Fundamentals of DIALYSIS
Knowing Your Kidneys

• Healthy Kidneys are the body’s cleaning crew

• These are twin bean shaped organs, of the size of fist

• They make up a filter system for the blood & reabsorb almost 99% of the fluid into the blood

• They allow blood to retain glucose, salts and minerals and remove toxic materials like urea, drugs etc
Knowing Your Kidneys

• Urine forms in kidneys, drains in ureter, gets stored in bladder and excretes through urethra

• Each day kidneys secrete 1.5 - 2.5 liters of urine
Functions of The Kidney

- Removes toxic and waste products & excess water
- Maintains body’s balance of salts
  - Sodium
  - Calcium
  - Phosphate and other acid substances
- Releases several hormones
  - Renin helps to regulate Blood Pressure
  - Erythropoietin helps in RBC production
  - Activated Vitamin D helps maintain normal bones
Kidney Diseases

- Kidney diseases alter the structure and function of Kidneys
- Leading causes are diseases like Diabetes and High BP
- Certain drugs also injure kidneys e.g. antibiotics, painkillers and antipsychotic drugs
Kidney Failure

- Kidney diseases lead to malfunctioning of kidneys
- In kidney failure, kidneys do not perform their normal function
- As a result toxic substances like urea & creatinine accumulate in body and vital components like albumin leak out in the urine
# Chronic Kidney Disease

<table>
<thead>
<tr>
<th>Stage</th>
<th>GFR</th>
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<td>I</td>
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<td>II</td>
<td>60-90</td>
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<td>III</td>
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<td>V/ESRD</td>
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[Click here for more information on Dialysis Zone](#)
Signs and Symptoms of Kidney failure

✓ Pale and sallow complexion
✓ Fatigue
✓ Shortness of Breath
✓ Body itch
✓ Poor appetite, sometimes with nausea/vomiting
✓ Swelling of the face and legs
✓ Frequent urination specially during nights
✓ Decrease in urine volume
Treatment of Kidney Failure

1. Dialysis

2. Kidney Transplantation

Kidney Transplantation is best and most comprehensive solution for kidney failure but many patients may not be suitable for the same.
Goals of Dialysis

• Solute clearance
  • Diffusive transport (based on countercurrent flow of blood and dialysate)
  • Convective transport (solvent drag with ultrafiltration)
• Fluid removal
Understanding Dialysis

• It’s a process of removing waste products and excess fluid when kidneys stop working
• Dialysis uses a membrane as a filter called dialyzer and a solution called dialysate to accomplish this

**BASIC PRINCIPLE OF DIALYSIS**

- Semi Permeable Membrane
- Blood from a patient with chronic renal failure
- Dialysate
- Waste products pass through membrane

**AT FIRST**

**A FEW HOURS LATER**
Dialysis is of two main types

**Hemodialysis**
- Uses an actual artificial kidney - **Dialyser** to clean the blood

**Peritoneal Dialysis**
- Uses **Peritoneum**, the lining of the abdomen, as a filter to clean the blood
What is Hemodialysis (HD)?

- The blood to be treated is pumped outside the body to a machine (Dialyzer) that acts like artificial kidney.
- Tiny pores in filter membrane filter out toxins while vital components such as proteins, are left in the blood.
- Excess water is also removed during the process of cleaning.
- After cleaning, the machine returns the clean blood back to body.
- HD is usually carried out three times a week and average session lasts for 4- hours.
- During the cleaning process, patients usually watch TV, read or talk to each other.
What is Hemodialysis (HD)?
- **Haemodialysis**
  - Diffusive transport of solutes
    - Relevant: cut-off of membrane
    - Relevant: weight of solutes

- **Haemofiltration**
  - Convective transport of solutes
    - Relevant: cut-off of membrane
    - Relevant: flow across membrane

- **Haemodiafiltration**
  - Diffusive transport of small solutes
  - Convective transport of large solutes
Solute transport in different dialysis modalities

Hemodialysis
- Dialyzer membrane
- Ultrafiltrate
- Dialysis fluid
- Blood

Hemofiltration
- Substitution fluid
- Ultrafiltrate
- Blood

Hemodiafiltration
- Pre-dilution from the patient
- Post-dilution to the patient

Blood
Ultrafiltrate
Substitution fluid
Dialysis fluid
Hemodialysis
Getting Ready for HD

• Before HD treatment, patient would need a dialysis access to allow blood to flow between body and dialyzer

• There are various types of accesses used for HD
  - Arterio-Venous Fistula the joining of vein and artery just under the skin
Getting Ready for HD

- Arterio Venous Graft used when the patient’s blood vessels are too small for fistula connection

- Subclavian Cannula/ internal jugular cannula is a soft plastic tube inserted into a vein under the collar bone or neck. It’s usually a temporary access for urgent dialysis
Dialysis Fluid in HD

• Also known as dialysate

• Fluid in the dialyzer that helps remove wastes and extra fluid

• Contains various chemicals depending on the status of the patient

• Dialysate is prepared according to the specific requirements of a patient
Possible Problems during HD

