Importance of resistance training for patients after a cardiac event

Jenny Adams, PhD, Matthew Cline, MS, Mike Reed, MS, Amanda Masters, BS, Kay Ehlke, MS, and Julie Hartman, MS

After a myocardial infarction (MI), percutaneous coronary intervention, or angina pectoris, patients receive conflicting advice from physicians about the level of activity that is acceptable. Most are told that they should not lift anything >5 pounds. When we conducted an informal survey of 28 patients from the Cardiac Rehabilitation Department at the Baylor Jack and Jane Hamilton Heart and Vascular Hospital, patients also recollected advice such as not to lift >10 pounds "for a while," not to lift anything for a week, not to drive more than 30 minutes, not to "get exhausted" for a month, not to exercise for a few weeks, and not to lift >25 pounds for a period of time—or ever. These guidelines are not only confusing but can also promote fear and inactivity.

Table 1. Cardiac rehabilitation resistance training guidelines by diagnosis*

Diagnosis	Guidelines from the American Association of Cardiovascular and Pulmonary Rehabilitation	Guidelines from the American College of Sports Medicine
Myocardial infarction	1- to 3-lb hand weights on cardiac rehabilitation program entry; traditional resistance training at 5 weeks if 4 weeks of supervised endurance training have been completed	Traditional resistance training at 3 months; 1- to 3-lb hand weights 2 weeks after myocardial infarction
Percutaneous coronary intervention	1- to 3-lb hand weights on cardiac rehabilitation program entry; traditional resistance training at 3 weeks if 2 weeks of supervised endurance training have been completed	2 weeks of aerobic exercise prior to traditional resistance training

*Adapted from references 3 and 4.

Further complicating the scenario is that while physicians typically prescribe aerobic exercise—and particularly walking—for the purpose of avoiding further heart complications, patients are more interested in being able to return to activities of daily living, such as mowing the lawn, lifting grandchildren, or vacuuming. The resistance training that would lead to that outcome is rarely prescribed.

Exercise physiologists, cardiac rehabilitation professionals, and personal trainers focus on three principles in training. One such principle is specificity. This principle indicates that the training effect is limited to the muscle fibers involved in the activity. For example, mitochondria adapt to endurance training, and contractile proteins adapt to resistance training. It is not reasonable to expect the arms to become trained during a 10-week jogging program, for example (1). When the specificity principle was applied to football, coaches moved from mile runs for training to 100-yard runs, simulating the longest distance a player would run in competition. The other two principles of fitness training are overload, which states that for a training effect to occur, a tissue must be challenged with an intensity, duration, or frequency to which it is not accustomed; and reversibility, which states that training gains are quickly lost when the overload is removed (1).

Over time, positive gains have been made in motivating patients to become more active following MI. Just 40 years ago, patients were put on bedrest for 4 to 6 weeks after an MI. Since then, it has been shown that after just a few days or weeks of bedrest, the patient experiences decreased cardiorespiratory fitness, strength, and flexibility (2).

While physicians now acknowledge the value of exercise in cardiac rehabilitation, they have been hesitant to allow resistance training. Part of the problem is the existing guidelines *(Table 1).* In our opinion, these guidelines not only delay resistance training unnecessarily but also prescribe weight amounts that are below what patients need for even the most basic activities of daily living. We argue that resistance training should be promoted following the principle of specificity—that is, based on the fact that most patients set goals not to run a 10-kilometer race or to go mountain biking but rather to rise from the bathtub or mow the lawn. The constraints faced in cardiac rehabilitation, from physician prescriptions and from the guidelines, are particularly worrisome, since in society today

From the Department of Cardiac Rehabilitation, Baylor Jack and Jane Hamilton Heart and Vascular Hospital and Baylor University Medical Center, Dallas, Texas (Adams, Masters, Ehlke, Hartman); Cardiodynamics, San Diego, California (Cline); and Texas Women's University, Denton, Texas (Reed).

Corresponding author: Jenny Adams, PhD, Cardiac Rehabilitation Center, 411 North Washington, Dallas, Texas 75246 (e-mail: jennya@BaylorHealth.edu).

we seem to place more importance on specifically training athletes (cyclists, marathon runners, football players) than we do on appropriately preparing patients to safely perform everyday activities. This limitation has become particularly obvious as cardiac rehabilitation patients have become younger. Some of these patients need to return to firefighting, police work, or other physically stressful jobs.

Our reasons for promoting resistance training are presented below.

1. ACTIVITIES OF DAILY LIVING REQUIRE MORE STRENGTH THAN MOST PEOPLE REALIZE

If patients are told not to lift more than 5 pounds, that instruction would mean that patients couldn't even open the door to the cardiac rehabilitation facility. In a previous study, we compared the strength required for various push and pull activities and compared them to the force involved in lifting weights (5) *(Table 2)*. Opening a car door was equivalent to lifting a 10-pound weight. Being able to do even the most basic daily activities requires strength, and having confidence that they can do these activities is beneficial to patients.

2. RESISTANCE TRAINING IMPROVES PATIENTS' QUALITY OF LIFE

An aerobic training program is unlikely to improve a patient's perception that he or she can undertake heavy arm work (6). Beniamini (7) recently investigated the effects of high-intensity resistance training on quality of life parameters in cardiac rehabilitation patients. A group of 38 patients added either high-intensity resistance training or flexibility training to their usual exercise prescription. The resistance-trained patients improved their self-efficacy scores for strength-related tasks and also for jogging when compared with the flexibility-trained controls. An added finding was that the resistance-trained patients also improved in quality of life parameters such as total mood disturbance, depression/dejection, fatigue/inertia, and emotional health domain scores.

