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QUESTION 1: Discuss the pathophysiological processes involved in renal failure.

ANSWER: Renal failure is the failure of the excretory functions of kidney. It is usually characterized by a decrease in glomerular filtration rate.

Renal failure is always accompanied by other complications like:

* Deficiency of calcitriol resulting in reduction in calcium absorption
* Deficiency of erythropoietin resulting in anemia
* Disturbances in acid-base balance

There are 2 kinds of renal failure

1. **Acute renal failure**- This is the sudden cesation of renal functions. It may result in sudden life-threatening reactions in the body with the need for emergency treatment.

It can be caused by sudden fall in blood pressure during hemorrhage, severe burns and cholera, blockage of ureter due to the formation of calculi (renal stone) or tumor, acute nephritis, acute tubular necrosis, renal ischemia.

Acute renal failure has features such as

* Oliguria – decreased urinary output
* Anuria- cessation of urine formation
* Proteinuria- appearance of protein in urine
* Hematuria- presence of blood in urine

A major physiological effect of acute renal failure is the retention of water, waste products of metabolism and electrolytes in the blood and extracellular fluid. This can lead to water and salt overload, which in turn, can lead to edema and hypertension. Excessive retention of potassium, is a serious threat to patients with acute renal failure because increase in plasma potassium concentration above 8mEq/L can be fatal. Because the kidneys are also unable to secrete sufficient hydrogen ions, patients with acute renal failure suffer from metabolic acidosis. In severe cases of acute renal failure, complete anuria occurs. The patient will die in 8-14 days unless an artificial kidney is used.

1. **Chronic renal failure**- This is the progressive, long standing and irreversible impairment of renal functions. It occurs when some of the nephrons lose their function and the other unaffected nephrons compensate for it. However, when more nephrons start to lose their function, the compensatory mechanism fails and chronic kidney failure develops.

It can be caused by chronic nephritis, polycystic kidney disease, renal calculi, urethral constriction, hypertension, atherosclerosis etc.

Chronic renal failure has features like

* Uremia- excess accumulation of end products of protein metabolism such as urea, nitrogen and creatine in blood.
* Anemia- due to lack of erythropoietin not secreted in the kidney during renal failure
* Blood loss- gastrointestinal bleeding accompanied by platelet dysfunction leads to heavy loss of blood.
* Edema, hyperparathyroidism.

In chronic renal failure, there’s a presence of anemia due to decreased renal secretion of erythropoietin which stimulates the bone marrow to produce red blood cells. In prolonged chronic renal failure, osteomalacia (a condition in which the bones are partially absorbed and become weakened) occurs due to decreased production of active vitamin D and by phosphate retention by the kidneys. There is an increase in urea and other nonprotein nitrogen (azotemia). The nonprotein nitrogen include urea, creatine etc. These nonprotein nitrogen are end products of protein metabolism and they are to be excreted out of the body normally, but due to renal failure they are retained.

QUESTION 2: **With the aid of suitable diagrams discuss the types of dialysis you know.**

ANSWER: Dialysis is the procedure used to remove waste materials and toxic substances from the kidney by differential diffusion through a semi-permeable membtane in order to restore normal volume and composition of body fluid during renal failure. There are 4 types of dialysis: hemodialysis, peritoneal dialysis, hemofiltration and intestinal dialysis. 

1. **Hemodialysis;** in hemodialysis, the patient’s arterial blood is passed continuously or intermittently through the artificial kidney and then back to the body through the vein. Heparin is used as an anticoagulant while passing the blood through the machine. Inside the artificial kidney, the blood passes through a dialyzer called hemofilter which contains minute channels interposed between two cellophane membranes. The membranes are porous in nature. The outer surface of these membranes are bathed in dialyzing fluid called dialysate. The used dialysate in the artificial kidney is constantly replaced by fresh dialysate. Urea, creatine, phosphate and other unwanted substances from the blood pass into the dialysate by concentration gradient. The essential substances required by the body diffuse from the dialysate into the blood. The dialysis machine has several blood pumps with pressure monitors which enable easy flow of blood from the patient to the machine and back to the patient. It also has pumps for flow of fresh dialysate and for drainage of used dialysate.



1. **Peritoneal dialysis:** this is the technique in which peritoneal membrane is used as a semipermeable membrane. It is used to treat patients suffering from renal failure. A catheter is inserted into the peritoneal cavity through anterior abdominal wall and sutured. The dialysate is passed through this catheter under gravity. The required electrolyte from dialysate pass through vascular peritoneum into blood vessels of abdominal cavity. Urea, creatine, phosphate and other unwanted substances diffuse from blood vessels into dialysate. Later, the dialysate is drained from peritoneal cavity by gravity. The peritoneal dialysis is simple, convenient and less expensive compared to hemodialysis. Patients can change the fluid on an outpatient basis.
2. **Intestinal dialysis:** in intestinal dialysis, the diet is supplemented with soluble fibers such as acacia fiber, which is digested by bacteria in the colon. This bacterial growth increases the amount of nitrogen that is eliminated in fecal waste, an alternative approach utilizes the ingestion of 1 to 1.5 liters of non-absorbable solutions of polyethene glycol or mannitol every fourth hour.
3. **Hemofiltration**: it is also known as continuous renal replacement. This type of dialysis is similar to hemodialysis but it makes use of a different principle. Where hemodialysis makes use of diffusive therapy, hemofiltration uses convective therapy. The blood is pumped through a dialyzer or hemofilter but no dialysate is used. Water follows pressure gradient and so 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. Risks associated with this are bleeding, infection, anaphylaxis, hypothermia.

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