Cardiac Rehabilitation

Practical Guidelines in Cardiac Rehabilitation

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"Cardiac Rehabilitation"

"Subjects"

Section 1: Introduction

Successful cardiac rehabilitation restores the cardiac - impaired patient to optimal physiologic, psychosocial and vocational function by involving the patient, as soon as is medically safe after a cardiac event, in a multidisciplinary program of exercise and education. There are two primary goals of any cardiac rehabilitation program: increasing the function capacity of the patient, and changing the natural history of the disease to reduce morbidity and mortality. The typical patient involved in cardiac rehabilitation program has a diagnosis of CAD and has just experienced a myocardial infarction or coronary artery bypass graft procedure (CABG). However, patients with other cardiac disease or surgical interventions may benefit from cardiac rehabilitation programs (see indications of cardiac rehabilitation). A standard cardiac rehabilitaition program has three phases. Each of the three phases has activity and education components as well as goals, but differs with respect to location and duration of the phase , amount of supervision and intensity of activity (see phases of cardiac rehabilitation). Risk factors for atherosclerotic CAD include elevated serum cholesterol, cigarette smoking, hypertension, DM, advanced age, male gender, history of previous cardiac event or abnormal ECG, and a family history of CAD before the age of 50 years. Instruction in the prevention of the progression or recurrence of CAD through risk factor modification is a significant portion of the cardiac rehabilitation program.

Section 2: Explanation of Terms in Cardiac Rehabilitation

1- METs: The term METs is often used in exercise physiology. One MET, equal to 3.5 ml $_{O2}$ / kg / min, describes energy required for the average person to sit quietly at rest, arms and trunk supported. Activities of increased workload are described in terms of this average metabolic rate. For example, self-care activities on average, are at 3 MET workload and cause average people to require three times the O_2 consumption that they would resting quietly, slowly climbing stairs is a 5 to 7 MET activity and the average person will increase O2 consumption 5 to 7 times.

2- Aerobic Capacity: Aerobic capacity is a physiological term used to measure the work capacity of an individual. It is represented by the maximum oxygen consumption (VO_2 max).

3- VO_2 max: Maximal ability of the body to take in, transport, and utilize oxygen (= functional aerobic capacity), usually expressed in millimeters of oxygen consumed per kilogram of body weight per minute.

4- Stroke Volume: The volume of blood ejected from the right and left ventricles during ventricular systole.

Note: With upright exercise it increases in a curvilinear fashion until it reaches a plateau at about 40% of VO_2 max.

5- Cardiac Output (CO)**:** (Stroke volume x heart rate) NOTE: In early exercise, CO increases due to augmented stroke volume via the frank - starling mechanism. In late exercise, CO is increased primarily through an increase in ventricular rate.

6- MVO_2 (Myocardial Oxygen Consumption): MVO_2 is the actual

oxygen consumption of the heart the MVO_2 rises in a linear fashion when plotted against the VO_2 or other measure of work load. It is limited by the anginal threshold if one exists, or by the VO_2 max if there is no CAD. **Notes:**

- Activities performed with upper extremities as opposed to the lower extremities generate a higher MVO_2 at the same VO_2.
- Activities performed supine as opposed to upright generate a higher MVO_2 at low intensities and a lower MVO_2 at higher intensities.
- Activities that have an isometric component generate a higher MVO_2 than a similar activity at the same VO_2 without the isometric component.
- Activities performed under emotional stress, after smoking a cigarette, after eating or in cold weather all generate a higher MVO_2 at the same VO_2 than activities performed at baseline.

7- Rate Pressure Product (RPP): It has been shown that the HR and systolic blood pressure (BP) correlate well with the actual MVO_2 and can be used as a clinical guide. The usual measure is the rate pressure product (RPP), which is calculated by multiplying the HR by the systolic BP and dividing the product by 100.

8- Ejection Fraction (EF): EF is a function that reflects all the parameters affection stroke volume (ventricular function). Normally the ventricles eject 60% - 70% of the blood they receive. The EF is often reduced in heart disease as a result of decreases in contractility.

9- Maximal Heart Rate (HR max): 220 - age in years.

10- Maximal Heart Rate In Cardiac Rehabilitation: Maximal heart rate observed on a symptom - limited exercise tolerance test.

