Effect of Relaxation Therapy on Cardiac Events After Myocardial Infarction: A 5-Year Follow-Up Study

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Background. *Evidence suggests that breathing and relaxation therapy may influence cardiac events in persons after acute myocardial infarction (MI). The authors studied the effects of breathing and relaxation therapy on rates of cardiac events and cost effectiveness in past MI patients.*
Methods. *Patients (n = 156) were chosen randomly to receive either exercise training plus relaxation therapy (relaxation group; n = 76) or exercise training only (control group; n = 80). The occurrence of major cardiac events and cardiac rehospitalizations in the two treatment groups was compared.*
Results. *At 5-year follow-up, 12 cardiac deaths had occurred, 5 in the relaxation group and 7 in the control group, reinfarction occurred in 10 and 12 patients, and cardiac surgery was performed in 2 and 11, respectively. In total, 15 (20%) and 26 (33%) patients, respectively, experienced at least one cardiac event (odds ratio [OR] for the relaxation group: 0.55, 95% confidence interval [CI] 0.29–1.05; adjusted for risk factors OR 0.52, 95% CI 0.28–0.99). Regarding all cardiac rehospitalizations, in the relaxation group, 30 patients (39%) had experienced 52 cardiac events, for which the patients were hospitalized for a total of 476 days. In the control group, 38 patients (48%) had experienced 78 cardiac events (OR 0.72; 95% CI 0.38–1.36), comprising 719 days of hospitalization. The total number of hospitalizations was reduced by 31% as a result of relaxation instruction.*
Conclusions. *In the long-term, the disease course after myocardial infarction is influenced favorably by giving relaxation therapy in addition to cardiac rehabilitation. The extra costs of the therapy are compensated by a decrease in hospitalization for cardiac problems.*

Key words: relaxation therapy, myocardial infarction, cardiac rehabilitation, secondary prevention.

Relaxation therapy is one of the treatment modalities in cardiac rehabilitation; since the first study by Kavanagh et al.[1] in 1970 many studies have demonstrated its effectiveness in cardiac patients.[2–10] However, routine implementation often is hampered by the fact that training in relaxation skills is not part of any specific discipline.

Relaxation Method

In the Dutch Guidelines for Cardiac Rehabilitation, relaxation techniques are described as a valid treatment modality that can be taught by any adequately trained member of the rehabilitation team.[11,12] These Guidelines propose different ways to initiate a process of self-regulation within the patient, involving both primary and secondary relaxation skills. Development of the primary skills requires focusing on the "internal state" and initiating a voluntary change in, for example, posture, muscle tension, breathing, and imagery to evoke perceptible changes in the mental and/or physical state. This process of generating changes is called self-instruction and basically consists of an alternation between active self-instruction and passive self-monitoring, to observe the effects of the applied technique.

Secondary relaxation skills involve the application of primary skills to daily activities. To achieve the ability for self-instruction, a set of instructions have been designed that offer a range of different modalities, graded from easy to more difficult, two of which are in the Appendix. Because of the alternation between active execution of the instruction and passive self-monitoring of its effects, the therapist can evaluate and select the modality that is easiest for the patient to practice. This alternation avoids the need to be suggestive. The therapist tells the patient what to do, but not what to feel. The patient is asked to report his or her experiences after stopping the active part. This brings the patient to focus on his or her internal state,

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with passive attention. For instance, the patient is asked (in the recumbent position) to pull up the feet toward him or herself, hold it and notice tension signals, to stop and notice the signals' disappearance. Or, the patient is asked to breathe out audibly, with the sound of "ff" made at the lips, approximately 5 to 6 times, to stop and notice any changes when respiration has returned to its normal rhythm. Or, the patient is asked (in the recumbent position) to roll the head slowly from side to side, a number of times, to stop and notice any changes in the way the body lies on the floor. The patient may be asked, in the sitting position, to slide the hands from the knees, along the outside of the legs to the ankle and back to the knee, along the inside of the legs, and repeat this approximately 20 times, in an easy, carefree way, without counting. Then the patient is asked to stop and notice any changes in the way he or she is sitting. From these basic elements, the instruction is built up and becomes more elaborate and difficult. For instance, the patient may be asked to pull up the feet while exhaling (coupling respiration and movement); to roll the head and stop, and notice the effect on respiration; to roll the head or stroke the legs, while at the same time breathing continues in its own rhythm (uncoupling respiration and movement); to breathe audibly out and in, through the lips, 5 to 6 times; to focus attention on the legs while breathing normally. After instruction, the patient is asked to stand up and notice any changes in his or her way of standing. Thus, the overall effect on posture, breathing, and mental state in a more active condition is evaluated. This facilitates generalization to daily life. The patient is asked to recall many times a day this sensation of standing. Secondary skills are further trained by discussing in detail the cues, indicating tension increase and decrease in daily life, and the best moments to practice. Patients are advised to practice when they are relatively quiet.

