Hemodialysis Essentials

Hemodialysis (HD) is a renal replacement therapy (RRT) that removes waste products, excess fluids, and toxins from the blood in patients with **kidney failure** (usually end-stage renal disease - ESRD). It mimics the **filtration function** of healthy kidneys.

Key Objectives:

- · Correct fluid and electrolyte imbalances.
- Remove nitrogenous waste products (e.g., urea, creatinine).
- Manage acid-base disorders.
- Control blood pressure in volume-overloaded states.

Clinical Pearl: Hemodialysis is not a cure but a **lifesaving supportive therapy** for patients with ESRD or acute kidney injury (AKI) when conservative treatment fails.

Indications for Hemodialysis

Hemodialysis is indicated in both **acute** and **chronic** kidney failure. The following acronym "**AEIOU**" is useful for remembering emergency dialysis indications:

"AEIOU" Indications for Emergent Dialysis:

Acronym	Meaning	Examples
A	Acidosis (severe, refractory)	pH < 7.1 despite treatment
E	Electrolyte imbalance (esp. hyperkalemia)	K? > 6.5 mmol/L with ECG changes
I	Intoxications	Lithium, methanol, ethylene glycol
0	Overload (volume overload unresponsive to diuretics)	Pulmonary edema
U	Uremia	Encephalopathy, pericarditis, bleeding

Chronic Indications:

- Glomerular filtration rate (GFR) < 10 mL/min/1.73 m²
- · Symptoms of uremia
- · Severe fluid overload
- Intractable hypertension

The Hemodialysis Machine

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The **hemodialysis machine** functions as an **artificial kidney**. It pumps the patient's blood through a dialyzer where **diffusion**, **ultrafiltration**, and **osmosis** occur to purify the blood.

Major Components:

Component Function

Dialyzer The "artificial kidney" with semi-permeable

membrane

Blood pumpMoves blood from the patient to the dialyzer

Dialysate pumpDelivers dialysate to the dialyzer

Heparin pumpAdministers anticoagulant to prevent clotting **Monitors**Track blood flow, pressure, temperature, air

bubbles, and safety

Air detector/clamp Detects air embolism risk and stops flow

Parts of the Dialysis Machine & Circuit

1. Dialyzer (Artificial Kidney)

- Contains thousands of hollow fibers with semi-permeable membranes.
- Blood flows inside fibers; dialysate flows outside? waste and excess solutes move across the membrane.

2. Dialysate

- A solution containing **electrolytes** and **bicarbonate**.
- Does not contain urea or creatinine, promoting diffusion from blood into dialysate.
- Adjusted to meet patient-specific needs (e.g., potassium concentration).

3. Tubing System

- Arterial line: Carries blood from the patient to the dialyzer.
- Venous line: Returns clean blood to the patient.

4. Blood Pump

• Ensures continuous flow (usually 300–500 mL/min) through the dialyzer.

5. Ultrafiltration System

• Controls **fluid removal** via transmembrane pressure (TMP).

Vascular Access for Hemodialysis

Effective dialysis requires **high blood flow** (?300 mL/min). Access is typically through:

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Arteriovenous (AV) Fistula

- Preferred access: connects a vein to an artery (e.g., radial-cephalic).
- Matures over 6–12 weeks.
- Long-term use with low complication rate.

Clinical Tip: Always assess the "thrill and bruit"—absence may suggest thrombosis.

Arteriovenous (AV) Graft

- Synthetic tube connects artery and vein.
- Used if veins are unsuitable.
- Higher risk of infection and thrombosis than AV fistula.

Central Venous Catheter (CVC)

- **Temporary access** (e.g., internal jugular, femoral vein).
- Used in emergency or acute dialysis.
- High risk of infection, stenosis, and thrombosis.

Hemodialysis Procedure Overview

- 1. Pre-Dialysis
 - · Assess vitals, fluid status, access site.
 - Check labs (especially K?, BUN, creatinine, Hb).
 - Weigh the patient.
- 2. During Dialysis
 - Monitor vitals, machine alarms, blood flow rate.
 - Watch for **complications**: hypotension, cramping, nausea, clotting.
- 3. Post-Dialysis
 - · Reassess weight and vitals.
 - Check access site.
 - Monitor for signs of bleeding or complications.

Complications of Hemodialysis

Complication
Hypotension
Cramps
Dialysis Disequilibrium Syndrome
Infection (Access-related)
Anemia

Amyloidosis

Most common; due to fluid removal
Electrolyte or fluid shifts
Cerebral edema due to rapid urea removal
Especially in CVCs
Due to reduced EPO and blood loss
?2-microglobulin accumulation in long-term
dialysis

Description / Features

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Nursing and Clinical Considerations

- Daily Assessments: Monitor weight, fluid status, and access patency.
- Education: Teach patients to avoid compression or venipuncture on fistula arm.
- Asepsis: Critical when handling catheters.
- **Nutrition**: Limit sodium, potassium, phosphorus; adequate protein intake.
- Medication Timing: Some meds (e.g., antihypertensives) may be held before dialysis.