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Biopac Student Lab® Lesson 5
ELECTROCARDIOGRAPHY (ECG) I
Analysis Procedure
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V.   DATA ANALYSIS

In this section, you will examine ECG components of cardiac cycles and measure amplitudes (mV) and durations (msecs) of the ECG components.

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 is different than the normal values and references in the Introduction.

FAST TRACK Data Analysis

1.   Enter the **Review Saved Data** mode.

- Note Channel Number (CH) designation:

    CH 1   **ECG** (Lead II)
    CH 40   **Heart Rate**

- Note measurement box settings:

Channel	Measurement
CH 40	Value
CH 1	Delta T
CH 1	P-P
CH 1	BPM

Detailed Explanation of Data Analysis Steps

If entering **Review Saved Data** mode from the Startup dialog or lessons menu, make sure to choose the correct file.
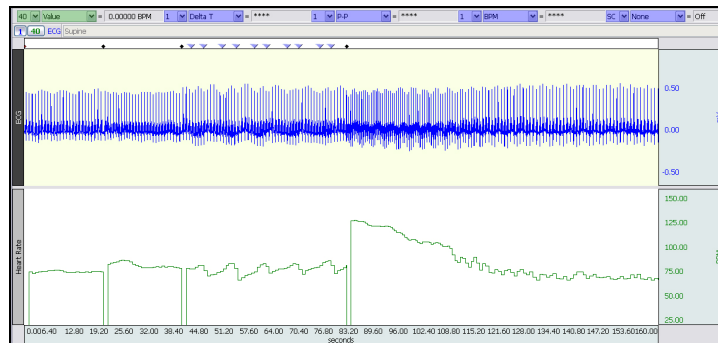

Fig. 5.14 Example data

The measurement boxes are above the marker region in the data window. Each measurement has three sections: channel number, measurement type, and result. The first two sections are pull-down menus that are activated when you click them.

Brief definition of measurements:

Value: Displays the amplitude value at the point selected by the I-beam cursor. If an area is selected, displays the value of the endpoint based on the direction the cursor was dragged.

- CH 40 heart rate data is only updated at the end of an R-R interval so it remains constant within an R-R interval; therefore, the Value (BPM) measurement will be accurate from any selected point in the R-R interval.

- Single point Values will be shown when placing the Arrow cursor over the data while holding down the left mouse button.

Delta T: Displays the amount of time in the selected area (the difference in time between the endpoints of the selected area).

P-P (Peak-to-Peak)**:** Subtracts the minimum value from the maximum value found in the selected area.

BPM: *Use only if CH 40 was not recorded.* The **B**eats **P**er **M**inute measurement first calculates the difference in time between the beginning and end of the selected area (seconds/beat,) and divides this value into 60 seconds/minute.

Rate Mean: If CH 40 Heart Rate data was recorded, use the Rate Mean measurement, which is designed specifically for rate data and calculates accurate statistical means using one value only for every cardiac cycle. This avoids any unintentional weighting due to time variation in heart rate, unlike the amplitude "Mean" measurement.

The õselected areaö is the area selected by the **I-beam** tool (including endpoints).

Data Analysis continues…

2. Set up your display window for optimal viewing of three complete cardiac cycles from the initial õ**Supine**ö segment.

NOTE: For accurate BPM data go past the first two cardiac cycles.

Textual notes (such as identifying components of the ECG wave) can be inserted into the graph by using the **Annotation** tool. This tool will place a small editable text box anywhere in the waveform.
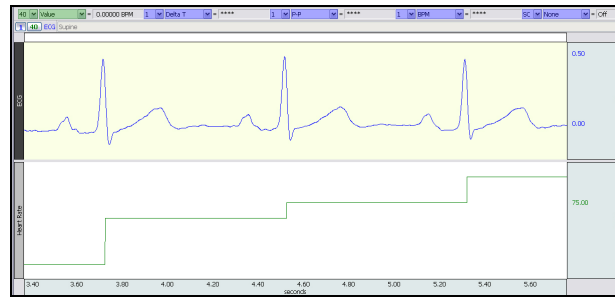

Fig. 5.15 Zoom in on "Supine" data

Note: The append event markers ✚ mark the beginning of each recording. Click (activate) the event marker to display its label.
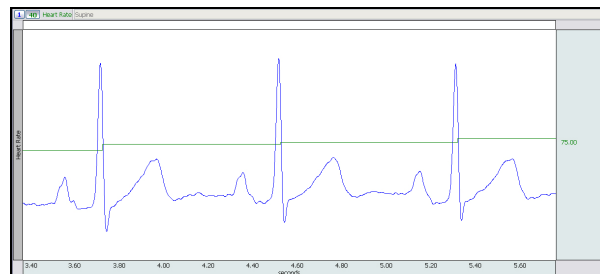
Useful tools for changing view:

Display menu: Autoscale Horizontal, Autoscale Waveforms, Zoom Back, Zoom Forward

Scroll Bars: Time (Horizontal); Amplitude (Vertical)

Cursor Tools: Zoom Tool

Buttons: Overlap, Split, Adjust Baseline (Up, Down,) Show Grid, Hide Grid, -, +

Hide/Show Channel: õAlt + clickö (Windows) or õOption + clickö (Mac) the channel number box to toggle channel display.

The Heart Rate channel is updated at the end of each R-R interval, so it will initially appear ‰out of sync,+or delayed by one interval. (See Fig. 5.17 for illustration.)

Fig. 5.16 Overlap sample: Heart Rate and ECG after supine Subject is seated

Adjust Baseline allows you to position the waveform up or down in small increments so that the baseline (isoelectric line) can be exactly zero. After **Adjust Baseline** is pressed, **Up** and **Down** buttons are generated. Simply click these to move the waveform up or down. This is not needed to get accurate amplitude measurements, but may be desired before making a printout, or when using grids.

3. For measuring heart rate, use the cursor to select any data point within an R-R interval.

📑 **A**

Data Analysis continues…

Note that the CH 40 Value measurement displays the BPM for the interval preceding the current R-R interval.

If CH 40 Heart Rate data was not recorded, use CH 1 BPM measurement to determine the heart rate; select from R wave peak to R wave peak as precisely as possible.

Follow the examples shown above to complete all the measurements required for the Data Report.

4. Take measurements within two other R-R intervals in the current segment.

    📑 **A**

5. Repeat measurements on the other segments as required for the Data Report.

    📑 **A**

Fig. 5.17 Data point selection for Heart Rate data correlated to ECG data

6. Hide CH 40.
7. **Zoom** in on a single cardiac cycle from õ**Supine**ö segment.
8. Measure Ventricular Systole and Diastole.

    📑 **B**

9. Repeat measurements for õ**After exercise**ö segment.

    📑 **B**

10. **Zoom** in on a single cardiac cycle from õ**Supine**ö segment.

11. Use the I-Beam cursor to select segments and measure the durations and wave amplitudes required for the Data Report. Use P-P measurement to obtain amplitudes.

    📑 **C**

The remaining measurements use ECG data only. To hide Heart Rate data display and focus on ECG data, Alt + click (Windows) or Option + click (Mac) the õ40ö channel number box.

For Ventricular Systole and Diastole measurements, the T wave reference point for the selected area is 1/3 of the way down the descending portion of the T wave; if necessary, see Fig. 5.2 and Table 5.1 in the Introduction PDF for selected area details.

Measurement data starts at the append event marker labeled õ**After exercise**.ö

Select the components of the ECG as specified in the Introduction and gather wave amplitude data for 3 cycles using the P-P measurement. If necessary, see Fig. 5.2 and Table 5.1 in the Introduction for selected area details.
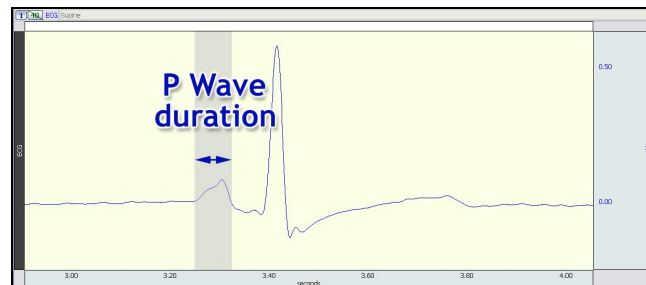
Fig. 5.18 Measuring P wave duration (Delta T) and amplitude (P-P)
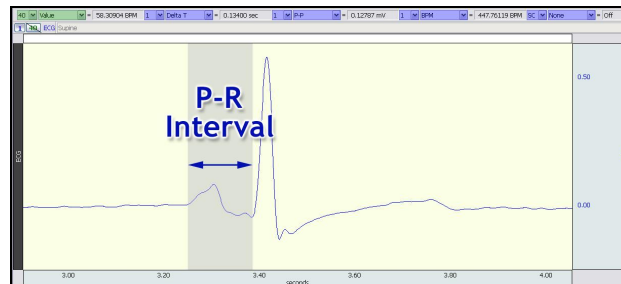
Fig. 5.19 Selection of P-R Interval

12. **Zoom** in on a single cardiac cycle from õ**After exercise**ö segment.

