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Review

A Review On Complications Of Post Dialysis Patients

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Abstract

The kidneys are a pair of vital organs that perform many functions to keep the blood clean and chemically balanced. The two most common causes of kidney disease are diabetes and high blood pressure. The National Kidney Foundation recommends three simple tests to screen for kidney disease: a blood pressure measurement. It is estimated that about 1, 00,000 persons suffer from ESRD each year of which only about 20,000 get treated. Dialysis is a process for removing waste and excess water from the blood. It is used primarily to provide an artificial replacement for lost kidney function in people with renal failure. Chronic kidney disease can progress to end-stage chronic renal disease (ESRD), which requires the use of replacement therapy (dialysis or kidney transplant) in life-threatening conditions. In ESRD, irreversible changes in the kidneys are associated with systemic changes of proinflammatory nature and dysfunctions of internal organs, skeletal muscles, and integumentary tissues. Hemodialysis is one of the renal replacement therapies, besides peritoneal dialysis and renal transplantation. Kidney diseases are highly prevalent globally. The risk factors for prevalence and incidence of hemodialysis are majorly hypertension and diabetes mellitus. Awareness of hemodialysis patients on the disease, medication, diet along with the life style modifications through the patient education was found to be very helpful for the patients to control their risk factors and to improve the compliance to the dosage regimen.

Keywords: Hemodialysis, Infections, ESRD, HD and PD complications, Methodology.

INTRODUCTION

Term dialysis is derived from the Greek words Dia, meaning “through, “and lysis, meaning “loosening or splitting.” It is a form of renal replacement therapy, where the kidney’s role of filtration of the blood is supplemented by artificial equipment, which removes excess water, solutes, and toxins. Dialysis ensures the maintenance of homeostasis (a stable internal environment) in people experiencing a rapid loss of kidney function, i.e., acute kidney injury (AKI) or a prolonged, gradual loss that is chronic kidney disease (CKD). It is a measure to

tide over acute kidney injury, buy time until a kidney transplant can be carried out, or sustain those ineligibles for it[1].

Dialysis is the treatment that removes waste and excess fluid from the blood when the kidneys are not functioning properly. It's a type of renal replacement therapy that causes artificial equipment to supplement the kidney's role of filtering blood.

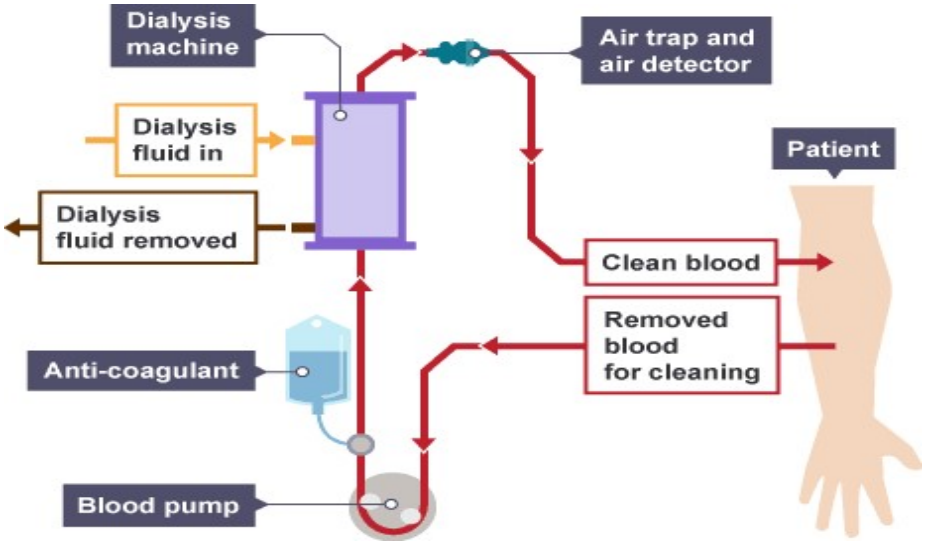


Fig 1: Diagrammatic representation by dialysis process

The kidneys are a pair of vital organs that perform many functions to keep the blood clean and chemically balanced. The kidneys are bean-shaped organs. They are located near the middle of the back, just below their rib cage, one on each side of the spine. The kidneys are sophisticated reprocessing machines. Kidneys process about 200 quarts of blood to sift out about 2 quarts of waste products and extra water per a day. The wastes and extra water become urine, which flows to the bladder through tubes called ureters. The bladder stores urine until releasing it through urination. Each kidney contains about 1 million nephrons. It generally works through osmosis and filtration of Fluid across a semi permeable membrane with the use of a dialysate [2].

