RENAL REPLACEMENT THERAPY

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Renal Failure

- Healthy kidneys remove waste and extra fluid from your body, also it removes acid to maintain a healthy balance of water, so they help regulate electrolyte balance, blood pressure, and the production of red blood cells.
- Renal failure means when your kidneys are no longer able to work well enough to keep you alive.
- There are two main types of renal failure : acute and chronic renal failure.
- Acute renal failure : can be caused by prerenal factors such as hypotension and drug use, intrarenal factors such as acute tubule necrosis, and postrenal factors obstruction
- Chronic renal failure : is commonly caused by diabetes mellitus and hypertension, as well as other conditions, such as glomerulonephritis, polycystic kidney disease and hemolytic uremic syndrome.

Renal replacement therapy (RRT)

- Renal replacement therapy is a term used to encompass life-supporting treatments for renal failure. Renal replacement therapy replaces nonendocrine kidney function in patients with renal failure.
- Renal replacement therapy is used whenever the kidney functions fail to achieve homeostasis, this include situations such as : acute kidney insufficiency, chronic renal failure ans septic shock.
- There are three main types of renal replacement therapy :
- 1- Dialysis : is the most common form of renal replacement therapy. It involves using a machine to filter the blood outside the body, mimicking the function of healthy kidneys. There are two primary types of dialysis: hemodialysis and peritoneal dialysis.
- 2- Kidney Transplantation: is the surgical procedure in which a healthy kidney from a living or deceased donor is transplanted into the recipient with kidney failure.
- 3- Conservative management: In some cases, particularly in individuals with multiple serious health conditions, advanced age, or personal preference, renal replacement therapy might not be pursued. Instead, a conservative approach focused on managing symptoms, controlling fluid and electrolyte imbalances, and optimizing comfort and quality of life is chosen.

Renal Dialysis

- is a medical procedure used to artificially replace some of the essential functions of the kidneys in individuals with kidney failure or severe kidney dysfunction.
- The primary goal of renal dialysis is to remove waste products, excess fluid, and electrolytes from the blood, helping to maintain a balance of these substances in the body and preventing the build up of toxins.
- Hemodialysis : is a process in which blood is filtered outside the body through a machine called a dialyzer or artificial kidney.
- Peritoneal dialysis : uses the body's own peritoneal membrane, which lines the abdominal cavity, as the filtering mechanism.

