Cardiac Rehabilitation in a Family Practice Setting

Tinsley W. Rucker, MD, Maj, US Army
Savannah, Georgia

In January 1978, a cardiac rehabilitation program was begun at Fort Ord, California. The program is unique in being designed and run by family physicians.

In the Medical Intensive Care Unit, the patient with a myocardial infarction is started on a graduated exercise program and a structured course concerning heart disease. Eight weeks after the infarction, the patient is asked to join an outpatient exercise class meeting three times a week. The patient's progress is followed by serial treadmill and blood tests.

After training for six months, the patients have shown an increase in exercise tolerance and a decrease in incidence of readmission for cardiac disease. Most importantly, the patients have become actively involved in their own treatment.

The care of the cardiac patient has undergone several transformations since the classic description of angina pectoris over 200 years ago. Heberden first noted the predilection of sedentary people to develop angina, and he recommended physical activity for those with angina. However, this philosophy was ignored in the early 20th century when the pathophysiology of angina and myocardial infarction became evident.[1] In 1929 strict bed rest for six weeks was recommended after an infarction, and until 1968, major cardiology textbooks still suggested two weeks of strict bed rest and six weeks of hospitalization. With this very conservative treatment, the post-infarction patient was in jeopardy of becoming a cardiac cripple.

In 1951 Levine and Lown advocated the early ambulation of the post-infarction patient.[2] More recently, the patient has been encouraged in advancing to a supervised aerobic exercise class to improve cardiovascular fitness. This aggressive approach to cardiac rehabilitation has proven to be safe, and in spite of a lack of controlled studies, there is a wealth of practical experience to show a significant improvement in the patient's physical and psychological status.

This article is based on a review of the literature as well as the experience of the Fort Ord Cardiac Rehabilitation Program which was initiated by the author and other family practice residents in January 1978. This program of cardiac rehabilitation will be presented in three parts: the inpatient phase, the home phase, and the supervised outpatient exercise phase.

Inpatient Phase

With the background of a caring, optimistic, and supportive nursing and house staff, the post-infarction patient is usually ready for cardiac rehabilitation to begin while still in the Coronary Care Unit (CCU). An education program in the form of pamphlets and informal classes is effective and well received by the patient and family after the acute phase of the infarction.

A progressive daily exercise regimen described in Table 1[1] (Tripler Army Medical Center: *Post Myocardial Infarction Rehabilitation Protocol,* in-house document, May 1974) maintains a degree of physical conditioning and tends to promote an optimistic attitude for the patient. The protocol in Table 1 is designed for a 14-day hospitalization but can easily be modified. Each step is individually

From the Department of Family Practice, Silas B. Hays Army Hospital, Fort Ord, California. Requests for reprints should be addressed to Dr. Tinsley W. Rucker, 1426 South Camden Circle, Savannah, GA 31406.

0094-3509/80/030407-08$02.00

Table 1. Post Myocardial Infarction Rehabilitation Protocol Inpatient Program[1]*

Step	Physician† Date	Ward Activity Level	Physical Therapy Program	Pre Exercise		Post Exercise	
				Pulse	Blood Pressure	Pulse	Blood Pressure
1		Bedrest, self feed at 45° w/arms & trunk supported	Initial interview. Explanation of program				
2		Same as 1, plus AM care. Brush teeth, wash in bed	Passive range of motion exercising of all extremities (5× each) in bed Active plantar and dorsiflexion of ankles several times a day				
3		Same as 2, plus dressing activity Dangle legs 10 minutes, three times a day	Active exercising in recumbent position: shoulder rotation, alternate hip flexion and extension, alternate hip abduction and adduction (5 reps each)				
4		Same as 3 May stand for short periods at bedside	Same as 3 Increase repetitions to 10 each				
5		Sit at bedside Stand to dress, shave, groom	Same as 4 but upper extremity done while standing				
6		All self care Walk with attendant to bathroom for non-vigorous shower	Same as 4 but all exercises done out of bed Slow walk 100 feet once a day				
7		Same as 6 May sit outside room for one hour at a time	Same as 6 Slow walk 100 feet three times a day				
8		Same as 7	Same as 7 but add trunk twist (10 reps)				
9		Same as 8 but may walk about freely on ward	Same as 8 but increase repetitions to 15 each				
10		Same as 9	Same as 9 Add slow half-knee bends, 5 reps				
11		Same as 10 Walk down 1 stairwell w/attendant	Same as 10 but do 10 reps of half-knee bends				
12		Same as 11 Walk up 1 stairwell w/attendant	Same as 11 but do 15 reps of all exercises				
13		Same as 12	Same as 12				
14		Same as 13	Same as 13 but do 20 reps of all exercises				

