Fluid therapy for critical pt. in ICU

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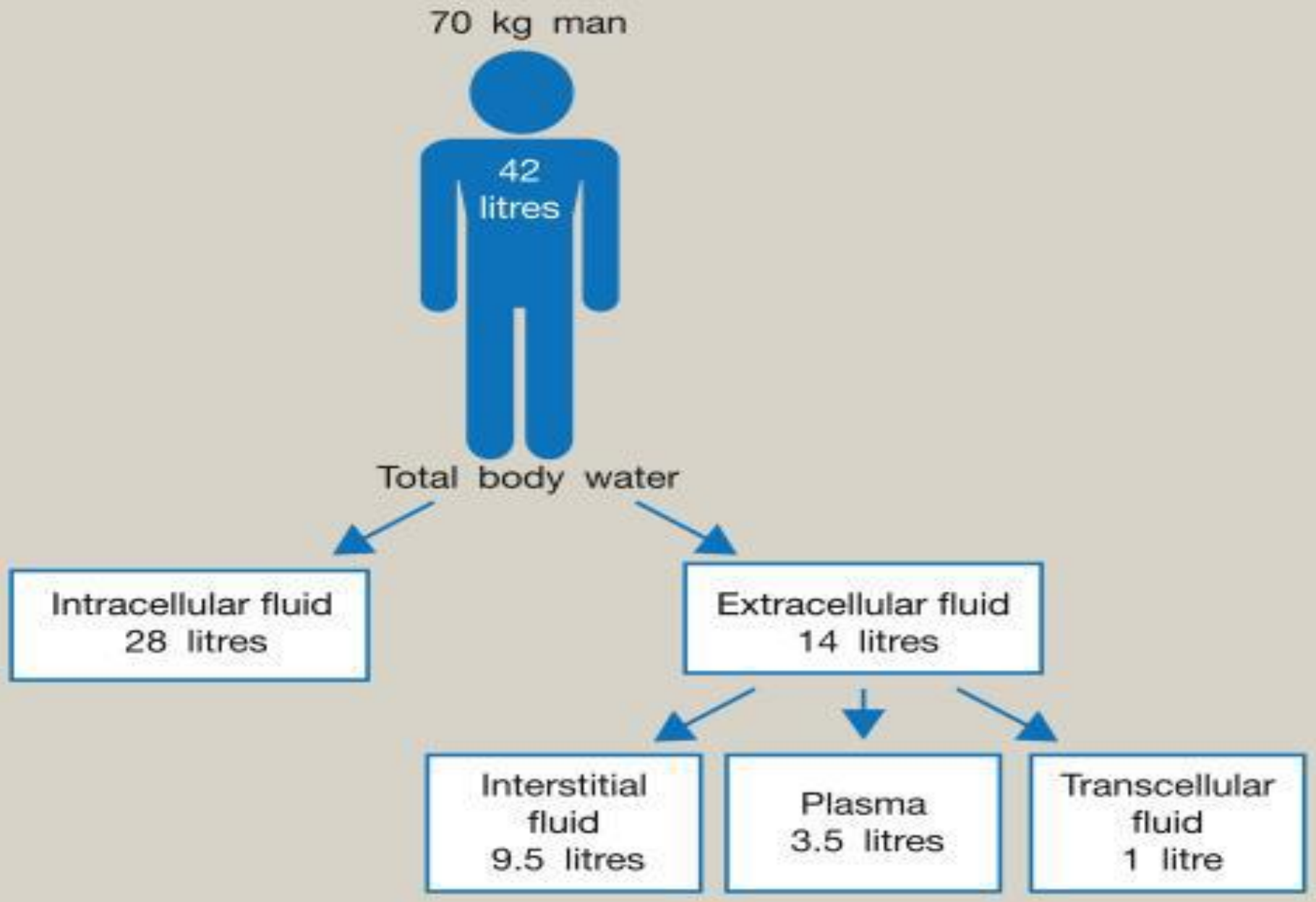
Second Lecture

Compartmentalization of total body water in an average 70 kg man



Introduction :

- Fluid therapy is **a cornerstone** of management for critically ill patients in the ICU.
- **It plays a vital role in maintaining :**

1.hemodynamic stability

2.ensuring proper tissue perfusion

3.and addressing electrolyte and fluid imbalances.

Water Requirements Increase with :

1.Fever & Hypermetabolism: Water needs increase by **100-150 ml/day** for each degree of temperature elevation.

