D.PHARM • SECOND YEAR

Biochemistry & Clinical Pathology

CHAPTER 10

Water and Electrolytes



ENGLISH CHAPTER NOTES

DIPLOMA IN PHARMACY

BODY WATER & FLUID COMPARTMENTS



TOTAL BODY WATER – TBW

Water is the most abundant component of the human body. It is about 50–70% of body weight, depending on age, sex and body composition. Infants and lean people usually have a higher percentage; adipose tissue contains less water.

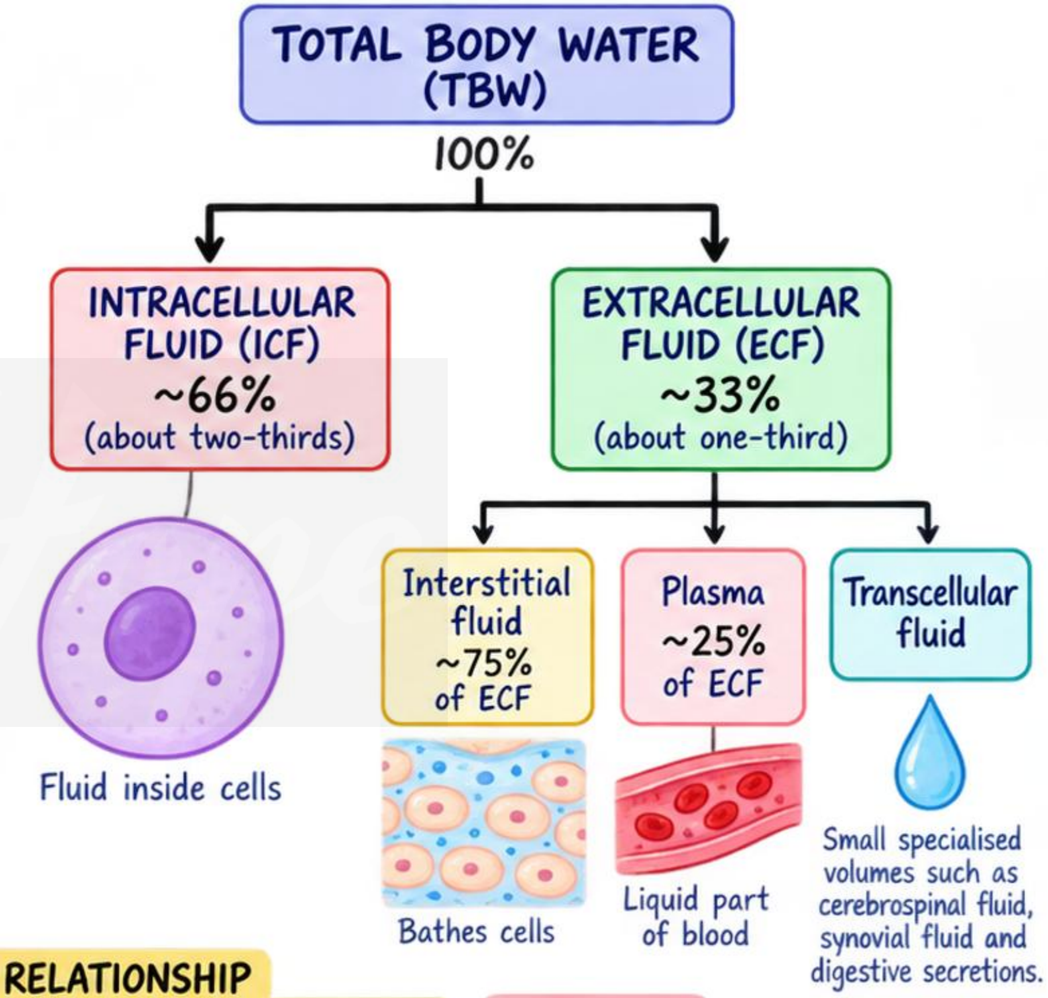
TWO MAIN COMPARTMENTS

INTRACELLULAR FLUID – ICF

- fluid inside cells
- about two-thirds, ~66%, of TBW

EXTRACELLULAR FLUID – ECF

- fluid outside cells
- about one-third, ~33%, of TBW
- includes interstitial fluid, plasma and small transcellular compartments



ECF SUBDIVISIONS

Interstitial fluid: about 75% of ECF; bathes cells.

Plasma: about 25% of ECF; liquid part of blood.

Transcellular fluid: small specialised volumes such as cerebrospinal fluid, synovial fluid and digestive secretions.