Post Dialysis

Post-dialysis care is essential for patients with kidney failure. Dialysis is a lifesaving treatment for end-stage renal disease [ESRD]. These are different types of dialysis, and patients may receive erythropoietin to help produce red blood cells.Dialysis is a treatment for individuals whose kidneys are failing. There are two types of dialysis, hemodialysis and peritoneal dialysis, that both perform normal kidney functions, filtering waste and excess fluid from the blood [3].

Post dialysis complications

Infections like HBV & HCV, disequilibrium syndrome, malnutrition, cardiac arrhythmias, hemorrhages, gastrointestinal effects, psychiatric illness (depression). The severity of these symptoms is usually proportionate to the amount and speed of fluid removal. Heparin is the most commonly used anticoagulant in hemodialysis, as it is generally well tolerated and can be quickly reversed with protamine sulfate. Heparin allergy can infrequent be a problem and can cause a low platelet count. In such patients, alternative anticoagulants can be used. In patients at high risk of bleeding, dialysis can be done without anticoagulation. Long term complications of hemodialysis include amyloidosis various forms of heart disease frequency and length of treatments have been shown to improve fluid overload and enlargement of the heart that is commonly seen in such patients [3].

Complecations Of Dialysis:

Mainly dialysis complication's is chronic dialysis and hemodialysis.

Hemodialysis Complications

Renal replacement therapy is an option to treat Patients with acute and/or chronic renal failure. here are two treatment options for a patient Who develops end stage renal failure with Evidence of uremia symptoms. Kidney Transplantation is the best option in treating End-stage renal failure (ESRF) patients, however, shortage of donated-

organs, pre and post transplantation follow up and worldwide transplantation team availability are obstacles and difficulties in many countries [1].

