Exercise in the Treatment of Coronary Artery Disease

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William Heberden (1803) recorded that one of his patients who suffered from angina pectoris apparently lost his symptoms following a period of sawing wood for half an hour daily. This must be one of the earliest records of the therapeutic value of exercise in the management of angina pectoris. At least it is unlikely that the result was influenced by the claims of an enthusiastic physician telling the patient that exercise would cure his chest pain.

Many physicians today should be able to match Heberden’s observation on the beneficial effect of programmed exercise on angina, but in other ways we are not much nearer knowing whether exercise can prolong the life of a patient known to have coronary heart disease or prevent the onset of the disorder.

However, observations on cardiac and other responses to physical training suggest that a physically fit person may have certain advantages which, in the event of a myocardial infarct, might enable him better to withstand the injury. Certainly in a middle-aged person who has undertaken a programme of ‘physical reconditioning’ there is a greater physical work capacity, increased oxygen uptake, a lower heart rate and increased stroke volume associated with the performance of a given exercise load (Clausen et al., 1969; Rechnitzer et al., 1965; Varnauskas, 1966).

A patient with angina is often able to cope with a physical task more easily and with less discomfort when physically fit than when unfit. It is also possible, although this is seldom stressed, that the coronary patient who has been in a physical conditioning programme has been made aware, if not of his increased level of fitness, at least of the level of his physical capacity. Thus, he may approach an arduous physical task with much greater confidence than formerly and on that account be less prone to anxiety, a factor that in itself could adversely affect his proneness to anginal pain.

Type of Exercise in Physical Conditioning

There is general agreement that different types of exercise are associated with different physiological effects. Isometric exercises, which include such
activities as body-building programmes and weight-lifting, increase the muscle bulk, but when performed, cause a rise in blood pressure with little increase in heart rate. Cardio-respiratory performance is probably not greatly changed (Lind, 1970). On the other hand, endurance exercises, such as running, jogging, swimming and cycling, produce more marked improvement in cardio-respiratory performance and can be carried out by middle-aged men with a resultant increase in physical fitness (O'Donnell et al., 1968). Some consider that the endurance type of exercises should have the main place in the context of treatment and prevention of coronary artery disease. However, this should not exclude the possible benefits of isometric exercises, since there are often day-to-day physical demands for which a predominantly 'isometric' performance is required.

A PHYSICAL RECONDITIONING PROGRAMME FOR CORONARY PATIENTS
Several reported programmes have laid stress on the merits of making objective tests of physical fitness in patients referred for physical conditioning (Hellerstein, 1969) in order to record accurately the changes in physical fitness and to formulate exercise programmes based on the results of the initial tests. In the Dunedin programme so far, it has not been policy to measure precisely initial physical fitness; nevertheless, patients are subjected to a screening procedure that involves a modest work load (500/kpm/min for 3 minutes) on an electrically braked bicycle ergometer under electrocardiographic surveillance (Fig. 1). This relatively simple test has allowed abnormal heart rhythm changes to be detected during the prescribed exercise spell and for several minutes afterwards. It is stressed that post-exercise arrhythmias can and do occur and may call for modified therapy. The details of our initial evaluation of the patient have been described elsewhere (Nye and Wood, 1971).

The presence of easily provoked angina or left ventricular failure requiring treatment are at present regarded as factors that exclude the patient from the programme. Exercise induced disturbances of cardiac rhythm, apart from occasional ectopic beats, are also regarded as reasons for exclusion. Patients are reviewed from time to time and may later be included in the programme if the unfavourable features are no longer present. Advice is given, where appropriate, on weight reduction and stopping smoking.

THE EXERCISE PROGRAMME
The mean age of patients in our programme is about 50 years, ranging from 39 to 74 years. Thus, the planning of an exercise programme requires con-
considerable flexibility of approach. For example, patients suffering from degenerative joint disease will find certain activities difficult if not impossible. The services of a trained physiotherapist interested in this field of rehabilitation are essential. Early exercises are aimed chiefly at increasing limb and joint mobility and are done twice daily at home. When progress appears to be satisfactory, as judged by weekly or fortnightly visits to the physiotherapist, the patient progresses to exercises designed to increase the strength of muscle groups and he also carries out daily walking at gradually increasing distance and pace. Finally, a strong endurance component is introduced to the exercises, consisting of running on the spot, or, if the patient prefers, jogging. Adequate rest periods between exercises conform to the principle of interval training so that at the end of an exercise session a patient is not overtired. Patients with joint problems may benefit from exercises in a heated swimming
pool, and the muscle strengthening programme may be supplemented or replaced by a pool programme leading eventually to swimming or some activity with an endurance component.

