Cardiac Rehabilitation
Current Status and Future Directions

HARRY GATTIKER, MD, *Quebec, Canada;* PATRICIA GOINS, RN, *La Jolla, California;*
and CHARLES DENNIS, MD, *Browns Mills, New Jersey*

Comprehensive cardiac rehabilitation is more than exercise training for patients with coronary artery disease and now includes all aspects of secondary prevention. Exercise training is individually prescribed based on clinical status and therapeutic goals. Smoking cessation and abstinence and the treatment of hypercholesterolemia are integral to the rehabilitation process. Education and counseling are important adjuncts to treatment, especially soon after a coronary event. Vocational rehabilitation can be included simply and effectively in the rehabilitation process. Efficient and cost-effective cardiac rehabilitation is tailored to a patient's medical condition, risk factor evaluation, and vocational status. The future of cardiac rehabilitation will be linked to the success of training nonphysician health professionals to provide preventive services.

(Gattiker H, Goins P, Dennis C: Cardiac rehabilitation—Current status and future directions. West J Med 1992 Feb; 156:183-188)

Cardiac rehabilitation had its origins in the 1950s, when the treatment of acute myocardial infarction evolved from three to six weeks of bed rest to "armchair" care and finally to early ambulation.[1,2] When such treatment was shown to be safe,[3] more formal programs of cardiac rehabilitation were developed that emphasized exercise training and vocational rehabilitation.[4] Still, as late as the mid-1970s, a hospital stay of three weeks was common after myocardial infarction. Early exercise testing after myocardial infarction became the standard of care only in the past decade.[5] This rather slow evolution of the care of patients recovering from myocardial infarction has placed the emphasis of cardiac rehabilitation on physical reconditioning after a cardiac event.

In the past decade, advances have occurred in several areas directly related to cardiac rehabilitation. Risk stratification after coronary events allows the early treatment of high-risk patients with medication and revascularization by coronary angioplasty and surgical treatment. Low-risk cases are identified early,[6] allowing comprehensive rehabilitative efforts to be started soon after a coronary event. A careful study of exercise reconditioning programs has led to the development of guidelines that ensure both the safety and efficacy of exercise training for patients with coronary artery disease.[7] Recent data showing that risk factor modification has the potential to slow and even reverse the atherosclerotic process further strengthen a philosophy of secondary prevention for cardiac rehabilitation services. Vocational rehabilitation may be simplified for most patients with coronary disease, allowing a more rapid return to work.[8]

The goals of this article are to review the current status of cardiac rehabilitation services and to offer a perspective on the changing needs for rehabilitation services in the coming years. The anticipated audience is physicians who may refer patients to cardiac rehabilitation programs or provide some rehabilitation services in their practice. Space considerations do not allow this article to serve as a primer for cardiac rehabilitation, but interested readers should understand the concepts of comprehensive cardiac rehabilitation from this article and should be able to expand that knowledge through directed reading.

Goals of Cardiac Rehabilitation

Cardiac rehabilitation may be defined as the process by which patients with cardiac diseases are returned to their optimal physical, psychological, social, emotional, vocational, and economic states. More precise short- and long-term objectives can be defined for cardiac rehabilitation.

Short-term objectives include physical reconditioning sufficient for resuming customary activities, educating patients and family about the disease process, and providing psychological support during the early recovery phase of the illness. Long-term objectives include identifying and treating risk factors that influence the progression of disease, teaching and reinforcing the health behaviors that improve prognosis, optimizing physical conditioning, and facilitating a return to occupational and avocational activities.[8]

Indications for Cardiac Rehabilitation

Cardiac rehabilitation services are generally provided to patients with manifestations of coronary artery disease. In particular, patients recovering from myocardial infarction or a coronary artery bypass operation and those with chronic stable angina are considered candidates. Nevertheless, there is no reason why other patients might not benefit from certain aspects of cardiac rehabilitation services as described later. Reimbursement from insurers and Medicare is generally restricted to patients with coronary artery disease and in some states includes patients recovering from heart transplantation.

Most commonly, patients recovering from uncomplicated myocardial infarction or uncomplicated coronary artery operations are referred for cardiac rehabilitation within three to six weeks of the event. Patients recovering from uncompli-

From the Division of Cardiovascular Diseases, Department of Comprehensive Cardiac Therapy, Department of Medicine, Scripps Clinic and Research Foundation, La Jolla, California. Dr Gattiker is a Visiting Professor from the University of Sherbrooke, Quebec, Canada.

