To summarise my philosophy of this type of research, I must say that I would think it essential to record spatial configuration of the trunk and limbs, the forces transmitted externally to the body and the phasic activity of the muscles as measured by EMG. In the

absence of information on all these quantities I feel that only an incomplete analysis could be made, and, in my opinion, the acquisition of information less detailed that this can lead only too easily to erroneous conclusions.

CHANGES IN HEART MOVEMENTS DURING CONTROLLED PHYSICAL ACTIVITY

R. VAS

Any significant physical activities immediately accompanied by an increase in both heart rate and stroke - volume. The more severe the exercise the greater the changes are observed but the fitter the individual the more difficult it is to take consistent results at low levels of loading and the more difficult it is to extract quantitative information about the functioning of the heart.

This paper is concerned with a new method of studying heart action during exercise which involves the detection and recording of changes in the movement of the heart particularly at the apex which is proving to be a very useful parameter.

The principle of the method lies in measuring changes in magnetic inductance using a probe coil which is part of an oscillator and is placed over the apex. Tissue displacement under the probe, which need not be in contact with the skin, are converted to electrical signals which can be transmitted to any standard recorder. The displacements observed are complex in origin and detailed features of the record can be associated with other known cardiological events.

RESULTS OBSERVED AT REST

Fig. 1 shows a typical apex movement as recorded above the torso of a normal subject in basic metabolic rate (approx. 90Kcal/hr.). The 'a' wave represents the

Fig. 1

apex recoil during atrial contraction. It is said that the ascending part of the 'a' wave represents the contraction of the right atrium and the descending part of the 'a' wave stands for the left atrial contraction. The isovolumetric contraction (some call it the pre-systolic wave) is shown on the heart movement as the ascending part of the E wave. The E point itself marks the opening of the aortic valve and therefore the beginning of the ejection phase of the heart. In this period the heart ejects the blood in the aorta. The O point represents the opening AV valves i.e. the beginning of the diastole which in turn ends at the onset of the 'a' wave. Two

Fig. 2

parts can be defined during the diastole. The one is the rapid filling wave (R.F.W.) which is a quick rise in the heart movements recordings and the 2nd is the slow filling wave (S.F.W.) which is almost parallel to the time base.

It is worthwhile to mention that in normal subjects at the basic metabolic rate:

1. the 'a' wave is small and in some cases not seen at all,
2. the slow filling wave is longer in time than the rapid filling wave.

EFFECT OF EXERCISE

Three main changes can be observed in the recording of heart movements during exercise. Figs. 2 and 3 show the qualitative changes of the heart movement patterns during exercise.

Fig. 3 Displacement cardiogram over the apex of the heart at basal metabolic rate.

1. the 'a' wave is increasing
2. the rapid filling wave is elongated and the slow filling wave period is shortened.

Fig. 4 shows the quantitative results obtained for all those changes. It can be seen that:

1. it is necessary to take relative values of both amplitudes and times instead of absolute values so as to eliminate the influence of varying sensitivities on the one hand and on the other hand it is desired to eliminate the influence of heart rate.

2. the recovery period shows that the changes obtained during exercise come back to normal if the recovery period is long enough.

Fig. 4a

Fig. 4b

EFFECT OF 'TRAINING'

Fig. 5 shows a qualitative description of the influence of fitness on the heart movements changes during exercise. Fig. 5a is a measurement taken from a person who is completely unfit and a heavy smoker. One can note the extreme values of the 'a' wave after 60 minutes of work. Fig. 5b shows the heart movements recorded over the same subject after 7 consecutive days of exercise. Note that the 'a' wave has significantly reduced its amplitude. Fig. 5c shows the heart movement obtained from a very fit person in the first day and after 60 minutes of exercise.

DISCUSSION

Presented here is a method of estimating the heart load during exercise of normal subjects. The changes of the 'a' wave during exercise as can be seen from Fig. 4 are much higher than those of the heart rate and whereas heart rate tends to equilibrate after some time of exercise, the changes in the 'a' wave keep on rising. This suggests that the measurement of the 'a' wave during exercise could become a better means of assessing the condition of certain hearts during physical exercise than does the heart rate. However, the results described here are preliminary and much more work should be put into this subject to reach eventually a reliable index of 'cardiac fitness'.

Fig. 5

THE USE AND ABUSE OF STATISTICAL METHODS IN RESEARCH

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Statistical methods must always be used with care and with full knowledge of their limitations. The use of these methods without consideration of the necessary conditions which must exist for them to be applicable has led to a general scepticism of statistical techniques. This is regrettable as such techniques are a most useful research tool.

I propose to outline in this paper the more common fallacies which arise in the application of statistical methods and to show that it is the misapplication of such methods and not the methods themselves which are worthy of scepticism.

PRESENTATION OF DATA

Statistical results are often presented in pictorial form, e.g. as pie charts, histograms, or graphs of relationships between variables, to make the information more digestible to the reader. For example, the pie chart (Fig. 1) is a very simple method of displaying data which might otherwise be a confusing mass of figures. The histogram or bar chart (Fig. 2) is another method of presenting the same sort of data but it is important to remember that it is the areas of the rectangles which represent the relative frequencies and, therefore, the widths of the rectangles should be kept constant. In