Biochemistry of biological fluids
BCH 472

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Course symbol:	BCH 472
Course Title:	Biochemistry of biological fluids
Credit hours:	3(2+1)

Clinical Biochemistry is one of the most rapidly advancing areas of laboratory and clinical medicine. The marked increase in the number and availability of laboratory diagnostic procedures has helped in the solution of clinical problems.

Metabolic changes associated with specific disorders may give rise to a change in the biochemical profile of a particular body fluid, e.g. blood glucose in diabetes mellitus; glucose levels in the cerebrospinal fluid in bacterial meningitis (which are greatly reduced). specific parameters are looked for in a specific body fluid when a disease is suspected.

Quality Control

- A major role of the clinical laboratory is the measurement of substances in body fluids or tissues for the purpose of diagnosis, treatment or prevention of disease, and for greater understanding of the disease process.
- To fulfil these aims the data generated has to be reliable for which strict quality control has to be maintained
- Quality control is defined briefly as the study of those sources of variation, which are the responsibility of the laboratory, and the procedures used to recognize and minimize them.

Accuracy has to do with how close the mean of a sufficiently large number of determinations. Accuracy is dependent on the methodology used.

Precision refers to the extent to which repeated determination on an individual specimen vary using a particular technique and is dependent on how rigorously the methodology is followed.

Specificity is the ability of an analytical method to determine solely the analyte it is required to measure.

Sensitivity is the ability of an analytical method to detect small quantities of the measured analyte.

Introduction

- Any fluid that is produced by human body that serves a purpose in maintaining homeostasis of the body environment.
- Functions of Fluids

  - Body fluids:
    - ✓ Facilitate in the transport [nutrients, hormones, proteins, & others…]
    - ✓ Aid in removal of cellular metabolic wastes
    - ✓ Provide medium for cellular metabolism
    - ✓ Regulate body temperature
    - ✓ Provide lubrication of musculoskeletal joints.
    - ✓ Component in all body cavities [parietal, pleural… fluids]
- *Water is the principal body fluid & essential for life.*

Types of body fluids

- Blood
- Lymph
- Pericardial fluid
- Pleural fluid
- Peritoneal fluid
- Synovial fluid
- Amniotic fluid
- Cerebrospinal fluid
- Seminal fluid
- Aqueous humor

