LABORATORY 10–ELECTROCARDIOGRAPHY
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Purpose:

Electrocardiography is the study of the electrical activity of the heart. Cardiac muscle cells are the sources of this electrical activity. EKG's are graphical records that measure the change in the electrical activity of the heart. Cassandra and Jasmin are going to measure the electrical activity to see how the activity looks.

Procedure:

10-A: Recording the EKG – Lead II

Procedure

1. To get things started:
   Before you turn anything on, be sure the IWX/214 unit is plugged in, and that the IWX/214 unit is connected to the laptop by USB cable.
   Be sure that the C-AAMI-504 EEG cable is inserted into the isolated inputs of Channels 1 and 2 of the IWX/214. Be sure that the three color-coded lead wires are correctlyinsertedintheleadpedestaloftheC-AAMI-504EEGcable. Insert the connectors on the red, black, and green electrode lead wires into the color-coded matching sockets on the lead pedestal of the ECG cable. The white and brown lead wires can be removed and neatly placed in the Iworx case, you do not need them for Lab 10, but after the week is over they will need to be replaced.
   Once everything is connected, FIRST turn on the laptop and allow it to fully boot up before you turn on the IWX/214 unit. Once the Iworx unit is on, the red indicator light on the Iworx unit should light up and you may hear the USB chime from the laptop if the laptop does not default to mute (many are set to default to mute).
2. Open the Labscribe3 program by clicking on the Labscribe3 icon on the desktop. As soon as the program opens, you should see a window pop-up that says "Hardware found IWX214:2008-1-24," click "OK."
3. In the second from the top row (the row that says "File Edit View Tools Settings Advanced External Devices Help"), click on the "Settings" tab. About one third of the way down the drop-down window should be a tab called "Human Heart." Click on that tab and that should lead you to a tab called "ECG-HeartSounds." Click on that tab and the main window will look like this after you close the pdf file:

4. Since Lab 10 is about ECG only, we can hide the lower "Heart Sounds" row by clicking on the symbol to the left of the row label, then clicking on the "Hide" tab, and then "Yes".

5. Remove the disposable ECG electrodes from its envelope and snap the lead wires onto the electrodes while the electrodes are still on the plastic shield. Instruct the subject to remove all jewelry from their wrists and ankles. Use an alcohol swab to clean a region of skin on the subject's right wrist, and the inside of both ankles. Let the area dry.
6. Apply the black (-1) electrode to the scrubbed area on the right wrist. Repeat Steps 5 and 6 for the inside of the left ankle and the inside of the right ankle, so that the following Lead II is arranged:
   the black (-1) lead is attached to the right wrist,
   the red (+1) lead is connected to the left ankle,
   the green (C or ground) lead is connected to the right ankle.
7. Instruct the subject to sit quietly with their hands in their lap. If the subject moves, the ECG trace will move off the top or bottom of the screen. If the subject moves any muscles in the arms or upper body, electromyograms (EMGs) from the muscles will appear on the ECG recording as noise.
8. Click on the Record button, located on the upper right side of the LabScribe Main window. The signal should begin scrolling across the screen. If the ECG appears upside down in Lead II (upside down P, R and T waves), click on the upside down triangle on the far left of "A1:ECG 0.3-35Hz," then click on the first option "Invert." This should correct the image of your Lead II ECG to be "right side up," but do this ONLY ONCE.
9. When you have a suitable trace, type <Subject's Name> Lead II in the Mark box to the right of the Mark button. Press the Enter key on the keyboard after the recording has started to attach the comment to the data.
10. Click on the AutoScale tab at the upper margin of the ECG channel (look for the row that says on the left "A1:ECG 0.3-35Hz" the AutoScale tab is the second icon after "Hz," it looks like a magnifying glass with a symbol on it). Your recording should look like the figure in step #4. If the ECG waves appear too compressed (too close together), consider clicking the tab above the "Mark" tab that looks like a snow-capped pyramid. When the mouse is on top of this tab, it will say "Half Display Time." Clicking this tab will spread out your ECG patterns for step 11. If you overdo that last step, reverse it by clicking on the tab that looks like double pyramids ("Double Display Time") just to the right of the Half Display Time tab.
11. Record for approximately one minute and then click Stop to halt recording. Label one set of the five ECG waves (P, Q, R, S andT). Notice that every cycle is similar but not identical, and the distances between the QRS complexes may alter slightly.

