IV fluids

Fluid compartments

Water comprises approximately 60% of the body weight of an average adult (about 40L in a 70 kg man). The total body water is divided functionally into the extracellular (ECF=20% of body weight, about 14L in a 70 kg man) and the intracellular fluid spaces (ICF= 40% of body weight, about 28L in a 70 kg man) separated by the cell membrane with its active sodium pump, which ensures that sodium remains mainly in the ECF.

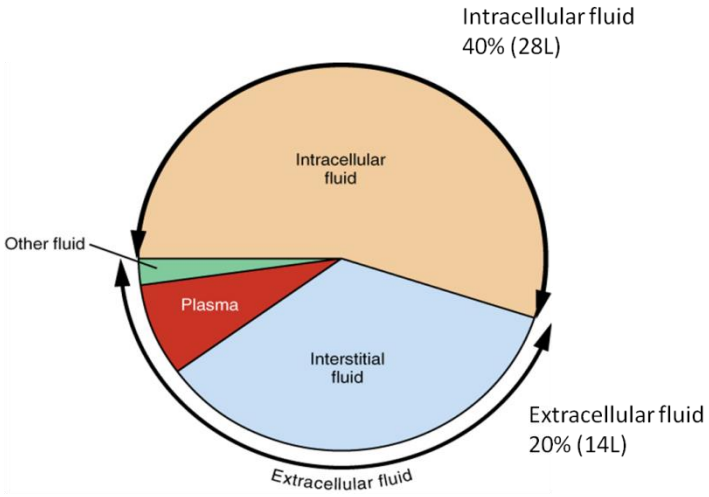

Figure 1: Types of body fluids.

The intracellular fluid compartment is the system that includes all fluid enclosed in cells by their plasma membranes. Extracellular fluid surrounds all cells in the body. Extracellular fluid has two primary constituents: the fluid component of the blood (called plasma, 5–7% of the body weight, approximately 4-5L) and the interstitial fluid (IF, about 15% of body weight) that surrounds all cells (except blood cells).

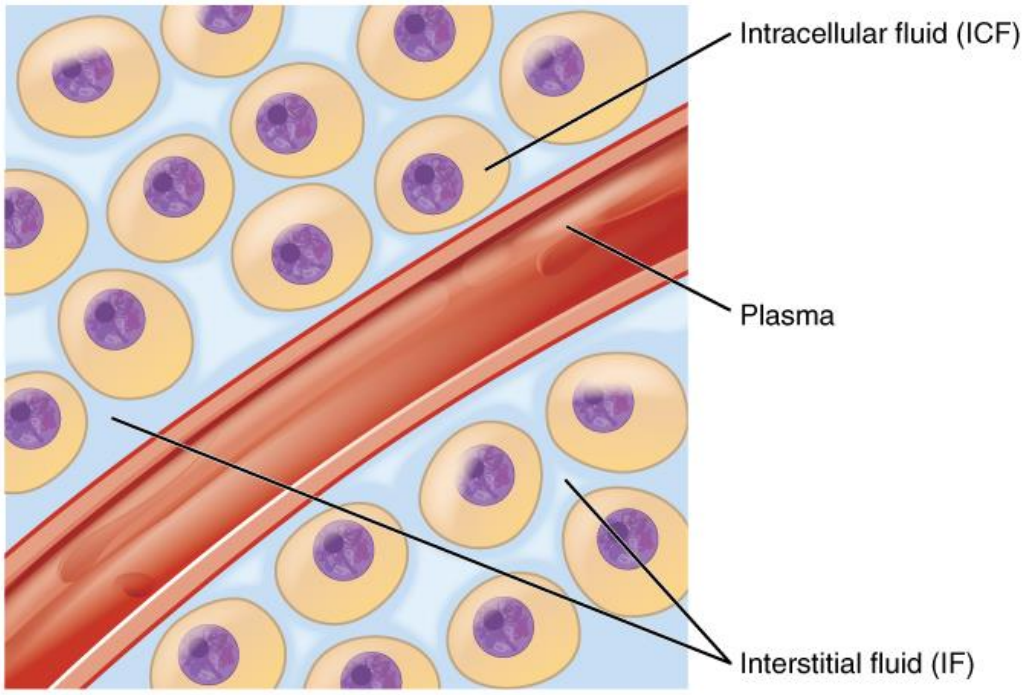

Figure 2. Fluid compartments in the human body.