Relaxation Effects

The short-term effects of relaxation generally are described as a reduction of arousal, or as a shift from an ergotropic state toward a less ergotropic and more trophotropic state.[13] Physical effects may be seen in a reduction in blood pressure,[3,5,14,15] heart rate,[2,8,14] myocardial ischemia,[1,9,16] and arrhythmia,[6,17] whereas mental effects include improvements in mood, level of anxiety, and feelings of well-being.[2,3,7,10] However, the effects of relaxation on cardiac complaints[4,6,18] and on activity in daily life and return to work[7,19,20] also may be explained by three processes, other than the trophotropic shift, that contribute to self-regulation, but are more difficult to measure: an improvement in dysfunctional breathing,[21,22] in quality of body movement, and in cognitive misunderstanding of relaxation.[23] For instance, after relaxation, the patient may perceive and appreciate the sensations of effortless breathing and small effortless movements more adequately. Thus, to achieve self-regulation an increase in body awareness is most important. On the one hand, patients become more aware of, for instance, signs indicating when to stop an activity and when to continue an activity, and learn to objectively monitor these to better cope with physical symptoms in daily life. On the other hand, patients become more aware of their tensions and inability to relax; some even report more complaints. Unpleasant experiences, however, are not necessarily harmful; they may contribute to self-regulation by stimulating the patient to recognize the best moments for self-instruction. A combination of short-term effects and internal awareness may be instrumental in increasing self-confidence, general status of health and social function, and improving the general effectiveness of rehabilitation[20] as a result of relaxation.

Research Question

Although the short-term effects of relaxation are established, the long-term effects have not yet been investigated. Therefore, within a randomized clinical trial, the present study examined the effects of individually tailored breathing and relaxation on major cardiac events (cardiac death, reinfarction, or cardiac surgery) during a 5-year period after infarction. In addition, we investigated whether use of relaxation techniques reduces the probability of any cardiac rehospitalization.

Material and Methods

Patients

From 1981 to 1983, approximately 200 patients per year were referred to the regional cardiac rehabilitation center at Kennemer Hospital, Haarlem, The Netherlands. Included in the study were patients with a diagnosis of recent myocardial infarction (within 1 month) and the ability to participate in a physical exercise program. A total of 159 patients were invited to participate; three patients refused, so the study group comprised 156 patients. The study protocol was approved by the institutional review board.

Design

Study patients were assigned at random to either a program with physical exercise training only (control group, $n = 80$) or to a program in which the same exer-

