Studying the Differences Between Palpatory and Auscultatory Method and the Influence of Exercise in ECG Durations

Simran Karim

Experimental Observations:

1. Blood pressure:

A) Background:

Blood pressure is the force that is exerted on the surface area of blood vessels due to the pumping of mechanism of the heart. Blood pressure is measured in mmHg and the readings comes in pairs, for example 120/75, where the top number is systolic pressure and the bottom is diastolic pressure. Systolic is the maximum pressure in the arteries when the heart contracts and the diastolic pressure is the minimum pressure in the arteries when the heart relaxes. The instrument that is used to measure arterial blood pressure is called a sphygmomanometer. The sphygmomanometer cuff is snugly wrapped over the arm where the brachial artery is located. The air is pumped out of the cuff to squeeze the brachial artery to completely cut off the blood circulation in the vessel. The pressure is slowly released from the cuff to measure the systolic pressure and diastolic pressure. There are two ways to measure those pressures. The first method is palpatory method where the first pulse is felt once the pressure is slowly released from the cuff. That first pulse is the systolic pressure. However, this method does not measure the diastolic pressure. The second method is the auscultatory method where the first sounds of blood turbulence/snap is heard with a stethoscope, which is placed just below the cuff, after the pressure in the cuff is released. The first sound is heard at systolic pressure followed by murmurs, thumping which is where the first diastolic pressure is, followed by muting and silence, where the pressure reaches below diastolic pressure. These sounds are known as the Korotkoff sounds, which were discovered by Dr. Nikolas Korotkoff in 1905.

B) Results:

	Trial 1	**Trail 2**	**Trial 3**	**Average**
Partner 1 Measurements	--	--	--	--
Palpatory Systolic Blood Pressure (mmHg)	120	118	120	119.33
Auscultatory Systolic Blood Pressure (mmHg)	120	120	120	120
Auscultatory Diastolic Blood Pressure (mmHg)	75	70	70	71.67

Partner 2 Measurements	--	--	--	--
Palpatory Systolic Blood Pressure (mmHg)	110	107	109	108.67
Auscultatory Systolic Blood Pressure (mmHg)	108	110	110	109.33
Auscultatory Diastolic Blood Pressure (mmHg)	73	70	71	71.33

Table 1. Representation of partner 1's and partner 2's systolic blood pressure using the palpatory method and systolic and diastolic blood pressure using the auscultatory method over three trials.

C) Discussion:

Both methods produced physiologically realistic and reliable values. The average values for the systolic blood pressure obtained from the palpatory method was slightly lower than that obtained from auscultatory method. This was observed in both participant's pressure. The auscultatory method appears to be more reliable since definitive sounds can be heard through the stethoscope. On the other hand, the palpatory method requires the examiner to rely on their senses of touch to feel for the pulse, which can be potentially missed while monitoring the sphygmomanometer.

2. ECG:

A) Background:

An ECG represents the electrical activity of the heart using voltage as a function of time. The ECG is measured using electrodes by placing them on the skin. The electrodes then detect the changes in the depolarization and repolarization of the cardiomyocytes during each cardiac cycle. The limb lead ECGs consist of three leads, where the ECG is recorded from each lead at a time. The graph representing an ECG shows deflection directions which indicates the directional relationship between the electrical current flow vector and the axis of each lead. An ECG graph provides features and information about the conditions of heart during each cardiac cycle that is very useful. The P wave observed in an ECG indicates atrial depolarization and the beginning of contraction. The QRS complex indicates ventricular depolarization. The T wave represents ventricular repolarization. The PR interval indicates the contraction of atria and the conduction of electricity through the AV node to the AV bundle branches. The ST segment indicates the spread of depolarization wave through the Purkinje fibers in the ventricles.

B) Limb Lead I, II, III results:
i. *See Appendix*
ii. Durations of the QRS complex and the PR, QT and RR intervals.

