Reading Material for
Dialysis Technician
(PAPER-A)

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PREFACE

Both incidence and prevalence of CKD are rising with immense pace in our country, especially dur to non-communicable diseases such as Diabetes Mellitus and Hypertension. It is imperative to understand the true prevalence as well as causes of CKD in both urban and rural areas of Pakistan, in relevance to age and gender. According to a research, overall prevalence of CKD among all age groups is 21.2%. Increased prevalence of CKD has led to increase number of Dialysis centers and hence need for trained Hemodialysis technicians is increased. This book is designed for comprehensive knowledge and understanding of Dialysis technicians.

Table of Contents

Objectives of Chapter - 1

1. Brief introduction
2. History of dialysis worldwide and Pakistan

CHAPTER:1

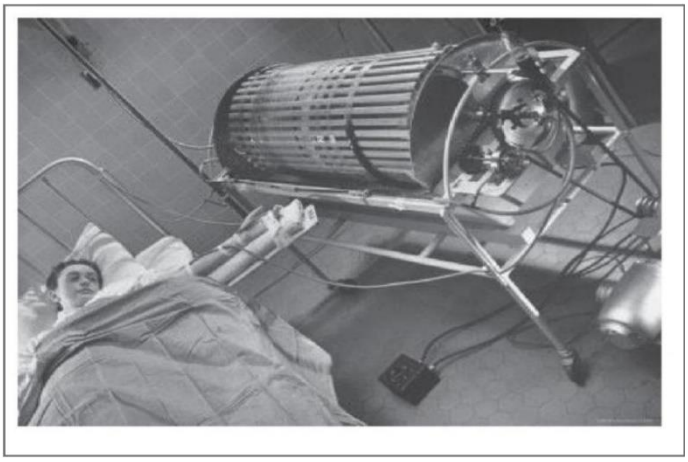
HISTORY OF HEMODIALYSIS

INTRODUCTION

In Roman and Middle ages Uremia was treated using hot baths, sweating therapies, bloodletting and enema.

Scottish chemist **Thomas Graham** known as the "**father of dialysis**, first described of dialysis in 1854.He used osmosis to separate dissolved substances and remove water thorough semi permeable membranes although he did not apply the method to medicine.

The history of dialysis dates back to the 1940s. The first type of dialyzer, then called the artificial kidney, was built in 1943 by Dutch physician Willem Kolff.



He had first gotten the idea of developing a machine to clean the blood after watching a patient suffer from kidney failure. Kolff came to the United States in the late 1940s and went to work at Mount Sinai hospital, trying to get kidney treatment to become a health service.

More experimentation led to the manufacturing of an improved design in the early 1950s. However, Kolff's device only treated acute kidney failure and not end stage renal disease (ESRD).

Dr. Belding Scribner, a professor of medicine at the University of Washington, developed a way for ESRD patients to received treatment through an access point in their arm.

In **1962,** Scribner opened the first official dialysis clinic for patients. He eventually developed a portable dialysis machine that allowed patients receive dialysis treatment at home.

Dialysis was first used successfully in the 1940's and became a standard treatment for kidney failure starting in the 1970s.

Nowadays, over 90 percent of dialysis patients receive treatment at dialysis centers. Many more treatment option have become available, including peritoneal dialysis, home hemodialysis and nocturnal in-center treatment.

HEMODIALYSIS IN PAKISTAN

The first hemodialysis treatment in Pakistan took place in **1962** at the Civil Hospital in Karachi.
Dr. Adeebul Hasan Rizvi, a Pakistani surgeon and philanthropist, played a pivotal role in introducing hemodialysis to the country.

Sample Questions

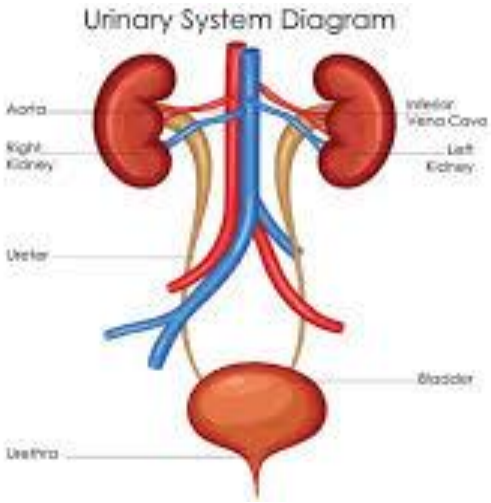
1. What do you know about history of dialysis worldwide and in Pakistan?

Objectives of Chapter -2

1. Macro and micro anatomy of kidneys.

CHAPTER:2

ANATOMY OF KIDNEYS:



- Located in lumbar region, **retroperitoneum** (behind/outside the peritoneum)
- **Bean shaped**, reddish brown organs.
- Measures about **10cm long**, **5 cm wide**, and **3cm thick.**
- Weighs about **125** to **170**gm in an adult.
- Protected by rib cage.
- The left kidney lies slightly above the right kidney.
- The outer surface is convex, inner surface is concave.
- longitudinal section: If we cut from between then front and back part separated

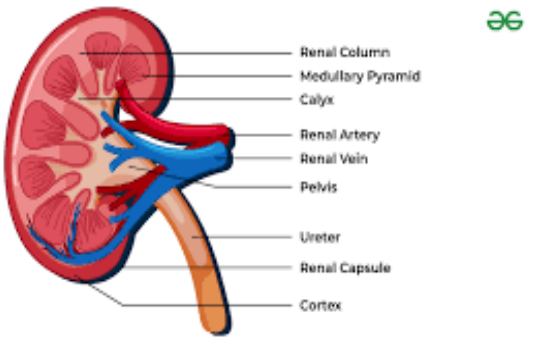
  Cortex-----pinkish colour

  Medulla---- light pink colour
- The concave side has depression in the middle, known as **hilum**, where the nerves and renal artery enters and renal vein and ureter exit the kidney

Location

The kidneys are located on either side of the spine, in the retroperitoneal space. The left kidney is situated a little higher than the right one

- **MICROSCOPIC STRUCTURE:**



Renal corpuscle

After blood enters a nephron, it goes into the renal corpuscle, also called a Malpighian body. The renal corpuscle contains two additional structures:

- **The glomerulus.** This is a cluster of capillaries that absorb protein from blood traveling through the renal corpuscle.
-
- **The Bowman capsules.** The remaining fluid, called capsular urine, passes through the Bowman capsule into the renal tubules.

Renal tubules

The renal tubules are a series of tubes that begin after the Bowman capsule and end at collecting ducts.

Each tubule has several parts:

- **Proximal convoluted tubule.** This section absorbs water, sodium, and glucose back into the blood.

- **Loop of Henle.** This section further absorbs potassium, chloride, and sodium into the blood.
- **Distal convoluted tubule.** This section absorbs more sodium into the blood and secretes potassium and acid in urine.

By the time fluid reaches the end of the tubule, it's diluted and filled with urea. Urea is byproduct of protein metabolism that's released in urine.

- **Renal cortex**:

Dark outer zone, **granulated.**

The renal cortex is surrounded on its outer edges by the renal capsule, a layer of fatty tissue. Together, the renal cortex and capsule house and protect the inner structures of the kidney.

- **Renal Medulla:**

The inner layer of kidney, contains **renal pyramids**, **renal papilla**, **renal calyces**, **renal pelvis.**

The site for salt, water and urea absorption.

Renal pyramids Renal pyramids are small structures that contain strings of nephrons and tubules. These tubules transport fluid into the kidney. This fluid then moves away from the nephrons toward the inner structures that collect and transport urine out of the kidney.

- **Renal Pelvis**:

The renal pelvis is a funnel-shaped space in the innermost part of the kidney. It functions as a pathway for fluid on its way to the bladder

Calyces

The first part of the renal pelvis contains the calyces. These are small cup-shaped spaces that collect fluid before it moves into the bladder. This is also where extra fluid and waste become urine.

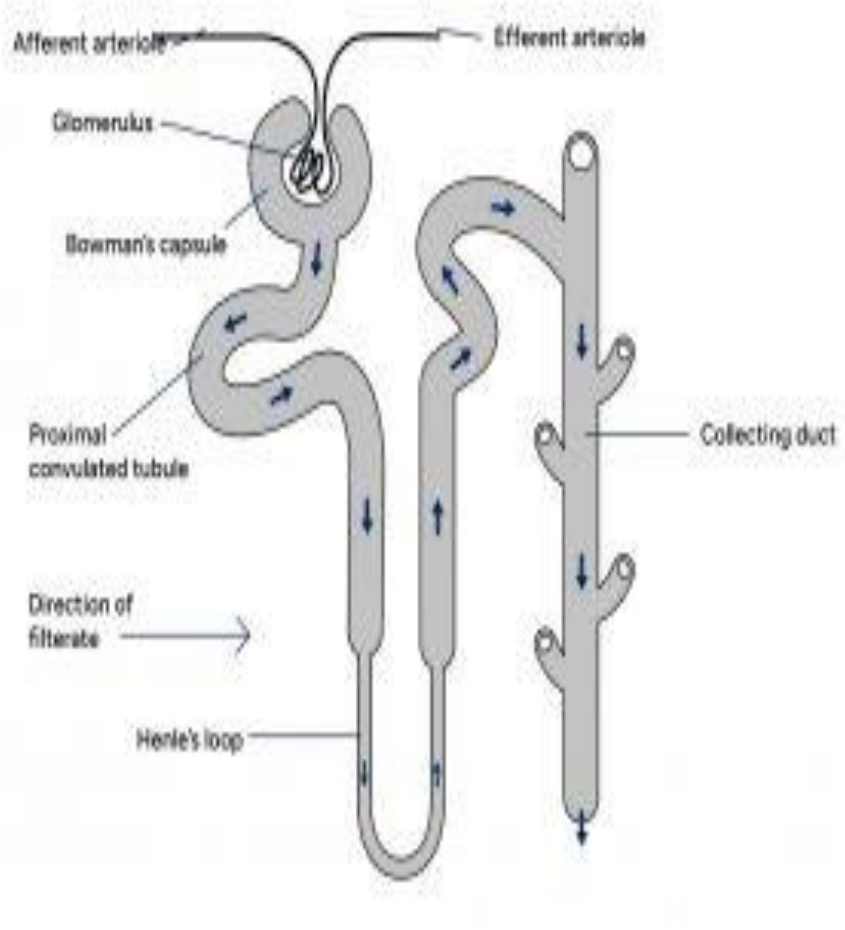
Hilum

The hilum is a small opening located on the inner edge of the kidney, where it curves inward to create its distinct beanlike shape. The renal pelvis passes through it, as well as the:

- **Renal artery.** This brings oxygenated blood from the heart to the kidney for filtration.
- **Renal vein.** carries filtered blood from the kidneys back to the heart.

