I.V FLUIDS

Done by :

Nizar Almaaitah

Yousef Hindi

Mosap Qtaishat

Shahd Almaaitah

Raneem Aljaafreh

Roaa Fararjah

Content

1. TBW & fluid compartments
2. Fluids input & output
3. Osmolarity & tonicity
4. I.V fluids types
5. I.V fluids indictions
6. Blood products
7. Hypovolemia & hypervolemia
8. MaintenanCe and DefiCit
9. Equipment of I.V therapy

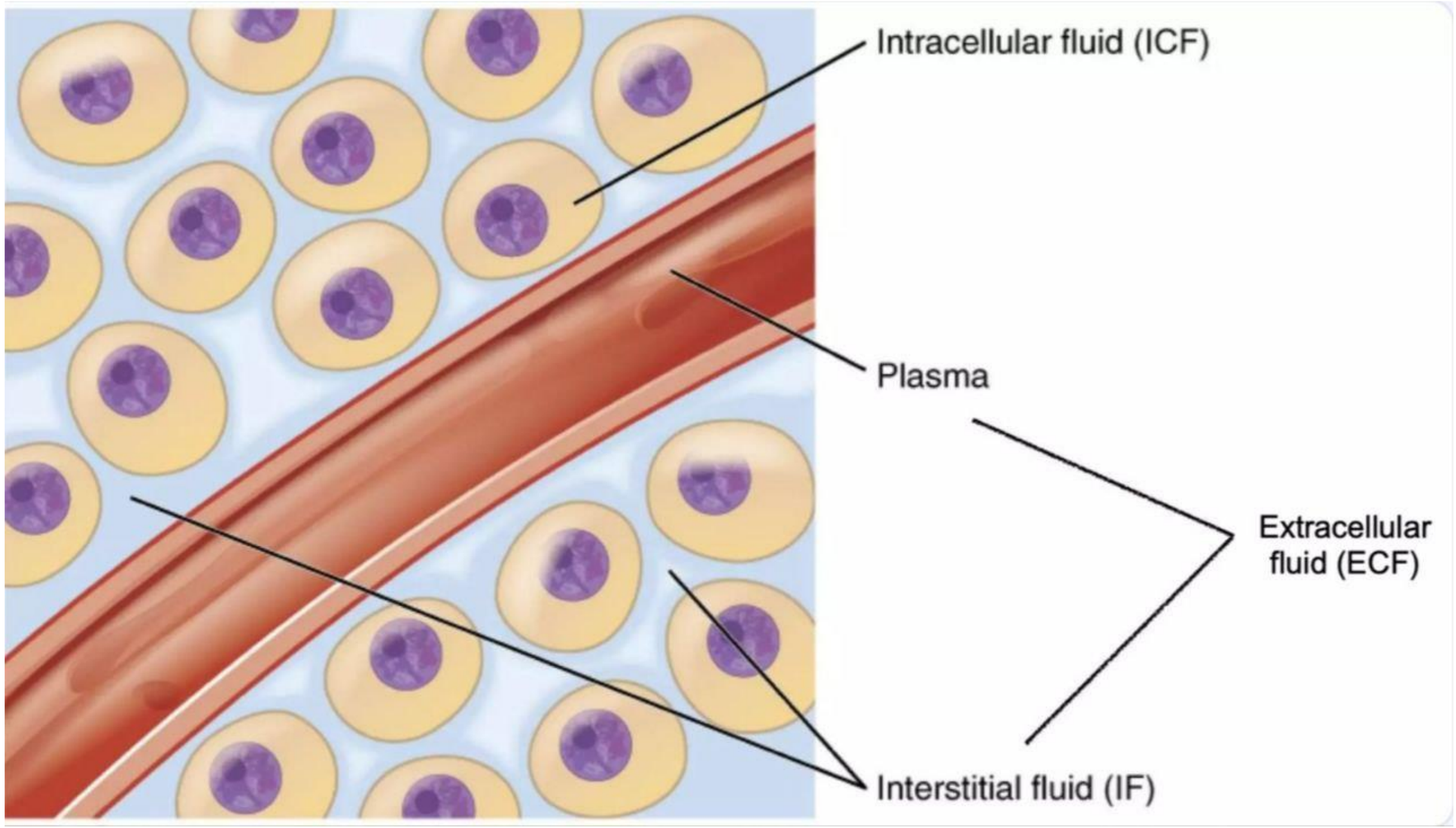
What are IV FLUIDS ?

