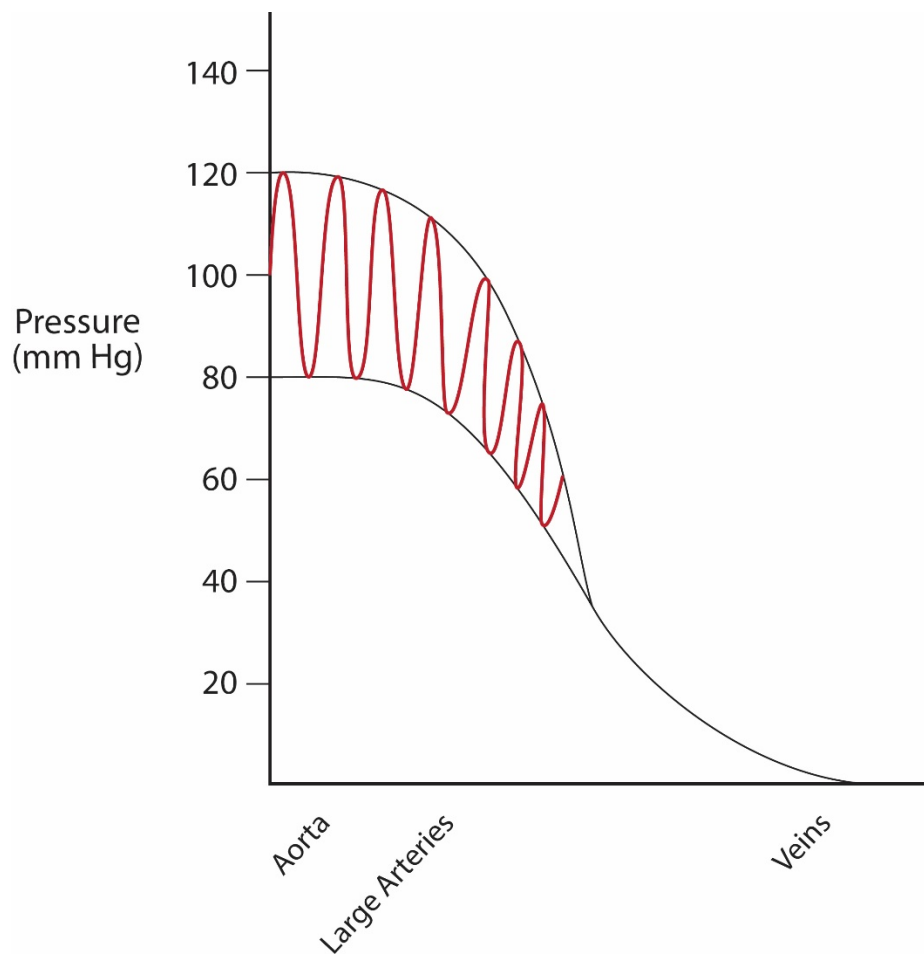


MODULE 3:

EKG, Pulses and Blood Pressure

An EKG (also called ECG) is a test that checks the electrical activity of your heart. Specifically, it measures the direction and magnitude of action potentials traveling through the conducting system of the heart.

A pulse is a pressure wave that can be felt over an artery that lies close enough to the skin. In the figure below you can see that blood pressure changes from a high (of about 120) to a low (of about 80). When the left ventricle contracts and a bolus of blood shoots into the aorta, the high pressure of 120 (systolic pressure) is reached. This pressure wave travels down the arteries and dissipates as arteries branch out into arterioles and capillaries. By the time blood reaches the veins, there is no pulse pressure left, it is just one continuous pressure gradient and it is near 0. There is a very distinct pulse pressure in the aorta, but it is difficult to palpate the aorta because it is so deep in the thoracic and abdominal cavity. However, there are several large arteries that still have a distinct pulse pressure and they are close to the skin and can be palpated.



Blood pressure is taken with an instrument called a sphygmomanometer. This instrument is used to stop blood flow in an artery that has a good pulse pressure and is relatively close to the skin. As pressure is released blood flow will begin to force its way through the artery when the pressure in the cuff is lower than the systolic pressure. This forcing of blood through a narrowed vessel opening creates a sound. A stethoscope is used to assess these sounds and mark the points of systolic and diastolic blood pressure.

This lab will include some activities and require some research that will help you understand and appreciate the EKGs, Palpable Pulses and Blood Pressure. There will be an online worksheet that you will enter your answers on. You will be allowed to "Save for Later" and "Submit" the worksheet as many times as you want. However, there are a couple of things to keep in mind.

1. You will not be allowed to Submit your worksheet after the deadline. If you do not submit before the deadline, you may be able to work out a way to submit it as a late assignment but there will be point deductions.
2. If you Submit the lab assignment, and then decide to retake it before the deadline, all of your answers will be gone and you will have to retype all answers before submitting again.