2. Tachypnea: Faster breathing raises insensible water loss through the lungs.

3. Gastrointestinal Losses: Vomiting, diarrhea, or high-output stomas increase water requirements.

4. Polyuria: Conditions like diabetes insipidus or use of diuretics lead to excessive urine output, raising water needs.

5. Burns: Extensive skin damage from burns results in significant water loss.

Water Requirements Increase with :

6. Sweating: Heat, fever, or physical activity increases water loss through sweat.

7. Trauma or Surgery: Blood loss and tissue injury during trauma or surgery elevate fluid needs.

8. Renal Dysfunction: Kidney conditions or therapies like dialysis may increase water requirements.

9. Hyperthyroidism: **Elevated metabolism** increases water loss.

10.Environmental Factors: Hot, dry climates or high altitude cause increased water loss through evaporation.

Water Requirements Increase with :

11.Enteral/Parenteral Nutrition : Additional water is needed to balance feeding solutions and prevent dehydration.

12.Increased Activity : Physical exertion, especially in heat, increases sweat loss.

13.Fluid Shifts : Conditions like sepsis or trauma cause fluids to shift, increasing water needs.

14.Infectious Diarrhea : Diseases like cholera cause massive fluid loss, raising water requirements.

* Water Requirements Increase By 100 To 150 ml/Day For Each Degree Of Body Temperature Elevation.

Fluid therapy :

- Oral route is always preferred over IV route.
- Can be life-saving in certain conditions.
- Loss of body water, whether acute or chronic, can cause a range of problems from mild headache to convulsions, coma, and in some cases, death.
- Though fluid therapy can be a life saver ,it's never always safe, and can be very harmful.
- Maintenance of appropriate hydration and electrolyte composition is essential in ICU patient and surgical patients.
- The use of intravenous (IV) fluids is one of the most common interventions in the intensive care unit (ICU).

Fluid therapy :

❖ Fluids are most commonly administered to critically ill patients for **intravascular resuscitation** in the treatment of various forms of

1.shock (ie, hemorrhagic, distributive, cardiogenic)

2.and dehydration

3.and for general maintenance of hydration status.

❖ **Each day, over 20% of patients in intensive care units (ICUs) receive intravenous fluid resuscitation, and more than 30% receive fluid resuscitation during their first day in the ICU.**

❖ **Routine maintenance**: **patients may need IV fluid therapy because**

-they are unable to maintain normal fluid levels **orally** or by another **enteral** route.

❖ Critically ill patients may experience —leaky vasculature with increased extracellular fluid and edema.

Aim of fluid therapy :

⌘ In the absence of normal homeostatic mechanisms, patients need:

❖ Basic maintenance fluids to replace normal daily water loss.

❖ Electrolyte losses.

❖ Additional resuscitation fluids to correct losses due to underlying pathology.

❖ To maintain an adequate tissue perfusion.

Tissue Perfusion and Fluid Therapy in ICU Patients :

⌘ Maintaining adequate tissue perfusion is a critical aim of fluid therapy in ICU patients.

⌘ Tissue perfusion refers to the

-flow of blood through the body‘s tissues,

-delivering essential oxygen and nutrients while removing waste products.

⌘ n critically ill patients, disrupted perfusion can lead to **tissue hypoxia, organ dysfunction, and failure.**

⌘ **Fluid therapy plays a key role in optimizing perfusion**, especially when normal homeostatic mechanisms are compromised.

How Fluid Therapy Assists in Maintaining Tissue Perfusion:

1.Restoring Intravascular Volume

In conditions like shock (e.g., hemorrhagic or septic shock), there is a significant loss of intravascular fluid, leading to a drop in blood pressure and reduced perfusion.

⌘ Fluid therapy helps by replenishing the circulating volume, thereby improving blood pressure and organ perfusion.

2. Optimizing Cardiac Output

Adequate perfusion is dependent on cardiac output, which is a product of stroke volume and heart rate.

⌘ **Fluids increase stroke volume by** expanding the intravascular compartment allowing the heart to pump more efficiently, thus improving oxygen delivery to tissues.

How Fluid Therapy Assists in Maintaining Tissue Perfusion:

3. Balancing Fluid Compartments

Different types of fluids (crystalloids and colloids) are **used to target specific compartments:**

- **Crystalloids** (e.g., saline, lactated Ringer's) are used to restore volume in the interstitial and intravascular spaces.
- **Colloids (e.g., albumin)** are used when intravascular expansion is needed to restore perfusion without excessive interstitial fluid accumulation.

4. Preventing Tissue Edema

While increasing fluid volume is essential for perfusion, over-resuscitation can lead to **tissue edema,** which **compromises microcirculatory flow and oxygen delivery.**

How Fluid Therapy Assists in Maintaining Tissue Perfusion:

Careful fluid management, including:

1.monitoring fluid balance and body weight

2.preventsfluid overload, which can cause issues like pulmonary or cerebral edema.