Reprint requests to Charles Dennis, MD, Chairman, Department of Cardiology, Deborah Heart and Lung Center, 200 Trenton Rd, Browns Mills, NJ 08015.

TABLE 1.—*Services Provided by or With the Assistance of Cardiac Rehabilitation Programs*

Exercise training
Evaluation and treatment of hypercholesterolemia
Smoking cessation and abstinence
Education and counseling
Vocational rehabilitation
Risk factor surveillance

cated angioplasty and those with stable angina may be referred sooner if they are clinically stable. In general, when a patient is clinically able to perform an exercise test, he or she is ready to begin cardiac rehabilitation.[8]

Rationale for Cardiac Rehabilitation Services

Traditional cardiac rehabilitation programs provide services in three general areas: exercise training, risk factor evaluation, and education and counseling. Other areas that can be offered under the auspices of cardiac rehabilitation include vocational rehabilitation and risk factor treatment (Table 1). Risk factor treatment may involve both medical and behavioral therapies.

Exercise Training

A substantial body of evidence suggests that physical activity provides primary protection from the development of coronary artery disease and favorably influences the prognosis of persons with coronary disease.[9] The Harvard alumni study[10] and the Multiple Risk Factor Intervention Trial results[11] suggest that habitual exercise is inversely associated with cardiovascular mortality. Even low- to moderate-intensity exercise appears to be protective. The risks of exercise in an otherwise healthy population are extremely low, with an estimated annual incidence of 1 cardiac arrest per 7,000 to 18,000 exercisers.[12-14]

Similarly, there is indirect evidence that habitual exercise in patients with coronary disease has a favorable effect on cardiovascular mortality. Several studies of exercise training were done in the past 20 years, only one of which showed a favorable effect on mortality.[15] All studies were limited for a variety of reasons: insufficient sample size, short duration, crossover problems, and a failure to account for other factors possibly influencing mortality, such as β-blocker and aspirin therapy. Two meta-analyses using pooled data on more than 4,000 patients surviving myocardial infarction, however, showed a reduction of overall and cardiovascular mortality by 20% to 25% for those performing regular exercise.[16,17] This magnitude of benefit is similar to that seen in randomized trials of β-blockade after myocardial infarction.[18] In these meta-analyses, there was no significant difference in the nonfatal reinfarction rate for patients randomly assigned to exercise training compared with those in the control group.

Exercise training has important physiologic effects.[19,20] The primary effect is an increase in peak exercise capacity, most commonly expressed clinically in METs (multiples of resting oxygen consumption). One MET—3.5 ml of oxygen uptake per kilogram per minute—is the approximate energy required to stand quietly. Treadmill workloads are commonly expressed in METs. Exercise training increases the MET capacity by 10% to 50%.[21] This increase is primarily mediated through adaptations in skeletal muscle, including increases in capillary density and mitochondrial and oxidative enzyme concentrations. These changes improve oxygen delivery and extraction by exercising skeletal muscle, thus decreasing the cardiovascular requirements of exercise.[22] There is some evidence that exercise programs of higher intensity and longer duration enhance left ventricular function,[23] perhaps through improved perfusion.[24]

Clinically, the effects of exercise training include lower resting and submaximal pulse rates and systolic blood pressures and increased maximal MET capacity.[20] These changes occur across all subsets of patients with coronary artery disease, including those with evidence of myocardial ischemia[21,25] and left ventricular dysfunction.[26,27] Although ischemia generally occurs at the same double product, increased skeletal muscle efficiency allows a greater level of work to be done before ischemia is manifested. The greatest effects generally occur in those patients most limited at the time exercise training is initiated. Other related benefits of exercise include improved lipid profiles,[28,29] improved blood pressure control in hypertensive patients,[30-32] and improved psychological profiles including increases in self-efficacy (to be described later).[33,34]

Evaluation and Treatment of Hypercholesterolemia

Substantial basic and clinical data link elevated serum cholesterol levels to clinical manifestations of coronary artery disease. In the past decade, clinical trials have shown that lowering serum cholesterol levels has a beneficial effect on cardiovascular morbidity and mortality in persons without symptomatic coronary disease.[35-37] More recent data from several studies suggest that lowering serum cholesterol levels in patients with symptomatic coronary artery disease slows the progression of coronary atherosclerosis in the majority of cases.[38] The status of coronary atherosclerosis was evaluated using serial coronary angiograms, with computer-assisted quantitation of luminal diameters in most studies.[39-41] Two studies also showed a significant reduction in symptomatic coronary events in treated patients compared with the control groups.[40,41] These studies have also shown for the first time that coronary atherosclerosis can be reversed in some patients. Thus, aggressive dietary and drug management of hypercholesterolemia is strongly indicated in patients referred for cardiac rehabilitation.[42]

