Practical Biology Lecture - 6

Kidney Dialysis Techniques Department

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Organs: Types, Definition, and Function (A Practical Introduction to Dialysis Technology)

Aim: To directly link anatomical and functional knowledge of organs with clinical practice in dialysis.

Organs: Types,

Subtitle: The Anatomical and Functional Basis for Understanding Renal Failure and its Treatment Definition, and Function

Learning Objectives

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

1- Define an organ and classify it within the body's structural organization levels.

2- Classify organs according to different body systems.

3- Describe the basic histological structure related to organ function.

4- Relate the normal function of each organ to the dialysis process.

5- Explain how kidney failure affects the functions of other organs.

Definition: What is an Organ ?

Definition: A distinct structure composed of two or more tissue types working together to perform a specific function ·.
Organization Level: Comes after Cell → Tissue → Organ.

Examples: Heart, Lung, Liver, Kidneys.

Interactive Activity: "What's the difference between a tissue and an organ?" (Brief discussion) .

Classification: Organs by System (1)

1- Cardiovascular System (Heart & Blood Vessels) :

****Function: Transport blood, oxygen, hormones.**

****Dialysis Link: Vascular access (Fistula/Graft) depends on this system's health. Blood pressure monitoring during treatment.**

Classification: Organs by System (2)

1- Respiratory System (Lungs):

Function: Gas exchange (O_2 in, CO_2 out).

Dialysis Link: Fluid overload (pulmonary edema) from kidney failure impairs breathing. Dialysis removes excess fluid.

Classification: Organs by System (3)

1- Digestive System (Liver, Pancreas, Intestines):

Function: Food digestion, nutrient absorption, detoxification (liver).

Dialysis Link: Urea waste buildup (uremia) causes nausea/vomiting. Importance of renal diet.

The Target Organ: The Kidneys (Gross Anatomy)

Location: Retroperitoneal, in the posterior abdomen.

Shape: Bean-shaped.

Functional Units: The Nephron (about 1 million per kidney) .

Structure: Cortex, Medulla, Pelv

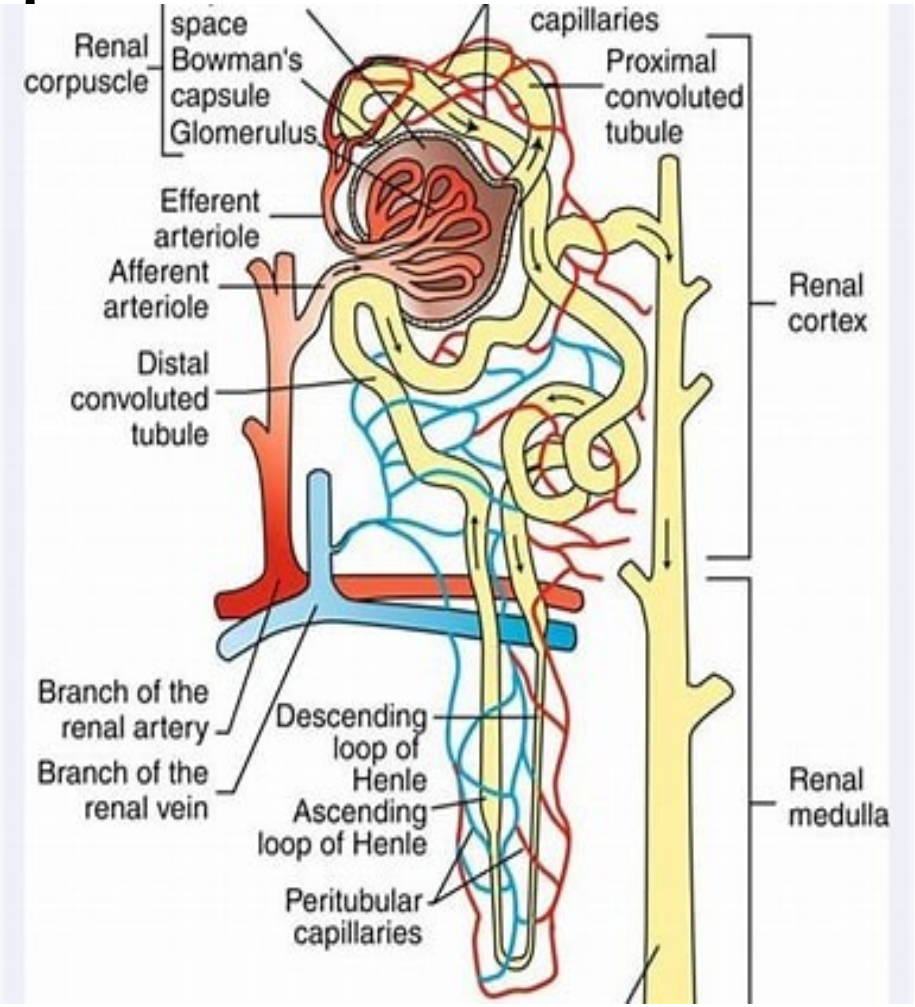


Image: Cross-sectional diagram of a kidney showing nephrons.