	Lead I	**Lead II**	**Lead III**
QRS Complex Duration [s]	0.087	0.093	0.112
PR Interval Duration [s]	0.263	0.202	0.185
QT Interval Duration [s]	0.372	0.36	0.355
RR Interval Duration [s]	0.736	0.709	0.691

Table 2. The durations of the QRS complex and the PR, QT and RR intervals for lead I, II and III.

C) Exercise results:
i. *See Appendix*
ii. Changes in QRS duration, QT interval and ST segment shift (deviations from the baseline) with exercise

Constant Load	**Baseline**	**2 min**	**4 min**	**6 min**	**8 min**
QRS Complex Duration [s]	0.148	0.109	0.112	0.072	0.091
PR Interval Duration [s]	0.426	0.201	0.304	0.108	0.201
QT Interval Duration [s]	0.362	0.308	0.354	0.305	0.319
RR Interval Duration [s]	0.765	0.582	0.656	0.463	0.519

Table 3. Changes in QRS duration, QT interval and ST segment shift (deviations from the baseline) with exercise in the case of constant load

Graded Load	**Baseline**	**2 min**	**4 min**	**6 min**	**8 min**
QRS Complex Duration [s]	0.148	0.0935	0.113	0.086	0.072

PR Interval Duration [s]	0.426	0.255	0.153	0.125	0.113
QT Interval Duration [s]	0.362	0.329	0.328	0.297	0.279
RR Interval Duration [s]	0.765	0.612	0.528	0.442	0.421

Table 4. Changes in QRS duration, QT interval and ST segment shift (deviations from the baseline) with exercise in the case of graded load

D) Discussion:

The ECGs of each lead almost similarly produced all the features of heart's electrical activity during one cardiac cycle. However, the ECG from lead I and lead II were very noisy, with lead II's being the noisiest. Lead III ECG had the least amount of noise in the signal so it was easy to identify each peaks, troughs, intervals and segments. The magnitude of each wave slightly varied in each lead ECG as well.

The most noticeable change observed was the duration between each wave. The duration significantly became shorter with exercise with graded load, although, that was somewhat the case for ECG observed for exercise with constant load. That could be due to how the participant did the experiment. Overall, the results suggest that the ECG waves become close to each other with increasing exercise times. Additionally, the magnitude of each ECG waves did not vary with increasing exercise times in both constant and graded loads. The QRS complex remained almost the same for both constant and graded load exercise times, whereas, the P and T waves became harder to identify with increasing exercise times in constant load than graded load.