11- Target Heart Rate (THR): Heart rate range to be used during exercise (for example, 60% maximal heart rate).

12- Heart Rate Reserve (HRR): Maximal HR (-) Resting HR.

13- Anaerobic Threshold: The level of O_2 consumption (VO_2) at which a significant increase in an aerobiosis occurs as evidenced by the increase in blood lactate levels and respiratory responses to an increasing exercise workload.

14- Body Mass Index (BMI): $\frac{\text{Weight (kg)}}{\text{Height2 (m2)}}$ BMI>29=Fatty Person Increased BMI= Increased risk of cardiovascular disease.

15- WHR: Waist / Hip Ratio

WHR-0.8 (Females) and-0.9 (Males) represents an android fat pattern = increased risk of cardiovascular disease.

16- PTCA: Percutaneous Transluminal Coronary Angioplasty.

Note: In the PTCA technique the narrowed coronary artery is dilated by balloon - tip catheter introduced through a peripheral artery.

17- Intracoronary Stent: The stent is a 15_23 mm woven wire mesh that fits snugly over the end of a catheter delivery system and can be placed in a appropriate location by positioning the catheter.

Section3: Indications of Cardiac Rehabilitation

1- Myocardial Infarction (MI): The rehabilitation program following MI is the classic model for cardiac rehabilitation. It can be divided into 3 phases: (a) The acute in - hospital phase beginning in the cardiac care unit (CCU).

Early mobilization of the patient with an acute MI was introduced by Wenger. This program takes the patient from bed rest in the CCU to climbing two flights of stairs in 14 days.

(b) Training phase, where aerobic conditioning is used to increase the patients physical work capacity. This is the actual exercise training program which most people associated with cardiac rehabilitation. This phase starts 6 weeks post myocardial infarction.

(c) Maintenance phase, where the gains achieved by training are sustained by regular exercise. (**See phases of cardiac rehabilitation**)

2- Coronary Artery Bypass Graft Surgery (CABG): Since patients who have just undergone CABG usually have not had a recent MI and have just been revascularized, they make excellent candidates for cardiac rehabilitation. A symptom - limited ETT can be safety performed at 3 to 4 weeks after surgery to determine the level of exercise that a patient can tolerate. Mobilization in the intensive care unit on postoperative day (POD) 1, includes sitting upright, active leg exercises, and mobilization out of bed. The POD 2 to 5 program should include progressive ambulation and daily exercise. The training (phase II) starts 3 to 4 weeks after CABG with 60% - 80% MHR attained on a symptom - limited ETT. For a patient on beta-blocker the target HR is set at 20 beats per minute above the resting HR.

3- Angina Pectoris: Rehabilitation of the patient with stable angina can begin once the medical regimen has been optimized. An aerobic training program results in an improved work capacity for these patients, even though there is no effect on the anginal threshold.

4- Cardiac Transplantation: Because of the loss of vagal inhibition to the sinoatrial node, the resting HR of the denervated heart is usually near 100 beats per minute. These patients have a blunted HR response to an incremental exercise test, with peak HRs 20% to 25% lower than those seen in age - matched controls. Resting hypertension, thought to be due to the renal effects of cyclosporine, is common.

The cardiac rehabilitation program in transplant patients should address their overall conditioning as well as their cardiac function. Walking, jogging, cycling, and swimming are common exercises used in the program for transplant patients. The program consists of progressively increasing distances for ambulation, with the pace designed to be at a level of 60% to 70% of peak effort for 30 - 60 min, three to five times weekly.

5- Valvular Heart Disease: In patients with valvular heart disease, the major problem is often deconditioning and CHF. After surgical correction, the patient improves in cardiac fitness as measured by improved VO_2. A complicating feature in these patients is the fact that many of them are on anticoagulation and need to be on low - impact exercise to avoid hemarthrose and bruising. The training program is similar to that followed for the post CABG patient.

6- Post Surgical Correction of Congenital Cardiac Defects: The training program is similar to that followed for the post - CABG patient.

7- Post Coronary Angioplasty or Stent: Less deconditioning at outset may allow greater activity level. Cardiac rehabilitation starts earlier than post CABG.