Smoking Cessation and Abstinence

Cigarette smoking increases the risk of manifestations of coronary artery disease developing and of recurrent complications occurring after coronary symptoms develop.[43] Stopping smoking lowers the primary risk of myocardial infarction to nearly that of nonsmoking within three years.[44,45] Smoking cessation and abstinence after myocardial infarction halves the risk of a recurrent coronary event in the first year. In addition to diminishing the cardiovascular risk, smoking cessation also favorably influences the risk from other diseases including several cancers, peptic ulcer disease, and chronic lung disease.[43] These data suggest that smoking abstinence programs should be incorporated into standard cardiac rehabilitation.[8,46,47]

Behavioral Treatments

Although type A behavior is regarded as a risk factor for the development of coronary disease,[48] controversy exists regarding its specific role. Type A behavior is characterized by three primary features—time urgency, competitive

achievement striving, and hostility. Only the last is thought to have a detrimental coronary effect.[49] The influence of type A behavior on the prognosis of symptomatic coronary disease is also controversial.[50-52] A single study suggests that specific therapy to modify type A behavior reduces the risk of cardiac death and nonfatal myocardial infarction in men with a history of myocardial infarction.[53] Although other disabling psychological problems, such as depression and anxiety, should be treated in patients referred to cardiac rehabilitation programs, the evidence that specific interventions for type A behavior are beneficial is not strong.

Other Risk Factors

There is no clear evidence that the aggressive treatment of hypertension, obesity, and diabetes mellitus influences the prognosis in patients with symptomatic coronary artery disease. A lack of data in these important areas should not deter physicians from providing optimal treatment of these well-established risk factors. Cardiac rehabilitation programs can assist in the management of these problems by providing close surveillance of blood pressure, weight, and glucose control at the time of regularly scheduled exercise sessions.[54]

Education and Counseling

Education and counseling are integral parts of most cardiac rehabilitation programs and show promise in enhancing quality of life, especially in the early recovery phases of myocardial infarction.[55] There are, however, few data to substantiate long-term beneficial effects on psychological outcome by these interventions.[54] One area in which cardiac rehabilitation has a well-established beneficial effect is in improved self-efficacy.[55] "Self-efficacy" is a psychological term describing how a person's judgment regarding his or her capacity to do a task is an important determinant of whether the task will be attempted. Self-efficacy is a measure of self-confidence and is a useful tool in developing and establishing healthy behaviors, such as exercising, dieting, and smoking abstinence. Specific techniques for increasing self-efficacy have been developed and can be helpful within the context of promoting healthy behaviors.[8,55]

Vocational Rehabilitation

The cost of cardiovascular disease is high, estimated at $85 billion annually for direct treatment costs alone. The cost of resulting short- and long-term disability is substantially higher, estimated at three to four times the direct costs of care. These indirect costs result from goods and services not provided due to cardiovascular disability. The indirect costs can be reduced by increasing the number of patients with cardiovascular disease returning to work and shortening the interval between a cardiac illness and return to work. Demographic, medical, and psychological factors all influence whether a patient works after a cardiac event. Age, work history, and job type are the most important demographic factors. The severity of the cardiac illness is the most important medical factor. Patients' perception of their health and the advice treating physicians give regarding reemployment are the most important psychosocial factors.[8]

In patients recovering from uncomplicated myocardial infarction, early exercise testing and specific advice regarding return to work shortened the interval from 75 to 51 days in a randomized trial.[56] More than 75% of working patients younger than 60 years can return to work earlier than is commonly allowed. Similar guidelines are probably applicable to patients recovering from uncomplicated coronary bypass grafting. Substantial financial benefits accrue to patients and employers as a result of shortening the interval between a cardiac event and return to work. A work evaluation can be easily incorporated into standard rehabilitative care.