*Tripler Army Medical Center: *Post Myocardial Infarction Rehabilitation Protocol*, in-house document, May 1974
†Prior to being done, each step *must* be initialed and dated by attending physician

Table 2. Treadmill Protocols and Metabolic Equivalents[3]

Treadmill Protocols	Metabolic Equivalents (METS) 1.6	2	3	4	5	6	7	8	9	10	11	12	13	14	
Bruce					1.7		2.5		3.4				4.2		MPH
					1.0		12		14				16		% Grade
Naughton	1.0	2.0	2.0	2.0	2.0	2.0	2.0	MPH							
	0	0	3.5	7.0	10.5	14.0	17.5	% Grade							

Note: One Metabolic Equivalent (MET) = Energy expended at rest
Example: At Stage 2 of the Bruce Protocol, one is walking up a 12 percent grade at a rate of 2.5 miles per hour and is expending seven times the energy one would expend at rest
Reprinted with permission from *Annals of Clinical Research*, Finnish Medical Society (DUODECIM), Helsinki, Finland

ordered by the physician and the exercises are monitored by a physical therapist or nurse. The pulse and blood pressure are taken before and after each exercise session to detect any inappropriate response to exercise. Examples of an inappropriate response are a drop in blood pressure or a rise in pulse rate of over 20 beats/minute following the exercise session.

Just prior to going home, the patient is given a mini treadmill test—Naughton Protocol[3] (Table 2)—to be stopped at a heart rate of 120 beats per minute or the onset of any symptoms or electrocardiographic (ECG) abnormalities. (It may be difficult to interpret the heart rate in patients taking beta blocking medications.) This test determines a "safe heart rate," and the patient is taught to take his/her own pulse. Using Table 2,[3] the time spent on the treadmill can be converted to metabolic equivalents (METS), one MET equaling the energy expended at rest. Referring to Table 3,[3,4] metabolic equivalents can be converted to activities of daily living. Coupling the "safe heart rate" and the METS system, a very specific and useful exercise plan can be prescribed for the patient.

In one 18-month period at Fort Ord Army Hospital, more than 50 post-infarction patients benefited from early ambulation in the above fashion, and no signficant complication arose during a patient's hospital stay.

Home Phase

It was experienced at Fort Ord that upon leaving the hospital, the patient is at high risk of being lost to follow-up. This can be prevented by a continuing education program and a specific exercise plan as outlined above. At Fort Ord, a CCU nurse has organized a formal program of six classes for the post-infarction patient and family. The classes meet weekly and cover diet, risk factors, cardiopulmonary resuscitation (CPR), relaxation techniques, work simplification, and sex for the cardiac patient.

Approximately six weeks after the infarction, the patient is considered for the outpatient exercise class. At Fort Ord, the only patients excluded from the class were those on warfarin (Coumadin) therapy, and those with severe orthopedic problems. Age does not need to be an excluding factor; the average age for the Fort Ord participants was 60 years, and two patients were over 70 years old. The few patients with angina at rest, or strongly positive treadmill tests were initially excluded from the program and referred for catheterization. Once selected for the program, the patient receives a Bruce treadmill test (Table 2)[3] and exercises to a heart rate of 85 percent of the age predicted maximum or until symptoms or ECG abnormalities develop. (Tables exist to determine the age predicted maximum heart rate,[4] but one can obtain an approximation by subtracting the patient's age in years from 220.) The patient is informed of a "safe heart rate" and is encouraged to join the supervised outpatient exercise class.