NEPHRON:

- **Basic structural and functional unit** of kidney. More than **1 million** of nephrons are present in each kidney.
- The main components of the nephron are the glomerulus, **the Bowman's capsule** or **glomerular capsule**, the **proximal convoluted tubule**, **the loop of Henle**, and the **distal convoluted tubule.**



TYPES OF NEPHRONS

There are **two types of nephrons:**

- **Cortical nephron**

These are the nephrons present within the cortex. These are short and comprise about **80%** of the total nephrons.

- **Juxtamedullary nephron**

These have long loops of Henle and extend into the medulla. These are about **20%.**

FUNCTIONS OF NEPHRON

The primary function of nephron is removing all waste products including the solid wastes, and other excess water from the blood, converting blood into the urine, reabsorption, secretion, and excretion of numerous substances.

Sample Question

1. Write a note on anatomy of kidneys?
2. What do you know about nephron?

Objectives of Chapter -3

1. To know about functions of kidneys.

CHAPTER: 3

FUNCTIONS OF KIDNEYS:

Functions of kidneys are:

- **Urine formation**
- **Acid base balance**
- **Electrolyte balance**
- **Filtration of blood**
- **Secretion of substances**
- **Maintenance of renal blood pressure**
- **Reabsorption of material**
- **Excretion of waste materials**

1.URINE FORMATION

Filtration process occurs in the kidney, which filters the waste material. Urine formation takes place in 3 steps:

1. **Ultrafiltration**
2. **Reabsorption along nephron**
3. **Secretion from blood to tubule**

2. ACID BASE BALANCE

It is key for maintenance of cellular stability.

Normal ph of blood is 7.35-7.45. When ph is less than 7.35, it is called **acidic.** If it is more than 7.45, then it is called **basic.** Kidney keeps this range normal by:

1. **Reabsorption of filtered bicarbonate**
2. **Excretion of the fixed acids**

3.ELECTROLYTE BALANCE:

Electrolytes balance plays an important role in our body. kidney maintains the balance of electrolytes like **Na+, Cl-, K+,** so that osmolarity of both the body fluids and urine remain same.

4.FILTRATION OF BLOOD:

The glomerulus is the site of filtration of blood.

5.SECRETION OF SUBSTANCES:

Kidney produces different kind of hormones.

- Erythropoietin: improves haemoglobin.
- Renin: maintains blood pressure.
- Prostaglandins: maintains kidney blood flow.
- 1,25-dihydroxyvitamin D3: Activates vitamin D.

6.MAINTENANCE OF RENAL BLOOD PRESSURE:

This process is achieved by the **Juxtaglomerular apparatus.**

7. REABSORPTION OF MATERIAL:

Nutrients such as glucose, amino acids and other metabolites are reabsorbed in **medulla.**

8. EXCRETION OF WASTE MATERIALS:

Kidneys excrete all the waste materials from the body such as:

- Urea
- Uric acid
- Creatinine
- Forein substances

- Metabolites of hormones

Sample Question

1. What are the different functions of kidneys?

Objectives of Chapter - 4

1. Different diseases of kidneys.
2. Acute kidney injury
3. Chronic kidney disease
4. Renal biopsy.

CHAPTER :4

RENAL DISEASES

Acute kidney injury:

Acute Kidney Injury: Acute Kidney Injury (AKI) is a sudden and often reversible loss of kidney function. This condition is characterized by a rapid decline in the glomerular filtration rate (GFR), resulting in the accumulation of waste products and electrolyte imbalances.

AKI is defined as:

- An absolute increase in serum creatinine by **0.3 mg/dL** or more within **48 hours**, or
- Relative increase of serum creatinine at least **1.5 times** baseline that is known or presumed to have occurred within 7 days.
- AKI is labelled if urine production is **less than 0.5ml/kg/hr for 6 hours.**

CAUSES:

Numerous factors can lead to AKI, broadly classified into prerenal, intrinsic renal, and postrenal causes:

1. **Prerenal Causes:**
    - Reduced blood flow to the kidneys due to dehydration, heart failure, sepsis, or hemorrhage.
    - Pre-renal means cause is outside and before the kidneys.
2. **Intrinsic Renal Causes:**
    - Direct damage to renal structures, often from infections, toxins, medications, or autoimmune diseases.
    - Renal means cause is within the kidneys.
3. **Postrenal Causes:**
    - Obstruction of urinary flow, such as kidney stones, tumors, or enlarged prostate.
    - Post-renal means outside and beyond/after the kidneys.

SYMPTOMS:

The presentation of AKI varies, but common symptoms include:

- **Decreased Urine Output**: Oliguria or anuria**.**
- **Fluid Retention**: Edema**,** particularly in the extremities and face.

- **Electrolyte Imbalances**: Hyperkalemia, metabolic acidosis, and hyponatremia.
- **Fatigue and Weakness**: Due to the retention of waste products.
- **Nausea and Vomiting**: Resulting from the accumulation of toxins.

Category	Common abnormality	Potential causes
Pre-renal	Changes in blood volume and pressure supply to kidneys	Bleeding, fluid loss, burns, cirrhosis, recent surgery, non-steroidal anti-inflammatory drugs, impaired cardiac function, anti-hypertensive medications, sepsis
Intra-renal	Structural anomaly in the kidneys (primarily damage to blood vessels, glomeruli and tubules of nephrons)	Acute tubular necrosis, glomerulonephritis, recent surgery, nephrotoxic medications, hypertension, sepsis, severe burns or trauma, nephritis, adverse reaction to certain non-steroidal anti-inflammatory drugs and antibiotics, vasculitis
Post-renal	Urinary obstruction anywhere between kidney tubules and urethra	Kidney stones, pyelonephritis, benign prostatic hyperplasia, swollen lymph nodes (infection), transitional cell carcinoma (typically bladder, ureters or urethra), retroperitoneal fibrosis, renal papillary necrosis

Categorization and causes of AKI

DIAGNOSIS:

1. **LABORATORY TESTS:**
    - **Serum Creatinine** and **Blood Urea Nitrogen (BUN)**: Elevated levels indicate impaired kidney function.
    - **Urinalysis:** Detects abnormalities like proteinuria, hematuria, and changes in urine concentration.
    - **Electrolyte Levels**: Assess for imbalances.

2. **IMAGING STUDIES:**
    - **Ultrasound**: Provides images of the kidneys to identify structural abnormalities.
    - **CT Scan or MRI**: Offers detailed views of the kidneys and urinary tract.

3. RENAL BIOPSY:

- In certain cases, a biopsy may be performed to determine the underlying cause, especially in cases of glomerulonephritis or interstitial nephritis.

- The patient should be admitted if there is sudden loss of kidney function resulting in abnormalities that cannot be handled expeditiously in an outpatient setting (eg, **hyperkalemia, volume overload, uremia**) or an acute intervention is needed, such as emergent urologic procedures or dialysis

CHRONIC KIDNEY DISEASE:

Structural and functional loss of Kidney function with **GFR less than 60 ml/min** and that persists **for at least 3 months**.

The most **common CKD risk factors** are:

- Diabetes
- High blood pressure (hypertension)
- Heart disease or heart failure
- Obesity
- Over the age of 60
- Family history of CKD or kidney failure
- History of unresolved acute kidney injury (AKI)
- Smoking and/or use of tobacco products

OTHER CAUSES:

CKD can also be caused by many other conditions or circumstances. Some examples include:

- **Glomerular diseases**: Nephrotic and Nephritic syndromes.
- **Inherited conditions**: polycystic kidney disease
- **Autoimmune conditions**: lupus (lupus nephritis)
- **Severe infections**: sepsis and hemolytic uremic syndrome (HUS)

- **Other causes**: kidney cancer, kidney stones, frequent untreated and/or long-lasting urinary tract infections (UTIs), hydronephrosis, and kidney and urinary tract abnormalities before birth

COMPLICATIONS

As CKD worsens, the risk of getting complications goes up. Some examples include:

- Cardiovascular disease (heart disease and/or stroke)
- High blood pressure
- Anemia (low levels of red blood cells)
- Metabolic acidosis (buildup of acid in the blood)
- Mineral and bone disorder (when blood levels of calcium and phosphorus are out of balance leading to bone and/or heart disease)
- Hyperkalemia (high levels of potassium in the blood)
- Kidney failure

STAGES OF CKD:

- **CKD stage 1:**

GFR 90 ml/min

- **CKD Stage 2:**

GFR 60-89 ml/min

- **CKD stage 3:**

3A --45-59 ml/min.

3B--30-44 mL/min

- **CKD stage 4:**

GFR = 15-29 ml/min

- **CKD stage 5:**

GFR <15 mL/min

Stages of CKD of all types		
Stage	**Qualitative Description**	**GFR (mL/min/1.73 m²)**
1	Kidney damage – normal GFR	> 90*
2	Kidney damage – mild ↓ GFR	60-89*
3a	Moderate ↓ GFR	45-59
3b	Moderate ↓ GFR	30-44
4	Severe ↓ GFR	15-29
5	End-stage renal disease	<15

*A GFR >60 mL/min/1.73 m² in isolation is not CKD, unless other evidence of kidney damage is present

CKD, chronic kidney disease; *GFR*, glomerular filtration rate

OTHER KIDNEY DISEASES:

Other common kidney disease include:

- **POLYCYSTIC KIDNEY DISEASE**:

This genetic disorder causes cysts (fluid-filled sacs) to grow on your kidneys, limiting their ability to filter waste from your blood.

