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EFFECTS OF ORGANIZED AEROBIC GROUP TRAINING IN ELDERLY PATIENTS DISCHARGED AFTER AN ACUTE CORONARY SYNDROME. A RANDOMIZED CONTROLLED STUDY

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ABSTRACT. The aim of this study was to compare the physiological effects of an individually adjusted outpatient group training programme to the standardized recommendations of walking in elderly patients (>65 years) discharged after an acute coronary episode. In all, 101 patients, 20 women and 81 men, aged 65–84 (mean 71) years, were randomized either to a supervised outpatient group training programme during three months ($n = 50$) or to a control group ($n = 51$). Exercise tolerance increased from 104 watts to 122 watts ($p < 0.001$) in the training group and from 102 watts to 105 watts (n.s.) in the control group. Self-estimated level of physical activity was higher in the patients in the training group than in the control group ($p < 0.001$), as was graded well-being ($p < 0.05$). Organized aerobic group training can easily be performed in elderly patients after acute coronary syndrome, with results of improved exercise tolerance and a higher self graded well-being.

Key words: elderly; myocardial infarction; unstable angina pectoris; acute coronary syndrome; randomized controlled study; cardiac rehabilitation; training; physiotherapy.

INTRODUCTION

Despite the well-proven benefits of cardiac rehabilitation and exercise training, elderly patients with coronary heart disease are not frequently referred or encouraged to pursue cardiac rehabilitation and training programmes (7, 9). The maintenance of an active lifestyle among the elderly may facilitate social contacts, enhance physical and emotional health, reduce risk of chronic disease and conserve vital functions (12). Regular physical activity maintaining exercise tolerance and physical fitness is associated with lower mortality from all causes (2). In the early years of exercise rehabilitation of patients with coronary heart disease, age exceeding 65 years was mostly and arbitrarily considered to be an exclusion criterion (14). In 1985, Williams et al. (16) reported that men older than 65 years, who participated in an early training programme, initiated within six weeks after a myocardial infarction or coronary bypass grafting, increased their physical capacity and their psychological response to exertion as much as younger patients. Although older coronary patients may improve exercise capacity to an extent similar to that of younger patients (1, 15), no randomized, controlled trial, to our knowledge, has addressed the efficacy and safety of a programme for physical rehabilitation after coronary events in this age cohort.

The aim of this prospectively randomized study was to evaluate the feasibility and physiological effects of an early individually adjusted aerobic outpatient group training programme in elderly patients after acute coronary syndrome.

MATERIALS AND METHODS

Material

The patient material comprises 109 consecutive patients aged ≥65 years (mean 71; SD 4.3) admitted to the Coronary Care Unit at Karolinska Hospital, Stockholm, due to acute coronary syndrome during the period from October 1994 until June 1997. Acute coronary syndrome was defined as either an acute myocardial infarction (AMI, $n = 64$) or an episode of unstable angina pectoris (UAP) with anginal chest pain and dynamic ECG changes (transient/manifest T-way inversion and/or ST depression >1 mm in at least two adjacent leads), but with no release of cardiac enzymes ($n = 45$). To be included, the patients had to be able to perform a pre-discharge exercise test at a workload ≥70 watts in males and ≥50 watts in females. For the group with UAP, a ST60 depression of >1 mm in at least two adjacent leads had to be documented. Patients with neurological sequelae ($n = 6$), memory dysfunction ($n = 3$), orthopaedic disability ($n = 7$), inability to understand Swedish ($n = 6$), planned coronary intervention within three months ($n = 37$) and other complicating diseases ($n = 19$) were not considered eligible for the study. Sixty-five patients declined to participate in the study, mostly due to practical problems.

