Effects of a comprehensive rehabilitation programme in patients with three-vessel coronary disease

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The aim of the study was to assess the effects of rehabilitation in 46 consecutive three-vessel coronary disease patients who were considered to have no possibility of revascularization; there were 45 males and one female (mean age 58) sent in the third week after acute myocardial infarction (N = 31) or after unstable angina (N = 15). Left ventricular ejection fraction (EF) was normal in 50% of the patients, but 15% had an EF ≤ 0.30. Three patients could not begin their rehabilitation because of unstable angina (N = 2) or severe pulmonary oedema (N = 1). After a 4-week rehabilitation programme, the comparison of stress tests revealed an increase in functional capacities (maximal work-load = 103.6 ± 27 W before rehabilitation, 126.4 ± 31 W after rehabilitation, P < 0.001), and an improvement of the ischaemic threshold [82 ± 32 W before rehabilitation, 91 ± 31 W after rehabilitation, P < 0.05].

During long-term follow up [20-8 months], four patients died of cardiac events [8.7%]; all of them had an EF < 0.45. Among the 42 living patients 61.9% were asymptomatic, 28.7% had exertional angina, and 9.4% had cardiac complications, and coronary surgery was performed in two cases with good results. The level of return to work was 85% with the mean delay of 1.7 months after rehabilitation. So, rehabilitation in three-vessel coronary disease patients is safe under medical control; improvements in exertional capacities are obvious and give the patients a better self confidence as assessed by the good score of return to work after rehabilitation.

Introduction

The extent of coronary artery disease (CAD) represents one of the major prognostic factors in the progress of coronary patients, as has been shown in several studies[1,2,3]. Thus, there is an increase in cardiac events and in cardiac deaths from 3% per year for one-vessel disease to 10% year⁻¹ when the three vessels are involved[2,3]. Patients with three-vessel CAD are therefore high-risk patients, especially when it is associated with an impaired left ventricular function. Then, the mortality rate is about 18% year⁻¹[3,4].

The frequency of three-vessel CAD varies with the different studies, being from 16% to 36% of coronary arteriographies[1,5,6,7].

Dramatic improvements in survival have been noticed in the last 15 years, due essentially to surgery as assessed by multicentre randomized trials[8]. These best results for surgery are particularly significant when the three-vessel coronary disease is associated with a ventricular dysfunction as shown in the CASS trial or in the Veterans Administration Study. However, about 5%[8] to 19%[7] of these patients with a poor prognosis have no surgically bypassable vessels, and in spite of an optimal medical treatment they are often very handicapped in their life by their angina or dyspnoea. So, the aim of this study was to assess the effects of cardiac rehabilitation in these patients, in safety, exertional capacities and quality of life.

Materials and methods

POPULATION

This study, performed between April 1984 and December 1986, involved 46 consecutive patients with three-vessel coronary disease who were considered to have no possibility of myocardial revascularization (coronary artery narrowings were considered to be present if the narrowing was more than 70% of the
luminal diameter, in the three major coronary arteries: left anterior descending, left circumflex and right). There were 45 males and one female, and their mean age was 58 (range 42–71 years).

Cardiac rehabilitation was prescribed in the third week after acute myocardial infarction (31 patients) or unstable angina (15 patients). Anti-anginal treatment involved at least two drugs (in 24 patients) or more (22 patients, with calcium antagonists in the first place (N = 42), often associated with nitrates (N = 39), and beta-blockers (14 patients), amiodarone (10 patients) or other drugs (7 patients).

The mean duration of the coronary disease was 37.5 months (range 21 days to 10 years). Most of the patients (76%) had had a previous myocardial infarction (MI): inferior in 20 patients, anterior in 12, circumferential in three.

Left ventricular ejection fraction (EF) evaluated by ventricular angiography was normal in 50% of the patients, moderately depressed (0.50 > EF > 0.30) in 35%, or very depressed (EF ≤ 0.30) in 15%. All patients except one had risk factors (mean 2.9 ± 1.2 risk factors by patient): hyperlipoproteinaemia (78%), tobacco smoking (58.7%), overweight (50%), hypertension (33%), heredity (26%), stress (24%) or diabetes (9%).

