Renal Physiology II: Fluid Balance

LAB REPORT / QUESTIONS

Before you begin:

1) Prepare 3 graphs from the class data and attach to your report:
   - Graph 1 – compare urine flow rate (ml/min) between the experimental conditions.
   - Graph 2 – compare specific gravity (g/l) between the experimental conditions.
   - Graph 3 – compare chloride ion content (mEq/min) between the experimental conditions.

Note: you can access the entire class data set and preliminary graphs from the course web page. To prepare your graph you may elect to isolate your individual groups data and/or use averaged class data to prepare your graph. Graphs may be prepared using Excel or by hand. All graphs must be clearly titled and labeled.

Graph 1: comparison of urine flow rate (ml/min) between the experimental conditions.

Graph 2: comparison of specific gravity (g/l) between the experimental conditions.
**Graph 1:** comparison of chloride ion content (mEq/min) between the experimental conditions.

**Exercises - Results / Data**

*Use the graphs you prepared to answer the questions below:*

1. Which condition resulted in the greatest increase in urine flow rate? Explain.

2. Which condition resulted in the greatest decrease in specific gravity? Explain.

3. Which condition resulted in the greatest increase in chloride ion concentration? Explain.

4. Outline the different renal mechanisms (stimulus and response) operating to restore water homeostasis in a water loaded individual. Indicate (i.e. diagram) the role of antidiuretic hormone (ADH), aldosterone, atrial natriuretic hormone and glomerular filtration in this situation.
5. Outline the different renal mechanisms (stimulus and response) operating to restore water homeostasis in a volume loaded individual (osmolarity of body fluids is unchanged). Indicate (i.e. diagram) the role of antidiuretic hormone (ADH), aldosterone, atrial natriuretic hormone and glomerular filtration in this situation.

QUESTIONS

6. Identify the hormone that stimulates the reabsorption of water and helps to produce a decrease in blood osmolarity. Explain where this hormone comes from and identify its target cells.

7. Describe the sequence of events that begin in the juxtaglomerular apparatus and lead up to the secretion of aldosterone. Include ALL intermediate steps and describe the mechanism of action of aldosterone.

8. Calcium is normally present in the plasma at a concentration of about 0.1 g/L. Calculate the mEq/L of calcium (Ca^{++}) in the plasma given that the atomic weight of calcium is 40.
9. Describe the likely results obtained when collecting urine samples from a dehydrated desert prospector over a period of 3 hours. Compare these results to that of an intoxicated alcoholic who also collects and analyzes his urine over the same 3 hour period. How do these results differ from a normally hydrated individual.

<table>
<thead>
<tr>
<th></th>
<th>Dehydrated Prospector</th>
<th>Intoxicated Alcoholic</th>
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<tbody>
<tr>
<td>Urine Volume</td>
<td></td>
<td></td>
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<tr>
<td>Specific Gravity</td>
<td></td>
<td></td>
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<tr>
<td>Na(^+) and/or Cl(^-) Content</td>
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10. Explain the results and differences above.

11. Explain why glucose in the urine is often accompanied by an increased volume of urination.

12. Outline the different renal mechanisms (stimulus and response) operating to restore water homeostasis in a dehydrated person. Indicate (i.e. diagram) the role of antidiuretic hormone (ADH), aldosterone, atrial natriuretic hormone and glomerular filtration in this situation.
13. One class of clinically used diuretic drugs inhibit Na$^+$ re-absorption in the loop of Henle. This in turn increases the delivery of Na$^+$ to the distal convoluted tubule and collecting duct.
   a. Explain how these types of diuretics decrease blood volume and pressure.
   b. Explain why these types of diuretics can lead to decreased blood potassium levels (hypokalemia).

14. Excess dietary salt (NaCl) is always accompanied by an increase in blood volume. With your knowledge of osmoregulation which hormones are involved in producing these effects. *Explain.*

**Clinical Correlation**

**Background:**
A 47 year old lawyer with a history of alcoholism had been feeling tired for several months but had attributed this to the stress he was under associated with a current case he was working on. Coworkers had even commented that he was looking particularly haggard, and that his usually prominent tan had “yellowed”. In addition he noticed that his urine was particularly dark and that it seemed to take longer for the bleeding to stop if he cut himself shaving. On visiting his physician the following results were obtained:

<table>
<thead>
<tr>
<th>Urinalysis:</th>
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<tr>
<td>Appearance . . . . . dark yellow</td>
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<tr>
<td>Bilirubin . . . . . . positive</td>
</tr>
<tr>
<td>Urobilinogen . . . . . negative</td>
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Stool sample shows evidence of steatorrhea

15. Define steatorrhea.

16. Based on these results (pay particular attention to the urinalysis results) what condition is suggested. Explain.
Follow up X-rays reveal gall stones in the common bile duct confirming a diagnosis of extrahepatic cholestasis (bile duct obstruction) resulting in obstructive jaundice.

17. Explain how obstruction of the bile duct can lead to the presence of bilirubin in the urine.
   Include in your answer an indication of what form of bilirubin would be expected in the urine.
   Explain why other forms of bilirubin are NOT found in the urine.

18. Explain how obstruction of the common bile duct might produce (a) steatorrhea and (b) a tendency to bleed.