Cardiac Rehabilitation after Myocardial Infarction
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Abstract
Cardiac rehabilitation / secondary prevention programs are recognized as integral to the comprehensive care of patients with coronary heart disease (CHD), and as such are recommended as useful and effective (Class I) by the American Heart Association and the American College of Cardiology in the treatment of patients with CHD. The term cardiac rehabilitation refers to coordinated, multifaceted interventions designed to optimize a cardiac patient’s physical, psychological, and social functioning, in addition to stabilizing, slowing, or even reversing the progression of the underlying atherosclerotic processes, thereby reducing morbidity and mortality.

Cardiac rehabilitation, aims at returning the patient back to normal functioning in a safe and effective manner and to enhance the psychosocial and vocational state of the patient.

The program involves education, exercise, risk factor modification and counselling.

A meta-analysis based on a review of 48 randomized trials that compared outcomes of exercise-based rehabilitation with usual medical care, showed a reduction of 20% in total mortality and 26% in cardiac mortality rates, with exercise-based rehabilitation compared with usual medical care.

Risk stratification helps identify patients who are at increased risk for exercise-related cardiovascular events and who may require more intensive cardiac monitoring in addition to the medical supervision provided for all cardiac rehabilitation program participants. During exercise, the patients’ ECG is continuously monitored through telemetry, which serves to optimize the exercise prescription and enhance safety. The safety of cardiac rehabilitation exercise programs is well established, and the occurrence of major cardiovascular events during supervised exercise is extremely low.

As hospital stays decrease, cardiac rehabilitation is assuming an increasingly important role in secondary prevention. In contrast with its growing importance internationally, there are very few cardiac rehabilitation centers in India at the present moment.

Coronary heart disease (CHD) is a major cause of mortality and morbidity in India. The reported prevalence of CHD in Indian adults has risen 4-fold over the last 40 years (to a present level of around 10%), and even in rural areas the prevalence has doubled over the past 30 years (to a present level of around 4%).1 Within the spectrum of CHD, myocardial infarction (MI) is the leading cause of death. For those who survive an MI, the prevention of subsequent coronary events and the maintenance of physical functioning are the major challenges.2 Secondary prevention is an essential part of the contemporary care of the patient with CHD. Cardiac rehabilitation/secondary prevention programs are recognized as integral to the comprehensive care of patients with CHD and as such are recommended as useful and effective (Class I) by the American Heart Association and the American College of Cardiology in the treatment of patients with CHD.3

What is Cardiac Rehabilitation?
The term cardiac rehabilitation refers to coordinated, multifaceted interventions designed to optimize a cardiac patient’s physical, psychological, and social functioning, in addition to stabilizing, slowing, or even reversing the progression of the underlying atherosclerotic processes, thereby reducing morbidity and mortality.4,5

In essence, cardiac rehabilitation services are comprehensive programs involving education, exercise, risk factor modification and counselling, designed to limit the physiological and psychological effects of heart disease, reduce the risk of death or recurrence of the cardiac event, and enhance the psychosocial and vocational state of patients.6

Inpatient Cardiac Rehabilitation after MI
After an MI, the goal is to mobilize the patient as soon as he is clinically stable. A patient is considered stable if there is no new or recurrent chest pain in the past eight hours; creatine kinase and/or troponin levels are not rising; no new signs of uncompensated heart failure and no new significant, abnormal rhythm or ECG changes in the past eight hours.

Once the patient is stable, he should be made to sit at the edge of the bed during the first day, and then gradually mobilized throughout the hospital stay. During mobilization the goal should be to keep the heart rate below 120 beats/min, or if the patient has a high resting heart rate, then the goal should be to keep the heart rate within 20 beats above resting heart rate. The patient should be made to walk within the room at first, and then in the corridors for about 2-5 minutes, three to four times a day. Progression of activity depends on the initial assessment as well as the daily assessment of the patient and may vary from a rapid increase in activity tolerance in the low-risk

Table 1: Patient Mobilization Guidelines for Inpatient cardiac rehabilitation

| Frequency: Early mobilization: 2 to 4 times per day. |
| Exercise intensity: |
| Post-MI: Maintain heart rate (HR) less than 120 beats/min or HR at rest + 20 beats/min |
| Rate of perceived exertion (RPE) < 13 on a 6-20 Borg scale |
| Exercise Type: Walking |
| Duration: Intermittent bouts lasting 2 to 5 minutes |

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For patients with systolic BP > 140 mmHg or diastolic BP ≥ 90 mmHg initiate lifestyle modification and drug therapy.

### Hypertension management

**Evaluation:**
- Measurement of resting BP on two or more visits.
- Assess current treatment and compliance.

**Goal:**
- Optimal BP is < 120/80 mmHg

**Intervention:**
- For patients with systolic BP ≥130 mmHg or diastolic BP ≥ 85 mmHg initiate lifestyle modification (including exercise, weight management, moderate sodium restriction, alcohol moderation and smoking cessation). Add drug therapy for patients with diabetes, heart failure, or renal failure.
- For patients with systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg initiate lifestyle modification and drug therapy.