8- Compensated Congestive Heart Failure: Uncompensated heart failure is a contraindication to initiating an exercise program. Decompensation is a reason to discontinue the exercise program. Limited exercise capacity is one of the earliest findings in heart failure. The normal response to exercise is often absent. Exercise in heart failure can cause a drop in ejection fraction, a decrease in stroke volume, and exertional hypotension, and in the worst cases, cardiac output might not be increased sufficiently to generate a dynamic exercise response. Despite these problems, there is documented benefit from exercise in this patients. A gradual program of increasing the HR above resting level can be safe and increase oxygen extraction efficiency. Patients who have participated in cardiac rehabilitation programs have lower HRs during submaximal exercise, and increased maximum workloads. Prolonged warm ups and cool downs are appropriate since these patients can increase the duration of exercise but are unable to tolerate more than a limited workload. The target heart rate should be 10 beats per minute below any significant endpoints, such as exertional hypotension, significant dyspnea or sustained arrhythmia seen in the pre training exercise test. The exercise program is best done under supervision with ECG monitoring. Intensity can be 40% - 60% of functional capacity or 11-13 RPE (Borg scale).

9- Persons With Increased Risk For CAD: People who have not yet had a cardiac event but who have significant risk factors for CAD should be included in exercise conditioning and given instructions about risk factor modification after medical evaluation.

Section 4: Contraindications of Cardiac Rehabilitation

A) Absolute contraindications

1. A recent significant change in the resting ECG suggesting MI or other acute cardiac events.

2. Recent complicated MI

3. Unstable angina

4. Uncontrolled ventricular dysrhythmias

5. Uncontrolled atrial dysrhythmia that compromises cardiac function.

6. 3rd degree A-V heart block

7. Acute congestive cardiac failure

8. Severe aortic Stenosis

9. Suspected or known dissecting aneurysm.

10. Active or suspected pericarditis or myocarditis

11. Thrombophlebitis or intracardiac thrombi

12. Recent systemic or pulmonary embolus.

13. Acute systemic illness or fever

14. Significant emotional distress (psychosis)

B) Relative contraindications

1. Resting diastolic BP> 120 mm Hg or resting systolic BP>200 mm Hg.

2. Moderate valvular heart disease.

3. Known electrolyte abnormalities (hypokalemia, hypomagnesemia) 4.Fixed rate pacemaker

5. Frequent or complex ventricular ectopy

6. Ventricular aneurysm

7. Cardiomyopathy

8. Uncontrolled metabolic disease

(E.g. diabetes, thyrotoxicosis/ myxoedema)

9. Chronic infectious disease (e.g. mononucleosis, hepatitis, AIDS)

10. Neuromuscular, musculoskeletal, or rheumatoid disorders that are exacerbated by exercise.

11. Advanced or complicated pregnancy.

Section 5: Personels in Cardiac Rehabilitation

1) Cardiac Rehabilitation Nurse (CRN): In most instances the CRN is the most visible member of the professional staff and is responsible for much of the program operation, patient care, reading and interpreting ECG, and providing emergency care. As a general rule one cardiac rehabilitation nurse is responsible for monitoring up to four patients per exercise class.

2) Physician: The physician director or advisor is often minimally involved with the daily operation but is responsible for determining the exercise prescription, evaluating clinical problem, and managing medical emergencies. An active role by the physician is a source of motivation and emotional support for the patient. Most physician directors are board certified in rehabilitation & physical medicine or cardiology.

The referring physician is not likely to be a member of the professional staff but nevertheless has an important role in cardiac rehabilitation and must be provided with regular patient reports. The information will help to assure continuity of care and will be useful in making appropriate therapeutic decision. If the attitude of the referring physician is positive and supportive, the patient is more likely to experience success.

3) Physical Therapist: In some programs physical therapists are responsible for phase I exercise and may be involved in other aspects of the program. In particular the physical therapist is used to assess musculoskeletal and joint mobility dysfunction. In the case of impaired joint mobility the therapist may prescribe additional exercises to meet specific needs. Physical therapists who work with cardiac patients must be able to

recognize adverse cardiovascular signs & symptoms.

4) Exercise Specialist: An exercise specialist may be used for leading exercises and teaching patients about the value of physical activity, as well as addressing patient questions concerning exercise. The exercise specialist must understand the appropriateness and clinical implication of different types of physical activities.

