Practical Biology Lecture -2

Kidney Dialysis Techniques Department

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Macromolecules of the Human Body

Learning Objectives

By the end of this lecture, the student will be able to:

Define macromolecules and their main classifications.

Explain the basic structure and function of carbohydrates.

Describe types and functions of proteins relevant to kidney function.

Understand the role of lipids in the body.

Identify nucleic acids and their relation to genetics.

What are Macromolecules?

Large complex biomolecules essential for the structure and function of living organisms.

Composed of smaller building blocks (monomers).

Four main classes:

Carbohydrates

Proteins

Lipids

Nucleic Acids

Carbohydrates
Main Function: structural & Quick energy source.

Classification:

- **-Monosaccharides (e.g., Glucose, Fructose) - Simplest form.**
- **-Disaccharides (e.g., Sucrose, Lactose) - Two monosaccharides.**
- **-Polysaccharides (e.g., Starch, Glycogen, Cellulose) - Long chains.**

Relevance to Dialysis:

- **Monitoring blood glucose levels is critical, especially for diabetic kidney patients.**

♣Proteins

Functions: Structure, Enzymes, Transport, Defense, Regulation.
Structure:

- **Monomer: Amino Acids (20 types).**
- **Linked by peptide bonds to form polypeptide chains.**
- **Structure determines function (Primary → Quaternary).**
- **Key Examples for Dialysis:**
- **Hemoglobin: Oxygen transport in blood.**
- **Albumin: Maintains blood osmotic pressure; low levels (hypoalbuminemia) are common in kidney disease.**
- **Enzymes: Catalyze metabolic reactions.**

♣ Lipids

Functions: Long-term energy storage, insulation, cell membrane structure, signaling.
Classification:

1-Triglycerides: Stored energy in fat cells.

2-Phospholipids: Major component of all cell membranes (bilayer).

3-Steroids: Hormones (e.g., cortisol, sex hormones) and cholesterol.

4-Cholesterol: Membrane fluidity and hormone precursor.

***Relevance to Dialysis:

♠ ♠ -Dyslipidemia (abnormal lipid levels) is a major complication of Chronic Kidney Disease (CKD).

♥ ♥ ♥ **Nucleic Acids**

Function: Store, transmit, and express genetic information.

Two Main Types:

***DNA (Deoxyribonucleic Acid):**

- **Double-stranded helix.**
- **Stores genetic blueprint in the cell nucleus.**

***RNA (Ribonucleic Acid):**

- **Usually single-stranded.**
- **Involved in protein synthesis (mRNA, tRNA, rRNA).**

****Monomer: Nucleotide (Sugar, Phosphate, Nitrogenous Base).**

Practical Lab: Detecting Macromolecules
Qualitative Tests:

1- Carbohydrates:

Benedict's Test: For reducing sugars (Green → Orange/Brown).

Iodine Test: For starch (Blue-Black color).

2- Proteins:

Biuret Test: For peptide bonds (Violet/Purple color).

3-Lipids:

Sudan IV Test: Stains lipids red.

Paper Spot Test: Translucent spot.

4-Nucleic Acids (DNA):

Dische Diphenylamine Test: Blue color.

Relevance to Dialysis Techniques

- **Protein-Energy Wasting (PEW): Understanding muscle and albumin loss in CKD.**
- **Uremia: Accumulation of nitrogenous wastes (from protein metabolism) removed by dialysis.**
- **Dyslipidemia Management: Part of comprehensive CKD care.**
- **Drug Metabolism: Many drugs are protein-bound; kidney failure affects this.**
- **Nutritional Assessment: Diet planning for dialysis patients focuses on protein, carbohydrates, and lipid intake.**

Summary

- Carbohydrates: Fast fuel. Monitor glucose.
- Proteins: Builders & workers. Watch albumin and urea.
- Lipids: Energy reserve & structure. Manage cholesterol.
- Nucleic Acids: Information center.

****Core Concept: Dialysis aims to correct the imbalance of these molecules' breakdown products in renal failure.

References & Questions

References:

1 - Campbell Biology, 12th Edition.

2 - Lehninger Principles of Biochemistry.

3 - National Kidney Foundation Clinical Guidelines.

Thank You! Questions?