Physical training and relaxation therapy in cardiac rehabilitation assessed through a composite criterion for training outcome

One hundred fifty-six myocardial infarction patients were randomly assigned to either exercise plus relaxation and breathing therapy (treatment A, $n = 76$) or to exercise training only (treatment B, $n = 80$). Effects on exercise testing showed a more pronounced training bradycardia and a remarkable improvement in ST abnormalities in treatment A ($p < 0.005$). A model was developed to integrate the various exercise parameters into a single measure for training benefit. Approximately half the patients showed a training success, with a more positive and less negative outcome in treatment A ($p = 0.09$). The odds for failure were 0.25 for treatment A and 0.51 for treatment B (odds ratio: 2.04; 95% confidence interval, 0.94 to 4.6). Thus the risk of failure was reduced by half when relaxation was added to exercise training. These results indicate that exercise training is not successful in all MI patients and that relaxation therapy enhances training benefit. (Am Heart J 1989;118:545.)

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Aerobic exercise training is widespread in cardiac rehabilitation. It is intended to increase physical fitness, heighten the exercise threshold for myocardial hypoxia, and prevent disability. Research has been focused primarily on the feasibility of physical training for cardiac patients (safety, indications) and physical effects.[1-4] It appears that exercise is safe, but that the training response is modest.[4-7] This response consists of increased maximal work load, a muting of the heart rate and blood pressure reaction to any given work level, and in turn, a decrease in myocardial oxygen demand.[8-10] However, not all patients can improve their exercise tolerance; some even have a negative training outcome.[4, 9-12] Therefore it is important to differentiate patients with training success from those who failed in training, preferably on the basis of a single outcome measure. To achieve such differentiation requires that a composite criterion be constructed that integrates several parameters into a single outcome category for training benefit. This strategy allows evaluation of cardiac rehabilitation in terms of indications (patients with benefit of training) and contraindications (patients without benefit or with adverse effects). To our knowledge such a composite criterion has not yet been presented.

The role of relaxation and breathing therapy in addition to exercise is investigated in this study. This therapy uses "exercises" as well, but its goals are coordination and awareness.[13, 14] The emphasis is not on work power and performance, but rather on learning how to handle tension and effort. The value of the "coordination-relaxation-flexibility" type of exercise[14] (e.g., yoga, breathing exercises, or active relaxation), has not yet been studied circumstantially in cardiac patients. There are few studies of relaxation therapy in cardiac patients, several of which reported physical benefit.[15-22] To date, the effects of relaxation and breathing therapy as additions to aerobic conditioning, have not been investigated. The question to be studied is whether relaxation therapy has any incremental value to an exercise training program with regard to training outcome.

METHODS

Patients. After discharge from several hospitals, cardiac patients are referred to the regional rehabilitation center at St. Joannes de Deo Hospital, Haarlem, The Netherlands. During a 3-year period, a total of 156 myocardial infarction (MI) patients were eligible for the study. They were

Table I. Baseline clinical data

Variable	Treatment A	Treatment B	p
No. of cases	76	80	
Age (years)	55.4 (8.2)	55.7 (8.1)	NS
Males	71 (93)	76 (95)	NS
Recurrent infarction	4 (5)	7 (9)	NS
Coronary bypass surgery	1 (1)	2 (2.5)	NS
History of angina >4 weeks' duration	14 (18)	12 (15)	NS
Size of MI:			
Unknown	4 (5)	4 (5)	
Small	20 (26)	27 (34)	
Medium	27 (36)	22 (27)	NS
Large	25 (33)	27 (34)	
Location of MI:			
Anterior	29 (38)	24 (30)	NS
Nonanterior	47 (62)	56 (70)	
Complications of hospital stay: heart failure	14 (18)	13 (16)	NS
Length of hospital stay (days)	18.2 (5.3)	19.6 (6.6)	NS
Postinfarction angina	28 (37)	25 (31)	NS
Medication on discharge:			
beta-Blockers	20 (26)	25 (31)	NS
Diuretics	27 (36)	20 (25)	NS
Antianginal agents	13 (17)	18 (23)	NS

Data are reported as events and percentage of cases or as means (±SD). MI, myocardial infarction. NS, not significant.

randomly allocated to two treatment protocols. Patients who were considered to need individual (psychosocial) help and not only exercise training were excluded. There were no age limits. Table I summarizes the clinical data at entry to the trial for the two randomized groups. Only nine women were referred for rehabilitation.

