BLOOD PRESSURE LAB

Name____________________________________ Lab________

Introduction:
Blood pressure measurement is an integral part of pre-testing assessment and exercise monitoring. Blood pressure readings that are too high should be assessed for their significance. Resting blood pressure classifications for adults 18 years and older are:

<table>
<thead>
<tr>
<th>Category</th>
<th>Systolic BP (mm Hg)</th>
<th>Diastolic BP (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal</td>
<td>&lt;120</td>
<td>&lt;80</td>
</tr>
<tr>
<td>Normal</td>
<td>120-129</td>
<td>80-84</td>
</tr>
<tr>
<td>High normal</td>
<td>130-139</td>
<td>85-89</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td>140-159</td>
<td>90-99</td>
</tr>
<tr>
<td>Stage 2</td>
<td>160-179</td>
<td>100-109</td>
</tr>
<tr>
<td>Stage 3</td>
<td>&gt;180</td>
<td>&gt;110</td>
</tr>
</tbody>
</table>

NHLBI 1997

High blood pressure, known as hypertension, is a common medical condition that contributes to the development of coronary artery disease (CAD) and stroke. Hypertension or a chronically elevated blood pressure seldom works alone in its role as a CAD risk factor. It tends to work in concert with other well-identified risk factors including elevated blood lipids, obesity, smoking, diabetes, and lack of exercise. About 90% of hypertension is idiopathic, meaning that the cause is indeterminable.

Blood pressure is highest during ventricular systole. Systolic blood pressure (SBP) is indicative of the force generated by the heart during ventricular contraction. SBP increases with exercise, but the magnitude is specific to the type of exercise performed.

During dynamic, low-resistance exercise, such as running and walking, SBP increases in proportion to exercise intensity. The arterial dilation that occurs as we exercise reduces resistance to flow and we would think that this would lower blood pressure. This effect is more than offset by the dramatic increases in cardiac output.

Posture can affect the SBP since posture influences venous return; variations in venous return influence stroke volume, which in turn changes cardiac output.

Diastolic blood pressure provides an indication of peripheral resistance. High diastolic blood pressure values indicate elevated peripheral resistance. Dynamic, low resistance exercise usually causes little or no change in diastolic blood pressure. High resistance exercise can result in large elevation in diastolic blood pressure.

The Mean Arterial Pressure (MAP) is the average pressure exerted by the blood on the arterial walls. The MAP is calculated as follows:

Resting  $\text{MAP} = \frac{(\text{SBP} - \text{DBP}) + \text{DBP}}{3}$
Exercising $\text{MAP} = \frac{(\text{SBP} - \text{DBP}) + \text{DBP}}{5}$

MAP steadily rises with exercise and at max approximates 130mmHg. The systolic time interval represents approximately 33% of the resting cardiac cycle. Because diastole is longer the MAP represents less than the average between SBP and DBP. Because the heart rate rises and time in diastole decreases the calculation of MAP in exercise may be altered to reflect this change. For a more accurate assessment of MAP in exercise divide the pulse pressure by 5 (as shown above).

Purpose:
The purpose of this lab is for the student to get accustomed to taking resting blood pressure readings. Along with resting readings the student will also practice taking readings in various body positions and during exercise.

**Equipment/Personnel:**
Stethoscope, sphygmomanometer, blood pressure cuff, leg ergometer, recumbent ergometer, leg extension machine, and all students participating.

**Definitions:**
1. **Blood Pressure (BP)**- The force exerted on the wall of the blood vessel by the blood as a result of contraction of the heart (systole) or relaxation of the heart (diastole).
2. **Systolic Blood Pressure (SBP)**- The pressure of the blood in the vessels caused from the contraction phase of the cardiac cycle, or heart.
3. **Diastolic Blood Pressure (DBP)**- The pressure that is maintained on the blood in the vessels during the relaxation phase of the cardiac cycle, or heart.
4. **Mean Arterial Pressure (MAP)**- The mean pressure exerted by the blood on the arterial walls. It is not simply the midpoint between SBP and DBP because the amount of time spent in diastole or systole is unequal.
5. **Hypertension**- High blood pressure, defined as values equal to or greater than 140/90 mmHg.

**Procedures:**
Each student will obtain a stethoscope, sphygmomanometer, and blood pressure cuff from the laboratory supplies. The class should then break into groups of three students. Each member of the group will practice taking blood pressure readings. After each member of the group has practiced and feels comfortable with the technique, designate one member of the group as the subject. Then take blood pressure readings on this person in the supine, seated, and standing postures. After you have taken these readings have the subject ride the cycle ergometer at 300kpm•min\(^{-1}\) or 50 Watts. Allow the subject to ride at this workload for five minutes. Palpate exercise heart rate and take blood pressure readings. Then have the subject pedal the recumbent cycle until the steady state heart rate approaches the heart rate on the cycle. After five minutes at this workload check the blood pressure. You will then take the subject to the leg extension machine. Have the subject complete three repetitions at a challenging resistance. Inflate the cuff and take the blood pressure readings as the subject completes another five lifts.

<table>
<thead>
<tr>
<th>SBP</th>
<th>DBP</th>
<th>MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upright Ergometer 300kpm•min(^{-1})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recumbent Ergometer workload</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg Extension</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Readings:**
Questions/Speculations:
1. Did blood pressure change when the subject changed positions? Why?
2. Why is the blood pressure so much higher during weight lifting?
3. If you calculated MAP in exercise using the resting formula, how far off is your assessment?

BLOOD PRESSURE PROTOCOL

1. Have client rest for 3-5 minutes
2. The subject should be comfortably seated, with the arm straight (just slightly flexed), palm up, and the whole forearm supported at heart level on a smooth surface.
3. Locate brachial artery by palpation
4. All blood pressure measurements should be taken on the right arm of the subject.
5. Use proper size of cuff. Each cuff has a range in which it will properly fit a subject. The rubber bladder should encircle at least 80% of arm circumference. If the range is not within the limits the next cuff size should be used.
6. Place the cuff (deflated) on the arm with the lower margin about 2-3cm above the inner elbow or antecubital space.
7. The stethoscope should be applied lightly just above and medial to the antecubital space making sure the head makes contact with the skin around its entire circumference. Excessive pressure on the stethoscope head can erroneously lower diastolic readings. The stethoscope should not be touching clothing, the cuff, or the cuff tubing in order to avoid unnecessary rubbings sounds.
8. With the stethoscope in place over the brachial artery, the stethoscope head should be held in place with the index and middle finger (do not use the thumb).
9. Place the earpieces of the stethoscope into the ear canals, angled forward to fit snugly.
10. Inflate cuff while listening for disappearance of all sounds. Note approximate cuff pressure at disappearance of sound. Deflate cuff.
11. After waiting 60 seconds, inflate cuff to a pressure 20mmHg above the level where sound disappeared. Release cuff pressure at a rate of 2-3mmHg per second.
12. As the pressure is released, the blood pressure sounds become audible and pass through several phases. The systolic pressure is marked by the appearance of faint, clear tapping sounds, which gradually increase in intensity. The represents the blood pressure when the heart is contracting.
13. As the cuff continues to deflate it will reach a pressure in which the blood can smoothly flow through the vessels again, without creating any noticeable sounds. At the point in which the tapping sounds stop is the diastolic pressure of the blood. This phase represents the blood pressure when the heart is relaxing.
14. If more measurements need to be taken, allow at least 60 seconds for normal circulation to return to the arm.

Revised 10/9/01