

LAB 4

Human Cardiovascular Lab

Assignments:

Due before lab:

Do IP exercises (*Factors that Affect Blood Pressure and Arterial Baroreceptor Reflex* (Pgs. 46-47)).

Quiz: Define the terms on pg 36 and IP exercises (pgs. 46-47).

During the lab period:

Complete the worksheets in today's lab concerning blood pressure and heart rate (pgs. 39-40 and 43-44).

Next Lab: Quiz on Case Studies (pg.48).

Objectives:

Define and understand important concepts concerning blood pressure.

Know how to calculate pulse pressure, mean arterial pressure, and pulse deficit.

Give a physiological explanation as to why there could be a difference between an apical and radial pulse.

Give physiological explanations for how various postural changes and exercise affect blood pressure and pulse rate.

IMPORTANT TERMS OF THE CARDIOVASCULAR SYSTEM

Define the terms below before coming to lab. These terms are found in your textbook or in the cardiovascular exercises.

- 1. Systolic Pressure**
- 2. Diastolic Pressure**
- 3. Pulse Pressure**
- 4. Mean Arterial Pressure**
- 5. Sphygmomanometer**
- 6. Sounds of Korotkoff**
- 7. Bainbridge Reflex**
- 8. Arterial Baroreflex**
- 9. Contractility**

PROTOCOL FOR THE LAB

BLOOD PRESSURE DETERMINATION

Students will divide up into groups of two. Each student will take their partner's blood pressure and have their blood pressure taken by their partner.

The technique will be described by your instructor and is also written out on pg. 38.

Systolic, diastolic, pulse and mean arterial pressures will be recorded on pg. 39.

HEART RATE DETERMINATION

Working with their partner, students will determine both their apical and radial pulse.

Record these on page 40.

EFFECT OF POSTURE ON HEART RATE AND BLOOD PRESSURE

Working in groups of 4 to 5 on the BIOPAC computers, students will determine the effect of postural changes on heart rate and blood pressure.

Directions are on pages 41 and 42.

Record these values on page 43.

Follow the directions below on how to take blood pressure.

1. Obtain a sphygmomanometer (blood pressure cuff) and stethoscope.
2. Make sure all the air in the sphygmomanometer is expelled before use.
3. Close the valve by turning clockwise.
4. Position the Subject's arm at heart level by either holding the Subject's arm or having the Subject rest his/her arm on the table.
5. Place the cuff over the Subject's brachial artery.
6. Wrap the cuff evenly and snugly around the Subject's arm and allow the Velcro to hold it in place.
7. Position the sphygmomanometer pressure dial indicator such that you can read the face of the dial.
8. Palpate the brachial artery between the antecubital fossa and the lower edge of the cuff to find where the pulse is best felt. The stethoscope diaphragm needs to be placed over the brachial artery where the **Korotkoff** sounds are best heard.
9. Inflate the cuff gradually to about 160 mmHg (if the person has normal blood pressure).
10. Place the stethoscope on the correct position.
11. Release the pressure slowly! Note the pressure at which the Korotkoff sounds first appear. This is your **systolic pressure**.
12. Continue to listen and note the pressure when the sounds completely disappear. This pressure is your **diastolic pressure**.
13. Deflate the cuff as rapidly as possible after all the sounds have disappeared.

CARDIOVASCULAR WORKSHEET - I

A. BLOOD PRESSURES – Work in groups of 2. Take your partners blood pressure and record the values below.

1. systolic pressure (SP)_____

2. diastolic pressure (DP)_____

3. Compute the **pulse pressure** (PP) which is the difference between the systolic and diastolic pressures and indicates the amount of blood forced from the heart during systole.

$$PP = SP - DP$$

pulse pressure (PP)_____

4. Also compute the **mean arterial pressure (MAP)**. $MAP = \text{diastolic pressure} + 1/3 \text{ pulse pressure}$.

$$MAP = DP + 1/3 PP$$

MAP = _____

5. Describe what mean arterial pressure (MAP) is (not how to calculate it! – refer to your textbook).

DO HEART RATE - next page

American Heart Association – Classification of blood pressures (mmHg)

	<u>Systolic</u>	<u>Diastolic</u>
Normal	< 120	<80
Prehypertensive	120-139	80-89
Hypertensive		
Stage 1	140-159	90-99
Stage 2	160 +	100 +

B. HEART RATE

Apical pulse - The apical pulse is the actual counting of the heartbeats using the stethoscope over the heart.

