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Role of Resistance Exercise in Cardiology

ABSTRACT

Resistance exercise is a form of exercise that increases muscular strength and endurance by exercising a muscle or muscle group against external resistance. Resistance exercises have an important potential in preventing cardiac diseases, increasing treatment efficiency, and improving quality of life. In spite of the fact that the vast majority of cardiology research to date has focused on aerobic exercise, an increasing number of studies on resistance exercise have been published in the past few years. Although resistance exercise was combined with aerobic exercise in most of these studies, its isolated efficacy was also examined. In conditions such as coronary artery disease, peripheral artery disease, heart failure, arrhythmias, and cardiac rehabilitation, resistance exercise (RE) is regarded as a potentially beneficial approach. In addition to interventional and medical treatments, resistance exercise can also be considered as a cost-effective and sustainable method. The effects of resistance exercise on a variety of cardiovascular conditions were investigated in this evaluation of the literature.

Keywords: Aerobic exercise, cardiac rehabilitation, cardiovascular disease, heart failure, resistance exercise

REVIEW

INTRODUCTION

Cardiorespiratory fitness, biological risk factors, and clinical health outcomes have been shown to exhibit relationships similar to those observed in the context of physical activity. Cardiovascular disease mortality and morbidity are reduced in apparently healthy middle-aged and older persons with higher cardiorespiratory fitness at baseline and in those who improve fitness over time.[1,2] Traditionally, various types of exercise have been categorized into 2 groups: resistance (strength) exercise and endurance activity. Anaerobic vs. aerobic exercise and those based on the type of muscle contraction are further categories of exercise. When a muscle contracts against tension, its length either increases (concentric contraction) or decreases (eccentric contraction). Although most cardiological studies have been related to aerobic-type exercise to date, many studies have been published on resistance exercise in recent years. Additionally, we now know that the physiological changes caused by aerobic group exercise and resistance exercises on the heart are different.[3] Resistance exercise (RE) may be encouraging in the treatment of coronary artery disease, peripheral artery disease, heart failure, arrhythmias, and cardiac rehabilitation.

Resistance Exercise

Resistance exercise involves working a muscle or muscle group against some sort of external resistance in order to improve the participant's strength and stamina. Resistance training can either be isometric or dynamic. In isometric exercise, there is static resistance, there is no muscle movement, and the muscle length does not change. Dynamic exercise may include fixed or variable muscle resistance. Especially power group and endurance group sports consist of resistance exercise components. Resistance training can be performed with bodyweight exercises, such as push-ups and squats, or with equipment, such as bands, dumbbells, kettlebells, and barbells, among others.

One repetition maximum (1RM) is defined as the maximum amount of weight a person can lift with 1 repetition in 1 range of motion. Usually, multiple repetitions

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are preferred over 1 repetition maximum for convenience and compliance reasons (5 RM or 10 RM).

Exercise intensity can be classified as low or moderate if it is less than 60% of 1-RM.[4,5] Aerobic endurance training is typically defined as resistance training at less than 20% of one's 1 RM. More than 20% of 1 repetition maximum causes the muscular capillaries to constrict during muscle contraction, producing a hypoxic stimulus that is what causes training effects. Strength improvements are best achieved with higher training intensities of 50%-70% of 1 RM with 8–15 repetitions. A moderate range of repetitions (9-15 RM) should be included in the resistance training program for people who cannot tolerate exercising at higher (i.e., higher intensity or higher resistance) loads because they produce superior gains in muscle hypertrophy and strength compared to a low-load program. High-load resistance training programs (80% of 1-RM, or 8 RM) can target both outcomes in shorter periods of training. Instead of short (1 minute) intervals, 3-5 minute intervals are preferable for muscle power recovery.

Resistance Exercise Prescription

Resistance exercise prescription should be patient-based. It is important for safety and efficacy to perform initial treatment under the supervision of an experienced team. Exercise prescription should be defined as frequency, intensity, duration and type. During the first weeks of the program, participants will need fewer sets (1-2 sets) and more repetitions (16%-20% of 1-RM) at a lower weight to become familiar with the exercise program and avoid potential injury and sore muscles.[6] Participants should rest enough time between sets and between different machines.[7] Baic muscle warm-ups increase muscle adaptation and exercise safety. However, intense aerobic exercise is not recommended prior to resistance exercise to minimize increases in BP and heart work during resistance exercise.[8]

Exercise dose response relationship varies in different populations. Maximum strength gains of untrained individuals occur at an average training intensity of 60% of maximum 1 rep (1RM) 3 days a week, and an average training volume of 4 sets per muscle group. Recreationally trained non-athletes individuals exhibit maximum strength gains with an average training intensity of 80% of 1RM, 2 days a week, and an average volume of 4 sets. For athlete populations, maximum strength gains occur 2 days per week at an average training intensity of 85% of 1RM and an average training volume of 8 sets per muscle group.[9]

One of the most important elements in exercise programs is to ensure continuity.[10] To avoid the plateau in cardiovascular disease (CVD) benefits seen in many exercise intervention studies in the later months, continuous individual strength evaluation and progressive prescription are crucial.

