





VOLUME CONTROL IN DIALYSIS PATIENTS

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LIST OF TITLES

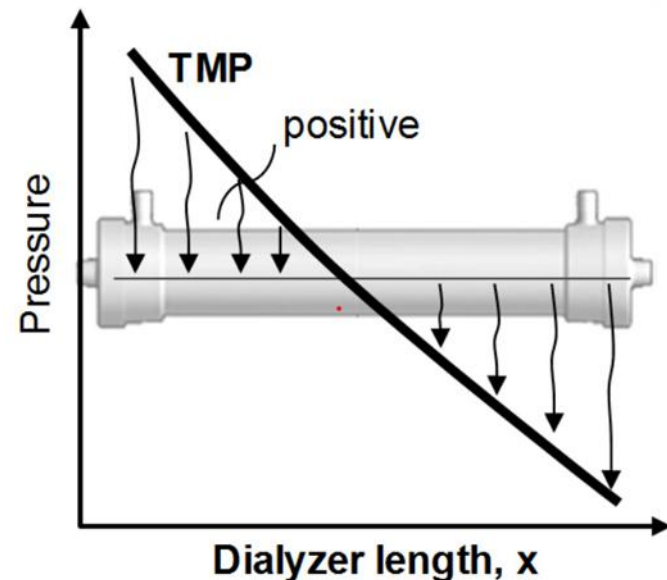
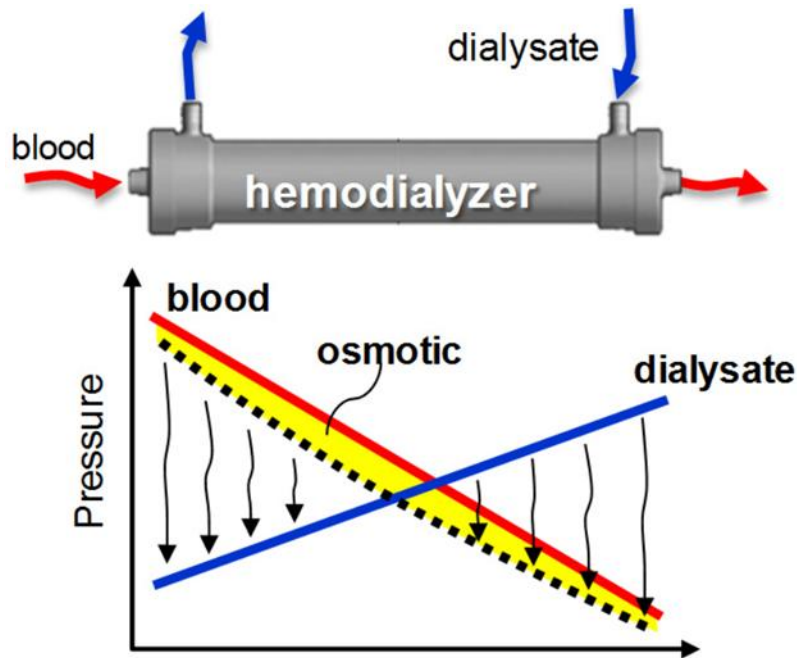
1. Ultrafiltration
2. Volume control in acute hemodialysis
3. Volume control in chronic hemodialysis (Dry weight)
4. Intradialytic hypotension

➤ ULTRAFILTRATION



ULTRAFILTRATION

❖ **Ultrafiltration, or fluid removal:** is the result of a combination of positive hydrostatic pressure in the blood compartment and “negative” pressure created in the dialysate compartment.





ULTRAFILTRATION

HD patients become symptomatic with a little decline of their blood volume:

- ❑ **Disparate cardiac response** and impaired constriction of resistance and capacitance vessels during volume depletion:
 - Autonomic dysfunction, diastolic dysfunction, increased core temperature, and intradialytic hypocalcemia, hypokalemia, alkalosis, and myocardial stunning.
- ❑ **Slow Rates of vascular refilling** from the interstitial and intracellular spaces:
 - decreased osmotic and oncotic pressures and increased vascular permeability because of Dialytic removal of solutes, malnutrition, and inflammation.