13. Repeat duration and amplitude (P-P) measurements using õ**After exercise**ö data as required for the Data Report.
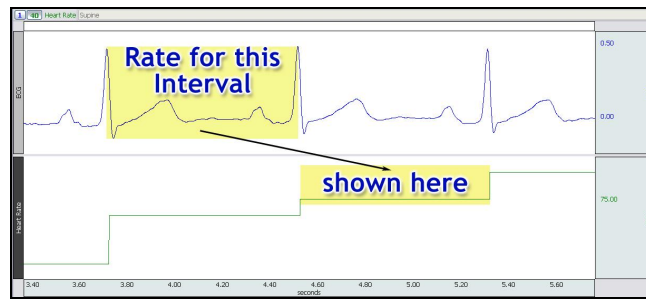
    📑 **C**

Follow the examples shown above to complete all the measurements required for your Data Report.

Data Analysis continues…

14. **OPTIONAL:** Using the **Annotation** tool, insert text boxes identifying the ECG components in the selected area. Copy and paste this graph to the Data Report at the end of Section C.

Use the **Annotation** Tool to insert text boxes into the graph identifying the ECG components in the selected portion, and then drag them to their correct locations within the ECG waveform.
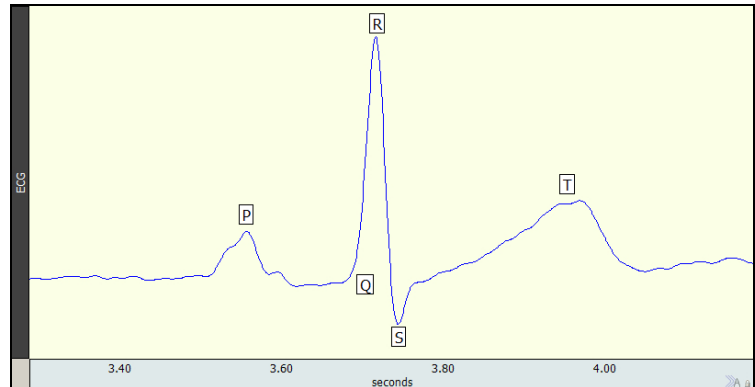
Fig 5.20 Example of ECG Component Annotations

- Use the **Copy Graph** button to copy the selected area.
- Use the contextual menu in the Journal to paste the graph into the Data Report.

15. Answer the questions at the end of the Data Report.
16. **Save** or **Print** the data file.
17. **Quit** the program.

An electronically editable **Data Report** is located in the journal (following the lesson summary,) or immediately following this Data Analysis section. Your instructor will recommend the preferred format for your lab.

END OF DATA ANALYSIS

END OF LESSON 5
Complete the Lesson 5 Data Report that follows.

ELECTROCARDIOGRAPHY I

- *ECG I*

DATA REPORT

Student's Name: _____

Lab Section: _____

Date: _____

I. Data and Calculations

Subject Profile

Name: _____   Height: _____

Age: _____   Gender: Male / Female   Weight: _____

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				
Seated				
Start of inhale				
Start of exhale				
After exercise				

- 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		
After exercise		

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] 1	2	3	Mean (calc)	**Amplitude (mV)** [1] [P-P] 1	2	3	Mean (calc)
Waves	Dur. (sec) / Amp. (mV)								
P	.07 - .18 / < .20								
QRS Complex	.06 - .12 / .10 . 1.5								
T	.10 - .25 / < .5								
Intervals	Duration (seconds)								
P-R	.12 - .20								
Q-T	.32 - .36								
R-R	.80								
Segments	Duration (seconds)								
P-R	.02 - .10								
S-T	< .20								
T-P	0 - .40								

Table 5.5

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

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.

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

     E.   Using data from table 5.3:

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

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

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

_____

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

1) _____

2) _____

3) _____

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

1) _____

2) _____

3) _____

4) _____

5) _____

6) _____

7) _____

8) _____

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

Sympathetic _____

_____

_____

Parasympathetic _____

_____

_____

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

_____

_____

K. What is meant by õAV delayö and what purpose does the delay serve?

_____

_____

L. What is the isoelectric line of the ECG?

_____

_____

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

_____

_____

III. OPTIONAL Active Learning Portion

A. *Hypothesis*

_____

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B. *Materials*

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C. *Method*

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D. *Set Up*

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E. *Experimental Results*

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End of Lesson 5 Data Report