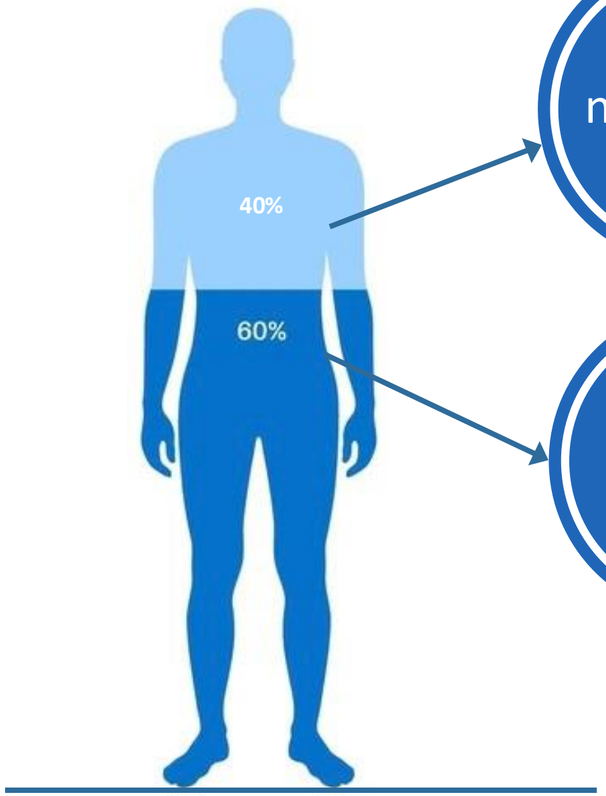
- IV fluids are specially formulated liquids that are injected into a vein to prevent or treat dehydration

Total body water

- highest percentage of TBW is found in newborns, with approximately 80% of their total body weight composed of water.

- The body of a healthy 70 kg male contains about 42 litres of water. That is, total body water constitutes about 60% of his total body weight.


Intracellular fluid (ICF)
Plasma
Extracellular fluid (ECF)
Interstitial fluid (IF)



40%
non-water

60%
water

1/3
extracellular

2/3
intracellular

1/4
plasma

3/4
interstitial

Fluid Input

- **The normal daily input-of water(oral intake) is about 2000 ml of water**
- **an additional 200-300 ml per 24 hours is provided endogenously by oxidation of carbohydrate and fat (i.e. metabolic water). This is consistent with daily water losses (output).**

Fluid Output

- **A healthy individual loses fluid and electrolytes by three routes:**

via the kidneys, via the gastrointestinal tract, and by evaporation from the skin and respiratory tract(insensible water loss !)

Fluid Output

- Daily water loss averages **2000-2500 mL** and is typically accounted for by

- **1500 mL in urine,**
- **Insensible losses :**
- **400 mL in respiratory tract evaporation**
- **400 mL in skin evaporation**
- **100 mL in sweat**
- **and 100 mL in feces.**

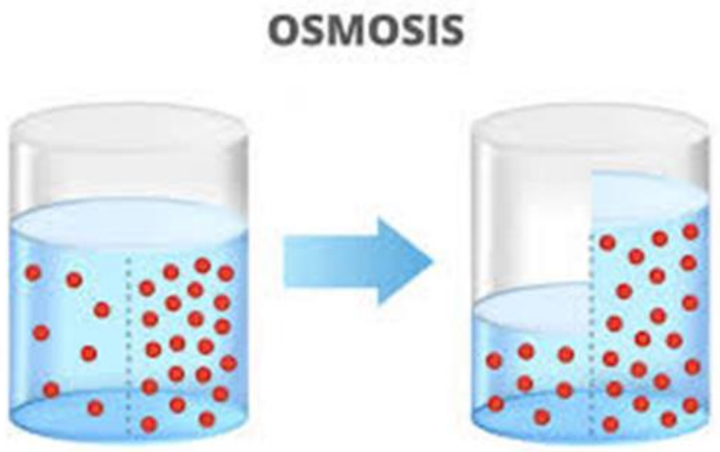
Fluid Output

- **Insensible losses increase in some Pathologic states like : -Burn(destroy of skin layers) -Fever**
- **Pyrexia** increases water loss from the skin by approximately **200 ml/day for each 1 °C** rise temperature.
- **Hyperventilation** increases insensible water loss via the respiratory tract

Osmolarity & Tonicity

Osmosis : simple diffusion of water from high conc. of water to low conc. of water across semi permeable membrane.

- The distribution of fluid between the intra- (the plasma) and extravascular compartments (interstitial fluids) is dependent on the oncotic pressure of plasma and the permeability of the endothelium. The plasma oncotic pressure is determined by the presence of colloid particles, of which albumin is the most important .