5) Psychologist / Psychiatrist: In most instances a psychologist, psychiatrist, or social worker is responsible for psychological testing and intervention. Between 30% and 50% of recovering cardiac patients suffer clinically significant levels of anxiety or depression. Both understanding and addressing the patient's psychological needs are necessary for the success of the entire rehabilitation program.

6) Nutrition Specialist: A nutrition specialist is used to obtain estimates of total daily caloric intake and dietary content of fat, saturated fat, cholesterol, sodium, and other nutrients. The nutrition specialist should assess target areas for nutrition intervention as outlined in the core components of weight, hypertension, and diabetes, as well as heart failure, kidney disease, and other comorbidities.

Section 6: Equipments in Cardiac Rehabilitation

1) Leg Ergometry: A stationary bicycle ergometer is often used for submaximal testing, and the workload can be quantified in watts (W) or kilopond - meters (kpm) / min. Workloads usually start at 25 to 50 W and progress by the amount every 3 to 5 minutes.

2) Arm Ergometry: The arm - crank ergometer is particularly useful for subjects who emphasize upper body activity, as well as for those with vascular or musculoskeletal limitations in the lower extremities.

3) Treadmill: Treadmill is more flexible than bicycle, since speed and grade can be varied independently to increase the workload. In addition, workloads are more accurately measured on the treadmill than on the bicycle.

4) Stationary Bicycle: For individuals who have difficulty walking because of age, debilitating illness, or orthopedic problems, the bicycle may be the best device for exercise.

5) Emergency Equipmets: ECG monitoring, defibrillator, medications, Oxygen, suction, blood perssure apparatus.

6) Audiovisual Equipments: Audio & video recorders and players, tapes, slides, flip charts, books.... are necessary because of the emphasis on patient education and lifestyle modification.

7) Other Equipments: Wall pulley, shoulder wheels, light weights, stepping device.

Section7: Space Requirements for Cardiac Rehabilitation

The most important factor in allocating space is a realistic estimate of size and future growth the number of patients likely to use each part of the facility at a given time. A facility may not be functional if the area is not well utilized. The following recommendations are for floor space in a traditional phase II facility:

1) One hundred square feet of the exercise training area is suggested for each patient. For example, if individual classes are plan to accommodate six patients, then 600 square feet is recommended. If the available space is less than that recommended, mirrors can help to create the appearance of greater size and modifications in the program may be needed. Colored walls, murals, pictures, hanging plants, mirrors, stereo music, and carpeting are encouraged.

2) The dressing area must be large enough to accommodate the maximum number of patients who will utilize the room at one time.

3) One hundred square feet is a minimal area recommended for exercise testing.

4) Space should be planned for patient education and lifestyle modification classes. A conference room large enough to accommodate 10 to 20 persons is suggested. The conference room should have a wall writing board, screen, and dimmer lights and should be well equipped for audiovisual presentations such as slides, videos, and movies.

5) A waiting area is recommended for patients and guests. The area should be large enough for one visitor per patient. One hundred square feet

is usually sufficient.

6) Adequate office space is required for the staff. Office should be pleasant and functional, allowing a minimum of 50 - 60 square feet for each person. The program director requires a private office that is large enough to be a small meeting room.

Section8: Exercise Tolerance Test in Cardiac Rehabilitation

Exercise testing prior to phase II cardiac rehabilitation is important for evaluation of cardiovascular function capacity & successful implementation of an exercise prescription.

The design of an exercise program & target heart rate will depend on the exercise test results. Exercise testing, however, is not recommended to follow patients serially in rehabilitation because of the high costs associated with these results.

The ideal time for this testing is 3 - 4 weeks post CABG. Bad prognostic indicators during symptom - limited exercise testing include (a) inability to achieve a treadmill work load of 4 METs, b) inability to achieve a peak systolic blood pressure of > 110 mmHg, (c) a decrease in systolic blood pressure below baseline, (d) > 1 mm ST - segment depression, and (e) exercise - induced angina pectoris.

There are many published protocols of exercise treadmill testing. In general, exercise treadmill protocols increase the external workload, in regular increment of 1 to 3 METs depending on the protocol, in regular time intervals, or every 2 to 3 minutes. MET, or work load, is increased by speeding up and / or elevating the treadmill. For example, a person undergoing a diagnostic maximal treadmill test may use a Bruce protocol that rapidly progresses to 3 METs activity and increase 2 to 2.5 METs in intensity every 2 minutes. On the other hand, a cardiac patient during a low level symptom - limited test would probably undergo a modified Bruce, or a Naughton protocol that starts at a level of 1.5 METs and even after 12 minutes only reaches an intensity of 4 METs.