5. Monitoring Perfusion In ICU patients

clinical signssuch as

-urine output

-blood pressure

-and capillary refill time

-along with advanced monitoring like central venous pressure (CVP)

-and lactate levels

help assess the adequacy of tissue perfusion.

This ensures fluid therapy is guided by the patient‘s hemodynamic status.

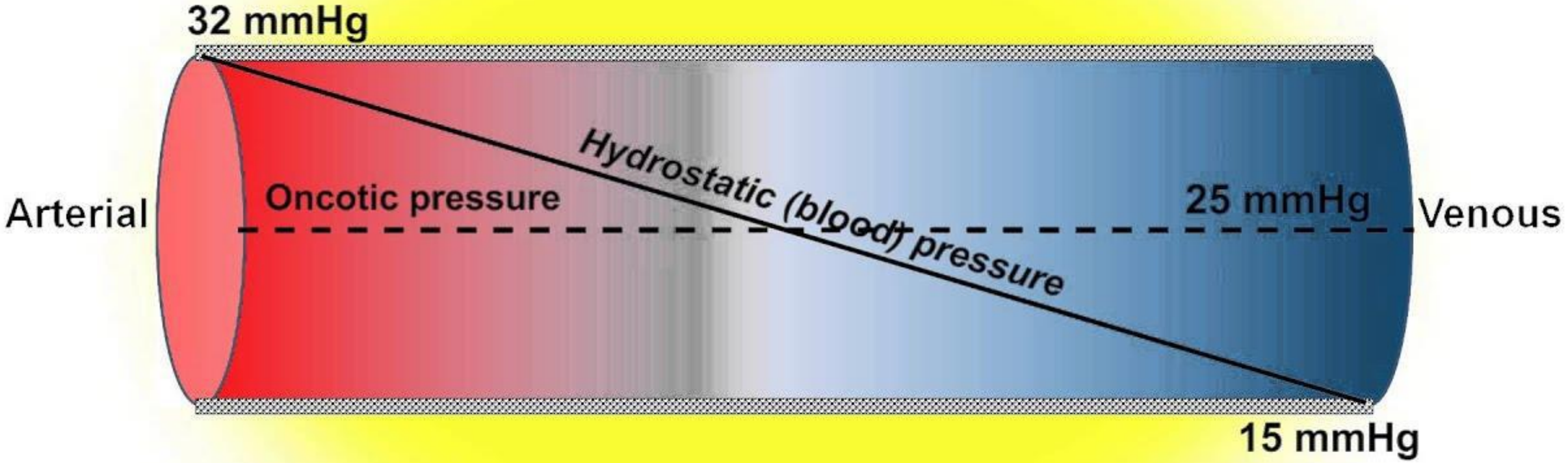
Key Strategies in ICU for Optimizing Tissue Perfusion :

- **Early Resuscitation**: In patients with hemodynamic instability, aggressive fluid resuscitation is crucial in the early stages to restore perfusion quickly.
- **Targeted Fluid Management**: Once the patient is **stabilized**, fluid therapy is adjusted based on their **specific needs**, avoiding both under-resuscitation (which leads to hypoperfusion) and over-resuscitation (which causes edema and organ dysfunction).
- **Using Vasopressors**: In cases where **fluid therapy alone is**insufficient to restore perfusion, vasopressors **(e.g., norepinephrine)** are used to

- supportblood pressure and improve tissue oxygenation.

The classic Starling theory :

- It s a physiological theory developed by Ernest Starling and others , which explain both administration and movement of fluids between body fluids compartment.
- According to this theory , fluid leaves the vasculature at the arterial end of the capillary bed (where the hydrostatic pressure gradient exceeds the osmotic pressure gradient) and re enters at the venous end of the capillary bed (where, as a result of prior fluid loss, hydrostatic pressure will be lower and osmotic pressure higher).



Basics of fluid calculation :

- In stable dehydrated patients, **the goal of fluid therapy is**

-to replace interstitial losses while simultaneously taking into account the patient's baseline fluid requirements and any excessive losses.

Thus, daily fluid needs are calculated on the basis of 3 values:

1) Dehydration.

2) Maintenance needs.

3) Ongoing loss.

* By depending 4-2-1 rule in maintenance need.

IV FLUIDS :

- IV fluids are the **commonest drugs prescribed in ICU**, **emergency settings and operating theatres.**
- **Used to**

-maintain effective blood volume

-and maintain organ perfusion

-also as diluents for drugs.

- Types: **Crystalloid vs Colloid**.

-Fluids are drugs with indications, contraindications, and side effects.-
Different indications need different types of fluids, e.g.:

- Resuscitation fluids should focus on rapid restoration of circulating volume.
- Replacement fluids must mimic the fluid that has been lost.
- Maintenance fluids must deliver basic electrolytes and glucose for metabolic needs.