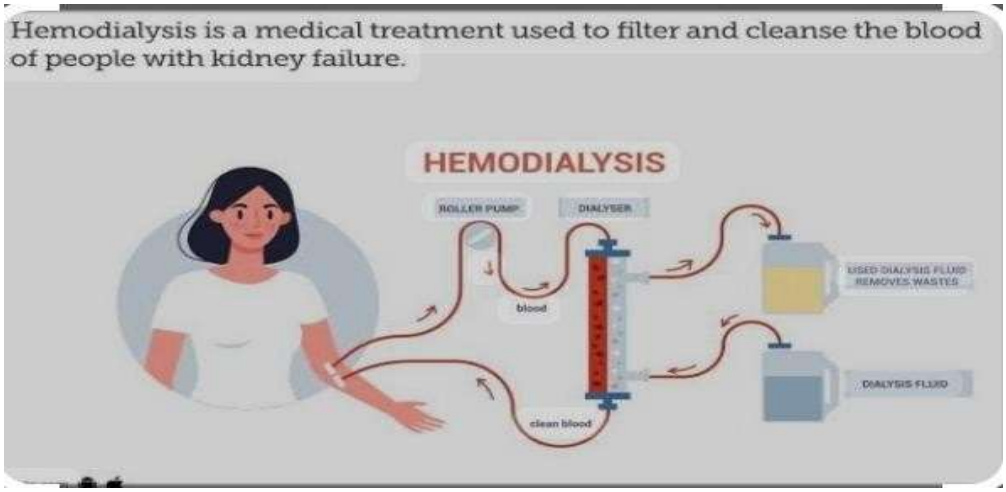


Fig 2: Diagrammatic representation by hemodialysis process

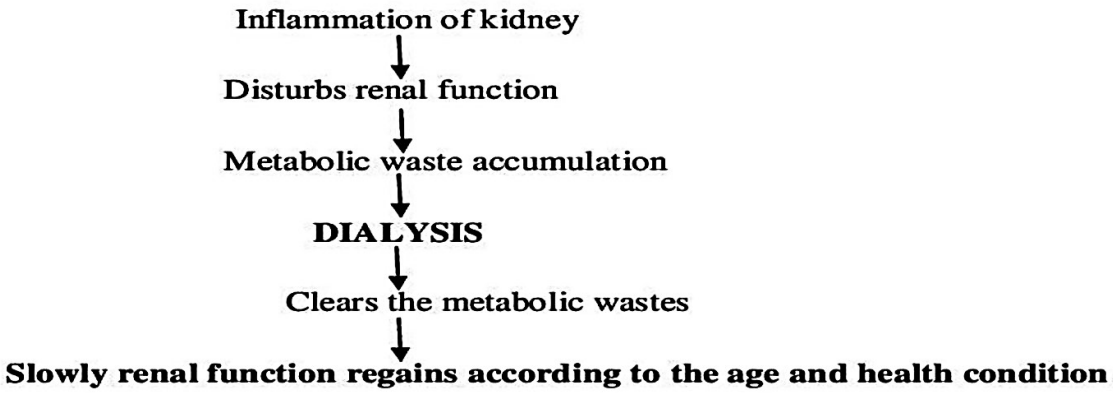
The underlying cause of end-stage renal disease (ESRD) is increasingly changing. In the United States, about 40% of patients have ESRD due to diabetes, hypertension, recurrent urinary tract infection, drug use, glomerulopathies, vasculitis diseases etc. The average age of patients commencing dialysis has risen to 64 years. This increase in starting dialysis age has led to more co-existent diseases that associated with aging as well dialysis complications [1].

Infections

Infection in patients with HD is one of the major Reasons for their increased morbidity and mortality. The commonest source of infection in HD is access Site-related infections. Other infective foci include Pneumonia, skin, and soft tissue, account for about 42%. Further, about 80% of these infections occurred in the community setting, with 44% needing hospitalization. Infection transmission typically occurs during the start and/or at the end of the HD session [1].

Cardiovascular complications of dialysis

Dialysis could be associated with moderate (hypotension, muscle cramps, anaphylactic reactions) to severe (cardiovascular disease (CVD)) complications. Ongoing inflammation is the main reason for the diseased kidney, which does not respond to medications. Chronic inflammation disturbs the normal functioning of the kidneys, resulting in the accumulation of metabolic wastes in the body. The process of dialysis helps in the removal of toxins from the body and, slowly, the kidney may regain its function; this depends on the age and the health condition of the individual [3].



Cardiovascular Complecations

Cardiovascular disease (CVD) is the major cause of death in ESRD patients on regular HD. Atherosclerosis is present in most if not all long-term dialysis patients. CVD in HD patients is 5 to10 times higher than in general population, and it accounts for at least half of all patients' deaths. The death in these patients were mainly due to coronary heart disease (CHD). Diagnosis of CHD in chronic dialyzed patients requires coronary artery bypass surgery that has more than three times increase in mortality rate in CKD patients than general population. Anemia is a commonest complication in HD patients. It is a major risk factor for CVD and increasing mortality in HD patients. Anemia correction by adequate tonic supplements, erythropoietin and adequate HD patients improves cardiovascular dynamics, exercise tolerance and morbidity as well the mortality [1].

How To Work Dialyzer

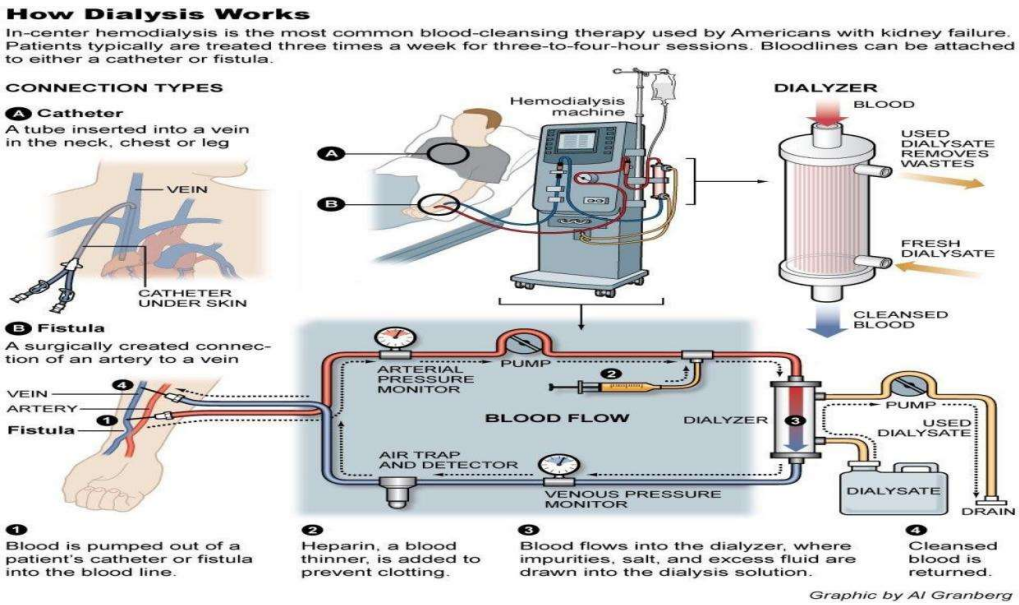
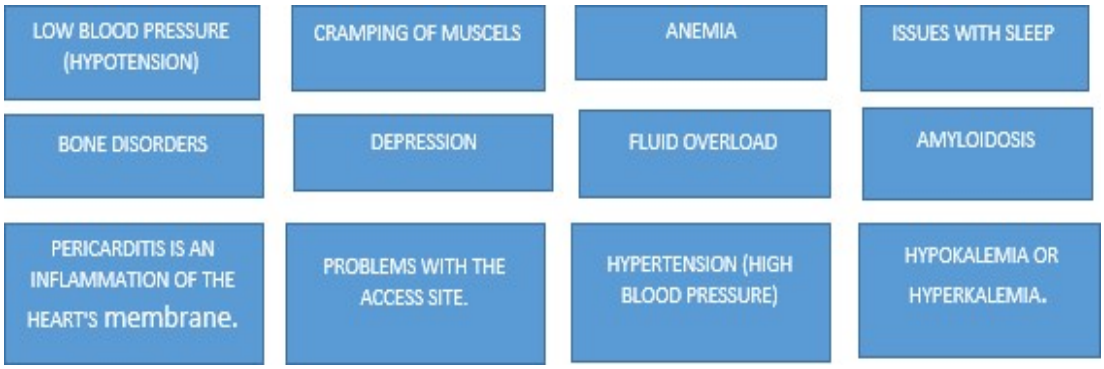