METHODS

Programme design

Patients were admitted for a four-week comprehensive cardiac rehabilitation programme, including physical training, secondary prevention and vocational counselling.

Physical training was prescribed after a first symptom-limited stress test on an ergometer bicycle: heart rate, blood pressure and 12-lead electrocardiogram were recorded at rest, every 3 min of exercise, at peak exercise, and after 2 and 5 min recovery. The test was started at 30 W, with the work-load increasing gradually by 30 W every 3 min. The exercise was terminated in the event of ST-segment depression over 2.5 mm, severe arrhythmia, falling blood pressure, fatigue, or when the maximal heart rate was reached. Then, the exercise prescriptions were individualized to achieve 75% of the peak heart rate, during 30-min endurance training on a ergometric bicycle. Exercise sessions were held daily, five days a week, and were supervised by telemetry. This endurance training was completed by a daily 1-h walk and calisthenics. At the end of the rehabilitation programme, a second exercise test was performed, with the same protocol and treatments.

In addition to this physical training, advice about risk factors and secondary prevention was given to the patients (weight control, dietary regimen, cessation of smoking etc.), and individual vocational counselling was provided.

Long-term follow-up

After discharge from the rehabilitation centre, a long-term study was done by sending questionnaires to the patient’s cardiologist or general practitioner.

Statistical analysis

Values were determined for the mean ± one standard error of the mean. Student’s t-test (two-tailed) for paired samples was used.

Results

PROGRESS DURING REHABILITATION PROGRAMME

Clinical profiles

Of the 46 patients, three could not begin their programme because of early cardiac events: episodes of unstable angina in two cases, or severe pulmonary oedema in one patient, necessitating rehospitalization for all these patients.

In the rehabilitation group most of the 43 patients showed no clinical complications, but eight suffered from stable exertional angina, and one had a pulmonary oedema.

Silent ischaemia was present in 20 patients (46.5%), as assessed by stress test in 16 cases, Holter recording in two, or both in two.

Evolution of physical capacity

The comparison of the exercise tests (Table 1) before and after rehabilitation reveals a slight decrease in the perception of angina: angina was present 10 times at the first and six times at the second stress test (ns). However, the second stress test shows a higher incidence of ischaemic responses, defined as 1 mm or more ST-segment depression (24 vs. 22 for the first test), which must be due to the higher frequency of the peak heart rate attained: 70% of the maximal heart rate (MHR) before rehabilitation vs. 79% MHR after rehabilitation (P < 0.001). The ischaemic threshold is higher, however, as the onset of significant ST depression appears for a work-load of 82.1 ± 32 W at the first test, and 92 ± 31 W at the second one.
Table 1  Comparison of stress test before and after rehabilitation

<table>
<thead>
<tr>
<th></th>
<th>Pre-rehabilitation stress test</th>
<th>Post-rehabilitation stress test</th>
<th>$P$</th>
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<tbody>
<tr>
<td>Angina ($N$)</td>
<td>10</td>
<td>6</td>
<td>NS</td>
</tr>
<tr>
<td>↓ ST ≥ 1 mm ($N$)</td>
<td>22</td>
<td>24</td>
<td>NS</td>
</tr>
<tr>
<td>Workload at 1 mm ST</td>
<td>82±1 ± 32</td>
<td>93 ± 31</td>
<td>0.05</td>
</tr>
<tr>
<td>Depression (W)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Maximal heart rate</td>
<td>70 ± 13</td>
<td>79 ± 13</td>
<td>0.001</td>
</tr>
<tr>
<td>Maximal work-load (W)</td>
<td>103-6 ± 27</td>
<td>126-4 ± 31</td>
<td>0.001</td>
</tr>
<tr>
<td>Duration (min)</td>
<td>9-3 ± 2-9</td>
<td>11-6 ± 3-2</td>
<td>0.001</td>
</tr>
</tbody>
</table>

NS, not significant.