Measurements. In all patients a graded exercise test was performed on a bicycle ergometer (Monark) before and after the physical training. After an adaptation period on the bicycle, the test started with a 1-minute period of cycling at 60 cycles/min without load, then for 2 minutes at 60 W. The test was continued by increasing the work load by 30 W every 2 minutes until symptoms limited the patient's continuance or until the physician terminated the test. The occurrence of angina pectoris, ST disturbances, or severe arrhythmias were noted in the protocol. The ECG was read by a cardiologist (H.A.S.) for repolarization abnormalities. Most were ST depressions ≥2 mm, horizontal or downsloping, that occurred during or immediately after the test. A (standard) bipolar ECG lead was taken and recorded during the last 30 seconds before the work load was increased. Heart rate was calculated from this recording. Immediately after the test, a 12-lead ECG was recorded. After the patient had rested for 6 minutes, the heart rate was measured.

Blood pressure was taken with a mercury sphygmomanometer before the test and at maximum work load.

Design. This was a randomized, controlled clinical trial. To study the incremental effect of a combined treatment of exercise training with relaxation and breathing therapy versus exercise training only, patients had to be randomly allocated to either of the two treatment protocols. Randomization was done after the intake interview for the rehabilitation program after informed consent had been obtained. Patients who needed individual help were referred for relaxation therapy or psychosocial counseling and were excluded from the study. The data were analyzed according to the "intention to treat" principle. The cardiologist supervising the exercise testing was not informed on the treatment of the patient.

Treatment programs. Rehabilitation consisted of a program of exercise training plus relaxation training (treatment A) or of exercise training only (treatment B). The exercise training consisted of 5 weeks of interval training, with exercise sessions once a day for 30 minutes on a bicycle ergometer. Training was done in groups of four patients supervised by two physical therapists. Each patient exercised up to 70% to 80% of the maximal heart rate (Karvonen method) attained at pretraining exercise test.

Relaxation training was given once a week in six individual-hour sessions. The relaxation therapy was done by five specially trained persons (three psychologists, one a medical doctor, and one a physical therapist; they did not participate in the exercise program). Several procedures for active and passive relaxation centered around a respiratory technique were used. The procedures are described in detail elsewhere.[13] In short, electromyocardiographic feedback of the frontalis muscle is used for muscle relaxation and to monitor unnecessary inspiratory effort. The patient learns to observe and elicit a shift in the respiratory pattern so that inspiration expands both the lower abdomen and the costal margin, and expiration is moderated and slow. Consequently, tidal volume increases and the respiration rate decreases, breathing movements involve the trunk as a whole and require less effort. The patient usually feels more quiet and calm (relaxation response). Hyperventilation, if present, decreases. Relaxation is practiced first in the supine, relaxed position, but later also in the sitting and standing positions (active relaxation). The patient is asked to practice daily at home and when experiencing chest discomfort.

Statistical analysis. Statistical tests were performed on the measurements separately by means of nonparametric tests. Wilcoxon's rank sum test was applied to repeated measurements of an ordinal nature, and the Mann-Whitney U test was used for independent samples (treatments A and B). Repeated measurements of a nominal nature were tested with McNemar's test for change, whereas comparisons between independent samples were done with chi square analysis. If the data consisted of more than two categories, the chi square analysis for trends was done.