Osmolarity of solution is equal to number of osmoles per liter of solution.
Normal range of osmolarity in plasma is about 280-295 milli-osmoles per liter.

calculation of plasma osmolarity

- osmolality of extracellular fluid is determined primarily by sodium and chloride concentrations. The following equation is a calculation of the serum osmolality;
- Osmolality= 2 sodium + glucose/18 +BUN(blood urea nitrogen) /2.8

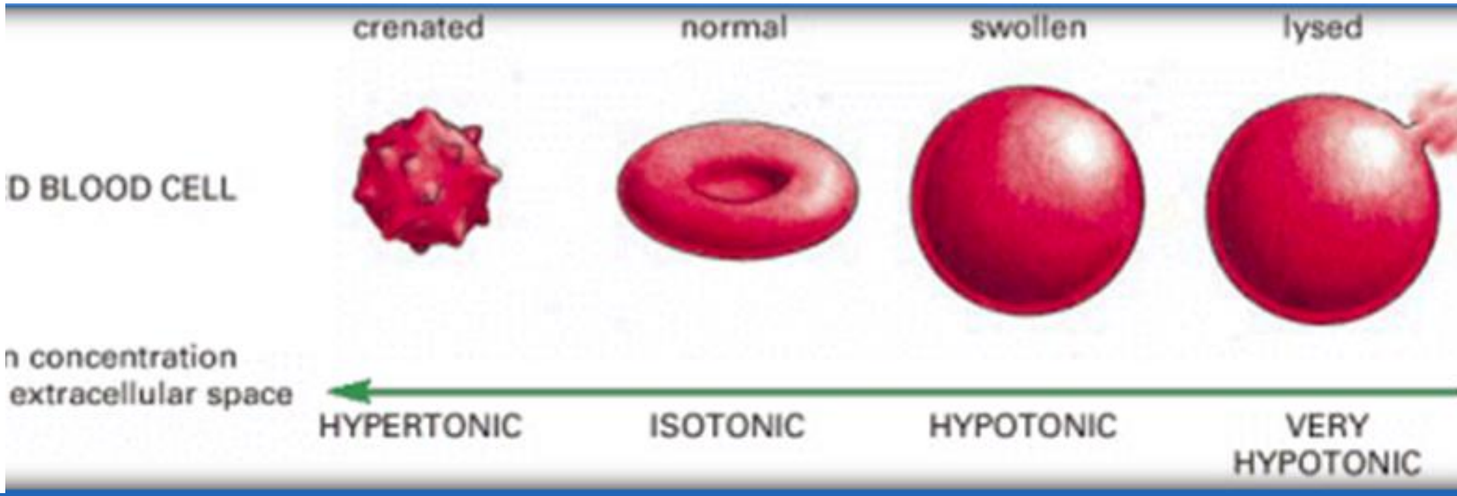
$$\text{Plasma osmolarity} = 2[Na^+] + \frac{\text{Glucose}}{18} + \frac{\text{BUN}}{2.8}$$

NOTE: Sodium is the largest determinant of plasma osmolarity

Tonicity is the total conc. of solutes which make an osmotic force across a membrane.

- The term tonicity is used to describe the osmolarity of a solution relative to plasma (280-295).

- Isotonic (osmolarity of a solution ~ to plasma)
- hypertonic (osmolarity of a solution > to plasma)
- hypotonic (osmolarity of a solution < to plasma)



Intervenors fluids:

IV fluids, or intravenous fluids, are sterile liquids administered directly into a patient's bloodstream through a vein using an intravenous (IV) catheter. They are used to:

1. **Rehydrate**: Replace lost fluids due to dehydration, vomiting, or diarrhea.
2. **Electrolyte balance**: Correct imbalances of electrolytes like sodium, potassium, and calcium.
3. **Nutritional support**: Provide nutrients, such as glucose or vitamins, when a patient cannot eat.
4. **Medication delivery**: Administer medications directly into the bloodstream for immediate effect.

IV fluids come in various types, including isotonic, hypotonic, and hypertonic solutions, each serving different medical needs.

Intervenors fluids type:

IV fluids can be classified based on their tonicity, composition, and purpose:

1. Based on Tonicity

- **Isotonic Solutions**: Have the same osmolarity as blood plasma, They help maintain fluid balance without shifting fluids in or out of cells, Examples include:
  - Normal Saline (0.9% Sodium Chloride) / Lactated Ringer's Solution / Dextrose 5% in Water (D5W)
- **Hypotonic Solutions**: Have a lower osmolarity than blood plasma, They cause fluid to move into cells, helping with hydration, Examples include:
  - 0.45% Sodium Chloride (Half Normal Saline) / Dextrose 2.5% in Water
- **Hypertonic Solutions**: Have a higher osmolarity than blood plasma, They draw fluid out of cells, which can be useful in certain medical conditions, Examples include:
  - 3% Sodium Chloride / Dextrose 10% in Water

Intervenors fluids type (2):

2. Based on Composition:

- **Crystalloids**: Solutions containing small molecules that can easily cross cell membranes. Common examples include saline and dextrose solutions.

