



# DIALYSIS



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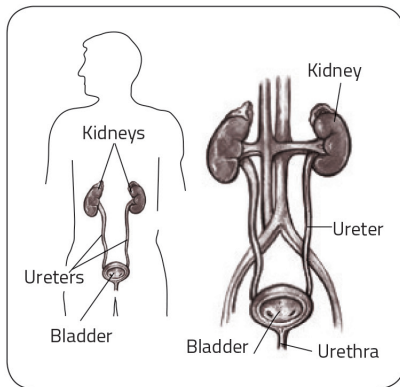
## DIALYSIS

Kidneys are extremely vital organs to maintain a healthy human body. Since they are the most important excretory organs, loss of kidney functions leads to malfunctioning of many other organs in the body.

## KIDNEYS

The kidneys are bean-shaped organs that have several essential regulatory functions in the human body. They remove waste products of metabolism from the blood. In addition, kidneys have homeostatic functions such as the regulation of electrolytes levels in blood, maintenance of acid base balance, and regulation of blood pressure.

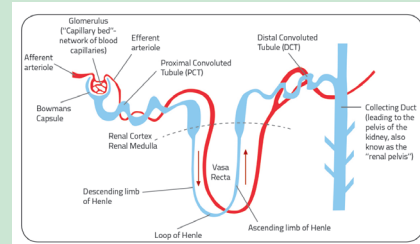
They serve the body as a natural filter of the blood, and remove water soluble wastes from blood and excrete in the urine. The kidneys excrete waste products of metabolism such as urea, creatinine and ammonium. They are also responsible for the reabsorption of water, glucose, and amino acids. The kidneys also produce hormones like Calcitriol, Erythropoietin, and the enzyme renin.



## BASIC FUNCTIONS OF KIDNEYS

1 Excretion of waste products

- 2 Acid-base homeostasis
- 3 Blood pressure regulation
- 4 Regulation of red blood cell formation
- 5 Production of vitamin D, which keeps the bones strong and healthy



Kidneys work 24 hours a day, seven days a week, cleaning the blood and it excretes waste products such as creatinine and urea through urine. The kidney participates in whole-body homeostasis, regulating acid-base balance, electrolyte concentrations, extracellular fluid volume, and blood pressure. The kidney accomplishes these homeostatic functions both independently and in concert with other organs, particularly those of the endocrine system. Various hormones coordinate these endocrine functions; these include renin, angiotensin II, aldosterone, antidiuretic hormone, and atrial natriuretic peptide.

## SIGNS AND SYMPTOMS OF KIDNEY DISEASES

- 1 Swelling around eyes, legs and face
- 2 High blood pressure
- 3 Back pain
- 4 Burning sensation while passing urine
- 5 Blood in urine
- 6 Reduced amount of urine
- 7 Breathing difficulty
- 8 Itching all over the body
- 9 Loss of appetite, nausea and vomiting

10 Pallor (anemia)

When kidneys are no longer able to remove waste products from the blood, these symptoms occur; but some patients do not have any symptoms until 90% reduction of kidney functions happen.

## TYPES OF KIDNEY IMPAIRMENT

There are two types of renal impairment

### 1 Acute renal impairment

Acute Kidney Injury (AKI) previously called as Acute renal failure (ARF), or acute kidney injury is a rapidly progressive loss of kidney function, generally characterized by decreased urine production (quantified as less than 500 ml per day in adults and less than 0.5 ml/kg/h in children) and fluid and electrolyte imbalance. Patient can regain the kidney functions within days or weeks with treatment.

#### 1.1 Causes of AKI

Severe vomiting, dysentery, Malaria, excess use of pain killers, infections, rat bite fever, snake bite, some antibiotics can be the reasons for acute kidney injury.

### 2 Chronic renal failure (CRF)

Chronic kidney disease (CKD) develops slowly over a period of months to years; initially there can be a very few symptoms. CKD can be the long-term consequence of irreversible acute disease or due to progression of a chronic disease.

#### Causes of chronic renal failure

There are many causes for CKD -

##### 2.1 Diabetic Nephropathy:

This is the commonest cause of CKD today all over the world. Diabetic nephropathy (or diabetic kidney disease)

is a progressive kidney disease caused by damage to the capillaries in the kidneys. It is characterized by loss of protein in urine and diffuse scarring of the glomeruli. This occurs in longstanding diabetes mellitus. Diabetic nephropathy often has no symptoms in the initial stages; symptoms can take 5 to 10 years to appear after the kidney damage begins.