The Kidneys (Core Functions) - "The Smart Cleaner“

1- Blood Filtration & Waste Removal: (Urea, Creatinine) .

2- Fluid & Electrolyte Balance: (Sodium, Potassium).

3- Blood Pressure Regulation: (Renin-Angiotensin System).

4- Hormone Production: (Erythropoietin for red blood cells).

5- Acid-Base Balance (pH Regulation).

What is Renal Failure? (A Functional Perspective)

*****Definition: Loss of kidney ability to perform core functions below <15%.**

*****Direct Consequence: Toxin buildup (uremia), fluid/electrolyte imbalance, anemia.**

*****Conclusion: Dialysis primarily replaces functions 1, 2, and 5.**

The Impact of Renal Failure on Other Organs (Crucial)

****Heart: Hypertension → Heart failure, pericarditis.**

**** Bones: Calcium/Phosphate metabolism disorder → Renal osteodystrophy.**

****Blood: Lack of Erythropoietin → Anemia.**

****Nervous System: Toxin buildup → Neuropathy, seizures.**

****Practical Link: We monitor the whole patient, not just a "dialysis access**

The Scientific Principle of Dialysis (The Bridge Between Organ & Machine)

**Dialysis = Compensation for the failed organ's function (Kidneys).

** How? Using physical principles:

1- Diffusion: Movement of wastes from blood (high concentration) to dialysate (low concentration).

2- Ultrafiltration: Removal of excess fluid via pressure.