Radial pulse - The radial pulse is measured by counting the pulses of blood in the radial artery located on the lateral aspect of the wrist, above the thumb.

Take the radial pulse of your partner while they record their apical pulse for the same minute. Record data below.

Apical pulse = _____ beats/minute

Radial pulse = _____ beats/minute

A pulse deficit is the difference between the apical vs. radial pulse. A pulse deficit greater than 4 might indicate some physiological problem.

1. Why can't the radial pulse be greater than the apical pulse?
2. Define pulse deficit.
3. What physiological problem might a pulse deficit indicate?

For Protocol C, use the Biopac System for determination of pulse rate (BPM) and measure blood pressure with the sphygmomanometer.

Record your data on page 32.

TO RUN BIOPAC

A. Setup:

turn on MP30
turn on computer
hit return for logon
double click on "Biopac Student Lab" (in middle)
click on "Lesson 5 (L05) – "ok"
type in subject's name

B. Hook up subject:

white lead – right arm
black lead – right leg (ground)
red lead – left leg

C. 1st Protocol : Control - Standing up

1. Hook up subject and have them stand still.
Run the calibration – it will stop automatically.
2. Record for 10-20 sec - **and at the same time have a student take the subjects blood pressure using the blood pressure cuff.** Hit suspend
3. Click on the small box at the top left hand corner of your screen. Scroll down and select bpm (beats per minute – this is your **pulse rate**)
4. Left click on the magnifying glass and enlarge 3 complete ECG recordings.
5. Left click on the I beam (lower left corner of your screen (I)) and drag it from one R peak to the next R peak. This will give you bpm (Look in the upper left hand box).
6. Hit zoom previous to return to original recording.
7. Record your data (pulse rate and blood pressure) on the data sheet.

D. 2nd Protocol: Lying down

1. Immediately recline. *** **Before reclining make sure the sphygmomanometer is in place.**
2. Hit resume for 10-20 sec. **At the same time another student will take the subjects blood pressure using the sphygmomanometer.** Hit suspend on the computer.
3. Measure the subjects pulse rate (bpm) similar to protocol C.
4. Record your data (pulse rate and blood pressure) on the sheet provided.

E. 3rd Protocol: Control for lying down prior to standing up

1. Lie down for 5 minutes. Hit resume for 10-20 sec and take the subjects blood pressure. Hit suspend
2. Measure the subjects pulse rate similar to protocol C.
3. Record your data on the sheet provided.

F. 4th Protocol: Standing up

1. Immediately stand up. Hit resume for 10-20 sec and take the subjects blood pressure. Hit suspend.
2. Measure the subjects pulse rate similar to protocol C.
3. Record your data on the sheet provided.

G. 5th Protocol: Control for Exercise

1. Wait 3 minutes after measurements for "F". Measure and record pulse rate and blood pressure using the protocol above.

H. 6th Protocol: After exercise

1. Exercise for 3 minutes.(Be careful with the leads during exercise)
2. Hit resume for 10-20 sec and take the subjects blood pressure. Hit suspend.
3. Measure the subjects pulse rate and blood pressure.
4. Record your data on the sheet provided.

Finish:

hit done – yes

File – exit (quit)

CARDIOVASCULAR WORKSHEET - II

I. EFFECT OF POSTURE AND EXERCISE ON BLOOD PRESSURE AND HEART RATE

You are responsible for the information in the Biopac Introduction and understanding the **Arterial Baroreflex** and the **Bainbridge Reflex**. Work in groups of 3 or 4.