Eventually, patients have been encouraged to take part together in games such as badminton and table-tennis and in pool activities, which entertain and encourage an interest in maintaining a high level of physical activity. The importance of this social element is emphasised by Heinzelmann and Bagley (1970) who noted that while persons joined an activity programme because of health considerations, a year later the social and recreational aspects of the programmes were regarded as being the main reasons for continuation. We now have patients who have attended for four years and some are capable of high levels of physical activity with no obvious ill effect or symptoms. Badminton appears to make the greatest physical demand, where heart rates of up to 180/minute have been recorded as well as higher blood lactate levels than observed with other common exercises (Sharrock and Nye, 1971). Other activities, e.g. table-tennis and swimming pool games, make less well-defined demands on cardio-respiratory performance, but should be retained as they encourage adherence to an overall commitment to changed exercise and living patterns. Thus, many of the patients have stopped or reduced smoking and have lost weight through dieting as well as exercise changes. They are also encouraged to increase their ordinary activities such as walking, using stairs instead of lifts, avoiding the use of the car for short journeys and, in some cases, taking up or resuming activities like golf, swimming, or country dancing. Patients are reviewed regularly, usually at three monthly intervals, when ergometry tests are repeated.

MORTALITY AND MORBIDITY IN THE PROGRAMME

Our data cannot be used as a basis for comment on the preventive value of the programme, since control data are lacking and numbers are much too small. To date, the programme has been in the nature of a feasibility study. However, since November 1967, 78 patients have been screened and started in the physical activity programme. Table 1 shows the accumulated experience at the time of writing. No patients have suffered infarcts or death during the actual performance of prescribed supervised activity. However, four cardiac deaths, one probably due to the development of a fatal arrhythmia, have occurred during the period of the programme. In two instances death occurred after the patients had withdrawn temporarily from the programme for reasons not connected with their cardiac state. Two other patients died suddenly, one while playing cricket and the other playing golf. One patient developed a transient hemiparesis but later resumed his activities.
Four other patients suffered further but not fatal myocardial infarcts. One of these has resumed the programme and another is expected to do so. The expectation of death or further infarction does not appear to be any greater than expected in such a group of coronary patients—it may even be less, but control studies must be done to determine this essential point.

Table 1. Experience with a long-term activity programme for post coronary patients. Length of maintained activity, home or ‘Coronary Club’ and reasons for discontinuation over time

|                  | Years of activity | Total Patients |
|------------------|-------------------|----------------|
|                  | <1    | 1    | 2    | 3    | 4    |                |
| All active patients |      |      |      |      |      |                |
| Home programme   | 9     | 7    | 9    | 1    | 2    | 28             |
| ‘Coronary Club’  | 2     | 6    | 9    | 10   | —    | 27             |
| Total            | 11    | 13   | 18   | 11   | 2    | 55             |
| Drop outs        |        |      |      |      |      |                |
| Deaths           | 1     | 1    | 2    | —    | —    | 4              |
| Complications of CAD |      |      |      |      |      |                |
| (further infarct, heart failure) | 3     | 1    | —    | —    | —    | 4              |
| Other disease    | —     | —    | —    | —    | —    | 2              |
| Left district    | 1     | 1    | 1    | —    | —    | 3              |
| Failed follow-up | 4     | 5    | —    | —    | —    | 9              |
| Other (change of job) |      |      |      |      | 1    | 1              |
| Total (all causes) | 9     | 8    | 5    | 1    | —    | 23             |

Psychological effects of the programme

The depression and anxiety seen in patients after a myocardial infarct (Wynn, 1967) may be due in part to uncertainty about the patient’s ideas on his future, as well as to the possible hazards of physical exertion. This contrasts with the elevation of mood and enhanced optimism noted in patients involved in a physical rehabilitation programme. The realisation that physical capacity can be brought up to a high level by suitable training is very encouraging to patients who frequently have been heard to make such comments as ‘I feel fitter now than before I had my heart attack’. A further and unlooked for advantage of the programme from the physician’s standpoint is the insight it gives into the physical capacities of trained coronary patients—and this has also been a source of astonishment to some physiotherapists unfamiliar with this area of therapy. For this and other reasons there is a great deal to be said for a considerable degree of personal involvement by the physician in such programmes.
MOTIVATION TO MAINTAIN PHYSICAL ACTIVITY

If, as seems probable but unproven, the maintenance of a high level of physical fitness is valuable in the treatment and prevention of coronary heart disease, then clearly the longer activity can be maintained the better. Our own and other reported studies (Hunter et al., 1968; Mann et al., 1969) show that normal middle-aged men can be kept active in jogging and formal exercise programmes for at least six months, by which time a high level of cardio-respiratory performance can be achieved. The interest of an investigating team helps to maintain motivation. When our group of middle-aged joggers was re-investigated six months after the formal end of the programme, a marked fall-off in jogging and in fitness had occurred, although many of the volunteers in the study had been athletically inclined when younger.

In the ‘Coronary Club’ atmosphere the social and recreational pleasures do seem to provide the necessary stimulus to keep the patients active, as noted by Heinzelmann and Bagley (1970). The same authors also found that a positive attitude on the part of the men’s wives encouraged continuation in the programme. ‘Coronary Club’ patients have an attendance record so far of about 75 per cent which, considering that they have three possible evening sessions to choose from, is impressive. The activities, while making a contribution to physical fitness, are not intended to replace the home programmes but are possibly more useful in making a regular reinforcement of a patient’s personal commitment to the maintenance of his general ‘health programme’.

Furthermore, as the Club sessions are regularly staffed by members of our medical team, patients have frequent opportunity to exert themselves under conditions calculated to give them confidence and, at the same time, they can informally discuss their progress with the physician.

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