MEDICAL PRACTICE

Hospital Topics

Exercise Programme after Myocardial Infarction

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British Medical Journal, 1973, 4, 213-216**Summary**

Fifty-nine men with known coronary disease entered an exercise rehabilitation programme. Forty-nine had sustained recent myocardial infarctions, nine had had past myocardial infarcts, and one had had a recent internal mammary implant for severe angina. Each class lasted about 45 minutes and they were held twice weekly; the course for each patient was three months. Sixteen patients dropped out from the course, only three for reasons obviously medical. No deaths or cardiac arrests occurred during the programme. Extrasystoles and angina were detected in a minority of patients and did not constitute reasons for failure to complete the course. The main aim of the study was to show that such a programme is feasible in a district general hospital. Improvement in the morale of patients was impressive and the incidence of return to work high.

Introduction

There is increasing evidence that lack of physical activity may be a potent predisposing factor in the development of coronary artery disease.¹ Exercise programmes after myocardial infarction have been developed in many countries and there is much evidence that they lead to psychological and physical improvement.² Exercise has been shown to delay onset of angina and to im-

prove exercise capacity in those with known coronary artery disease.³ Groden *et al.*⁴ reviewed the facilities available in this country for exercise rehabilitation after myocardial infarction and concluded that these were less than in many other countries of the western world.

Attitudes towards the management of acute myocardial infarction have become more aggressive in the last decade. Early mobilization and discharge from hospital are increasingly practised in this country. In our own male coronary care unit patients who are free from hypotension and chest pain are nursed sitting out of bed from the second hospital day onward, start walking on the sixth day if their progress has been uneventful, and almost 90% are discharged from hospital before or at the 10th day.⁵ Patients return for their first follow-up visit six weeks after discharge. If they are then free from complications they are advised to return to work.

This is a report of an exercise programme for patients with known coronary disease, most of whom had had recent myocardial infarction. The study lasted for one year and the aim was to show that such a programme is feasible in a district general hospital.

Patients and Methods

During the year 59 male patients were entered in the exercise programme. The mean age was 49 years (range 27-64). Forty-nine of these patients had sustained recent myocardial infarction and started in the exercise course six weeks after discharge from the coronary care unit. They were selected in the clinic because they appeared to be well motivated and there were no overt contraindications to exercise. The nature of the course was briefly explained to them and, if they agreed to enter the classes, the time of their first visit was arranged. Heart failure, hypertension requiring treatment, anticoagulant therapy (which is used in our coronary unit only for patients with venous thromboembolic complications), diabetes requiring insulin, chronic obstructive lung disease with dyspnoea on mild exertion, and more than one past myocardial infarction were taken as contraindications to entry into the course.

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Ten other patients were admitted to the programme. Nine had known past myocardial infarcts and one had had an internal mammary implant for severe angina two months before entry into the programme. An exercise programme was advocated because of physiological or physical inability to cope with their normal patterns of life.

Exercise took place in the physiotherapy department gymnasium twice weekly for three months between 4 p.m. and 6 p.m., each session lasting about 45 minutes. Up to eight patients could be exercised simultaneously in the gymnasium. No special arrangements for travel to the department were made, and a physician and physical educationalist were always present throughout the exercise programme. At a first attendance the doctor took a brief clinical history with special emphasis on the presence, frequency, and severity of angina and dyspnoea. Examination of the cardiovascular system was performed and weight, pulse rate and rhythm, blood pressure, and heart sounds were recorded. The doctor emphasized that any untoward symptoms throughout the exercise sessions should be reported to him immediately.

E.C.G. monitoring during exercise was not performed at any time in any of the patients. Full resuscitation equipment was available in a room adjacent to the changing room of the gymnasium; this included an E.C.G. oscilloscope and recorder, a portable defibrillator, oxygen equipment, and drugs for resuscitation. At the first few sessions each patient's cardiac rhythm was assessed by auscultation on completion of each exercise; at later sessions cardiac rhythm was assessed on completion of the more strenuous exercises. Every suspected arrhythmia was recorded by electrocardiography. Coronary care unit facilities were available 200 yards from the gymnasium.