Types

- Autosomal dominant polycystic kidney disease.
- Autosomal recessive polycystic kidney disease.

ADPKD (AUTOSOMAL DOMINANT POLYCYSTIC KIDNEY DISEASE)

- Develop Late in life after 30-40yrs.
- If one of the parents have ADPKD, then there are 50% chances that every child gets this.

ARPKD (AUTOSOMAL RECESSIVE POLYCYSTIC KIDNEY DISEASE)

- If both parents have this disease than there will 25% chances that every child get this.
- Early in life.
- Genetic disorder.

SYMPTOMS

- UTI
- Headache
- Hematuria
- The Fullness in abdomen
- Lower back pain.
- Hypertension.

- **LUPUS NEPHRITIS**:
    - Lupus is an autoimmune disease, meaning your immune system attacks healthy cells. Lupus nephritis is when your immune system attacks your kidneys.

- **INTERSTITIAL NEPHRITIS**:
    - This condition happens when you have a bad reaction to a medicine that limits your kidneys' ability to filter toxins. If you stop the medicine, your kidney health should improve.

- **GLOMERULONEPHRITIS**:
    - Glomeruli are the thousands of tiny filters that remove waste from your blood in your kidneys. This condition damages them, and your kidneys can't function as well. Inflammation in the glomeruli can happen after a strep infection, as well.

Sample Questions

1. What are the different diseases of kidneys.
2. What is acute kidney injury and what are its causes?
3. What is chronic kidney disease. What is its classification and causes?
4. What is renal biopsy and why it is performed?

Objectives of Chapter - 5

1. Dialysis introduction
2. Types of dialysis
3. Indications of dialysis

CHAPTER:5

TYPES OF DIALYSIS AND INDICATIONS:

INTRODUCTION OF DIALYSIS:

- Dialysis is a type of treatment that helps your body to remove extra fluid and waste products from your blood when the kidneys fail to do.

- Dialysis initiation should be considered when GFR is near 10 mL/min/1.73 m2 and uremic symptoms are present. Other indications for dialysis, which may occur when GFR is 10–15 mL/min/1.73 m2, are fluid overload unresponsive to diuresis and refractory hyperkalemia.

LIFE EXPECTANCY

Life expectancy on dialysis varies depending on your other medical conditions, how well you follow your treatment plan, and various other factors. The average life expectancy on dialysis is 5-10 years. However, many patients have lived well on dialysis for 20 or even 30 years.

TYPES OF DIALYSIS:

The different types of dialysis are:

- **Hemodialysis (HD)**
- **Peritoneal dialysis (PD)**

1. HEMODIALYSIS :

Hemodialysis is a form of dialysis that uses a filter called a **hemodialyzer t**o remove waste and extra fluid from the blood.

Session of hemodialysis typically occurs three times a week. Sessions last 3–5 hours, depending on medical condition and type of dialysis access.

2. Peritoneal Dialysis:

Peritoneal dialysis uses the natural filtering ability of the peritoneum, the internal lining of the abdomen, to filter waste products from the blood

There are different kinds of peritoneal dialysis:

- **Continuous ambulatory peritoneal dialysis (CAPD),** in which the patient exchanges the dialysate four to six times a day manually

- **Continuous cyclic peritoneal dialysis (CCPD),** which utilizes a cycler machine to automatically perform exchanges at night.

INDICATIONS OF DIALYSIS:

- Acute kidney injury
- Uremic encephalopathy
- Pericarditis
- Life-threatening hyperkalemia
- Refractory acidosis
- Hypervolemia causing end-organ complications (e.g., pulmonary edema)
- Failure to thrive and malnutrition
- Peripheral neuropathy
- Intractable gastrointestinal symptoms
- Asymptomatic patients with a GFR of 5 to 9 mL/min/1.73 m^2
- Any toxic ingestion

Sample Questions

1. What is the definition of dialysis?
2. What are different types of dialysis?
3. When will you perform dialysis?

Objectives of Chapter - 6

1. Principles of dialysis
2. Modalities of dialysis
3. Water treatment
4. Blood circuit
5. Dialysis solution circuit

CHAPTER:6

PRINCIPLES OF HEMODIALYSIS

Hemodialysis removes uremic toxins and excess fluid from the blood by diffusion dialysis and ultrafiltration. The efficiency of this process depends on the size, shape, and type of semipermeable membrane used in the hemodialyzer.

PRINCIPLES OF HAEMODIALYSIS:

- **DIFFUSION**
- **ULTRA-FILTRATION**
- **CONVECTION**

DIFFUSION:

Movement of solute particles from higher concentration to lower concentration.

Diffusion is based on:

- Concentration
- Number of pores
- Size of particle
- Molecular weight
- Velocity

ULTRAFILTRATION:

Ultrafiltration (UF) is a purification process in which water is forced through a semipermeable membrane. Suspended solids and high-molecular-weight solutes remain on one side of the membrane, the retentate side, while water and low-molecular-weight solutes filter through the membrane to the permeate side

FACILITATING FACTORS:

- **TMP**
- **Oncotic force beyond membrane**
- **Kuf (High Flux)**

IMPLICATIONS OF CONVECTION:

- **HEMOFILTRATION:**

Where a large amount of ultrafiltration is coupled with the infusion of replacement fluid to remove solutes by convection.

- **HEMODIAFILTRATION:**

It combines the benefit of HD and HF.

-Dialysis apparatus and the dialyzer:

DIALYSIS MACHINES:

The modern dialysis machine consists of:

-The blood circuit

-Dialysis solution circuit

-Dialyzer

BLOOD CIRCUIT:

Blood circuit consists of following components:

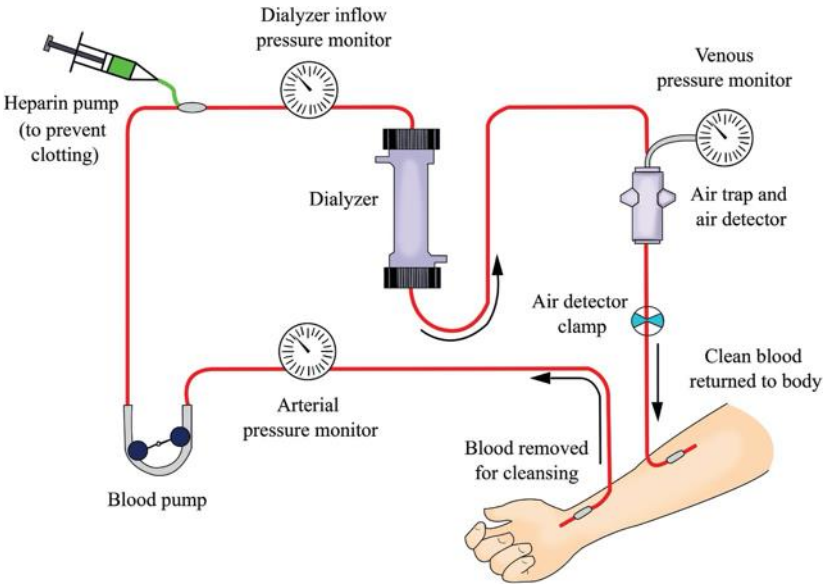
-Pressure

-Blood tubing

-Blood pump

-Heparin pump

-Air leak detector and clamps



DIALYSIS SOLUTION CIRCUIT:

The key components of this circuit include:

-Heating

-Deaeration

-Proportioning

-Monitoring

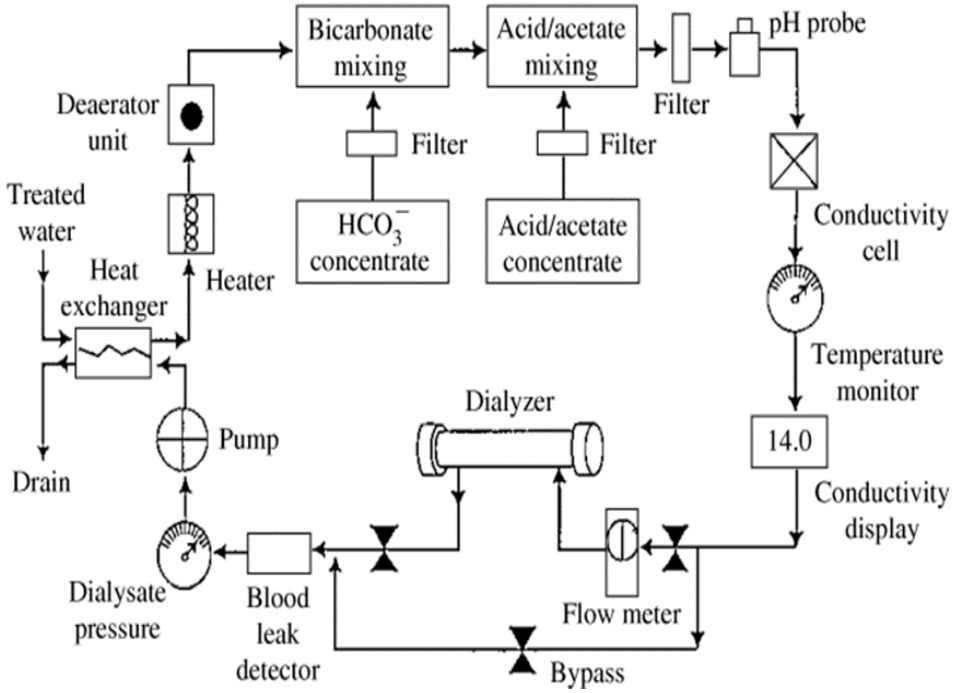
-UF

-Disinfection

DIALYZER:

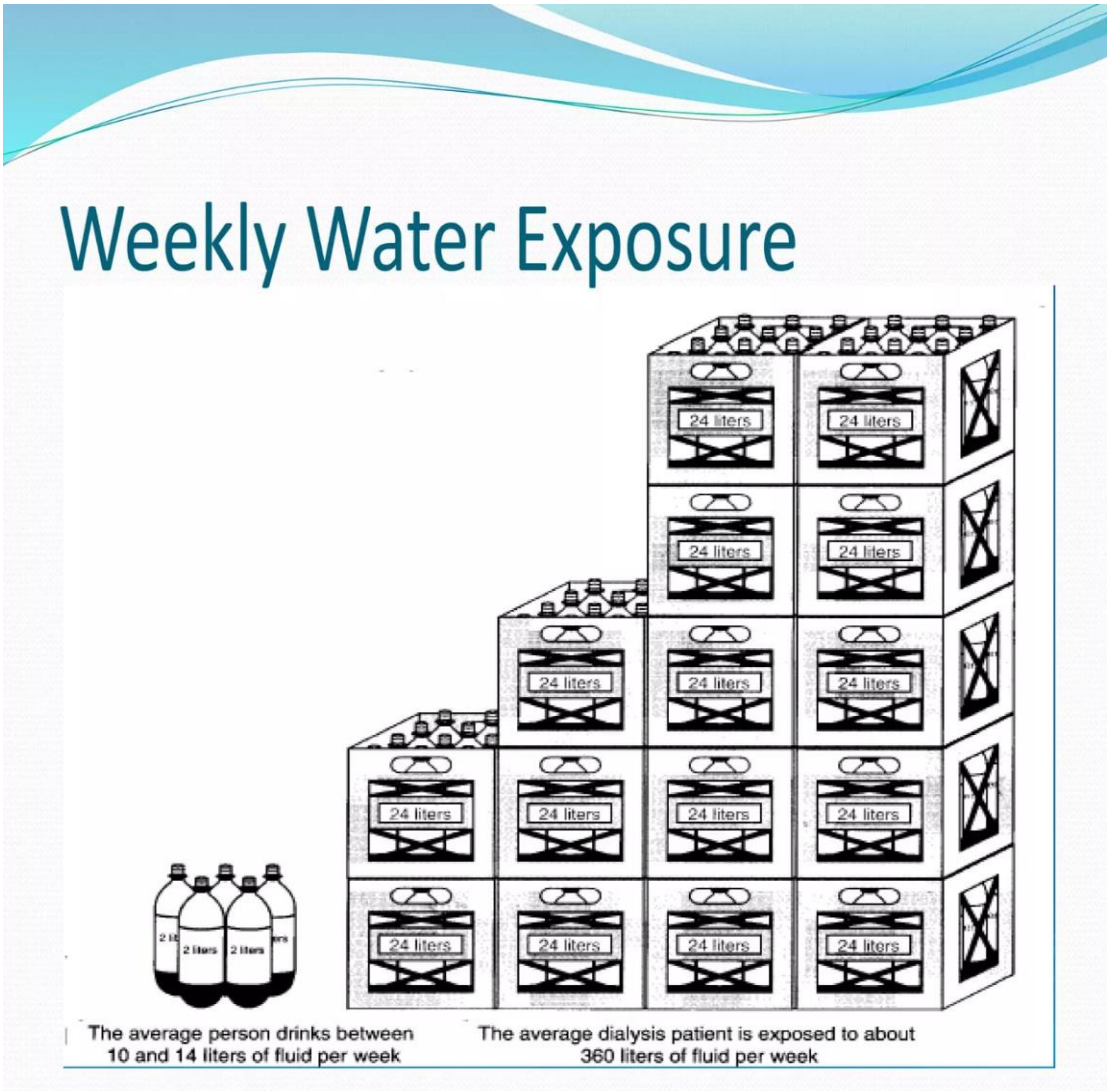
- The dialyzer shell is a box or tube with 4 ports.
- 2 ports communicate with blood compartment
- 2 ports communicate with dialysate compartment.
- Dialysate and blood compartments are separated by a semi-permeable membrane
- The surface area is maximized by dividing the membrane into hollow Fibers or parallel plates

DIALYSATE PATHWAY



CHAPTER: 7

WATER TREATMENT



- **<u>NEED OF PURE WATER</u>**
- . Exposure to 120 – 200 L of dialysis solution per session
- . Small molecular contaminants of raw water may accumulate in absence of renal excretion
- Hence, dialysis solution prepared from purified water or “product water” & electrolytes added later
- **<u>WATER SUPPLY</u>**
- Two sources of municipal water.

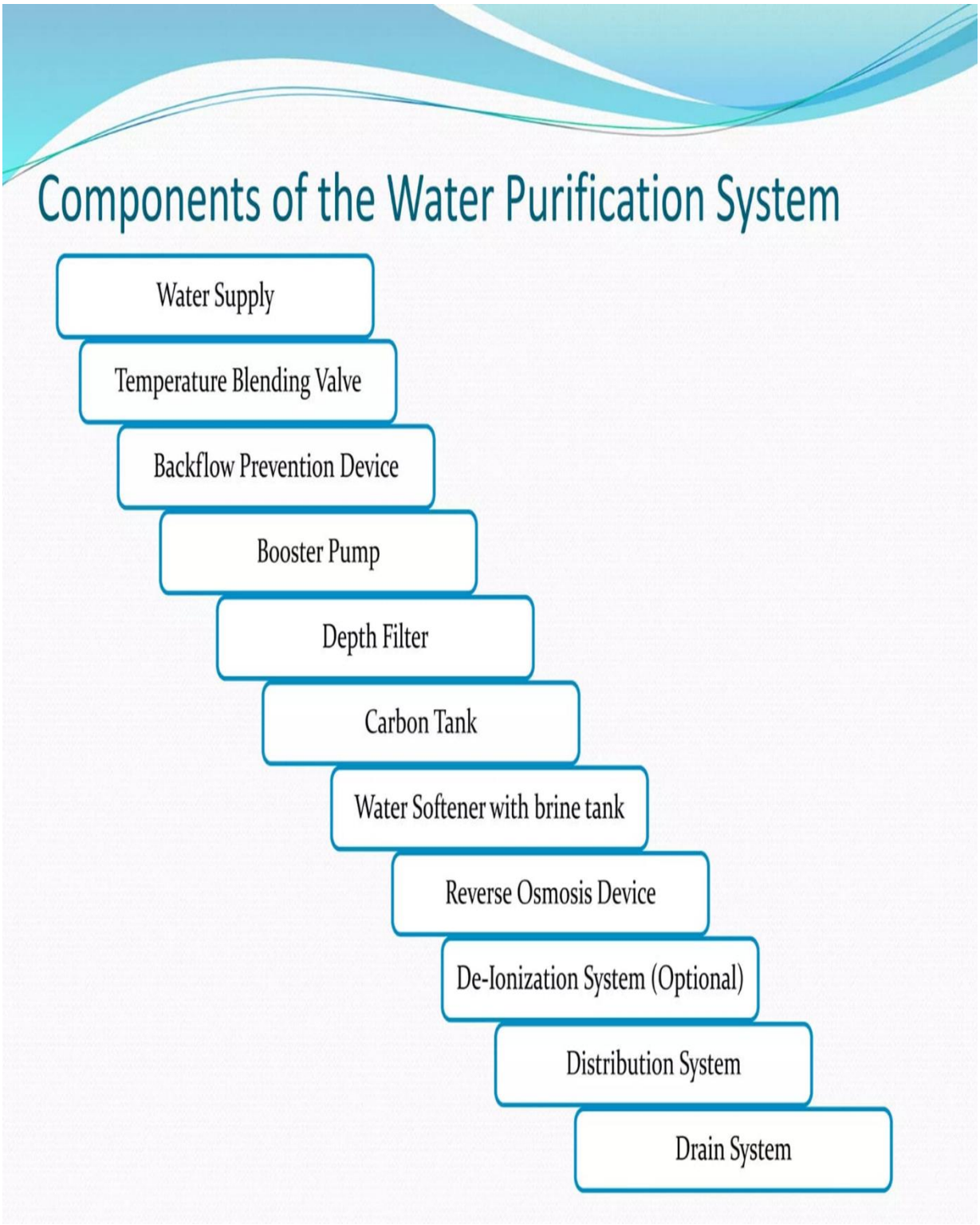
- **SURFACE WATER**: More contaminated with organisms and microbes, industrial wastes, fertilizers, and sewage
- **GROUND WATER**: Lower in organic materials but contains higher inorganic ions such as iron, ca, mg and sulfate.
- **WATER CONTAMINANTS** :

Potentially harmful water contaminants are:

1. **Aluminium** – added as a flocculating agent by many municipal water systems to remove nonfilterable suspended particles. It is toxic to dialysis patients, becoming sequestered in bone for long period of time, resulting in adynamic bone disease and osteomalacia. It can also cause the well-described dialysis encephalopathy syndrome.
2. **Chloramine** – added to water to prevent bacterial proliferation. It can cause hemolytic anemia (see Table 1 for other causes of hemolysis in patients on dialysis).
3. **Fluoride** – added to water to reduce tooth decay. Large amounts of fluoride can elute from an exhausted deionizer and cause pruritis, nausea, and arrhythmias.
4. **Copper and zinc** – can leach from metal pipes and fittings. Another cause of hemolytic anemia.
5. **Bacteria and endotoxin** – the substances added to municipal water to suppress bacterial proliferation are removed in the water purification process for dialysis treatment. Passage of endotoxin, endotoxin fragments and other bacterial products across the dialyzer membrane and into the bloodstream can lead to pyrogenic reactions.

