Intravenous Fluid Therapy

Introduction

Can You Imagine life without water?

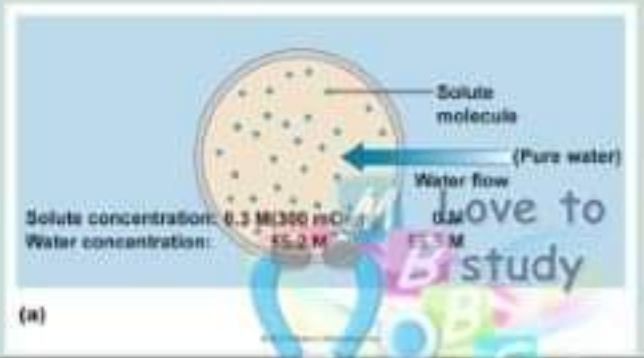
Of course not, because water is essential to sustain life. Likewise, body fluids are vital to maintain normal body functioning

Total body fluid (TBW), accounts for approximately 60% of total body weight (this can be 70%or higher in a newborn down to 50–55% in a mature woman).

Total Body Fluid can be divided into Intracellular and Extracellular

Intracellular Fluid

- 2/3 of the total body water .
- Found inside the plasma membrane of the body's cells. In humans (average 70 KG), the intracellular compartment contains on average about 28 liters of fluid .



Extracellular Fluid

Accounts for 1/3 of the TBW, either:

Interstitial, Intravascular and 3rd space

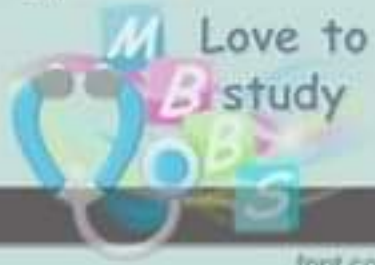
1-Interstitial compartment

•It the small, narrow spaces between tissues or parts of an organ. It is filled with what is called interstitial fluid

•When excessive fluid accumulates in the interstitial space, edema develops. In the average male (70 kg) human body, the interstitial space has approximately 10.5 liters of fluid (15% of the TBW)

Importance:

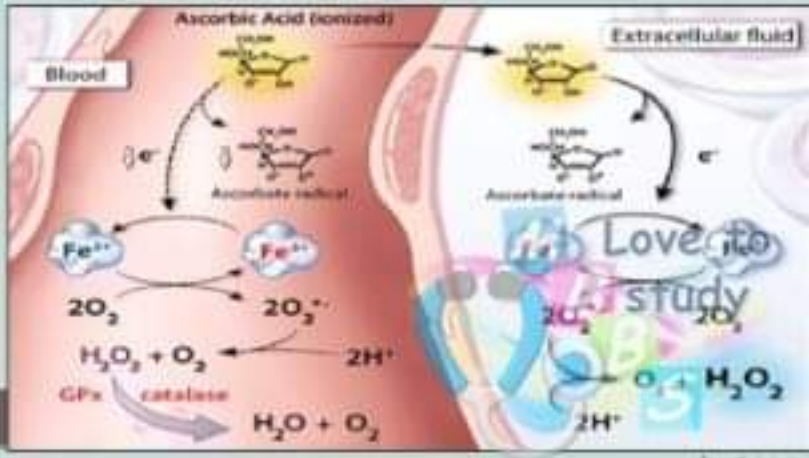
It acts as the microenvironment that allows movement of ions, proteins and nutrients across the cell barrier .



Extracellular Fluid

2-Intravascular compartment

- The main intravascular fluid in humans is blood; the average volume of blood in humans is approximately 70-75 ml/kg



Extracellular Fluid

3- Third space

- The third space is space in the body where fluid does not normally collect in larger amounts.
- For examples the peritoneal cavity and pleural cavity are major examples of the third space.
- Small amount of fluid does exist normally in such spaces, and function for example as lubricant in the case of pleural fluid .

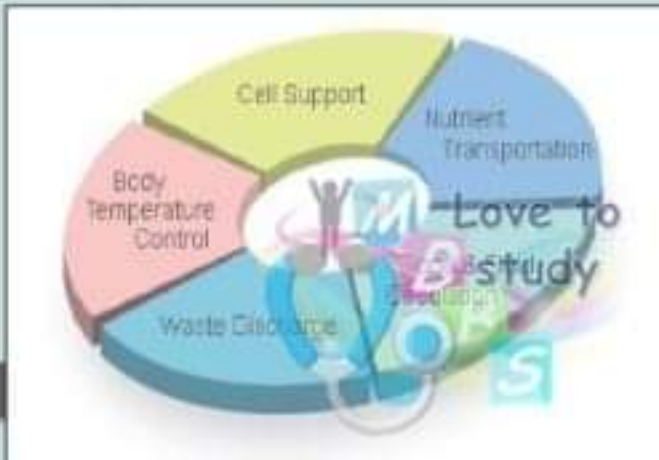
WATER

- Water is the body's primary fluid and is essential for proper organ system functioning and survival.
- People can live several days or even weeks without food, but they cannot survive only a few days without water .