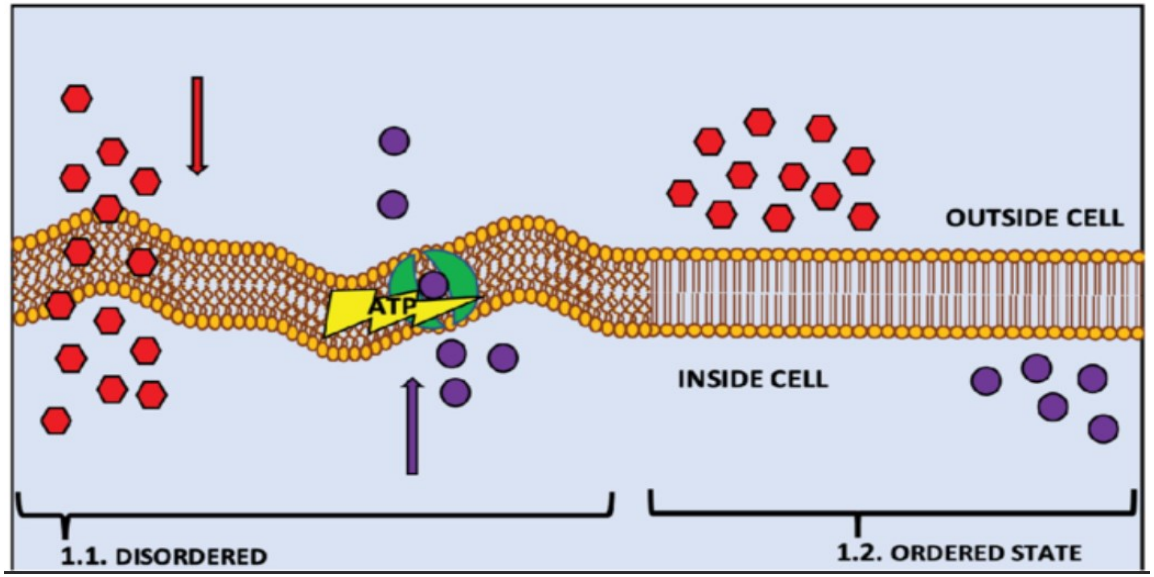
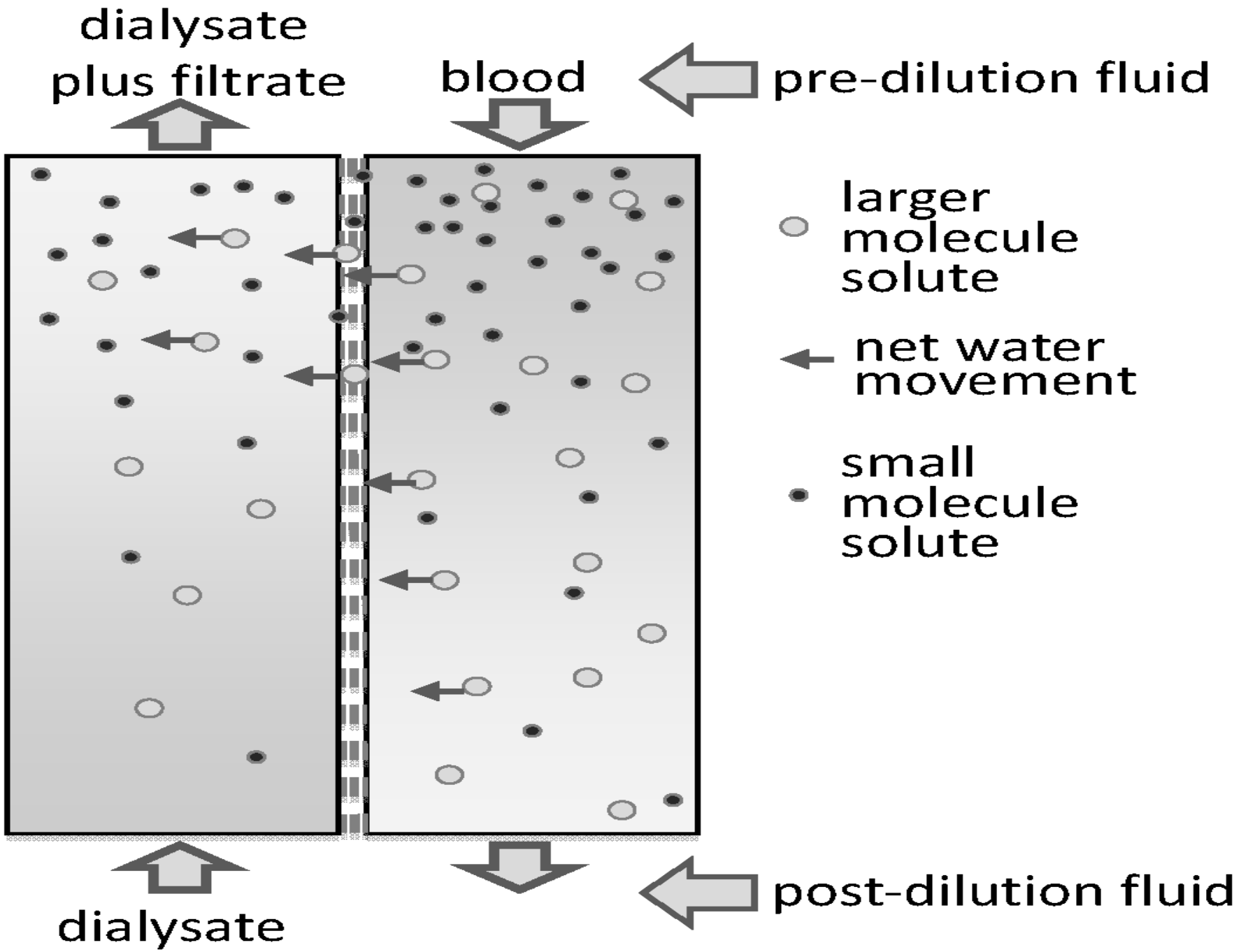


Image: Diagram illustrating diffusion and filtration across a dialyzer membrane.


dialysate
plus filtrate
blood
pre-dilution fluid
larger
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post-dilution fluid

How Does the Dialyzer (Artificial Kidney) Mimic the Nephron?

****Blood ⇄ Semi-permeable Membrane ⇄ Dialysate Fluid.**

**** It DOES: Remove Urea, Creatinine, excess Potassium.**

****It DOES: Correct Bicarbonate levels (for acidosis.(**

****It DOES: Remove excess water (UF).**

****It Does NOT: Secrete hormones (like EPO) → Requires replacement medication.**

Practical Application: Understanding Lab Values

*****High Creatinine = Indicator of waste buildup (Filtration function) .**

*****High Potassium = Danger to the heart (Electrolyte balance function).**

***** Low Hemoglobin = Anemia (Hormonal function).**

*****Your Role as a Technician: Understand why dialysis is being performed and what you aim to remove or correct.**

Interactive Practical Activity (Mini Case Stud)

**Case: A new patient with labs: Potassium 6.5 mmol/L, Creatinine 8 mg/dL, 3 kg over dry weight.

Questions:

1- Which kidney functions are impaired? (Refer to Slide befor) .

2- Which other organs are at risk? (Refer to Slide befor).

3- What machine parameters should be focused on? (Treatment time, Dialysate Potassium concentration, Ultrafiltration volume).

References & Next Steps

References: Anatomy & Physiology textbook (e.g., Guyton or Human Body).

**Next Step: Lecture on "Components of the Hemodialysis Machine and Their Function."

**Food for Thought: How will your knowledge of the normal organ change the way you monitor a dialysis patient?