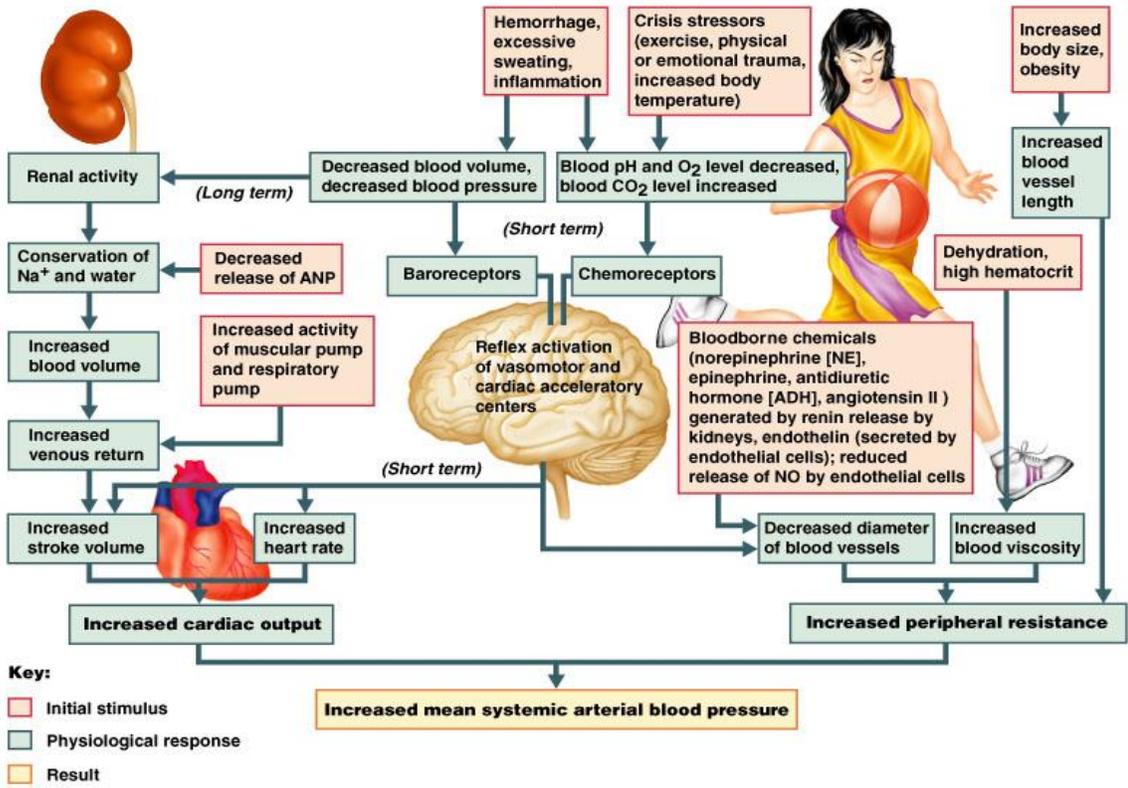
Protocol	BP mmHg	Heart rate (beats/min)
1. Standing quietly - control		
2. Immediately upon reclining		
3. After reclining for 5 minutes Control for standing		
4. Immediately upon standing		
5. After standing for 3 minutes- control for exercise		
6. After exercising for 3 minutes		

Give a physiological explanation (below) for each postural change recorded (i.e. if arterial pressure or pulse rate changed, why it did so?)

II. Compare your results from the standing control to immediately reclining (1-2). What differences did you see? Give a physiological explanation for these results. Think about how the Bainbridge reflex might be involved.

III. Compare your results from reclining for 5 minutes to immediately standing (3-4). Give a physiological explanation for your results. Think about how the arterial baroreflex might be involved. Refer to the diagram on pg. 34.

IV. Compare your results from before exercise (control for exercise) to after exercise (5-6). Give a physiological explanation for your results.



Diagrams illustrating the arterial baroreceptors.