##### 2.2 Hypertension:

Increase in blood pressure damages the blood vessels and decreases kidney function.

##### 2.3 Glomerulonephritis:

Glomerulonephritis is caused by deposition of certain proteins called immuno globulins in the kidney.

##### 2.4 Polycystic kidney disease:

Polycystic kidney disease (PKD) is an inherited kidney disorder (autosomal dominant or sporadic). It causes fluid-filled cysts to form in the kidneys. PKD may impair kidney function and cause kidney failure over many decades.

##### 2.5 Interstitial Nephritis:

Interstitial nephritis is a disease affecting the interstitium of the kidneys. There are many reasons for this problem.

##### 2.6 Drug induced renal disease:

Excessive use of pain killers. some antibiotics, anticancer drugs can cause renal failure

##### 2.7 Urinary obstruction:

Urinary obstruction causes blockage of the flow of urine. It is a common cause of acute and chronic renal failure. Kidney stones can lead to obstruction in the urinary tract.

##### 2.8 Other causes for CKD

- Systemic lupus erythematosus
- Certain types of cancers
- AIDS
- Genetic disorders

## TREATMENT

Early diagnosis and treatment of the underlying cause and/or the institution of secondary preventive measures are imperative in patients with chronic kidney disease (CKD). If kidneys lose 90% of their functions, the condition is called End stage renal failure. Dialysis and kidney transplantation are the treatment modalities for patients with end stage renal failure (ESRD).

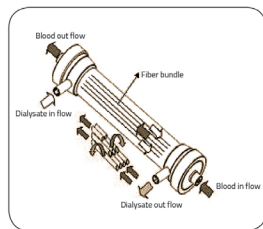
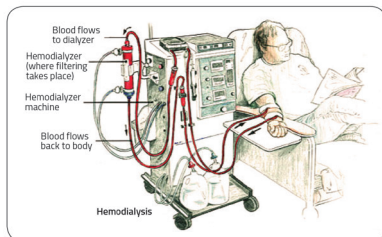
## WHAT IS DIALYSIS?

The word Dialysis means "to remove". (ie: purifying the blood.) Dialysis is of two types:

- 1 Hemodialysis
- 2 Peritoneal Dialysis

## WHAT IS HEMODIALYSIS?

In hemodialysis, an artificial kidney (hemodialyzer) is used to remove waste products and excess water from the blood. To get adequate blood into the artificial kidney, a vascular access (entrance) into your blood vessels needs to be made. This is done by a minor procedure on the arm or leg. (AV fistula)

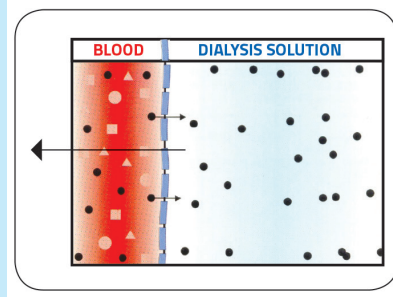


Artificial Kidney / Dialyzer

For long term hemodialysis a vascular access is made by joining an artery to a vein under the skin, this is called an AV fistula. However, if your blood vessels are not adequate for a fistula, the doctor may use a soft plastic tube to join an artery and a vein under the skin. This is called an AV graft

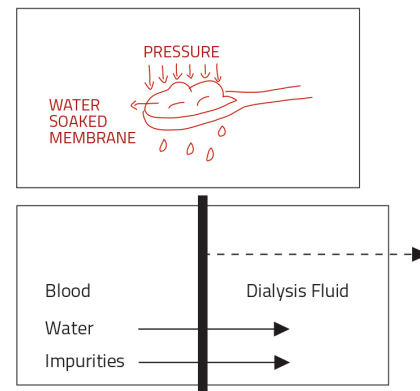
## PRINCIPLES OF DIALYSIS

### DIFFUSION



Diffusion is the movement of dissolved particles (solutes) across a semipermeable membrane from an area of higher concentration to an area of lower concentration. It removes waste products such as urea and creatinine from the blood.

### ULTRA FILTRATION:



Ultra filtration is controlled fluid (water) removal by the use of hydro static pressure; excess water is removed by this process.

**Urea nitrogen:** is a waste product obtained from the breakdown of proteins in the body. Normally, this is filtered by the kidneys and leaves the body through urine. UREA nitrogen accumulates in the blood in kidney failure.

**Serum creatinine:** is an important indicator of kidney failure as this accumulates in blood when kidneys fail. It is easily measured and is an end product of muscle metabolism.