Indications for dialysis in kidney failure

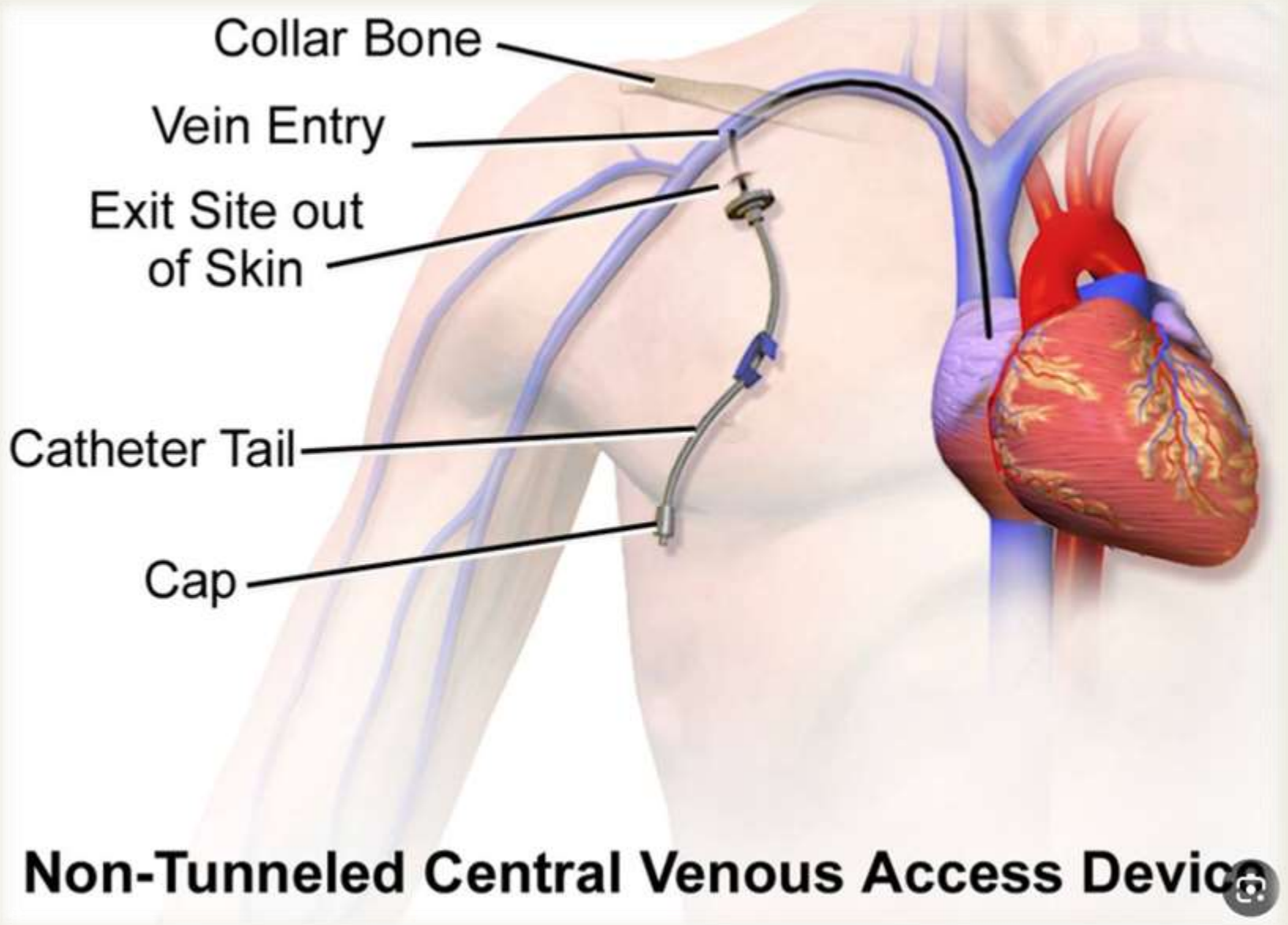
- 1- Impaired kidney function ; when the glomerular filtration rate (GFR), a measure of kidney function, falls significantly below normal levels (usually below 15 mL/min/1.73m).
- 2- Uremia and symptoms ; such as fatigue, nausea, vomiting, anorexia, pruritus and confusion.
- 3- Fluid and electrolyte imbalances ; in advanced kidney failure, fluid retention and electrolyte imbalances can occur, leading to complications like congestive heart failure, hypertension and dangerous arrhythmias.
- 4- Persistent acid-base imbalance ; in kidney failure, acidosis can occur due to the impaired excretion of acid by the kidneys.
- 5- Pericarditis and Pleuritis ; the accumulation of waste products in kidney failure can lead to inflammation of the pericardium and pleura causing pericarditis and pleuritis.
- 6- Uncontrolled hyperkalemia ; that is unresponsive to conservative measures,such as dietary modification, medication adjustments, or insulin administration
- 7- Volume overload and pulmonary edema