Fig 3: Diagrammatic representation by dialyzer process

Hemodialysis is using a machine filter called a Dialyzer or artificial kidney to remove excess water and salt, to balance the other electrolytes in the body and to remove waste products of metabolism. Blood Is removed from the body and flows through tubing into the machine, where it passes next to a filter Membrane. A specialized chemical solution (dialysate) flow on the other side of the membrane. The dialysate is formulated to draw impurities. from the blood through the filter membrane. Blood and Dialysate never touch in the artificial kidney machine [1].

Common post-dialysis risks



Risk Facters For Hospitalization In Patient Receiving Heamodialysis

Nutrition and inflammation

- low body mass index (<20kg/m2)
- Hypophosphataemia
- Hyponatremia
- Hypoalbuminemia
- Anemia
- Poor malnutrition assessment scores (for example, malnutrition inflammation score or subjective global assessment of malnutrition)
- High p-cresol sulfate
- Poor or very poor self-reported appetite
- Hyperkaliemia owing to high dietary potassium intake **[4]**

Comorbidities

- High Charlson comorbidity score
- Type 2 diabetes
- Cardiovascular disease
- Peripheral vascular disease
- Cerebrovascular disease
- Cancer **[4]**

Demographic factors

- limited health literacy
- Smoking
- minority ethnicity
- older age **[4]**

Psychosocial 2] factors

- Depression
- Anxiety symptoms
- Poor social support
- low self-efficacy **[4]**

Dialysis access and facility support

- use of central venous catheter for vascular access
- Treatment in a center with a high patient-to-staff ratio
- non-adherence to dialysis treatment (missed or shortened dialysis sessions)**[4]**

Others

- High (>4%) inter-dialytic weight gain
- Previous history of hospitalization or emergency department visit
- Residence in a nursing facility [4]**.**

After care for hemodialysis patients

- The key to feeling better after dialysis treatment depends on what you do before and between dialysis treatments.
- Adhering to your prescribed fluid restrictions is very important.
- If you gain more fluid than prescribed, you will need to remove more fluid during the prescribed dialysis time. This causes rapid fluid shifts in your body, leading to hypotension and fatigue.
- Your diet is also essential. You must follow the diet prescribed by the nutritionist/dietitian. Remember that your kidneys can no longer excrete food by-products, so the by-products will accumulate until your subsequent treatment. This can make you feel weak and tired.
- Take your medication as prescribed unless your healthcare provider tells you to alter the pre-dialysis dose.
- Treating the condition that caused kidney failure is essential to maintain your health and well-being.
- It would be best if you incorporated some activities based on your tolerance. This will help you feel better over time. [2]

Methodology

Equipment

Haemodialysis (HD) apparatus includes:

1. Blood circuit
2. Dialysis solution circuit

A dialyzer bridges these circuits. Side ports attached to the bloodlines are used for saline or heparin infusion, air entry detection, and pressure measurements. The dialysate is pumped through the dialysate compartment, separated from the blood compartment by the dialyzer's semi-permeable membrane. Biocompatible synthetic membranes made of polysulfide provide a semi-permeable interface with lower complement cascade activation compared to the older bio-incompatible ones.[5]

Blood Circuit

A spring-loaded roller pump moves blood through the dialyzer. Internal filtration (IF) enhanced hemodialysis requires no additional equipment like a roller pump and is more convenient than hemodiafiltration. The inflow bloodline or pre-pump segment connects the vascular access to the blood pump. It contains a saline infusion line, a sampling port, and a "pre-pump" pressure monitor. A "T" line primes the dialyzer circuit and rinses the blood compartment toward the end of the dialysis session. The heparin line delivers heparin at a constant rate throughout dialysis. A venous pressure alarm is attached to the venous line; however, it may not be reliably alert to an accidental venous line detachment.[5]

The venous air trap chamber contains any air in the bloodline, which cuts off the power supply to the pump and stops dialysis, thus ensuring patient safety. A clamp below the drip chamber along the tubing returning blood to the patient is activated by the air present in it and snaps shut, stopping the blood pump.[5]

The dialysis fluid circuit includes:

- A water purification system
- A proportionating system that mixes the water and concentrates and feeds it to the dialyzer
- Monitors, alarms, and ultrafiltration control with advanced control options. [5]

The standards for water purity in dialysis are defined by the Advancement of Medical Instrumentation (AAMI). The delivery system can be:

1. Central: A single apparatus combines with purified water to provide the dialysis solutions for the unit, supplied to each machine through pipes. However, it does not allow for individualization of dialysate composition and risks exposing many patients to complications arising from an error in the system.
2. Individual: Each machine proportions its dialysate concentrates and purified water.

Before the delivery of the dialysate to the dialyzer, correction for temperature by heating to 35–38 C followed by exposure to negative pressure for degassing is performed. Special attention must be paid to the osmolality of the dialysis solution, as a severely hyperosmolar solution can cause hypernatremia and other electrolyte disturbances. An alarm indicates any disturbance in the conductivity of the dialysate beyond 12 to 16 mS/cm and diverts the dialysate to the drain. [5]

An implantable artificial kidney employs silicon nanotechnology and tissue engineering to produce a surgically implanted device that mimics a native kidney. It includes a high-efficiency filter, the hem cartridge made of microchips, and a bioreactor of cultured epithelial cells of the renal tubule harvested from the cadaveric kidney, the bio cartridge. The ultrafiltrate produced closely resembles urine. It prevents electrical pumps as the patient's blood pressure drives the device. No dialysate is needed since salt and water reabsorption by the bio cartridge helps maintain a neutral fluid balance while eliminating concentrated wastes. These devices provide gradual, continuous ultrafiltration therapy, which will reduce intradialytic hypotension and cardiac disease of dialysis. [5]

How does haemodialysis work?

In hemodialysis, the blood is cleaned outside of the body (extracorporeal). The treatment usually takes place in a dialysis center (a clinical facility that specializes in dialysis). The procedure involves removing blood from a blood vessel, usually in a forearm, passing it through the dialysis device and then transporting it back into the body. This is the best way to remove harmful substances, waste products and excess water from the blood and get rid of them together with the dialysis fluid. Hemodialysis usually takes around four to five hours. During this time, all the blood in the body is pumped through the dialysis device several times. Afterwards, the blood is clean enough. In Germany, hemodialysis is usually done three times a week. In hemodialysis, the blood is cleaned outside the body[6].

