Experiment HH-8: Heart Sounds

Background

The cardiac cycle begins with the electrical activity of specialized myocardial cells in the sinoatrial (SA) node on the right atrium of the heart. The electrical activity spreads from the node across the muscle fibers of the atria, through another node and a set of fibers that go to the ventricles. The resulting sequential contraction and relaxation of the heart moves blood to the lungs and other organs. As blood moves between the atria and the ventricles, and the ventricles and the large blood vessels, the sounds of the valves between these parts of the circulatory system can be heard with a stethoscope. Electronic devices, like the heart sound monitor used in this experiment, can also be used to record and display the heart sounds as waveforms on a computer screen.

The electrical activity of the heart is recorded as an electrocardiogram (ECG) with identifiable waves:

- The P wave is the summation of the action potentials from the muscle fibers in the atria. This event is known as the atrial depolarization and causes the contraction of the atria.
- The QRS complex results from the return of the atrial muscle fibers to their resting membrane potential in an event known as atrial repolarization. The second event is the summation of the action potentials from all the muscle fibers in the ventricles. This process is known as the ventricular depolarization and causes the contraction of the ventricles.
- The T wave results from the return of the ventricular muscle fibers to their resting membrane potential, or ventricular repolarization.

The mechanical activity of the heart chambers can be visualized by using ultrasound to create an echocardiogram. These tests are extremely effective at providing information about the size, volume, and thickness of the heart chambers, as well as the pumping function of the cardiac musculature and the structure and movement of the cardiac valves. The movement of blood through and out of the heart can also be visualized by using ultrasound to conduct a Doppler examination. The volume, velocity, and direction of blood moving through chambers can be measured with this technology.

The devices used to conduct echocardiograms and Doppler examinations are invaluable diagnostic tools. Before these electronic tools were available, the sounds created by the opening and closing of the valves between the chambers and vessels leaving the heart were used to diagnosis problems with the heart. the technique of listening to heart and vessel sounds is called auscultation. Practitioners use auscultation to detect subtle differences in heart sounds which may indicate irregularities in the heart and blood vessels. Finding these irregularities using auscultation leads to the use of ultrasonic tests to complete the diagnosis.

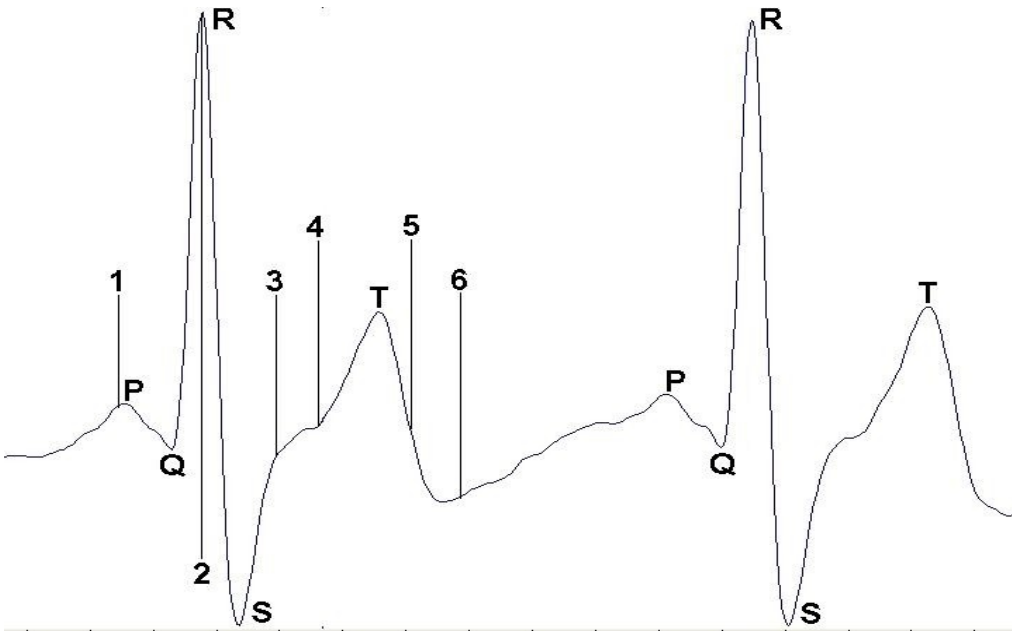

Figure HH-8-B1: A typical ECG trace with labels identifying the P, QRS, and T waves and the points during the ECG cycle when mechanical events usually occur: 1, atrial contraction; 2, closing of the mitral and tricuspid values at the beginning of the ventricular contraction; 3, opening of the semilunar valves with the increase in ventricular pressure; 4, point of maximum ventricular and aortic pressure; 5, closing of the semilunar values as the ventricular pressure drops below the aortic pressure; 6, opening of the mitral and tricuspid valves as the ventricular pressure drops below the atrial pressure.

In this lab, students will record the heart sounds that occur during the cardiac cycle using a heart sound monitor placed on the four prescribed auscultation areas around the heart. The first heart sound (S1) occurs during the early phase of ventricular contraction and is produced by closing of the atrioventricular valves, which prevents blood flow back into the atria as the ventricle contracts. The second heart sound (S2) occurs when the ventricles relax and is produced by the closing of the semilunar valves, which prevents blood from flowing back into the ventricles from the large blood vessels. The ECG of the subject is recorded as the heart sounds are recorded so that you can visualize when heart sounds occur during the ECG cycle.