Exercises consisted of progressive circuit routines with five stages of exercise level.* At one stage of each training session patients exercised for a known period of time on a bicycle ergometer at known work load. The amount of exercise performed was dictated by the instructor's and doctor's impressions of his capability. All who completed the course had a progressively increasing amount of exercise at each session. The rate of increase was determined by previous performance; those obviously fit were performing vastly more work at each session than those less fit. The two most strenuous exercises were those in which step-ups were made; during these the amount of exertion was restricted to maintain a heart rate below 160/min in men under 55 years, and under 140/min in those over 55. The initial work load on the bicycle ergometer was 50 watts for three minutes and progressively increased to a maximum of 125 watts for five minutes in most patients and 175 watts for eight minutes in one patient.

After the last exercise session a brief history and physical examination were undertaken similar to that made on entry. Questions were asked specifically about work capacity, leisure activities, presence and severity of angina, dyspnoea, and other symptoms. Forty-one of 43 patients completing the exercises filled in a questionnaire on their impressions and experiences during the course.†

Results

DROP-OUTS

Of the 59 patients who started the course 43 completed it. Of the sixteen "drop-outs" 13 had had recent acute myocardial infarction and three had had past infarcts. Four patients never actually attended the gymnasium and two withdrew from the course at their first sessions due to anxiety. In three patients no reason was given for ceasing to attend, and they dropped out after the first, third, and fourth sessions, while in the other four

conflict with working hours was alleged as the reason for failure to attend. In only three patients were there obvious medical reasons for failure to continue; one developed heart failure after the fourth session, one had a further myocardial infarct while on holiday, and the third patient had psoriasis which led to embarrassment when changing.

COMPLICATIONS

None of the patients who completed the course nor any who dropped out died within the three months from the start of the course. Angina during the sessions was volunteered or admitted by seven patients. Nevertheless, analysis of the questionnaire suggests that the true incidence of angina may have been underestimated since some symptoms which could have been cardiac pain were not always reported to the doctor or instructor. One patient had severe and prolonged angina during an exercise session and was admitted immediately to the coronary care unit for observation. Serial E.C.G.'s and enzyme determinations showed no evidence of further myocardial infarction and his pain quickly ceased. After discharge from the unit he re-entered the exercise course at a lighter work load which was progressively increased as with all the other patients. He continued to have some angina of effort and was given practolol, and he then completed the course satisfactorily but with some continuing mild angina. Only two of the patients who dropped out experienced angina during the sessions. Four out of seven patients with angina were treated with a beta-adrenergic blocking agent, three receiving practolol and one propranolol. In only one did the angina cease in subsequent exercise sessions after this treatment, and in the others the angina was variable and did not become more severe.

RETURN TO WORK

Of the 36 patients with recent myocardial infarction who completed the exercise course 10 returned to work at the same time as they started the programme—that is, six weeks after discharge from the coronary care unit. Twenty-three went back to work during the course of the programme, one retired, and only two had not returned on completion of the course. Of these two one appeared to be poorly motivated, and one was awaiting surgery for a duodenal ulcer and had been advised to rest—a somewhat paradoxical situation.

Seven patients completed the course who had not had recent myocardial infarcts and this group was mainly selected for the programme because of anxiety symptoms. Of these seven one was at work at the start of the course, three returned to work during the course, and three had not returned to work by completion. Of these three patients poor motivation appeared to be responsible for the lack of return to work in two, and one had become redundant and was unable to find employment.

Thus 37 patients of the 43 who completed the course had returned to work by the end of their three-month programme. Twenty-seven of these were at their original jobs, nine were doing lighter work, and one was doing heavier work.

PATIENTS' OPINIONS

Forty-one of the 43 patients who completed the course returned the questionnaire. The most important features of their answers are now summarized.

Most patients felt that two exercise sessions a week was sufficient but many of the others felt that more sessions a week would have been better. Only one patient thought that the individual sessions were too short, the rest believing that the 45 minutes was about right. Between 4 and 6 p.m. was a convenient time and most had no difficulty in arranging transport to the gym. All patients preferred to do the exercises in the

*Details of the exercises are available from the authors.

†The questionnaire and the answers are obtainable from the authors.

company of others and most felt that the doctor should have been present, as he was, throughout the sessions. Many had muscle stiffness during the course, mostly in the first month.

When the programme was first discussed with the patients 29 thought that it was the right plan for them, eleven had no opinions either way, and only one felt that it was the wrong approach. On completion of the course only one patient did not express any views about its possible value and 40 thought it was the right thing to have done. At the first visit to the gym 36 patients felt that the instructor asked them to perform about the right amount of exercise and only four said they were asked to do too much. Eleven patients admitted in retrospect to a fear of illness while at the gymnasium.