Prior to discharge, all patients received verbal and written

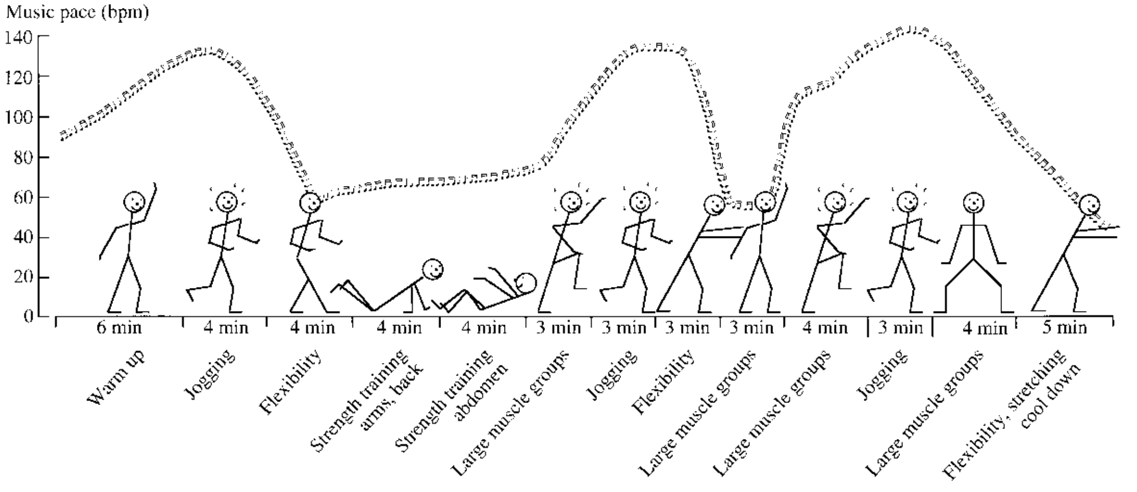

Fig. 1. A schematic illustration of the training programme. Duration 50 minutes. Music pace in beats per minute (bpm).

information about the importance of physical activity after an acute cardiac event, i.e. they were instructed to take a daily walk according to energy, increase the time and length of the walk gradually, start at a slower tempo and increase it after a while. All patients were also invited to monthly information meetings at our department. In this context, they had the opportunity to ask questions about their disease and how to cope with it, and about their pharmacological therapy. They could also discuss their problems with a professional team specializing in cardiac rehabilitation. All patients were encouraged to contact this team at any time during the study period. The medical follow-up at the outpatient clinic was the same for all patients.

Patients were informed and included in the study before discharge from hospital. However, randomization was not done until after the baseline exercise test, performed within six weeks after the acute event. This protocol was chosen so that the allocation of individual patients to either study group would not in any way influence their performance at the baseline investigation. The median delay between initial hospital admission and the time of randomization was 18 days, 21 days in the Intervention Group (Group I) and 16 in the Control Group (Group C). Before randomization, the patients were stratified according to diagnosis, AMI or UAP.

All patients gave their informed consent to participate. The study was approved by the Committee of Ethics at the Karolinska Hospital.

Training programme

The training programme consisted of outpatient group training for 50 minutes (including warm-up and cool-down) three times a week for three months (10). The training sessions were supervised by a specialized physiotherapist.

Two exercise targets were used:

1. An individual exercise intensity of $\geq$50% based on the relation between maximal heart rate and maximal oxygen uptake (11) for at least 40 minutes, and
2. $\geq$80% of the estimated maximal oxygen uptake during three periods of 3–4 minutes, engaging large muscle groups for training the central circulation (17). The complete programme was supported by music, which guided the intensity of the performance during the session. A schematic illustration of the programme is presented in Fig. 1. The training sessions were followed by 10 minutes of relaxation, also supported by music.

To ascertain that the planned exercise intensity had been reached, heart rate was assessed at one of the three weekly training sessions during weeks 1, 6 and 12 with a portable heart rate recorder (Sport Tester, Polar Electro Oy, Kempele, Finland). Perceived exertion was evaluated using a 6–20 graded scale, Borg's Ratings of Perceived Exertion (RPE) scale (4) at the three most intense exercise periods, as described above.