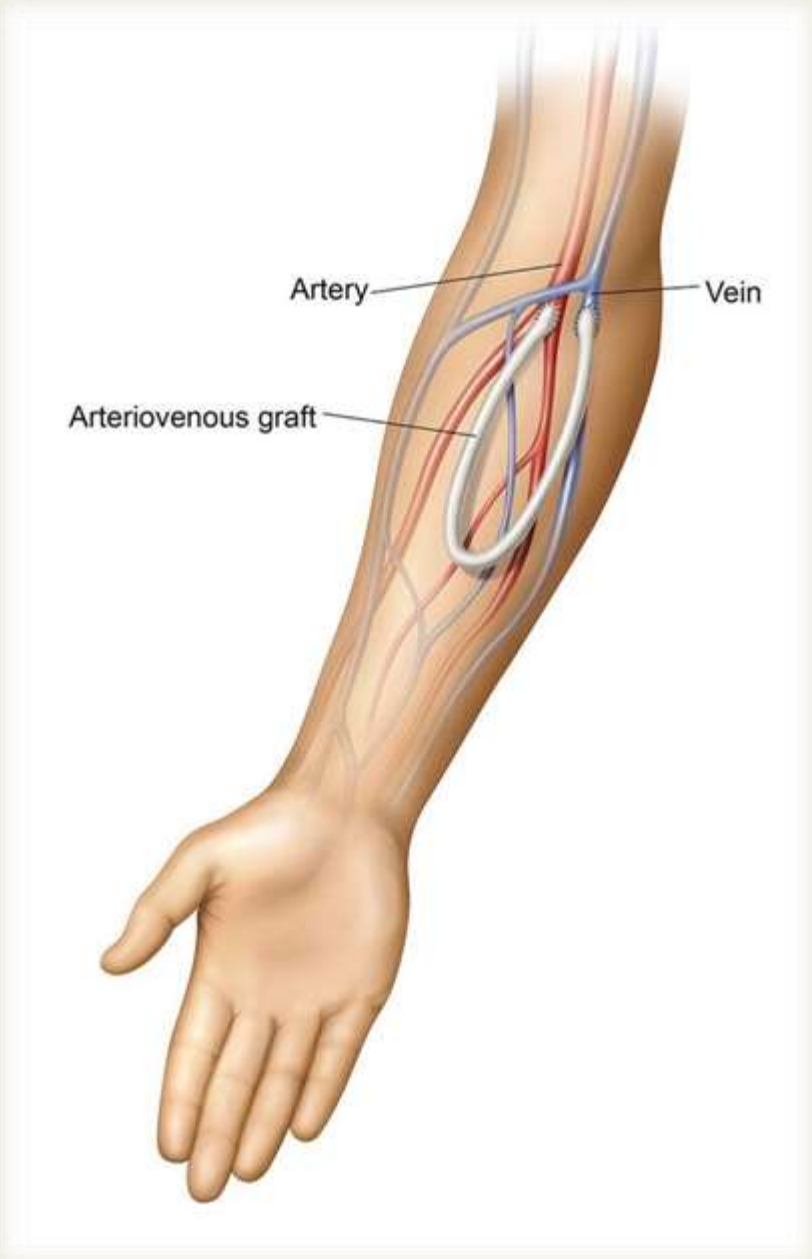
Hemodialysis

- Hemodialysis is a type of dialysis that performs normal kidney functions . It removes your blood , filters out toxins in a machine and then sends your filtered blood back into your body

Hemodialysis

- Access: before hemodialysis can begin, a suitable vascular access point should be stablished. This is a point on body where blood can be safely withdrawn and returned during the procedure.
- Types of vascular access :
- 1- Arteriovenous fistula (av fistula) : this is a surgically created connection between an artery and a vein, usually in the arm. Over time, the vein becomes larger and stronger, providing a reliable access point for dialysis.
- 2- Arteriovenous graft (avg) : similar to an avf, an avg is a synthetic tube placed under the skin to connect an artery and a vein. Its often used when a natural a v is not feasible due to small or weak veins.
- 3- Central venous catheter (cvc) : in some cases, a temporary catheter may be inserted into a large vein, usually in the neck or chest. CVCs are typically used when immediate dialysis is required but are associated with a higher risk of infection and other complications.