At the end of the first few sessions 17 patients remembered feeling very tired and 18 moderately tired; only six felt normal. By the end of the course only four patients felt very tired and 19 felt normal. During the last few exercise sessions 36 thought that they were being asked to do the right amount of exercise. On completion of the course 22 patients claimed that they felt more fit than before their heart attack, nine felt no different, and only 10 patients stated that they felt less fit. Thirty-five patients said that the course had made them more confident about the future, five felt that it had had no effect on their attitude, and one said that he felt less confident. Twenty-four patients said that they planned to continue taking as much exercise in the future as they had been doing towards the end of the course and nine said that they planned to do more. Only four were planning to take less physical activity. Eleven patients stated that they felt they could do strenuous activity more easily than before their heart attacks and 16 thought there had been no change; two patients felt that they were less able to do strenuous exertion. All but one felt that the course had helped them.

Discussion

This work shows that an exercise rehabilitation programme after acute myocardial infarction in selected male patients is feasible in a district general hospital. In terms of feasibility four factors have to be considered—the convenience for the patients to attend the course, the availability of staff to instruct and to provide medical cover, the availability of a gymnasium, and the cost. Our patients found little difficulty in attending the gymnasium for two sessions a week which were held in the late afternoon; indeed many of them would have welcomed a third session. Transport to and from the gymnasium was the responsibility of the individual patients.

In this year's feasibility trial the instructor for the exercises was a lecturer in physical education from the local College of Building and Commerce. It is possible, however, that this aspect could be covered by a physiotherapist with a special interest and training in this type of rehabilitation, and many physiotherapy departments probably have members of their staff who would be suitable for this type of work. Medical cover in this work was given by a local general practitioner at clinical assistant grade. The essential qualities in a doctor providing such cover are awareness and understanding of potential arrhythmias and experience in dealing with them, including cardiac arrest and resuscitation procedures. We believe that similar cover could be provided by a member of the junior hospital staff who had such experience.

Most hospitals in Britain have a gymnasium in their physiotherapy departments of sufficient size to prevent overcrowding during the exercises, and we found that eight men could exercise at the same time in our gymnasium. We also believe that eight is the maximum for whom one doctor can provide adequate medical supervision.

The cost of the year's trial was £2,000. This, however, could be greatly reduced, particularly if this type of programme is to be conducted purely as a service function without any major research endeavours. The biggest item of expenditure was for

salaries for two additional staff but, as indicated above, this work could probably be covered by members of the full-time hospital staff. The second biggest item was the Elema-Schönder bicycle ergometer (£700) but this was purchased for research purposes for measurement of precise work loads. There is no reason why bicycling should be part of the routine exercises, and if it is to be included other cheaper bicycle ergometers are commercially available, though their calibration may be less accurate. Additional mats and weights for the gymnasium in this study cost £110 and this was essential expenditure for the type of exercises which we wished to use.

The results of this work have no absolute value in terms of assessing improvement of mortality or morbidity after acute myocardial infarction. To do this a long-term controlled trial is essential and this we are shortly hoping to start. Such a trial will require randomization of suitable patients into exercised and a non-exercised control groups. Though the present trial has not yielded, and was not intended to yield, any fundamental points other than feasibility, several interesting observations can be made. The most striking was the improvement in morale in the patients who completed the course. Of the 41 who completed and returned the questionnaire 35 reported that they felt "more confident about the future." This statement is obviously rather nebulous but we believe that, in terms of morale, it is highly encouraging. Certainly the atmosphere in the gymnasium at the time of the classes was one of infectious enthusiasm. Many patients on entry into the course reported surprise and pleasure that they were asked and able to do so much more than they or their wives had expected.

The second feature strongly suggesting benefit from the course was the incidence of return to work. Of the patients with recent myocardial infarction 36 completed the course and 33 were back to work before the end of their three months' exercise programme. Of the three who had not returned to work one had retired and one was awaiting operation for a duodenal ulcer. Nevertheless, since this was not a controlled trial and since patients were selected because of their apparent good motivation, too much weight cannot be placed on these figures.

Of the 59 patients who started the course 16 dropped out at some stage. Anxiety about the wisdom of the exercises was given as one reason and it seems probable that this was the chief reason in four patients who never attended. This emphasizes the need for a full explanation when offering this type of rehabilitation to patients after recent myocardial infarction. It was helpful to let patients at their first visit to the gymnasium sit for a few minutes just watching others perform. In only two patients were there cardiac reasons for dropping out. One had a second myocardial infarct while on holiday and one developed symptoms and signs of heart failure during his fourth session.