Appendix

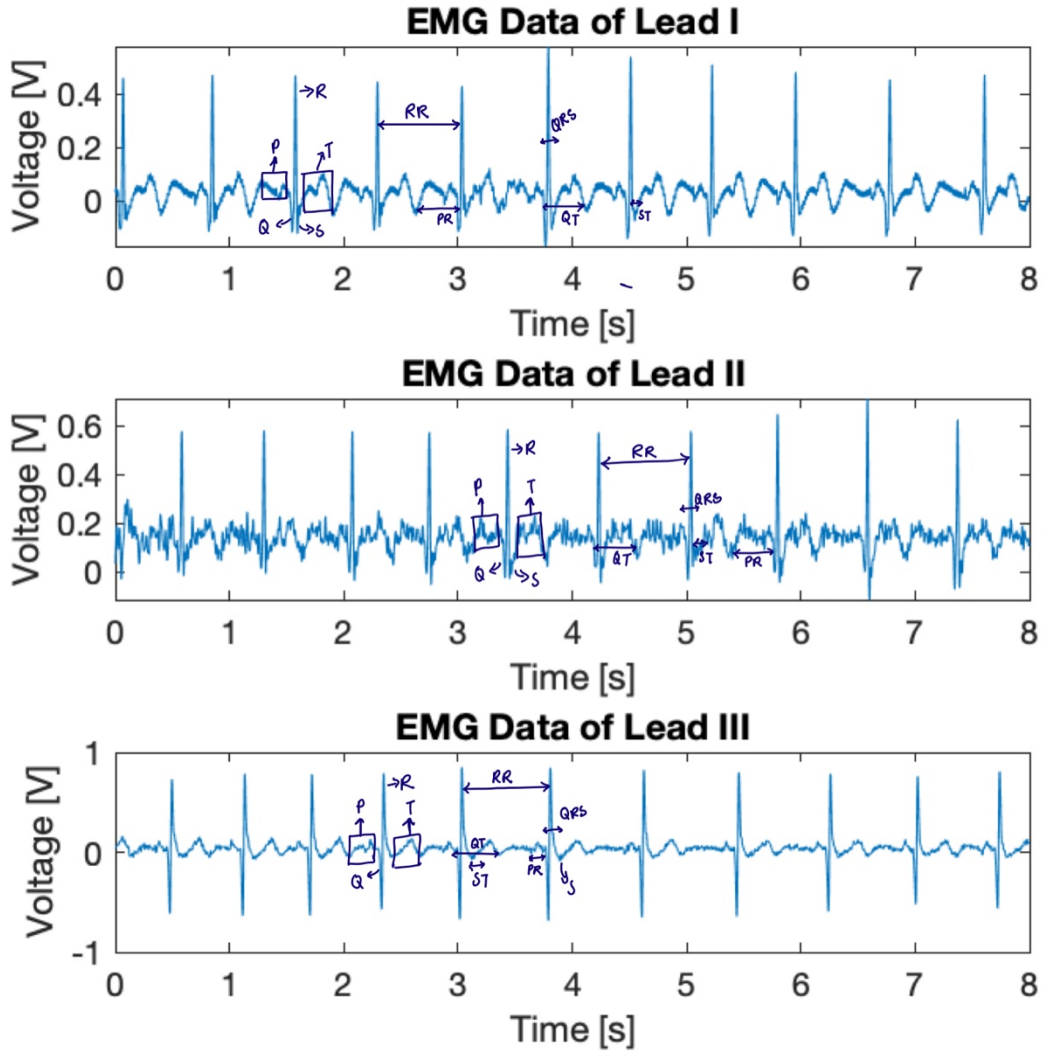

Figure 1. Representation of each lead ECG (I, II, III) and the features of ECG waves and intervals to indicate specific heart electrical activity