CORE RELATIONSHIP

TBW = ICF + ECF

ECF = interstitial fluid + plasma + transcellular fluid

REMEMBER

The percentages are approximate and describe a healthy average—not every individual.

ICF, ECF, PLASMA & INTERSTITIAL FLUID

PLASMA

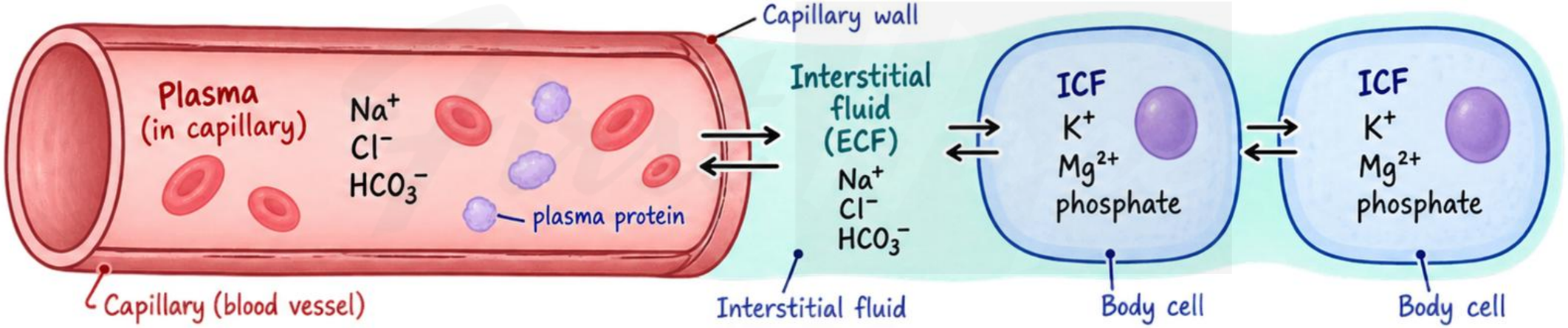
Fluid portion of blood within vessels. Contains water, electrolytes, nutrients, hormones, wastes and plasma proteins.

INTERSTITIAL FLUID

ECF between tissue cells. It forms the immediate environment from which cells receive nutrients and into which they release wastes. It has much less protein than plasma.

INTRACELLULAR FLUID – ICF

Fluid inside cells. Its composition is maintained by selective cell membranes, channels and pumps.



DOMINANT ELECTROLYTES

ICF: K^+ high • Mg^{2+} relatively high • phosphate and proteins are major anions.

ECF: Na^+ high • Cl^- high • HCO_3^- important.

Cytosolic free Ca^{2+} is kept extremely low.

MOVEMENT BETWEEN COMPARTMENTS

- water moves mainly by osmosis
- small solutes cross capillary walls according to pressure and permeability
- cell membranes selectively control ions and nutrients
- plasma proteins largely remain inside blood vessels

WHY THE GRADIENT MATTERS

Unequal ion distribution is essential for membrane potential, nerve impulses, muscle contraction and cell volume.

REMEMBER

Na^+ mainly outside; K^+ mainly inside.

FUNCTIONS OF WATER

WATER IS AN ACTIVE PART OF PHYSIOLOGY

It is not merely a filler. Its polarity, fluidity and high heat capacity support many body processes.

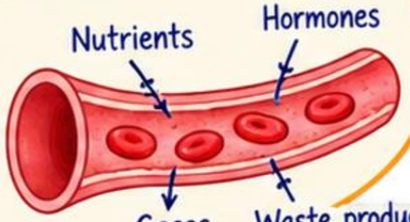
1. SOLVENT

Dissolves ions, nutrients, gases and wastes so reactions and transport can occur.



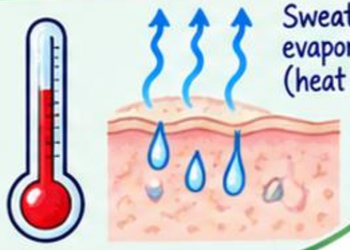
2. TRANSPORT MEDIUM

Blood and lymph carry nutrients, hormones, gases and waste products in an aqueous medium.



3. THERMOREGULATION

High heat capacity buffers temperature change; sweating removes heat by evaporation.