Complications during the three-month course for the individual patients were few. None developed a cardiac arrest, either in the gymnasium or at any other time during the three-month period. E.C.G. monitoring during exercise⁶ was not performed in any patient. It seems wise, however, to have full resuscitative equipment available in the immediate vicinity of the gymnasium and this and the opportunity for urgent admission to the coronary care unit were constantly present in this study. Only one patient during the year was admitted to the unit with prolonged angina; there was no evidence of further myocardial infarction and he re-entered the exercise programme the following week.

During the first few sessions the doctor assessed the heart rhythm of the patient clinically after each exercise. Once they were fitter this assessment was made only after the more strenuous exercises and in particular after the step-up exercise. Extrasystoles were detected in eight patients on 12 separate occasions, usually during the first few sessions. They always disappeared after a short period of rest and exercises were then resumed at a lower work load. Presumably the true incidence of extrasystoles was much higher than that detected by clinical means.

Angina was present in at least seven patients during the exercises and they were exercised at lighter work loads. This was not a

major cause for dropping out from the programme. As with extrasystoles it seems likely that the true incidence of angina was higher than that reported or diagnosed by direct questioning. Analysis of the questionnaire results suggests that a large number of the men had various types of chest pain, some of which may well have been angina.

If exercise is proved to be good for patients with coronary disease, and there is mounting evidence that this is so,⁷ many questions arise. After recent acute myocardial infarction, what are the benefits? Questions about improvement in subsequent mortality and morbidity, attitudes and confidence, and incidence of return to work can only be answered by larger, longer, and controlled future trials. This study does not contribute any answers to these questions except that it strongly suggests that such exercises do lead to improvement in morale and probably encourage return to work.

Another question which will have to be answered is the correct time for starting such physical training after myocardial infarction. In this study patients have been selected for the programme six weeks after discharge from hospital, which is usually about two months after acute myocardial infarction.⁵ This decision was arbitrary and was made because this time coincides with our first follow-up clinic visit. Royston,⁸ however, starts his patients on light exercises while still in hospital and this may prove to be correct.

If there is any therapeutic value to exercise, what is the mechanism? Some types of exercise may confer benefit and others be useless or even harmful. It is fashionable and tempting to believe that the type of exercise which leads to most improvement in cardiac haemodynamic performance will prove to have the greatest therapeutic value but, as yet, we know of no evidence to confirm this. It could well be that prognosis after myo-

cardial infarction is more closely related to other unknown factors than to changes in the better understood physiological ones which can be routinely measured in cardiac catheterization laboratories. Sustained exercise over long periods may be of greater benefit than more strenuous short-term bouts which increase cardiac output and work.⁹ Future controlled trials will have to keep these possibilities in mind.

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One Thousand Vasectomies

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Summary

In a prospective study of 1,000 people treated by vasectomy at the Margaret Pyke Centre under local anaesthesia as outpatients minor sepsis occurred in 12 cases, an abscess in one, and haematoma needing drainage in seven. Spontaneous recanalization of the vasa occurred in six patients and an unsuspected third vas was found in one.

Except in patients with recanalization or a third vas the semen was always free from motile spermatozoa within three months, but non-motile spermatozoa have so far persisted for up to 17 months in a few cases.

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Introduction

Vasectomy has become an increasingly acceptable form of birth control, thanks largely to the advocacy of the Simon Population Trust.¹ Since 1972 Parliament has added vasectomy to the methods of contraception which may be provided by local authorities. Nevertheless, several questions remain unanswered, the first of which concerns the operation itself.

OPERATIVE TECHNIQUE

Numerous surgical techniques have been described. All have been designed to interrupt the passage of spermatozoa, prevent spontaneous recanalization of the vas, permit reanastomosis if the patient later changes his mind, and minimize the risks of sepsis and haematoma. Details of technique vary considerably. Many surgeons insist on a general anaesthetic, others prefer a local; some only cut the vasa, others remove a section; some seal the cut ends with diathermy, others tie them with silk, thread, or catgut, and others still prefer single or double tantalum clips. Some surgeons advise that the cut ends should be doubled back or crossed over or that the two distal and the two proximal ends should be tied together.²⁻¹³ Satisfactory evidence that any one of these methods is preferable is wanting. The reported incidence of surgical complications differs widely between series and has generally been attributed to incompetence or inexperience—