10-B: Demonstration of Einthoven's law (Note: the one student in your group doing 10-B should be the last one doing 10-A – Lead II)

Procedure

1. Keep the electrodes on the skin and carefully unsnap the red (+1) lead wire off the left ankle and snap it onto the electrode on the left wrist. Be sure to use an alcohol swab to clean a region of skin on the subject's left wrist, if not done yet. Let the area dry.
2. Click the red Rec button again and the signal will resume scrolling across the screen (but will look different).
3. When you have a suitable trace, type <Subject's Name> Lead I in the Mark box to the right of the Mark button. Press the Enter key on the keyboard after the recording has started to attach the comment to the data.
4. Click on the AutoScale button at the upper margin of the ECG channel.
5. Record for approximately one minute and then click the black Stop button to halt recording. Label one set of the five Lead I ECG waves (P, Q, R, S &T).
6. Keep the electrodes on the skin and carefully unsnap the red (+1) lead wire off the left wrist and snap it back onto the electrode on the left ankle. Then carefully unsnap the black (-1) lead wire off the right wrist and snap it onto the electrode on the left wrist.
7. Click the Record button again and the signal will resume scrolling across the screen (but will look different).
8. When you have a suitable trace, type <Subject's Name> Lead III in the Mark box to the right of the Mark button. Press the Enter key on the keyboard after the recording has started to attach the comment to the data.
9. Click on the AutoScale button at the upper margin of the ECG channel.
10. Record for approximately one minute and then click Stop to halt recording. Label one set of the five Lead III ECG waves (P, Q, R, S &T).

11.Scroll back through the recording and find a section of data with five or six exemplary

Lead III ECG/pulse cycles in succession.

12. Use the Half Display Time icons to adjust the Display Time of the Main window to show approximately four complete ECG/Pulse cycles on the Main window. This will spread out the ECG enough to do your analysis.

13. It is possible to do the analysis from the Main Window. Move the red cursor lines (there are two) by left clicking on the red cursor line and while holding down the left mouse pad button, sliding your finger on the mouse pad to move one red cursor line to the lowest point of the Q wave, then releasing the left mouse pad button. Move the other red cursor line to the highest point of the R wave. Look at the top right of the screen where it says "T2 – T1" = _____ msec (ignore this number), just below that find V2 – V1 = _____mV (record this number). This number may be difficult to read due to your laptop screen's aspect ratio. If you can make out the number, repeat this step so you have V2 – V1 =

_____mV numbers for all three leads. If you cannot make out the numbers, go to Step 14.

14. Click on the Analysis window icon on the LabScribe toolbar (it is the fifth icon from the left in that row: New File, Open File, Save File, Main Window, and Analysis). Look at the Function Table that will appear between the row with the Analysis window icon and your ECG graph. The names of the mathematical functions used in the analysis, V2-V1 (what you need) and T2-T1 (this you can ignore), appear in this table. See if you can make the numbers out there. If you can make out the numbers, repeat this step so you have V2 – V1 = _____mV numbers for all three leads. If you cannot make out the numbers, go to Step 15.
15. Left click on the numbers you cannot make out, and then click on the top choice "Add Ch. Data to Journal." Then go to that same row above the Function table where you found the Analysis window icon. Go to the eighth icon from the left in that row (three to the right of the Analysis window icon): New File, Open File, Save File, Main Window, Analysis, FFT (Spectrum), XY View, and Journal. Click on Journal and your numbers will clearly visible.
16. Now repeat steps #14-15, so you have V2 – V1 = _____mV numbers for all three leads.
17. Add the mV numbers from Leads I and III, does it equal the mV number from Lead II? One issue that can throw off your math is an inverted Q-R amplitude in Leads I or III. If the R wave is inverted, that V2-V1 amplitude needs to be a negative number (you need to subtract it from the mV of the other Lead, not add to it).
18. Even if the cumulative numbers for Leads I and III are close to the mV of Lead II, did the subject actually demonstrate Einthoven's Law? Why not? (See top of p. 65.)

10-C: Examination of abnormal EKGs

Procedure

1. Be able to recognize each of the following abnormalities.

Sinus bradycardia – A very slow resting heartbeat, below 60 BPM.