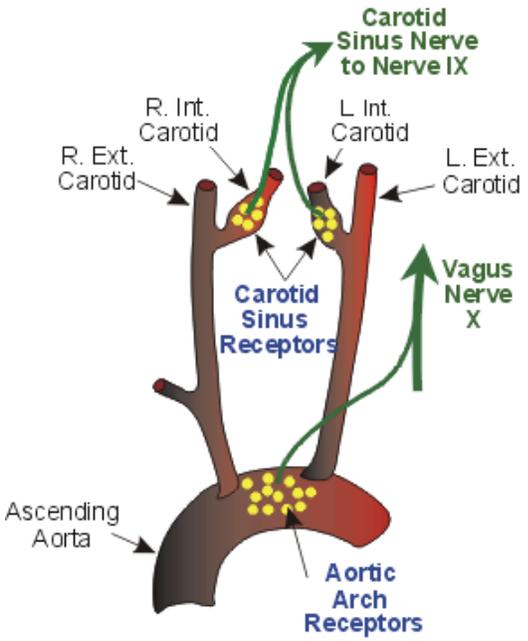
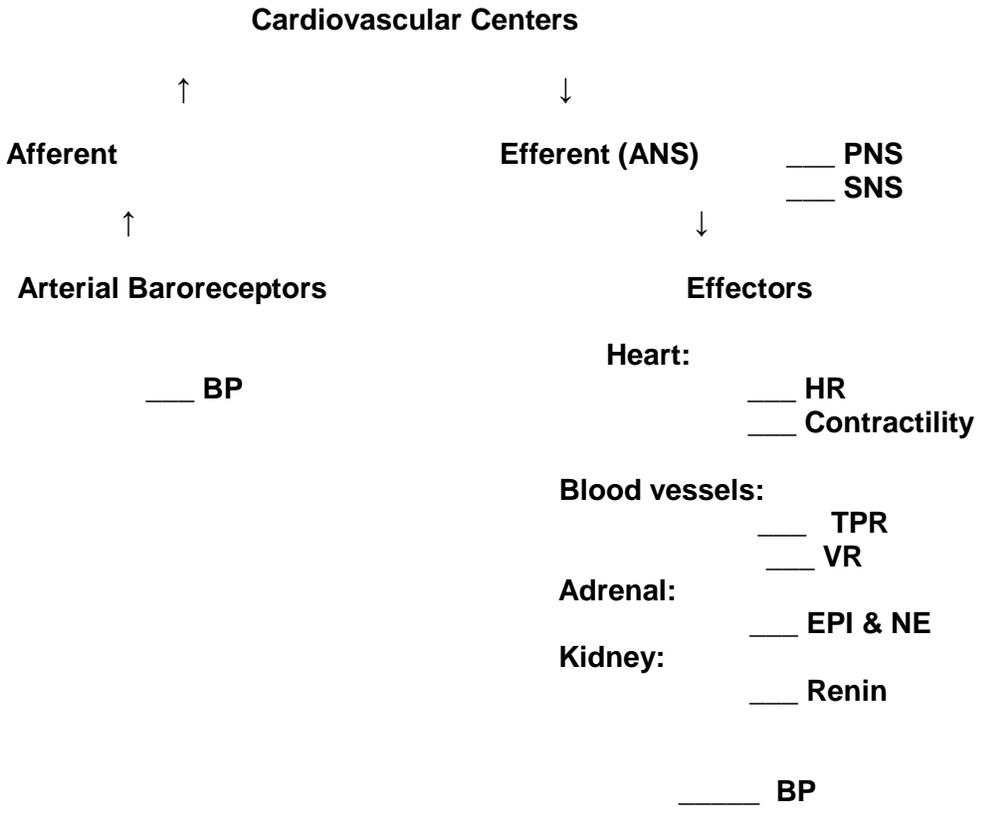


Figure 1. Location and innervation of arterial baroreceptors.

Using your textbook, fill in the blanks below in response to a decrease in BP



Cardiovascular System – Factors Affecting Blood Pressure (Lab 4)

View the Interactive Physiology module on Mastering A&P (Mastering A&P> study area>A&P Fix>Interactive Physiology> IP2:Factors Affecting Blood Pressure)

1. What are the main factors that affect blood pressure (BP)?
 - a.
 - b.
 - c.

2. Salt intake → __ water retention → __ blood volume (BV) → __ BP
 Diuretics or excessive sweating → __ BV → __ BP
 Caffeine → __ HR → __ CO → __ BP

3. Mean Arterial Pressure (MAP) is determined by CO x _____

4. What are the three main factors that influence total peripheral resistance (TPR)?
 - a.
 - b.
 - c.

5. High Altitudes → __ hematocrit (Hct) → __ blood viscosity → __ TPR → __ BP

6. An ↑ in fatty tissue → __ total vessel length → __ TPR → __ BP

7. Smoking or stress → __ SNS → __ vessel diameter → __ TPR → __ BP

8. An ↑ in epinephrine → __ vessel diameter → __ TPR → __ BP
 Atherosclerosis → __ vessel elasticity → __ vessel diameter → __ TPR → __ BP
 Meditation → __ SNS → __ vessel diameter → __ TPR → __ BP