Exercise capacity

Maximal exercise capacity was assessed on two occasions, before randomization and three months thereafter. All tests were conducted until symptom limitation was reached on an electrically braked bicycle ergometer (Siemens Elema, Ergomed 840, Sweden) starting at 30 watts, with the workload increased stepwise by 10 watts every minute (18). A 12-lead ECG was continuously monitored during the test using a computerized electrocardiograph (Siemens Megacart, Sweden). Systolic blood pressure was recorded every minute, as were subjective symptoms. Perceived exertion was graded according to Borg's RPE scale (4), while chest pain, shortness of breath and leg fatigue were assessed on a 0–10 graded scale, Borg's Category Ratio scale (CR-10 scale) (3). The test was terminated due to fatigue, severe angina (grade at least 5 out of 10), severe symptomatic arrhythmias, fall in blood pressure $>$10 mmHg in two consecutive recordings or a ST60 depression $>$2 mm.

The graded RPE score at the two submaximal workloads of 50 and 70 watts were analysed as an indicator of the patients' tolerance to submaximal levels of exercise. These workloads were chosen to imitate activities in everyday life.

All exercise tests were supervised by the same technician without knowledge of who belonged to which group.

Table I. *Classification system of physical activity**

1. Hardly any physical activity.
2. Mostly sitting, sometimes a short walk, or the equivalent.
3. Light physical exercise less than 2 hours a week (walking, light gardening, fishing, light home repair).
4. Light physical exercise around 2 hours a week (walking, bicycling, dancing, tennis, gardening, light aerobic training).
5. Moderate exercise at least 2 hours a week (jogging, skiing, ice-skating, tennis, swimming, aerobic training).
6. Strenuous exercise at least 3 hours a week (jogging, skiing, ice-skating, tennis, swimming, badminton, aerobic training).

* Ad modum Frändin & Grimby (6).

Self-estimated physical activity, capacity and well-being

Before randomization and after three months, the patients estimated their levels of physical activity on a six-graded scale (6), as presented in Table I.

The achieved expectations of physical capacity was assessed at three months by means of a Visual Analogue Scale (VAS) of 100 mm with the extremes "worse than before" and "fully achieved expectation", with a zero in the middle marking the condition at study-start. The same scale was used for evaluation of the patients' estimations of their total life situation and perceived physical activity. Self-graded well-being was assessed using a VAS of 0–100 mm, with the extremes "not good at all" to "very good".

Statistical methods

Results are presented as mean, SD and range, or median and range when data were ordinal. Analyses were performed using two-sided Student's paired and unpaired *t*-tests or Wilcoxon's signed-ranks test and rank sum test when data were ordinal. Statistically significant differences were assumed when $p = 0.05$.

RESULTS

Fifty-six patients were randomized to Group I and 53 patients to Group C. Eight patients withdrew from the study due to Coronary Artery Bypass Graft surgery (CABG) ($n = 4$; two from each group after 8, 8, 9 and 12 weeks), lack of time ($n = 2$ from Group I after 1 and 6 weeks), moved from the area ($n = 1$ from Group I after 4 weeks) or orthopaedic reasons ($n = 1$ from Group I after 5 weeks). In all, 101 patients completed the full study, 50 in Group I (AMI = 29, UAP = 21) and 51 in Group C (AMI = 31, UAP = 20). Patient characteristics are presented in Table II.

The pharmacological treatment did not differ significantly between the two groups at baseline, and there were no major changes in drug therapy during the study period (Table III).

The average compliance (actually performed training sessions divided by possible sessions) in the intervention group was 87% (range 64–100%). There were no complications of any kind during the training sessions.

Satisfactory recordings of heart rate during the training sessions were obtained from 48 patients. In the two missing cases, proper recordings were not possible due to intermittent atrial fibrillation and frequent premature beats.