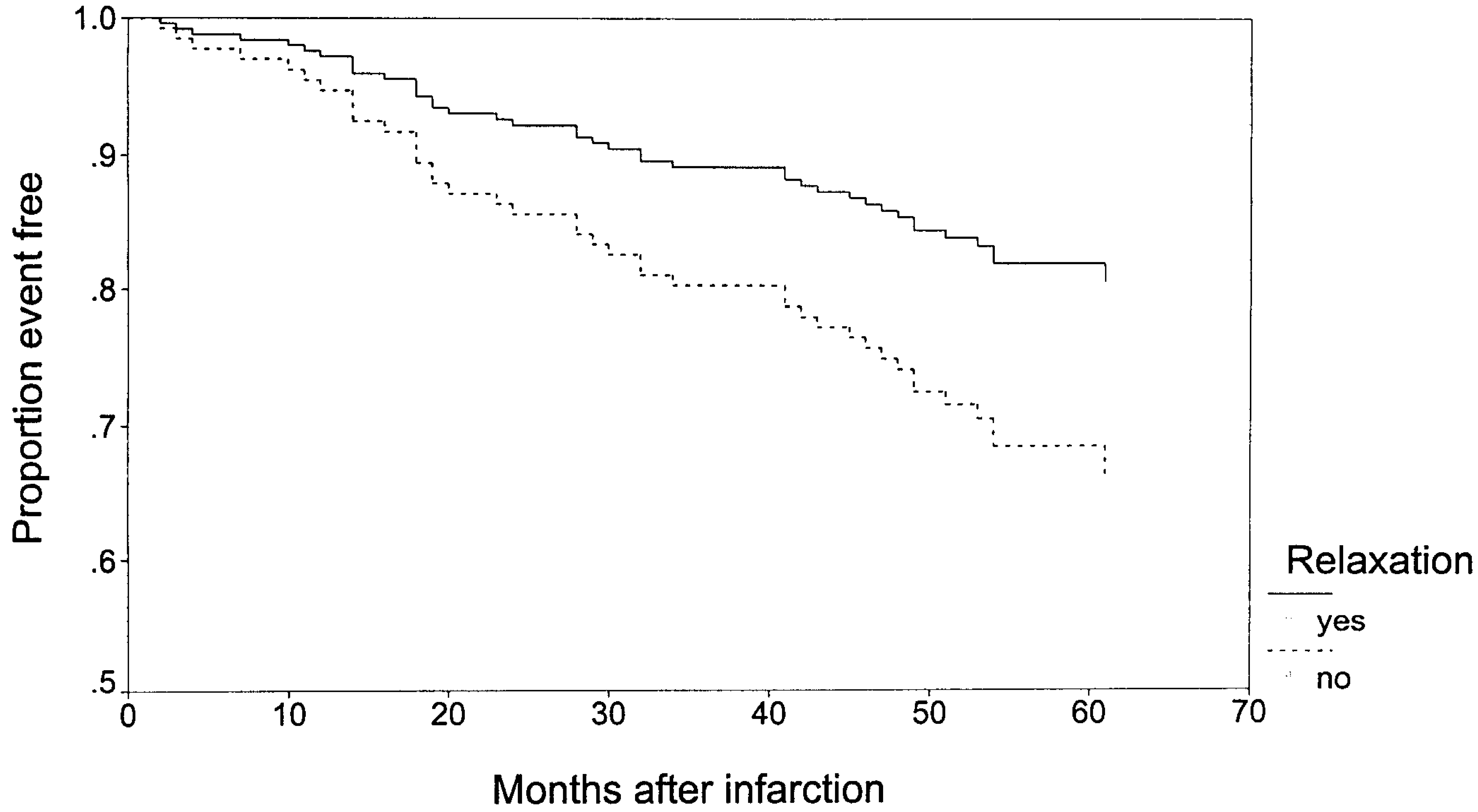

Figure 1. Hazard rate for major cardiac events (cardiac death, reinfarction, cardiac surgery) in 5 years after myocardial infarction for patients with and without relaxation instruction. Yes: Relaxation instruction plus exercise training; No: exercise training only

results suggest that the inclusion of breathing and relaxation therapy improves the long-term outcome of cardiac rehabilitation. In three studies with cardiac patients similar long-term effects of relaxation and stress management were found: a trial by Patel et al.[25] with a 4-year follow-up of relaxation training in patients with high cardiovascular risk, a study by Blumenthal et al.[16] with a 5-year follow-up of stress management training in patients with myocardial ischemia, and a pilot study by Appels et al.[26] with a 2-year follow-up of the same relaxation therapy as reported in the present study in angioplasty patients who remained exhausted after percutaneous transluminal coronary angioplasty. This study, however, investigated the contribution of relaxation instruction in addition to exercise rehabilitation, which is known to have a beneficial effect in the long-term.[27]

Self-Regulation of Tension

It is important that patients learn to master the primary relaxation skills.[6] In the present study, the patients participated in six 1-hour sessions, individually tailored to the needs of each patient. The minimum number of sessions was put at six, but in practice, this number may vary depending upon the ability of the patient to reach sufficient self-regulation. Whereas the classical relaxation approaches requires patients to adapt to a standard training protocol, the present approach adapts the instructions to the patients. In a meta-analysis, Linden and Chambers[28] found that highly individualized stress management was equally as effective as drug treatment for hypertension. In our sessions, the selection, number, and sequence of relaxation instructions depends on the response of the patient. The therapist observes the occurrence of any meaningful process that may contribute to self-regulation. Thus, the quality of relaxation therapy may account for the favorable results. In clinical practice, only a minority of cardiac patients are considered suitable for classical relaxation training.[29] In this study, however, 88% of all myocardial infarction patients learned a primary relaxation skill and after 5 years 70% of them still practiced some form of relaxation. The use of relaxation techniques can be incorporated within a physical training or a psychoeducational program. Relaxation enhances the effect of exercise rehabilitation on physical fitness because it promotes the process of recuperation. It is important, however, to evaluate to what degree skills in self-regulation of tension have been mastered.