Section 9: Borg Scale in Cardiac Rehabilitation

Exercise intensity can also be prescribed from rating of perceived exertion (Borg Scale). Use this scale where 6 means no exertion at all and 20 means a totally maximum effort. The 13 on the scale is a somewhat heavy exercise but capable of being performed at steady state (ie, anaerobic threshold).

Borg scale is especially helpful for patients who are taking heart ratealtering medication such as beta - blockers. The original numeric scale was devised for represent approximately 10% of the heart rate range in healthy group and middle - aged men.

Borg Scale:

6- No exertion at all

7- Very, very light

8-

9- Very light (warm up. recovery)

10-

11- Fairly light (Aerobic threshold)

12-

13- Somewhat hard (Anaerobic threshold)

14-

15- Hard (VO_2 max)

16-

17- Very hard (peak lactate or lactate tolerance)

18-

19- Very, very hard

20- Maximum all - out effort with absolutely nothing being held in reserve.

Borg scale rating in the range of 11 – 13

are used as an indication of exercise intensity

in cardiac rehabilitation.

Section 10: Risk Stratification in Cardiac Rehabilitation

Cardiac rehabilitation patients are often stratified based on prognostic risk for the purpose of recommending the appropriate supervision and monitoring required.

A) Low - Risk Patients

- Uncomplicated clinical course in hospital.
- Normal left ventricular function (EF-50).
- A functional capacity- 7 METs.
- No evidence of myocardial ischemia.
- Absence of significant ventricular ectopy.
- Asymptomatic including absence of angina with exertion or recovery.
- Normal haemodynamics with exercise or recovery.

B) Intermediate- Risk Patients

Moderately impaired left ventricular function (EF= 35-49%)

Signs/symptoms including angina at moderate levels of exercise (5 - 6.9 METs) or in recovery.

Changing pattern or new development of angina pectoris

C) High - Risk Patients

Decreased LV function (EF-35%).

Functional capacity<5 METs

Survivors of cardiac arrest or sudden death

Complex ventricular dysrhythmia at rest or with exercise.

MI or cardiac surgery complicated by cardiogenic shock, CHF, and /or signs / Symptoms of post procedure ischaemia.

- Fall in exercise systolic blood pressure or failure of systolic blood pressure to rise more than 10 mm Hg on exercise tolerance test
- Persistent or recurrent ischemic pain 24 hours or more after hospital admission.

Section 11: Electrocardiogram Monitoring In Cardiac Rehabilitation

Electrocardiogram monitoring is an issue of considerable debate that has implications for Safety program effectiveness, and cost containment. Although there are no universally accepted guidelines governing the use of ECG monitoring, several recommendations have been made. The most obvious use is for identifying and counting arrhythmias, which are more likely to be detected with continuous patient monitoring than exercise testing. What is known is that patients with poor left ventricular function and complex and frequent arrhythmias and other patients who are at high risk require careful supervision and continuous ECG monitoring. The rationale for continuous monitoring is that patients adhere to the exercise prescription, are less anxious about exercise, and can exercise safely. Non monitored exercise has been shown to be safe and beneficial for low - risk patients, although factors other than clinical need to be considered.

Generally, ECG monitoring is recommended for at least 7 weeks and could be justified for as long as 12 weeks. Electrocardiogram monitoring is also recommended whenever the prescription is changed. Additional evidence in support of patient monitoring is that significant untoward events rarely occur in monitored programs.

Note: The risk of life - threatening events in phase II is small. Proper medical supervision, continuous patient monitoring, individualized exercise prescription, complying with the guidelines for exercise, and having the necessary equipment to handle untoward events help to promote safety.

