtrate rate.
- **Intra renal failure**: This results from acute damage to renal structure. It is caused by acute glomerulonephritis, pyelonephritis, and acute tubular necrosis, damage from toxins, solvents, drugs and heavy metals. However the most common cause is acute tubular necrosis.
- **Post renal failure:** This results from obstruction to the flow of urine anywhere along the renal tract distal to the opening of the collecting tubules, ureter, bladder neck or urethra. Possible causes are obstruction of urine outflow by calculi, tumours, prostrate hypertrophy.

CLINICAL FEATURES

This depends on the underlying cause of acute renal failure and on the stage of the disease at which the patient presents.

1. **ACUTE NEPHRITIS**
   In this case there would be renal dysfunction which results from extensive proliferation of epithelial cells in the glomeruli, increase in glomerular permeability and decreased glomerular filtrate rate. Features of this disorders are; proteinuria, haematuria, oedema, mild hypertension, fluid retention due to diminished glomerular filtrate rate and increased salt and water reabsorption in the distal nephron.
2. **TUBULAR DISORDER**
   When acute renal failure is caused by tubular damage of the nephron, the disease will progress through three characteristic phases. They are:
   - Oliguria phase: this phase lasts for an average of 7 – 10 days with urinary output at less than 400ml per day. It leads to accumulation of waste products of metabolism in the blood and resultant azotaemia, metabolic acidosis, hyperkalaemia, hypernatremia and hypervolemia. Specific gravity of the urine is low but the concentration of sodium in urine tends to be elevated.
   - Diuretic phase: With the onset of healing of the tubules there is improvement in urinary output.
   - Phase of recovery: Full recovery occurs in half the cases while others end in death.

3. **PRE-RENAL DISORDER**
   These are disorders in which neither the glomeruli nor tubules are damaged. This is seen in ischemia caused by renal arterial obstruction, hypervolemia, hypotension or cardiac insufficiency. Due to repressed blood flow there is decrease in glomerular filtrate rate causing oliguria, azotaemia, oedema and possible fluid retention.

CHRONIC RENAL FAILURE

This is characterized by progressive and irreversible deterioration of renal function. There is slow destruction of renal parenchyma, which eventually leads to death when a number of nephrons have been damaged. The major problem in chronic renal failure is acidosis with development of azotaemia and clinical uraemia syndrome.

CAUSES
All chronic nephropathies can lead to chronic renal failure. The diseases leading to chronic renal failure can be classified in two groups. They are:

- Those causing glomerular pathology
- Those causing tubulointerstitial pathology

However it doesn't remain confined to the tubules or glomeruli alone. In the final stages all parts of the nephron are involved.

DISEASE CAUSING GLOMERULAR PATHOLOGY
A number of glomerular diseases associated with chronic renal failure have their pathogenesis in immune mechanism. Glomerular damage results in changes in filtration process and it leads to nephritic syndrome characterized by proteinuria, hypoalbuminaemia and oedema. A primary glomerular disorder includes **chronic glomerulonephritis** which is a major cause of chronic renal failure. Systemic/secondary glomerular disorders originate outside the renal system but induce changes in the nephron, they include: **lupus erythematous, serum sickness nephritis and diabetic nephropathy.**

DISEASE CAUSING TUBULOINTERSTIAL PATHOLOGY
Any damage to the tubules will result in alteration in reabsorption and secretion of important constituents leading to the excretion of large volumes of dilute urine. It can be categorized into four causes:

- Vascular causes: Hypertension will produce characteristic changes in the renal arteries and arterioles and this can be referred to as nephrosclerosis
- Infections: Pyelonephritis will result in progressive damage to the nephrons
- Toxic causes: High doses of analgesics, aspirin, acetaminophen and also prolonged exposure to lead, uranium and cadmium could lead to chronic renal failure.
- Obstructive cause: Chronic obstruction can lead to progressive damage to the nephron due to fluid backpressure.

Chronic renal failure evolves progressively through four stages despite the cause. These stages are:

- Diminished renal reserve; GFR is 35 -50% less than normal
- Renal insufficiency; GFR is 20 – 35% less than normal
- Renal failure; GFR is 20% and below less than normal
- End stage kidney disease; GFR is 5% and below less than normal

CLINICAL MANIFESTATIONS

Clinical manifestation of full blown chronic renal failure is classified into two:

1. **Primary Renal Manifestation:** These symptoms develop when there is slow and progressive deterioration of renal function. They are:
    - Metabolic acidosis:
    - Hyperkalaemia
    - Sodium and water imbalance
    - Hyperuricaemia
    - Azotaemia
2. **Secondary Renal Manifestation**: These symptoms manifest secondarily as a result of metabolic acidosis, fluid and electrolyte imbalance. They are:
    - Anaemia
    - Deposition of urinary pigment in skin and increase in urea content in sweat and plasma
    - Congestive heart failure
    - Pulmonary congestion and oedema
    - Ulceration of mucosal lining in the stomach and intestine
    - Renal osteodystrophy
    - Uremic encephalopathy

QUESTION TWO

With the aid of diagrams, discuss the types of dialysis you know.

ANSWER

Dialysis is a treatment that filters and purifies the blood using a machine. This helps keep the fluids and electrolytes in balance when the kidneys can't do their job. Without this, salts and their waste products will accumulate in the blood, poison the body and damage other organs.