- **Colloids**: Solutions containing larger molecules (like proteins) that do not easily cross cell membranes. They are used to expand blood volume. Examples include:
  - Hydroxyethyl starch (HES)
  - Albumin

Intervenors fluids type (3):

3.Based on Purpose:

- **Maintenance Fluids**: Used to maintain fluid balance in patients who are unable to eat or drink.
- **Replacement Fluids**: Used to replace lost fluids and electrolytes due to surgery, illness, or dehydration.
- **Nutritional Fluids**: Provide essential nutrients and calories to patients who cannot eat, often used in total parenteral nutrition (TPN).

Each type of IV fluid has specific indications and should be chosen based on the patient's clinical condition.

Intervenors fluids type (4):

4.Types of IV Fluids Based on Clinical Uses:

- **Preoperative Fluids**: Used to prepare patients before surgery to ensure fluid balance.
- **Emergency Fluids**: Used in emergencies such as trauma or bleeding, where rapid fluid replacement is required.
- **Supportive Fluids**: Used to support the patient during treatment, such as in chemotherapy cases.

5. Indications for Using IV Fluids

- **Dehydration**: To prevent dehydration from vomiting or diarrhea.
- **Injuries**: To compensate for lost fluids due to injury or surgery.
- **Diabetes**: In diabetes cases, fluids may be used to regulate glucose levels.
- **Critical Conditions**: Such as organ failure or shock, where vital functions need immediate support.

Types

Three main types

- Crystalloids
- Colloids
- Blood products

Normal Saline (NaCL)

0.9% Normal Saline

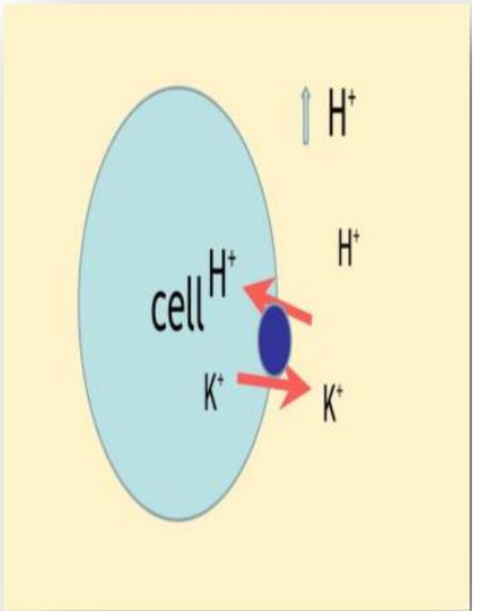
- Approximately same osmolarity as plasma
- [Na] = [Cl] = 154 mmol/liter
- total osmolarity = 308 mOsmol/liter vs. 285 m0sm/L plasma
- isotonic
- 25% remains in intravascular space
- Used for volume replacement
- Hypovolemic shock
- Septic shock