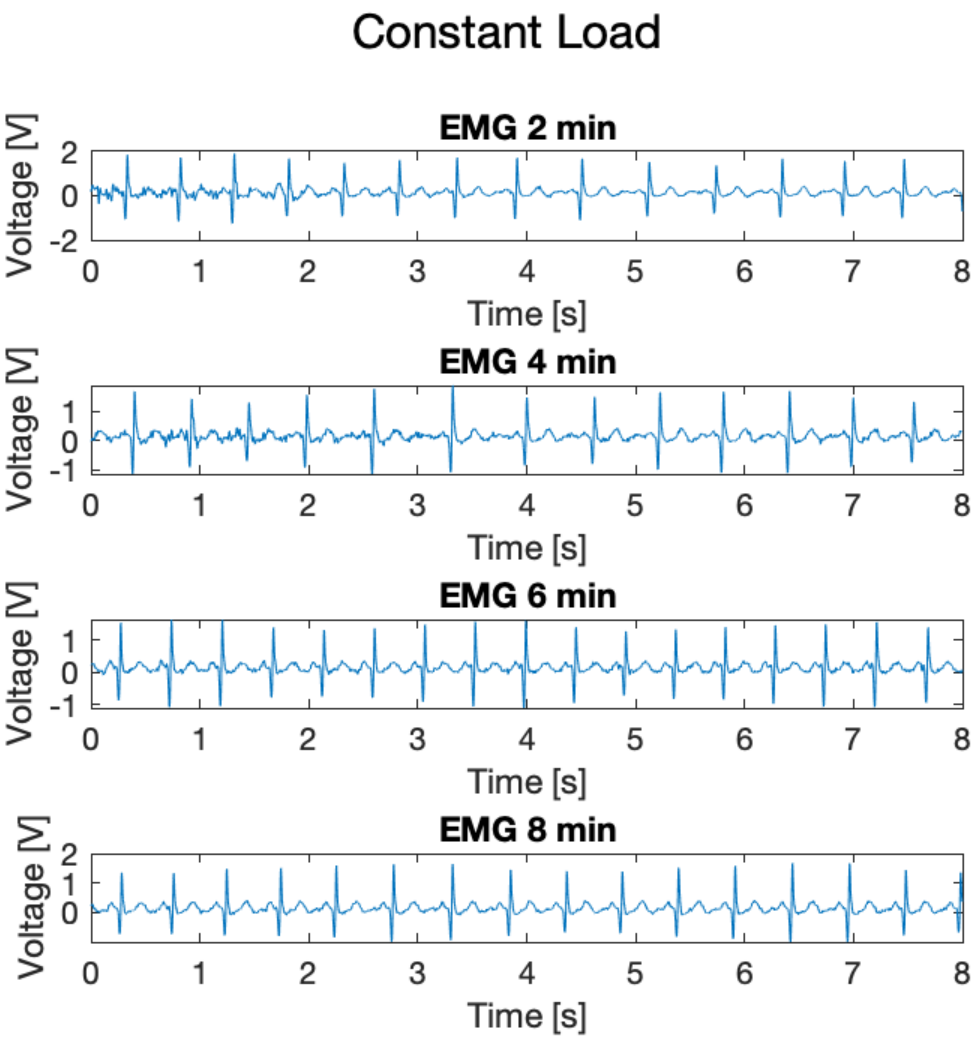

Figure 2. Representation of each ECG data collected at different times for exercise with constant load.