4. CHEMICAL REACTIONS

Acts as a reactant or product. Hydrolysis uses water to split bonds during digestion and metabolism.

$$A-B + H_2O \longrightarrow A-H + B-OH$$

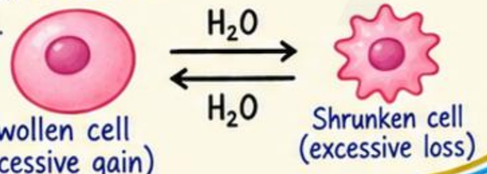
5. LUBRICATION & CUSHIONING

Synovial fluid lubricates joints; tears and saliva moisten tissues; cerebrospinal fluid cushions the brain and spinal cord.



6. CELL SHAPE & VOLUME

Water movement maintains osmotic balance. Excessive gain makes cells swell; excessive loss makes them shrink.



7. EXCRETION

Helps eliminate wastes through urine, sweat and faeces.



MEMORY KEY | Solvent • transport • temperature • reactions • lubrication • cell volume • excretion

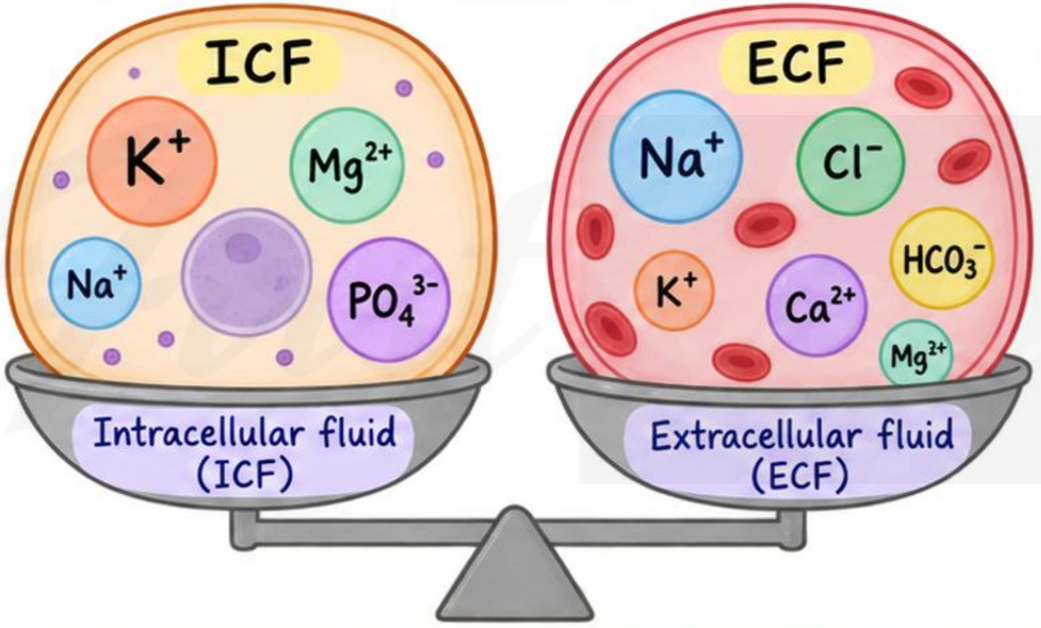
MAJOR ELECTROLYTES & DISTRIBUTION

ELECTROLYTES

Ions dissolved in body water. Their asymmetric distribution supports osmotic pressure, acid–base balance, enzymes, nerve conduction and muscle contraction.

MAINLY IN ICF

- K^+ about 140 mEq/L
- Mg^{2+} about 20–30 mEq/L in the source table
- Phosphate: high
- Na^+ about 10–15 mEq/L
- Cl^- and HCO_3^-: low
- Free cytosolic Ca^{2+}: extremely low



MAINLY IN ECF / PLASMA

- Na^+ about 135–145 mEq/L
- K^+ about 3.5–5.0 mEq/L
- Cl^- about 98–106 mEq/L
- HCO_3^- about 22–26 mEq/L
- Ionised Ca^{2+} about 1.1–1.3 mmol/L
- Mg^{2+} about 1.7–2.2 mEq/L in the source table
- Phosphate: lower than ICF

COMMON FOOD SOURCES

Na^+/Cl^-: salt



K^+: bananas, oranges, spinach, legumes



Ca^{2+}: dairy and leafy greens



Mg^{2+}: nuts, whole grains, green vegetables



phosphate: meat, dairy, grains



UNIT NOTE

For monovalent ions, mmol/L and mEq/L have the same numerical value. For divalent ions, mEq/L = 2 × mmol/L.

REMEMBER

Concentration ranges vary slightly by laboratory and specimen.

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