Forty-one patients (82%) reached the target of an exercise intensity ≥50% of the estimated maximal oxygen uptake during ≥80% of the training sessions, while 35 patients (70%) reached the target of ≥80% of the estimated maximal oxygen uptake during the three intense periods of the programme.

Table II. *Characteristics of the patients in the intervention group (Group I) and the control group (Group C) at time of randomization. Variables are presented as mean (age) and number (*n*) of patients*

Variables	Group I ($n = 50$)	Group C ($n = 51$)
Age (years; mean (SD))	71 (3.9)	71 (4.7)
Range	65–84	65–83
Sex (M/F)	41/9	40/11
Diabetes mellitus	10	6
Hyperlipidemia	9	8
Hypertension	18	14
Previous AMI	18	11
Previous angina pectoris	20	21
Previous PTCA[1]	7	5
Previous CABG[2]	9	9
Congestive Heart failure	2	5

[1] PTCA = Percutaneous Transluminal Coronary Angioplasty.
[2] CABG = Coronary Artery Bypass Graft surgery.

Table III. *Pharmacological treatment of the patients in the intervention group (Group I;* $n = 50$*) and the control group (Group C;* $n = 51$*) at randomization and after three months. Variables are presented as number (*n*) of patients*

	Randomization		Three months	
Type of drug	Group I	Group C	Group I	Group C
β-blocker	38	44	41	41
Digitalis	3	3	2	3
Long-acting nitrate	30	26	29	27
Diuretic	11	14	11	12
ACE inhibitor	12	9	11	9
Calcium antagonist	11	9	12	11
Aspirin	45	49	46	47
Lipid-lowering	8	6	8	9

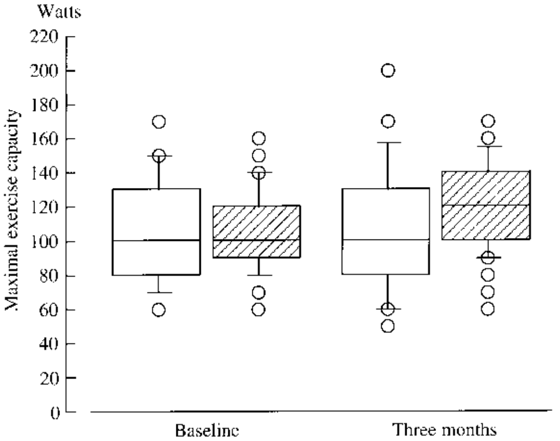

Fig. 2. Maximal exercise capacity at baseline and after three months. The box plot indicates the 10th, 25th, 50th, 75th and 90th percentiles and circles indicate outliers. The difference between the two groups was not statistically significant at baseline. After three months, subjects in the intervention group (Group I) had improved their maximal exercise capacity significantly ($p < 0.001$), which was not the case in the control group (Group C). ▨ = Group I, □ = Group C.

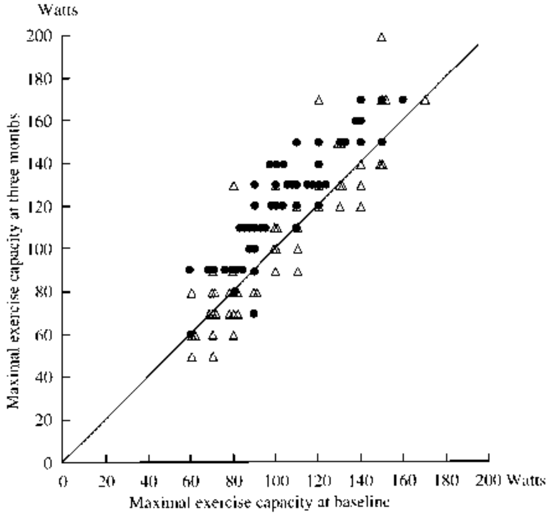

Fig. 3. Individual maximal exercise capacity at baseline compared with maximal exercise capacity after three months. ● = Group I, △ = Group C, — = line of identity.