WATER

Water has many functions in the body !

- Essential for Cell life.
- Interfere in the Chemical and metabolic reactions .
- Nutrients absorption and transport.
- Regulate the Body temperature.
- Elimination of waste products through urine .



How much of you is water?

- Body muscle mass is rich in water, while Adipose Tissue has a lower percentage of water content. That's why:
- **Overweight or obese** people have a lower percentage of water compared to someone who's lean and muscular.
- **Women** typically have a lower percentage of total body water than men due to a higher percentage of body fat.
- **Older adults** tend to have a lower concentration of water overall, due to an age-related decrease in muscle mass.
- **Children** tend to have a higher percentage of water weight-as much as 70-80% in a full-term neonate.

How much of you is water?

Input and Output of the "Normal" Adult

Minimal Obligatory Daily input:

500mL: Ingested water:

800mL: Water content in food

300mL : Water from oxidation :

TOTAL: 1600mL

Minimal Obligatory Daily water output:

- 500mL : Urine
- 500mL: Skin
- 400mL: Respiratory tract
- 200mL: Stool
- TOTAL: 1600mL

•On average, an adult input and output is 30-35mL/kg/day (about 2.4L/day)

Water requirements increase with:

- Fever
- Burns
- Surgical drains
- Gastrointestinal losses through Vomiting or diarrhea

Sweating

Tachypnea

Polyuria

Water requirements increase by 100 to 150 mL/day for each Cdegree of body temperature elevation.

What are Solutes?

A substance dissolved in another substance

- There are many SOLUTES, for example:

) Plasma proteins (eg. albumin, globulins, fibrinogen)

) Ions (sodium chloride, magnesium, calcium, bicarbonates)

) Food molecules (eg. glucose, amino-acids), waste products as urea

What's Osmolality?

Term refers to the solute concentration in the body fluid by weight. The number of milliosmols (mOsm) in a kilogram (kg) of solution.

In humans normally the osmolality in plasma is about 275-295 mOsm/Kg

FLUIDTHERPY

Importance !

- 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 lifesaver, it's never always safe, and can be very harmful.

Types of Fluid

The fluids used in clinical practice are usefully classified into **colloids**, **crystalloids** and **blood products**

1.Colloid

Solutions that contain large molecules that don't pass the cell membranes.

When infused, they remain in the intravascular compartment and expand the intravascular volume and they draw fluid from extravascular spaces via their higher oncotic pressure

Types of Fluid

2. Crystalloid

Solutions that contain small molecules that flow easily across the cell membranes, allowing for transfer from the bloodstream into the cells and body tissues.

This will increase fluid volume in both the interstitial and intravascular spaces (Extracellular)

It is subdivided into:

* Isotonic
* Hypotonic
* Hypertonic

Isotonic Fluids

When to consider a solution isotonic?

When the concentration of the particles (solutes) is similar to that of plasma, So it doesn't move into cells and remains within the extracellular compartment thus increasing intravascular volume.

Isotonic Fluids

Types of isotonic solutions include:

- 0.9% sodium chloride (0.9% NaCl)
- lactated Ringer's solution
- 5% dextrose in water (D5W)
- Ringer's solution

Isotonic Fluids

A- 0.9% sodium chloride (Normal Saline)

Solutions	Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	HCO_3^-	Dextrose	mOsm/L
0.9% NaCl	154				154			308

- Simply salt water that contains only water, sodium (154 mEq/L), and chloride (154 mEq/L).
- It's called "normal saline solution" because the percentage of sodium chloride in the solution is similar to the concentration of sodium and chloride in the intravascular space.

A- 0.9% sodium chloride (Normal Saline)

When to be given?

1-to treat low extracellular fluid, as in fluid volume deficit from

- Hemorrhage - Severe vomiting or diarrhea - Heavy drainage from GIsuction, fistulas, or wounds

2Shock

3 Mild hyponatremia

4Metabolic acidosis (such as diabetic ketoacidosis)

5- It's the fluid of choice for resuscitation efforts.