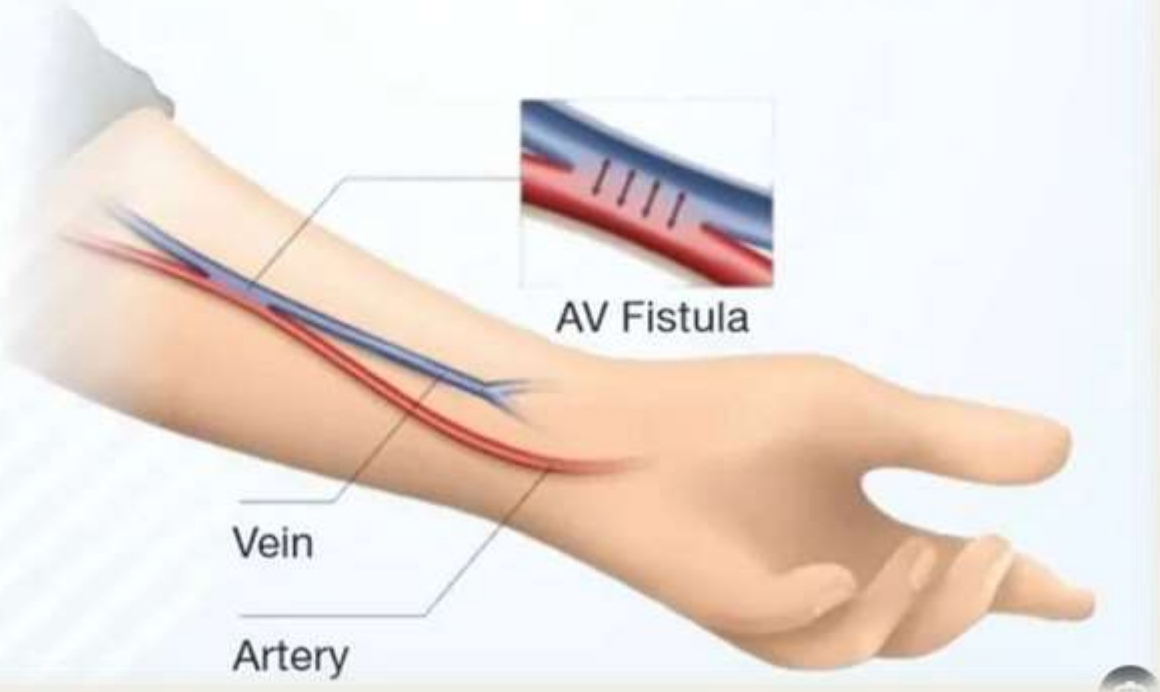

Collar Bone
Vein Entry
Exit Site out of Skin
Catheter Tail
Cap
Non-Tunneled Central Venous Access Devic


