

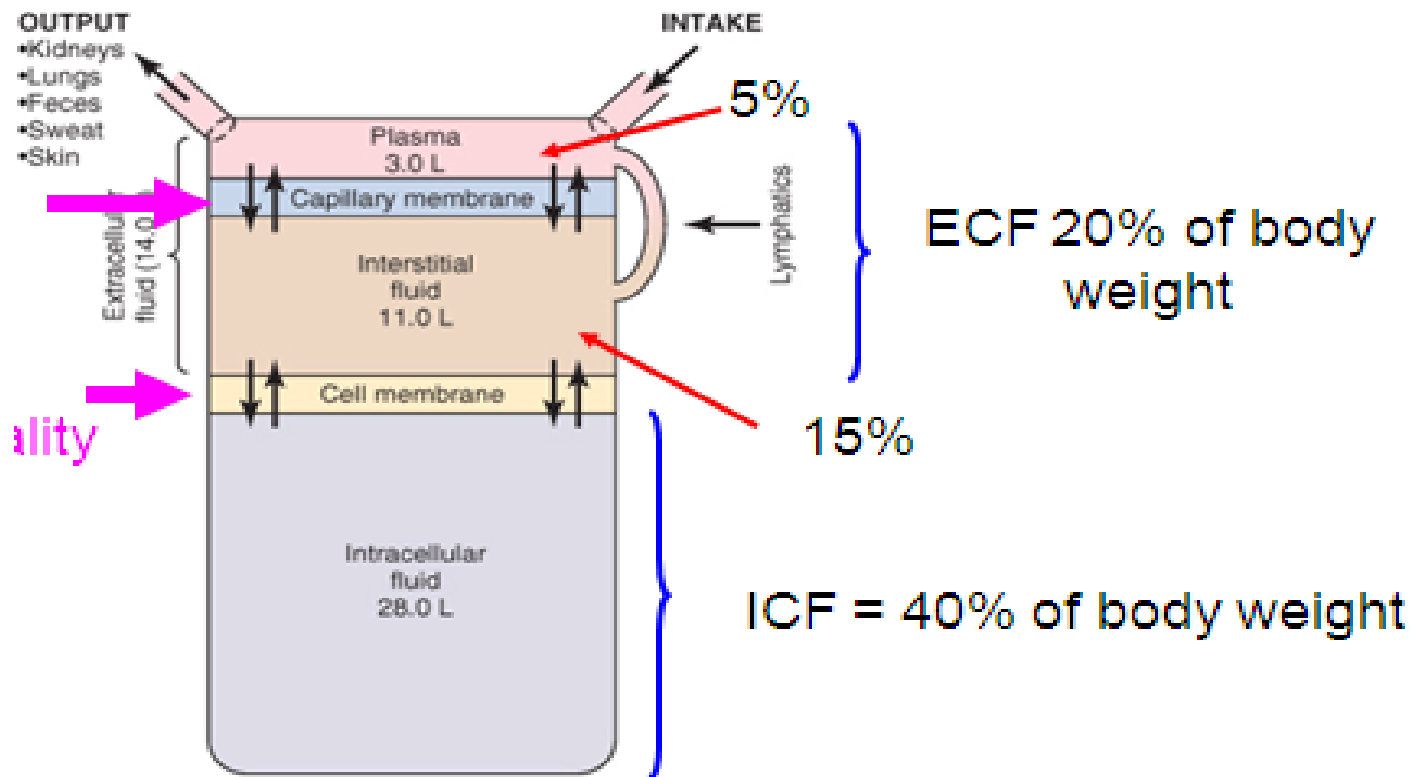
INTRAVENOUS FLUIDS

25/05/2021

INTRODUCTION:

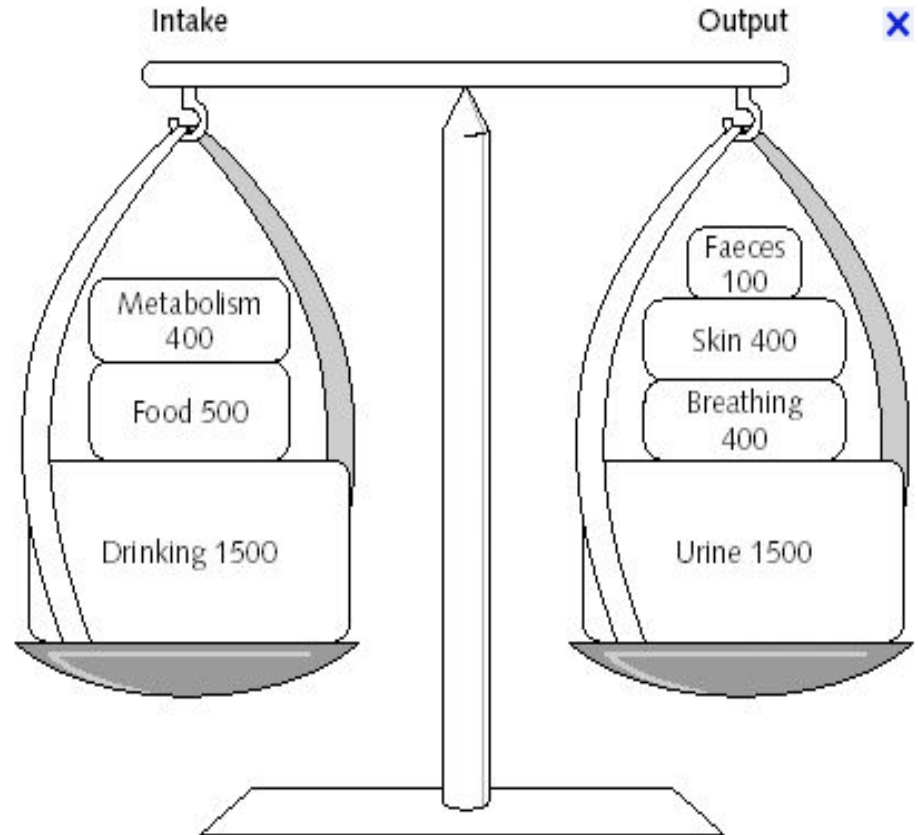
Fluid Compartments

60-70% of total body weight is made up of water



Delicate balance...

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



Components of Fluid Therapy

- ***Maintenance therapy*** - replaces the ongoing losses of water and electrolytes under normal physiologic conditions via urine, sweat, respiration, and stool.
- ***Replacement therapy*** - corrects any existing water and electrolyte deficits.

Increased fluid requirements:

- Fever (each °C of body temp elevation above 37°C ↑s fluid requirements by 100-150 ml/day)
- Burns , skin failure
- Surgical drains
- GIT losses- vomiting/diarrhea
- Sweating
- Tachypnea
- Polyuria

Osmolality

- Refers to the solute concentration in the body fluid by weight.
✓ ie. the number of milliosmoles in a kg of solution.
- Humans: normal osmolality= 275-295 mOsm/Kg
- **Osmolarity**- number of solute particles per litre of solvent

Which fluid, when???

?Normal saline

!!Ringer's lactate

?!5% dextrose

!?Half normal saline

Albumin???



Types of Intravenous Fluids

1. Crystalloids
2. Colloids
3. Blood products

1. CRYSTALLOIDS

- Contain small molecules that flow easily across cell membranes → allows for transfer from blood to cells and body tissues.
- Increase fluid volume in both the interstitial and intravascular spaces (Extracellular)
- Divided into:
 - * Isotonic
 - * Hypotonic
 - * Hypertonic

