(3) Tuesday October 26th

Cardiovascular experiments in the human

An assessment of cardiovascular function can be made by determining the heart rate and the systemic blood pressure. These two measurements which are fairly easy to make enable us to study how the cardiovascular system responds to changing situations.

1. Pulse Rate

Find the radial pulse at the inner surface of the forearm proximal to the thumb. Count the number of beats in 15 seconds and multiply by 4 to give the pulse rate in beats per minute.

2. Blood pressure

Blood pressure in man is usually determined by an indirect method. An inflatable cuff, connected to a pressure gauge (sphygnomanometer), is placed around the upper arm and pumped up. The pressure in the cuff which just stops blood flow in the arm equals the peak blood pressure, termed systolic, whilst that which just lets the blood flow unimpeded corresponds to the diastolic pressure.

These two pressures may be determined by listening to the sounds made by the blood passing through the compressed artery. The sounds are known as Korotkow sounds and the technique is termed auscultation. Alternatively, the systolic pressure may be determined by finding the pressure which stops the radial pulse (palpitation).

Procedure

The subject should be relaxed, seated with one arm resting supinated on the bench. The upper part of the arm should be bare.

Find the brachial artery which lies under the medial edge of the biceps muscle just above the elbow. The pulse can be felt by compressing it against the humerus.

Wrap the cuff around the upper arm so that its lower edge is not less than 2 inches above the ante-cubital fossa. Connect the cuff to the manometer and using the palpitation method estimate the systolic pressure. Release the air from the cuff by turning the screw on the neck of the bulb. Place the stethoscope over the brachial artery and raise the pressure in the cuff to about 30 mmHg more than that estimated by palpitation. Open the screw on the bulb so that the air leaks slowly from the cuff.

Initially no sound is heard from the artery because blood flow has been stopped, but as the pressure falls and systolic pressure is reached, a sharp tapping sound is heard. Note the pressure at which this occurs. As the pressure drops further, the noise becomes louder then suddenly softens and looses it sharp quality. This point corresponds to the diastolic pressure. Note its value then let the remaining air out of the cuff.

Blood pressure is usually written as systolic pressure over diastolic pressure and normal values are 120/80 mmHg. The difference between the two readings is the pulse pressure.

Automatic sphygnomanometers are now available. They work on the same principle as the manual ones, a microphone replacing the stethoscope. To use them, place the cuff around the arm with the microphone over the brachial artery, pump up the cuff and read the values indicated on the device as the pressure falls.

Experiments

a) Determine the pulse rate, systolic, diastolic and pulse pressures on the seated subject and when lying down. Take 3 sets of readings in each position. Then make the subject stand up and take 3 more sets of readings.

Does posture affect the behaviour of the cardiovascular system?

b) Secure the cuff around the subjects arm but disconnect it from the manometer. Make the subject do 3-5 minutes vigorous exercise. At the end of the time reconnect to the manometer and record pulse rate and blood pressures at ½ or 1 minute intervals until the values return to normal.

Using a single graph, plot pulse rate, systolic and diastolic pressures against time. What changes occured, how are they brought about?

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