BIOPAC Systems, Inc.
Registered to ISO 9001:2015
42 Aero Camino, Goleta, CA 93117
www.biopac.com

Biopac Student Lab® Lesson 5
ELECTROCARDIOGRAPHY (ECG) I
Data Report
Rev. 02202020

Richard Pflanzer, Ph.D.
Associate Professor Emeritus
Indiana University School of Medicine
Purdue University School of Science

William McMullen
Vice President, BIOPAC Systems, Inc.

ELECTROCARDIOGRAPHY I

- *ECG I*

DATA REPORT

Student's Name: Thisari Amarasekara
Lab Section: Electrocardiography (ECG) I
Date: 23/11/2022

I. Data and Calculations

Subject Profile
Name: D.K.D.Dewagiri_____ Height: 171cm_____

Age: 22 years____ Gender: Male / ~~Female~~ Weight: 53kg_____

A. Heart Rate

Complete the following tables with the lesson data indicated, and calculate the Mean as appropriate;

Table 5.2

Recording: Condition	Cardiac Cycle 40 Value 1	2	3	Mean (calculate)
Supine	69.12442	70.42253	73.98273	71.1765
Seated	73.3496	72.0288	70.1754	71.8513
Start of inhale	69.7674	70.0116	67.1892	68.9894
Start of exhale	73.8916	70.1754	72.4637	72.1769
After exercise	101.0175	103.80622	95.08716	99.9703

- If CH 40 was not recorded, use 1 BPM.

B. Ventricular Systole and Diastole

Table 5.3

Condition	Duration (ms) 1 Delta T	
	Ventricular Systole	Ventricular Diastole
Supine	**0.304**	**0.606**
After exercise	**0.247**	**0.325**

C. Components of the ECG

Table 5.4

Condition: Supine Recording (measurements taken from 3 cardiac cycles)										
ECG Component	**Normative Values** Based on resting heart rate 75 BPM		**Duration (ms)** 1 Delta T				**Amplitude (mV)** 1 P-P			
			1	**2**	**3**	**Mean (calc)**	**1**	**2**	**3**	**Mean (calc)**
Waves	Dur. (sec)	Amp. (mV)								
P	.07 - .18	< .20	0.099	0.089	0.099	0.096	0.206	0.19592	0.19348	0.1985
QRS Complex	.06 - .12	.10 – 1.5	0.076	0.074	0.079	0.076	1.035	1.05743	1.05468	1.0490
T	.10 - .25	< .5	0.227	0.231	0.197	0.218	0.2935	0.33416	0.32897	0.3189
Intervals	Duration (seconds)									
P-R	.12 - .20		0.137	0.135	0.134	0.135				
Q-T	.32 - .36		0.399	0.3958	0.389	0.395				
R-R	.80		0.9	0.881	0.847	0.876				
Segments	Duration (seconds)									
P-R	.02 - .10		0.49	0.48	0.45	0.47				
S-T	< .20		0.092	0.107	0.101	0.10				
T-P	0 - .40		0.306	0.306	0.345	0.32				

Table 5.5

Condition: After Exercise Recording (measurements taken from 1 cardiac cycle)				
ECG Component	**Normative Values** Based on resting heart rate 75 BPM		**Duration (ms)** 1 Delta T	**Amplitude (mV)** 1 P-P
Waves	Dur. (sec)	Amp. (mV)		
P	.07 - .18	< .20	0.073	0.2005
QRS Complex	.06 - .12	.10 – 1.5	0.96	1.13189
T	.10 - .25	< .5	0.156	0.1358
Intervals	Duration (seconds)			
P-R	.12 - .20		0.125	
Q-T	.32 - .36		0.298	
R-R	.80		0.646	
Segments	Duration (seconds)			
P-R	.02 - .10		0.031	
S-T	< .20		0.094	
T-P	0 - .40		0.22	

Note Interpreting ECGs is a skill that requires practice to distinguish between normal variation and those arising from medical conditions. Do not be alarmed if your ECG does not match the "Normative Values."

II. Questions

D. Using data from table 5.2:

1) Explain the changes in heart rate between conditions. Describe the physiological mechanisms causing these changes.

Considering the states supine, seated and after exercise, the mean heart rate is lowest when in supine state. This is mostly due to the control of the parasympathetic activities. The heart rate increases slightly when changing from supine to seated showing a brief sympathetic control and the heart rate decreases while continuing to stay seated since parasympathetic takes the control again.

Considering after exercise stage, the heart rate increases significantly due to the increased demand of Oxygen by the body. The heart rate continues to stay at a higher level for some time even after finishing the exercise.