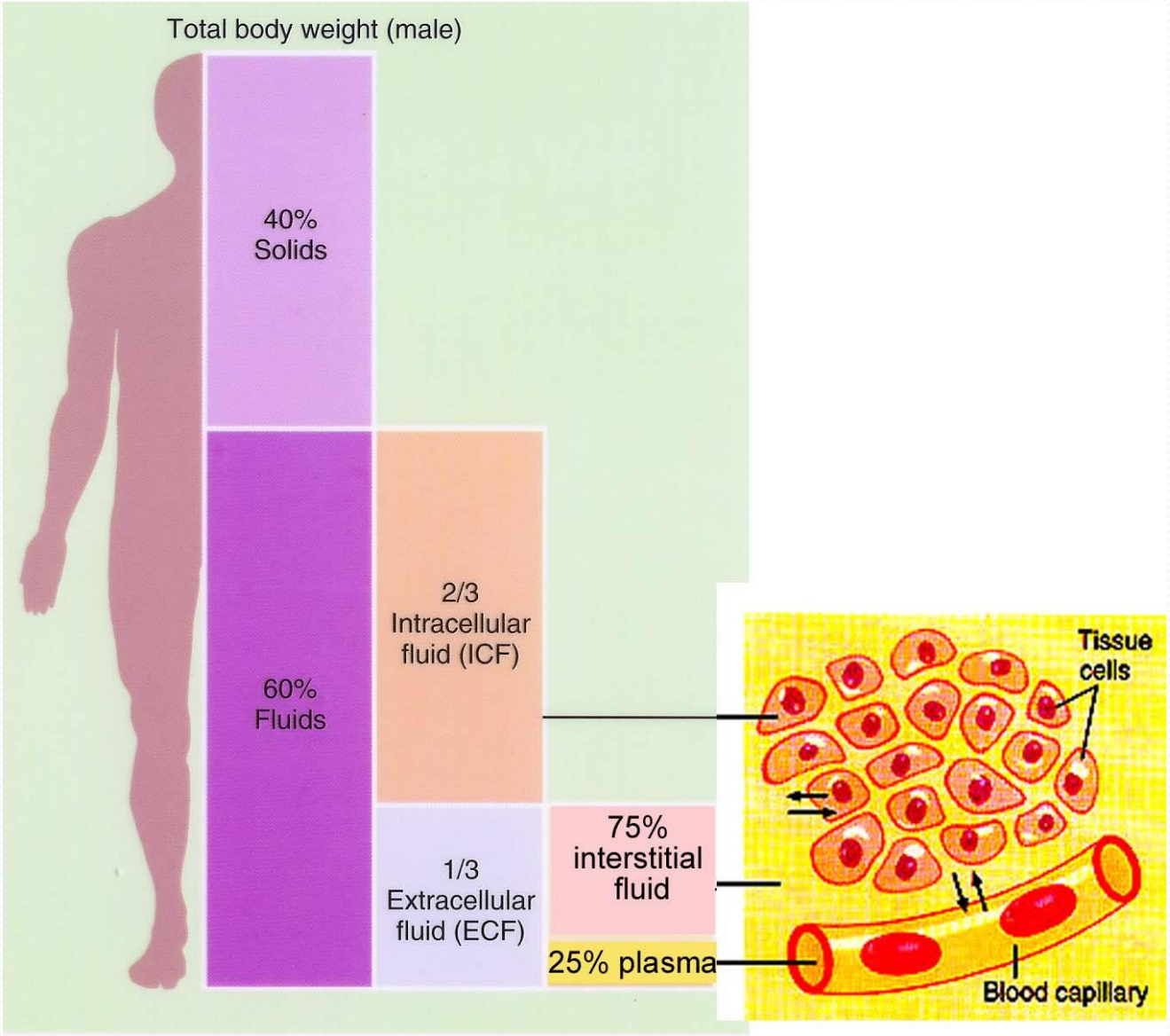
Distribution of Body fluids

Total body fluid is distributed between two compartments:

Extracellular fluid

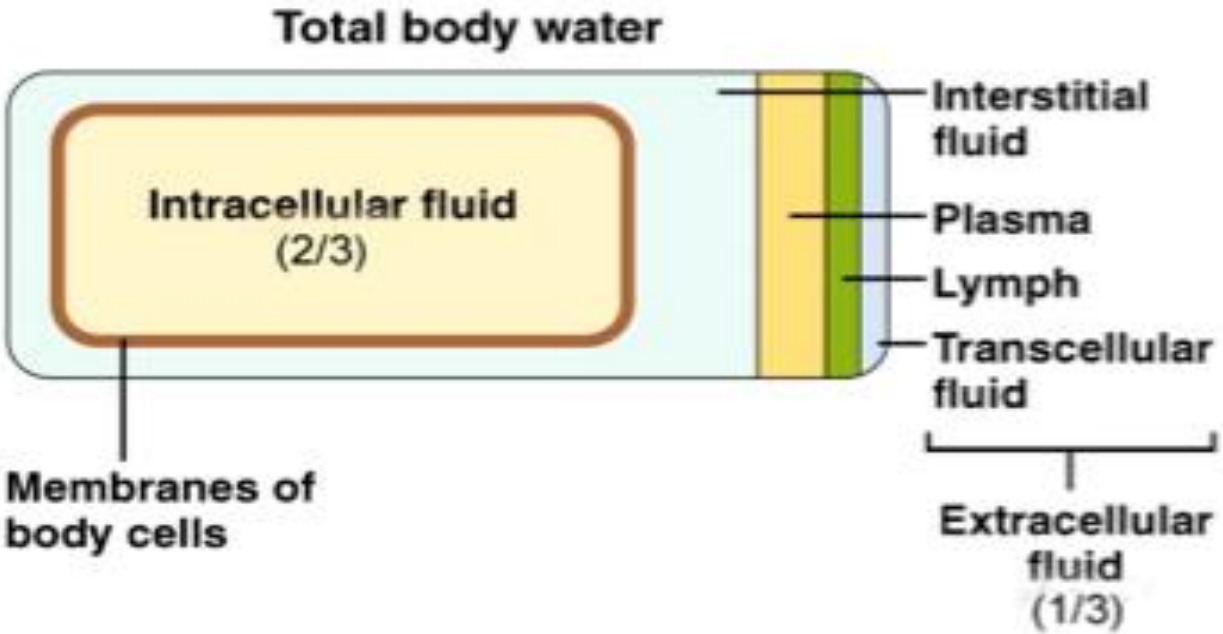
- interstitial fluid
- blood plasma

Intracellular fluid


Total body weight (male)
40%
Solids
60%
Fluids
2/3
Intracellular
fluid (ICF)
1/3
Extracellular
fluid (ECF)
75%
interstitial
fluid
25% plasma
Tissue
cells
Blood capillary

Transcellular Fluid

- Small compartment containing body fluids formed by the secretion of epithelial cell and is contained within epithelial lined spaces
- Includes fluid in the synovial, peritoneal, pericardial, and intraocular spaces, as well as the cerebrospinal fluid
- Specialized type of extracellular fluid
- Constitute about 1 to 2 liters.


Total body water
Intracellular fluid
(2/3)
Interstitial fluid
Plasma
Lymph
Transcellular fluid
Extracellular fluid
(1/3)
Membranes of body cells

In an average 70-kilogram adult human

- Total body water is about 42 liters or **60 percent** of the body weight

- This percentage can change depending on:
  - Age
  - Gender
  - Degree of obesity.

Age and Body Fat

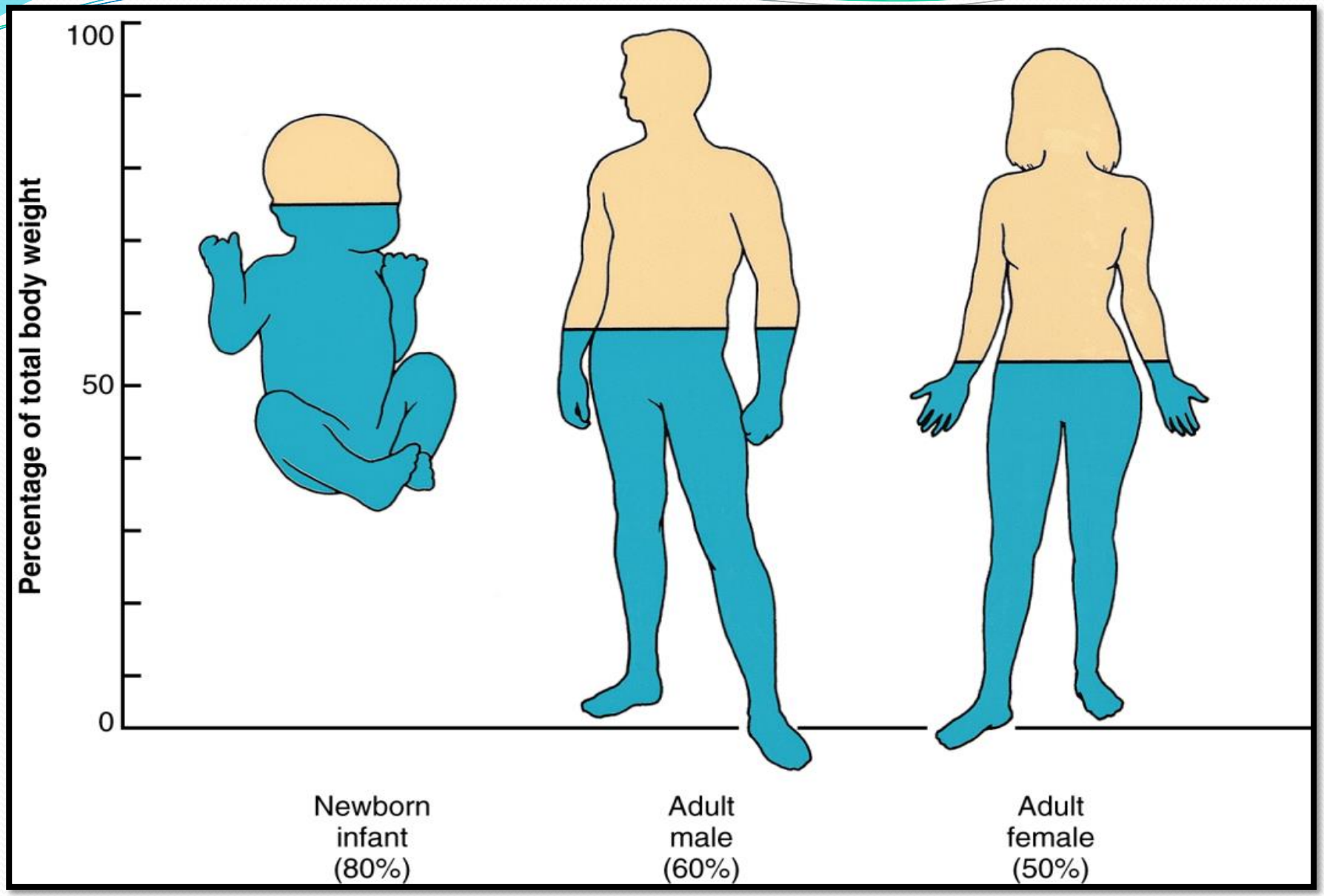
As a person grows older → % total body weight that is fluid gradually decreases