Outpatient Exercise Class

To achieve aerobic or cardiovascular fitness, the patient should exercise at least three times a

Table 3. Approximate Metabolic Cost of Activities[3,4]

Energy Level	Occupational	Recreational
1½–2 METS	Desk work Auto Driving Typing	Standing Walking (1 mile/hr) Playing cards
2–3 METS	Auto repair Janitorial work Bartending	Walking (2 mile/hr) Bicycling (5 mile/hr) Bowling, billiards Golf (power cart) Playing piano
3–4 METS	Brick laying Machine assembly Trailer-truck in traffic Welding Cleaning windows	Walking (2½ mile/hr) Bicycling (6 mile/hr) Golf (pulling cart) Fly fishing Pushing light lawn mower Archery, sailing, horseshoes
4–5 METS	Painting, masonry Paper hanging Light carpentry	Walking (3 mile/hr) Bicycling (8 mile/hr) Golf (carrying clubs) Dancing Tennis (doubles) Many calisthenics Sexual intercourse
5–6 METS	Digging garden Shoveling light earth	Walking (3½ mile/hr) Bicycling (10 mile/hr) Horseback (trot) Stream fishing Ice skating
6–7 METS	Shoveling (10 lb load)	Walking (5 mile/hr) Bicycling (11 mile/hr) Tennis (singles) Snow shoveling Water skiing
7–8 METS	Digging ditches	Jogging (5 mile/hr) Bicycling (12 mile/hr) Horseback (gallop) Basketball Ice hockey Paddleball
8–9 METS	Shoveling (14 lb load)	Running (5½ mile/hr) Bicycling (13 mile/hr) Handball Skiing (loose snow)
10+ METS	Shoveling (16+ lb load)	Running 6 mph-10 METS 7 mph-11½ METS 8 mph-13½ METS 9 mph-15 METS 10 mph-17 METS

Reprinted with permission from *Annals of Clinical Research,* Finnish Medical Society (DUODECIM), Helsinki, Finland

week and maintain for 20 minutes a heart rate over 75 percent of the age-predicted maximum.[3] The exercise class at Fort Ord begins with 10 minutes of warm-up stretching exercises (Figure 1)[5] followed by 45 minutes of fast walking or jogging. The patient is coached to begin slowly, to gradually increase the distance and speed on a weekly basis, to keep the actual heart rate below the predetermined "safe heart rate," and to have a bottle of sublingual nitroglycerine readily available. Most patients begin with slowly walking one mile and after several months are fast walking or jogging two to three miles per exercise session. At Fort Ord, moderate weather conditions allow the use of an outdoor track without exposure to temperature and weather extremes. Belonging to the