The lab worksheet has been reproduced for you on the following pages, so that you can work on things offline. If you have printed the lab manual, you might write notes in the textbox fields, or you might use a .pdf document annotator on your computing device. Whatever you decide to do is fine, but ultimately, only answers entered on the I-learn worksheet can be submitted for grading.



Follow the instructions below very carefully. Many of the items in this assignment require reading or videos or something else to do. Be sure to write your answers completely before submitting the assignment. There is an option in the bottom right to save your answers and come back later, but once you submit this assignment, it will be graded.

EKG

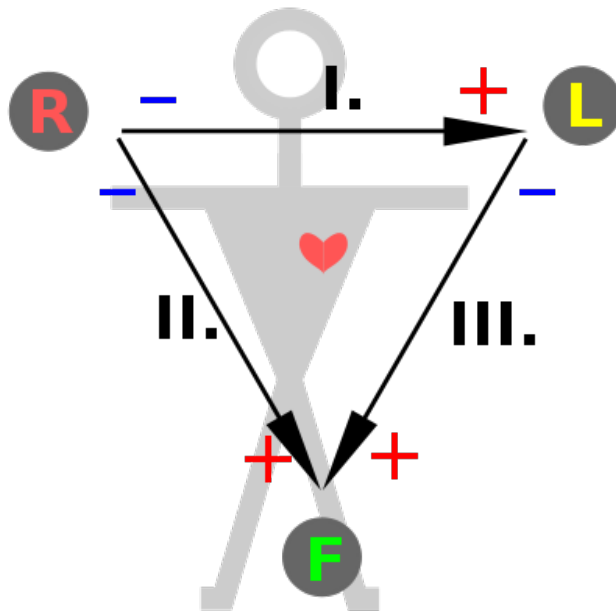
The electrocardiogram (ECG or EKG) is the standard clinical tool used to measure the electrical activity of the heart. Data obtained from an EKG provide a graphical representation of the rate, rhythm and pattern of electrical signals produced by action potentials traveling through cardiac myocytes. Recall that in a cell at rest, the inside of the cell has a negative charge with respect to the outside. That charge reverses when an excitable tissue such as a cardiac muscle cell depolarizes during an action potential. If one group of cardiac myocytes is depolarized (positive inside and negative outside) while another group is at rest (negative inside and positive outside) we have perfect conditions to generate an electrical current. If these oppositely charged areas are then connected by some sort of a conductor, an electrical current will flow. In our bodies, the extracellular fluid acts as a conductor allowing current to flow around the heart. Electrodes placed at strategic locations can then detect that current. By attaching electrodes to a galvanometer, tracings can be recorded that give us information about the magnitude and direction of the currents. Furthermore, by placing the positive and negative electrodes at different locations on the body the EKG will give different "views" of the electrical activity. Each unique positioning of the electrodes is referred to as a lead. For example in Lead I the positive electrode is placed on near the left arm and the negative electrode is placed near the right arm, for Lead II the positive electrode is placed on near the left leg and the negative electrode near the right arm. By placing the electrodes in different positions, a total of 12 standard leads can be obtained, six limb leads and 6 chest leads, giving 12 unique views of the electrical activity of the heart.

[CLICK HERE](#) to watch a video about the electrical activity of the heart (about 10 minutes)

[CLICK HERE](#) to watch a video that explains the ECG waves (about 17 minutes)

[CLICK HERE](#) to get the animation that was in the last video

1. Describe in your own words what each wave form means on a standard ECG tracing.



Downloaded from Wikicommons Nov 2013. Title: Einthoven Triangle; Author: Kychot; License: [Creative Commons Attribution-Share Alike 3.0 Unported](#)

Einthoven's triangle is a standard bi-polar 3 lead set up for an ECG tracing. By convention, lead I has the positive electrode on the left arm, and the negative electrode on the right arm, and therefore measures the potential difference between the two arms. In the lead II configuration, the positive electrode is on the left leg and the negative electrode is on the right arm. Lead III has the positive electrode on the left leg and the negative electrode on the left arm. These three leads form a triangle (with the heart at the center). This is often referred to as Einthoven's triangle in honor of Willem Einthoven who developed the electrocardiogram in 1901. It does not matter if the leads are attached to the trunk

or the end of the limb (wrists and ankles) because the limb can simply be viewed as a conductor "like a wire" originating from a point on the trunk of the body.

[CLICK HERE](#) to watch a video explaining Einthovens Triangle and a standard 3-Lead ECG setup further.

If you are attending the campus lab, you will be given instructions on how to use our equipment to set up a 3 lead ECG test and perform it.