Cost-Effectiveness

The results were reported previously at the Fifth World Congress on Cardiac Rehabilitation (Bordeaux, cise training took place plus individual sessions for relaxation therapy (experimental group, $n = 76$). Patient characteristics have been reported elsewhere.[9,10] There were no statistically significant differences between the two groups for any demographic, clinical, or psychosocial characteristics.

Exercise Training

Cardiac rehabilitation comprised a 5-week program with exercise sessions on a bicycle ergometer once a day for 30 minutes. Training was done in groups of four patients supervised by two physical therapists, with standard electrocardiographic monitoring.

Breathing and Relaxation Therapy

Individual instruction was given for 1 hour once a week for 6 weeks. First, the patients learned to relax in the recumbent position and received biofeedback (Myotron 220, Enting; The Netherlands) about frontalis muscle tension. They also learned a method of breathing regulation, which could be applied in the supine, sitting, and standing positions. From a large repertoire of instructions the therapist could choose the most appropriate ones for each patient. Two examples of the instructions are given in the Appendix. The basic procedure in each instruction was an alternation between a direct influence on the patient, and a phase in which this influence was ceased and the patient passively monitored the resulting changes. The therapist was careful not to indicate any desired effect, but merely invited patients to report their experiences. Patients were asked to practice at home. In subsequent discussions the perception of tension signals received particular attention to help patients more accurately observe the need for timely rest and relaxation.

Procedure of Data Collection

The medical records of all study patients were searched in the regional hospitals at 2 and 5 years after discharge. In case of readmission to hospital, the diagnosis and reason for readmission, date and duration of hospital stay were noted. All patients who were still alive were mailed a questionnaire asking about rehospitalization. If data were incomplete, the general practitioner was contacted for relevant information. All hospital readmissions for cardiac problems up to 5 years postdischarge were included in the analysis.

Statistical Analysis

The effect of relaxation instruction was investigated by calculating the relative risk (odds ratio [OR]) for the occurrence of major cardiac events (cardiac death, reinfarction, heart surgery). Because of the small sample size and because baseline characteristics associated with the outcome (covariates) may be distributed unequally between patients with and without relaxation, a multivariate statistical model (i.e., Cox's proportional hazards model[24]) had to be used. To estimate the effect of treatment more accurately, the OR was recalculated, adjusted for the covariates clinical data (size and location of infarction, previous infarction, previous angina pectoris, and signs of mild heart failure during hospital stay), and data after discharge (medication, exercise tolerance, heart rate, smoking status, level of anxiety, and feeling of well-being). Variables making a large contribution to the variation in endpoint ($P \leq 0.10$) were included in the model, together with the treatment condition (relaxation group, coded as 1; control group, coded as 0). The level of significance was fixed at 0.05 (two-tailed). In a second analysis all readmissions to hospital were counted to assess the degree that medical consumption differed between the two treatment groups.

Results

At 5-year follow-up, 140 of the 156 patients were still alive; of these, 132 (94%) returned the question-

Table 1. ***Major Cardiac Events at 2 and 5 Years After Myocardial Infarction, in Patients With and Without Relaxation Therapy***

	After 2 Years		*After 5 Years*	
Cardiac events	*With Relaxation ($n = 76$)*	*Without Relaxation ($n = 80$)*	*With Relaxation ($n = 76$)*	*Without Relaxation ($n = 80$)*
Cardiac death	1 (1.3)*	5 (6.2)	5 (6.6)	7 (8.8)
Sudden Death	1	3	2	4
Heart failure	0	2	2	3
Recidive infarction	5 (6.6)	2 (2.5)	10 (13.2)	12 (15)
Cardiac surgery	2 (2.6)	6 (7.5)	2 (2.6)	11 (13.8)

*Values are number of events (%).

naire. The average follow-up period was 58.5 months (range 5 to 72 months). The results are given in Table 1.

