Lab 8: Blood Pressure, Peripheral Circulation and Imposed Conditions

Overview

The ventricles contract to push blood into the arterial system and then relax to fill with blood before pumping once more. This intermittent ejection of blood into the arteries is balanced by a constant loss of blood from the arterial system through the capillaries. When the heart pushes blood into the arteries there is a sudden increase in pressure (called the systolic pressure), which slowly declines until the heart contracts again (the lowest arterial pressure is called the diastolic pressure). In the previous lab these two pressure values were measured from willing volunteers in a study of the effects of cuff location and body position on blood pressure.

In this lab volunteers will be engaged in a number of short-term experiments to see the effects of apnea, exercise and temperature on blood pressure and peripheral circulation.

Warning: *As explained previously, this procedure involves stopping blood flow to the arm. This is potentially dangerous. Please take the following precautions:*

1 Know what you are doing ahead of time.

2 Do not leave the cuff inflated for any prolonged period of time (>30 seconds).

3 The volunteer should flex and extend their fingers between experiments—to maintain blood flow.

4 This experiment should be performed by healthy individuals who do not have a personal or family history of cardiovascular or respiratory problems. If possible, use more than one volunteer during the course of the lab session.

Equipment Required

PC computer
iWorx/214 and USB cable
Plethysmograph
Blood pressure cuff
Event marker
Plastic bag, ice, cold and hot water

Equipment Setup

1 Connect the iWorx/214 unit to the computer (described in Chapter 1).

2 Plug the DIN connector on the end of the plethysmograph cable into Channel 3 (Figure 6-21).

3 Place the plethysmograph on the volar surface (where the fingerprints are located) of the distal segment of the middle finger, and wrap the Velcro strap around the end of the finger to attach the unit firmly in place.

4 Plug the DIN connector of the event marker into Channel 4 (Figure 6-21).

5 Place the blood pressure cuff around the upper portion of the left arm, between the elbow and the shoulder.

6 The volunteer should sit quietly.

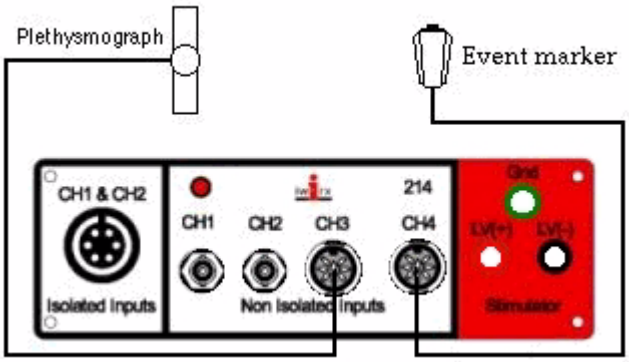

Figure 6-21: The equipment used to measure blood flow from a volunteer.

Start the Software

1 Click the Windows **Start** menu, move the cursor to **Programs** and then to the **iWorx** folder and select **LabScribe**; or click on the LabScribe icon on the Desktop.

2 When the program opens, select **Load Group** from the **Settings** menu.

3 When the dialog box appears, select **ahk214.iws** and then click **Load**.

4 Click on the **Settings** menu again and select the **BP-ImposedConditions-214** settings file.

5 After a short time, LabScribe will appear on the computer screen as configured by the **BP-ImposedConditions-214** settings.

Exercise 1: Procedure for Measuring Blood Pressure

Aim: To measure the blood pressure.

Procedure

1 Ask the volunteer to sit down and relax, with both hands in their lap.

2 Click **Start** and record the finger pulse. Check Channel 3 (**Pulse**); if the pulse goes down, **Stop** the recording. Use the **Invert** function in the rightclick menu for Channel 3 to orient the image in the correct direction, and **Start** recording again.

3 Click **AutoScale** for the Channel 3 (**Pulse**) to make the signal bigger.

4 During this initial recording, type “BP Measurement” in the comment line (next to the **Mark** button), and press the **Ente**r key on the keyboard.

5 Inflate the cuff until the pressure is just above 200 mmHg. Notice that the finger pulse disappears as the cuff is inflated (Figure 6-22).