The composite criterion. To obtain a single measure for overall training outcome, the measurements recorded at

exercise testing were considered jointly. A composite criterion for training benefit (TB) was constructed in the form of a set of decision rules to select individuals who exhibit clearly positive or negative change. The purpose was to trichotomize the patients as follows: (1) patients with no or doubtful change (TB = 0), (2) patients who improved (TB = +), or (3) patients who deteriorated (TB = −). The measurements were ranked in a sequence of four levels reflecting their clinical relevance as judged independently by three cardiologists. The most important criteria were applied first, and negative effect had priority over positive effect because the first purpose of any intervention should be not to harm the patient. The decision rules for patient selection were applied sequentially as follows:

1. Signs of cardiac dysfunction: (a) exercise-induced repolarization disturbance, (b) exercise-induced angina pectoris, (c) serious arrythmia (groups or runs or multifocal or frequent premature ventricular complexes, bigeminy, or ventricular tachycardia). An individual in whom any of these signs was absent before training, but present after the training, was considered to have a negative effect (TB = −). Disappearance of these signs was considered as a positive effect (TB = +). However, changes in these signs were not used as indicators if relevant medication was changed or maximal work level increased or decreased more than 30 W over the same time period.

2. Maximal work load. Reduction of maximal work load was considered as a negative effect (TB = −), and an increase as a positive effect (TB = +), when the change was at least 30 W.

3. Heart rate. For comparison, heart rate was measured at similar work loads before and after the training period. The highest work load attained during both exercise testing was used as a criterion. An increase of the heart rate >10% of the initial value was considered a negative training effect (TB = −). Conversely, a decrease of the heart rate >10% of the initial value was considered a positive training effect (TB = +). This criterion was not applied when a change in relevant medication (particularly beta-blocking agents) coincided.

4. Blood pressure response. The last measurement was systolic blood pressure at the same work levels. When the blood pressure response during the test after training was >12 mm Hg higher than before training, this was considered a negative effect (TB = −), unless beta-blocking or antihypertensive medication had been stopped. Conversely, when the systolic pressure response was at least 12 mm Hg lower after training, this was considered a training success (TB = +), unless relevant medication had been started.

5. Dropouts. Patients who could not be classified on the basis of the previous measurements were considered unchanged (TB = 0) unless they had not performed an exercise test after training. In that case, the reason for the dropout of the rehabilitation program was used to decide whether the outcome was positive or negative with regard to physical recovery or cardiac function. Patients who stopped the training because they resumed their normal

Table II. Pretest values and changes in exercise testing for treatment A and treatment B groups

	Pretest X (SD)	*Change* X (SD)	p*	
Maximum Watt				
Treatment A	136.4 (23.6)	+7.0 (15.8)	0.01	
Treatment B	131.5 (20.8)	+8.4 (17.1)	0.0005	
Heart rate (beats/min)				
Watt = 0				
Treatment A	88.3 (17.2)	−3.7 (14.0)	0.02	(n = 67)
Treatment B	86.5 (16.8)	−0.7 (11.1)	NS	(n = 72)
Watt = 90				
Treatment A	115.9 (20.4)	−4.8 (10.8)	0.0004	(n = 66)
Treatment B	114.5 (19.2)	−3.4 (10.7)	0.05	(n = 71)
Watt = 120				
Treatment A	130.6 (20.3)	−5.7 (10.8)	0.0001	(n = 62)
Treatment B	130.0 (21.8)	−5.4 (11.7)	0.001	(n = 66)
Watt = 150				
Treatment A	140.2 (22.4)	−6.3 (15.7)	0.05	(n = 28)
Treatment B	142.5 (22.8)	−4.2 (12.9)	NS	(n = 27)
Blood pressure				
Diastolic				
Treatment A	86.0 (9.9)	−0.15 (10.2)	NS	
Treatment B	86.9 (10.3)	−0.75 (10.2)	NS	
Systolic				
Treatment A	131.7 (17.9)	0.39 (14.4)	NS	
Treatment B	128.4 (15.7)	2.1 (14.3)	NS	
Systolic pressure response				
Treatment A	27.0 (17.3)	−0.9 (18.3)	NS	
Treatment B	27.1 (20.0)	1.4 (22.3)	NS	

Treatment A, n = 67, exercise plus relaxation; treatment B, n = 72, exercise only. +, Increase; −, decrease. NS, not significant.
*Significance level: Wilcoxon's rank sum test, two-tailed.

daily activity were considered successful outcomes (TB = +); patients who stopped the training for cardiac problems were considered negative outcomes (TB = −); patients who stopped for other reasons were considered neutral with regard to outcome (TB = 0).