### Diabetes management

**Evaluation:**
- Obtain fasting plasma glucose measurements in all patients and HbA1C in diabetic patients to monitor therapy.

**Goal:**
- Near normal fasting plasma glucose (< 100 mg/dl) and near normal HbA1C (< 7)

**Intervention:**
- Provide education and counseling. Encourage patient to quit at each and every visit.
- Provide nicotine replacement and pharmacological therapy as appropriate.

### Smoking / Tobacco

**Evaluation:**
- Document smoking and / or tobacco consumption habits in detail, including amount and duration.

**Goal:**
- Complete cessation.

**Intervention:**
- Provide individual education and counseling. Encourage patient to quit at each and every visit.
- Provide nicotine replacement and pharmacological therapy as appropriate.

### Weight management

**Evaluation:**
- Measure weight, height, and waist circumference. Calculate body mass index (BMI).

**Goal:**
- BMI 21-25 kg/m², waist < 35 inches in men and < 31 inches in women.

**Intervention:**
- For patients who do not meet the goal criteria, advice a reduction in total caloric intake, and increase in energy expenditure through a combined program of diet, and exercise.
- The initial goal of weight loss therapy should be to reduce body weight by approximately 10% from baseline. With success, further weight loss can be attempted , if indicated.

### Psychosocial management

**Evaluation:**
- Identify patients with clinically significant depression, anxiety, anger, and substance abuse.

**Goal:**
- To minimize the patient’s psychosocial distress.

**Intervention:**
- Stress management and individual or group education to help the patient adjust to his/her disease.

Concern about the safety of unsupervised exercise after discharge led to the development of highly structured rehabilitation programs that were supervised by physicians and included electrocardiographic monitoring. The focus of these programs was almost exclusively on exercise. A meta-analysis based on a review of 48 randomized trials that compared outcomes of exercise-based rehabilitation with usual medical care, showed a reduction of 20% in total mortality and 26% in cardiac mortality rates, with exercise-based rehabilitation compared with usual medical care. Over time, cardiac rehabilitation programs have evolved, to comprehensive cardiovascular risk reduction programs, with exercise being an integral component of the program, but not the only component.

Since, hospital stays for MI has dramatically decreased over time, thereby reducing the opportunity for in-hospital risk factor interventions, outpatient cardiac rehabilitation programs have gradually broadened their scope to become an important avenue for secondary prevention.
Table 3: Contraindications for Exercise in Outpatient Cardiac Rehabilitation. (From Ref 10)

1. Unstable angina
2. Resting systolic BP (SBP) > 200 mm Hg or resting Diastolic BP (DBP) > 110 mm Hg that should be evaluated on a case-by-case basis.
3. Orthostatic BP drop of >20 mm Hg with symptoms.
4. Critical aortic stenosis (i.e., peak SBP gradient of > 50 mm Hg with an aortic valve orifice area of <0.75 cm² in an average-size adult.
5. Acute systemic illness or fever
6. Uncontrolled atrial or ventricular dysrhythmias
7. Uncontrolled sinus tachycardia (> 120 beats per min).
8. Uncompensated CHF.
9. Third-degree atrioventricular (AV) block without pacemaker.
10. Active pericarditis or myocarditis.
11. Recent embolism
12. Thrombophlebitis
13. Resting ST-segment depression or elevation (> 2mm).
15. Severe orthopedic conditions that would prohibit exercise.
16. Other metabolic conditions, such as acute thyroiditis, hypokalemia, hyperkalemia or hypovolemia

Table 4: Summary of Aerobic Exercise and Resistance Training Recommendations for Patients with CHD

Frequency:
Aerobic: Structured exercise 3-5 days per week (lifestyle physical activity daily)
Resistance: 2-3 days per week

Intensity:
Aerobic: 60-85% of HRmax (Predicted HRmax = 220 – age of person).
Resistance: Moderate (avoid breath holding and excessive straining)

Time (duration):
Aerobic: 20-60 minutes
Resistance: 10-15 repetitions; 3 sets of 8-10 different exercises for both upper and lower body

Type of exercise:
Aerobic: Walking, running, cycling, swimming, etc.

Special Considerations:
Monitor for abnormal signs and symptoms, i.e., chest pain or pressure, dizziness, and dysrhythmias.
High-intensity exercise may precipitate cardiovascular complications in post-MI patients.
Patients with stable angina should always carry nitroglycerin and be educated in its use.
Heart rate guidelines may not be applicable to patients taking drugs, which slow down the heart rate, e.g., beta-blockers.
Lift weights through a full range of motion and avoiding breath-holding

Components of Cardiac Rehabilitation

A comprehensive cardiac rehabilitation program should aim to identify each patient’s risk factors, establish risk reduction goals and then help the patient achieve these goals through lifestyle modification, supervised exercise, and medications. Table 2 lists the major risk factors, their evaluation, goal values, and suggested intervention. For maximum efficacy the program staff should coordinate their efforts with the patient’s personal physician.

Physical Activity / Exercise

Physical activity can be defined as “bodily movement produced by skeletal muscle that requires energy expenditure and promotes health benefits.” Exercise can be defined as “planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness.”