Many patients who have had an MI are limited more by an inappropriate perception that they cannot do an activity than by any real physical limitation. Because of this, improvements in self-efficacy resulting from resistance training may allow patients to resume a more normal lifestyle and thus improve the quality of their lives.

3. RESISTANCE TRAINING HAS NOW BEEN SHOWN TO BE EFFECTIVE IN REDUCING RISK FACTORS FOR CARDIOVASCULAR DISEASE

For many years, resistance exercise was not endorsed as an appropriate intervention for the prevention of cardiovascular disease risk factors (8). Early studies examining the effects of resistance exercise on risk factors for cardiovascular disease reported negligible improvement. Unfortunately, the resistance exercise protocols used in these early studies were designed primarily for strength development and muscle hypertrophy. They entailed the use of heavier loads (>70% of the subjects' one-repetition maximum) and <10 repetitions.

Table 2. Forces required to perform activities of daily living as measured using a Chatillon medical dynamometer*

Activity	Force pounds
Lifting 1-lb dumbbell	2
Lifting 3-lb dumbbell	4
Lifting 5-lb dumbbell	6
Lifting 10-lb dumbbell	12.5
Lifting 25-lb dumbbell	26
Lifting 50-lb dumbbell	52
Opening refrigerator	9
Pushing lawn mower	36
Pulling lawn mower	38
Pulling out full dishwasher rack	5
Lifting full laundry hamper	21.5
Pushing vacuum cleaner	7.5
Pulling vacuum cleaner	8.5
Lifting full coffee pot	6.5
Pushing with aid of right arm to rise off bench	27.5
Opening car door	12.5
Opening door to cardiac rehabilitation facility	15.5

*Adapted from reference 5.

Subsequent research, however, has revealed that resistance exercise performed with a lighter load and higher repetitions does have a beneficial effect on risk factors—such as reducing plasma glucose and insulin levels, increasing high-density lipoprotein cholesterol levels, and lowering resting blood pressure—without altering cardiovascular function in healthy subjects (9).

The safety concerns with resistance training for MI patients have been related to blood pressure increases and particularly increases in mean arterial pressure that were reported in the literature some time ago. The original studies showed a dramatic increase in mean arterial pressure during isometric contractions (usually accompanied by breath holding), such as contractions in the forearm muscles during isometric handgrip dynamometry (2, 10).

Yet, when the focus is on the myocardial work, which is represented by the rate pressure product (peak systolic blood pressure × peak heart rate), the results show that exercising on a treadmill places more of a demand on the heart than resistance training does. We have started our own study of this comparison (unpublished data), and our results have corroborated others' findings (11).

4. UNDER THE SUPERVISION OF EXPERIENCED PERSONNEL, RESISTANCE TRAINING IS SAFE

Supervised exercise occupies a central role in the rehabilitation of patients with coronary artery disease. Traditionally, the exercise prescription comprises aerobic activities such as walking and cycling, which utilize large muscle groups in rhythmic

contractions and improve exercise tolerance and functional capacity through a variety of circulatory and peripheral muscle adaptations. No recommendations are usually given to rehabilitation professionals about starting levels for the treadmill or bike. Rather, patients are encouraged to progress gradually, with increases in intensity made based on the observations of the staff and subjective responses of the patients (4). So, rehabilitation professionals are left to progress patients using responsible and reliable methods. We argue that the same should be true regarding resistance training. Rehabilitation exercise professionals are trained to choose the right exercises for the patient—just as they guide patients in their aerobic activities, which also carry some risk.

CONCLUSION

When considering the specific needs and goals of individuals participating in a cardiac rehabilitation program, resistance exercise—specifically circuit resistance training employing a short rest interval protocol—may be a preferable alternative or addition to aerobic exercise. The ability to perform activities of daily living places a much greater stress on the musculoskeletal system as opposed to the cardiovascular system. Therefore, an emphasis on the development of muscular strength and endurance rather than aerobic capacity may be justified in preparing patients to return to independent living. Resistance exercise programs have been effective in significantly improving muscular strength (12), muscular endurance (13), and maximum power output on a cycle ergometer (14) and significantly reducing perceived exertion of patients performing at submaximal power outputs (14). Cardiovascular benefits have also been observed from resistance training, such as improvements in peak oxygen uptake, stroke volume, and cardiac output (12). An additional benefit for cardiac rehabilitation patients is the efficacy of resistance training in improving cardiovascular disease risk factors such as hypertension, dyslipidemia, and insulin sensitivity.

The guidelines for cardiac rehabilitation clearly state that the long-standing perception that resistance exercise is harmful to cardiac patients is not supported by the scientific literature (4). The guidelines also state that resistance exercise training improves skeletal muscle strength and endurance. Strength and endurance are important for the safe return to activities of daily living and vocational activities, and in the frail and elderly they reduce the susceptibility to falls. Most patients must do some form of lifting, carrying, or pushing in their daily routine. Thus, including resistance training as part of the patients' normal exercise will better prepare them to perform these tasks safely and more efficiently (2).

Ironically, physicians and rehabilitation experts spend a considerable amount of time promoting the importance of exercise as a daily routine and then often advise against the performance of the activities patients usually choose to perform. As mentioned, overcautious and limiting exercise guidelines after a cardiac event often promote fear and inactivity in patients. During this healing period, patients need to be motivated to exercise and resume self-supporting activities (6, 15). Since many patients with an uncomplicated course return to work within 4 weeks of their MI, resistance training in phase II cardiac rehabilitation is likely to assume greater importance in the future (16).

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