a) Isotonic Fluids

1. Normal saline (0.9% sodium chloride)
2. Ringer's lactate (LR)
3. 5% dextrose (D5W)
4. Ringer's solution

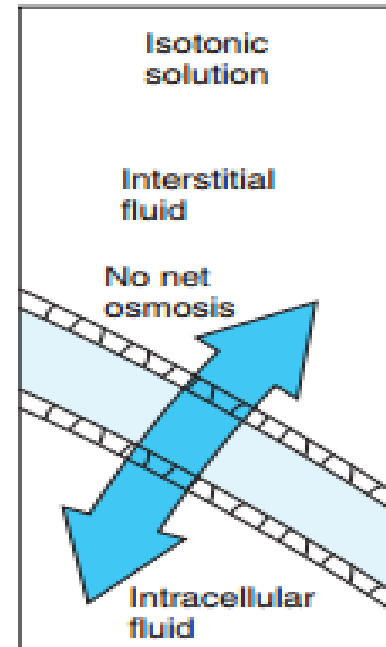


Figure 3-2. Isotonic solutions do not result in any significant fluid shifts across cellular or vascular membranes.

i) Normal Saline (0.9% NaCl)

Solutions	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Cl ⁻	HCO ₃ ⁻	Dextrose	mOsm/L
0.9% NaCl	154				154			308

INDICATIONS

- ✓ Correction of fluid volume deficit from:
 - **Hemorrhage** - **Severe vomiting or diarrhea** - **Heavy drainage from GI suction, fistulas, or wounds**
- ✓ Shock
- ✓ Mild hyponatremia
- ✓ DKA
- ✓ Fluid of choice for resuscitation efforts.

ii) Ringer's lactate (Hartmann's solution)

Solutions	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Cl ⁻	HCO ₃ ⁻	Dextrose	mOsm/L
Lactated Ringer's	130	4	3		109	28		273

INDICATIONS

- ✓ 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.

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

Ringer's lactate continued...

- LR is metabolized in the liver, which converts the lactate to bicarbonate.
- Caution in:
 - liver disease as they can't metabolize lactate.
 - severe renal impairment as it contains K^+
 - shouldn't be given if $pH > 7.5$

iii) 5% dextrose in water (D5W)

Solutions	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Cl ⁻	HCO ₃ ⁻	Dextrose	mOsm/L
D5W							50gm/l	278

- Considered an isotonic solution, but when the dextrose is metabolized, the solution actually becomes **hypotonic** and causes fluid to shift into cells.
- Provides free water that passes through membrane pores to both IC & EC spaces, expanding both compartments simultaneously.
- Provides **170 calories /litre**→ can provide some nutrition while patient is NPO, but not enough for prolonged periods.

Precautions with D5W:

- May increase risk of cerebral edema in pts with ↑d ICP.
- Shouldn't be used in isolation to treat fluid volume deficit →dilutes plasma electrolyte concentrations
- Not used for resuscitation as the solution won't remain in the intravascular space.

iv) Ringer's solution

- Similar composition as LR, except lactate.
- Doesn't have the contraindications related to lactate.



b) Hypotonic Solutions

- Have a lower concn. of solutes (osmolarity <250 mOsm/L).
- Lower the serum osmolarity within the vascular space.
- Cause fluid to shift from the intravascular space to both the intracellular and interstitial spaces.
- These solutions will hydrate cells.

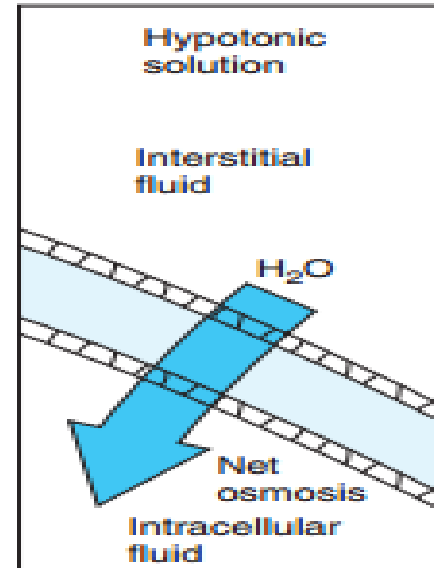


Figure 3-4. A hypotonic solution given IV will cause fluids to leave the vasculature for the interstitial and intracellular spaces.