Artery
Vein
Arteriovenous graft

AV Fistula Surgery

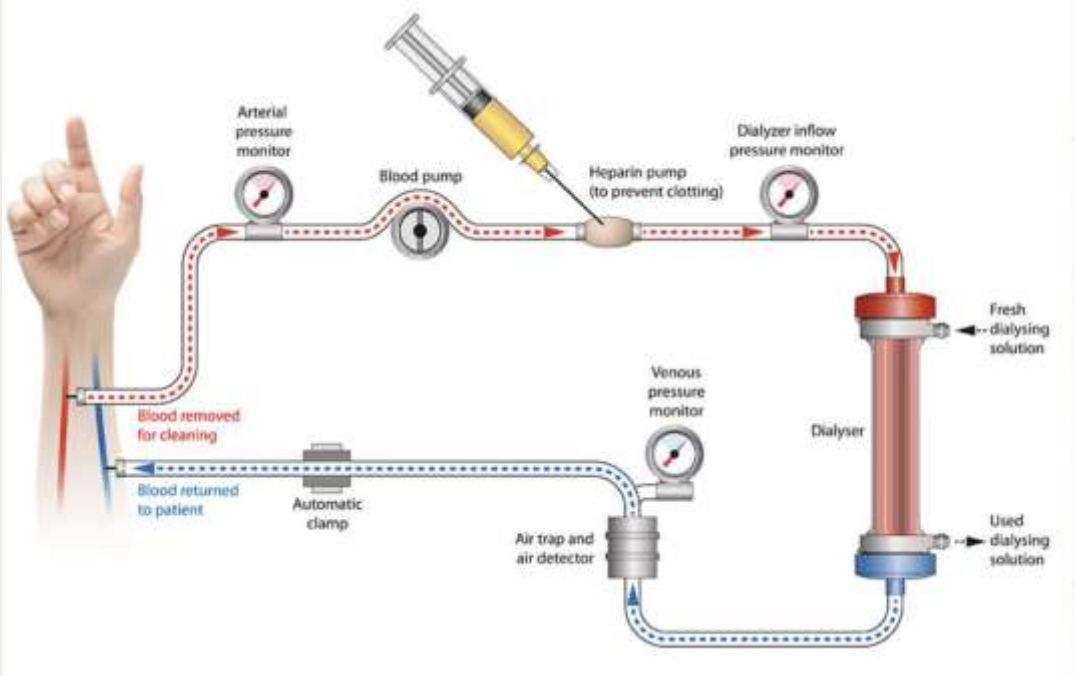
PACE HOSPITALS

AV fistula surgery is a procedure to create a direct connection between an artery and a vein in your arm. This connection is used for long-term hemodialysis access in patients with chronic kidney disease.



Process:

- The patient's blood is pumped by an artificial pump outside of the body through the **dialyzer**, which typically consists of fine capillary networks of semipermeable membranes. The **dialysate** flows on the outside of these networks, and fluid and solutes diffuse across the membrane.
-The patient's blood must be heparinized to prevent clotting in the dialyzer.



Frequency:

- Most hemodialysis patients require 3 to 5 hours of dialysis 3 days per week

- **Advantages**:

➢ More efficient than peritoneal dialysis.

➢ High flow rates and efficient dialyzers shorten the period of time required for dialysis.

➢ It can be initiated more quickly than peritoneal dialysis, using temporary vascular access in the emergent setting.

- **Disadvantages**:

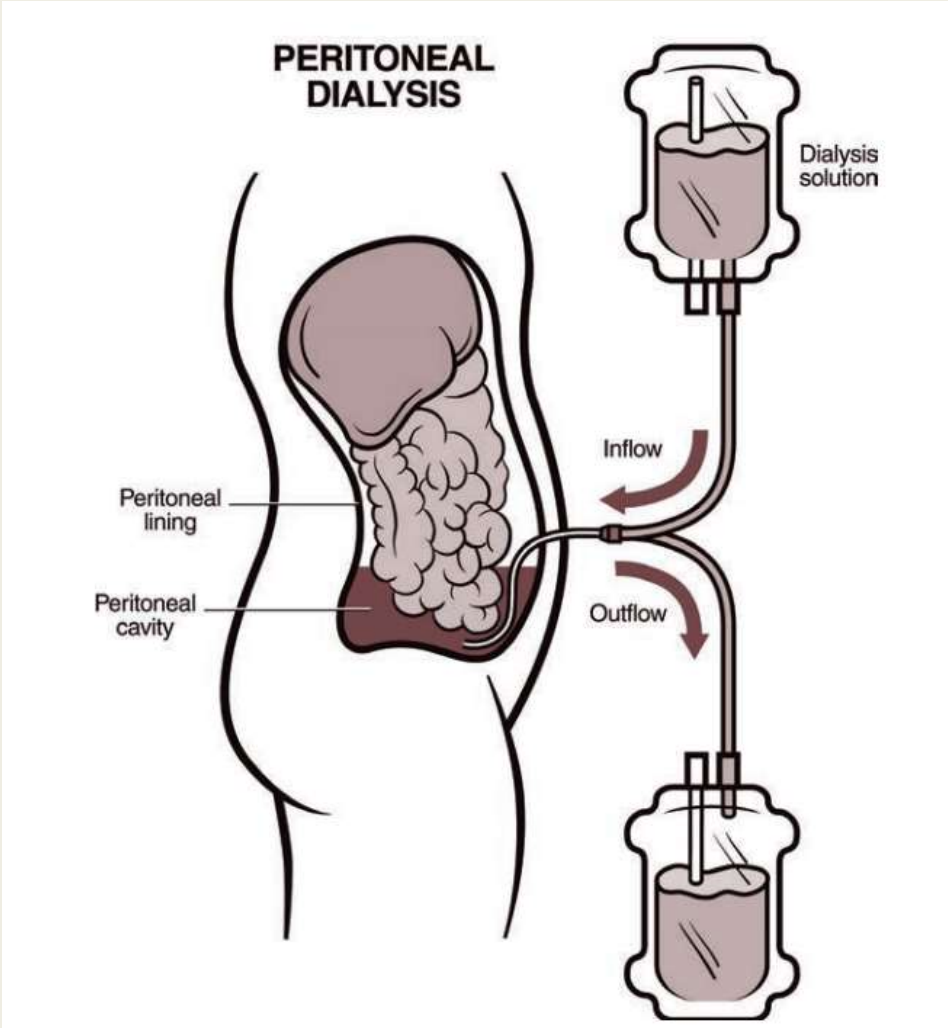
- It is less similar to the physiology of natural kidney function than is peritoneal dialysis, predisposing the patient to the following:
  - *Hypotension due to rapid removal of intravascular volume leading to rapid fluid shifts from the extravascular space into cells.*
  - *Hypo-osmolality due to solute removal.*
- Requires vascular access