The median graded perceived exertion according to Borg's RPE scale, was 11 (range 6–15) during the most intense periods of the training sessions.

Exercise capacity

At baseline there was no difference in exercise capacity between the groups. After three months, the maximal exercise capacity had increased from 104 (SD 24; range 60–160) to 122 (SD 27; range 60–170) watts ($p < 0.001$) in Group I and from 102 (SD 30; range 60–170) to 105 (SD 37; range 50–200) watts (n.s.) in Group C (Fig. 2).

The difference between the groups at three months was also statistically significant ($p = 0.013$). Individual values of maximal exercise capacity at baseline and the corresponding data after three months are illustrated in Fig. 3.

Maximal heart rate, assessed at the two exercise tests, did not differ in the two groups at baseline (Group I 116, SD 17; Group C 118, SD 16) and three months thereafter (Group I 119, SD 17; Group C 121, SD 18).

The intensity during the training sessions was based on the baseline exercise test. To verify the adequacy of the exercise intensity in Group I, a second calculation was performed based on the maximal heart rate at the second exercise test. The maximal heart rate from the baseline exercise test was 97% (80–117%) of that of the second, indicating that the estimated exercise intensity based on the first test was set at an adequate level.

The graded RPE score at submaximal workloads, which was similar in Group I and Group C at baseline, became significantly lower in Group I after three months at both 50 ($p = 0.02$) and 70 watts ($p < 0.01$). This differed from the findings in Group C, in which there was no significant decrease compared to baseline neither at 50 watts ($p = 0.06$) nor at 70 watts ($p = 0.3$).

Self-estimated physical activity, capacity and well-being

The self-estimated level of physical activity was similar

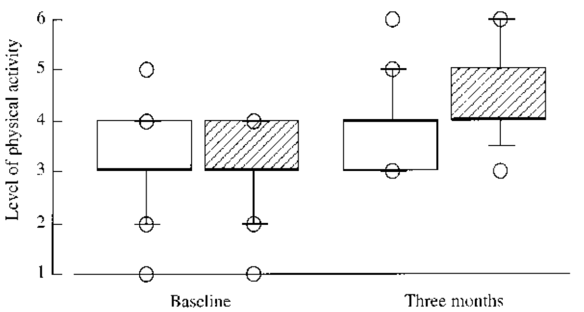

Fig. 4. Self-estimated level of physical activity at baseline and after three months. The box plots indicates the 10th, 25th, 50th, 75th and 90th percentiles and circles indicate outliers. ▨ = Group I, □ = Group C.

Table IV. *Achieved expectations of physical capacity, self-estimation of total life situation and perceived physical activity, assessed by means of a Visual Analogue Scale (VAS) of 100 mm, with the extremes "worse than before" and "fully achieved expectation", with a zero in the middle marking the condition at study-start. Self-graded well-being by means of a VAS of 100 mm, with the extremes "not good at all" to "very good" at three-month follow-up. Values presented as median (range).*

	Group I ($n = 50$)	Group C ($n = 51$)	p-value
Achieved expectations of physical capacity	3.7 (−4.2–+5)	2.6 (−2.9–+5)	<0.001
Self-estimation of total life-situation	3.8 (−4.3–+5)	3.0 (−3–+5)	<0.05
Perceived physical activity	3.5 (−4.9–+5)	2.5 (−3.2–+5)	<0.02
Graded well-being	9.0 (1.8–10)	7.8 (2.5–10)	= 0.03

in the two groups at baseline. After three months, there was a significant improvement in Group I ($p < 0.001$), but not in Group C. There was also a difference between the two groups ($p = 0.002$; see Fig. 4).

The achieved expectations of physical capacity, self-estimation of total life situation, perceived physical activity and graded well-being at three months are presented in Table IV.