RESULTS

A total of 156 patients were admitted to the study (treatment A, n = 76; treatment B, n = 80). Baseline clinical data are shown in Table I. There were no differences between the two treatments. Three patients had previous coronary artery bypass grafting (CABG), 11 patients experienced recurrent infarction, and 26 patients had a history of angina pectoris. Infarction size was classified on the basis of the peak serum enzyme levels according to the standards of the participating hospitals. In most hospitals, an infarction is classified as small when the serum glutamic-oxaloacetic transaminase (SGOT) level is elevated, but remains below 60 U/L, whereas the infarction is classified as large when SGOT levels rise above 120 U/L. The infarction was classified as small in 47 patients, as medium in 49 patients, and as large

Table III. Signs of myocardial ischemia during stress testing: Repolarization disturbances on ECG (ST-T segment)

| Before training | Treatment A | | | Treatment B | | |
| | After training | | | After training | | |
	Absent	Present	Total	Absent	Present	Total
Present	12	12	24	4	16	20
Absent	42	1	43	47	5	52
Total	54	13	67	51	21	72

McNemar's test: $p < 0.005$, two-tailed; not significant

Table IV. Overall outcome of training based on composite criterion for training benefit

	Treatment A	Treatment B
TB = + (Success of training)	42(55%)	37(46%)
TB = 0 (No change)	19(25%)	16(21%)
TB = − (Failure of training)	15(20%)	27(33%)
Total	76(100%)	80(100%)

TB, Training benefit.
LInear chi square: 2.85, $df = 1$, $p = 0.09$, two-tailed.

in 52. In eight patients the enzyme levels were not available. In-hospital signs of heart failure (hypotension, cardiothoracic ratio >50%, pulmonary congestion) were present in 27 patients (17%). Assessment of ventricular function was not performed routinely in the participating hospitals. The average patient's hospital stay lasted almost 3 weeks. Postinfarction angina was present in one third of the patients in the study.

Exercise testing: Univariate analysis. A total of 139 patients completed the rehabilitation program (treatment A, $n = 67$; treatment B, $n = 72$). The initial values and the changes after training are shown in Table II. There were no significant differences in exercise parameters between the treatments before rehabilitation.

Maximum work load increased for both treatments to a small degree [treatment A: 7.0 W (5%; $p < 0.01$); treatment B: 8.4 W (6.4%; $p < 0.0005$)]. For treatment B, initial work load was slightly lower and the increase more pronounced; the difference between the two treatments was not significant. Most patients regained the pretest work level after training. Only 39 of 139 patients (28%) had a greater maximum work load (treatment A, 18; treatment B, 21). Conversely, seven patients (treatment A, 4; treatment B, 3) ended the test period with a lower maximum work load.

Average heart rate. For both treatment groups, the average heart rate at similar work levels was lower after training. There was a trend for more pronounced training bradycardia in treatment A compared with treatment B at most levels of effort; the difference did not reach significance. If a reduction of more than 10% of the initial value is used as a cutoff point, heart rate at maximum work level decreased for 22 patients, two of whom reached a lower work level after training. Thus 20 patients (14%) experienced a significant training response in maximum heart rate (treatment A, $n = 8$; treatment B, $n = 12$). When the same cutoff point is applied, maximum

heart rate increased in 18 patients, 10 of whom reached a higher work level. This means that eight patients (6%) had a negative training effect in this respect (both treatments, $n = 4$).