- Low BP
- Nausea (feeling sick)
- Cramps
- Headaches
- Fatigue
- Infections
- Clotting
- Fluid Overload
Peritoneal Dialysis
Possible Problems in PD

• Fluid overload

• Fluids leak in the groin or around the catheter

• Infections are the major risk, mainly of two types
  • Exit site infections
  • Peritonitis infection of the peritoneal membrane
Fluid Management in Dialysis

• People with renal failure make little or no urine and depend on Dialysis for excess water’s removal

• It is essential to control the volume of fluid intake to prevent the body from fluid overload, which might cause complications like increase in BP, shortness of breath, swollen eyelids and ankles or feet and distended abdomen
Fluid Management in Dialysis – Few Tips

• Count all fluids, all ice cubes, gravies, soups in your fluid allowance

• Measure a jug of water to restrict to the allowed amount

• Reduce salt intake

• Instead of few large drinks divide daily fluid into smaller and frequent drinks

• When mouth feels dry rinse with water

• Weigh yourself daily and check for any unusual weight gains
Dialysis Process

• Once the patient is diagnosed for acute/chronic or ESRD will be referred for Dialysis by Nephrologist Dr.
• Patient will be send for catheterization.
• Will do dialysis with the Double lumen catheter till his/her Arterial-Venous Fistula is surgically created & matured.
• It takes about a month for this.
Patient at Dialysis unit

- Patient will come for dialysis with Catheter/AVF
- Pre dialysis parameters like BP, pulse, body temperature & weight is checked recorded.
- Blood access site is observed for patency, cleaned with antiseptic & prepared for dialysis.
- Machine is Rinsed/disinfected/surface cleaned.
- Dialyser (artificial kidney/filter) and blood tubing set is rinsed with normal saline to remove air & disinfectant.
- Machine and kit is tested for traces of disinfectant to avoid chemical reaction.
Patient during dialysis

- Dialysis is started, all the machine parameters & safety alarm limits are set.
- BP, pulse are checked again after starting treatment, monitored & recorded every hourly.
- Patient is monitored for 4 hours during the dialysis for any discomforts.
- During the dialysis patient can read books, watch TV, eat food.
Ending dialysis

• Patients blood is returned using normal saline.
• The kit is send for washing/cleaning & disinfection to reprocessing room.
• Any post dialysis injections like vitamins, antibiotics are given.
• AVF needle removed & dressing done.
• For catheter patient heparin/antibiotic lock is given and dressing done.
• All vital signs post dialysis weight & parameters are recorded with clinical episodes if any.
Patient leaving dialysis unit

• Patient well being is confirmed by RMO DR on duty.
• Send back home with next dialysis schedule.
• Any special instructions communications are given at this time eg. Blood test due on next dialysis etc.
Acute Complications of Dialysis

- Hypotension (25-55%)
- Cramps (5-20%)
- Nausea and vomiting (5-15%)
- Headache (5%)
- Chest pain (2-5%)
- Back pain (2-5%)
- Itching (5%)
- Fever and chills (<1%)
Acute Complications of Dialysis

• Chest pain
  • Can be associated with hypotension and dialysis disequilibrium syndrome
  • Always consider angina, hemolysis, and (rarely) air embolism
  • Consider pulmonary embolism if recent manipulation of thrombus and/or occlusion of the dialysis access
Acute Complications of Dialysis

• Hemolysis
  • Suggestive findings include port wine appearance of the blood in the venous line, a falling hematocrit, or complaints of chest pain, SOB, and/or back pain
  • Usually due to dialysis solution problems, including overheating, hypotonicity, and contamination with formaldehyde, bleach, chloramine, or nitrates in the water, or copper in the dialysis tubing
  • Treatment includes discontinuation of dialysis without blood return to the patient, and evaluation for hyperkalemia with medical treatment as necessary
Acute Complications of Dialysis

• Arrhythmias
  • Common during, and between, dialysis treatments
  • Controversial whether due to disturbances in plasma potassium
  • Treatment is similar to the non-dialysis population, except for medication dosing adjustments
Critical quality area in Dialysis

- Reverse osmosis plant/ water availability.
- Dialyser and blood tubing reprocessing
- Customer care services
- Infection control /Bio hazard handling
- Emergency trolley check
- All Resources/ facility in working condition round the clock.
- Staff competency to handle medical emergency
- Dialysis unit ambience/structure standardization.
- Machine/RO & all equipments routine maintenance.
Other Complications of Kidney Failure

Renal Osteodystrophy
- ESRD causes increased bone breakdown and abnormal metabolism of Calcium, Phosphorus, Vitamin D and PTH, leading to Renal Osteodystrophy
- Affects most of the ESRD patients and causes bones to become thin, weak or malformed

Itching (Pruritus)
- Many patients complain of itchy skin
- Phosphate binders such as calcium carbonate and aluminium hydroxide help
- Some patients also improve with EPO shots

Sleep Disorders
- Quite common in ESRD patients when on dialysis
Amyloidosis

- Dialysis related amyloidosis is common problem for older (more than 5 years) dialysis patients
- Proteins deposit in joints and tendons, causing pain, stiffness and fluid in the joints
Thank You