Chemical Contaminants and their toxic effects

Contaminant	Possible effects
Aluminum	Dialysis encephalopathy, renal bone disease
Calcium, Magnesium	Hard water syndrome, hypertension, hypotension
Chloramine	Hemolysis, anemia, methameglobinemia
Copper	Nausea, headache, liver damage, fatal hemolysis
Fluoride	Osteomalacia, osteoporosis
Sodium	Hypertension, pulmonary edema, confusion, headache, seizures, coma
Microbial	Pyrexia reactions, chills, fever, shock
Nitrate	Methmeglobinemia, hypotension, nausea
High iron	Hemosiderosis
Sulfate	Nausea, vomiting, metabolic acidosis
Zinc	Anemia, vomiting, fever
Aromatic hydrocarbons	Potential chemical carcinogens



Components of water purification system

METHODS OF WATER PURIFICATION FOR HEMODIALYSIS

The essential **three key steps** are:

1. **Pre-treatment**
2. **Primary purification**
3. **Distribution**

1. Pre-treatment

- This involves a valve to blend hot and cold water to a constant temperature, preliminary filtration, softening, and adsorption with activated carbon.
- Injection of hydrochloric acid to correct the pH in the case of excess alkalinity is sometimes required as this can disturb the carbon adsorption beds and the reverse osmosis (RO) membrane.
- **Water softeners** exchange calcium and magnesium for sodium that has been affixed to a resin bed. Although these ions are also removed by RO, water softeners in regions with 'hard water' reduce accumulation of calcium and magnesium salts, thereby prolonging the life of the RO membrane.
- **Carbon adsorption** by activated carbon removes chlorine, chloramines, and other dissolved organic contaminants.

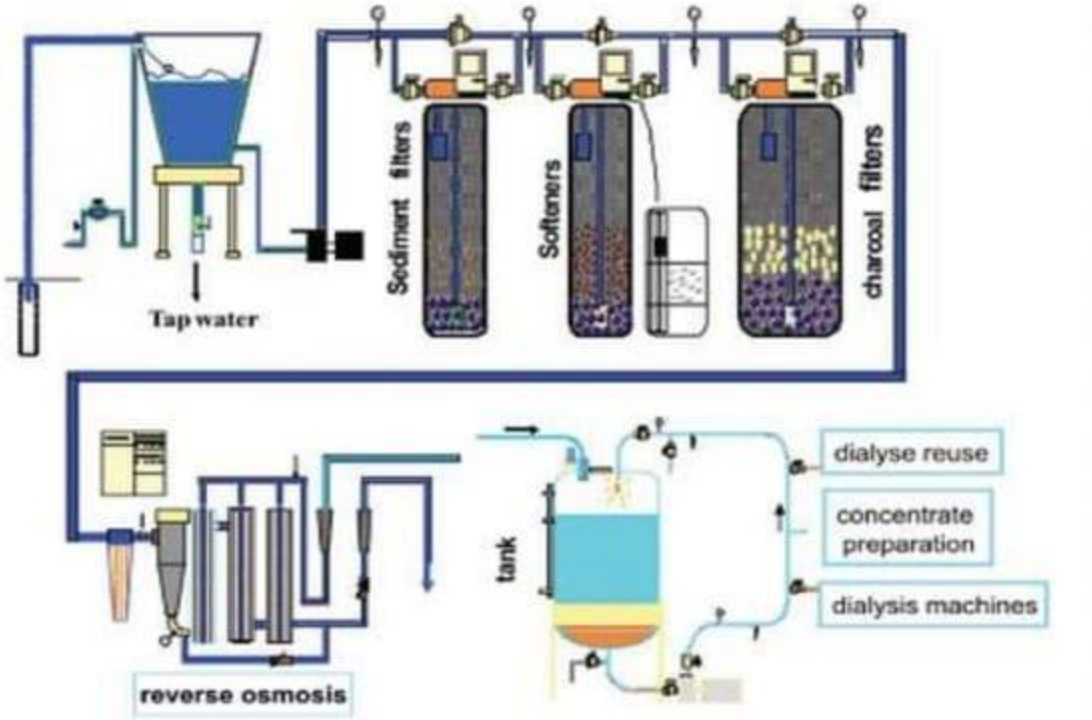
2. Primary purification process

- A filter is placed just upstream to the RO membrane to catch any carbon particles and resin beads that have been inadvertently released from the pre-treatment system.
- RO is the mainstay of dialysis water purification. Hydrostatic pressure drives water across a semipermeable membrane and excludes >90% of the contaminants. This strategy removes ionic contaminants, bacteria, and endotoxin.
- **Deionization (DI)** removes ionic contaminants by exchanging cations for H^+ and anions for OH^-. The exchanged H^+ and OH^- ions then combine to become water. DI is usually used for water purification when the RO membrane fails or as an additional purification process.

3. Distribution of purified water

- Purified water for hemodialysis is then distributed to individual dialysis machines to produce dialysate solution that remains free of contaminants.
- Inert material such as plastics are used to avoid chemical contaminants.
- Water piping systems must be carefully designed and constructed to avoid bacterial contamination with regular disinfection to prevent bacterial colonization of the system and to minimize formation of biofilm

Overall plan of Water Purification



Sample Questions

1. What are different principles of dialysis?
2. What are different modalities of dialysis?
3. Write a note on water treatment?
4. Enumerate and draw the blood circuit?
5. Enumerate and draw the dialysis solution circuit?

Objectives of Chapter - 7

1. Vascular access
2. Different types of vascular access
3. Different types of catheters and fistulas
4. AV graft

CHAPTER:7

VASCULAR ACCESS FOR HAEMODIALYSIS

A haemodialysis access, or vascular access, is a way to reach the blood for haemodialysis. The access allows blood to travel through soft tubes to the dialysis machine where it is cleaned as it passes through a special filter, called a dialyzer. An access is placed by a minor surgery.

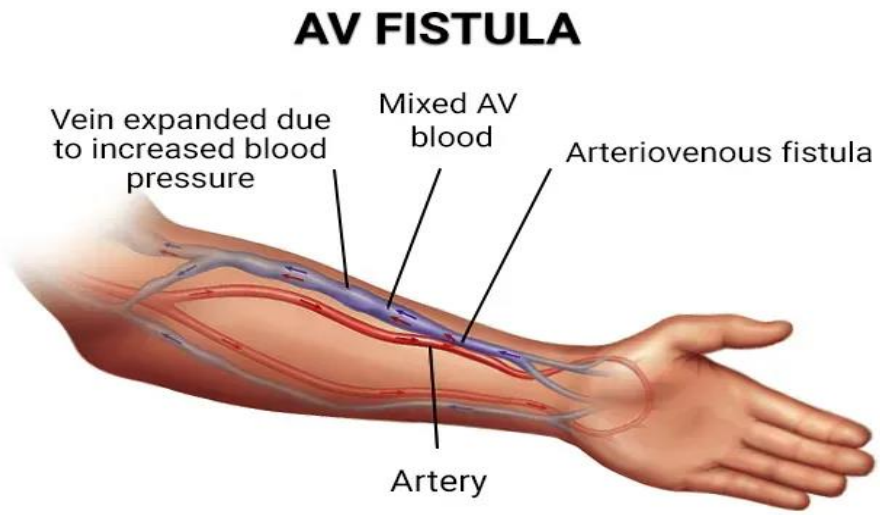
TYPES OF VENOUS ACCESS

1) AV Fistula:

An access made by joining an artery and vein in your arm. A fistula should be considered the first choice for your access. However, some patients may not be able to receive a fistula because their blood vessels are not strong enough.

Advantages: Natural, durable, and associated with fewer infections.

Complications: Maturation issues, aneurysm formation, and thrombosis

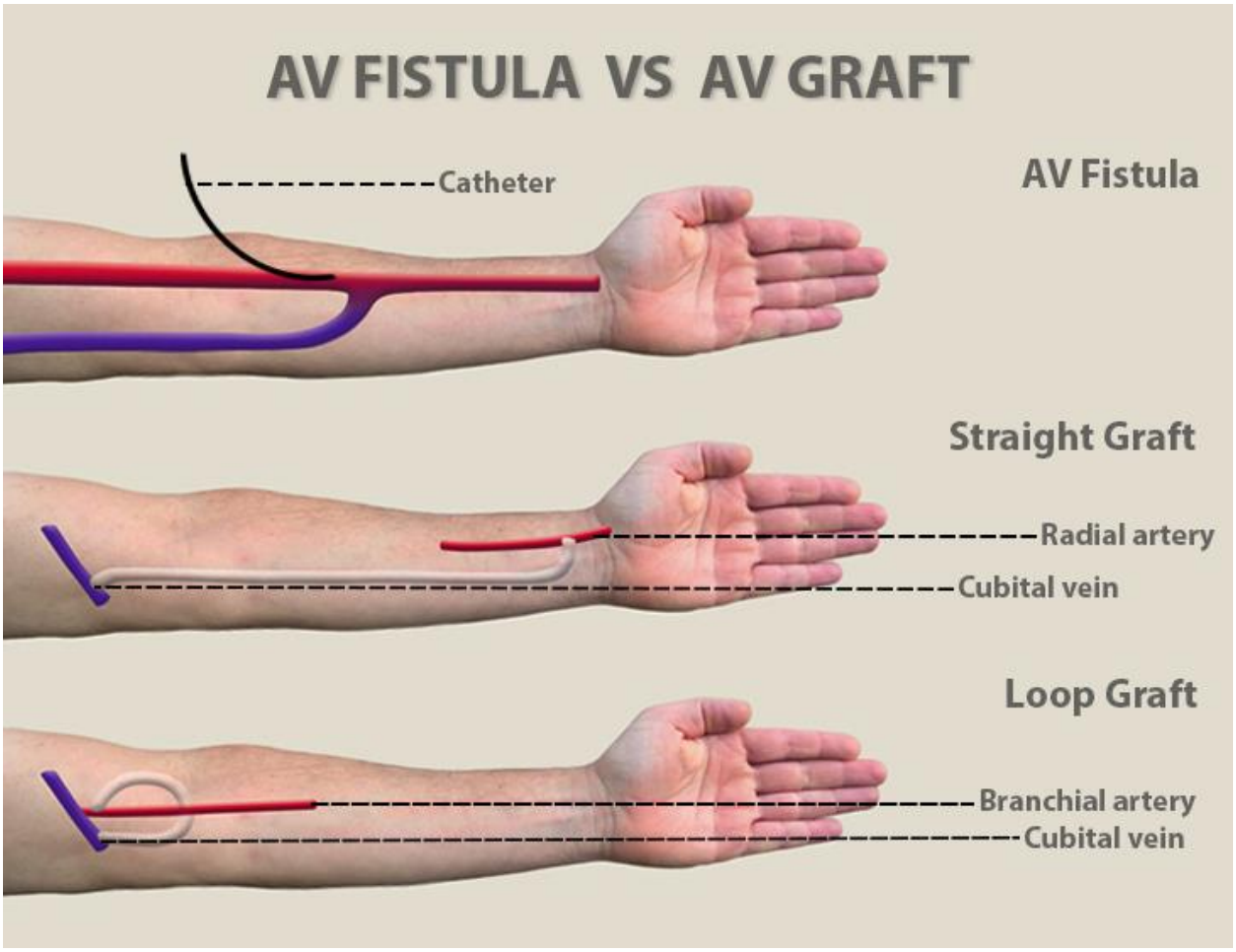


2) GRAFT:

An access made by using a piece of soft tube to join an artery and vein in the arm. A graft is considered the second choice for an access.

Advantages: Suitable when AVF is not feasible.

Complications: Higher infection risk, thrombosis, and pseudoaneurysm formation.



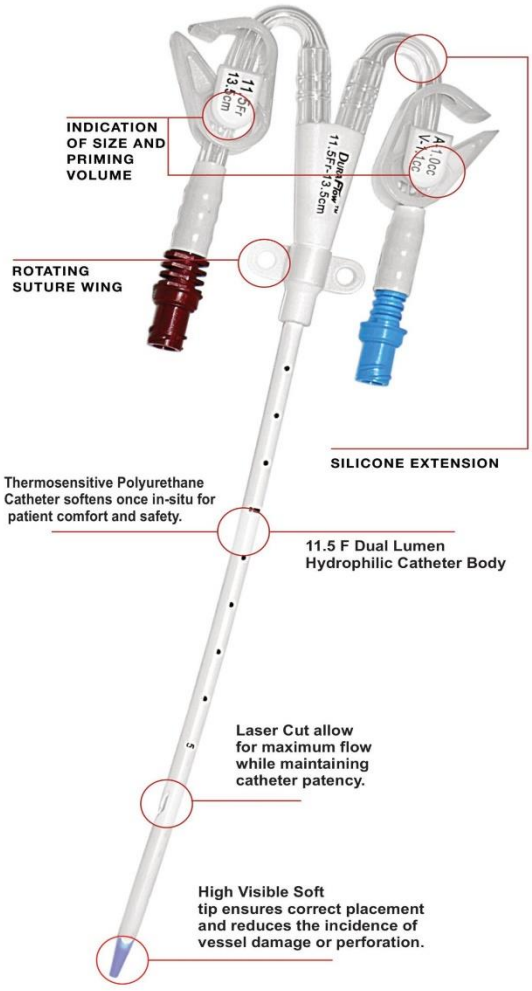
3) CATHETER: A soft tube that is placed in a large vein, usually in your neck. They are of two type:

1) Double lumen and

2) Permanent catheter

Advantages: Immediate access.

Complications: Infections, thrombosis, catheter dysfunction, and central vein stenosis.



Whether your access is a fistula, graft or catheter, you should make sure to take good care of it. Your dialysis care team will teach you the steps of good access care. The chart below gives you some general tips about everyday access care and how to prevent problems

CARE FOR THE VENOUS ACCESS

- Fistula or graft Wash with an antibacterial soap each day, and always before dialysis.
- Do not scratch your skin or pick the scab.
- Check the blood flow several times each day by feeling for a vibration, also called a pulse or thrill.
- Do not wear tight clothes or jewellery on your access arm.

- Do not carry anything heavy or do anything that would put pressure on the access.
- Do not sleep with your head on the arm that has your access.
- Do not let anyone use a blood pressure cuff on your access arm.
- Do not let anyone draw blood from your access arm.
- Do not be afraid to ask your dialysis care team to rotate needle sites.
- Apply only gentle pressure to the access site after the needle is removed.
- Too much pressure will stop the flow of blood through the access.
- If you have breakthrough bleeding after you have dialysis, apply gentle pressure to the needle site with a clean towel or gauze pad.
- If the bleeding does not stop in 30 minutes, call your doctor or your dialysis centre.

Sample Questions

1. What do you mean by vascular access?
2. What are the different types of vascular access?
3. What are the different types of catheters and fistulas?
4. What is AV graft?

Objectives of Chapter - 8

1. Dialysis Monitoring
2. Types of monitoring
3. Clinical and laboratory monitoring

CHAPTER:8

GUIDELINE FOR LABORATORY DATA DIALYSIS

1. PRE-DIALYSIS ASSESSMENTS

a. Baseline Laboratory Tests:

Routine pre-dialysis assessments include renal function test, electrolytes, and complete blood count (CBC).

b. Assessment of Fluid Status:

Laboratory markers like serum sodium and osmolality help assess fluid status, providing insights into the patient's hydration and guiding fluid management during dialysis.

2. DURING DIALYSIS MONITORING

a. Electrolyte Balance:

Continuous monitoring of electrolyte levels, including sodium, potassium, calcium, and phosphorus, is crucial to prevent imbalances that can lead to complications such as cardiac arrhythmias or bone disorders.

b. Hemoglobin and Hematocrit Levels:

Monitoring hemoglobin and hematocrit levels is vital to address anemia, a common complication in individuals with renal insufficiency.

3.POST-DIALYSIS ASSESSMENTS

a. Clearance Indices:

Evaluating clearance indices, such as Kt/V (urea clearance multiplied by time divided by volume), provides a quantitative measure of dialysis adequacy and helps optimize treatment plans.

b. Post-Dialysis Weight

Monitoring post-dialysis weight aids in assessing fluid removal efficacy, helping prevent complications related to fluid overload or dehydration

4.INTERPRETATION OF LABORATORY TRENDS

a. Longitudinal Data Analysis:

Regularly assessing trends in laboratory data over time allows healthcare professionals to identify patterns, anticipate complications, and tailor treatment plans for optimal patient outcomes.

b. Collaboration with Nephrologist

Collaborating with nephrologists in the interpretation of laboratory data is essential, fostering a multidisciplinary approach to patient care and ensuring comprehensive management of renal conditions.

STAY UPDATED ON GUIDELINES:

Regularly updating knowledge on guidelines of the National Kidney Foundation (NKF) or Kidney Disease Improving Global Outcomes (KDIGO)

Sample Questions

1. What is dialysis Monitoring?
2. What are different types of monitoring?
3. What are different clinical and laboratory parameters of monitoring?

Objectives of Chapter - 9

1. Anticoagulation
2. Indications of heparin
3. Contraindications of heparin
4. Doses of heparin

CHAPTER:09

ANTICOAGULATION AND HEPARIN USE IN DIALYSIS

INTRODUCTION:

The use of anticoagulants, notably heparin, is integral to the dialysis process, preventing clotting within the extracorporeal circuit. This chapter explores the significance of anticoagulants in dialysis, the challenges associated with their use, and the considerations for ensuring both efficacy and patient safety.

1.IMPORTANCE OF ANTICOAGULANTS IN DIALYSIS:

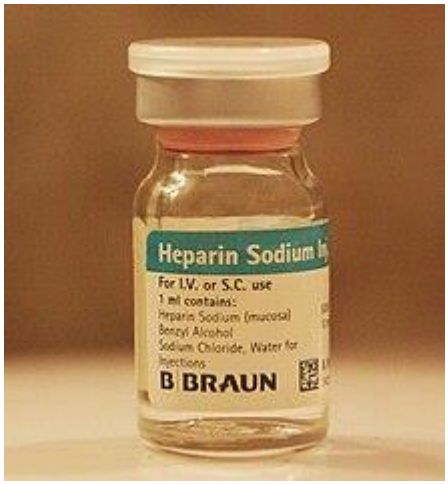
a. Prevent Clot Formation:

Anticoagulants are essential to maintain the patency of the dialysis circuit by inhibiting the formation of blood clots. Clotting can compromise the efficiency of dialysis and pose risks to patients.

b. Preserving Filter Functionality:

The dialyzer, a critical component of the dialysis machine, relies on anticoagulants to prevent the clotting of blood within its Fibers, ensuring proper filtration.

2. **HEPARIN: THE PRIMARY ANTICOAGULANT IN DIALYSIS:**



a. MECHANISM OF ACTION:

Heparin acts by enhancing the activity of antithrombin, inhibiting clotting factors and preventing the formation of thrombi in the dialysis circuit.

b. ADMINISTRATION PROTOCOLS:

Heparin can be administered in different ways during dialysis, including pre-dilution, post-dilution, or as a continuous infusion. Individualized dosing is often necessary based on patient factors and the specific dialysis machine used.

INDICATIONS OF HEPARIN FREE DIALYSIS:

- **Pericarditis**
- **Recent surgery:**

. Eye surgery

. Parathyroidectomy

. Renal transplant

. Vascular surgery.