6- it's the only fluid used with administration of blood products.

B-Ringer's lactate or Hartmann solution

Solutions	Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	HCO_3^-	Dextrose	mOsm/L
Lactated Ringer's	130	4	3		109	28		273

- is the most physiologically adaptable fluid because its electrolyte content is most closely related to the composition of the body's blood serum and plasma.
- Another choice for first-line fluid resuscitation for certain patients, such as those with burn injuries.

A- 0.9% sodium chloride (Normal Saline)

TAKE CARE:

Because 0.9% sodium chloride replaces extracellular fluid, it should be used cautiously in certain patients (those with cardiac or renal disease) for fear of fluid volume overload.

B-Ringer's lactate or Hartmann solution

When to be used?

- To replace GI tract fluid losses (Diarrhea or vomiting)
- Fistula drainage
- Fluid losses due to burns and trauma
- Patients experiencing acute blood loss or hypovolemia due to third-space fluid shifts.

B-Ringer's lactate or Hartmann solution

Notice. Both 0.9% sodium chloride and LR may be used in many clinical situations, but patients requiring electrolyte replacement (such as surgical or burn patients) will benefit more from an infusion of LR.

-LR is metabolized in the liver, which converts the lactate to bicarbonate. LR is often administered to patients who have metabolic acidosis not patients with lactic acidosis

-Don't give LR to patients with liver disease as they can't metabolize lactate

-used cautiously in patients with sever renal impairment because it contains some potassium

- LR shouldn't be given to a patient whose pH is greater than 7.5

C-Ringer's solution

~~Like LR, contains sodium, potassium, calcium, and~~ chloride in similar. But it doesn't contain lactate. Ringer's solution is used in a similar fashion as LR, but doesn't have the contraindications related to lactate.

D-Dextrose 5%

Solutions	Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	HCO_3^-	Dextrose	mOsm/L
D5W							50gm/l	278

It is considered an isotonic solution, but when the dextrose is metabolized, the solution actually becomes hypotonic and causes fluid to shift into cells.

D- Dextrose 5%

How does it work?

- D5W provides free water that pass through membrane pores to both intracellular and extracellular spaces. Its smaller size allows the molecules to pass more freely between compartments, thus expanding both compartments simultaneously
- It provides 170 calories per liter, but it doesn't replace electrolytes.
- The supplied calories doesn't provide enough nutrition for prolonged use. But still can be added to provide some calories while the patient is NPO

D- Dextrose 5%

Take Care !

-D5W is not good for patients with **renal failure** or cardiac problems since it could cause fluid overload.

-patients at risk for intracranial pressure should not receive D5W since it could increase cerebral edema

-D5W shouldn't be used in **isolation** to treat fluid volume deficit because it dilutes plasma electrolyte concentrations

-Never mix dextrose with blood as it causes blood to hemolyze.

-Not used for **resuscitation**, because the solution won't remain in the intravascular space.

-Not used in the **early postoperative** period, because the body's reaction to the surgical stress may cause an increase in antidiuretic hormone secretion

Difference between NS and D5W in distribution

	Free water content	ICF	ECF	Interstitial	Intravascular
D5W	1000cc	660cc	340cc	226cc	114cc (**11%**)
NS	0	0	1000cc	660cc	330cc (**33%**)

Precautions in usage of Isotonic solutions

- Be aware that patients being treated for hypovolemia can quickly develop hypervolemia (fluid volume overload) following rapid or overinfusion of isotonic fluids.

- Document baseline vital signs, edema status, lung sounds, and heart sounds before beginning the infusion, and continue monitoring during and after the infusion.

Precautions in usage of Isotonic solutions

- Frequently assess the patient's response to I.V. therapy, monitoring for signs and symptoms of hypervolemia such as:

hypertension / bounding pulse / pulmonary crackles / peripheral edema / dyspnea/ shortness of breath / jugular venous distention (JVD)

- Monitor intake and output
- Elevate the head of bed at 35 to 45 degrees, unless contraindicated .
- If edema is present, elevate the patient's legs.

- monitor for signs and symptoms of continued hypovolemia, including:

  - urine output of less than 0.5 mL/kg /hour /
  - poor skin turgor
  - tachycardia
  - weak, thready pulse
  - hypotension

- Educate patients and their families about signs and symptoms of volume overload and dehydration
- instruct patients to notify if they have trouble breathing or notice any swelling.
- Instruct patients and families to keep the head of the bed elevated (unless contraindicated).