Organizing Cardiac Rehabilitation Services

Inpatient Cardiac Rehabilitation

The cardiac rehabilitation process usually begins during a hospital stay for myocardial infarction, unstable angina, or coronary revascularization by angioplasty or bypass procedure. With the shortening of hospital stays for all cardiac treatments, the goals of inpatient cardiac rehabilitation should be limited to the most important areas. These important goals include providing a structured progressive ambulation program so that patients will be physically able to perform customary activities at home; teaching patients to recognize important cardiac symptoms and to take appropriate action; maintaining smoking abstinence; teaching patients the doses, effects, and side effects of their medications; instructing patients in how to obtain routine and emergency medical care; and providing basic information about the outpatient rehabilitation process.

Effective inpatient cardiac rehabilitation programs are multidisciplinary. They usually involve nurses, physicians, physical therapists, nutritionists, and exercise physiologists. Coordinated programs of mobilization and education are sufficient to meet the basic needs of most patients.[8] The concepts of risk factor modification should be introduced in the hospital, especially the continued abstinence from smoking. Patients who have been admitted to hospital have a limited capacity to retain new information, however. Therefore, most efforts of secondary prevention should be deferred to the outpatient program.

Outpatient Cardiac Rehabilitation

Comprehensive standards for traditional outpatient rehabilitation programs have recently been published.[7,8,57-61] These specific guidelines should be incorporated into all existing and new outpatient programs to ensure a safe, efficacious, and consistent approach to cardiac rehabilitation. Several specific services may be offered by outpatient programs.

Exercise training. Structured exercise sessions are the hallmark of outpatient cardiac rehabilitation. A symptom-limited exercise test is the basis for the exercise prescription. Patients without evidence of angina or asymptomatic ischemia, congestive heart failure, or electrical instability are usu-

TABLE 2.—*Increased Risk for Exercise Training in Patients Who Should Receive Greater Surveillance During Exercise Training or Who Should Not Exercise*

Pathophysiology	*Manifestation*
Left ventricular dysfunction	Congestive heart failure; ejection fraction < 30%; history of cardiogenic shock
Myocardial ischemia	Angina pectoris; exercise-induced ST depression; severe coronary artery disease
Ventricular arrhythmias	Complex arrhythmia at rest; complex arrhythmia during exercise; history of sudden cardiac arrest

ally good candidates for symptom-limited testing. The exercise test will establish the patient's MET capacity and guide the development of a rational exercise prescription. In some patients it will identify high-risk characteristics that require further diagnostic evaluation or therapeutic interventions. The test also identifies cases in which exercise training is safe but should be done in more carefully monitored settings (Table 2). The exercise test is especially important in the modern era of thrombolytic therapy and early coronary interventions to be certain that occult myocardial ischemia and electrical instability are not present.

The fundamental concepts of exercise training of patients with cardiac disease are well described.[7] Exercise training effects are related to the FIT principle: frequency, intensity, and time. Most cardiac exercise programs provide three sessions a week for 12 weeks. The intensity of exercise training is best prescribed as a percentage of the peak heart rate attained on symptom-limited exercise testing. Conservative target heart rates are prescribed initially to ensure that patients can complete the exercise session safely without excessive fatigue. The time of each session varies between 30 and 90 minutes. Patients monitor their exercise by their pulse rate.

In patients without important contraindications, exercise training is safe. A national survey of cardiac rehabilitation programs estimated the rate per 1 million patient hours of exercise of fatal events at 1.3, of myocardial infarction at 3.4, and of resuscitated cardiac arrest at 8.9.[62] Patients at higher risk require more intensive surveillance, including continuous electrocardiographic monitoring during training. Patients at lower risk can exercise in a supervised setting using pulse counting and intermittent electrocardiographic monitoring for surveillance. All programs should have resuscitation equipment immediately available, and the staff must be trained in advanced cardiac life support procedures.

As patients improve with exercise training, their prescriptions may be advanced by increasing the target heart rate and by adding exercise sessions at home. The same techniques for self-monitoring pulse rate and symptoms must be used in home exercise, so patients must be competent in these techniques before home exercise is recommended.[8,63-65]

Risk factor evaluation. Patients entering cardiac rehabilitation should have their risk factors assessed at entry. These include blood pressure, fasting lipid and glucose levels, weight, smoking status, and stress levels. Goals should be individually tailored for each patient. The patient should have a clear understanding of the goals and how they might be accomplished. Specific guidelines for evaluating hypercholesterolemia are available through the National Cholesterol Education Program.[42]

Risk factor treatment. Risk factor treatment is an area where cardiac rehabilitation programs and primary physicians should coordinate their efforts. In many respects, the cardiac rehabilitation program is an ideal setting for risk factor treatment. Most of the issues related to long-term health-related behavioral change require frequent visits, time-consuming face-to-face interactions, social and professional support, and access to nonphysician health care professionals such as nutritionists and nurses. A cardiac rehabilitation program that provides 36 one-hour sessions over 12 weeks can incorporate techniques for educating patients, enhancing and monitoring compliance, and establishing social support systems. In contrast to the physician's office, where visits are usually infrequent and brief, in a cardiac rehabilitation program, healthy behaviors can be introduced, molded, and reinforced more effectively.