The intracellular fluid (ICF) is the fluid within cells. The interstitial fluid (IF) is part of the extracellular fluid (ECF) between the cells. Blood/plasma is the second part of the ECF. Materials (e.g. glucose) travel between cells and the plasma in capillaries through the IF (interstitial fluid).

Types of IV fluids

The osmolality is the amount of particulate per unit volume of a liquid preparation, which is measured in milliosmoles (mOsm)/L. Normal osmolality of blood is 280-320 mOsm/L (average 290 mOsm/L). On the basis of osmolality fluids are of following 3 types.

Isotonic fluid/solution

An isotonic solution has same osomolality like that of blood (290 mOsm/L), in which body cells can be bathed without a net flow of water across a semipermeable membrane. Examples are

1. 0.9% Saline.
2. 5% dextrose in water (also used as a hypotonic solution after it is administered because the body absorbs the dextrose).

3. 5% Dextrose in 0.225% saline

4. Lactated Ringer's.

Use of isotonic fluid

1. To increase the extracellular fluid volume due to blood loss, surgery, dehydration due to any cause (e.g. diarrhoea, vomiting).

2. Fluid loss that has been loss extracellularly.

Hypotonic fluid/solution

Hypotonic fluid have a lower concentration or tonicity, of solutes and have an osomolality equal to or less than 250 mOsm/L. The infusion of hypotonic solutions lowers the osmolality of blood and causes fluid to shift to the intracellular and interstitial space. As a result cells will swell but may also delete fluid within the vascular space.

Examples of hypotonic solutions include

1. 0.45% sodium chloride

2. 0.33% sodium chloride

3. 0.2% sodium chloride.

4. 2.5% dextrose in water

Uses of hypotonic solutions

Hypotonic solutions are used when the cell is dehydrated and fluids need to be put back intracellularly. This happens when patients develop diabetic ketoacidosis (DKA) or hyperosmolar hyperglycemia.

Monitoring while infusing hypotonic fluid

1. Monitor for hypovolemia and hypotension related to fluid shifting out of the vascular space.

Precaution: Do not administer to patient with increased intracranial pressure (ICP), as it may exacerbate cerebral edema. Use cautiously in patients with burns, liver failure, and trauma.

Hypertonic fluid/solution

Hypertonic solutions have a higher concentration, or tonicity of solutes and have an osomolality equal to or greater than 375 mOsm/L. The osmotic pressure gradient draws water out of the intracellular space into the extracellular space, which will cause the cell to shrink. It is preferred to give hypertonic solutions via a central line due to hypertonic solution being vesicant on the veins and the risk of infiltration.

Examples of hypertonic solutions include

1. 3% Saline
2. 5% Saline
3. 10% Dextrose in water
4. 5% Dextrose in 0.9% saline
5. 5% Dextrose in 0.45% saline
6. 5% Dextrose in Lactated Ringer's

Precautions

Hypertonic solutions may cause intravascular fluid volume overload and pulmonary edema, and they should not be used for an extended period of time. Hypertonic solutions should not be used in patients with heart or renal disease who are dehydrated.

What are the colloidal solution/fluid?

Colloidal solutions contain large molecules that cannot pass through semi-permeable membranes and are used to expand intravascular volume by drawing fluid from extravascular space via high osmotic pressure. Examples of colloid solutions are albumin, dextran and hydroxyethyl starches.

Properties of colloidal fluids

–Large proteins

–Remain in vascular space

–Blood replacement products

–Plasma substitutes (hypertonic)

- Dextran

-Hetastarch

What are the crystalloidal solutions?

Crystalloidal solutions contain solutes such as electrolytes or dextrose, which are easily mixed and dissolvable in solution. Crystalloids contain small molecules that flow easily across semi-permeable membranes, which allows for transfer from the bloodstream into the cells and tissues.

Properties of crystalloid fluids

–Use to volume replacement and increase cardiac output and blood pressure.

– Isotonic

– No proteins

– Moves into tissue over short time.

May be isotonic, hypertonic or hypotonic.

Examples of crystalloid fluids: Normal Saline (0.9% NaCl), hypertonic saline (3, 5, & 7.5%), Ringer's solution.