Section12: The Phases of Cardiac Rehabilitation

A standard cardiac rehabilitation program has three phases. Each of the three phases has activity and education components as well as goals, but differs with respect to location and duration of the phase, amount of supervision, and intensity of activity. (Table 12.1)

Table 12 – 1 : Three phases of a cardiac rehabilitation program

Phases	Location	Initiation	Duration	Monitored	Activity / Intensity
I	Inpatient	2-4 days	Hospitalization	Yes	Progress to independent self – care and short distance ambulation
II	Outpatient	3 weeks from onset	8 – 12 weeks	Yes	Progressive cardiac conditioning 1 hour 3 times per week (THR based on ETT)
III	Community	After phase II	Lifetime	No	Maintenance of cardiac conditioning 1 hour 3 times per week

A) Phase I in cardiac Rehabilitation

The goals of phase I are to avoid the sequelae of immobility, to tolerate self - care activity and household ambulation by the time of discharge from acute care, and to introduce the concepts of low - fat diet, the benefits of exercise, and independence in administering medication. Mobilization in the intensive care unit on postoperative day (POD), 1 includes sitting upright, active leg exercises, and mobilization out of bed. The POD 2 to 5 program should include progressive ambulation and daily exercise.

Appropriately prescribed and monitored early activity and ambulation is safe and does not increase risk of complications. The patient must be monitored during and after activity for signs & symptoms of activity - induced cardiovascular dysfunction.

While in phase I, the patient should not participate in activity that raises the heart rate above 20 beats per minute over the resting heart rate. In phase 1, activities are performed for 5 to 30 minutes, 2 to 3 times each day;

CABG patients progress slightly faster than MI patients.

B) Phase II

Phase II of cardiac rehabilitation is a supervised outpatient program of individually prescribed exercise with continuous or intermittent ECG monitoring. This is the actual exercise training program which most people associated with cardiac rehabilitation. The exercise program is based on an individualized prescription of intensity, duration, frequency, and mode of activity (**See exercise prescription**).

Phase II of cardiac rehabilitation begins with a symptom - limited ETT. The test screens outpatients with contraindication for exercise training, such as dangerous arrhythmias or a drop in BP with increasing exercise intensity. The results of this test are used to determine a target HR for exercise training. It is critical for patient safety that target HRs in this population be based on actual ETT, not tables or equations estimating maximum rates from the patient's age.

This phase usually begins 6 weeks post myocardial infarction and 3-4 weeks post CABG. Each session lasts 45 - 60 minutes per day, 3 times per week for 8 - 12 weeks. The focus of phase II is regular aerobic exercise that is designed primarily to improve muscular endurance and cardiovascular fitness. Target HR is ordinarily established between 60% - 80% MHR attained on a symptom - limited ETT.

Education about diet, stress, medication, exercise, and symptomatology continue in phase II.

C) Phase III (Maintenance phase)

The maintenance phase is probably the most important phase of all, because if it is neglected, the benefits of the training are lost within a few weeks. Phase III of cardiac rehabilitation should be considered a permanent change in lifestyle, and should continue throughout the person's life to minimize cardiac disease morbidity and mortality. The actual exercises included should reflect the selection of muscles trained in the preceding period and should fit within the interests and lifestyle of the individual patient. Exercise at least twice a week and preferably three times a week for at least 30 min should be considered a minimum requirement. ECG monitoring is not necessary during this phase.

The results from the graded exercise test help to determine the intensity of training. A conservative level of effort, for example, 70% of MHR is recommended for patients who did not participate in phase II. The target heart rate is based on the most recent exercise test. The beginning THR is usually 80% MHR for patients having completed phase II and is usually progressed gradually until 85% MHR when training adaptation is normal. In some instances exercise intensity is prescribed using the Borg scale ratings or perceived exertion (RPE). The Borg scale is particularly useful within patients who have difficulty in counting their heart rate, those on negative chronotropic medications, and transplant patients.

Individual training sessions consists of the exercise prescription incorporated into a regimen of warm - up, training stimulus, and cool down. There is no best mode of exercise, although walking and jogging are popular because no additional equipment is necessary. Rowing, bicycling, and swimming are also excellent and popular, but require special facilities and

equipment. Upper-extremity exercises are important in long term programs because of training specificity. Resistance exercises have been shown to be safe, as well as beneficial, for cardiac rehabilitation. Specifically, circuit weight training has been shown to improve strength, lean body mass, flexibility, and cardiovascular endurance and perhaps to increase bone mineral content, reducing the possibility of Osteoporosis with aging.