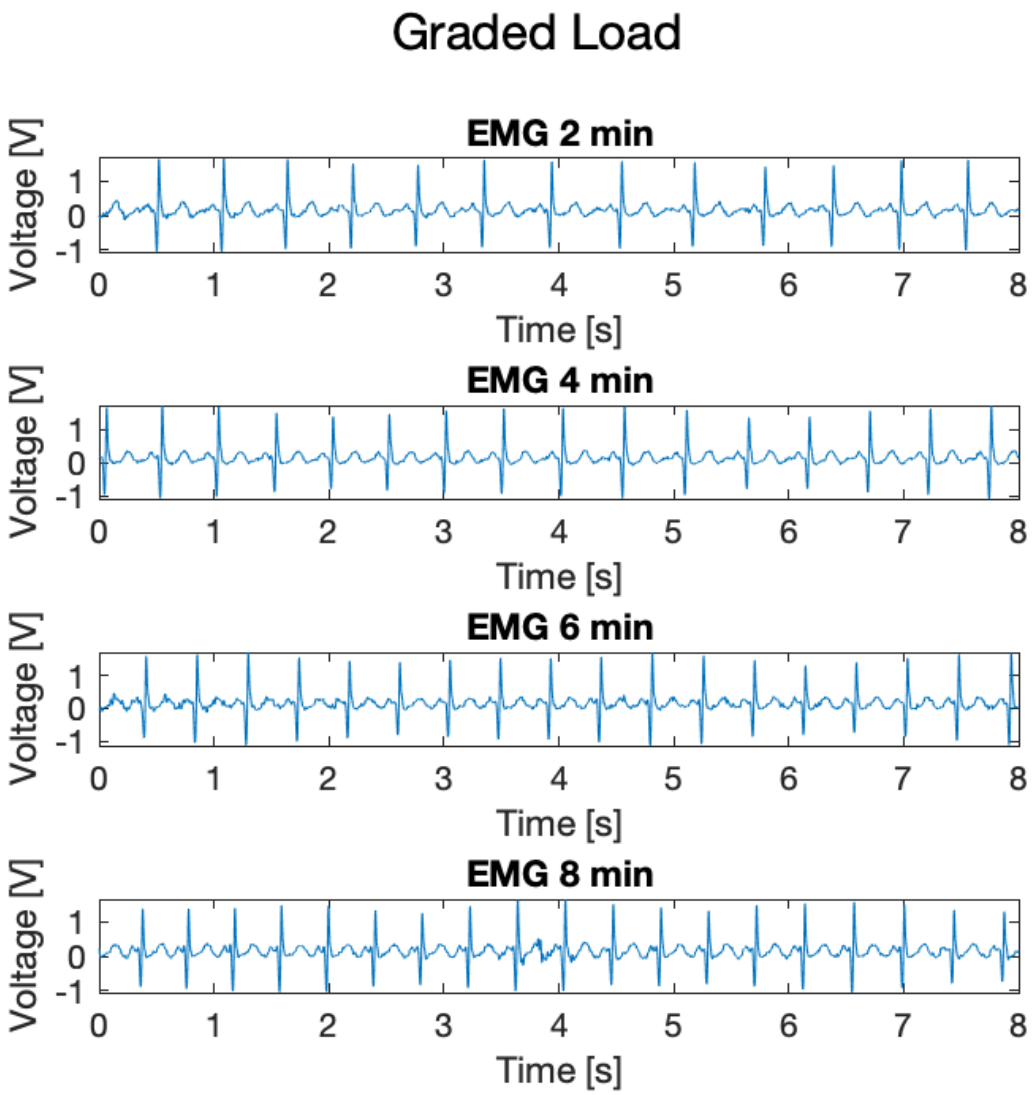

Figure 3. Representation of each ECG data collected at different times for exercise with graded load.