TABLE 3.—*Treatment Thresholds and Goals for Patients With Coronary Artery Disease**

Cholesterol	Threshold, mmol/liter (mg/dl)	Goal, mmol/liter (mg/dl)	Treatment Form
Low-density lipoprotein...	≥3.36 (130)	≤3.36 (130)	Dietary
Low-density lipoprotein...	≥4.14 (160)	≤3.38 (130)	Drug

*From the National Cholesterol Education Program.[42]

Specific guidelines for cholesterol management have been published (Table 3).[42] Dietary management can be facilitated with the help of a nutritionist for both individual and group teaching. Drug therapy is effective if dietary treatment is insufficient for reaching the goals of reducing low-density-lipoprotein cholesterol levels. Exercise training can raise the high-density-lipoprotein cholesterol values. Smoking abstinence can be facilitated by individual or group programs and reinforced during exercise sessions. The use of nicotine polacrilex can improve the short- and long-term abstinence rates. Stress reduction can also be accomplished by group and individual treatment. Stress reduction commonly occurs as a by-product of regular exercise sessions.

Education and counseling. Most cardiac rehabilitation programs provide group education that addresses a variety of topics. Sessions are usually open to both patients and family. The education focuses on those areas relevant to the long-term management of coronary artery disease. Possible topics include basic pathophysiology, treatment options, diet, cholesterol evaluation and treatment, medication effects and side effects, stress management, and other topics of interest to the group. Informal social support groups are often formed by patients and can be beneficial to them and their families in the early recovery period after a cardiac illness.

Vocational rehabilitation. Because most working patients younger than 60 years will return to work after a cardiac event,[55] complex vocational rehabilitation is necessary for only a few patients. Occasionally patients cannot return to the same job after a cardiac event because of a medical complication, such as stroke or severe congestive heart failure, that makes them incapable of doing the work. A small number of patients are legally restricted from returning to their previous job, such as pilots and public safety workers. In these circumstances, which mandate a change of job, specialized vocational rehabilitation services are indicated.

The majority of patients recovering from uncomplicated myocardial infarction or a coronary bypass procedure can return to work earlier than is commonly recommended. The average patient with no complications has a functional capacity of 7 to 8 METs within a month of the illness. This capacity is sufficient to perform most jobs, including those with moderate physical requirements. In the case of jobs requiring higher levels of physical activity, exercise training can usually bring the physical capacity to a sufficient level. In the absence of signs of a poor prognosis, such as substantial left ventricular dysfunction or myocardial ischemia, most patients can return to work within 30 to 40 days of their cardiac illness. The symptom-limited exercise test done before entry into a cardiac rehabilitation program may be used to substantiate a good prognosis, assess the functional capacity, and aid

the physician and cardiac rehabilitation team in providing specific guidelines for a return to work.[8]

Future Directions in Cardiac Rehabilitation

Traditional efforts in cardiac rehabilitation that have emphasized exercise training will be replaced by a more comprehensive approach to secondary prevention in the coronary population. While exercise clearly benefits patients with coronary disease, aggressive treatment of other risk factors improves prognosis as well.

The process of cardiac rehabilitation begins with risk stratification to identify and treat abnormalities of left ventricular dysfunction, myocardial ischemia, and electrical instability. Once these important prognostic factors are evaluated and treated, secondary prevention measures should begin. These include exercise training, smoking cessation and abstinence, cholesterol evaluation and treatment, stress management, vocational rehabilitation, and education.