In the first 2 years of follow-up, 6 patients had died due to cardiac events: 1 in the relaxation group, 5 in the control group. After 5 years 12 patients had died, 5 in the relaxation group and 7 in the control group. The diagnosis "sudden death" was applied to 6 patients, 2 in the relaxation group, 4 in the control group. These patients died out of hospital. Five patients died due to heart failure, 2 in the relaxation group and 3 in the control group. Within 2 years, 7 patients survived a reinfarction, 5 in the relaxation group and 2 in the control group. After 5 years, 22 patients survived a reinfarction, 10 in the relaxation group and 12 in the control group. Coronary bypass surgery was performed in 8 patients within the first 2 years, 2 in the relaxation group, and 6 in the control group. After 5 years, coronary bypass surgery was performed in 12 patients, 2 in the relaxation group, and 10 in the control group. In addition, 1 patient in the control group underwent aortic valve surgery.

A total of 41 patients either died from cardiac causes, or survived a recurrent infarction, or underwent cardiac surgery: 15 (20%) in the group with relaxation and 26 (33%) in the control group (Table 2). The relative risk for these major cardiac events was lower in patients in the relaxation group (OR 0.55, 95% CI 0.29–1.05). Using Cox's regression analysis, four variables appeared to be associated with the outcome: previous angina pectoris, size and location of infarction, and signs of mild heart failure. When these were included in the model as confounding variables, the adjusted relative risk remained lower after relaxation instruction (OR 0.52, 95% CI 0.28–0.99). Figure 1 shows the hazard rate in time for the two groups.

In addition to these major cardiac events, of the 156 study patients, 15 were readmitted to hospital for coronary angiography, 9 patients had extended hospital stay after cardiac surgery, 39 were readmitted because of unstable angina pectoris, 8 because of atypical anginal pain, and 12 due to other cardiac reasons. In the relaxation group 30 patients (39%) were readmitted 52 times, for a total duration of 476 days. In the control group 38 patients (48%) were readmitted 78 times, for a total duration of 719 days. The relative risk for the occurrence of any event was lower in the relaxation group (OR 0.72, 95% CI 0.38–1.36). Thus, the number of rehospitalized patients was reduced by 28% after relaxation therapy. The average number of readmissions was 0.68 (SD 1.07) in the relaxation group and 0.98 (SD 1.43) in the control group. This means that readmission frequency was reduced by 31% after relaxation therapy. The average duration of hospital stay was 6.26 (SD 11.1) days in the relaxation group and 9.0 (SD 15.9) days in the control group, giving a 30% reduction in number of days in hospital after relaxation therapy. Thus, there was a marked reduction in medical consumption in the 5 years after relaxation instruction.

Discussion

The major finding of this study was that the use of individually tailored breathing and relaxation techniques improves recovery after myocardial infarction, even in the long term. In a 5-year period after infarction, patients enrolled in cardiac rehabilitation with additional breathing and relaxation therapy, had considerably less cardiac events and rehospitalizations than patients who had exercise training only. The

Table 2. *Effect of Relaxation Instruction on the Relative Risk for Cardiac Events and Readmissions to Hospital in Myocardial Infarction Patients at 5 years*

	With Relaxation (n = 76)	*Without Relaxation (n = 80)*	*Odds Ratio (95% CI)*
Major cardiac events*	15 (19.7)†	26 (32.5)	0.55 (0.29–1.05) 0.52 (0.28–0.99)‡
Readmissions to hospital for cardiac reasons§	30 (39.5)	38 (47.5)	0.72 (0.38–1.36)

95% CI = 95% confidence interval.
*Cardiac death, recurrent infarction, heart surgery.
†Values are number of patients (%).
‡Adjusted for risk factors for cardiac events using Cox's regression analysis.
§Coronary angiography, clinical rehabilitation after heart surgery, unstable angina pectoris, atypical angina pectoris, and other cardiac reasons.

