Personalized Exercise Prescription for Heart Patients

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Introduction

Strong evidence shows that physical inactivity increases the risk of many adverse health conditions, including the world's major noncommunicable diseases, such as coronary heart disease, type 2 diabetes, and breast and colon cancers, shortening life expectancy. Cardiovascular diseases account for most noncommunicable disease deaths. This draws attention to the importance of exercise in primary prevention of heart disease and in secondary prevention measures, such as cardiac rehabilitation. Even though exercise prescription has become a popular topic, it is still a "novel" science that needs to be developed with lack of evidence-based clinical practice and conclusive guidelines. The purpose of this Invited Commentary is to implement scientific guidelines with the most recent scientific advances, with the aim of overcoming the obstacles that prescription of physical exercise for patients with cardiovascular disease are met by professionals. The novelty resides in the application of evidence-based medicine to a modern personalized approach to exercise prescription.

Exercise Prescription Modalities

Exercise is a subcategory of physical activity defined as a planned and structured action with the purpose of improving or maintaining physical fitness or health. Exercise involves some combination of isometric and isotonic stress. Training protocols vary by: intensity (aerobic and anaerobic); type (endurance, resistance, and strength); method (continuous and intermittent/interval); application (systemic, regional, and respiratory muscle); control (supervised and nonsupervised); and setting (hospital/center and home-based).

Before prescribing any form of physical activity and exercise, one should perform a functional evaluation of the patient, using a cardiopulmonary test as the gold standard. Through the cardiopulmonary test, physiological descriptors of aerobic energy yield during incremental exercise can be derived: $\dot{V}O_2$ at the first and second ventilatory thresholds and peak $\dot{V}O_2$, which is the single best indicator of cardiorespiratory fitness. A cardiopulmonary test allows us to match the unique physiological responses of different exercise intensity domains to the individual patient pathophysiological and clinical status, maximizing the benefits in relation to the risk assessment. An individualized exercise prescription approach should take into consideration metabolic responses to exercises to increase responsiveness to training as opposed to a standardized approach.

In clinical practice, cardiopulmonary exercise testing is not always available, and it is necessary to use alternative indirect methods, such as the 6-min walk test and submaximal exercise evaluations, using heart rate, heart rate reserve, and rating of perceived exertion as alternative measures of exercise intensity.

Fitness of the muscular component may be assessed by the handgrip strength test being a strong predictor of morbidity and mortality. For assessing power strength or muscular endurance jump, dynamic sit-up, and bent-arm hand tests have been used with young adults and older people. Agility, balance, speed, or coordination is included in the motor component. Agility is a combination of speed, balance, power, and coordination. Some tests used to measure the motor component are 30-m sprint test and 4-m × 10-m shuttle run tests for young people and 30-m walk test and 8-ft-and-go for older adults. For measuring static balance, single leg balance, with or without open eyes, is a good alternative test. Flexibility is a morphological component; chair sit-and-reach tests and back scratch tests are two validated tests for measuring this capacity.

Exercise Prescription in Selected Cardiac Patient Groups

In the overall population, to achieve cardiovascular risk reduction, the American Heart Association and American College of Cardiology recommend a total of at least 150 min of weekly moderate-intensity aerobic exercise (3 METs to 6 METs), divided into sessions of 40 min, performed three to four sessions per week). This appears to be the minimum amount of exercise required to reduce the all-cause mortality rate. In addition, every adult should perform resistance exercise strength

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training to maintain muscular strength and endurance a minimum of 2 d·wk^{-1};

- 8 to 10 exercises should be performed on 2 or more nonconsecutive days each week using the major muscle groups.
- 8 to 12 repetitions of each exercise resulting in volitional fatigue. Flexibility and balance training should complete the exercise program to maintain and increase patient functional state.

Chronic heart failure patients demand a specific structured exercise training which is recommended for stable New York Heart Association class I to III heart failure patients. The key words are clinical stability and early, but gradual, mobilization to improve movement coordination and respiratory capacity. Three different training modalities have been proposed with different combinations: the first one is endurance aerobic training (both in continuous and in interval settings), with the recommendation of starting low and going slow in more deconditioned patients, incrementally slowing the amount of exercise, the duration, and the number of sessions if well tolerated. Recommended training intensities are 40% to 50% at the starting point, increasing to 70% to 80% of $\dot{V}O_{2peak}$. The second one is resistance/strength training, clearly seen as a complement, but not substitute, of endurance exercise in heart failure patients. In these patients, it is suggested to go through three phases: instruction, resistance/endurance, and finally strength phase going from 12 to 25 repetitions at low intensity (30% to 40% of 1-maximal repetition) to higher intensity (40% to 60% 1-maximal repetition). The third one is respiratory training, suggested to start at 30% of the maximal inspiratory mouth pressure and to readjust the intensity every 7 to 10 d up to a maximum of 60% (20 to 30 min·d^{-1} with a frequency of 3 to 5 sessions per week for a minimum of 8 wk). Patients with an internal defibrillator or cardiac resynchronization therapy should set a level of training keeping the maximal heart rate 20 beats under the device's intervention zone.

Coronary artery disease patients, if stable, should engage in regular physical activity. They should exercise three times per week for at least 30 min, including 5 min of warm-up and cool-down calisthenics and at least 20 min of exercise at an intensity requiring 70% to 85% of peak heart rate.

Stable angina pectoris patients have one mandatory consideration during training: exercise safety. It is suggested to exercise 3 to 5 times per week following a warm-up of 5 to 15 min at moderate to high intensity (always below the ischemic threshold) for a period of 20 to 40 min followed by a cool-down period of 5 to 10 min.

Postcoronary angioplasty patients should exercise similarly to stable angina patients; it has been found that high- to severe-intensity interval training helped to reduce 6-month restenosis in the stunted segment, improved left ventricular remodeling, and increased endothelial nitric oxide production.

Pacemaker patients follow the same principles of nonpacemaker ones. If an exercising patient's chronotropic response exceeds the pacemaker upper-rate limit, the device should usually produce a Wenckebach pattern to maintain a relatively high heart rate without risking rapid ventricular responses.

Chronic atrial fibrillation patients benefit from both light- to moderate-intensity and moderate- to high-intensity domains of dose exercise, monitoring it better with rate of perceived exertion than heart rate due to the highly variable ventricular chronotropic response.

Patients who have undergone traditional *open chest coronary artery by-pass graft surgery* can start the rehabilitation program 1 wk postsurgery, refraining from the upper-extremity aerobic exercise training for at least 4 to 6 wk postsurgery to ensure the stability of the sternum wound.

Valvular repair or replacement patients may benefit from both light to moderate and moderate to high domains of exercise dose. In patients with moderate aortic stenosis, maximal heart rate during exercise should be kept under the threshold that might precipitate symptoms of reduced cardiac output.

Heart transplant patients are better prescribed by using the Borg Scale of Perceived Exertion: starting with a 10 to 12 rate of perceived exertion intensity, they can slowly increase the amount of exercise to higher intensity.

Peripheral artery disease patients show early benefit from the initiation of the training program (even in the first 4 wk). They should walk at least three times weekly to their maximal tolerable pain, rest, and then resume the process for at least 30 min per session.

Conclusions

The field of exercise medicine is markedly growing and improving in recent years. Although there is still a need for more advanced scientific knowledge, exercise prescription is becoming a novel and valuable science solution to efficiently fight noncommunicable diseases, which are more often cardiovascular.

Similar to a drug, exercise has to be prescribed in modality, dose, frequency, with not only a pathology but also a personalized patient approach. New data are needed to make this new science not only *evidence-based* and *personalized,* but also a *precision* approach.

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