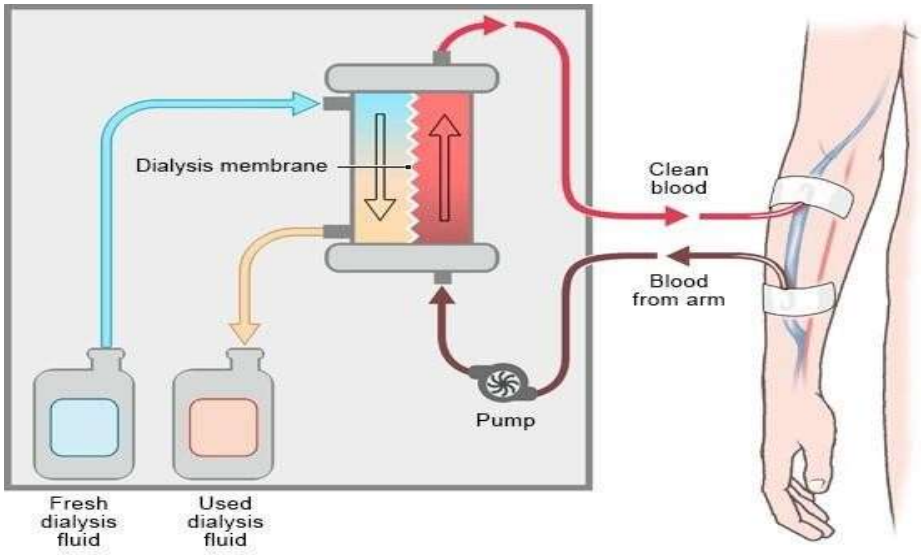


Fig 4: Diagrammatic representation of work for hemodialysis process

How does peritoneal dialysis work?

In peritoneal dialysis, the blood isn't cleaned outside the body, but inside the body, in the abdominal cavity (the hollow space surrounding the organs in the abdomen). The peritoneum is well-supplied with blood and covers the organs like the small and large intestines. Before starting peritoneal dialysis, a catheter is inserted into the abdominal cavity. The catheter allows you to put the dialysis fluid into your abdomen yourself. Any harmful substances will then Diffuse into the dialysis fluid from the blood vessels in the peritoneum. Because the dialysis fluid contains sugar or substances similar to sugar, excess water is also removed from the blood by osmosis.

After a few hours, you drain the dialysis fluid from your abdominal cavity again and then usually replace it with fresh dialysis fluid right away so that the blood is constantly being cleaned. At night, you can use a device called a cycler to automatically drain and replace the dialysis fluid in peritoneal dialysis, dialysis fluid is passed into the abdominal cavity[6].

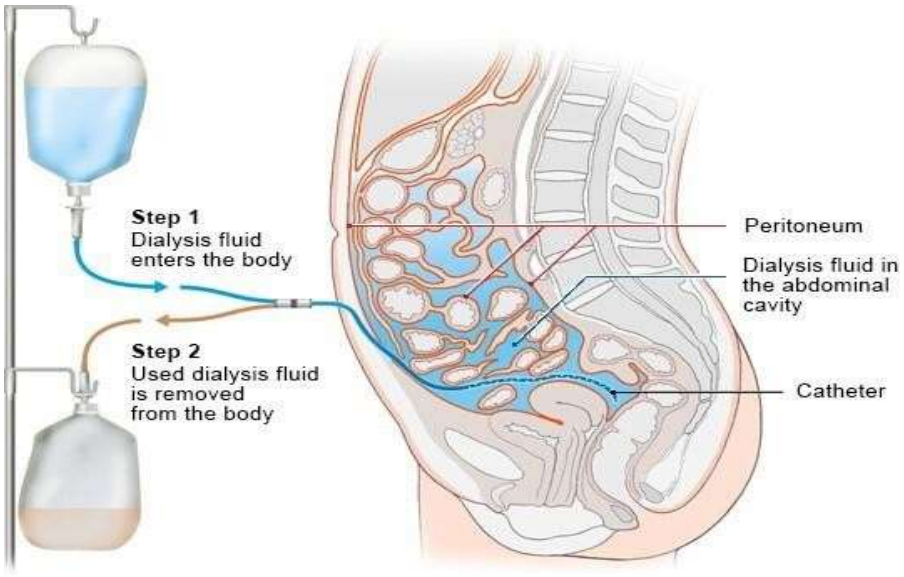


Fig 5: diagrammatic representation by work for peritoneal dialysis

Signs and symptoms

- Signs and Symptoms It can vary from person to Person.
- Someone in early-stage kidney disease may Not feel sick or notice symptoms as they occur.
- When kidneys fail to filter properly, waste Accumulates in the blood and the body, a condition Called azotemia.
- Very low levels of azotemia may Produce few, if any, symptoms.
- If the disease Progresses, symptoms become noticeable (If the Failure is of sufficient degree to cause symptoms) [7].