Resistance Exercise in Coronary Artery Disease Patients

The benefits of aerobic exercise (AE) for cardiovascular disease (CVD) have been well documented. Recent studies show the positive effects of combined exercise and resistance exercise on coronary artery disease. The greatest gains in microvascular function will be produced by RE programs that engage the highest amount of skeletal muscle mass and recruit the greatest number of muscle fibers within each muscle. Resistance exercise may have a positive role in the pathophysiology of atherosclerosis, both through the modification of the cardiovascular risk factor and its direct effect on the microvascular function.[11]

The combination of resistance range training plus aerobic exercise is more effective in improving cardiac outcomes and aerobic capacity.[12] When compared to time-matched aerobic or weight exercise alone, combination training for as little as 8 weeks may offer greater CVD benefits to people at a higher risk for CVD.[13] Additionally, low-intensity RE training has beneficial effects on heart rate variability (HRV) in patients with coronary artery disease.[14] This effect is another reason for the positive monitoring of long-term cardiovascular outcomes.

Cardiovascular diseases have been studied in various subgroups. Resistance exercise has been shown to be effective in preventing cardiovascular disease in obese people.[15] However, in this group, combined therapy has better results compared to both aerobic and resistance exercise alone. In the patient group with metabolic syndrome, although the positive effects of resistance exercise are observed, there is no clear data yet that it reduces cardiovascular disease.[16]

In an another study, Only blood pressure and muscle strength can be improved by RE; biomarkers and the impact on muscle size were not statistically significant. In addition, there is some evidence that resistance training is safe, with a positive effect on hemodynamic responses but no effect on vascular function. Thus, it may be offered as an alternative kind of exercise to enhance skeletal muscle function and general health in a safe and effective manner.[17] There are limited data on the possibility that resistance exercise can be the only exercise method in coronary artery disease. Furthermore, RE is secure and linked to considerable gains in muscle strength; as a result, it could be given to CAD patients as an alternative exercise option to aerobic exercise to improve skeletal muscle performance.

Resistance exercise may produce blood pressure fluctuations associated with the Valsalva maneuver. Regulation of

HIGHLIGHTS

- Resistance exercises have an important potential in preventing cardiac diseases, increasing treatment efficiency, and improving quality of life.
- Resistance exercise (RE) is considered a potentially useful approach in conditions such as coronary artery disease, peripheral artery disease, heart failure, and cardiac rehabilitation. Satisfactory data on cardiac electrophysiology are not yet available.
- Studies on resistance exercise have mostly been done in combination with aerobic group exercise. Combined exercise produces safe and effective results. In addition, it seems that resistance exercise alone may be beneficial in an individual-based approach.

breathing during exercise can prevent this situation. Regular Valsalva maneuvers can be compared to enhanced external counterpulsation (EECP). The main logic in EECP is to develop the coronary capillary bed with counterpulses and to provide antianginal activity.[18] Therefore RE may play a role in antianginal activity by having a similar physiological effect.

Resistance Exercise in Heart Failure

One of the major contributors to HF patients' exercise intolerance and poor ventilatory efficiency is muscle atrophy.[19] It worsens quality of life and increases the escalation of other chronic disorders. It is related to a longer length of stay in the hospital, more frequent readmissions, and a worsening prognosis.[20] Resistance exercise represent the currently one of the most used strategies against wasting disorders. When persons with HF are unable or unable to engage in aerobic activity, RE alone can be effective. Resistance exercise is safe for people with HF and makes their physical performance and quality of life better.[21]

There are also studies with resistance exercise in preserved heart failure (HFpEF). A combination of endurance and resistance training (combined exercise) has been shown to be beneficial for the ratio of peak early to late diastolic mitral entry velocities and early diastolic mitral annual velocity.[22] In these patients, it may be useful to add resistance exercise to the exercise prescription. Exercise training enhances HFpEF patients' physical well-being and capacity for exercise.[23] This advantage is related to better left ventricular diastolic function and atrial reverse remodeling.