DISCUSSION

This is, to our knowledge, the first randomized controlled study of organized aerobic group training in elderly patients discharged from hospital after acute coronary syndrome. The study showed that the intervention group increased their exercise capacity and improved their well-being, compared to a group of patients who, as the only attempt for physical rehabilitation, received the standard recommendation of daily walking according to energy level.

The training programme was intentionally designed to be easy to introduce at any cardiac rehabilitation centre, without any demands for costly equipment. In fact, the high compliance rate and the absence of complications are evidence that this goal was accomplished. As previously reported from other studies, mostly involving younger patients, the incidence of fatal cardiac events is very low during supervised exercise training: 1/784,000 patient hours (13). In a study by Marchionni et al. 1994 (8), there were no age-related differences in interrupted training sessions from pathological causes when comparing younger cardiac patients with elderly patients. The present programme, designed for elderly subjects, appears to be as safe as other programmes. Accordingly, it seems that it is feasible and safe to train patients in this age group.

The patients obviously trained on a rather high level, despite the fact that they perceived their level of exertion as "fairly light" (11 out of 20 on the RPE scale). This was confirmed by most patients reaching the predetermined targets of training intensity at the predetermined proportion of maximum oxygen uptake. Participation in a group and the presence of music may be reasons why they experienced the training as not too tough. The reason that all patients did not reach the predetermined targets may also be an effect of group training, which allows individual adaptation of training intensity. Despite the differences in exercise capacity, all patients joined the same programme, however, with individual adjustment according to physical capacity. The intensity may have been too much for some and too little for others, giving some of the patients more of an endurance training effect than an effect on maximal oxygen uptake.

An interesting finding was that maximal heart rate during the baseline and second exercise tests did not differ significantly (116, SD 17 vs 119, SD 17) in Group I, despite an increase in exercise capacity. The fact that maximal heart rate did not change after the training period may be due to this group's use of beta-blockers, which do not allow the heart rate to exceed a certain level. This does not, however, alter the response to physical training (5).

The improvement in physical capacity and the trend towards lower perceived exertion at submaximal levels of exercise in the intervention group may influence daily life beneficially. The training was not only intended to induce increased maximal exercise capacity, but also to affect endurance capacity. The subjects in the intervention group probably achieved an ability to stress themselves somewhat more than the control patients, allowing trained individuals to maintain a higher level of physical activity for longer periods of time.

The intervention group had higher self-estimated levels of physical activity after three months, indicating that these subjects had more physically active lifestyles. This may be an effect of being part of a training group and having a sense of responsibility towards the group, but also towards the physiotherapist responsible for the training, who was also a member of the study team.

The intervention group reported a greater sense of well-being and more satisfactory total life situations. This may indicate that the results from the training programme had had an overall positive effect on their quality of life.

One limitation of this study may be that only fairly "healthy" elderly patients were included. Some patient selection is a prerequisite for the accomplishment of a training programme in elderly patients. Thus, the results of this study should not be generalized to all patients over the age of 65, but to those who are able to perform an exercise test at a reasonably low intensity corresponding to a brisk walk on flat ground. Besides this prerequisite, the patients in the present study were consecutively recruited from a standard population as seen in coronary care units.

The rehabilitation focused on physical training. It is, of course, not possible to completely separate this from a more multifactorial intervention. All patients, regardless of group allocation, had access to a professional team specializing in cardiac rehabilitation during the study, including a medical follow-up at the outpatient clinic. In addition, the intervention group had opportunity to ask questions and discuss problems before and after each training session, and to share their problems with other patients. The control group was encouraged to contact the study team at any time during the study period. Patients in both groups may have benefited from this increased attention. This may have influenced such factors as well-being and self-estimated total life situation.

In conclusion, organized aerobic group training can easily be offered to elderly patients after an acute coronary episode. This will result in improved exercise tolerance and higher self-graded well-being. There is no need for costly equipment for patient monitoring. Thus, this training programme may be applied in any cardiac rehabilitation centre. This knowledge should influence attitudes towards cardiac rehabilitation in elderly patients.

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