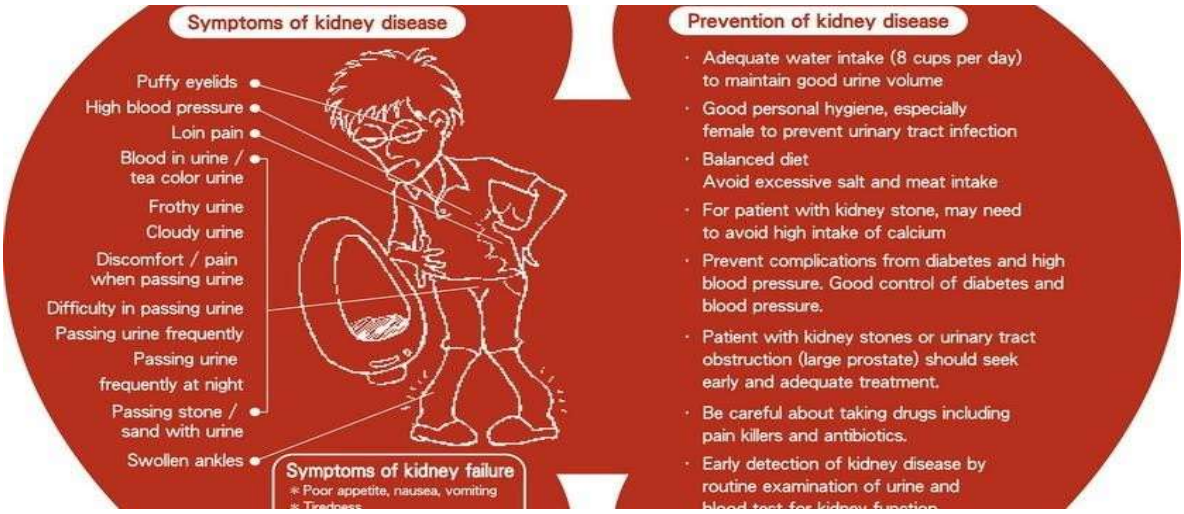


Fig 6: Signs and symptoms and prevenction by dialysis

Blood pressure is increased due to fluid overload and production of vasoactive hormones created by the kidney via the RAS(renin-angiotensin system),increasing one's risk of developing hypertension and or suffering from congestive heart failure.[8]

Mechanism

The mechanism of hemodialysis

In hemodialysis, the wastes and excess water are removed by using an external filter called a dialyzer, which contains a semipermeable membrane. The separation of wastes is done by creating a counter-current flow gradient, where blood flow is in one direction and the fluid of the dialyzer is in the opposite direction. Peritoneal dialysis uses the peritoneum as a natural semipermeable membrane and removes waste and water into the dialysate[13].

Principle

The basic principle involved in dialysis is the movement or diffusion of solute particles across a semipermeable membrane (diffusion). Metabolic waste products, such as urea and creatinine, diffuse down the concentration gradient from the circulation into the dialysate (sodium bicarbonate (NaHCO3), sodium chloride (NaCl), acid concentrate, and deionized water). During their diffusion into the dialysate, the size of particles, in turn, determines the rate of diffusion across the membrane. The larger the size of the solute particle, the slower is the rate of diffusion across the membrane. Here, arteries carrying oxygenated blood from the heart are connected to a vein forming an arteriovenous shunt, which makes the vein strong (by forming muscles around it like an artery) enough to be punctured many times; its pressure is also monitored during the process of dialysis. The diagrammatic representation of a dialyzer is shown in Figure [14].