Blood pressure. The average changes in blood pressure were negligible. There was neither an effect of training nor an additional effect of relaxation on systolic or diastolic pressure. Resting systolic blood pressure increased slightly in treatment B. The systolic blood pressure reaction to effort did not change on average. However, with a cutoff point of a change >12 mm Hg, the blood pressure reaction was reduced in 34 patients; in three of them work level also diminished. Thus 31 patients (22%) had a positive training effect in this respect (treatment A, 13; treatment B, 18). However, blood pressure increased in another 34 patients, 11 of whom also reached higher work level. This means that 23 patients (17%) had a negative training effect (treatment A, 9; treatment B, 14).

Cardiac dysfunction. With respect to signs of cardiac dysfunction, Table III shows that repolarization disturbances in the ECG during the initial stress test were present in 44 patients (treatment A, 24; treatment B, 20). These were mainly ST-T depressions; in five patients, exercise induced ST elevations. After training, ST abnormalities disappeared in half the cases in treatment A, whereas it appeared anew in only one patient ($p < 0.005$). In treatment B, ST disturbance disappeared in four patients and appeared in another five patients. The difference between treatments was significant ($p < 0.02$). Angina pectoris during initial stress testing was present in 18 patients (nine in both treatment groups). It was present in 12 patients (six in both treatments) at the posttraining test. In treatment A, angina pectoris disappeared in four of nine patients, but appeared in one patient. In treatment B, angina disappeared in six of nine patients, but appeared in three others. The changes after training are statistically not significant, probably because of the small number of patients. There was no difference between the two treatments. Serious arrhythmias were present in 14 patients

(treatment A, 5; treatment B, 9); three of them were complex. Major change occurred in only one patient in treatment B (i.e., complex arrhythmia was present at the posttraining test where none existed at the pretraining test). There was no change in antiarrhythmic medication.

Exercise testing: Composite criterion. The overall outcome based on all measurements results in a trichotomy: the patient can have a success or failure of exercise training, or no change. Table IV and Figs. 1 and 2 show the outcome for both treatment groups. Four test criteria are considered sequentially: cardiac dysfunction, maximum work load, maximum heart rate, and systolic blood pressure response. In addition, the 17 patients who dropped out of the program are classified according to the reasons for not completing the training. Two patients felt good enough to resume full activity and did not complete the training; they are considered successful outcomes (TB+: $n = 2$; both in treatment A). Nine patients had to stop the program because of cardiac problems; these are considered to have a negative outcome (TB = −; $n = 9$; treatment A, $n = 3$, treatment B, $n = 6$): three patients had coronary bypass operation, two developed arrhythmias (one was later readmitted to the hospital), three patients were readmitted to the hospital for unstable angina pectoris, and one patient died. Six patients stopped the training for noncardiac reasons. These patients were considered neutral with regard to outcome (TB = 0: $n = 6$; treatment A, $n = 4$; treatment B, $n = 2$). Five of the six patients had physical problems that prevented training (chronic lung disease, hepatitis, complaints of hip, lower back, and knee, respectively) and one had social reasons. Thus, according to the "intention to treat principle," all randomized patients are classified.