- **Coagulopathy.**
- **Heparin induced**

. thrombo-cytopenia (HIT)

- **Parathyroidectomy**
- **Cerebral Haemorrhage**
- **Sometimes in acute dialysis**

.to save from D.D.S/ uraemia ---- urea brain increased

Indications for Heparin-free Dialysis

- Pericarditis
- Recent surgery, with bleeding complications or risk, especially:
  - Vascular and cardiac surgery
  - Eye surgery (retinal and cataract)
  - Renal transplant
  - Brain surgery
  - Parathyroid surgery
- Coagulopathy
- Thrombocytopenia
- Intracerebral hemorrhage
- Active bleeding
- Heparin contraindication (eg persons with heparin allergy)

HOW TO DO HEPARIN FREE DIALYSIS:

- 1L N/S and 3000 IU of the heparin and Rinse circuit.
- QB > 300-400mL/min
- intermittent bolus of saline.
- 200mL after 15mints as much N/S we give we set UF We as high
- Heparin coated dialyzer.

From this heparin remains in dialyzer.

- Small surface dialyzer.

Blood speed increase and clotting time also increased.

- Avoid thigh UF-rate.
- Blood lipid transfusion avoid.
- Regional citrate anti-coagulation

HEPARIN DOSING:

First, we check coagulation factors:

- PT=Pro-thrombin= 13
- APTT=activated partial prothrombin.
- Time=33
- INR= international normalized ratio= 1.1
- INR=Pt Patient/Pt normal

TIGHT HEPARIN:

• Check initial whole blood partial prothrombin time (WBPTT) on Activated clotting time (ACT) and give 750 IU heparin.

• Check WBPTT or ACT After 3 mints and try to keep above 40% of baseline

Infusion 600IU per hr

0.7mL Heparin---3125 units

9.3mL N/S

1omL---3 3125 units

1CC --- 5000 IU

0.5cc-- 2.500 IU

0.25CC ---1250 IU

0.125cc-- -675 TV

0.625 CC--- 3125 units.

10 mL ---- 3.125 units

5mL--- 1550 units

2.5mL---- 775 units.

(2.5cc=bolus)

Then we give 600IV per hour infusion.

ROUTINE HEPARIN

- Single bolus method
- 4000 IV boluses
- Continuous infusion method.
- In single bolus method:
- We give 4000 IU at the start of dialysis if you need after we give again 1000 IU bolus
- In continuous infusion method we give initial 2000 IU in venous. And the per hour 1200 IU.
- If AVF then we should finish one hour, before
- If catheter then we give through-out the dialysis.

3.CHALLENGES AND CONSIDERATIONS:

a. Risk of Bleeding:

The use of anticoagulants, including heparin, comes with inherent risks of bleeding.

Close monitoring of coagulation parameters and adjusting heparin dosage accordingly is crucial to balance the risk-benefit profile.

b. Heparin Alternatives:

Some patients may be sensitive to heparin or at an increased risk of bleeding complications. Alternative anticoagulants, such as citrate or low molecular weight heparin, may be considered based on individual patient needs.

4 ANTICOAGULATION MONITORING:

a. Activated Clotting Time (ACT):

ACT is a commonly used parameter to monitor the anticoagulation status during dialysis. Regular measurement helps healthcare providers adjust heparin doses to maintain optimal clotting times.

b. Point -of-Care Testing:

Advances in technology enable point-of-care testing, allowing for real-time monitoring of coagulation parameters, enhancing the precision of anticoagulant management.

Sample Questions

1. What is anticoagulation?
2. What are the indications of heparin?
3. Wat are the contraindications of heparin?
4. What are the different doses of heparin?

Objectives of Chapter - 10

1. Different complications of hemodialysis.
2. Management of complications.
3. Prevention of complications.

CHAPTER:10

COMPLICATIONS OF HEAMODIALYSIS

Hemodialysis is a medical procedure used to filter and remove waste products and excess fluids from the blood when the kidneys are unable to perform these functions adequately. While hemodialysis is a life-saving treatment for individuals with end-stage renal disease (ESRD), it comes with certain complications. It's important to note that advancements in technology and medical practices continue to improve the safety and effectiveness of hemodialysis. Here are some potential complications associated with hemodialysis:

1.HYPOTENSION (LOW BLOOD PRESSURE):

During hemodialysis, rapid fluid removal can lead to a drop in blood pressure. This can cause symptoms such as dizziness, nausea, and fainting. To mitigate this risk, healthcare providers may adjust the rate of fluid removal or prescribe medications.

2: MUSCLE CRAMPS:

Dialysis can lead to electrolyte imbalances, such as low levels of potassium or magnesium, which may result in muscle cramps. Adequate monitoring and adjustments to the dialysis prescription can help prevent this.

3: INFECTION:

Infections are a potential risk due to the use of vascular access points, such as catheters or arteriovenous fistulas. Proper hygiene and care of access sites are crucial to reduce the risk of infection.

4: BLEEDING:

The use of anticoagulants during dialysis to prevent blood clotting may increase the risk of bleeding. This is especially relevant in patients with a tendency to bleed or those taking medications that affect blood clotting.

5: ACCESS SITE COMPLICATIONS:

Depending on the type of vascular access used (catheter, arteriovenous fistula, or graft), complications such as infection, clotting, or narrowing of the blood vessels may occur.

6: ANEMIA:

Chronic kidney disease often leads to anemia, and hemodialysis can further contribute to it. Anemia may require additional treatment with erythropoietin-stimulating agents or iron supplements.

7: ALLERGIC REACTIONS:

Some individuals may experience allergic reactions to the dialyzer membrane, dialysate, or medications used during the procedure.

8: AMYLOIDOSIS:

Over time, individuals on long-term hemodialysis may develop amyloidosis, a condition characterized by the accumulation of abnormal proteins in tissues, leading to joint pain and stiffness.

9: PSYCHOSOCIAL ISSUES:

Enduring regular dialysis treatments can have a significant impact on a person's quality of life, leading to stress, anxiety, and depression.

Complications of Hemodialysis

COMPLICATIONS OF HEMODIALYSIS

Complication	Differential diagnosis
Fever	Bacteremia, water-borne pyrogens, overheated dialysate
Hypotension	Excessive ultrafiltration, cardiac arrhythmia, air embolus, pericardial tamponade; hemorrhage (gastrointestinal, intracranial, retroperitoneal); anaphylactoid reaction
Hemolysis	Inadequate removal of chloramine from dialysate, failure of dialysis concentrate delivery system
Dementia	Incomplete removal of aluminum from dialysate water, prescription of aluminum antacids
Seizure	Excessive urea clearance (first treatment), failure of dialysis concentrate delivery system
Bleeding	Excessive heparin or other anticoagulant
Muscle cramps	Excessive ultrafiltration

10) DIALYSIS DISEQUILIBRIUM SYNDROME:

Dialysis disequilibrium syndrome (DDS) is a rare but potentially serious complication associated with hemodialysis, a treatment for patients with kidney failure. This syndrome occurs when there is a rapid shift of solutes, particularly urea, from the blood into the brain during dialysis. The brain, being more sensitive to these changes, may swell, leading to neurological symptoms.

PATHOPHYSIOLOGY:

DDS is primarily attributed to osmotic disequilibrium between the brain and the blood during rapid removal of urea and other solutes. The urea gradient between the blood and the brain can lead to water influx into brain cells, causing swelling.

RISK FACTORS:

Patients with elevated pre-dialysis urea levels are at a higher risk. Conditions such as severe metabolic acidosis and cerebral edema may predispose individuals to DDS.

CLINICAL MANIFESTATIONS:

Symptoms range from mild nausea and headache to severe manifestations like seizures and coma. Neurological signs typically develop during or shortly after dialysis.

DIAGNOSIS:

Diagnosis is clinical, based on the presence of neurological symptoms during or after dialysis. Imaging studies may be used to rule out other causes of neurological symptoms**.**

PREVENTION:

Gradual initiation of hemodialysis helps prevent DDS. Individualized treatment plans, adjusting dialysis parameters based on patient tolerance, are crucial.

MANAGEMENT:

If DDS occurs, the dialysis session may need to be stopped or slowed down. Supportive care includes measures to address symptoms like seizures or increased intracranial pressure.

PROGNOSIS:

Prompt recognition and intervention usually lead to a favorable prognosis. Long-term neurological consequences are rare if DDS is effectively managed.

Sample Questions

1. What are the different complications of hemodialysis?
2. How will you manage the complications?
3. How will you prevent the complications?

Objectives of Chapter - 11

1. Objectives of infection control in hemodialysis unit.
2. Importance of infection control in hemodialysis unit.
3. Control measures for infection control in hemodialysis unit.

CHAPTER: 11

INFECTION CONTROL IN HEMODIALYSIS UNIT:

We would learn in this chapter the following aspects of infection control in hemodialysis unit:

1) Objectives of infection control in hemodialysis unit.

2) Importance of infection control in hemodialysis unit.

3) Control measures for infection control in hemodialysis unit.

OBJECTIVES OF INFECTION CONTROL IN HEMODIALYSIS UNIT:

In a hemodialysis unit, establishing clear and specific objectives for infection control is essential to safeguard the health and well-being of patients, prevent the spread of infections, and maintain a safe healthcare environment.

PREVENTION OF BLOODSTREAM INFECTIONS:

A significant reduction in bloodstream infections associated with vascular access points by consistently adhering to aseptic techniques during catheter care and vascular access procedures.

MAINTENANCE OF WATER QUALITY:

Water used in dialysis meets the required quality standards by regularly monitoring and testing water sources, dialysate, and water treatment systems, and promptly addressing any deviations from acceptable levels.

HAND HYGIENE COMPLIANCE:

Improve hand hygiene practices among healthcare providers and staff through education and training programs.

ADHERENCE TO PERSONAL PROTECTIVE EQUIPMENT (PPE) GUIDELINES:

Ensure consistent and correct use of PPE, including gloves, gowns, masks, and eye protection, during patient care activities to minimize the risk of cross-contamination and exposure to infectious agents.

REDUCTION IN ENVIRONMENTAL CONTAMINATION:

Minimize the risk of healthcare-associated infections by implementing and sustaining rigorous environmental cleaning and disinfection protocols, focusing on high-touch surfaces and patient care areas.

