Laboratory #1

Resting & Exercise Measures of Cardiovascular Function

Introduction

Heart rate (HR) is an easy way to measure an individual's cardiac function and estimate fitness level. The more efficient the cardiovascular system the lower the heart rate and the greater the stroke volume (amount of blood ejected by the heart with each beat). HR increases proportionally with the workload (up to maximum levels where HR plateaus – "steady state"). Blood pressure (BP) is the force exerted by blood against the arterial walls and is determine by how much blood is pumped and the resistance to the blood flow. In terms of exercise prescription it is critical to understand that a linear relationship exists between HR, BP, and exercise intensity.

Statement of the Objectives

1. To become familiar with blood pressure and heart rate responses to aerobic exercise.
2. To practice palpation and auscultation measures of heart rate and blood pressure.
3. To understand the influence of various physiological and environmental factors.
4. Measurement of blood pressure (BP), heart rate (HR) during rest and exercise.

Methods

- Obtain subjects height and weight; provide these data to the laboratory assistant. \
- Fit the subject with a Polar heart rate monitor and ask the subject to be seated for approximately 3 minutes. Measure resting heart rate from the monitor and radial artery.
  Record these data.

Arterial locations for taking the pulse by palpation:

A. **Carotid artery** --in the neck, just to the side of the larynx (voice box).
B. **Brachial artery** -- in the upper arm, medial to the inferior third of the bicep.
C. **Radial artery** -- lateral side of the wrist.

To measure radial heart rate:

- ❖ Use your index and middle fingers
- ❖ Do not use your thumb since it contains an arterial pulse itself
- ❖ Start the stopwatch on a pulse beat and begin the count with zero
- ❖ Count the pulse at one location during a 30-second interval

- Determine systolic and diastolic blood pressure by auscultation with the subject seated.

  To measure blood pressure: .
  - ❖ Wrap cuff smoothly and snugly around the arm, centering the bladder over the brachial artery .
  - ❖ The lower margin of the cuff should be 1 inch above the anticubital space .
  - ❖ Position the stethoscope over the brachial artery, below the cuff .
  - ❖ Rapidly and steadily, inflate the cuff to approximately 160 mm Hg .
  - ❖ Release the air at a rate of 2 to 3 mm Hg per second .
  - ❖ Listen for the following sounds (*Korotkoff* sounds – 1st = SBP, Last = DBP)

- Have subject lie supine for approximately 2 minutes. Determine both measures of HR and blood pressure of subject in this position.
- Position subject on cycle ergometer and adjust seat to proper height. Measure resting HR and blood pressure.
  - ❖ Adjust the seat height of the bicycle to conform to your subject's legs length.
  - ❖ A very slight angle in the knee should be present when the foot is resting on the pedal and at the bottom of a pedal stroke.
  - ❖ Make sure the subject is comfortable before the test begins

- Instruct the subject to begin pedaling. Start the clock when the desired rate and resistance are achieved. (Instructor will clarify workloads for LOW and HIGH)

- Measure HR (last 3 seconds of each minute) and BP during each minute of exercise. Note: measure BP from 20 seconds into each minute of exercise.

- At the end of the 6-minute exercise period, stop exercise. Subject should remain seated on the cycle for a 2-minute recovery period. Measure recovery HR and BP for each minute of the post-exercise period. Proceed to next condition (high power output) when HR is ± 10-15 beats/min from resting HR (when seated on bike).

Laboratory #1 – Recording Form

Measurement of Heart Rate & Blood Pressure during rest and exercise.

Subject Name _____ Age _____

Sex _____ Height _____ in Weight _____ kg

Resting HR & BP
(Subject **Seated**)
HR (Polar) _____ $b \cdot min^{-1}$ HR (Radial artery) _____ $b \cdot min^{-1}$
Systolic BP _____ mm Hg Diastolic BP _____ mmHg

(Subject **Supine**)
HR (Polar) _____ $b \cdot min^{-1}$ HR (Radial artery) _____ $b \cdot min^{-1}$
Systolic BP _____ mm Hg Diastolic BP _____ mmHg

LOW workload HIGH workload

	Time (min)	HR ($b \cdot min^{-1}$)	Systolic BP (mmHg)	Diastolic BP (mmHg)
Seated on bike	1			
	2			
Start Exercise	1			
	2			
	3			
	4			
	5			
	6			
Recovery	1			
	2			

	Time (min)	HR ($b \cdot min^{-1}$)	Systolic BP (mmHg)	Diastolic BP (mmHg)
Seated on bike	1			
	2			
Start Exercise	1			
	2			
	3			
	4			
	5			
	6			
Recovery	1			
	2			

Results

Graph the following for each power output over time:
*Use **15-second** intervals and be sure to include resting and recovery data.
HR over time
Systolic & Diastolic BP over time

Discussion Questions

Compare seated, & supine heart rates and blood pressure. What factors may account for the differences with these postural changes?

Were the 2 methods of measuring HR the same? Explain. List some possible reasons why the Polar monitor and palpation would differ.

Did the physiological responses reach a steady state during cycle exercise? Was this true at both power outputs? If not, which power output did not reach a steady state? What are some reasons why this may have occurred? Hint: define 'steady state!'

Which energy fuel substrate is being utilized during rest and at each test condition? Why?

References:

Adams, G.M. (2002) Exercise Physiology Laboratory Manual: 4th Ed. McGraw-Hill: New York.

American College of Sports Medicine (2000). ACSM's guidelines for exercise testing and prescription: 6th Ed. Lippincott Williams & Wilkin: Philadelphia.

Brooks, G.A., Fahey, T.D., White, T.P., Baldwin, K.M. (2000) Exercise Physiology: Human Bioenergetics and Its Applications: 3rd Ed. McGraw-Hill: New York.

McArdle, W.D., Katch, F.I., Katch, V.L. (1996) Exercise Physiology: Energy, Nutrition, and Human Performance: 4th Ed. Lippincott Williams & Wilkins: Baltimore.

Nieman, D.C. (1999). Exercise testing and Prescription: A Health-Related Approach: 4th Ed. Mayfield Publishing Company: California.

Powers, S.K. & Howley, E.T. (2004). Exercise Physiology: 5th Edition. WCB McGraw-Hill: Boston, MA.