Examples

1. 0.45% sodium chloride (0.45% NaCl)
2. 0.33% sodium chloride
3. 0.2% sodium chloride
4. 2.5% dextrose in water

Uses

- Situations associated with intracellular dehydration, when fluid needs to be shifted into the cell:
 - ✓ Hyponatremia

Precautions

- May exacerbate cerebral oedema
- May deplete intravascular volume in patients with burns, trauma → worsen existing **hypovolemia** and **hypotension** and cause cardiovascular collapse.

c) Hypertonic Solutions

- Have a high solute concentration (osmolality ≥ 375 mOsm/L).
- The osmotic pressure gradient draws water out of the intracellular space, increasing extracellular fluid volume, so they are used as **volume expanders**.

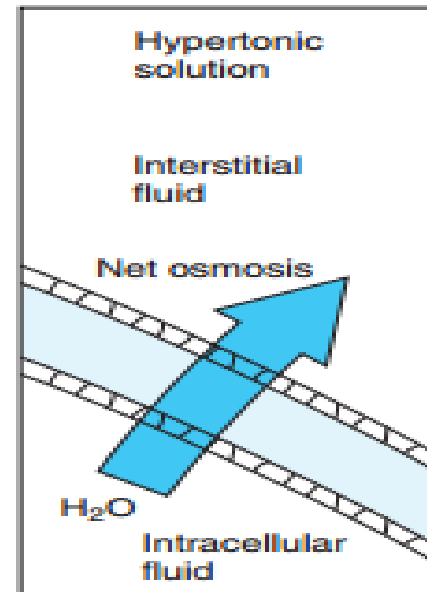


Figure 3-3. A hypertonic solution given IV will draw fluids from the cells and interstitial spaces into the vasculature.

Examples

1. **3% sodium chloride (3% NaCl):**

- Used in cases of severe hyponatremia.
- May be of benefit in cerebral edema.

2- **5% Dextrose with normal saline (D5NS):**

- Replaces sodium, chloride and some calories

COLLOIDS

- High molecular weight substances that largely remain in the intravascular compartment, thereby generating an oncotic pressure.
- Expand the intravascular volume by drawing fluid from the interstitial spaces into the intravascular compartment.
- Similar effect as hypertonic crystalloids but:
 - ✓ Require administration of less total volume
 - ✓ Have a longer duration of action as the molecules remain within the intravascular space longer.

Types

1. Natural

- eg. 5% albumin (Human albumin solution)

2. Artificial:

- Dextran
- Gelatin solutions
- Hydroxyethylstarches

i) 5% Albumin

- Most commonly used colloid.
- Contains plasma protein fractions obtained from **human plasma**.
- Rapidly expands plasma volume.
- Considered a blood transfusion product → requires all the same nursing precautions used when administering other blood products.
- Expensive
- Effect lasts 16-24h

Uses

- 1) Volume expansion in shock states
- 2) Moderate protein replacement

ii) Dextran

- Polysaccharide.
- Effect lasts 6-12h
- Disadvantages:
 - ✓ Anaphylactic reactions
 - ✓ Coagulation abnormalities- ↓platelet adhesiveness, ↓ factor VIII.
 - ✓ Interferes with cross matching of blood by coating RBCs
 - ✓ May plug renal tubules precipitating ARF.

iii) Gelatins

- Large molecular weight proteins formed from hydrolysis of collagen
- Duration of action shorter compared to albumin & starches
- Ex. Polygeline (Haemaccel)

iv) Hydroxyethylstarches

- Examples: Hetastarch, Pentastarch, Tetrastarch
- Used for hemodynamic volume replacement following major surgery and to treat major burns.
- Less expensive than albumin

Precautions with use of Colloids

- Can interfere with platelet function and increase bleeding times, so monitor the patient's coagulation indexes.
- May cause anaphylactoid reactions (rare).

THE END

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