➤ VOLUME CONTROL IN ACUTE HEMODIALYSIS



GUIDELINES FOR UF ORDERS IN ACUTE HEMODIALYSIS

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- ❖ **Avoid hypotension** that caused further renal damage and delay of functional renal recovery.
- ❖ Fluid removal rates of **10 mL/kg/h** are usually well tolerated in volume overloaded patients.
- ❖ It is best to remove fluid at a **constant rate** throughout the dialysis treatment.
- ❖ Increase of dialysis **frequency** to ultrafiltration control.
- ❖ Account the 0.2 L that the patient will receive at the end of dialysis in the form of saline to rinse the dialyzer.



ACUTE HEMODIALYSIS

- ❑ patients who are **edematous and in pulmonary edema**: rarely need removal of **more than 4 L** of fluid during a 2-hour period.
 - If severe electrolyte abnormalities, such as hyperkalemia, are not present, we can shut off dialysis solution flow and isolated ultrafiltration for 1 to 2 hours, thereafter, dialysis can be performed for 2 hours. And The remaining excess fluid is best removed during a second session the following day.
 - An alternative way to remove fluid asymptotically is to use SLED.
- ❑ If the patient **does not have pedal edema or anasarca**, in the absence of pulmonary congestion: it is unusual to need to remove greater than **2 to 3 L** over the dialysis session.
- ❑ in patients with **little or no jugular venous distention**: the fluid removal requirement may be **zero**.



- The postdialysis weight should be compared with the predialysis weight.
- Unpredicted pre-to-post weight changes are usually due to the failure to take into account fluid administered to the patient during dialysis in the form of saline, medications, hyperalimentation, or oral fluid or food ingestion.

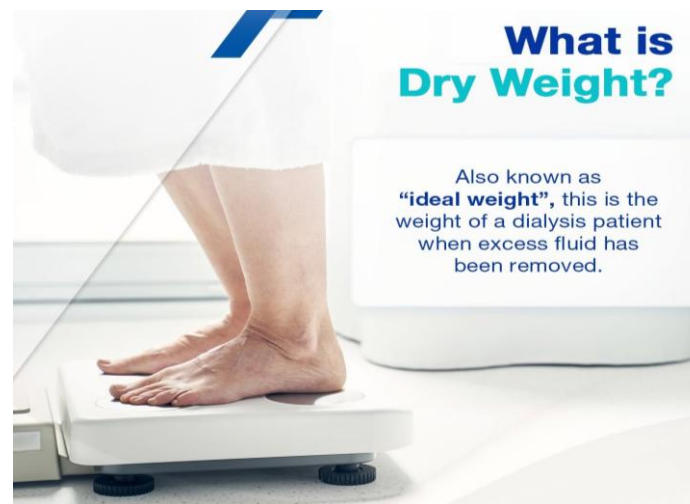
➤ VOLUME CONTROL IN CHRONIC HEMODIALYSIS



DRY WEIGHT

Optimum postdialysis weight: Is the postdialysis weight at which all or most excess body fluid has been removed and further fluid removal would produce hypotension, muscle cramps, nausea, and vomiting.

The body weight at which **extracellular volume is physiologic**





DRY WEIGHT

If target weight is set too **low**:

**EXCUSE ME NURSE, HAVE I
REACHED MY DRY WEIGHT YET?**



- The patient may suffer frequent **hypotensive** episodes
- They often experience **malaise, cramps, and dizziness** after dialysis
- The postdialysis recovery is extremely stressful and unpleasant.
- The risk of arteriovenous (AV) access **clotting** is increased.



CHRONIC HEMODIALYSIS

❖ If target weight is set too **high**:

- The patient will remain in a **fluid-overloaded** state.

Are you sure that you accurately assessed the patient's **DRY WEIGHT**?



❖ **Frequent resetting of the dry weight.** (at least **every 2 to 4 weeks**).

- If a patient loses flesh weight, (eg. **nutritional disturbance or disease process**) the previously dry weight becomes **high** and can result in patient overload.