In heart failure rehabilitation programs, RE is usually planned as a complement to aerobic exercise. This approach seems to be an appropriate choice in heart failure rehabilitation. However, RE alone is functionally beneficial and is a reasonable option, especially in patients with mobility problems.

Resistance Exercise in Peripheral Arterial Diseases

Studies to date have generally been associated with aerobic exercise. Knowing the physiological effects of RE in peripheral arterial disease helps to perceive its therapeutic efficacy. In response to the increased metabolic demand of the muscle during resistance training, blood flow to the working muscle increases dramatically.[24] In the active limb, RE may cause brief high flows and increase antegrade and net shear rates. Even while there is a slight antegrade current increase during exercise, there is no discernible effect in the passive limb during RE.[25] Several studies have shown that regular resistance exercise might be linked to poor vascular function. This is because resistance exercise causes blood to flow backwards in the active limbs.[26] However, other studies have demonstrated the benefit of RE in peripheral arterial disease. Gains in the contralateral extremity may improve quality of daily life by increasing functional capacity. Additionally resistance exercise acutely reduces arterial stiffness in symptomatic peripheral arterial disease patient.[27] Resistance exercise improves maximal treadmill walking distance and quality of life measures, particularly stair climbing ability.[28] Higher intensity training was associated with better outcomes.

Peripheral arterial patients may have limited mobility due to various chronic diseases or have severe cladication in walking. Resistance Training does not typically cause claudication pain.[29] Therefore RE is a good option especially in such patients. In summary, RE is a cost-effective and rational method that should be encouraged in all peripheral arterial patients with or without cladication.

Resistance Exercise in Cardiac Rhythm

Most of the resistance training studies so far are related to heart rate variability (HRV). Autonomic imbalances, illnesses, and mortality can all be assessed by measuring heart rate variability. Heart rate variability (HRV) increases with efferent vagal activity and decreases with sympathetic stimulation. Decreased HRV in otherwise healthy people is related with an increased risk of cardiac events and mortality.[30,31] It is hypothesized that RE raise HRV by enhancing the vagal influence over the sympathetic influence on the heart. This is why physical activity has the potential to reduce cardiovascular risk. However, exercise-based studies in patients with atrial fibrillation did not show a positive effect in terms of quality of life, serious adverse events, or mortality.[32] It is still questionable whether intensive level resistance exercise can trigger myocardial fibrosis.[33] Potential fibrotic regions could potentially act as substrates for the process of arrhythmia. The widespread use of cardiac magnetic resonance imaging may provide insight. More cardiac arrhythmia studies are needed on resistance exercise.

Resistance Exercise in Cardiac Rehabilitation

According to current recommendations, Phase II-IV cardiac rehabilitation exercise prescriptions should include resistance exercise (RE).[34] Cardiac rehabilitation phases are shown in Table 1. As mentioned above, the positive effects of RE are seen especially in patients with coronary artery disease and heart failure. This effect can be observed both in combination with aerobic exercise and in RE alone. Resistance exercise should be considered alone, especially in immobilized patients.

Resistance exercise is more effective for gaining muscle strength than aerobic exercise. This has a lot of implications for rehabilitation programs, especially for people with heart disease who are frail, the elderly, and women.[34] In the context of cardiac rehabilitation, remote resistance training is effective and can be done safely. However, it is still highly unexplored and needs more research. The results of RE in post-surgical rehabilitation programs have not been elucidated. The results are evaluated positively in patients with

Table 1. Cardiac Rehabilitation Phases

Phase 1	Acute, in hospital patient period	Consultation, education
Phase 2	Subacute, post discharge period	2-12 weeks, self-management education, consultation
Phase 3	Exercise and education program	6 mounts, consultation, education
Phase 4	Maintenance	Indefinite, without supervision

coronary artery disease and heart failure. In addition, a similar situation is also present in some congenital diseases.[35] However, further studies are needed for valve surgery or Transcatheter Aortic Valve Implantation.

CONCLUSION

The importance of resistance exercise has been increasing in recent years, especially with its positive effects in cardiovascular disease, heart failure and peripheral arterial disease. Resistance exercise can be added to aerobic exercise in cardiac rehabilitation programs and a patient-based approach seems positive. It is a good option in immobilized patients with peripheral artery disease or in patients with severe claudication due to aerobic exercise. It provides protection in coronary artery disease by risk modification and may have positive effects on microvascular functions. In addition, RE contributes to prognosis by preventing sarcopenia and increasing effort capacity in heart failure and reduces hospitalization. More research is needed on the effects of RE on cardiac arrhythmias and after percutaneous and surgical valve surgeries.

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