The flowcharts (Figs. 1 and 2) show that for each of the subsequent criteria, several patients were selected with a positive change, but a small number were also selected because of a negative effect. Approximately half the patients completed the training successfully (treatment A, 42 patients (55%); treatment B, 37 patients (46%). Conversely, training failure occurs in a substantial number of patients: 15 patients in treatment A (20%) and 27 patients in treatment B (33%). Nineteen patients (25%) in treatment A and 16 patients (21%) in treatment B showed no change. The overall training outcome is shifted slightly more to the positive side for patients in treatment A than for patients in treatment B. However, the difference between the two treatments was not significant at the 5% level (chi square, 2.85, $df = 1$, $p < 0.09$, two-tailed test for differences).
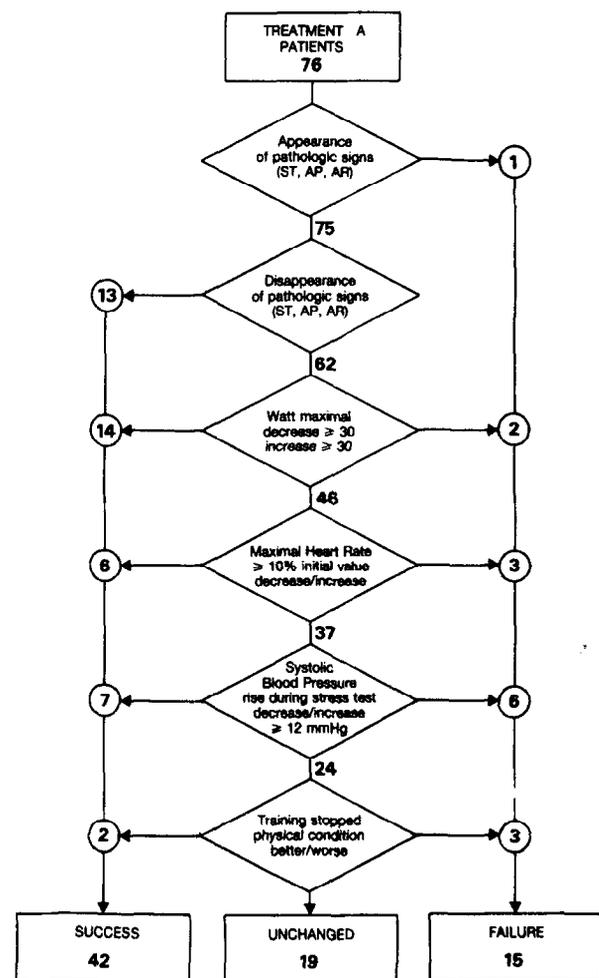

Fig. 1. Training benefit for patients in treatment A group: Exercise + relaxation.

DISCUSSION

Relaxation effect. A 5-week daily exercise program for patients soon after myocardial infarction resulted in a modest training response: maximum work load increased, and heart rate at a given work level was reduced significantly. There was no clear evidence of an incremental effect of relaxation therapy on these measurements separately. However, training bradycardia was more pronounced at all levels of effort for patients who were taught to relax. In accordance with other studies,[21, 23] relaxation was found to decrease resting heart rate significantly, whereas exercise did not. Exercise-induced signs of cardiac dysfunction remained stable during rehabilitation, except for a substantial decrease of ST abnormalities in patients who received relaxation therapy. A similar result was found in cardiac patients in an earlier study by Kavanagh[18] and in normal subjects at high cardiac risk more recently by Patel et al.[24] It is remarkable that relaxation influences myocardial ischemia. If