## HOW TO START HEMODIALYSIS?

Before starting Hemodialysis, there has to be vascular access. Through this vascular access blood is taken from the body to the dialyzer (artificial kidney).

Vascular access

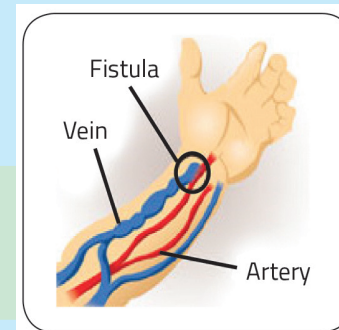
- 1 Permanent Vascular Access
- 2 Temporary Vascular Access

## 1 WHAT IS A PERMANENT ACCESS ?

Permanent access can be

- 1 Arterio Venus Fistula
- 2 Arterio Venus Graft
- 3 Permcath

## 1. ARTERIO VENUS (AV) FISTULA

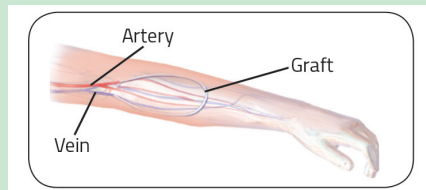


AV fistula used for hemodialysis is a direct connection of an artery to a vein, usually created on the upper limb. This is the preferred type of access, because once the fistula properly matures, it provides an access with good blood flow that can last for a long time. After the fistula is surgically created, it can take 6 - 8 weeks to mature and be ready to be used for hemodialysis. Exercises of the arm including squeezing a rubber ball would strengthen the fistula, before its use is recommended.

## FISTULA CARE

- Keep the limb with the AV fistula clean at all times.
- Avoid tight clothing or jewelry that could put pressure on the vascular access area.
- Do not keep any heavy items over the access area.
- Don't let anyone tie a blood pressure cuff on the access arm - have the blood pressure taken from the other arm.
- Ensure that blood for tests is drawn from the other arm.
- Don't sleep with access arm under the head or pillow.
- Feel the pulse in the access daily.

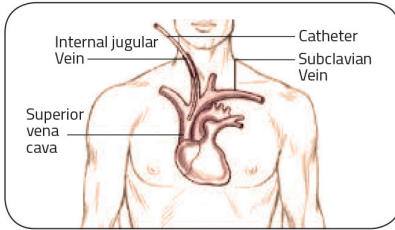
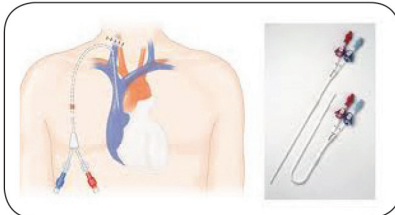
## 2 ARTERIO VENUS GRAFT



The AV graft is similar to a fistula, except that a plastic tubing connects the artery and vein and is placed underneath the skin. It is 6-8mm in diameter and is made from a type of plastic material



### 3 PERMCATH



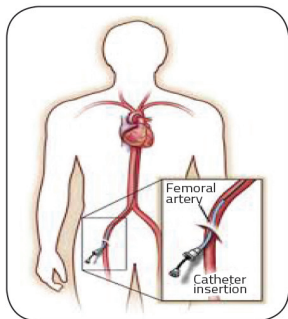
The permanent catheter is placed in one of the large veins. A common site is superior vena cava (SVC). The catheter is placed in the SVC by puncturing the internal jugular vein in the neck. It is important to ensure that the area of insertion site is clean and the care team changes the dressing at each dialysis session.

#### I. TEMPORARY VASCULAR ACCESS

##### 1 Internal jugular venous catheter

A catheter is inserted into the jugular vein in neck. This can be used as an access for usually for a few weeks.

##### 2 Femoral catheter



A catheter is placed in the femoral vein, can be used for seven to ten days.

#### HEMODIALYSIS PROCESS

##### PREPARATION:

Before the time the patient arrives for his/her scheduled session of hemodialysis, dialysis machine is to be prepared. The tubings and dialyser should be primed with saline. After each dialysis session, the dialyser and tubing should be cleaned, disinfected and preserved.

##### INITIATION OF DIALYSIS:

Once the machine, tubings and dialyser are ready, the dialysis can be started. The access should be cleaned and disinfected. When needle is inserted into the vein of the AV fistula, the blood flows through the tubings to the dialyser (artificial kidney), and the purified blood is returned to the body through another needle. The duration of this process will be 4 to 5 hours. At least 150 litres of pure (RO) water is needed to purify blood. During the dialysis session, patients can involve in activities like listening to music, reading books, watching TV. After dialysis, the dialysis staff will remove the needle and tubings, then clean the site and apply a tourniquet, which should be left in place for 6 hours and then removed.

