LAB 8

RENAL PHYSIOLOGY LAB

Assignments:

Due before lab:
Quiz*: Urinary Terms page 83 and Renal IP exercise – Urinary System - Anatomy Review pages 88 - 90.*

Review Anatomy of the kidney and nephron (Lab 5).

During the lab period:
Complete the worksheets on pages 86 and 87. Answer the questions completely and thoroughly.

Due next lab period:
Complete the Interactive Physiology exercises assigned in Lab 9 and be prepared for a quiz.

Summer Labs:
In the summer, labs 8 & 9 are combined. The quiz covers Renal and Digestive IP exercises on pages 92-93 and pages 96-97.

Objectives:

Understand what a urinalysis is and what positive values for various substances present in the urine may indicate.

Be able to explain the results from the experiments dealing with fluid volume and osmolarity.

Calculate specific gravity and chloride content in a urine sample and understand what they indicate.

Be able to predict and explain whether ADH is present in the various experimental groups and why.

Urinalysis results: Learn before coming to lab

Findings	Non-Pathological	Pathological Causes
Protein (Proteinuria)	Pregnancy High protein diet	Damage to glomerular membrane: Ex: Glomerulonephritis Hypertension
Urea	High protein intake	Impaired renal function
Glucose (glycosuria)	High sugar intake	Diabetes mellitus (brain injury/ myocardial infarction)
Ketones (ketonuria)	Low carbohydrate diet	Diabetic acidosis Starvation
Blood (hematuria)	Menstrual contamination	Urinary tract infection Kidney stones / Renal disease (Trauma / burns /anemia / transfusion reactions)
Leukocytes (pyuria)	Contamination from vaginal discharge	Urinary tract infection (kidney infections) Glomerulonephritis
Nitrites		Urinary tract infections due to certain bacteria
Urobilinogen (urobilinogenuria)	Small amounts normal	Liver disease Hemolytic anemia
Bilirubin (bilirubinuria)		Liver disorders Obstructed bile duct
pH Acidic Alkaline	Normal range: 4.5-8.0 High protein intake Vegetarian diet	
Specific Gravity Deionized water	Normal range: 1.001-1.035 1.000	

Kidney Function: Regulation of extracellular volume and osmolarity

Prior to Lab:

AVOID VERY SALTY FOODS AND BEVERAGES CONTAINING CAFFEINE
(water retaining) (diuretic)

1. For the 2 hours proceeding laboratory, note the type and quantity of food and beverages you consumed.

   a.
   b.
   c.
   d.

2. Record the time of bladder emptying before coming to lab.

   time:

During Lab:

Step 1. Void urine in specimen cup and return sample to lab for testing. This first sample is your **Control Sample**.

Record time and volume on kidney function results page.

Step 2. Drink/eat one of the following:

1. **1 liter of distilled water** (Water group)- hypotonic solution
   (approx. 4-5 glasses)

2. **Eat potato chips or drink tomato juice**
   (Salt and water group)

   Need to have approx. 3 glasses of tomato juice or 2+ plates of potato chips with 1-2 glasses of distilled water

   or

3. **Do not eat or drink anything** (Control group)

IF YOU HAVE HIGH BLOOD PRESSURE DO NOT CHOOSE THE HIGH SALT GROUP

Step 3. Do a **urinalysis** on your Control Sample.

Check physical characteristics and use a **Chemstrip** - record your results on Chemstip results page.

Also do a specific gravity on your urine and test for chloride content. Record these values on Kidney function results page.

Directions:

1. Specific gravity – using the Refractometer:
   - Raise the plexiglass cover and place one drop of urine on the blue prism. Carefully lower the cover.
   - While looking through the blue dot in the eyepiece, press the button on top of the refractometer to turn on the light. Read the scale on the far right.
   - The reading is taken at the interface of the dark and light blue fields. (Distilled water is 1.000)

2. Chloride content - place test tube in rack. Add:

   - 0.5 ml of urine using transpet.
   - one drop of 20% potassium chromate to urine and shake. The solution will be yellow.
   - add 2.9% silver nitrate one drop at a time, gently shaking after each drop. **Count the number of drops required to form a brick-red precipitate.**

Remember to gently shake the solution because you will see a transitory precipitate before the end point of your titration is reached. Each drop equals 61 mg of Cl^- per 100 ml. Thus, **multiply number of drops by 0.61 to calculate the concentration of Cl^- in mg/ml.** Record on chart. The metal chromium should NOT go down the drain. Please empty test tube into marked waste container before rinsing at sink.

Step 4. After drinking solution, urine is voided every 30 minutes.

For each urine sample record volume, specific gravity and chloride content on kidney function results chart.