Research answers for the following questions:

2. Explain what a PR interval is and also explain what might cause it to change (Be detailed. Explain the mechanisms that cause the change and don't just list situations that can cause change)?

3. Explain what a PR segment is also explain what might cause it to change (Be detailed. Explain the mechanisms that cause the change and don't just list situations that can cause change)?

4. Explain what a QT interval is and also explain what might cause it to change (Be detailed. Explain the mechanisms that cause the change and don't just list situations that can cause change)?

5. Explain what an ST segment is and also explain what might cause it to change (Be detailed. Explain the mechanisms that cause the change and don't just list situations that can cause change)?

Electrical Axis

The electrical axis of the heart is the mean or average direction of the action potentials traveling through millions of cells in the heart during depolarization. The QRS complex, which represents ventricular depolarization, is used for the determination of the electrical heart axis. The term, electrical heart axis, usually refers to the electrical axis in the frontal plane. It is measured by the standard bipolar limb leads I, II and III (I and III are most often used).

[CLICK HERE](#) to watch a video that shows what an electrical axis is and how to measure it.

[CLICK HERE](#) to get an assignment to measure an electrical axis. If you are taking the lab on campus, you may measure your own electrical axis from your own ECG tracing instead of doing this assignment.

6. Hopefully you downloaded and printed the .pdf file from the assignment above. You probably noticed a coordinate axis page in the assignment. In the text box below, put in the value in degrees of where the electrical axis fell. *If you are doing your own electrical axis show your work to your instructor or TA before entering the value in below.*

7. If we measure an electrical axis while lying down, it will change when we stand up. In which direction do you think the electrical axis will change in the standing position? Explain.

Abnormal ECG Tracings

An ECG looks at how the electrical impulses in your heart "travels". Many things can change the way action potentials conduct through the myocytes of the heart. You have already examined some things that can change the periods of time between different points on an ECG. Now, we want to look at things that can change the shapes and patterns of an ECG tracing. Learning the characteristics of various ECG abnormalities has proven to be a valuable tool in diagnostic medicine. This part of lab will introduce you to some basic ECG tracings found with well-known alterations (some normal and harmless & others lethal).

[CLICK HERE](#) to watch a video that explain basic abnormal ECG tracings.

[CLICK HERE](#) to work through some practice images of abnormal ECG tracings.

8. Have you gone through the practice slides enough that you easily understand and recognize each of the abnormal patterns there?

Did you complete the activities above?

- Yes
- No

Taking a Pulse

Palpating a pulse involves locating areas on the body where an artery is big enough and close enough to the surface that the systolic pressure waves can be felt. It also helps if the artery can be pressed against a bone so that the pressure in the artery can be amplified. When taking a pulse, it is best to use your index and or middle finger. Don't use your thumb as people can often feel their own pulse in their thumb when it is pressed and this will confuse you. If you are not feeling a pulse, it may be that you are pressing too hard, try to lighten your touch and concentrate.

There are key places to palpate. The most common places to check for pulses are as follows: carotid, brachial, radial, femoral, popliteal, posterior tibial, and dorsalis pedis.

CLICK [HERE](#) to get a picture of the common location for pulses. Find someone to practice on and see if you can feel a pulse for each of the following:

- Carotid (Be very gentle. Don't press hard!)
- Brachial
- Radial
- Popliteal
- Posterior Tibial
- Dorsal Pedis

Some of these pulses are more difficult than others to palpate. In the text box below, describe your experience. Which pulses were more difficult? Explain why you think some pulses were harder to palpate. Medical professionals will often discover through their experience ways to feel some pulses better. They might change the subject's position or change the position of their fingers or any number of things.

9. Did you discover anything to help you palpate any of these pulses? Explain.

Blood Pressure

Measuring blood pressure requires a sphygmomanometer or blood pressure cuff and a stethoscope. At rest, the blood normally travels quietly through the arteries. The blood in the center of the artery travels slightly faster than the blood near the walls of the artery. Think of water flowing in a river, the water near the banks flows the slowest and as you move toward the middle of the river the water moves progressively faster. In the blood vessels this same phenomenon creates multiple layers or lamina of blood flowing through the vessels with each subsequent layer moving a little faster you move closer to the center of the vessel. Due to the physics of this type of flow (laminar flow) there is little mixing of blood between the layers as they move through the vessels. Under certain circumstances mixing can occur in which case we call the flow turbulent flow. Turbulent flow often creates sounds that can be heard with the stethoscope. When the blood pressure cuff is inflated to a pressure above the systolic pressure of the blood, the blood flow in the vessel stops and the blood is silent. However as the pressure in the cuff is gradually lowered, blood will begin to flow through the vessel when the cuff pressure drops below the systolic pressure. The blood is pushed through the partially compressed walls of the artery creating a turbulent flow and creating a detectable sound. Sound is produced in the blood as long as the pressure in the cuff is less than the systolic pressure but greater than the diastolic pressure. As pressure continues to decrease in the cuff, the quality of the sound changes. There are 5 phases of sound in the vessels under these conditions.