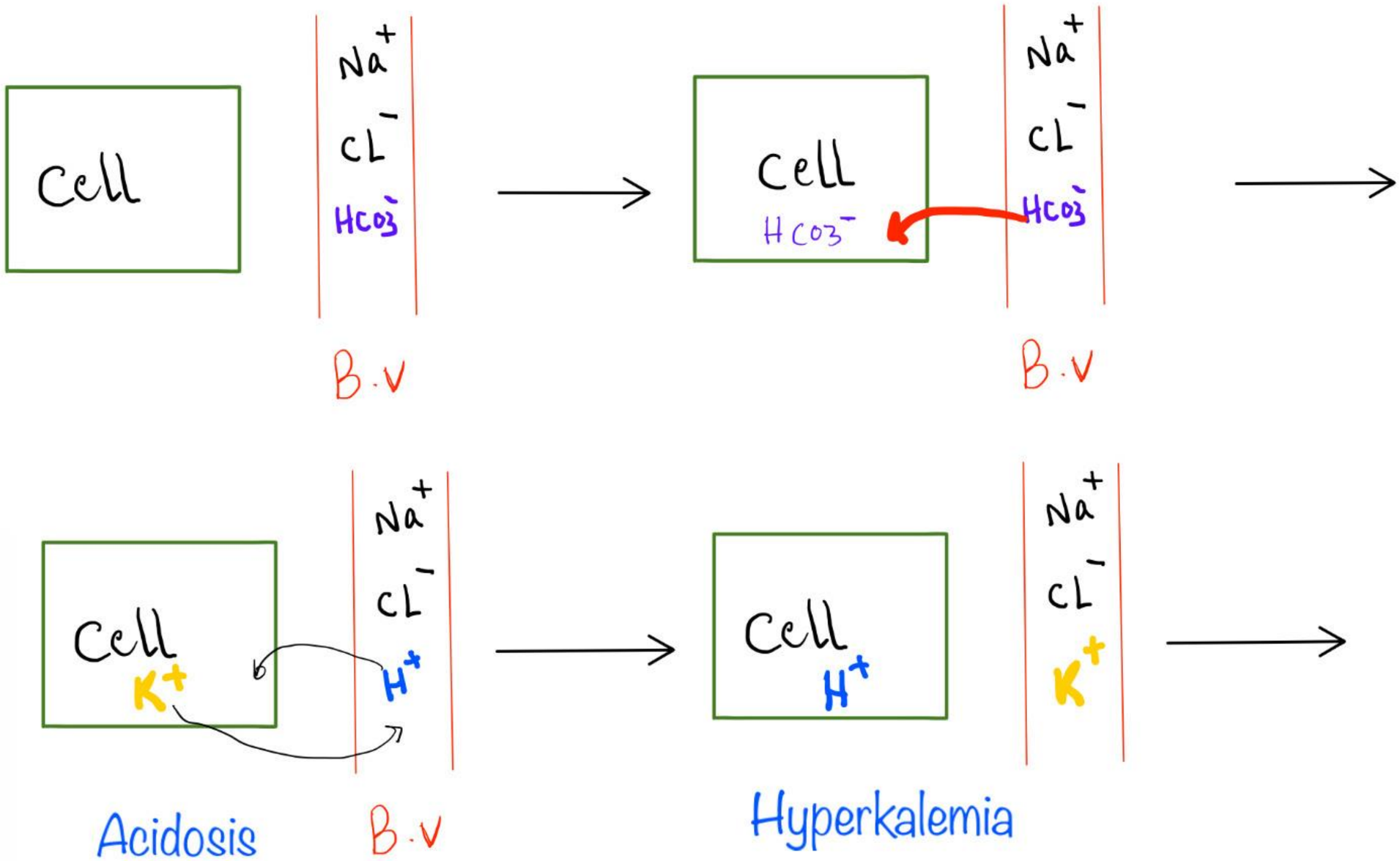
Normal Saline

Normal Saline Results in influx of chloride ions (Cl)

- Causes shift of bicarbonate ions (HCO3) into cells
- Causes acidosis (pH)
- Acidosis → potassium shift out of cells
- T serum potassium
- "Hyperchloremic metabolic acidosis"
- contraindications:

CHF, CKD, Liver cirrhosis



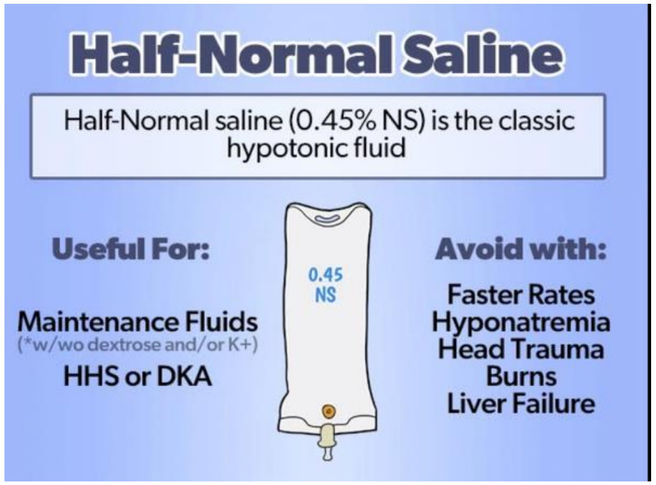

Cell
Na^+
Cl^-
HCO_3^-
B.V
Cell
HCO_3^-
Na^+
Cl^-
HCO_3^-
B.V
Cell
K^+
Na^+
Cl^-
H^+
Acidosis
B.V
Cell
H^+
Na^+
Cl^-
K^+
Hyperkalemia

Half Normal Saline

- 0.45% Normal Saline
- [Na] = [Cl] = 77 mmol/liter
- total osmolarity = 154 mOsmol/liter vs. 285 mOsm/L plasma
- Hypotonic solution concentration of sodium chloride

Does not remain intravascular

Half Normal Saline



Used as "maintenance fluids"

Replaces daily losses of sodium and water

Hypernatremia

Severe DKA

Half-Normal Saline is rarely given alone, but **usually in combination with Potassium or dextrose**

- 5% dextrose often added: D5 half NS
- Potassium can be added: D5 half NS with 20mEq K
- Often used when oral intake is low

LACTATED RINGER

Sodium, chloride, potassium, calcium, and lactate.