Exercise Prescription

A comprehensive exercise prescription for the cardiac patient includes activities performed in formal supervised programs, as well as everyday physical activities. The exercise program should prescribe the appropriate mode, frequency, intensity, and duration of exercise, which should be tailored to the individual’s cardiovascular and general medical status. However, there are

Table 5: Comparison of Effects of Aerobic Endurance Training with Strength Training on Health and Fitness Variables. (From Ref 11)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Aerobic Exercise</th>
<th>Resistance Exercise</th>
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<tbody>
<tr>
<td>Indicators values increase; 1 arrow, small effect; 2 arrows, moderate effect; 3 arrows, large effect; HDL, high-density lipoprotein cholesterol; and LDL, low-density lipoprotein cholesterol.</td>
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Body composition
- Bone mineral density
- Percent body fat
- Lean body mass
- Muscle strength

Glucose metabolism
- Insulin response to glucose challenge
- Basal insulin levels
- Insulin sensitivity

Plasma lipids and lipoproteins
- HDL cholesterol
- LDL cholesterol
- Triglycerides

Cardiovascular dynamics
- Resting heart rate
- Stroke volume, resting and maximal
- Cardiac output, rest
- Cardiac output, maximal
- SBP at rest
- DBP at rest
- VO₂max
- Submaximal and maximal endurance time
- Submaximal exercise rate-pressure product
- Basal metabolic rate

Health-related quality of life
some patients for whom exercise is contraindicated, as listed in Table 3.

A summary of the exercise prescription is given in Table 4. After two to four weeks of participation in a traditional aerobic exercise program, low-to-moderate risk patients should initiate resistance training. Prescribed and supervised resistance training (RT) enhances muscular strength and endurance, functional capacity and independence, and quality of life while reducing disability in persons with CHD.11

Both endurance and strength training can elicit substantial increases in physical fitness. Table 5 summarizes many of these benefits and attempts to weigh them according to the current literature. Endurance training induces greater improvements in aerobic capacity and associated cardiopulmonary and metabolic variables and more effectively modifies CHD risk factors. Resistance training enhances muscular strength, endurance, and muscle mass to a greater extent.11

Nutrition Counselling

It is necessary to assess the dietary habits of the patient to obtain an estimate of total caloric intake, as well as daily consumption of saturated fat, cholesterol, sodium, and other nutrients. Patients should be recommended a diet low in fat (especially saturated fat), and high in complex carbohydrates.3 As a general guideline, the diet should consist of 50-60% calories from carbohydrates, up to 30% from fat (with saturated fat forming 10% or less), and 10-15% from protein. Individualized plans should be formulated, depending on the presence of risk factors, such as diabetes, hypertension, and hypercholesterolemia.

Psycho-Social Rehabilitation

After an MI, some of the common psychological reactions that patients may experience are: low mood, tearfulness, sleep disturbance, irritability, anxiety, acute awareness of minor somatic sensations or pains, poor concentration and memory.

It should be explained to the patient that these symptoms are normal, that they are universal, and are part of the natural course of recovery following any potentially life threatening event.12

Psychological factors are strong risk factors for CHD and adversely affect recovery after major CHD events. Although most of the attention has been directed at depression, other adverse psychological characteristics, including anxiety and hostility, may also be significant CHD risk factors. Studies have demonstrated reductions of between 40% and 70% in the prevalence of depression, anxiety, and hostility after cardiac rehabilitation.13 Studies have also shown that depressed patients with CHD who attended a formal cardiac rehabilitation program, had nearly a 70% reduction in mortality risk. It has been found that only small improvements in exercise capacity may produce profound improvements in depression and depression-related mortality.13,14,15

Safety

Use of a risk stratification schema, to evaluate patients on entry into cardiac rehabilitation programs is essential to optimize patient management and minimize potential risk. The relative safety of medically supervised, physician directed, cardiac rehabilitation exercise programs is well established. The occurrence of major cardiovascular events during supervised exercise ranges from 1/50,000 to 1/120,000 patient-hours of exercise, with only 2 fatalities reported per 1.5 million patient-hours of exercise.16

Risk stratification helps identify patients who are at increased risk for exercise-related cardiovascular events and who may require more intensive cardiac monitoring in addition to the medical supervision provided for all cardiac rehabilitation program participants.1

Return to Work

Although improvement in functional capacity and the associated reduction in cardio-respiratory symptoms may enhance a cardiac patient’s ability to return to work, factors unrelated to physical fitness appear to have a greater influence on whether a patient returns to work after a cardiac event. These include socioeconomic and worksite-related issues and previous employment status. The educational and vocational counselling components of cardiac rehabilitation programs should further improve the ability of a patient to return to work.3 Therefore, the time to return to work, after an MI can vary greatly from about two weeks, to upwards of six weeks.

Patient Participation in Cardiac Rehabilitation

International guidelines and experts recommend the use of cardiac rehabilitation after MI. As hospital stays decrease, cardiac rehabilitation is assuming an increasingly important role in secondary prevention.3 In contrast with its growing importance, there is little contemporary information on the use of cardiac rehabilitation after MI, and essentially no published data on the same.

References

7. American Association of Cardiovascular and Pulmonary


