Heart Sounds, Pulse, Blood Pressure Lab

Any comprehensive study of human cardiovascular physiology takes much more time than a single laboratory period. However, it is possible to conduct investigations of a few phenomena such as pulse, heart sounds, and blood pressure, all of which reflect the heart in action and the function of blood vessels.

In a healthy heart, the two atria contract simultaneously. As they begin to relax, simultaneous contraction of the ventricles occurs. However, according to general usage, the terms systole and diastole refer to events of ventricular contraction and relaxation, respectively. The cardiac cycle is equivalent to one complete heartbeat – during which both atria and ventricles contract and then relax. It is marked by a succession of changes in blood volume and pressure within the heart.

The average heart beats approximately 72 beats per minute, and so the length of the cardiac cycle is about 0.8 second. Of this time period, atrial contraction occupies the first 0.1 second, which is followed by atrial relaxation and ventricular contraction for the next 0.3 second. The remaining 0.4 second is the quiescent, or ventricular relaxation, period. When the heart beats at a more rapid pace than normal, this last period decreases.

During the cardiac cycle, two different types of phenomena control the movement of blood through the heart: the alternate contraction and relaxation of the myocardium, and the opening and closing of valves (which is entirely dependent on the pressure changes within the heart chambers).

Purpose

Determine a purpose for the laboratory activities

Materials

- Stethoscope
- Alcohol swabs
- Sphygmomanometer (blood pressure meter)
- Spirometer (and disposable mouthpiece)

Safety

- Safety goggles & gloves are not required, but may be used
- All stethoscope & spirometer surfaces that come in contact with students should be cleaned with alcohol prior to use
- Stethoscope may be cold (you'll just need to get over it...or warm it before touching your partner)
- Blood pressure cuff should not be kept inflated for more than 1 minute before deflating (prolonged interference with blood pressure homeostasis can lead to fainting)
- Dispose of all materials as directed
- Wash hands once completed with lab
Procedure

Part A – Heart Sounds
1. Obtain a stethoscope and alcohol swabs
2. Heart sounds are best listened to if the subject’s outer clothing is removed
   Preferably, each group will have a male student so they can lift or remove their shirt to allow the stethoscope to contact the skin directly
3. With an alcohol swab, clean the earpieces of the stethoscope and allow the alcohol to dry
4. Place the stethoscope on your ears and ensure proper and comfortable fit
5. Place the diaphragm of the stethoscope on your partner’s thorax, just to the sternal side of the left nipple at the fifth intercostal space (bottom right image as shown below)
6. Listen carefully for heart sounds
   The first sound will be a longer, louder (more booming) sound than the second
   The second sound will be short and sharp
7. After listening for a couple of minutes, try to time the pause between the second sound of one heartbeat and the first sound of the subsequent heartbeat
8. **Record the interval in your data table**
9. To differentiate individual valve sounds somewhat more precisely, listen to heart sounds over specific thoracic regions as illustrated at the top of the next page & **record observations as you proceed**
   • AV Valves
     As a rule, the mitral valve closes slightly before the tricuspid valve
     a. Hear the mitral valve clearly by following the steps above (bottom right image)
     b. To hear the slight lag of the tricuspid valve more clearly, you should shift the stethoscope more medially (bottom left image)
        (the actual “best” location may vary from the location shown below to the other side of the sternum...test them out to see what works best)
   • Semilunar Valves
     The aortic valve normally shuts just ahead of the pulmonary valve. If the subject inhales deeply but gently, filling of the right ventricle may be slightly delayed, allowing the two sounds to be heard more distinctly.
     c. Positioning the stethoscope over the second intercostal space just to the right of the sternum will provide the best location to hear the aortic valve when your partner takes a deep breath (top left image)
     d. Moving the stethoscope to the left side of the sternum in the same line will best allow for hearing the pulmonary valve (top right image)
Part B – The Pulse

1. Place your first 2 or 3 fingers of one hand (no thumbs) over the radial artery  
   *Easily found at the lateral aspect of the wrist, just above the thumb*

2. Compress the artery firmly as you begin checking for the pulse

3. Immediately ease up on the pressure slightly

4. **Record observations about the regularity of the pulse, along with the degree of tension**

5. In addition to the radial artery, attempt to find pulse points at the following superficial locations:
   - common carotid artery – *at the side of the neck*
   - temporal artery – *anterior to the ear, in the temple region*
   - facial artery – *clench the teeth, pulse is found just anterior to the masseter muscle on the mandible*
   - brachial artery – *just above the elbow, at the point where the artery splits into the radial and ulnar arteries*
   - popliteal artery – *at the back of the knee*
   - posterior tibial artery – *just above the medial malleolus*
   - dorsalis pedis artery – *on the top of the foot*
   - femoral artery – *in the groin (do not test this one – you may search for it on your own outside of class)*
6. Answer the following questions in your notebook:
   a. Which pulse point had the greatest amplitude
   b. Which had the least?
   c. Provide a possible explanation for this.

Because of its easy accessibility, the pulse is most often taken on the radial artery.
7. Find the pulse in the radial artery once again
8. With your partner sitting quietly, practice counting the radial pulse for 1 minute
9. Record the value in your data table
10. Make three counts, recording each one, and average the results

There is a correlation between the pulse rates of the heart (apical pulse) and the arteries (radial pulse – if from the radial artery). An apical pulse may be slightly faster than the radial pulse due to a slight lag in time as the blood rushes from the heart into the arteries. However, large differences between the values observed (a pulse deficit) may indicate cardiac impairment or abnormal heart rhythms.
11. With the subject sitting quietly, one student, using a stethoscope, should position it over the fifth left intercostal space (bottom right image from image on previous page)
12. A second student should be positioned to simultaneously take the radial pulse
13. The students taking the radial pulse will determine the starting point for the count, and give the stop-count signal exactly 1 minute later
14. Record values for apical & radial counts. Identify any pulse deficit that may be observed.

Part C – Blood Pressure
1. Obtain a stethoscope, alcohol swabs, and sphygmomanometer
2. Clean earpieces of stethoscope with alcohol and let dry
3. Check the cuff for the presence of trapped air by compressing it against the table
4. The subject should sit in a comfortable position with one arm resting on the lab table (approximately at heart level if possible)
5. Wrap the cuff around the subject’s arm, just above the elbow (our cuffs may or may not be marked with an arrow; if so, the arrow should be placed over the brachial artery)
6. Secure the cuff by bringing the Velcro areas together
7. Locate the brachial artery with your fingers and gently mark its position with a pen
8. Place and hold the diaphragm of the stethoscope over the pulse point
Prior to beginning the following steps remember:
The cuff should not be kept inflated for more than 1 minute
If there is trouble obtaining a reading within this time, deflate the cuff, wait 1-2 minutes, and try again

9. Inflate the cuff to approximately 160 mm Hg pressure and slowly release the pressure valve

10. Watch the pressure gauge as you listen carefully for the first soft thudding sounds
   (This is the blood spurting through the partially closed artery)

11. Mentally note this pressure (systolic pressure) and continue to release the cuff pressure

12. You will notice first an increase, then a muffling, of the sound

13. Note, as the diastolic pressure, the pressure at which the sound disappears

14. Calculate the pulse pressure for each trial
   It is the difference between the systolic and diastolic pressures
   [It indicates the amount of blood forces from the heart during systole (the “working” pressure)]

15. Calculate the mean arterial pressure (MAP) for each trial
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    MAP = \text{diastolic pressure} + \frac{\text{pulse pressure}}{3}
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