For safe fluid and electrolyte administration

1. The oral route should be used whenever possible.

2. IV fluids can usually be avoided in patients who are eating and drinking.

3. The possibility of enteral tube administration should also be considered if safe oral intake is compromised.

Points to be considered before considering IV fluids

1. Does my patient need IV fluid resuscitation? This is the first question, since urgent IV fluid therapy is a critical element in the management of most shocked patients.

2. Can my patient meet fluid and electrolyte needs by the oral or enteral route? Provide intravenous (IV) fluid therapy only for patients whose needs cannot be met by oral or enteral routes, and stop as soon as possible.The unnecessary use of IV fluids should be avoided. When they are needed, they should be stopped as soon as possible.

3. What is my patient's current fluid and electrolyte status? Assessment must be informed by all information available including a focused history and examination along with results of clinical monitoring and laboratory results.

4. What are my patient's routine maintenance needs for fluid and electrolytes? The average person requires 25–30 ml/kg water per day and about 1 mmol/kg of Na+ and K+.

5. Does my patient have existing fluid or electrolyte deficits or abnormal ongoing losses? All IV fluid prescriptions should add enough fluid and/or electrolytes to correct any existing deficits or meet abnormal ongoing losses, to estimates of routine maintenance requirements. In case of diarrhoea we have to calculate the already deficit fluid, then ongoing loss and daily requirement.

6. Does my patient have problems with internal redistribution of fluid or other fluid handling issues from either their primary problem or significant co-morbidities? IV fluid prescriptions must aim to account for both non-specific responses to illness, as well as the more complex problems of fluid distribution or handling caused by specific organ or system dysfunction and/or malnutrition.

7. What is the cause of IV fluid administration? Maintainece of daily fluid, glucose and electrolytes balance, correction of dehydration, volume expander etc.

8. When prescribing IV fluids, remember the 5 Rs: Resuscitation, Routine maintenance, Replacement, Redistribution and Reassessment.

Commonly use IV fluids are

Normal saline, 5% DNS, 10% DNS, cholera saline, IDS, Hartman saline, 3% sodium, baby saline.

Common uses of different IV fluids

Normal saline (isotonic)

1. Correction of dehydration due to any cause e.g. vomiting, diarrhoea etc
2. Correction of dehydration of diabetic ketoacidosis, HONK patients.
3. Correction of dehydration due to diarrhoea in DM patient.

4. Correction of hyponatraemia.

5. To administer drugs e.g. IV potassium.

6. Irrigation solution e.g. cleansing of tissues, body cavities, wounds or irrigation of catheters.

5% DNS (hypertonic saline)

1. Replacement of nutrition in NPO patients

2. Correction of dehydration

3. IV drug administration e.g. aminophylline, antisnake venom etc.

10% DA

1. Nutrition supplementation.

Cholera saline

It is a electrolyte rich fluid, containing

1. Sodium chloride

2. Potassium chloride

3. Sodium acetate

Uses of cholera saline

1. To replenish and restore the normal electrolyte balance of the body which results from various conditions e.g. diarrhoea, vomiting, profuse sweating etc.

3% sodium (hypertonic saline)

1. Use to correct hyponatraemia

Hartmann saline (isotonic)

Composition-sodium chloride, potassium chloride, calcium chloride, sodium lactate.

Use-as volume expander, also as replacement of electrolytes.

IDS

Composition: Sodium chloride, dextrose.

Use: Nutrition and electrolytes replacement in patient with raised intracranial pressure.

Aminoacid solution

Indications

Indicated as an adjunct in the prevention of net nitrogen loss or in the treatment of negative nitrogen balance in patients where:

(1) The alimentary tract by the oral, gastrostomy or jejunostomy route, cannot or should not be used

(2) Gastrointestinal absorption of protein is impaired or

(3) Metabolic requirements for protein are substantially increased, as with extensive burns.

Contraindications

1. Patients with renal failure.

2. Patients with clinically significant elevation of plasma concentrations of sodium, potassium, magnesium and/or phosphorus.

3. Patients with severe liver disease - hepatic coma.

4. Patients with a congenital abnormality of amino acid metabolism.

5. Known hypersensitivity to one or more amino acids, any other active or excipient.

Fatty acid solution

Composition: Refined soyabean oil, purified egg lecithin, glycerol.

Indication: Patient with essential fatty acid deficiency patient who cannot maintain or restore essential fatty acid by oral intake.

Precaution: Infuse slowly because it may cause phlebitis.