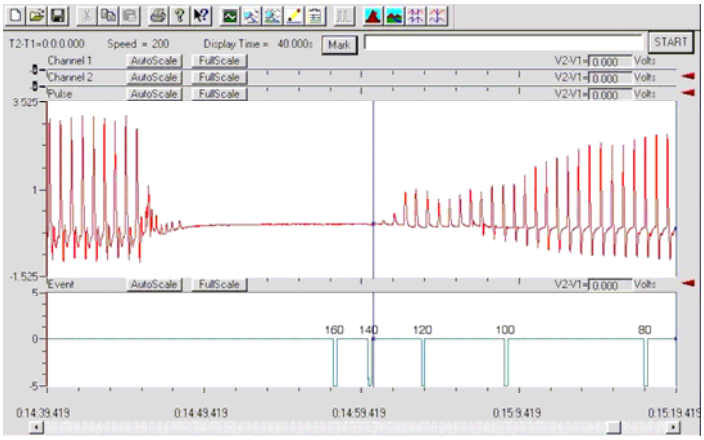

Figure 6-22: A finger pulse record during the blood pressure measurements. In this experiment a few pulses were recorded (left) before inflating the cuff around the left upper arm. As the pressure in the cuff exceeded that in the artery, the pulse signal disappeared indicating that blood circulation had ceased. As the cuff pressure was released (marked in 20mmHg increments on the lower trace) the signal appeared (at the blue cursor line) between 140 and 120mmHg.

6 Slowly release the cuff pressure. When the pressure reaches 200mmHg, quickly press and release the event marker to produce a signal on Channel 4 (**Event**). Repeat the signal every time the pressure drops by an increment of 20mmHg.

7 When the cuff reaches 40mmHg, click the **Stop** button and remove the cuff. The volunteer should flex and extend their fingers to encourage blood circulation.

8 Select **Save As** in the **File** menu, type a name for the file. Choose a destination on the computer in which to save the file(e.g. the **iWorx** or class folder). Click the **Save** button to save the file (as an ***.iwd** file).

Data Analysis -Measure Blood Pressure

Systolic Pressure

1 Click the **2-Cursor** icon (Figure 6-23) so that two blue vertical lines appear on the **Main** window.

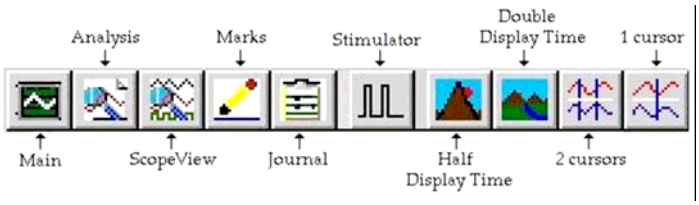

Figure 6-23: The LabScribe toolbar

2 Find the section of Channel 3 (**Pulse**) where the pulse wave first reappears after the cuff pressure is released (around 120mmHg in Figure 6-22).

3 Use the cursors to select the section of the recording that includes this small pulse wave and the closest event mark on each side of the wave.

4 Click the **Analysis** icon (Figure 6-23) to open the **Analysis** window (Figure 6-24).

5 To find the systolic pressure, place one cursor on the peak of the smallest pulse wave (Figure 6-24) and the second cursor on the event mark to the right of the peak. Measure the time interval between them and call it “Time Value #1” (Figure 6-24).

6 Move the cursor from the pulse wave to the event mark on the left side of the pulse wave. Measure the time interval between the two event marks and call it “Time Value #2” (Figure 6-24).

7 Calculate: (Time Value #1 / Time Value #2) x 20mmHg.

8 Add the number calculated in Step 7 to the lower blood pressure value associated with the event mark on the right side of “systolic” pulse wave. The sum of these two numbers is the systolic blood pressure.

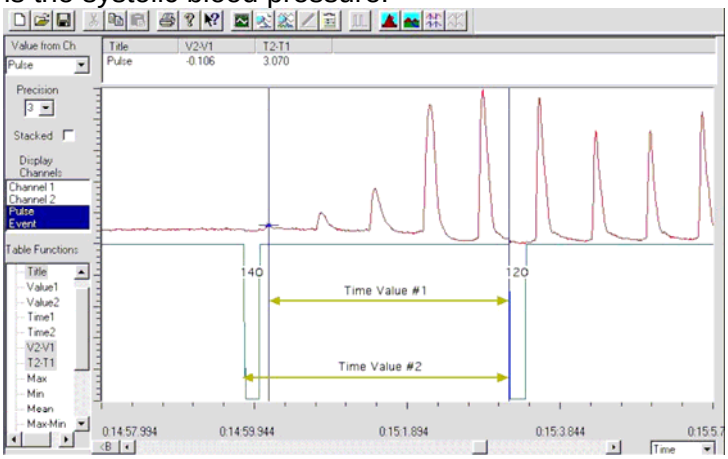

Figure 6-24: The finger pulse trace showing the recording taken as cuff pressure declined from 140 (left) to 120 (right) mm Hg. The (blue) cursor is located at the first pulse signal and the time values to be measured are shown.