- "Balanced fluid"
- Isotonic: osmolarity 286 mOsm/L
- 25% remains in intravascular space
- Lactate metabolized to bicarbonate
- Acts as buffer in acidotic states
- Most common use: trauma resuscitation

Indications & Contraindications

Indications:

- •First-line replacement therapy in the perioperative period.
- •Fluid resuscitation after a blood loss due to trauma, surgery, or a burn injury.
- •Replace GI tract fluid losses.
- •Metabolic acidosis.

Indications & Contraindications

Contraindications:

- Poor liver function. (affect lactate metabolism → Lactic acidosis)
- Hyperalkalosis
- Citrated blood transfusions
- (Clumping of red cells if it is co-administered with blood products)

DEXTROSE SOLUTION 5%

Dextrose solution 5% (5 g of dextrose/100 ml water) does not contain any electrolytes.
The dextrose is rapidly metabolized in the body,such that dextrose solution is equivalent to administering water; which distributes rapidly and evenly throughout the entire body fluid compartments.
It is also useful for replacing water deficit, in patients with hypernatremia.

DEXTROSE SOLUTION 5%

Because it contains sugar, it is employed as a measure to prevent the catabolic state (i.e. hypoglycemia and ketosis) that follows prolonged fasting (e.g. keeping the patient NPO before surgery).
More concentrated dextrose solutions (10%, 20% and 50% are available, but their use is limited to the management of diabetic patients or patients with hypoglycemia.
These solutions are irritant to veins.

Hypertonic Saline

Hypertonic Saline

- Hypertonic: ~900 mOsm/liter
- Draws fluid out of tissues into vascular space
- ICF ⟶ ECF
- Used in two circumstances:
    1. Elevated intracerebral pressure
    2. Severe hyponatremia

Hypervolemia

- Causes:
  - Heart failure
  - Cirrhosis
  - Nephrotic syndrome

- Clinical features:…
  - Weight gain
  - Pitting edema
  - Elevated jugular venous pressure
    - –Pulmonary edema

- Treatment:
  - Diuretics

Hypovolemia

- Causes:
  - Vomiting/diarrhea
  - Poor oral intake
  - Third spacing/fluid leak: sepsis, trauma

- Clinical features:
  - Decreased urine output
  - Dry mucous membranes
  - Poor skin turgor

- Treatment:
  - Oral intake
  - IV fluids

Maintenance and Deficit

MaintenanCe of fluid

Maintenance fluids address the patient's physiological needs. (4-2-1 rule)

(4ml/kg for the first 10kg) + (2ml/kg for 11-20kg) + (1ml/kg for every kg above 20) = hourly rate

DefiCit

Deficit = normal maintenance fluid rate x number of hours starved

In the first hour of surgery 50 % of the deficit should be replaced, and 25 % during each of the second and third hours

ExaMple:

Calculate the hourly maintenance fluid rate for a 70kg patient who is NPO (4ml x 10kg) + (2ml x 10kg) + (1ml x 50kg)

40ml + 20ml + 50ml = 110ml/hr

Maintenance and Deficit

ExaMple:

Calculate the hourly maintenance fluid rate for a 50 kg patient who is NPO for 8 hours

—> first calculate the maintenance:

(4ml x 10kg) + (2ml x 10kg) + (1ml x 30kg) 40ml + 20ml + 30ml = 90ml/hr

—> deficit :

(90 ml * 8) = 720 ml

Maintenance of electrolytes:

Na+: 3 mEq/kg/day, K+ : 1 mEq/kg/day

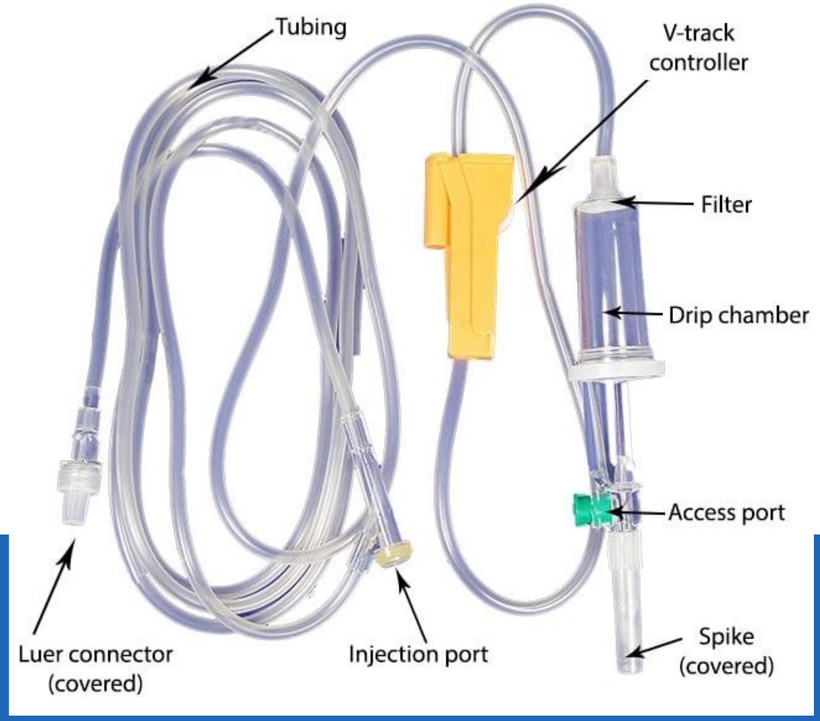
e.g. Calculate a 50 kg patient's maintenance requirements • Fluid = 40 + 20 + 30 = 90 mL/hour = 2160 mL/day