Sinus tachycardia – A very rapid resting heartbeat, above 100 BPM.

Ectopic focus – A spontaneous depolarization away from the SA node.

Atrial flutter – A rapid ectopic heartbeat that produces identical waves.

Atrial fibrillation – A very rapid ectopic focus of the atrium producing an irregular EKG.

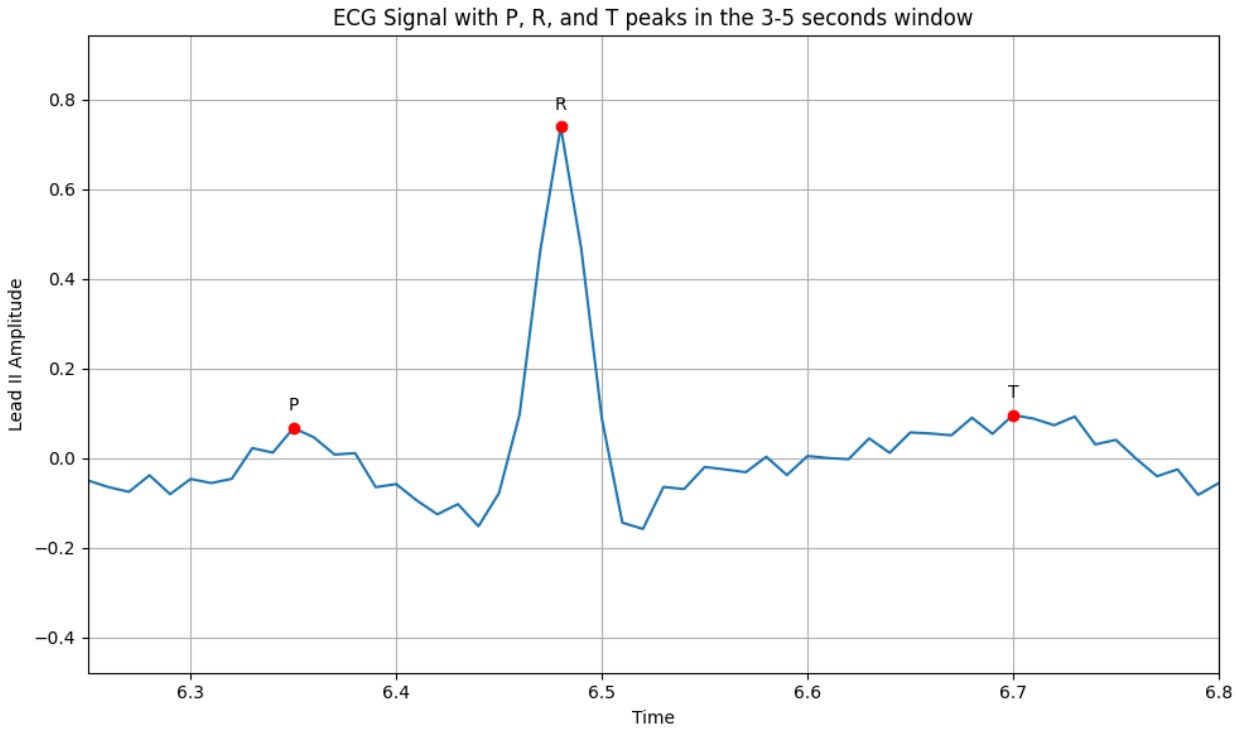
Premature ventricular contraction (PVC) – Ectopic focus in ventricle

Premature atrial contraction (PAC) – Ectopic focus in atrium

Ventricular fibrillation – A rapid depolarization of the ventricle producing an irregular EKG.

Heart block – Blockage of conductive pathways giving a partial EKG.
Myocardial ischemia – Reduced blood supply causing a depressed or inverted T wave.
Myocardial infarction – Death of the cardiac tissue resulting in an elevated S-T interval.

Results:



Discussion:

Using the code to graph this was interesting to see. It was something neither Cassie or Jasmin had done before and even though it looked hard, doing it step by step, seeing each one get graphed as it was was really interesting to see. Now, we graphed her ECG and added it to our lab. Even labeled it and it was cool.

Conclusion:

It mostly looked like a normal heart ECG. The purpose of this lab was to see and graph a heart ECG and that is what we did. Overall, it looks like a good heart ECG to us.