Using your textbook or Lecture Notes, fill in the following:

9. Name three hormones that act as vasoconstrictors.
 - a.
 - b.
 - c.

10. Name two hormones that result in an increase in blood volume.
 - a.
 - b.

Cardiovascular System – Arterial Baroreceptor Reflex

View this IP animation on Mastering A&P and answer the following questions.
(Mastering A&P> study area>A&P Fix>Interactive Physiology> Cardiovascular System)

1. Two major arterial baroreceptors are located: (a) _____
(b) _____

2. Using up and down arrows, show the effect of increased blood pressure (BP) on the impulses sent to the brain, the effect on the parasympathetic (PNS) and sympathetic (SNS) nervous systems and the resulting change in blood pressure.

↑BP → ___ impulses → ___ PNS and ___ SNS → ___ BP

3. As a result of these changes in the PNS and SNS, list an effect on the heart and blood vessels.

Heart → ___ HR
Blood vessels → ___ TPR

4. Similar to question 2, show the effect of decreasing blood pressure.

↓BP → ___ impulses → ___ PNS and ___ SNS → ___ BP

5. As a result of these changes in question #4 in the PNS and SNS, list 2 effects on the heart and 1 on blood vessels.

Heart → ___ HR
___ SV due to an increase in _____

These 2 effects on the heart lead to an increase in _____

Blood vessels → ___ TPR

6. In addition to effects on the heart and blood vessels with decreasing BP, what hormones were released from the adrenal gland?

_____ + _____

7. An increase in these hormones from the adrenal cortex lead to:

___ HR, ___ Contractility and ___ TPR
Thus, they further ___ BP

Case Studies – Critical Thinking YOU are to answer these questions by using your lecture notes, textbook and the following websites: www.mayoclinic.com www.webmd.com or www.clevelandclinic.com Your instructors and tutors are not allowed to answer your questions!!!

1. Mary Francis visits the doctor complaining of weakness, fatigue, fainting and confusion. Her heart rate is 40 bpm. An ECG indicates no P waves but normal QRS complexes. What is the explanation and what can be done for this patient?
2. During a severe hemorrhage John goes into hypovolemic shock and his heart rate starts racing. Why does his heart rate increase?
3. A hypertensive patient is successfully treated with diuretics. Discuss what problem this treatment is addressing and the role of the kidneys in blood pressure control.
4. Another hypertensive patient #4 is given *captopril* (an ACE inhibitor) and her blood pressure decreases. Explain how this drug works to lower blood pressure.
5. Elderly patient #5 sometimes gets dizzy if he stands up too quickly. One time he almost fainted and is afraid this will lead to a fall and bone fractures. Explain his condition.
6. After visiting the doctor, April discovers that her cholesterol levels are 250 mg/dL. Her doctor warns her that if she doesn't control her cholesterol levels she is in danger of becoming hypertensive. April doesn't understand how cholesterol and hypertension are related. But, since you have taken BIO 139, you can explain to poor April how the two are associated. What would you tell her? Be specific!
7. Gabriel, a heroin addict, feels tired, is weak and feverish, and has vague aches and pains. Terrified that he has AIDS, he goes to the doctor and is informed that he does not have AIDS. As you can imagine he is relieved. The doctor tells him that he is suffering from an infection of the interior lining of the heart. He also has abnormal heart sounds. What conditions explain his symptoms? What is the most likely way Gabriel became infected?
8. Frank, a 50-year old airline pilot, visits his doctor complaining of severe, intense, crushing sensations in his chest that radiates to his left shoulder and down the inside of his left arm, triggered by an off-duty rugby match. The chest discomfort was relieved by resting. An exercise tolerance test was performed. Mild exertion resulted in chest pain, which was relieved by nitroglycerin. Frank was given beta-blockers and calcium channel blockers as a pharmacologic therapy.

Vital signs: HR = 98 bpm BP= 160/110 mmHg

- a. What is this patient experiencing?
- b. What is the cause of the pain?
- c. What is the site of action of nitroglycerin?
 - Beta-blockers?
 - Calcium channel blockers?