CHEMSTRIP RESULTS

Test	Normal values	Results
WBCs/leukocytes	negative	
Nitrites	negative	
pH	4.5 - 8.0	
Protein/Albumin	negative	
Glucose	negative	
Ketone bodies	negative	
Urobilinogen	negative	
Bilirubin	negative	
Blood/hemoglobin	negative	

KIDNEY FUNCTION RESULTS

Treatment Group _____

	U Control	U1	U2	U3
Time (previous)	Control Time (min):	Time (min):	Time (min):	Time (min):
Volume (ml)				
Specific Gravity				
Cl^- Content (mg/ml) (**U_{Cl}**)				
*Urine Flow Rate (**v**) (ml/min)				
UE of Cl (**$V \times U_{Cl}$) (mg/min)				

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* **Urine Flow Rate (v)**: Divide the ml of urine by the number of minutes since the last urine collection Compare results with others in same treatment group. Are your results in agreement with others? If not, what might be causing the differences?

UE of Cl: Multiply Urine chloride content by the urine flow rate ($v \times U_{CL}$).

Explain what happens to urine flow rate, specific gravity and urinary excretion of chloride in each group (put ↑ or ↓). **Explain the physiological mechanisms involved** (Ex: ADH stimulated or inhibited because…) in the results from each group:

1. **Distilled water- 1 L** (Hypotonic)

   urine flow rate (v)

   Specific Gravity

   Chloride Content (U_{CL})

   Urinary Excretion of Chloride (UE_{CL})

   ADH

2. **Salt and Water Group** (Potato chips and water) – (Isotonic)

   urine flow rate (v)

   Specific Gravity

   Chloride content (U_{CL})

   Urinary Excretion of Chloride (UE_{CL})

   ADH

3. **No water** – control – (hypertonic)

   urine flow rate (v)

   Specific Gravity

   Chloride Content (U_{CL})

   Urinary Excretion of Chloride (UE_{CL})

   ADH

View the Urinary System – Anatomy Review on the Interactive Physiology CD, answer the questions on pages 88 - 90 and be prepared for a quiz.

Urinary System – Anatomy Review

1. Name the organs in the urinary system:

    1. _____
    2. _____
    3. _____
    4. _____

2. The kidneys are_____(behind the peritoneum) lying against the dorsal body wall in the upper abdomen.

3. The_____gland sits atop the kidneys. Blood vessels enter and leave the kidney at the renal_____.

4. The functional units of the kidney are the_____. They are called _____if they are located mainly in the cortex._They are called_____if they are located in both the cortex and medulla.

5. Blood enters the kidney through the_____artery. The artery branches into smaller and smaller arteries and arterioles. Complete the sequence below:

    _____arteriole → _____capillaries →

    _____arteriole → _____capillaries and vasa recta

6. Complete the sequence below showing all parts of the nephron:
   Bowman's Capsule → _____ convoluted tubule → _____
   (both descending and ascending limb →
   _____ convoluted tubule →
   _____ (both cortical and medullary sections)

7. The renal corpuscle consists of two parts: _____ capillaries and
   _____ A portion of the plasma is filtered into the capsular space due to the hydrostatic pressure of the blood.

8. The filtration membrane consists of:

   _____ capillary endothelium
   porous _____ membrane and
   the _____ (which contain filtration slits).

   This filtration membrane permits (large or small) molecules to be filtered.

9. Proximal tubule: The simple cuboidal cells of the proximal tubule are called
   _____ cells because they contain numerous microvilli. The microvilli increase the _____ for reabsorption.

   The proximal tubule cells are highly permeable to water and many solutes. The
   _____ permit the movement of water between the cells.

10. Loop of Henle : The thin descending limb of the loop of Henle is highly permeable to _____ but not to _____.

    The thin ascending limb of the loop of Henle is highly permeable to
    _____ but not to _____.

11. The thick ascending limb of the loop of Henle runs back between the afferent and efferent arterioles as they enter and leave Bowman's capsule. The juxtaglomerular apparatus consists of the_____cells of the tubule and the _____(modified smooth muscle) cells of the afferent arteriole.

    _____cells → serve as baroreceptors sensitive to blood pressure within the arteriole.

    _____cells → monitor and respond to changes in the osmolarity (or electrolyte composition) of the filtrate in the tubule.

12. After the juxtaglomerular apparatus, the tubule becomes the distal tubule. The late distal tubule and cortical collecting duct contain two functional types of cells:

    _____cells → hormones regulate their permeability to water and solutes.

    _____cells → these cells secrete hydrogen ions for acid/base regulation.

13. The medullary collecting duct is composed of_____cells.

    Their permeability to_____and_____is hormonally regulated.