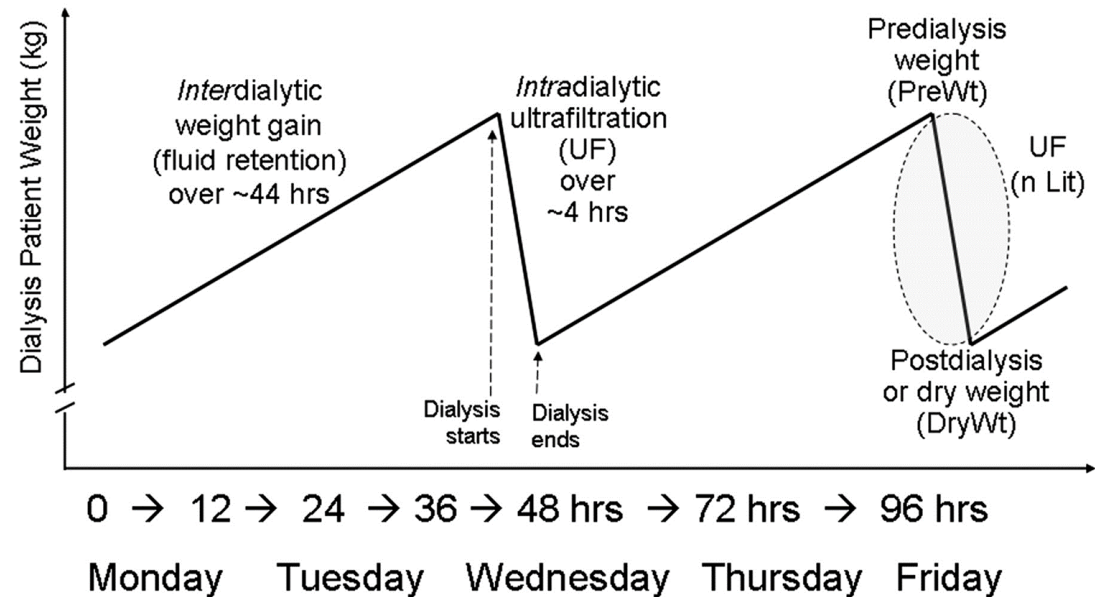


CHRONIC HEMODIALYSIS

Trial-and-error basis

$$\text{DryWt} = \text{PreWt} - \text{UF}$$

UF = Fluid Retention



periodic empiric challenges of the patient's end-dialysis weight by 0.2 to 0.3 kg/session when excess volume is suspected.



CHRONIC HEMODIALYSIS

- ❖ Choose target or dry (euvolemic) weight carefully.
- ❖ HD patients may become symptomatic before their physiologic weight is reached.
- ❖ Some level of volume overload is required in many patients to prevent IDH.

Hypoperfusion of the heart, brain, and gut may have cumulative adverse consequences, suggesting that targeting a euvolemic weight may not always be advisable.



CHRONIC HEMODIALYSIS

- Usually chosen on clinical basis: **blood pressure, edema, and tolerance of UF.**
- Can be aided with **testing** (eg, bioimpedance devices, measurement of serum atrial natriuretic factor levels, relative blood volume monitors, and pulmonary ultrasound).
- Intradialytic hematocrit monitors: A “flat-line” hematocrit response (eg, lack of an increase during dialysis) despite fluid removal indicates extremely rapid blood compartment refilling and suggests fluid overload.



CHRONIC HEMODIALYSIS

Fluid removal rate:

- Usually, fluid is removed at a **constant rate** during dialysis.
- Survival is increased in patients undergoing hemodialysis with a **lower ultrafiltration rate**.
- There appears to be no threshold value.
- In the United States : about 7.5 mL/kg/h (about 550 mL/h for an average-sized patient).



CHRONIC HEMODIALYSIS

Approaches to reduce the fluid removal:

- ✓ Extend the dialysis **time**.
- ✓ Reducing interdialytic weight gain by **limiting sodium intake**.
- ✓ In patients with substantial urine volume, use of **diuretics**.
- ✓ Increase the fluid removal rate during the initial 1-2 hours of dialysis and reduced toward the end of dialysis. The dialysis solution sodium level also may be increased during the initial phase of dialysis to help maintain the blood volume osmotically.