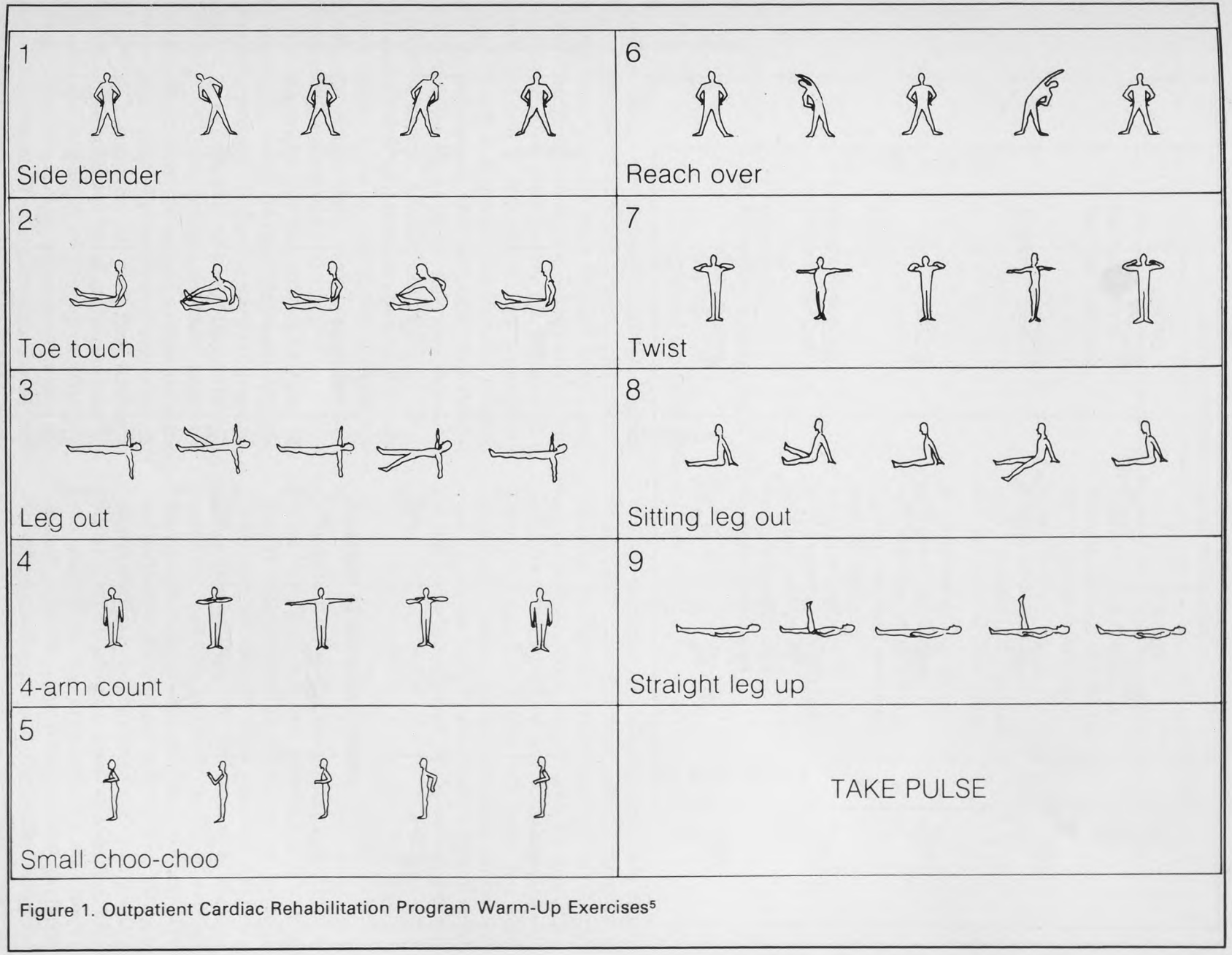

Figure 1. Outpatient Cardiac Rehabilitation Program Warm-Up Exercises[5]

10

Big choo-choo

11

Reach over

12

One leg up then both to buttocks

13

Row the boat

14

Alternate knee to chest

15

Both legs apart

16

Standing toe touch

17

Airplane

18

Knee to elbow

TAKE PULSE

Figure 1, continued. Outpatient Cardiac Rehabilitation Program Warm-Up Exercises[5]

Table 4. Fort Ord Outpatient Cardiac Rehabilitation Program Six-Month Follow-Up of 18 Patients

Item	Outcome
1. Readmission to CCU	1 patient (atrial fibrillation)
2. Exercise Tolerance	Average increase of 3 METS (50% increase in exercise tolerance)
3. Angina	Prior to rehabilitation, angina present in six patients with activities of daily living
	At six-month follow-up, no patient had angina with activities of daily living
4. Ectopy	1 patient resolved exercise-induced bigeminy
5. Weight Reduction	4 patients lost over 10 lb
6. Triglycerides	50% decrease in the 4 patients who lost over 10 lb
7. Cholesterol	No significant change
8. Pulmonary Function Tests Vital Capacity Peak Flow Forced Expiratory Volume (1 second)	No significant change

exercise class, the patient is provided group encouragement to continue a prolonged cardiac rehabilitation exercise program, and is also provided a safe environment in which to exercise. The element of safety must include the presence of a physician with a defibrillator and resuscitation drugs. In its first 18 months, the Fort Ord program had 26 participants, and fortunately experienced no cardiac problems other than an occasional episode of angina. A larger experience at Albert Einstein College of Medicine reported only one major cardiac event in over 75,000 exercise sessions; that patient had a cardiac arrest and was successfully resuscitated.[6]

The outpatient exercise phase of cardiac rehabilitation is essential to provide the patients with long-term support to improve aerobic fitness as well as to lose weight, take medicines, and quit smoking. All these changes represent major behavior modifications and present a challenge to the motivational skills of even the best physician. At Fort Ord, compliance with long-term rehabilitation has been enhanced by several techniques: (1) spouses are encouraged to join the exercise program, (2) patients lead the warm-up exercises, and (3) periodic treadmill and blood tests quantify improvements. Most importantly, patients have been exposed to cardiac rehabilitation since their arrival in the CCU. Even with these selling techniques, it has been the Fort Ord experience that only 30 percent of post-infarction patients who are cleared for exercise actually join and stay with the outpatient exercise program on a long-term basis. The main reasons for noncompliance are work conflicts, a lack of interest by the patient, and a lack of belief in risk factor modification by the referring physician.