##### DIALYSER:

The dialyser is known as artificial kidney. It contains hollow fibers which are made up of semipermeable membranes. It acts as the filter; the blood flows through the hollow fibers that are surrounded by the dialysate fluid which flows through the dialysate compartment. Through the semipermeable membrane, excess water and toxic substance like urea and creatinine moves from the blood compartment to the dialysate

compartment, which is then thrown out into the drain.

##### DIALYSATE:

Dialysate is a special fluid consisting of water, glucose, sodium, potassium, magnesium, calcium in specified amounts. It contains electrolytes in the same concentration as in blood. Dialysate (dialysis fluid) is free of substances like urea & creatinine that are present in higher concentration in the blood of a patient with renal failure. These waste products diffuse into the dialysis fluid and are then removed along with certain electrolytes which are in excess in patient's blood.

##### WHY IS HEPARIN USED ?

As the blood is flowing outside the body, there is a chance of blood clotting in the dialyser and tubings. Heparin is used to prevent clotting. The action of Heparin in the body will last for about six hours.

##### HOW MANY DIALYSIS SESSIONS ARE TO BE DONE IN A WEEK ?

Hemodialysis is usually done 3 days a week and takes four hours each time. It is very important that the patient follows the instructions given by doctors and takes care of his/her health.

##### WHAT IS THE NEED TO TAKE MEDICINES?

The kidneys are involved in so many different body functions and it is not possible for dialysis to replace everything that a healthy kidney can do. During dialysis some vitamins are removed from the body. In order to replace vitamins and maintain blood pressure and glucose level in blood, it is important to take medicines prescribed by the doctors.

#### MEDICINES TO REDUCE PHOSPHATE IN THE BLOOD

The kidneys excrete excessive amounts of phosphate from the blood. Therefore, the most common cause of increased phosphate levels (or hyperphosphatemia) is the kidney's inability to get rid of phosphate. High phosphate level in blood cause itching and low bone density. Doctors prescribe medications to reduce phosphate levels in blood.

#### ANTIHYPERTENSIVE DRUGS

It is very important to take antihypertensive drugs. Some patients may need to avoid these medicines before each dialysis session to prevent hypotension during dialysis. The doctors shall decide which patient needs to avoid these medicines on the day of dialysis.

#### IMPORTANCE OF IRON TABLETS

There is likely to be iron deficiency in people with kidney failure; so it is important to take iron supplements as advised by doctor to maintain iron level in blood.

#### IMPORTANCE OF CALCIUM SUPPLEMENTS

Blood level of calcium is likely to be low in patients with kidney failure. In order to correct it, calcium is added in dialysate solution. Doctors prescribe calcium tablets to maintain bone health.

#### IMPORTANCE OF ERYTHROPOIETIN

Erythropoietin (or EPO) is a glycoprotein hormone produced by the human kidney. EPO should be administered to dialysis patient with symptoms attributable at least in part to anemia. These include fatigue, decreased exercise tolerance, congestive heart failure, and angina. Due to the availability of recombinant human

erythropoietin therapy, repeated blood transfusions are discouraged except in patients with severe anemia. Moreover, blood transfusions may cause allergic reactions and infections.

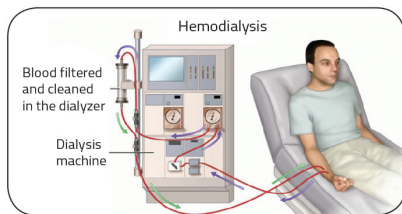
### IMPORTANCE OF BLOOD TESTS DURING DIALYSIS

Every month, blood tests have to be done to determine the adequacy of dialysis and to modify the medications based on blood parameters. The patient is at risk for transmission of certain blood borne infections, which needs to be checked periodically.

### IS HEMODIALYSIS EQUAL TO NORMAL KIDNEY?

Dialysis is a temporary solution and hemodialysis can never be equal to a normal kidney function.

The table shows the differences between normal kidney and artificial kidney (hemodialysis)



Normal kidney	Artificial kidney (hemodialysis)
It works 24 hrs in a day and 168 hrs in a week.	It works 4-5 hrs in day and 10-12 hrs in a week.
Erythropoietin (hormone) produced in the human kidney.	Erythropoietin injections are given.
Kidney excretes excess water and waste products in our body.	It filters excess water and salt from the body.