Complications of Hemodialysis

- First-use syndrome - chest pain, back pain, and rarely, anaphylaxis may occur immediately after a patient uses a new dialysis machine
- Hypotension – especially towards end of session - so monitor and adjust.
- Muscle cramps – so hydrate and balance electrolytes.
- Hematoma
- Infection – especially central venous catheter insertions. It is the 2nd most common cause of death in dialysis patients (cardiovascular disease is #1)
- Hemodialysis-associated amyloidosis of β2-microglobulin in bones and joints, can lead to bilateral carpal tunnel syndrome.

Peritoneal Dialysis

- A form of RRT in which the peritoneum serves as the dialysis membrane. Dialysate fluid is infused into the peritoneal cavity, then fluids and solutes from the peritoneal capillaries diffuse into the dialysate fluid, which is drained from the abdomen.
- Continuous ambulatory peritoneal dialysis (CAPD) (manual exchange) or Automated peritoneal dialysis (APD) (machine; while patient sleeps).

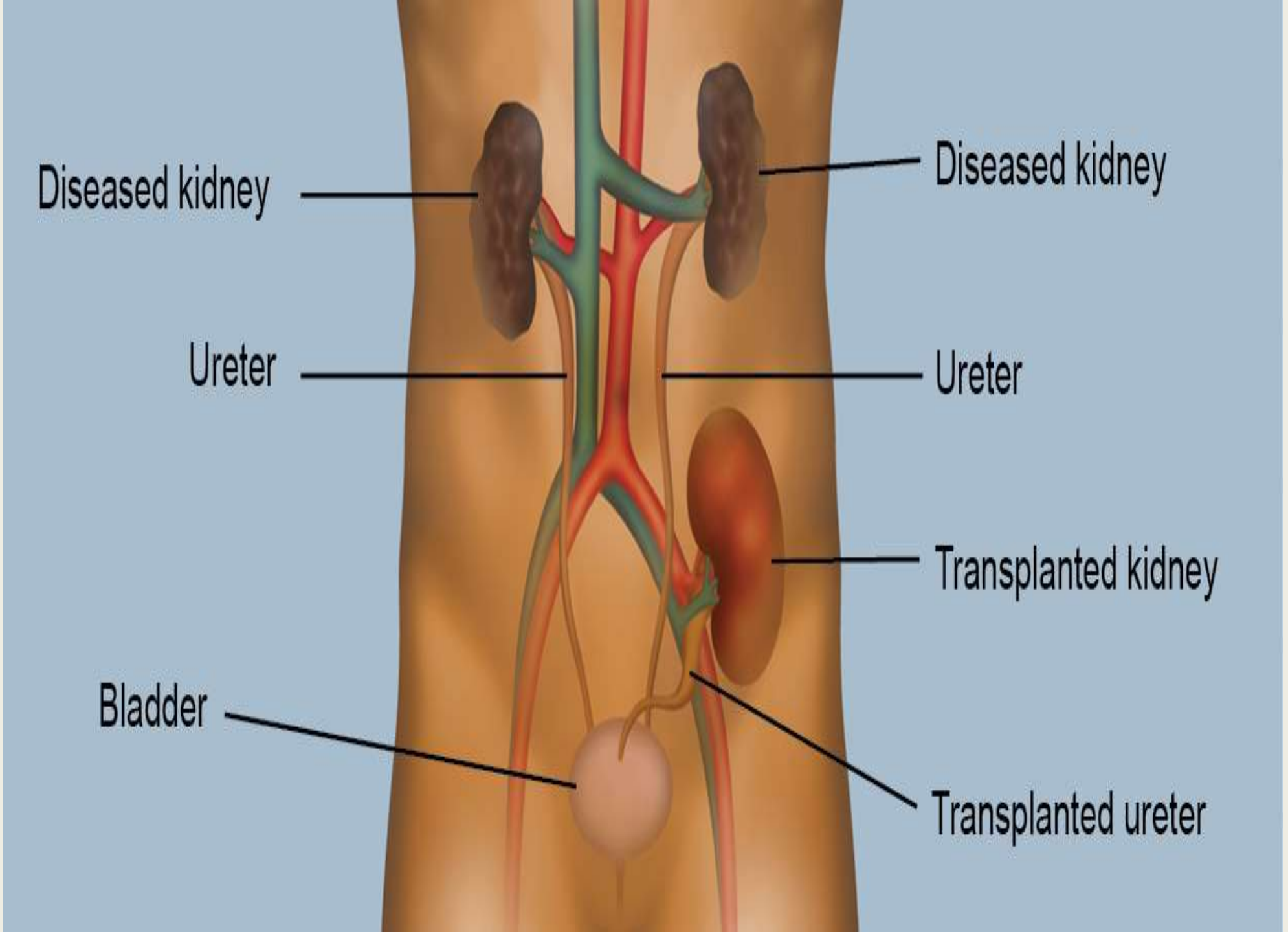


- **Advantages**
  - The patient can learn to perform dialysis on their own.
  - No vascular access
  - It mimics the physiology of normal kidney function more closely than hemodialysis in that it is more continuous. Better tolerated by patients with heart failure.
- **Disadvantages**
  - Uses hyperosmolar high-glucose dialysate → High glucose load may lead to hyperglycemia and hypertriglyceridemia, especially in diabetics.
  - The patients must be highly motivated to self-administer it.
  - Cosmetic—there is increased abdominal girth due to dialysate fluid.

- **Complications:**
  - **Peritonitis** – cloudy peritoneal dialysate fluid, abdominal pain and fever. Usually caused by skin flora, so initiate (intraperitoneal>) empiric antibiotics while awaiting confirmatory testing.
  - **Hernias** due to increased intra-abdominal pressure
  - **High protein loss and loss of water-soluble vitamins** (especially folic acid)

Keep in mind:

Dialysis does not replicate the kidney's synthetic functions. Therefore, dialysis patients are still prone to *erythropoietin and vitamin D deficiency*.


Diseased kidney
Diseased kidney
Ureter
Ureter
Transplanted kidney
Bladder
Transplanted ureter