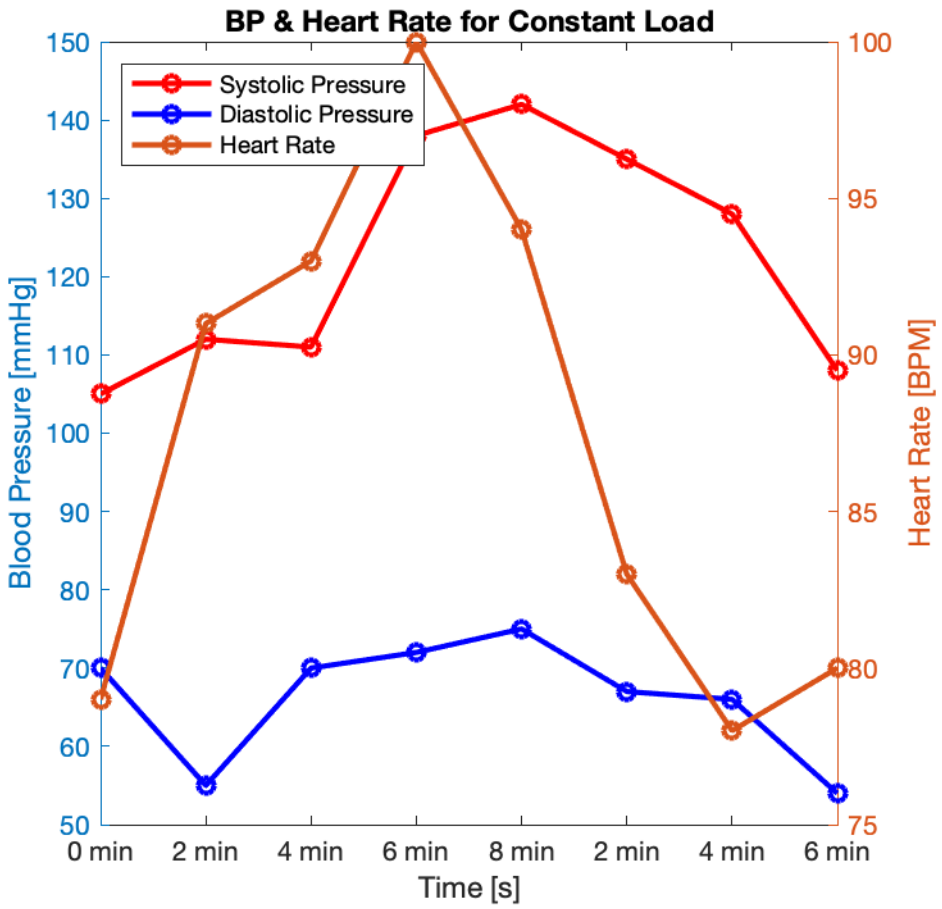

Figure 4. Representation of blood pressure and heart rate for constant load with time in seconds. The last three time points indicate recovery times.

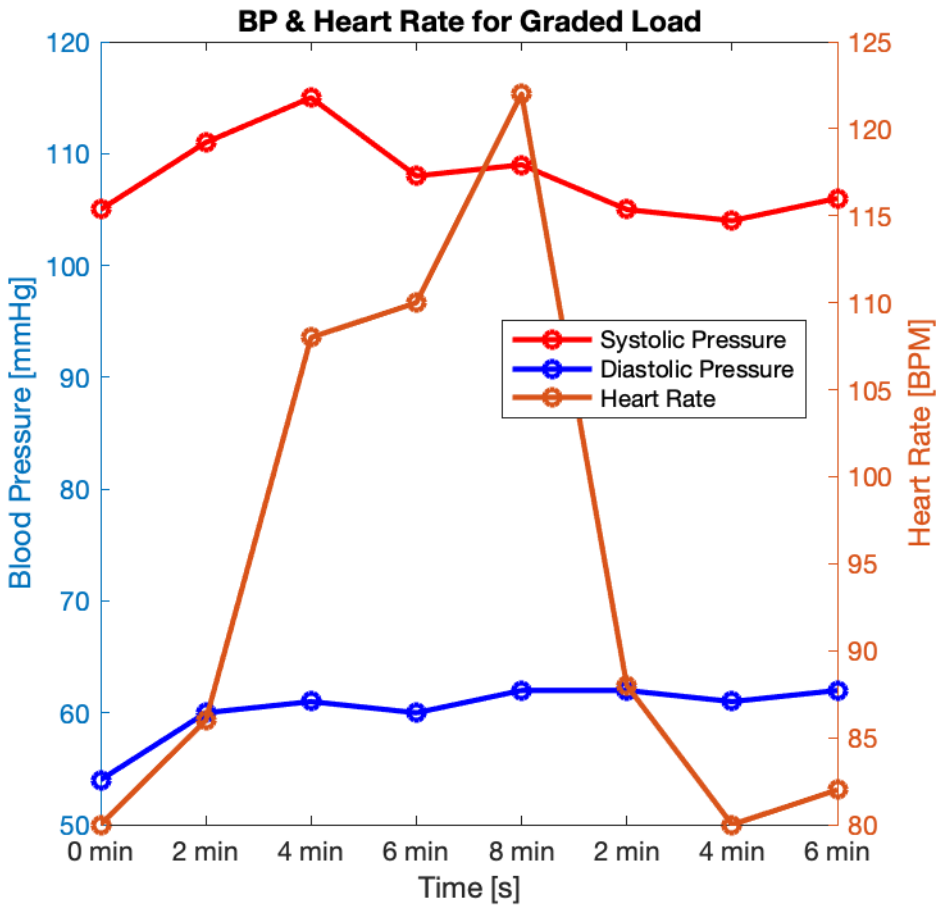

Figure 4. Representation of blood pressure and heart rate for graded load with time in seconds. The last three time points indicate recovery times.