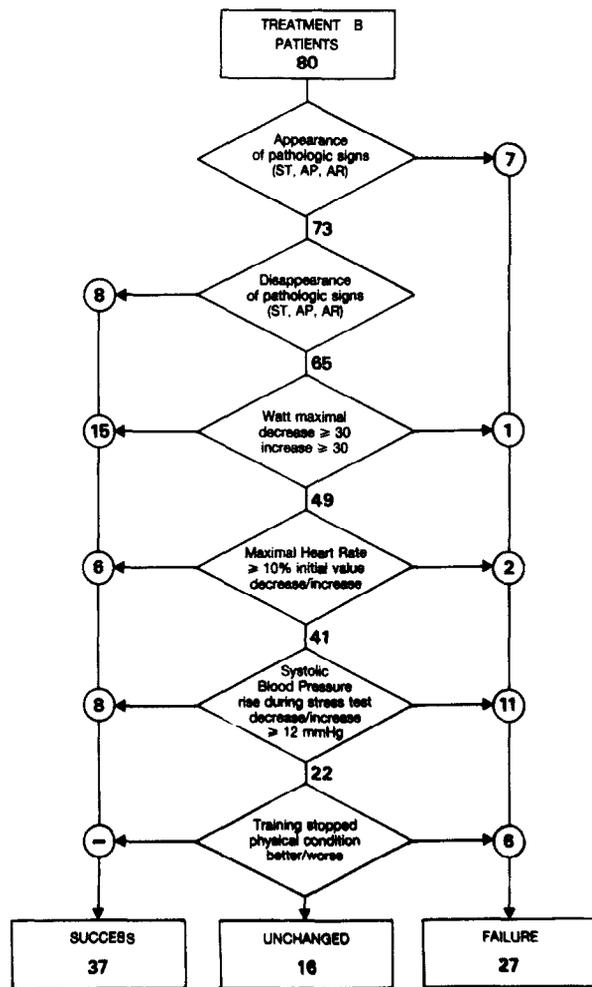TREATMENT B
PATIENTS
80

Appearance
of pathologic signs
(ST, AP, AR) — 7

73

Disappearance
of pathologic signs
(ST, AP, AR) — 8

65

Watt maximal
decrease ≥ 30
increase ≥ 30 — 1
15

49

Maximal Heart Rate
≥ 10% initial value
decrease/increase — 2
6

41

Systolic
Blood Pressure
rise during stress test
decrease/increase
≥ 12 mmHg — 11
8

22

Training stopped
physical condition
better/worse — 6
—

SUCCESS **37**   UNCHANGED **16**   FAILURE **27**

Fig. 2. Training benefit for patients in treatment B group: Exercise only.

this finding is replicated, it will be of clinical significance and may also have prognostic implications.[25] This suggestion is empirically supported in a follow-up study in which relaxation was shown to reduce the number of cardiac events during a 2-year period, particularly readmission to the hospital for unstable angina pectoris or CABG.[26]

However, when the average outcome for two treatments is compared, important information may be missed. The result made on the basis of the composite training criterion demonstrated that a "modest" training response masks the fact that some patients clearly benefit, whereas others do not benefit or even deteriorate. Physical training was effective in only approximately half the patients. A substantial number of patients had a negative outcome. The proportion of success versus failure of training was more positive for patients who received breathing and relaxation therapy. The reduction of training failure in particular is intriguing. The odds for failure were 15/

61 (0.25) for treatment A, and 27/53 (0.51) for treatment B. The odds ratio for a negative outcome was 2.04 (95% confidence intervals, 0.94 to 4.6). Thus relaxation and breathing therapy reduces the risk of failure bv half.

Outcome differences can be interpreted as an effect of relaxation because the patients had been randomly assigned to either of the two treatments. There were no differences in clinical baseline characteristics or exercise parameters that might explain the results. Therefore it can be concluded that relaxation and breathing therapy has incremental value to exercise training for improvement of exercise tolerance. The study does not determine the effect of relaxation without exercise.

The study was not designed to investigate possible mechanisms by which relaxation therapy might exert its effect. In future studies, several options deserve consideration. First, relaxation may influence sympathetic reactivity[15, 23, 24] and thus reduce the risk of effort,[7] especially for the "overzealous" patient.[18] Second, breathing therapy in particular may affect hypocapnia, which results from hyperventilation.[27] Carbon dioxide is a potent vasodilator and can modulate coronary blood flow.[28, 29] Third, a slow respiratory pattern promotes parasympathetic activity,[30] (e.g., respiratory sinus arrhythmia), which counteracts sympathetic reactivity. Considering that cardiac and respiratory activity are linked physiologically, for instance, in nervous regulation in the brain stem, the breathing component of the relaxation technique may have special relevance. Respiration is also connected mechanically to cardiac activity, for instance, via its effect on venous return as well as via thoracic mobility.[31] Finally, silent ischemia appears to be linked to psychologic processes, particularly denial.[32] Consideration of these factors in future studies may help to distinguish those patients who might benefit from a particular type of relaxation therapy.