As for other coronary patients, exercise training improves functional capacities: there is a significant increase in the maximal work-load reached during the exercise tests: 103-6 ± 27 W before rehabilitation and 126 ± 31 W at the end of the four-week programme ($P < 0.001$). This is associated with a significant increase in the mean duration of the test, from 9-3 ± 3-2 min at the beginning, to 11-6 ± 3-2 min at the end of the rehabilitation. Therefore, we can say that exercise training improves exertional capacity and increases the ischaemic threshold of those patients with very low functional capacities.

LONG-TERM RESULTS

The mean duration of post-rehabilitation follow-up was 20-8 months (extremes were 7 and 36 months), and all the patients were followed-up.

During this study, four patients died of cardiac events (8-7% of the patients), two of them in the second month of follow-up, and the other two in the second year (17 and 18 months). Their mean age was 55-2 years (range 48-62 years), and the causes of death were sudden in one, unstable angina with cardiac insufficiency in two (one of these patients died just after he was submitted as a coronary bypass), and the last patient died of reinfarction with severe cardiac failure. All the dead patients had an impaired left ventricular function with an ejection fraction below 0-45, with dyskinesia in two. None of these patients were on beta-blockers.

Among the 42 living patients 61-9% were totally asymptomatic; exertional angina was present in 12 patients (28-7%) but for seven patients it was less severe than before exercise training.

Six patients (9-4%) had other cardiac complications: unstable angina needing rehospitalization in four; for two of them, coronary artery bypass has been performed with good results, though one year before surgery was considered impossible. Other events included pericarditis with ventricular arrhythmia in one, and one case of transient cerebral ischaemia.

Secondary prevention has been effective in most of the patients (Table 2), concerning essentially cessation of smoking (93% of the patients) and normalizing total cholesterol level (83%), normalizing weight (82-3%), but only 61% of the patients had a regular exercise training.

Table 2  Modifications of risk factors before and after comprehensive rehabilitation

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Before rehabilitation (%)</th>
<th>After rehabilitation (%)</th>
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<tbody>
<tr>
<td>Smoking</td>
<td>58-7</td>
<td>7</td>
</tr>
<tr>
<td>Hypercholesterolaemia</td>
<td>78</td>
<td>17</td>
</tr>
<tr>
<td>Overweight</td>
<td>50</td>
<td>17-7</td>
</tr>
</tbody>
</table>

Finally, the level of return to work is 85% (17 patients among the 20 active patients) in the short mean delay of 1-7 months after rehabilitation (range 1 week to 6 months).

Comments

Our study confirms the safety of supervised progressive exercise training in high-risk coronary patients, defined as three-vessel coronary disease, associated or not with depressed left ventricular function. Indeed, rehabilitation was often considered to be contraindicated for patients with a very low level of ischaemia: in our study, no major cardiac events (only exertional angina) occurred during training. Training obviously increased physical capacity, giving patients greater confidence and a better quality of life as assessed in other studies [9].
Mean twenty-one month follow-up showed an 8.7% cardiac mortality, which is less than that in the previous studies evaluating medical therapy in three-vessel coronary disease patients. Nevertheless, this study emphasizes the bad prognosis for patients with left ventricular dysfunction: the four deaths occurred in patients with an ejection fraction below 0.45. This represents 17% mortality for the subgroup of patients with impaired left ventricular function ($N = 23$) compared with no long-term mortality in the other group ($N = 23$).

The secondary prevention was effective in most of these patients, due to individualized information, and it must be one of the reasons for the good health status of nearly 86% of the patients. Most striking is the good record of return to work which is 85% in the active population, better than the average score of 78% in our Rehabilitation Centre; this confirms the fact that return to work is rarely correlated with cardiac function.

Conclusions

In summary, we can conclude that rehabilitation in three-vessel disease patients is safe under medical control, no complications having been noticed during the training, even if sometimes rehabilitation would be contraindicated in these patients. We also conclude that (i) post-rehabilitation follow-up showed good results, with only 8.7% mortality at about two-year follow-up, and (ii) improvements in exertional capacities are slight but obvious, and give the patients better self confidence as assessed by an 85% return to work after rehabilitation.

References