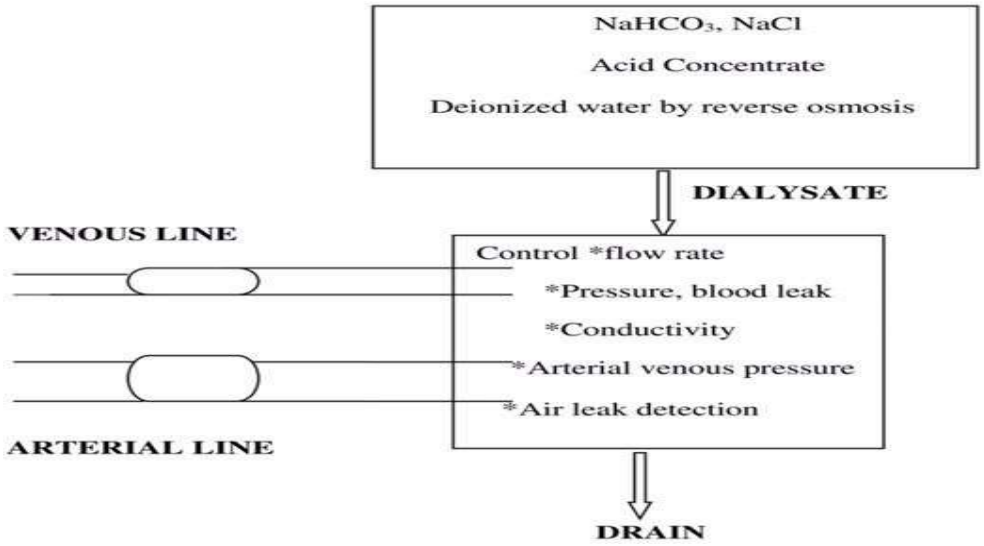


Fig 7: Diagrammatic representation of dialyzer

Treatment

In the United States, approximately 430,000 patients are dependent on hemodialysis. Options for access include catheters, arteriovenous fistulas (AVFs), and arteriovenous grafts (AVGs). A 15- gauge needle is inserted to access circulation. Blood is pumped through the dialyzer at a rate of 300 to 500 ml/min while dialysate flows in a counter-current direction at 500 to 800 ml/min. The negative hydrostatic pressure on the dialysate side is used to achieve adequate fluid removal or ultrafiltration. Dialysis targets depend on the urea reduction ratio, that is, the fraction of blood urea nitrogen reduced per hemodialysis session, ideally 65 to 70% [14].

Home hemodialysis is done 3 to 6 nights per week for 6-8 hours each for those who prefer it for lifestyle considerations. It is associated with a raised risk of vascular access complications, caregiver burden, and rapid decline in residual kidney function [14].

Medical Breakthroughs in Dialysis Treatment Medical Improved Dialysis Membranes

Dialysis membranes play a crucial role in filtering waste and excess fluids from the blood. Recent advancements in membrane technology have led to the development of more efficient and biocompatible membranes, improving treatment outcomes and reducing complications. Medi cover Hospitals has adopted these advanced dialysis membranes, ensuring their patients receive the highest quality care [15].

Online Hemodiafiltration (HDF)

Online hemodiafiltration (HDF) is a cutting-edge dialysis technique that combines the benefits of hemodialysis and hemofiltration. This method uses a high-flux dialysis membrane to remove both small and large waste molecules from the blood, providing more comprehensive cleansing [15].

The Role of Technology in Enhancing Dialysis Treatments Telemedicine and Remote Monitoring

Telemedicine and remote monitoring have revolutionized the way dialysis treatments are managed. These technologies enable healthcare providers to monitor patients' health and treatment progress in real-time, allowing for timely interventions and adjustments [16].

Artificial Intelligence and Machine Learning

Artificial intelligence (AI) and machine learning are playing an increasingly important role in dialysis treatments. These technologies can analyse vast amounts of data to identify patterns and trends, helping healthcare providers make more informed decisions about patient care [16].

Latest improvement

As a membrane science researcher, I am working on creating haemodialysis membranes that are more compatible with the human body than current membranes. My short-term aim is to achieve reduced patient side-effects and increase quality of life. My long-term goal is to design an artificial wearable kidney based on a membrane with greatly improved performance compared to those in use in hospitals today. This is the only research program in Canada to address key problems associated with dialysis membranes [17].

Problems and challenges with haemodialysis

First, dialysis treatment is expensive, costing the Canadian health-care system more than $100,000 per patient per year. And while it does prolong life, it presents a number of challenges. The five- year survival rate for hemodialysis patients is 35 per cent, and only 25 per cent for hemodialysis patients with diabetes. Additional kidney failure patients are now requiring treatment as more than 30 per cent of patients hospitalized with COVID-19 develop kidney injury. Some studies in Canada showed that around 54 per cent of the Canadian patients who were hospitalized with COVID-19 developed acute kidney injury. Although the rates of acute kidney injury have fallen from the early months of the pandemic, high-risk patients should have their kidney function and fluid status monitored closely.

CONCLUSION

Kidney diseases are highly prevalent globally. They have become a major public health problem and associated with considerable co-morbidity and mortality. Maintenance dialysis therapy is the commonest mode of Renal Replacement Therapy (RRT) and demand for this service is increasingly progressively worldwide. Over one million people worldwide are alive on dialysis. In UK, AKI requiring dialysis is 200ppm and in USA by 2010, >6 lakhs patients were on RRT (Dialysis). In India, it is estimated that about 1 lakh persons suffer from ESRD each year. Considering the varied factors that may affect the morbidity and mortality of HD patients and the steady increase in patients with CKD on HD worldwide, it is clear that there is a huge need for more research to assign the best way to diagnose and to treat kidney diseases at early stages to prevent late complications of CKD and HD.

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