Section 13: Exercise Prescription

A) Intensity:

The most important factor of the exercise prescription is intensity of effort, usually expressed as a percentage of functional aerobic capacity or maximal heart rate (MHR). A typical exercise prescription might be written with a target HR (THR) to be sustained after an appropriate warm up period. THR is ordinarily established between 60% - 80% MHR attained on a symptom - limited exercise tolerance test (ETT).

Notes:

1) THR is increased by 5% every 4-6 weeks.

2) If the individual is very frail or deconditioned, or if the limiting factor on the ETT was a dangerous arrhythmia, then an intensity as low as 60% of maximum can be prescribed and a training effect can still be expected.

3) Competitive athletes may require greater than 80% MHR for training adaptation.

4) Trained individuals must exercise at a higher level than untrained persons because they require a greater intensity of effort to achieve the same benefit.

5) Submaximal aerobic exercise is recommended to improve cardiovascular fitness and muscle endurance.

6) The training stimulus should not provoke fatigue, musculoskeletal strain, or mental or emotional burnout.

7) Alternatively, if the training exercise is to be the same as the testing

exercise, then the prescription can written in terms of the workload on a bicycle ergometer, or speed and grade on a treadmill.

8) Another method used to prescribe exercise intensity is with the use of metabolic equivalents, or METs. For example, if one attains 10 METs on an exercise test and the training intensity is 70% VO_2 max, then activities of 7 METs or less are prescribed as safe & suitable.

9) Exercise intensity can also be prescribed from rating of perceived exertion or Borg scale. Borg scale is especially helpful for patients who are taking heart rate - altering medication such as beta - blockers. (See Borg Scale in cardiac rehabilitation)

10) For a patient on a beta - blocker the target HR is set as 20 beats per minute above the resting HR.

B) Duration:

The exercise session lasts for about 45-60 minutes. The training session is divided into warm up (10 - 15 minutes), conditioning exercise (20-30 minutes) and cool down (10-15 minutes) see the training session).

Notes:

1) The duration of training is sometimes increased while intensity is decreased early in the training program to prepare the musculoskeletal

System for vigorous exercise and to reduce the chance of injury.

2) In general, training at a lower intensity of exercise requires a longer duration to achieve a training effect, and training at a relatively higher intensity requires a shorter duration.

C) Frequency:

Aerobic training schedules usually involve exercise 3 days a week. Programs involving exercise at lower intensities should be performed at least 5 days a week.

D) Length of the Program:

Most monitored cardiac rehabilitation programs last for 8-12 weeks (24-36 sessions).

E) Mode of Exercise:

Aerobic & continuous rhythmic exercise that incorporate large muscle groups is the best exercise for cardiac patients. Brisk walking, running, jogging, swimming, bicycling, rowing, and cross- country skiing are all excellent.

Notes:

1- Heavy - resistance and isometric exercise have limited value in cardiac rehabilitation.

2-Isokinetic exercise is a resistance exercise that enhances strength and cardiovascular function.

F) Specificity of Exercise:

A key concept in all exercise training is that of specificity of training. The

changes in the cardiac response to exercise apply only to exercise with muscles that have been involved in the training program. Training with a walking program or on a bicycle does not affect the cardiac response to upper extremity work. Training a carpenter with a vigorous treadmill program does nothing to change his cardiac response to strenuous woodworking activities performed with the arms. All muscle groups that the person needs for vocational or avocational pursuits should be included in the training program.

G) Updating the Prescription:

The most patients will usually begin to improve after 4 - 6 weeks of exercise. As adaptation occurs, heart rates are reduced at fixed submaximal level of effort, thereby requiring more physical work to maintain the target heart rate. Workloads must continue to be increased for training changes. Target heart rate is increased by 5% every 4 - 6 weeks. Over a 12-week cardiac rehabilitation program, the THR may be increased to 80% MHR.

H) Types of Training Program (Continuous Versus Interval Exercise):

Continuous exercise consists of activity that is usually prolonged and aerobic. Generally, the target heart rate is achieved and maintained in a steady state throughout the duration of the activity. Interval or intermittent exercise consists of short bouts of higher - intensity exercise interspersed with periods of rest. There are advantages in each of these training methods, and the best prescription probably contains elements of both. Continuous training is recommended early in the program, especially for those in poor

condition, to get the musculoskeletal system prepared for vigorous exercise. Beginning an exercise program with high - intensity, interval training can invite unnecessary muscle soreness, fatigue, and injury. However, interval training is particularly beneficial because it is flexible and easily applied in carefully regulated doses and can incorporate a variety of activities.