Single outcome category: Success vs failure. To our knowledge a composite criterion for assessing success or failure of exercise training has not yet been presented. The rationale for such a criterion is that it results in a single outcome category, reflecting success or failure of training for the individual patient. This allows evaluation of cardiac rehabilitation in terms of indications (expected benefit of training) and contraindications (expected adverse effects). Exercise testing provides the proper measures for physical training. However, a positive outcome is not necessarily a result of training. The natural recovery after myocardial infarction may contribute to it as well.[33] Nevertheless, differences in exercise tolerance after sufficiently intensive training are usually con-

sidered as a training response. Absence of this response implies that training was not successful. Similarly, a negative outcome might be caused by progression of ischemic heart disease. Conversely, progressive training effort may provoke symptoms and increase risk.[7, 34] This training failure is partly preventable, as the reduction of negative outcome by relaxation in this study demonstrates. Thus the failures or dropouts provide essential information on the unsuitability for the particular treatment.[35]

Exercise testing yields several measurements, both continuous and dichotomous, and their clinical importance varies. They may show disparate results. To reduce this number of measurements, combinations can be made, for example, the rate-pressure product or the work level where cardiac dysfunction appears (angina threshold or ST threshold). The purpose of our strategy was to develop a model to integrate the measurements in a single classification of overall outcome. The basic idea is to rank the various parameters of exercise testing in order of importance. In the case of MI patients, signs of cardiac dysfunction (ST abnormalities, angina pectoris, complex arrhythmias) were considered to be of primary relevance. Priority was given to negative changes, because treatment should first of all exclude any harm, *primum non nocere.* The level at which a change is scored was high. For instance, only serious arrhythmias are included.

The next three steps concern changes in parameters of physical fitness: maximal work load, heart rate, and systolic blood pressure, in this order. The cutoff levels were higher than those used for univariate comparisons.[36] For instance, the minimal change in work load is 30 W, corresponding with a substantial degree of improvement or deterioration (about 22%). Heart rate and blood pressure effects were compared in the third and fourth step for the common highest work level at pretraining and posttraining test. The criterion was intended to be a measure of overall physical effect or recovery; it includes change in fitness, provided that cardiac dysfunction does not change. The underlying concept was that fitness cannot compensate for dysfunction.

Implications for rehabilitation policy. The model results in a single trichotomous outcome measure, which seems to be a sufficiently sensitive and realistic criterion for the purpose of evaluation. An "in between" category of "no change" allows one to focus on either indications (benefit vs no benefit) or contraindications (failure vs no failure) for training. Because cardiac rehabilitation programs are rather expensive and involve a certain risk, much effort could be saved when the likelihood of benefit could be pre-

dicted on the basis of initial data.[36] A composite criterion, resulting in a single outcome measure, would be a valid end point for prediction and subsequent patient selection.

However, the absence of physical benefit does not necessarily mean that rehabilitation is useless. It does not imply absence of social or psychologic benefit. Patients without training effect may still benefit from rehabilitation. In fact, there is little evidence for the assumption that physical fitness is associated with well-being and improved mental health, or is instrumental for social recovery or reduction of anxiety or depression.[37] Nevertheless, although physical criteria are obviously insufficient to evaluate rehabilitation, they are crucial to evaluate whether the choice of exercise as a treatment was appropriate. Rehabilitation should be tailored to the individual need. Patients without training success may possibly benefit from other treatment modalities. When the likelihood of training success is low, one option is to concentrate treatment on behavioral intervention such as information, education, counseling or risk-factor modification. This study suggests three other options. One is to provide relaxation and breathing therapy, either on a one-to-one basis or in groups. Another is to integrate this relaxation therapy in exercise training (e.g., as part of the warming up and cooling down). Finally, the exercise itself may be changed to the flexibility-coordination-relaxation type,[14] as in yoga,[38] or in awareness through movement,[39] and active relaxation. The outcome of this study suggests that this may result in physical benefit for some patients who do not have success with exercise training per se.

Breathing and relaxation therapy provide a different viewpoint on exercise. As Hellerstein has noted,[40] exercise training is an established treatment, but currently "there is a plethora of repetitive exercise programs in cardiac research that are devoid of original hypotheses." It may be time to differentiate qualitatively the content and aim of exercise in such a way that patients with low probability of training success may still benefit from rehabilitation.

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