

NROSCI/BIOSC 1070 and MSNBIO 2070

Exam # 2

October 25, 2019

1) The following questions relate to drugs commonly used in cardiology. Circle the drug that best fits the characteristics indicated. **(2 points each; 10 points total)**

- a. Phenylephrine: an α_1 receptor agonist
- b. Prazosin: an α_1 receptor antagonist
- c. Metoprolol: a β_1 receptor antagonist
- d. Phenoxbenzamine: an $\alpha_1 + \alpha_2$ receptor antagonist
- e. Clonidine: an α_2 agonist that affects the central nervous system
- f. Propranolol: a combined $\beta_1 + \beta_2$ antagonist

a) Which of the following drugs produces the greatest **positive** chronotropic effect?

Phenylephrine

Clonidine

Prazosin

b) Which of the following drugs produces the greatest **increase** in total peripheral resistance?

Propranolol

Clonidine

Metoprolol

c) Which of the following drugs produces the greatest **positive** inotropic effect?

Prazosin

Clonidine

Phenoxbenzamine

d) Which of the following drugs induces the largest **increase** in activity of RVLM neurons?

Phenylephrine

Clonidine

Phenoxbenzamine

e) Which of the following drugs produces the greatest **increase** in activity of NTS neurons?

Phenylephrine

Clonidine

Metoprolol

Exam Copy 160

- 2) A research subject is taking L-NAME, a nitric oxide synthase inhibitor. The subject subsequently exercises on a stationary bicycle. Will blood flow to his leg muscles be different from that which typically occurs during exercise? If so, how are the responses different and what is the physiologic mechanism? **(5 points)**.
- 3) A patient taking an ACE-inhibitor to treat hypertension presents to the Emergency Department with muscle weakness and paralysis and severe ECG abnormalities. Discuss the physiologic changes induced by the ACE inhibitor that resulted in these medical signs and symptoms. **(5 points)**.

Exam Copy 160

- 4) A patient with cerebral edema is infused with **hypertonic** saline. At 45 minutes after the start of infusion (when blood osmolarity is higher than normal), how will the following physiologic parameters have changed from those prior to infusion? **(2 points each; 10 points total).**

- a) Hematocrit

Higher Same Lower

- b) Flow of fluid from the interstitial space into lymph capillaries

Higher Same Lower

- c) Cell size

Cells Expand Same Cells Shrink

- d) Firing rate of RVLM neurons

Higher Same Lower

- e) Firing rate of arterial baroreceptor afferents

Higher Same Lower

Exam Copy 160

- 5) During exercise, a number of physiological parameters change. Indicate the change in each of the following physiological parameters in an individual after 25 minutes of maximal exercise on a stationary bicycle. Assume that the individual is drinking water to account for fluid loss by sweating. **(2 points each; 10 points total).**

- a) Angiotensin-II Levels

Higher Same Lower

- b) Diastolic Blood Pressure

Higher Same or Slightly Lower Over 50% Lower

- c) Atrial Natriuretic Peptide Levels

Higher Same Lower

- d) Sensitivity (Responsiveness) of NTS Neurons to Baroreceptor Inputs

Higher Same Lower

- e) Right Atrial Pressure (Central Venous Pressure) Just Prior to Tricuspid Valve Opening

Higher Same Lower

Exam Copy 160

- 6) A patient presents to the Emergency Department with dyspnea (shortness of breath). To diagnose the patient's condition, the attending physician orders a blood test for B-type (brain) natriuretic peptide. B-type natriuretic peptide levels are elevated, and a subsequent echocardiogram is ordered, which reveals aortic valve stenosis.

Discuss why: 1) B-type natriuretic peptide levels are elevated in the patient and 2) aortic valve stenosis resulted in dyspnea in the patient. **(10 points)**.

Exam Copy 160

- 7) Samples of filtrate are obtained from Bowman's capsule and the end of the thick ascending limb of the loop of Henle in a normal healthy individual. Compare the concentration of the following substances in the two samples (end of thick limb of loop of Henle compared to Bowman's capsule). **(2 points each; 10 points total)**.

| Substance | Relative Concentration at the End of Loop of Henle | | |
|-----------------------|-----------------------------------------------------------|-------|------|
| Creatinine | Higher | Lower | Same |
| Na ⁺ | Higher | Lower | Same |
| Glucose | Higher | Lower | Same |
| Tyrosine (Amino Acid) | Higher | Lower | Same |
| Urea | Higher | Lower | Same |

Exam Copy 160

- 8) The table below indicates the major segments of the nephron. For each segment, indicate the major Na⁺ transporter on the apical membrane (if any is present) and the approximate amount of sodium reabsorption that occurs. **(12 points)**.

| Segment | Na⁺ Transporter on Apical Membrane (if no Na ⁺ reabsorption occurs, indicate "NONE") | % of Filtered Na⁺ Reabsorbed in Segment |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Proximal Convoluted Tubule | | |
| Thin Descending Limb of Loop of Henle | | |
| Thin Ascending Limb of Loop of Henle | | |
| Thick Ascending Limb of Loop of Henle | | |
| Distal Convoluted Tubule | | |
| Collecting Duct | | |

Exam Copy 160

- 9) Measurements of creatinine in blood and urine are used to estimate glomerular filtration rate (GFR), whereas measurements of PAH (para-aminohippurate) are used to estimate renal blood flow.
- a) Describe the characteristics of creatinine that make it ideal for estimating GFR. **(5 points).**
- b) Describe the characteristics of PAH that make it ideal for estimating renal plasma flow. **(5 points).**

Exam Copy 160

- c) Using these methodologies and others, a nephrology clinic determines the following physiologic parameters for a patient:

Renal blood flow=1000 ml/min

Hematocrit=40%

GFR=120 ml/min

Urine flow=1 ml/min

Cardiac output=5000 ml/min

Systolic blood pressure=120 mm Hg

Diastolic blood pressure=80 mm Hg

Calculate the patient's filtration fraction. You must show your calculations. **(5 points).**

- d) Is the patient's filtration fraction normal, higher than normal, or lower than normal? **(3 points).**

Normal

High

Low

Exam Copy 160

- 10) The liver generates urea from NH_4^+ , the primary nitrogenous end product of amino-acid catabolism. The kidney freely filters urea at the glomerulus, and then it both reabsorbs and secretes it.
- a) What is the physiological reason for this complex handling of urea by the kidney? **(5 points)**.
- b) Does urea concentration in the filtrate increase, decrease, or remain constant from the beginning to end of the proximal convoluted tubule? What is the physiologic mechanism responsible for the change in urea concentration along the proximal convoluted tubule? **(5 points)**.

Exam Copy 160

Please Print Your Name Below
This page will be filed away until exam grading is
complete.

Print Your Name

| |
|----------------------------------------------------|
| <p>Exam # 2 October 25, 2019</p> |
|----------------------------------------------------|