Currently only 15% of all patients eligible for cardiac rehabilitation services enroll in formal cardiac rehabilitation programs. Formal programs, which are generally supervised by nurses, exercise physiologists, and other nonphysician health professionals, do not yet completely address the comprehensive approach outlined here. The future of cardiac rehabilitation must include more coordinated efforts between physicians and rehabilitation programs if cardiac rehabilitation is to meet these standards. Systems must be developed whereby all patients with coronary artery disease can benefit from comprehensive programs of secondary prevention that are individually prescribed. Multidisciplinary teams of nonphysician health professionals offer the greatest potential for providing the breadth of preventive services necessary to accomplish the goals outlined here. Ultimately, primary and secondary prevention is the most cost-effective means of improving prognosis in coronary heart disease.[66,67]

REFERENCES

1. Levine SA, Lown B: 'Armchair' treatment of acute coronary thrombosis. JAMA 1952; 148:1365-1369

2. Wood P: Diseases of the Heart and Circulation, 2nd Ed. London, Eyre & Spottiswoode, 1956

3. Bloch A, Maeder JP, Haissly JC, et al: Early mobilization after myocardial infarction—A controlled study. Am J Cardiol 1974; 34:152-157

4. The Exercise Standards Book. Dallas, Texas, American Heart Association, 1979

5. DeBusk RF, Blomqvist CG, Kouchoukos NT, et al: Identification and treatment of low-risk patients after acute myocardial infarction and coronary-artery bypass graft surgery. N Engl J Med 1986; 314:161-166

6. DeBusk RF: Specialized testing after recent acute myocardial infarction—A review. Ann Intern Med 1989; 110:470-481

7. Leon AS, Certo C, Comoss P, et al: Position paper of the American Association of Cardiovascular and Pulmonary Rehabilitation: Scientific evidence of the value of cardiac rehabilitation with emphasis on patients following myocardial infarction—Section I: Exercise conditioning component. J Cardiopulm Rehabil 1990; 10:79-87

8. Dennis C: Rehabilitation of the patient with coronary artery disease, *In* Braunwald EB (Ed): Heart Disease, 4th Ed. Philadelphia, Pa, WB Saunders, 1991

9. Powell KE, Thompson PD, Caspersen CJ, Kendrick JS: Physical activity and the incidence of coronary heart disease. Annu Rev Public Health 1987; 8:253-287

10. Paffenbarger RS Jr, Hyde RT, Wing AL, Steinmetz CH: A natural history of athleticism and cardiovascular health. JAMA 1984; 252:491-495

11. Leon AS, Connett J, Jacobs DR Jr, Rauramaa R: Leisure-time physical activity levels and risk of coronary heart disease and death—The Multiple Risk Factor Intervention Trial. JAMA 1987; 258:2388-2395

12. Thompson PD, Funk EJ, Carleton RA, Sturner WQ: Incidence of death during jogging in Rhode Island from 1975 through 1980. JAMA 1982; 247:2535-2538

13. Siscovick DS, Weiss NS, Fletcher RH, Lasky T: The incidence of primary cardiac arrest during vigorous exercise. N Engl J Med 1984; 311:874-877

14. Friedewald VE, Spence DW: Sudden cardiac death associated with exercise: The risk-benefit issue. Am J Cardiol 1990; 66:183-188

15. Kallio V, Hämäläinen H, Hakkila J, Luurila OJ: Reduction in sudden deaths by a multifactorial intervention programme after acute myocardial infarction. Lancet 1979; 2:1091-1094

16. Oldridge NB, Guyatt GH, Fischer ME, Rimm AA: Cardiac rehabilitation after myocardial infarction—Combined experience of randomized clinical trials. JAMA 1988; 260:945-950

17. O'Connor GT, Buring JE, Yusuf S, et al: An overview of randomized trials of rehabilitation with exercise after myocardial infarction. Circulation 1989; 80:234-244

18. Yusuf S, Peto R, Lewis J, Collins R, Sleight P: Beta blockade during and after myocardial infarction: An overview of randomized trials. Prog Cardiovasc Dis 1985; 27:335-371

19. Blomqvist CG: Cardiovascular adaptation to physical training. Annu Rev Physiol 1983; 45:169-185

20. Clausen JP: Circulatory adjustment to dynamic exercise and effects of physical training in normal subjects and in patients with coronary artery disease. Prog Cardiovasc Dis 1976; 18:459-495

21. Thompson PD: The benefits and risks of exercise training in patients with chronic coronary artery disease. JAMA 1988; 259:1537-1540

22. Franklin BA, Wrisley D, Johnson S, Mitchell M, Rubenfire M: Chronic adaptations to physical conditioning in cardiac patients—Implications regarding exercise trainability. Clin Sports Med 1984; 3:471-512