Section 14: The Training Session

The patient enters phase II after a physician referral and orientation. A comprehensive evaluation is administered prior to training and includes medical and lifestyle history, physical examination, laboratory and blood tests. Physical fitness assessment, and the exercises stress test.

A typical exercises class consists of patient preparation, warm - up, exercise training, cool down, and relaxation.

A- Patient Preparation: A list of pre exercise instruction is provided to the patient prior to the first class.

Patient Instructions before Exercise

1. Do not eat a large meal for at least 2 hours prior to the exercise session. A small snack is fine.

2. Alcohol should not be consumed before exercise.

3. Do not drink beverages with caffeine, i.e., coffee, tea, cola, etc., for at least 2 hours prior to exercise.

4. Do not smoke at least 1 hour prior to exercise. 5. Wear comfortable clothing to exercise, i.e., gym shorts, loose-fitting slacks, Sneakers, socks, loose - fitting blouse or Shirt, etc.

6. Please be prompt Try to arrive 10 to 15 minutes prior to the scheduled time of the exercise class to get ready.

7. If you experience any unaccustomed symptoms of pain, discomfort, or soreness, let the nurse know before starting to exercise.

8. Inform the nurse of any changes in medications before exercising.

B- Warm - UP: Consists of general and specific exercise (for example, flexibility and stretching exercises) at low intensity for the purpose of preparation for more vigorous exercise and to lower the risk of musculoskeletal trauma. The warm up should last for a minimum of 10 – 15 minutes. The procedures are illustrated in figure 14.1

C- Exercise Training: The goal of exercise training is to achieve a target heart rate (THR) that reaches the training adaptation threshold. Individual THRs, exercise workloads, and the sequence of exercise modes are provided on an exercise prescription card (figure: 14. 2), which is given to the patient at the beginning and collected at the end of each session. The intensity of effort is increased gradually until the THR is attained and maintained at that level for the duration of the session with continuous or intermittent training Generally, THR should be maintained 60% - 80% MHR for at least 20-30 minutes, 3 - 5 times a week for most persons. Dynamic - rhythmic and aerobic activities are emphasized. The traditional exercise program is designed to improve upper & lower extremity muscle groups, and may incorporate the following types of equipment: bicycle ergometer, arm ergometer, treadmill, wall - pulley, steps, rowing machine, and light weights. The patient usually exercise 5 to 10 minutes on each of several modalities with approximately 1 minute between bouts. Arm training is especially important as there is little crossover adaptation from leg exercise. Exercise programs are sometimes modified for patients with specific needs or limitations. These changes may be slight or substantial depending on the - individual. Many of these modifications reflect the art used in prescribing exercise.

D- Cool down: The level of effort is gradually reduced following exercise to maintain systemic blood flow at a level that doesn't increase myocardial Oxygen demand. A low level of activity should be continued for 10 15 minutes. In general, cool down should incorporate large muscle groups that have a massaging effect on the veins and enhance venous return to aid in the removal of lactic acid. Vigorous exercise that is stopped suddenly is associated with venous blood pooling in the lower extremities, reduced return to the heart, and compensatory increase in heart rate. Hypotension, decreased blood flow to the brain, lightheadedness, dizziness, and fainting are possible.

E - Relaxation Exercises: Relaxation exercises are recommended for the end of cool down and can be effective for reducing heart rate, blood pressure, and cardiac arrhythmias. The basic technique incorporates controlled breathing with alternating muscle contraction and relaxation. It is important that these techniques be regularly practiced. A sample of relaxation exercises is provided in table 14.2.

	TABLE 14,2: Instructions for Relaxation Exercises
1.	Close eyes and relax (in a supine position)
2.	Take a deep breath....and relax. Concentrate on your breathing. Allow 10 to 15 sec between commands.
3.	Again, a deep breath...and relax.
4.	Now, contract the muscles in one arm (either one)....and relax.
5.	Repeat with opposite arm.
6.	Contract the muscle in one leg.... and relax.
7.	Repeat with opposite leg.
8.	Now contract the muscles of an arm and the leg of the opposite side....and relax.
9.	Repeat with other arm and leg.