Diastolic Pressure

As more pressure is released from the cuff, the amplitude of the pulse wave increases. The pressure at which the pulse wave reaches the maximum amplitude is the diastolic pressure (around 80mmHg in Figure 6-24).

Use the cursors to select the area around the pulse wave, that first reaches the maximum amplitude. Include the event mark closest to the wave, on each side of the wave. Use the **Analysis** window to interpolate the data and make the same type of calculation used to determine the systolic pressure.

Procedure

Two types of experiments will be performed in this lab and student volunteers should participate in only one type of experiment:
• Long-term experiment—in which measurements are taken every 20 minutes throughout the lab.
• Short-term experiments—in which measurements are taken during a manipulation conducted in the periods between the long-term experiment.

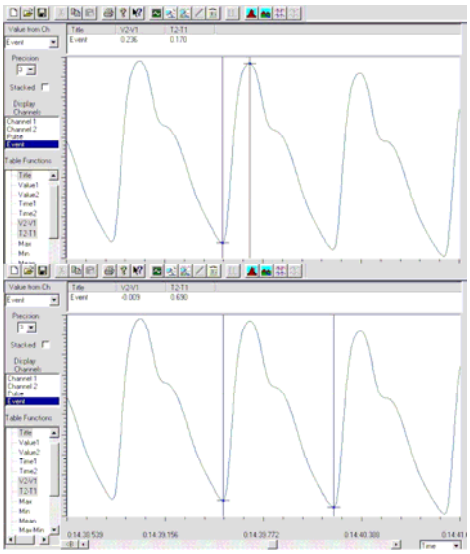

Figure 6-25: An integrated signal from the plethysmograph shown in the Analysis window with the cursors placed to measure the amplitude (V2-V1) of the signal (upper) and thetime delay (T2-T1) between the two signals (lower).

Exercise 2: Effects of Exercise

Aim: To examine the effects of exercise on blood pressure.

Procedure

1 Plug the DIN connector on the end of the plethysmograph cable into Channel 3.

2 With the cuff around the left upper arm and the plethysmograph on the left middle finger:
• Record the volume pulse for 30 seconds.
• Record the data needed to determine the subject's blood pressure.

3 Remove the DIN connector of plethysmograph from the iWorx/214 unit and have the subject hold it in their left hand.

4 The subject should exercise carefully, with minimal class disruption but vigorously enough to elevate heart rate. Try walking up and down stairs.

5 Immediately after exercise, plug the plethysmograph into Channel 3.

6 Click **Start**, inflate the cuff and record the data needed to determine the subject's blood pressure, as it was done in Exercise #1. After the cuff is deflated, type "Recovery from Exercise" on the comment line and press the **Enter** key on the keyboard.

7 Click **Stop** to halt recording.

8 Select **Save** from the **File** menu.

Data Analysis

Determine blood pressures using the technique used in previous exercises.

Question

Compare the blood pressure before and after exercise. Does exercise change blood pressure?

Exercise 3: Apnea (holding breath)

Aim: To examine the effects of apnea on blood pressure and peripheral circulation.

Procedure

1 If a new volunteer is used, measure their resting blood pressure.

2 As a preliminary study, record volume pulse and have the volunteer take in a deep breath, hold it for as long as possible and then breathe normally (type appropriate comments to label each part of the experiment).

Questions

1 What are the effect of periods of apnea on heart rate and the amplitude of the volume pulse?

2 Are there any changes when breathing is initiated once more?

3 Explain your results. Do you think apnea has an effect on blood pressure?

Procedure

Repeat the above procedure and measure blood pressure when the volunteer is holding their breath – be careful.

Questions

1 What is the effect of apnea on blood pressure?

2 Explain your results.