23. Ehsani AA, Biello DR, Schultz J, Sobel BE, Holloszy JO: Improvement of left ventricular contractile function by exercise training in patients with coronary artery disease. Circulation 1986; 74:350-358

24. Froelicher VF, Jensen D, Atwood E, et al: Cardiac rehabilitation: Evidence for improvement in myocardial perfusion and function. Arch Phys Med Rehabil 1980; 61:5117-5122

25. Ades PA, Grunvald MH, Weiss RM, Hanson JS: Usefulness of myocardial ischemia as predictor of training effect in cardiac rehabilitation after acute myocardial infarction or coronary artery bypass grafting. Am J Cardiol 1989; 63:1032-1036

26. Squires RW, Lavie CJ, Brandt TR, Gau GT, Bailey KR: Cardiac rehabilitation in patients with severe ischemic left ventricular dysfunction. Mayo Clin Proc 1987; 62:997-1002

27. Dubach P, Froelicher VF: Cardiac rehabilitation for heart failure patients. Cardiology 1989; 76:368-373

28. Haskell WL: The influence of exercise training on plasma lipids and lipoproteins in health and disease. Acta Med Scand 1986; 220(Suppl 711):25-37

29. Krauss RM: Exercise, lipoproteins, and coronary artery disease. Circulation 1989; 79:1143-1145

30. Hagberg TM, Seals DR: Exercise training and hypertension. Acta Med Scand 1986; 220(Suppl 711):131-136

31. Björntorp P: Effects of physical training on blood pressure in hypertension. Eur Heart J 1987; 8(Suppl B):71-76

32. Martin JE, Dubbert PM, Cushman WC: Controlled trial of aerobic exercise in hypertension. Circulation 1990; 81:1560-1567

33. Dishman RK: Medical psychology in exercise and sports. Med Clin North Am 1985; 69:123-143

34. Ewart CK, Taylor CB, Reese LB, DeBusk RF: Effects of early postmyocardial infarction exercise testing on self-perception and subsequent physical activity. Am J Cardiol 1983; 51:1076-1080

35. Lipid Research Clinics Program: The Lipid Research Clinics Coronary Primary Prevention Trial results: I. Reduction in incidence of coronary heart disease. JAMA 1984; 251:351-364

36. Lipid Research Clinics Program: The Lipid Research Clinics Coronary Primary Prevention Trial results: II. The relationship of reduction in incidence of coronary heart disease to cholesterol lowering. JAMA 1984; 251:365-374

37. Frick MH, Elo O, Haapa K, et al: Helsinki Heart Study: Primary-prevention trial with gemfibrozil in middle-aged men with dyslipidemia—Safety of treatment, changes in risk factors, and incidence of coronary heart disease. N Engl J Med 1987; 317:1237-1245

38. Arntzenius AC, Kromhout D, Barth JD, et al: Diet, lipoproteins, and the progression of coronary atherosclerosis: The Leiden Intervention Trial. N Engl J Med 1985; 312:805-811

39. Blankenhorn DH, Nessim SA, Johnson RL, Sanmarco ME, Azen SP, Cashin-Hemphill L: Beneficial effects of combined colestipol-niacin therapy on coronary atherosclerosis and coronary venous bypass grafts. JAMA 1987; 257:3233-3240

40. Brown G, Albers JJ, Fisher LD, et al: Regression of coronary artery disease as a result of intensive lipid-lowering therapy in men with high levels of apolipoprotein B. N Engl J Med 1990; 323:1289-1298

41. Buchwald H, Varco RL, Matts JP, et al: Effect of partial ileal bypass surgery on mortality and morbidity from coronary heart disease in patients with hypercholesterolemia: Report of the Program on the Surgical Control of the Hyperlipidemias (POSCH). N Engl J Med 1990; 323:946-955

42. Report of the National Cholesterol Education Program expert panel on detection, evaluation and treatment of high blood cholesterol in adults. Arch Intern Med 1988; 184:36-69

43. Fielding JE: Smoking: Health effects and control (pts 1,2). N Engl J Med 1985; 313:491-498; 555-561

44. Rosenberg L, Kaufman DW, Helmrich SP, Shapiro S: The risk of myocardial infarction after quitting smoking in men under 55 years of age. N Engl J Med 1985; 313:1511-1514

45. Rosenberg L, Palmer JR, Shapiro S: Decline in the risk of myocardial infarction among women who stop smoking. N Engl J Med 1990; 322:213-217