1992). The present article was prompted by the Dutch Guidelines for Cardiac Rehabilitation,[11] in which the cost-effectiveness of the therapy was of value. In a second analysis, therefore, all hospitalizations of our study population were counted to assess the degree of reduction in medical costs. It appeared that the extra costs of the individual relaxation training sessions is outweighed by the benefits in terms of reduction in medical consumption. After relaxation instruction fewer patients were less often readmitted to hospital; there was a 30% reduction in the number of days in hospital after relaxation therapy. The actual costs of readmissions was reduced even more (approximately 46%), because of the reduction in cardiac surgery.[30,31]

Beyond the Scope of the Study

The results of this study indicate the need for a replication study with a larger sample size and including indications other than myocardial infarction. Replication also is necessary because of the increased effectiveness of medical treatment today compared with the time of this study. Follow-up of the patients should be extended. In a meta-analysis of psychosocial intervention studies the effect was reported to decrease after 2 years,[32] whereas Hedback et al.[33] found a greater effect of rehabilitation after 10 years compared with the 5-year outcome. The intermediary processes deserve more attention. From the questionnaires it appeared that patients in the two groups did not differ in smoking or the use of medication like beta-blocking drugs, in this study. Despite the considerable smaller number of cardiac surgeries in the relaxation group, the patients did not differ in degree of anginal complaints, in the amount of effort that could be sustained, the need for rest, or in return to work (data not shown). We had no information on lipid profile or depression. Three months after rehabilitation we found a slightly slower respiration rate in the relaxation group, associated with increased heart rate variability and lower resting heart rate.[34] At 2-year follow-up, a subgroup of patients showed that respiration rate was still slower after relaxation.[35] Finally, it is important to compare the effects of different relaxation therapies, to assess the periods of relaxation practice in more detail, and compare the effect between high and low practitioners.

Conclusion

This study contributes long-term data to the short-term reports on the effectiveness of relaxation instruction for cardiac patients. Relaxation instruction, as an independent treatment modality, may improve the outcome of cardiac rehabilitation.

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Appendix

Two of the 24 breathing and relaxation instructions from the Dutch Guidelines for Cardiac Rehabilitation. The text can be read to the patient and adapted to his or her response. Text in brackets is intended for the therapist and should not be read to the patient.

1. "**Supine position, pulling the feet up**"

Lie down on your back, the legs extended, with a folded towel under the head	Notice how your legs are lying
Pull the toes towards you, hold the feet in this position, continue breathing	Notice where you feel tension ... you are increasing tension deliberately ... where do you feel it
Let your feet relax; wherever you noticed the tension increasing, let go (Repeat this two times)	Pay attention to the decrease of tension as you relax your feet and let the tension go (Say: notice the exact places where tension changes are perceptible ... this can be different each time ..., and discuss it with the patient)
Relax the legs, let them lie quietly	Compare how the legs are lying now, compared to before ... how is your back ... your pelvis
(When the instruction is done well and the subject reports clear changes, continue, otherwise repeat the first step)	
Pull up the toes towards you, hold the feet in this position	Notice whether this influences your lower back... abdomen... breathing
Relax the feet and legs (Repeat this 2–3 times)	Feel the tension decreasing in the legs and notice how your breathing is now (Ask: what is the difference between breathing with tight and loose legs?)
(When respiration is easier or slower with relaxed legs, proceed to the third step; when respiration remains quick or uneven, try first 'audible exhaling')	
Now let's combine breathing and pulling up the feet Breathe in normally through the nose ... when inhalation is complete wait a second, pull the toes and feet up, keep them in this position and exhale through the lips ... when exhalation is complete, relax the legs totally, breathe in softly and quietly	As if you are exhaling by pulling up the feet ... and as if you are inhaling by relaxing the legs and feet
Breathe normally 2–3 times, let the legs lie quietly, and then combine again	Repeat the combination as often as you like, preferably until the combination feels easy
Lie quietly and breathe normally	Compare how your legs are lying ... how is your back ... your breathing ... how is your attention ... your mood
Sit up, wait a little and then get up	Compare how you are standing now ... how you are aware of your body ... and how you are breathing

2. "**Audible exhaling**"

(In the supine position) Let one hand rest on the abdomen	Let the hand feel the movement of your body during breathing
Inhale quietly through the nose and blow the air softly out through slightly pursed lips, making the sound of "fff", again inhale through the nose	Repeat this approximately 5 times
Close the lips and breathe normally through the nose (Repeat this twice)	Compare the way you breathe before the audible exhalation: quicker or slower? ... larger or smaller? ... easier or more difficult? ... more or less regular?
Breathe as you normally do	Notice how your body feels ... how is your attention ... your mood ... how does your body continue breathing by itself
(The same instruction can be done in sitting or standing position)	