CHRONIC HEMODIALYSIS

Interdialysis weight gain

- The predialysis weight should be compared with the patient's last postdialysis weight and with the dry weight.
- A large IDWG with dyspnea: cardiovascular examination and reassessment of the target weight.
- Patients should keep their interdialysis weight gain **below 1.0 kg/d.**
- **Limiting sodium rather than fluid intake.**
- Excessive thirst may be due to a high dialysis solution sodium level.

➤ INTRADIALYTIC HYPOTENSION



INTRADIALYTIC HYPOTENSION

Reducing Volume-related IDH:

- ❑ Maneuver that **slows the UFR**: Avoid large interdialytic weight gains:
 - Extending the weekly **time** on dialysis
 - The additional Saturday treatment.
 - Reducing the weekly volume of **fluid ingestion**.
 - Increasing the volume of **urine** excreted.
- ❑ A **maximum UFR of 13 mL/kg per hour** has been recommended to minimize IDH. (greater UFR (more than 10 to 13 mL/kg/hour) accompanied with higher mortality).



INTRADIALYTIC HYPOTENSION

❖ In hypotension-prone patients:

- ✓ UF modeling
- ✓ Avoiding intradialytic hypocalcemia, hypomagnesemia, and alkalosis
- ✓ lowering T D
- ✓ Increasing duration or frequency of HD
- ✓ Reducing dietary Na intake

❖ Sequential UF was found to be inferior to Na modeling and dialysate cooling in preventing IDH.



CHRONIC HEMODIALYSIS

- ❖ KDOQI 2006 : Treatment time **not be reduced below 3 hours** (for thrice-weekly dialysis) in patients with little or no residual urine output.
- ❖ The European Best Practice Guideline: **4 hours** of therapy should be provided for all patients dialyzed on a three-per-week schedule, regardless of body size.
- Increasing dialysis frequency without increasing weekly dialysis time does not always reduce IDH, although in one study, the degree of myocardial stunning was reduced with short daily hemodialysis.



INTRADIALYTIC HYPOTENSION

- ❖ Use an **appropriate dialysis solution sodium level**.
 - When it is **below** than of plasma, the blood returning from the dialyzer is hypotonic and to maintain osmotic equilibrium, **water leaves the blood compartment**, causing an **acute reduction in the blood volume**.
 - Higher dialysis solution sodium levels limit the reduction in blood volume, but they also increase interdialytic weight gain, blood pressure, and postdialysis thirst.
- ❖ **Sodium modeling (or sodium gradient dialysis)**: Use of a high dialysis solution sodium early in treatment (145-155 mM), with a progressive fall to lower levels (135-140 mM) at the end of treatment.



INTRADIALYTIC HYPOTENSION

- ❖ Using a relatively high dialysis **solution sodium** (**>142 mmol/L**) may benefit **frail patients** at high risk for IDH.
- ❖ On the other hand, use of a relatively low dialysate sodium level might reduce IDH because it tends to lower interdialytic weight gain and the need for ultrafiltration.
- ❖ In the United States: Use a **dialysate sodium** of **138 mmol/L**.
- ❖ Mortality was increased in patients being dialyzed against a dialysate sodium of less than 138 mmol/L, and the increased mortality association was unrelated to the level of predialysis serum sodium.



MUSCLE CRAMPS

- ❖ The four most important predisposing factors are:
 - ❑ Hypotension
 - ❑ Hypovolemia (patient below dry weight)
 - ❑ High UFR (large weight gain)
 - ❑ Use of low-sodium dialysis solution.
- ❖ These factors all tend to favor **vasoconstriction**, resulting in muscle hypoperfusion, leading to secondary impairment of muscle relaxation.
- ❖ The frequency of cramping increases with the weight loss requirements.
- ❖ Cramping is more common during the first month of dialysis and It is more common in patients with a low cardiac index.



Thanks for
your
attention