46. Kottke TE, Battista RN, DeFriese GH, Brekke ML: Attributes of successful smoking cessation interventions in medical practice: A meta-analysis of 39 controlled trials. JAMA 1988; 259:2883-2889

47. Davis RM: Uniting physicians against smoking: The need for a coordinated national strategy (Editorial). JAMA 1988; 259:2900-2901

48. The Review Panel on Coronary-Prone Behavior and Coronary Heart Disease: Coronary-prone behavior and coronary heart disease: A critical review. Circulation 1981; 63:1199-1225

49. Williams RB: Refining the type A hypothesis: Emergence of the hostility complex. Am J Cardiol 1987; 60:27J-32J

50. Dimsdale JE: A perspective on type A behavior and coronary disease. N Engl J Med 1988; 318:110-112

51. Ragland DR, Brand RJ: Type A behavior and mortality from coronary heart disease. N Engl J Med 1988; 318:65-69

52. Ahern DK, Gorkin L, Anderson FL, et al: Biobehavioral variables and mortality or cardiac arrest in the cardiac arrhythmia pilot study (CAPS). Am J Cardiol 1990; 66:59-62

53. Friedman M, Thoresen CE, Gill JJ, et al: Alteration of type A behavior and its effect on cardiac recurrences in post myocardial infarction patients: Summary results of the Recurrent Coronary Prevention Project. Am Heart J 1986; 112:653-665

54. Greenland P, Chu JS: Efficacy of cardiac rehabilitation services—With emphasis on patients after myocardial infarction. Ann Intern Med 1988; 109:650-663

55. Houston-Miller N, Taylor CB, Davidson DM, et al: The efficacy of risk factor intervention and psychosocial aspects of cardiac rehabilitation. J Cardiopulm Rehabil 1990; 10:198-209

56. Dennis C, Houston-Miller N, Schwartz RG, et al: Early return to work after uncomplicated myocardial infarction: Results of a randomized trial. JAMA 1988; 260:214-220

57. Position paper on cardiac rehabilitation: Recommendations of the American College of Cardiology. J Am Coll Cardiol 1986; 7:451-453

58. Health and Public Policy Committee, American College of Physicians: Position paper on cardiac rehabilitation services. Ann Intern Med 1988; 109:671-673

59. American Association of Cardiovascular and Pulmonary Rehabilitation: Guidelines for Cardiac Rehabilitation. Champaign, Ill, Human Kinetics Books, 1990

60. Standards for Cardiac Rehabilitation in California. San Francisco, Calif, California Society for Cardiac Rehabilitation, 1990

61. American College of Sports Medicine: Guidelines for Exercise Testing and Prescription. Philadelphia, Pa, Lea & Febiger, 1991

62. Van Camp SP, Peterson RA: Cardiovascular complications of outpatient cardiac rehabilitation programs. JAMA 1986; 256:1160-1163

63. Balady GJ, Weiner DA: Risk stratification in cardiac rehabilitation. J Cardiopulm Rehabil 1991; 11:39-45

64. Jugdutt BI, Michorowski BL, Kappagoda CT: Exercise training after anterior Q wave myocardial infarction: Importance of regional left ventricular function and topography. J Am Coll Cardiol 1988; 12:362-372

65. Iskandrian AS: Exercise training after anterior Q wave myocardial infarction: Harmful or beneficial? (Editorial). J Am Coll Cardiol 1988; 12:373-374

66. Dennis C: Cost-effectiveness in cardiac rehabilitation. J Cardiopulm Rehabil 1991; 11:108-114

67. Wenger NK, Alpert JS: Rehabilitation of the coronary patient in 1989. Arch Intern Med 1989; 149:1504-1506

HERMAN KATTLOVE IS OUR ONCOLOGIST

After fifteen years, Herman and I talk of art—
Georgia O'Keefe and Degas
and travel and cities we love—
Berlin and Paris
our grown children and what they are doing.

Dr. Kattlove and Shelley talk of drugs—
Megace and tamoxifen
of therapies—radiation and chemo
and experimental treatments.

Herman tells me to come back in six months
(A year is too long, he'd miss me.)
He tells Shelley to come back in a month—or less.

Shelley and I talk of art and travel
and favorite cities.
She tells me of her treatments.
I remember mine.
I wonder when Shelley and Herman will discuss
Bali and Vienna?
Andrew Wyeth and Van Gogh?

MARY KAY CROWTHER©
Long Beach, California