* Aging is associated with an increased % of the body weight being fat, which decreases the % of water in the body

Gender and Body Fat

- Women normally have more body fat than men

- They contain slightly less water than men in proportion to their body weight


100
50
0
Percentage of total body weight
Newborn infant (80%)
Adult male (60%)
Adult female (50%)

ICF and ECF are different in ionic composition

	CATION	ANION
INTRACELLULAR FLUID	K^+ Mg^{2+}	PO_4^{3-}
EXTRACELLULAR FLUID	Na^+	Cl^- HCO_3^-

- Plasma and interstitial fluid are identical in ionic composition. the difference between plasma and interstitial fluid is protein content. Plasma contains a large amount of protein, while the interstitial fluid contains less.

Extracellular and Intracellular Fluid

- **Cell membrane is semipermeable**, only water and small, noncharged molecules can move freely between interstitial and intracellular compartment. Ion can not cross easily.

- All kinds of ionic pump or channel on cell membrane determine the uneven distribution

Movement of Fluid between Compartments

- Hydrostatic pressure and osmotic pressure regulate the movement of water and electrolytes from one compartment to another.

Transport Mechanisms

- Materials move through membranes and within cells by PASSIVE TRANSPORT mechanisms such as DIFFUSION or OSMOSIS.
- Materials may also move through membranes by ACTIVE TRANSPORT mechanisms.

Passive Transport:

the cells do not use any energy to move the molecules. The molecules move through a gradual change or GRADIENT.

Active Transport:

The cell uses energy to get molecules into or out of the cell against the gradient.

Diffusion:

Is the tendency of molecules or materials to move from areas of high concentrations into areas the same molecules are in a lower concentration. Most materials move by simple diffusion through the semi permeable membrane surrounding the cell. A semi permeable membrane only allows certain types of molecules to enter or leave the cell. Limitations may be based on sized or charge of the molecules.

OSMOSIS:

Is the movement of a solvent such as water through a semipermeable membrane from areas of high concentration to areas of low concentration of the same solvent. In cells the solvent is water.

In **HYPOTONIC solutions, water moves into the cell; in ISOTONIC solutions, the water entering and leaving is about equal and so there is no net movement; in HYPERTONIC solutions, water moves out of a cell.**

In **FACILITATED DIFFUSION** **transport proteins in the membrane help move molecules along the concentration gradient without any additional energy input by the cell.**

Certain molecules in the membrane, mostly proteins, act like pumps using energy to move materials against concentration gradients.

- The sodium-potassium pump moves K + into the cell and Na + out.
- Other membrane pumps move glucose, amino acids and other raw materials into the cell.