EDUCATION AND TRAINING PROGRAMS:

Improve infection control knowledge among healthcare providers, patients, and their families through regular educational programs

and training sessions.

VACCINATION COVERAGE:

Achieve and maintain high vaccination coverage rates among healthcare providers and eligible patients, particularly for influenza and hepatitis B, to prevent vaccine-preventable infections.

EMERGENCY PREPAREDNESS:

Develop and regularly update a comprehensive plan for managing infectious disease outbreaks and emergencies, including communication strategies, access to necessary supplies, and coordination with public health authorities.

PATIENT AND FAMILY ENGAGEMENT:

Objective: Promote active involvement of patients and their families in infection prevention by providing education on infection control measures, encouraging open communication, and addressing any concerns or questions.

WASTE MANAGEMENT AND DISPOSAL:

- **Objective:** Ensure proper disposal of medical waste, including sharps and other potentially infectious materials, following established guidelines and regulations.
- Establishing measurable objectives and regularly assessing progress toward these goals is crucial for the ongoing success of infection control efforts in a hemodialysis unit. Continuous monitoring, feedback, and adaptation of strategies based on emerging evidence and best practices contribute to maintaining a safe and infection-free healthcare environment for both patients and healthcare providers.

- **IMPORTANCE OF INFECTION CONTROL IN HEAMODIALYSIS UNIT :**

Infection control in a hemodialysis unit is of paramount importance due to several critical reasons that directly impact the health and safety of both patients and healthcare providers. Here are key reasons highlighting the significance of infection control in a hemodialysis setting:

- **Patient Safety:**
- Hemodialysis patients are at an increased risk of infections due to their compromised immune systems and the repeated exposure of their bloodstream during dialysis. Strict infection control measures are crucial to protect patients from healthcare-associated infections, including bloodstream infections and access site infections.

- **Prevention of Bloodstream Infections:**
- Infections, especially bloodstream infections, are a significant cause of morbidity and mortality in hemodialysis patients. Adhering to infection control protocols helps minimize the risk of bloodstream infections related to vascular access points, such as catheters and fistulas.

- **Water Quality Management:**

  - Dialysis machines use water to prepare the dialysate, and poor water quality can lead to serious infections. Ensuring the proper treatment and monitoring of water sources help prevent waterborne infections and protect patients from potential harm.

- **Reducing Cross-Contamination:**

  - Hemodialysis units serve patients with various health conditions, and preventing cross-contamination is essential. Proper hygiene practices, including handwashing and the use of personal protective equipment, help minimize the risk of transmitting infections among patients and healthcare providers.

- **Maintaining Access Site Integrity:**

  - Vascular access points, such as catheters and fistulas, are critical for hemodialysis. Infection control measures, including sterile techniques during access site care, help maintain the integrity of these access points, reducing the risk of infections that could compromise their function.

- **Quality of Life Improvement:**

  - Infections can significantly impact the quality of life for hemodialysis patients. By effectively controlling and preventing infections, healthcare providers contribute to enhancing the overall well-being of patients, minimizing complications, and improving their daily lives.

- **Healthcare Cost Reduction:**

  - Infections can lead to increased healthcare costs due to prolonged hospital stays, additional treatments, and the use of expensive antibiotics. Effective infection control measures help reduce the economic burden associated with treating preventable infections.

- **Patient and Staff Confidence:**

  - Strict adherence to infection control protocols fosters trust and confidence among both patients and healthcare providers. Patients feel more secure in the care they receive, and healthcare staff can work in an environment where safety is prioritized.

- **Compliance with Regulations and Standards:**

  - Hemodialysis units are subject to regulatory standards and guidelines that mandate infection control practices. Compliance with these standards is not only essential for legal reasons but also ensures the delivery of high-quality, safe care.

- **Preventing Outbreaks and Transmission:**

  - Hemodialysis units may house a vulnerable population, and infections can spread rapidly within such settings. Robust infection control measures help prevent outbreaks and reduce the risk of transmission of infectious agents among patients and staff.

- **Promoting Public Health:**

  - Effective infection control in a hemodialysis unit contributes to public health by preventing the spread of infectious diseases within the community. It is particularly important given that hemodialysis patients often have comorbidities that make them more susceptible to severe complications from infections.

- **<u>CONTROL MEASURES FOR INFECTION CONTROL IN HEAMODIALYSIS UNIT:</u>**

Infection control in a dialysis unit is of paramount importance to ensure the safety and well-being of patients receiving hemodialysis treatment. Dialysis patients are particularly vulnerable to infections due to the repeated exposure of their bloodstream during the procedure. Here is a comprehensive overview of infection control measures in a dialysis unit:

- **Hand Hygiene:**

- Strict hand hygiene practices among healthcare providers are crucial. This includes thorough handwashing with soap and water or using alcohol-based hand sanitizers before and after patient contact, after removing gloves, and after touching any potentially contaminated surfaces.

- **Personal Protective Equipment (PPE):**

- Healthcare workers should use appropriate PPE, such as gloves, gowns, masks, and eye protection, to prevent the transmission of infectious agents. PPE should be used consistently and changed between patient interactions.

- **Environmental Cleaning:**

- Regular cleaning and disinfection of all surfaces, equipment, and patient care areas are essential. High-touch surfaces, such as doorknobs, light switches, and counters, should be disinfected frequently.

- **Water Quality:**

- Dialysis machines use water to prepare the dialysate. Ensuring the quality of water is crucial to prevent waterborne infections. Regular testing and monitoring of water quality, as per established guidelines, are necessary.

- **Dialyzer Reuse Protocols:**

- If dialyzers are reused, strict protocols for cleaning, disinfection, and storage must be followed. This includes effective rinsing and disinfection procedures to eliminate any risk of cross-contamination.

- **Vascular Access Care:**

- Proper care of vascular access points, such as catheters or fistulas, is essential to prevent infections. Sterile techniques should be employed during access site care, and catheters should be regularly assessed for signs of infection.

- **Patient Screening and Surveillance:**

- Patients should be screened for infections regularly, and any signs of infection, such as fever or redness at the vascular access site, should be promptly addressed. Surveillance for healthcare-associated infections is crucial for early detection and intervention.

- **Isolation Precautions:**

- Implementing isolation precautions for patients with known or suspected infectious diseases is necessary. This includes the use of dedicated equipment and, if possible, isolation rooms to prevent the spread of infections

- **Education and Training:**

- Ongoing education and training for healthcare staff, patients, and their families are critical components of infection control. This includes teaching proper hand hygiene, recognizing signs of infection, and understanding the importance of following protocols.

- **Vaccination:**

- Healthcare providers and patients should be up-to-date on vaccinations, particularly those for influenza and hepatitis B. Vaccination helps prevent the spread of vaccine-preventable diseases in the dialysis unit.

- **Waste Disposal:**

- Proper disposal of medical waste is crucial. Sharps and other potentially infectious materials should be disposed of in designated containers according to regulations.

- **Surveillance and Quality Improvement:**

- Regular surveillance of infection rates and continuous quality improvement initiatives help identify areas for improvement and ensure that infection control practices are effective.

- **Emergency Preparedness:**

- Having a well-defined plan for managing infectious disease outbreaks and emergencies is essential. This includes communication strategies, access to necessary supplies, and coordination with public health authorities.

Sample Questions

1. What are objectives of infection control in hemodialysis unit?
2. What is the Importance of infection control in hemodialysis unit?
3. What are the control measures for infection control in hemodialysis unit?

Objectives of Chapter - 12

1. Dialysis Unit monitoring
2. Water system and Machines monitoring
3. Patient monitoring

CHAPTER:12

PATIENT AND MACHINE MONITORING IN DIALYSIS

INTRODUCTION:

Monitoring during dialysis is a multifaceted process that involves continuous assessment of both the patient and the dialysis machine. This chapter delves into the significance of patient and machine monitoring in dialysis, outlining the various parameters, technologies, and practices employed to ensure a safe and effective treatment environment.

1. PATIENT MONITORING:

a. Vital Signs:

Regular monitoring of vital signs, including blood pressure, heart rate, and respiratory rate, is fundamental to gauge the patient's physiological response during dialysis.

Abnormalities in vital signs may indicate complications or the need for intervention.

b. Clinical Parameters:

Blood parameters such as hemoglobin levels, electrolytes, and urea are closely monitored to assess the effectiveness of dialysis and make necessary adjustments to the treatment plan.

c. Symptomatology:

Assessing patient symptoms, such as dizziness, nausea, or cramping, provides valuable insights into the overall well-being of the patient during dialysis.

2.MACHINE MONITORING:

a. Pressure and Flow Rates:

Monitoring the pressure and flow rates within the dialysis machine ensures that blood is processed optimally through the dialyzer.

Deviations from normal values may indicate issues with the machine or the dialysis process.

b. Temperature Control:

Precise control of the temperature of the dialysate is crucial for patient comfort and safety.

Continuous monitoring and adjustment of temperature settings prevent complications such as hypothermia or overheating.

c. Alarms and Alerts:

Dialysis machines are equipped with alarms and alerts to notify healthcare providers of any irregularities.

Timely response to alarms is essential to address issues promptly and prevent adverse events.

3.TECHNOLOGY INTEGRATION:

a. Remote Monitoring:

Advancements in technology allow for remote monitoring of both patients and dialysis machines. Healthcare providers can access real-time data, enabling proactive intervention and enhancing patient care.

b. **Data Analytics**:

Utilizing data analytics provides insights into trends and patterns, facilitating personalized treatment plans and predictive maintenance for dialysis machines.

4.QUALITY ASSURANCE AND REGULATORY COMPLIANCE:

a. Documentation:

Comprehensive documentation of monitoring data is crucial for quality assurance and regulatory compliance.

Regular audits ensure adherence to established protocols and standards.

b. Training and Education:

Ongoing training for healthcare professionals on the use of monitoring equipment and interpretation of data is vital for maintaining a high standard of care.

Sample Question

1. What do you mean by dialysis unit and patient monitoring?

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