- **Phase 1.** A loud clear tapping (or snapping) sound is evident, which increases in intensity at the cuff is deflated. This phase begins just as the pressure cuff drops below the systolic pressure of the subject's blood. The systolic pressure is noted when this sound is first heard.
- **Phase 2.** Is best described as a series of murmurs.
- **Phase 3.** A loud thumping sound, similar to phase 1, but less clear.
- **Phase 4.** A muffled thumping sound.
- **Phase 5.** Silence. This phase begins as the pressure cuff reaches the diastolic pressure of the subject's blood. The diastolic pressure is noted at the point that the vessel first becomes silent.

Blood pressure is measured in millimeters of Mercury (mmHg). This is a description of how much pressure is required to raise a column of mercury a certain distance.

Optional: If you have a computer that will play flash animations, you may

[CLICK HERE](#) to work through a really good tutorial on blood pressure.

[CLICK HERE](#) to see a video showing how to perform a blood pressure measurement with a sphygmomanometer and stethoscope.

10. Explain in the text box below what causes the first thumping sound (Phase 1) and why this represents systolic blood pressure.

11. Explain what phase represents the Diastolic pressure. What is happening at the heart and vessel level to explain this.

Heart Sounds

The art of listening to body sounds with the stethoscope is called auscultation. These sounds are often described as "lub-dub." The "lub" portion is also known as the first sound (S1) and is produced by the closure of the AV valves during the first portion of ventricular contraction. The "dub" or second sound (S2) is heard as the semilunar valves close in response to the relaxation of the ventricles as the pressure within the ventricles becomes less than that in the aorta. There is a sound referred to as the third heart sound (S3) but it is rare. If it occurs, it occurs after the "lubb-dubb". It is generally associated with the sudden and rapid opening of a more rigid than normal ventricle. This sudden opening occurs when blood rushes into the ventricle during the first part of diastole. There is an even more rare fourth heart sound (S4). This sound if it occurs happens just before the "lubb-dubb". It occurs because the atria is contracting more forcibly than normal. This excessive atrial contraction happens usually as an attempt to overcome stiffness and loss of elasticity in the ventricles.

Due to the position of the heart, much of the sound produced by the valves is masked by the sternum and ribs. Despite this, there are areas on the chest where individual valve sounds can be heard more clearly. These areas are named according to the valve which can be heard best there. The first is located to the right of the sternum at the second intercostal space and is known as the aortic area. Here you can hear the aortic semilunar valve most clearly. The second is the pulmonic area and is found at the left of the sternum at the second intercostal space. The pulmonary semilunar valve can be heard best in the pulmonic area. Since the closing of the semilunar valves is responsible for the 2nd heart sound the "dub" will be more pronounced when listening in the aortic or pulmonic areas. The tricuspid valve is heard best when the stethoscope is placed in the 5th intercostal space either just to the right or left of the sternum. Finally, the bicuspid valve can be heard best in the 5th intercostal space in line with the middle of the clavicle (mid clavicular line). Since the AV valves produce the first heart sound, when listening in these areas the "lub" will be more pronounced. Notice that the stethoscope has two listening devices, the bell and the diaphragm. The bell is more sensitive to low frequency sounds and the diaphragm is more sensitive to high frequency sounds. When doing a routine examination it is best to listen with both the bell and the diaphragm as some types of abnormalities produce low pitch sounds and others produce high pitch sounds. Abnormal heart sounds are called murmurs. These are typically caused by valves that either do not open properly or do not close properly. As the blood moves through these damaged valves it creates sounds that can be heard with the stethoscope in addition to the normal heart sounds. If a valve doesn't open properly we say that it is stenotic or the person has stenosis of a particular valve. The murmur produced by a stenotic valve typically precedes the normal sound for that valve. If a valve doesn't close properly we say it is incompetent and we get regurgitation or backflow of blood through the valve. Murmurs produced by incompetent valves typically follow the normal sound of that valve. If you are attending the campus lab, your instructor will show you how to do these auscultations with a partner. If you have a stethoscope

at home, you should try to see what you can hear at the areas mentioned above. Work your way through the following web site and complete the tutorial.

<http://www.blaufuss.org/tutorial/index1.html>

Also, work your way through the proficiency quiz to see how well you can identify heart sounds.

<http://www.blaufuss.org/HStest/index.html>

Did you practice listening to the heart sounds and did you work your way through the proficiency quiz?

12. Did you complete the activities above?

- Yes
- No

13. In the text box below, explain what causes each of the 4 heart sounds (S1, S2, S3, S4).