WHICH TYPE IF IV FLUID?? :

- Type of fluid is recommended according **to**

-which target body fluid compartment needs to be resuscitated

or maintained:

- **Intracellular space** –deficits mainly due to H2O loss.
- **Interstitial space**–deficits mainly due to H2O and electrolyte loss.
- **Intravascular space** –deficits of plasma volume and/or red blood cells (RBC).

WHICH TYPE IF IV FLUID?? :

- Decisions to initiate, maintain and discontinue IV fluids **requires careful assessment** to minimize risk of:
  - Insufficient or excess administration of fluids
  - Electrolyte abnormalities such as hypo-or hypernatremia, hypo-or hyperkalemia and hyperchloremicacidosis.
  - **Of note**, **in contrast to most drugs,** there is no standard therapeutic dose for fluids.

Common complication of fluid therapy :

- **Rapid infusion of any type of fluid may precipitate :**

► pulmonary edema.

► Acute Respiratory Distress Syndrome (ARDS)

► Or even a compartment syndrome (e.G, abdominal compartment syndrome, extremity compartment syndrome).

- **The risks of receiving too much fluid often depend on individual circumstances, but they can include:**

► excess fluid collecting inside the lungs, which can cause breathing difficulties and increased risk of pneumonia.

► swelling of the ankles, and an imbalance of electrolytes in the blood, which can disrupt organs.

Complication of fluid therapy IN ICU PATIENTS :

- Both **under resuscitation** and **volume overload** increase morbidity and mortality in critically ill patients.
- Uncorrected hypovolemia, leading to **inappropriate infusions of vasopressor agents, may increase organ hypo perfusion and ischemia**.
- **Overzealous fluid resuscitation has been associated with**
  - increased complications,
  - increased length of ICU and hospital stay
  - and increased mortality.

Fluid balance :

- **The balance between**

- The balance between
-total intake of fluid and electrolytes (enteral and IV)

versus

- the combined output (from kidneys, GI tract and insensible losses through
skin, and lungs)
Determines overall fluid and electrolyte balance.

Fluid balance : Intake

- Average required daily intake for healthy adults is:

-water 25–35 mL/kg/day

-sodium ~1 mmol/kg/day

-potassium ~1 mmol/kg/day.

- When estimating intake, remember to include concomitant **IV**

medication fluids (i.e. from antibiotics, steroids, inotropes, etc.)

Fluid balance : Output

- Ongoing losses may occur from:

1-Kidney losses (obligatory volume to excrete solute load and maintain renal function is ~500 mL in healthy adults):

- Kidneys are the

- main regulator for fluid

- and electrolyte elimination

- and metabolism

- **Polyuria** indicates potential excessive renal losses of water, sodium and Potassium.

- Obligatory volume increases during critical illness, surgery and catabolic conditions.

Fluid balance : Output

2-Gastrointestinal losses (normally 100–500 mL/day in the stool in healthy adults):

- Vomiting and NG loss –excessive losses of K+ and Cl–may cause
  - hypochloremic
  - (hypokalemic)
  - Metabolic alkalosis
- Biliary drainage, pancreatic drainage or fistula
- Ileal or jejunal loss via stoma or fistula
- Diarrhea or excess colostomy loss.

Fluid balance : Output

3-Insensible losses (normally 0.4 –1 L/day from skin and lungs in healthy adults):

- Pure water loss (i.e. low in electrolyte contents) through skin and lungs
- Increased by fever, sweating, hyperventilation and burns.

4-Blood loss:

-Blood is an important source of fluid

-and losses during surgery

-or loss due to internal hemorrhage, GI hemorrhage or melena ⟶ should be considered.

Additional practical points

- Weighing the patient daily is important.
- Minimize fluids required to administer medications.
- Once patient is established on nutritional support they may not require —routine maintenance crystalloids.
- Dramatic weight gain due to fluid overload may respond to judicious use of low-dose diuretics if hemodynamically tolerated.

CONCLUSION :

- Proactively administering a sufficient fluid volume is important during

-**the early phases** (rescue and optimization phases) of a critical illness, during which the hemodynamics are **(instable).**

fluid administration should not be restricted in this stage.

- **Restrictive fluid therapy** should only be started in the **later phases** when the hemodynamics **(stabilize)**.

FOR PROPER FLUID THERAPY, IT IS NECESSARYTO KNOW :

- Etiology of fluid deficit and type of electrolyte imbalance present.
- (Associated illness)i.e. DM, HTN, IHD, RHD, renal or hepatic disorders, etc.
- Clinical status (Hydration, vital data, urine output) etc.