2) Are there differences in the cardiac cycle with the respiratory cycle ("Start of inhale-exhale" data)?

Yes, theoretically at the start of the inhale the heart rate should increase slightly since the baroreceptors are activated due to the lowering of arterial blood pressure caused by the reduction in intra-thoracic pressure. And vice versa, the heart rate should decrease during start of exhale. However, in the practical scenario this was observed to be opposite which could be due to some condition of the individual.

E. Using data from table 5.3:

1) What changes occurred in the duration of systole and diastole between resting and post-exercise?

Both durations of systole and diastole has been reduced post exercise compared to the resting state. This is because of the increase of the heart rate during the exercise.

F. Using data from tables 5.4 and 5.5:

1) Compared to the resting state, do the durations of the ECG intervals and segments decrease during exercise? Explain

Yes, all the durations of the ECG intervals and segments have been decreased during exercise compared to the resting state. This is because the heart pumps fast, consequently reducing the diastole. i.e. The lower ECG intervals and segments are due to the shorter time to rest in-between.

2) Compare your ECG data to the normative values. Explain any differences.

Almost all the ECG data were within the normative range or very close to that. The only data that significantly differ from the normative values is duration of QRS complex after exercise which could be result of the difference of age and the fitness level of our subject compared to the subject used for normative values.

3) Compare ECG data with other groups in your laboratory. Does the data differ? Explain why this may not be unusual.

Yes, the data from the three individuals of the groups differ for some ECG data like durations of R-R interval and QRS complex. This could be due to the differences of fitness level, height, weight and other factors contributing to the heart rate which is normal scenario. Also, it is normal for different individuals to have different heart size and conditions causing a difference in the cardiac output.

G. In order to beat, the heart needs three types of cells. Describe the cells and their function.

1) Cardiac Muscle Cells: These cells are the most abundant cells in the heart and are specialized muscle cells that are striated with a high number of mitochondria to support their energy demand. They are responsible for the forceful contractions in the heart resulting in pumping blood from the heart.

2) Pacemaker Cells: These specialized cells are responsible for initiating the electrical impulses that control the heart's rhythms. They are found in the SA node located in the right atrium of the heart. Pacemaker cells generate electrical impulses spontaneously and rhythmically, setting the pace for the rest of the heart.

3) Conducting Cells: These cells distribute the electrical impulses generated by the pacemaker cells through the heart, coordinating the timing and strength of the heart's contractions. These are found in the AV node, the bundle of His, and the Purkinje fibers. The AV node delays the electrical impulse before passing onto the ventricles allowing the atria to fully empty out its blood into the ventricles. The bundle of His and the Purkinje fibers rapidly conduct the impulse throughout the ventricles, causing them to contract forcefully.

H. List in proper sequence, starting with the normal pacemaker, elements of the cardiac conduction system.

1) SA Node
2) Internodal pathway
3) Atrial Myocardium
4) AV Node
5) Bundle of his
6) Left and Right bundle branches
7) Purkinje fibers
8) Ventricular Myocardium

I. Describe three cardiac effects of increased sympathetic activity, and of increased parasympathetic activity.

Sympathetic	Increase in heart rate by increasing the rate of depolarization of the sinoatrial (SA) node
	Increase in the contractility of the myocardium, which results in an increase in stroke volume and cardiac output
	Causes a constriction of peripheral blood vessels, which increases the resistance to blood flow and causing a raise in blood pressure.
Parasympathetic	Reducing heart rate by slowing down the rate of depolarization of SA node
	Decreases the contractility of the myocardium causing a decrease in stroke volume and cardiac output
	Dilates the blood vessels decreasing the resistance to blood flow resulting in a decrease of blood pressure

J. In the normal cardiac cycle, the atria contract before the ventricles. Where is this fact represented in the ECG?

Occurrence of the P wave on the ECG which corresponds to the aria depolarization before the QRS complex which corresponding to the depolarization of the ventricles.

K. What is meant by "AV delay" and what purpose does the delay serve?

AV delay is the time interval between the activation of the atria and the activation of the ventricles.

The purpose of the AV delay is to ensure that the atria has enough time to contract and pump the blood into the ventricles before the contraction of the ventricles.

L. What is the isoelectric line of the ECG?

It is a baseline of the ECG signal that represents the absence of any electrical activity in the heart meaning it is not depolarizing neither repolarizing.

M. Which components of the ECG are normally measured along the isoelectric line?

PR segment and ST segment

End of Lesson 5 Data Report