There are three types of dialysis:

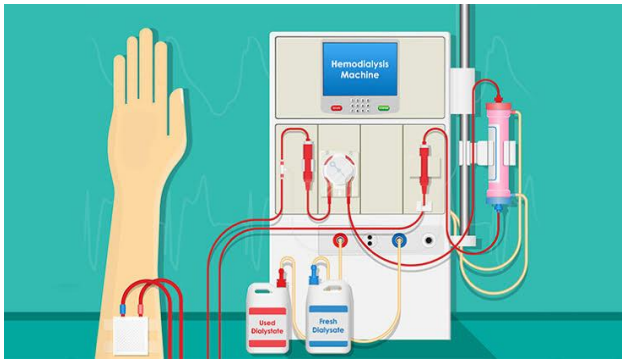
- Haemodialysis
- Peritoneal Dialysis
- Continuous Renal Replacement Therapy

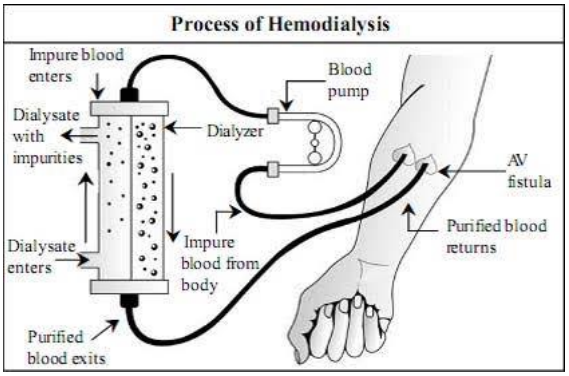
HEAMODIALYSIS

This is the most common type of dialysis treatment. This process uses an artificial kidney otherwise known as a haemodialyser to remove waste and extra fluid from the blood. The blood is removed from the body and filtered through the haemodialyser then the filtered blood is returned to the body with the help of a dialysis machine. The doctor performs surgery to create and entrance point into the blood vessel. There are three types of entrance points and they are:

- Ateriovenous fistula
- Ateriovenous graft
- Vascular access catheter

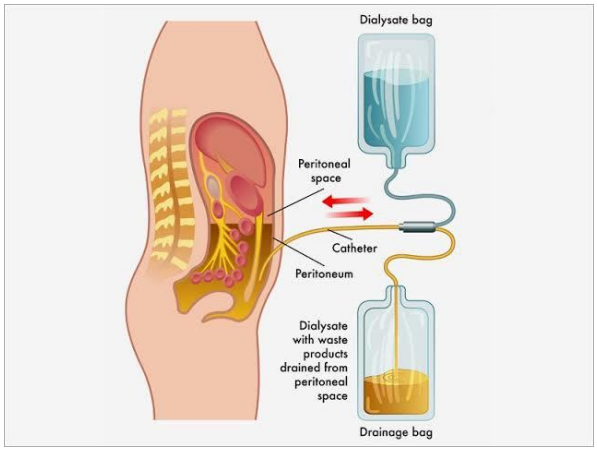
The AV graft and fistula are designed for long term dialysis treatment while the catheter is designed for temporary or short term use. This treatment usually last for 3 - 5 hours and are performed 3 – 5 times a week, however it can be completed in more frequent sessions.

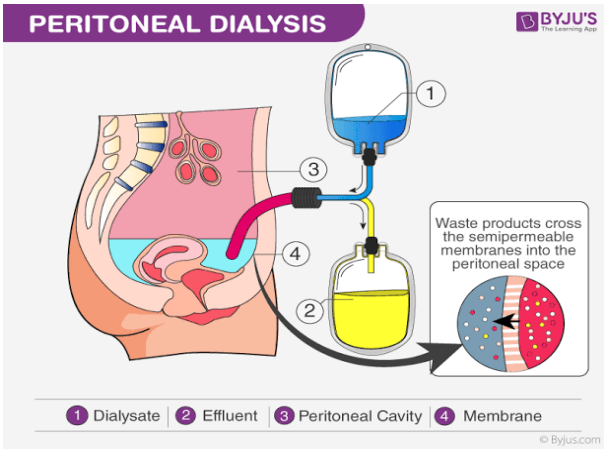




PERITONEAL DIALYSIS

This involves surgery to implant a peritoneal dialysis catheter into the abdomen. The catheter helps filter the blood through the peritoneum. During treatment a special fluid called dialysate flows into the peritoneum and absorbs waste products, the dialysate draws out waste from the bloodstream and is drained from the abdomen. This process takes a few hours and is repeated four to six times per day. However it can be done while you're sleeping or awake.





The main types of peritoneal dialysis are:

- **Continuous ambulatory peritoneal dialysis** – The abdomen is filled and drained multiple times each day. It doesn't require a machine and must be performed while awake.
- **Continuous cycling peritoneal dialysis** – It uses a machine to cycle the fluid in and out of the abdomen. It is done at night while one is sleeping.
- **Intermittent peritoneal dialysis** – It is performed in the hospital or at home. It uses the same machine above but takes longer.

CONTINUOUS RENAL REPLACEMENT THERAPY

It is used in the intensive care unit for people with acute kidney failure. It is also known as hemofiltration. A machine passes the blood through tubing and a filter the removes the waste and water. The blood is returned to the body along with fluid replacement fluid. It is performed 12 – 24 hours a day.