- **Na+ = 150 mEq/day**
- **K+ = 50 mEq/day**

Equipment of I.V. therapy

1. Solution containers.

2. I.V. administration sets.



3- IV CANNULA:

• Present day IV cannula are available from sizes 14 gauge to 26 gauge with universal color coding for easy recognition of IV cannula. Smaller the gauge, wider is the cannula and has higher flow rate.

1.orange color

- 14 Gauge.
- 2 mm diameter.
- 300 ml/min flow rate.

2. grey color

- 16 Gauge.
- 1.6 diameter.
- 150-180 ml/min flow rate.

**14-16 G used in situations requiring rapid fluid transfusion like trauma

Colour **Orange**	**Colour** **Grey**
Gauge **14G**	**Gauge** **16G**
Typical Flow Rate 300ml/min	**Typical Flow Rate** 160-180ml/min
Diameter 2mm.	Diameter 1,6mm
Typical Usage Mainly used in: • Trauma, high risk Surgery • For rapid infusion, of whole blood, blood components or viscous fluids	**Typical Usage** Mainly used in: • Trauma, or surgery when high volume fluids required quickly • For rapid infusion, of whole blood, blood components or viscous fluids

3. Green color:

- 18 gauge.
- 1.2 mm diameter.
- 80 ml/min flow rate.

4. Pink color:

- 20 gauge.
- 1 mm diameter
- 55 ml/min flow rate.

5. Blue color

- 22 gauge.
- 0.8 mm diameter
- 30-35 ml/min flow rate.

**18-20 G size used in normal adult

**pink is most commonly used

**22 G used preferred in pediatric

Colour	Colour	Colour
Green	**Pink**	**Blue**
Gauge	**Gauge**	**Gauge**
18G	**20G**	**22G**
Typical Flow Rate	**Typical Flow Rate**	**Typical Flow Rate**
80ml/min	**55ml/min**	**33ml/min**
Diameter	Diameter	Diameter
1.2mm	1mm	0.8mm
Typical Usage	**Typical Usage**	**Typical Usage**
Mainly used in:	Mainly used in:	Mainly used in:
• Total parenteral nutrition (TPN) • Large volume of crystalloid fluids	• Multi-purpose • For hydration IV medication, blood sampling	• Chemotherapy, elderly patients, Paediatrics, slow infusions

6. Yellow color:

- 24 gauge.
- 0.7 mm diameter.
- 20 ml/min flow rate.

7. Violet:

- 26 gauge.
- 0.6 mm diameter.
- 15 ml/min flow rate.

**Infants and neonates size: 24-26 G

Colour
Yellow

Gauge
24G

Typical Flow Rate
20ml/min

Diameter
0.7mm

Typical Usage
Mainly used in:

- Short-term infusions
- Frail patients, elderly patients, paediatric patients

Colour
Purple

Gauge
26G

Typical Flow Rate
15ml/min

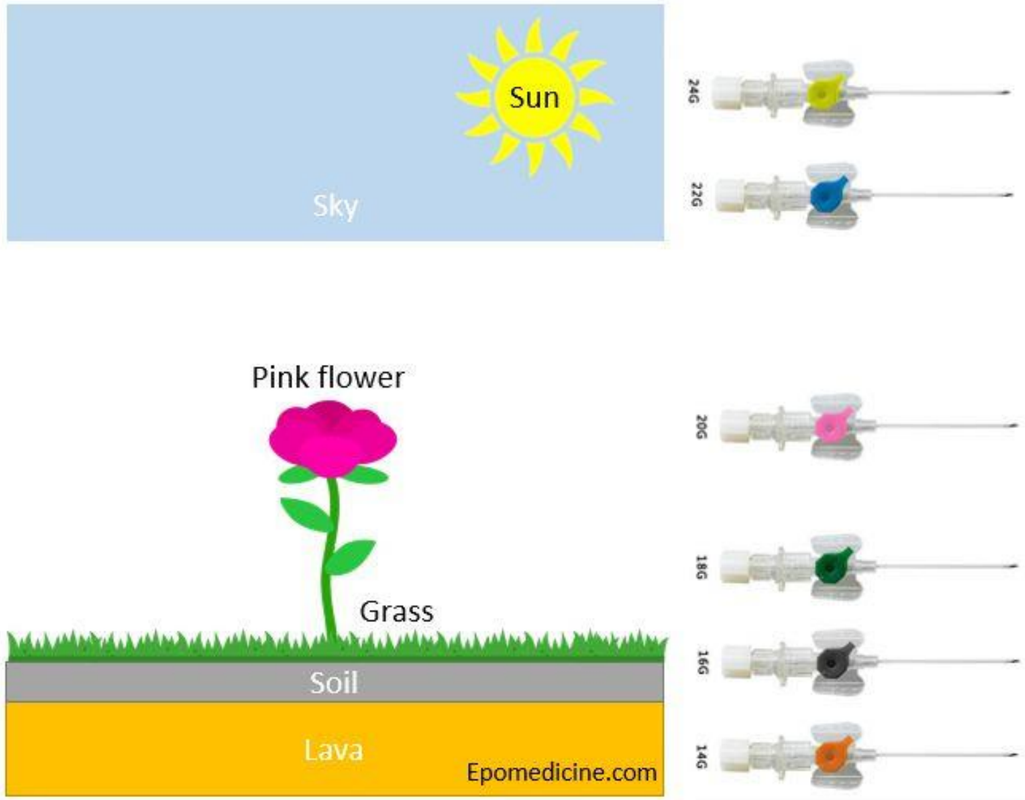
Diameter
0.7mm

Diameter
0.6mm

Typical Usage
Mainly used in:

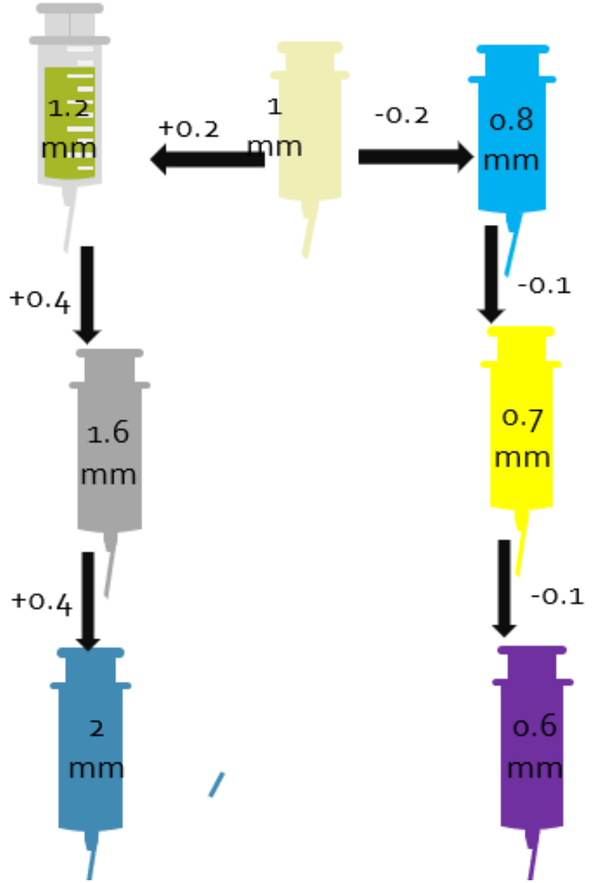
- Paediatric – neonates

1. The earth has magma inside **(orange color) – 14 G**
2. There is soil on surface **(grey color) – 16 G**
3. Grass has grown on the soil **(green color) – 18 G**
4. Pink flower has grown above the grass **(pink color) – 20 G**
5. Above is the blue sky **(blue color) – 22 G**
6. The sun is in the sky **(yellow color) – 24 G**



External diameter of cannula :

- Remember the pink (20 G) cannula is **1 mm** in diameter. For cannula next to pink: 1 +/- 0.2 mm
- 18 G (green): 1.2 mm
- 22 G (blue): 0.8 mm
- For cannula smaller “gauge” than 18 G:
- 16 G (grey): 1.2 + 0.4 = 1.6 mm
- 14 G (orange): 1.6 + 0.4 = 2 mm
- For cannula larger than 22 G:
- 24 G (yellow): 0.8 – 0.1 = 0.7 mm
- 26 G (purple): 0.7 – 0.1 = 0.6 mm



Color	Gauge	External diameter (mm)	Length (mm)	Flow rate (mL/min)
Orange	14	2.0	45	300
Gray	16	1.6	45	150
Green	18	1.2	45	80
Pink	20	1.0	33	55
Blue	22	0.8	25	25
Yellow	24	0.7	19	15
Violet	26	0.6	19	14

THANKS!