It balances the electrolytes such as calcium, Phosphorus, Potassium, sodium.	It balances electrolytes such as calcium, phosphorus, potassium, sodium within a particular range
Control phosphorus and calcium balance in the blood.	Needs supplementation with phosphate binding drugs and calcium supplements to maintain bone density.
Excess water in the body is excreted through urine.	Only a definite amount of excess water will be removed
Produces vitamin D3.	Vitamin D3 supplements are given.

### DIET MODIFICATIONS

Foods containing high amounts of sodium, phosphorus and potassium are restricted. Intake of salt should be restricted to 4 grams in a day. Excess intake of salt will increase thirst and water consumption.

**Potassium:** When kidneys fail, the excess amount of potassium is not excreted in urine. Potassium accumulated in blood, leads to changes in heart rhythms, and sometimes can lead to cardiac arrest, if levels are significantly high.

**Proteins:** Proteins are the basic units of body building. Protein needs are higher in patients with hemodialysis due to losses that occur during dialysis. The recommended dietary protein intake for clinically stable maintenance hemodialysis patients is 1.2g/kg/day. If nutrient intake appears inadequate, malnutrition is apparent, or adverse events or illnesses threaten nutritional status, protein intake should be increased. If protein-calorie needs cannot be met with the usual diet, patients should be offered dietary supplements.

### Foods containing more sodium

It is very important to avoid pickles, pappad, salty snacks, dry fruits, sauce which contain more sodium and it will increase thirst and intake of water consumption; it may lead to pulmonary edema (breathing difficulty).

### Foods containing more potassium

All the fruits except papaya, apple, pineapple, guava, contains a significant amount of potassium. Such fruits should be avoided by hemodialysis patients. Vegetables such as potato, drumstick, tapioca, elephant yam, tender coconut, legumes contain more potassium. Cereals such as raggy, wheat-flour, have more potassium. Chocolate, Coffee, Fruit Juice and also butter should be avoided. The consumption of Fenu Greek, Coriander, Dry Chilly has to be reduced.

### Foods containing moderate potassium

Vegetables such as Carrot, Beans, Ladies Finger, Melon, Onion, Cauliflower, Bitter Guard, Radish contain minimal amount of potassium. These can be used after boiling and discarding the water. Leeching is the process for removing excess potassium by draining the water two times during boiling.

### Low potassium diet

Vegetables such as Lettuce, Beetroot, Red Radish, Cucumber, Tender Mango, Green Peas contain low amount of Potassium can be used without leeching.

### Is it important to control water consumption?

Patients on dialysis should decrease the amount of water intake, because excess water intake leads to breathing difficulty by accumulation of water in the lungs.

### Foods containing more water content

All fruits contain plenty of water. Watermelon, Tomato, Grapes, Mango, Pineapple, Ice Cream, Curd, Payasam,

Kanji, contain more amounts of water. Hence these are to be avoided.

### Why should heavy food be avoided during dialysis session?

During dialysis a particular amount of blood is taken out of the body for purification. Heavy meal causes a lot of blood to go into the gastrointestinal tract. This increases the risk for fall in blood pressure during dialysis. Only light snacks should be taken during dialysis sessions.

### First dialysis

Initial few dialysis sessions are done on consecutive days and are of a shorter duration. First session of dialysis will be for two hours. During the initial few dialysis sessions, there are chances of nausea, vomiting or headache because the body is adjusting with the new procedure. This is called as disequilibrium syndrome and it can be treated with medicines.

### COMPLICATIONS DURING DIALYSIS

**Breathing difficulty:** It occurs because of excess fluid collection in the lung, as a result of excess water and salt intake. It can be reduced by adopting a sitting position instead of lying on the bed.

- **Hypotension:** Fall in the blood pressure is common during dialysis if a large amount of water is removed in a short time.

- **Headache:** It occurs when the blood pressure increases or decreases beyond a certain level.

- **Muscle cramps:** It happens because of removal of a large volume of water from the body. It can be relieved by massaging the affected portion and with certain drugs.

- **Bleeding from fistula hand:** If the tourniquet is misplaced or loose, it leads to bleeding. To stop the bleeding apply pressure with a cotton gauze and apply

tourniquet again.

### Scheduled dialysis

A patient on maintenance dialysis should not miss dialysis sessions. Otherwise complications would happen.