Benefits of Aerobic Fitness

In spite of the modest compliance rate, a review of the Fort Ord data is very encouraging (Table 4). The 18 patients who have been in the exercise class over six months have received follow-up Bruce treadmill tests to 100 percent of the age predicted heart rate and have shown an average increase in exercise tolerance of 50 percent. The six patients with post-infarction angina with activities of daily living, now have angina only with a higher level of exercise. Most importantly, only one patient in the exercise class had to be readmitted to the hospital for a cardiac problem. This patient had an episode of atrial fibrillation and responded quickly to treatment. In sharp contrast,

Table 5. Physiological Benefits of Physical Training in Post-Infarction Patients[6,8]

Item	Outcome
1. Work capacity	Increased
2. Peripheral muscle oxygen uptake	Increased
3. Heart Rate	
resting	Decreased
during submaximal exercise	Decreased
during maximal exercise	May increase
4. Stroke volume at rest	
or submaximal exercise	May increase
5. Cardiac output at submaximal exercise	May decrease
6. Blood pressure at rest and	
during submaximal exercise	May decrease
7. Double product (blood pressure × pulse)	
during submaximal exercise	Decreased
8. Double product (blood pressure × pulse)	
at time of angina	May increase
9. Reversal of atherosclerosis	Inconclusive
10. Formation of collateral	
circulation in myocardium	Inconclusive

within a year of infarction, readmission for either angina or repeat infarction was required in 20 percent of the patients who did not join and continue with the exercise class.

In a more extensive study, Kellermann in Israel followed 194 post-infarction patients for over five years. The patients who continued with the exercise program had one third the incidence of fatal reinfarctions as compared with the patients who did not continue with the exercise program.[7]

Physiologic effects of physical training in patients with coronary artery disease are summarized in Table 5.[6,8] In addition to promoting weight loss, decreased smoking, and increased compliance with medications, aerobic fitness improves the efficiency of the peripheral muscles. Specifically, as the muscles are able to extract a greater percentage of oxygen from the perfusing blood, the heart is required to do less work. Documentation of reversal of atherosclerosis and improved cardiac blood flow is still inconclusive in spite of encouraging practical evidence.[8]

Conclusion

The Fort Ord Cardiac Rehabilitation Program began as a research program for a family practice resident. It has now developed into a useful self-sustaining preventive medicine program. With a relatively small investment in time and money, a new dimension to family practice has developed.

Cardiac disease remains one of the leading causes of morbidity and mortality in the American adult, and must be of major concern to the family physician. Cardiac rehabilitation is not the complete answer, but can be a useful adjunct to the use of medications and revascularization procedures.

References

1. Wenger NK, Hellerstein HK (eds): Rehabilitation of the Coronary Patient. New York, John Wiley, 1978
2. Levine SA, Lown B: The "chair" treatment of coronary thrombosis. Trans Assoc Am Physicians 64: 316, 1951
3. Fox SM, Naughton JP, Haskell WL: Physical activity and the prevention of coronary heart disease. Ann Clin Res 3:404, 1971
4. American College of Sports Medicine: Guidelines for Graded Exercise Testing and Exercise Prescription. Philadelphia, Lea and Febiger, 1975
5. Weiss RA, Karpovich PV: Energy cost of exercises for convalescents. Arch Phys Med 27:447, 1947
6. Scheuer J, Greenberg MA, Zohman LR: Exercise training in patients with coronary artery disease. Mod Concepts Cardiovasc Dis 47:85, 1978
7. Kellermann JJ, Denolin H (eds): Critical Evaluation of Cardiac Rehabilitation. New York, S Karger, 1977
8. Blankenhorn DH: Reversibility of latent atherosclerosis. Mod Concepts Cardiovasc Dis 47:79, 1978