### Emotional status

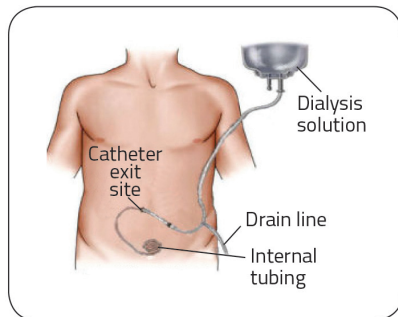
Patient and his family members should manage the financial and mental stress appropriately.

Patients and family members are likely to have anxiety about the treatment modality (dialysis) and its outcomes. Many patients undergoing dialysis would be depressed. It is very important for the family members to give emotional support to the patients. Interactions with the other patients on dialysis and their family members will help to decrease the stress factors to some extent.

### Patients doing proper dialysis

Patients on regular and proper dialysis can lead a normal life. They can manage their job, family and social responsibilities.

### Peritoneal dialysis

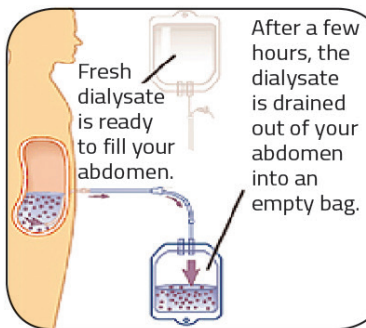
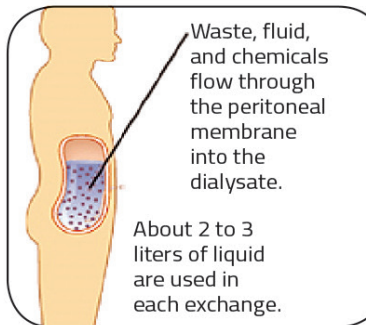
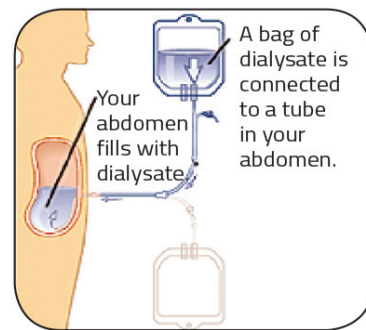


Fluid is introduced through a permanent plastic tube in the abdomen and waste products are removed by a process of osmosis and diffusion. The abdomen is cleaned in preparation for surgery, and a catheter is surgically inserted with one end in the abdomen and the other end protruding from the skin.

## DIFFERENT TYPES OF PERITONEAL DIALYSIS

### 1. Continuous Ambulatory peritoneal Dialysis (CAPD)

Continuous ambulatory peritoneal



dialysis (CAPD) is done to remove waste products, chemicals, and extra fluid from the body. During CAPD, a liquid called dialysate is put into the abdomen

through a plastic catheter (thin tube). The dialysate pulls wastes, chemicals, and extra fluid from the blood through the peritoneum. Two liters of dialysis fluid are run via the catheter into the peritoneal cavity, and this remains in the abdominal cavity for four to six hours before being drained out into an empty bag by gravity. This is called an exchange procedure. The waste products that are normally removed by the kidney are contained in the drained fluid, which is disposed of into the drain. A new bag of fluid is then drained into the peritoneal cavity. Patients can do it at home with the help of family members and can do normal duties once the fluid is inside the abdomen

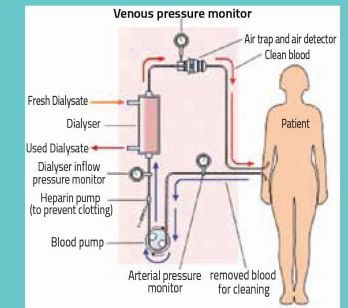
### 2. Automated Peritoneal Dialysis (APD) OR Continuous Cyclical Peritoneal Dialysis (CCPD)

This is a type of peritoneal dialysis with the help of a machine doing treatment during sleep. Before going to bed, the catheter is connected to the bag of PD fluid kept in the machine. The machine pushes the fluid into the peritoneal cavity and after some time drains the fluid out. This process goes on during the night when the patient is asleep

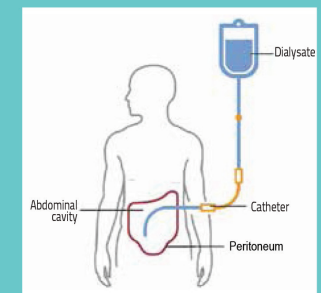


Peritoneal Dialysis Machine

### Hemodialysis



### Peritoneal Dialysis





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